#44

March 11, 1983

From: Chief, Production Branch

Subj: Attached CDC "Arthropod-borne Virus Information Exchange"

To: Recipients of the "Arthropod-borne Virus Information Exchange"

Attached is your copy of the most recent "Arthropod-borne Virus Information Exchange."

An announcement is included of a commercial source of arbovirus reagents. Since many laboratories are not equipped to produce their own arbovirus reagents, you are encouraged to let me know about other sources of commercial reagents. This information will be disseminated to our readers in the future.

Most of you are to be congratulated for mailing your reports to arrive in Atlanta before March 1. As usual, a few were received late and will have to be held until October.

Don't forget to send me items of interest to arbovirologists around the world.

All communications should be sent to the undersigned at the address given.

W. Adrian Chappell

W. ADRIAN CHAPPELL, Ph.D
Chief, Production Branch
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March 1983

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The AMERICAN COMMITTEE ON ARTHROPOD-BORNE VIRUSES

SUBCOMMITTEE ON EVALUATION OF ARTHROPOD-BORNE STATUS

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REPORT FROM THE SUBCOMMITTEE ON EVALUATION OF ARTHROPDO-BORNE STATUS (SEAS) FOR 1982

During 1982, 14 registered viruses and one previously reviewed virus were evaluated by this subcommittee. Many (8) of these newly-recognized agents are the result of collaborative studies between CDC-Fort Collins and colleagues in Ecuador.

The viruses and their sources are as follows:

1. Las Maloyas. Group Anopheles A - Argentina, mosquitoes.
2. Kotonkan. Rabies-related - Nigeria, Culicoides.
3. Abras. Group Patois - Ecuador, Mosquitoes.
4. Babahoyo. Group Patois - Ecuador, Mosquitoes.
5. Cananeia. Group Guama - Brazil, sentinel mouse.
6. Enseada. Ungrouped - Brazil, mosquitoes.
7. Itimirim. Group Guama - Brazil, rodent.
8. Naranjal. Group B - Ecuador, sentinel hamster.
9. Palestina. Group Minatitlan - Ecuador, mosquitoes.
10. Playas. Group Bunyamwera - Ecuador, mosquitoes.
11. Pueblo Viejo. Group Gamboa - Ecuador, mosquitoes.
12. San Juan. Group Gamboa - Ecuador, mosquitoes.
13. Vinces. Group C - Ecuador, mosquitoes
14. Yug Bogdanovac. Group Vesicular Stomatitis -Yugoslavia, phlebotomines.

Six of these agents (Kotonkan, Babahoyo, Cananeia, Naranjal, Palestina and Vinces) were considered "probable" arboviruses and the remaining 8 have been rated "possible" arboviruses.

One additional virus, Rio Grande (Group Phlebotomus Fever) was upgraded to "probable" arboviruses on the basis of experimental transovarial virus studies.

cont.

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Roy Chamberlain resigned his subcommittee membership at the end of last year at the time of his retirement. One new member was added 21 December 1981, namely Dr. Edward E. Cupp, medical entomologist from Cornell University, Ithaca. The other members of the subcommittee are: Drs. Bruce Francy, Duane Gubler, James Hardy, Donald McLean and John Woodall. In July of this year I advised the Chairman, ACAV that I would be reaching 70 in August. Having held the chairmanship of this subcommittee since 1973 and as my future plans are rather fluid, I recommended stepping down in favor of a younger person who could develop his own, and perhaps more innovative, program. Thus I hereby tender my chairman resignation but with the offer that I would be pleased to retain my membership in the subcommittee as long as this is agreeable to the ACAV.

Respectfully submitted

Thomas H. G. Aitken
Chairman
4 November 1982

THGA:cb

P.S. The above report was presented at the annual open meeting of the ACAV, 10 Nov. 1982, in Cleveland, Ohio.

Since that time two additional viruses were evaluated.

15. Shokwe. Group Bunyamwera-South Africa, mosquitoes. Probable arbovirus.

16. Tibrogargan. Ungrouped-Queensland, Culicoides. Possible arbovirus.

Thomas H. G. Aitken
March 9, 1983

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.

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.

OBITUARY

Dr. Vojtech B a r ḑ o s (1914-1982)

Many arbovirologists and friends throughout the world will be deeply saddened by the untimely death of Vojtech Bárdoš, M.D., M.P.H., D.Sc., due to a heart attack which occurred on June 4, 1982 in Bratislava.

Tahyna virus, an European member of California group viruses (Bunyaviridae), was isolated by him (and V. Danielová of the Institute of Parasitology, Czechoslovak Academy of Sciences) in 1958; this was the first mosquito-borne virus isolated in Central Europe. He made then valuable contributions to the research of Tahyňa virus ecology and medical importance in Czechoslovakia and elsewhere. Two years later, he isolated (with Dr. E. Čupková) and studied another new arbovirus - Čalovo (Batai) - from mosquitoes in Czechoslovakia.

Dr.V. Bárdoš was born on September 30, 1914 in Trenčín (western Slovakia, Czechoslovakia). He finished the grammar school with distinction in 1932, and in 1938, he graduated at the Medical Faculty of the Comenius University in Bratislava, Czechoslovakia. In the period 1938 to 1945, he was the Head of the Regional Bacteriological Institute in Prešov, Eastern Slovakia, where he did many epidemiological studies (paratyphus, spotted fever, malaria etc.). From 1945 to 1952 he was Chief epidemiologist in Slovakia (a territory with 3.5 million inhabitants) with an interruption in 1946-47 when he was studying at the Johns Hopkins School of Public Health in Baltimore (USA) - there he received his M.P.H. degree and acquainted himself with the virological techniques. From 1952 to 1971, he headed the Virological Department of the Research Institute of Epidemiology and Microbiology (nowadays Research Institute of Preventive Medicine) in Bratislava, and since 1953 his interest was focused mainly on biology, ecology and epidemiology of arboviruses in Czechoslovakia. Starting with tick-borne encephalitis virus (e.g., the first isolation of the virus from a patient in Slovakia; the first epidemiological evidence on acquisition of the infection in man by drinking of the infected raw goat milk in Eastern Slovakia - as early as 1944; the epidemiological study of a large epidemic of TBE in Rožnava; preparation of an immune gamma-globulin for therapy of TBE), he moved later to mosquito-borne viruses and succeeded in the isolation of the viruses Tahyňa and Čalovo. In 1962, he received the degree of D.Sc. from the Czechoslovak Academy of Sciences in Prague for his thesis "On the ecology of arboviruses in Czechoslovakia" (published later on in Slovak: Bratislava 1965, 198 pp.). Another milestone in his scientific career was the initiation and organization of a highly successful international symposium "Arboviruses of the California complex and the Bunyamwera group", held at Smolenice near Bratislava in October 1966. Proceedings of that symposium, which appeared in 1969, are the source of basic and detailed informations on these viruses even today.

Dr.Bárdoš joined in 1965 the World Health Organization and acted in consecutive years as consultant in microbiology and virology in Afghanistan (Kabul: 1965-1966), Sri Lanka (Colombo:

1966-1969) and Burma (Rangoon: 1969-1972). From 1971 till his death he joined the staff of the Institute of Parasitology, Czechoslovak Academy of Sciences, where he made many significant contributions to the medical importance(the virus isolation from sick children) and ecology (the isolation of the virus from larvae of Culiseta annulata) of Tahyna virus. It would be difficult to list all his duties and merits. He lectured in epidemiology and virology at the Medical Faculty of the Comenius University and at the Institute of Postgraduate Education for Physicians in Bratislava, he was a member of the editorial board of three journals in the field of microbiology and virology, a member of several committees at the level of Department of Health or Czechoslovak Academy of Sciences, a respected teacher of about a dozen research workers. He was a member of both Czechoslovak Microbiological Societies, of the Czechoslovak Biological Society, and in 1958 he was elected as Active Member of the New York Academy of Sciences. In 1966 he was awarded a Medal of Louis Pasteur by the Institute of Pasteur in Paris, and by two scientific medals of the Institute of Virology in Moscow. Dr. Bárdoš was honoured several times also by Czechoslovak authorities for his excellent work in the area of microbiology and epidemiology. He published five monographs on the epidemiology of infantile poliomyelitis in Slovakia (1950), general epidemiology (1954), natural focal infections in Eastern Slovakia (1961), the ecology of arboviruses in Czechoslovakia (1965), and Tahyna virus infections (1981: in "CRC Handbook Series of Zoonoses, Section B, vol. I, pp. 208-213). Further he published (starting from 1950) about 110 papers with the following frequency distribution of topics: Tahyna virus (46 papers), TBE virus (20), arboviruses (10 polythematic papers), LCM virus (6), MHV (5), general virology (4), Čalovo virus (3), Bhanja virus (3), rickettsiae (3 - including the first description of a respiratory epidemic in a Czechoslovak cotton-processing factory), EMC virus (2), rabies virus (2), bacterial infections (2: Salmonella paratyphi, Pseudomonas aeruginosa), poliomyelitis (1), Coxsackie A (1), hemorrhagic nephroso-nephritis (1), CMV (1). The papers of Dr. V. Bárdoš were cited 248 times in the years 1965-1981 (according to Science Citation Index) which represents a mean citation rate 14.6 per year - a much higher rate than for publication of an "average" cited Czechoslovak microbiologist (ca.3.-4.citations per year). This shows again that he was an outstanding member of Czechoslovak microbiological community, and a prominent European arbovirologist. Many auditors in this country and abroad were always impressed by his kind of logical construction and enthusiasm of his lectures. Moreover, a keen but helpful criticism appeared in his comments and discussions which contributed markedly to a higher scientific standard of all symposia he participated in. The family of arbovirologists will never forget Vojtech Bárdoš.

(Submitted by Dr. Z. Hubálek)

INTERNATIONAL CONFERENCE ON HEMORRHAGIC DENGUE AND ITS VECTOR

This Conference will be held in the International Conference Center of Habana City, Cuba from 28 to 30 November, 1983. The program will include Sessions, Plenary sessions, Symposia, Workshops and Free Communications on topics such as general considerations on hemorrhagic dengue outbreaks; comparative analysis of dengue in Asia, Western Pacific and America; epidemiological, clinical pathological, therapeutical and diagnostic aspects; the control of Aedes aegypti, and basic components of research on Dengue.

For further information, please contact:

"Conferencia Internacional sobre Dengue Hemorrágico
y su Vector"
Consejo Nacional de Sociedades Científicas
Calle 4 #402, e/17 y 19
Vedado, Habana, Cuba

Commercial Sources of Arbovirus Reagents

Since it is so difficult to find commercial sources of arbovirus reagents, this issue and each future issue of this publication will give information submitted about the availability of arbovirus reagents.

Dr. Kanai Chatiyanonda of the Virus Research Institute in Bangkok sent the following information:

Reagents available:
Japanese encephalitis HAI antigen
Dengue types 1-4 HAI antigen
Dengue positive, pooled human sera

Price: U.S.A. $12.00 per 0.5 ml lyophilized ampule

Source: The Virus Research Institute
Department of Medical Sciences
Yod-se, Bangkok 10100
Thailand

Telex: MEDICIENCE

This report is reprinted from the Morbidity and Mortality Weekly Report, Centers for Disease Control, U.S. Department of Health and Human Services, Public Health Service, Vol 32, Number 7, pages 90-92, February 25, 1983.

Zinga Virus: A Strain of Rift Valley Fever Virus

Rift Valley fever (RVF), an arthropod-borne viral disease, has caused widespread epizootics in domestic animals and epidemics in humans in sub-Saharan Africa and, in 1977 and 1978, in Egypt (*1*). In humans, RVF virus (RVFV) infection is associated with febrile illness, which may be complicated by encephalitis, blinding retinitis, or fatal hemorrhage (*2*). Zinga virus, originally isolated from mosquitoes and humans in the Central African Republic (C.A.R) (*3,4*), produces a disease similiar to RVF, but was believed to be a serologically ungrouped arthropod-borne virus. Although RVFV was previously known to be indigenous to Nigeria (*5,6*), isolations of Zinga from mosquitoes collected in Senegal, Madagascar, and Guinea, and from infected humans in Senegal, further extend the confirmed range of RVFV activity in West Africa (*7*).

While testing antisera to African viruses in an enzyme-linked immunosorbent assay using RVFV as antigen, the Yale Arbovirus Research Unit detected a cross-reaction between Zinga virus hyperimmune antisera and RVFV. The relationship between RVF and Zinga viruses was determined using three monoclonal antibodies, each highly specific for different antigenic sites on three structural proteins found in all RVFV strains that have been examined. In indirect fluorescent antibody tests, each monoclonal antibody reacted to either RVFV or Zinga virus antigen with identical titers. Plaque reduction neutralization tests with reference hyperimmune antisera confirmed that the prototype strain of Zinga virus (Institut Pasteur strain Ar B 1976) was serologically identical to RVFV.

Because of its threat to humans and to animal production, research on RVFV in the United States is restricted to high containment laboratories. During the last few years, Zinga virus has been studied in many laboratories in North America, Europe, and Africa, and numerous Zinga infections have resulted from laboratory accidents (*7*). Any laboratory with Zinga virus in its collection should be aware that it is a strain of RVFV and represents a substantial biohazard to people and animals.

Reported by JM Meegan, PhD, RE Shope MD, Yale Arbovirus Research Unit, Yale University School of Medicine, New Haven, Connecticut; CJ Peters, MD, US Army Medical Research Institute for Infectious Diseases, Frederick, Maryland; JP Digoutte, MD, Institut Pasteur de Dakar, Dakar, Senegal; Animal and Plant Health Inspection Svc, US Dept of Agriculture; Special Pathogens Br, Div of Viral Diseases, Center for Infectious Diseases, CDC.

Editorial Note: The discovery that Zinga virus cannot be differentiated from RVFV is important to laboratorians who may have been working with Zinga, unaware of its pathogenic potential, and to public health and agriculture officials concerned with RVF control in livestock. Documentation that the geographic range of RVF includes much of West Africa should alert physicians to consider RVF in the differential diagnosis of dengue-like illnesses or hemorrhagic fever in travelers returning from that area. Since the onset of meningoencephalitis and retinitis may occur late in RVF, clinicians should be aware that these complications may be the presenting features of RVF in a returning traveler.

RVF is primarily an arthropod-borne viral disease of man, sheep, goats, and cattle. In epizootics, the infection results in significant mortality among adult animals, and abortion rates and mortality rates in young animals approach 100%. The 1977 epidemic in completely susceptible human populations of Egypt resulted in an estimated 20%-30% attack rate in epidemic areas, with a case-fatality ratio of 3% (*8*). Thus, RVF has proven to be a disease of both economic significance and public health importance.

Importation of RVF into the United States is regarded as a threat to the livestock industry and to human public health. Although animals imported from areas known to have enzootic RVF are quarantined before entry, viremic travelers could introduce the virus, since indigenous mosquitoes may serve as vectors. Because of these potential threats and the many documented cases of laboratory-acquired RVF, work with this virus is restricted to laboratories with high-containment facilities. The U.S. Department of Agriculture (USDA) has developed contingency plans to respond to and control an RVF outbreak.

Importation regulations for laboratory strains of RVF and other exotic etiologic agents and vectors are a joint responsibility of the US Public Health Service and USDA. Under the Foreign Quarantine Regulations (42CFR Section 71.156), a permit is required for importation and subsequent domestic transport of such agents and vectors. Adherence to these regulations rests on the good faith of laboratorians. The potential usefulness of such regulation is shown in this instance in which Zinga could be traced to two laboratories in the United States. Other laboratories that have Zinga should contact the Animal and Plant Health Inspection Service of the USDA (301-436-8017) for instructions on proper disposal.

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The AMERICAN COMMITTEE ON ARTHROPOD-BORNE VIRUSES

1982 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 1982, 175 mailings of Catalogue material were being made. During the year, three addresses were dropped and five new participants were added to the mailing list. At the end of the year, 177 mailings of Catalogue material were being made, including 58 within the U.S.A. and 119 to foreign addresses. Distribution by continent was: Africa 20, Asia 22, Australasia 7, Europe 39, North America 72, and South America 17.

Abstracts and Current Information: A total of 633 abstracts or references were coded by subject matter and distributed to participants during 1982. Of this total, 452 were obtained from Biological Abstracts, 178 from Abstracts on Hygiene and the Tropical Diseases Bulletin, and three from current journals, personal communications, or other sources. A total of 13,826 references or units of information have been issued since the start of the program.

Registration of New Viruses: Fourteen new viruses were registered during 1982. As of December 1981, the Catalogue contained 446 registered viruses. With the acceptance of 14 new virus registrations during 1982, the total number of registered viruses increased to 460 as of December 1982. The viruses registered during 1982 are listed below:

Virus Name	Recommended Abbreviation	Country	Source	Antigenic Group
Las Maloyas	LM	Argentina	Mosquitoes	ANA
Kotonkan	KOT	Nigeria	Culicoides spp.	Rabies
Yug Bogdanovac	YB	Yugoslavia	Phlebotomines	VSV
Abras	ABR	Ecuador	Mosquitoes	PAT
Babahoyo	BAB	Ecuador	Mosquitoes	PAT
Cananeia	CNA	Brazil	Sentinel mice	GMA
Enseada	ENS	Brazil	Mosquitoes	
Itimirim	ITI	Brazil	Rodents	GMA
Naranjal	NJL	Ecuador	Sentinel hamster	B
Palestina	PLS	Ecuador	Mosquitoes	MNT
Playas	PLA	Ecuador	Mosquitoes	BUN
Pueblo Viejo	PV	Ecuador	Mosquitoes	GAM
San Juan	SJ	Ecuador	Mosquitoes	GAM
Vinces	VIN	Ecuador	Mosquitoes	C

These registered viruses were isolated between 1967 and 1980. KOT was isolated in 1967, PV in 1974, ABR, BAB, PLA, SJ and VIN in 1975, NJL, PLS and YB in 1976, ENS in 1977, CNA and ITI in 1978, and LM in 1980.

BAB, KOT, NJL, PLS and VIN were evaluated as Probable Arbovirus by the Subcommittee on Evaluation of Arthropod-Borne Status (SEAS)*, while all others were evaluated as Possible Arbovirus.

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

None of these newly registered viruses have been isolated from man, nor have any of them been associated with the production of disease in man.

Antigenic Grouping: Serological studies carried out with 50 vertebrate rhabdoviruses resulted in the determination of several antigenic relationships which had not been described previously (1). Prior to the end of 1981, the VSV serogroup consisted of seven registered viruses. At the end of that year, Jurona virus was added to the VSV serogroup as a result of relationships determined by IFA, CF, and neutralization tests. In addition, three other registered rhabdoviruses have been shown to be related to members of the VSV serogroup (1). These include Keuraliba, La Joya, and Yug Bogdanovac viruses. The latter virus was registered recently. Two additional new members of the VSV serogroup presently are unregistered.

The Mossuril serogroup which previously consisted of Mossuril and Kamese viruses, now includes Bangoran, Barur, Charleville, Kern Canyon and Marco viruses (1). All of the new members previously were listed as antigenically ungrouped rhabdoviruses. The responsible investigators have renamed this expanded set of viruses the Charleville serogroup because all members cross-reacted by CF with Charleville virus (1). The Catalogue has retained the "Mossuril serogroup" name for obvious reasons. The presently proposed antigenic set only represents the addition of new virus members to a previously established and named serogroup in which Mossuril virus is still the oldest registered member. One additional new member of this serogroup is presently unregistered. The expansion of the Mossuril serogroup is provisional pending verification of CF relationships by at least one additional serological test.

Previously, Zinga virus was listed as an antigenically ungrouped virus possessing bunyavirus-like characteristics. Recently, it was included in the Phlebotomus fever serogroup as a provisional new member. Serological studies have indicated that Zinga virus is closely related or identical to Rift Valley fever virus (2).

With the registration of kotonkan virus, there now are two lyssaviruses registered in the Catalogue. Both kotonkan and Lagos bat viruses have been shown by other investigators to be antigenically related to members of the rabies serogroup (3). Since both registered viruses comprise a serogroup, we have continued the use of a previously established name (rabies serogroup) for designating a set of antigenically related lyssaviruses.

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.

Molecular analyses indicate that Dhori virus and a Thogoto group virus have virion RNA species and structural polypeptides comparable to those of members of the family Orthomyxoviridae (4). The same may be said for Quaranfil virus although those observations are less certain at this time (4).

The taxonomic status of Dhori and Thogoto viruses have been amended to reflect the findings described above. Changes in the taxonomic status of Quaranfil virus will await verification of the preliminary observations.

The International Committee on Taxonomy of Viruses (ICTV) has established "a new family of invertebrate, small RNA viruses (divided genome, single-stranded [SS] RNA viruses)" (5). This new family was named Nodaviridae and presently consists of a single genus. Nodamura virus was designated as the type species for the genus Nodavirus. The taxonomic designation of Nodamura virus has been amended in this report to reflect the ICTV decisions.

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)* (6). Eleven registered viruses listed in Tables 5 through 33 have not been rated by SALS yet. Appendices I and II, following Table 38, 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 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 460 viruses registered in the Catalogue as of December 1982. 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 (7). 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

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

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. Fifty-seven antigenic groups have been designated for viruses registered in the Catalogue. That includes the previously established rabies serogroup. There are several instances in which only a single virus is shown in an antigenic group. That is so because one or more antigenic relatives of that virus have not been registered.

It is also noted that the Bunyavirus genus represents 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 33 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 are rated as Arbovirus (11 viruses) or Probable Arbovirus (one virus).

Tables 6, 7, and 8. Flaviviruses: Of the 63 registered flaviviruses, 48% have been placed in the mosquito-associated category (Table 6), 24% are considered to be tick-borne (Table 7), and 29% are categorized as not being associated with a proven arthropod vector (Table 8).

Naranjal virus, a recently registered virus, was added to the list of mosquito-associated flaviviruses. It was isolated from a sentinel hamster and Culex spp. mosquitoes collected in Ecuador. Additional information on the properties of this virus must be obtained.

Twenty-four 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.

Eighteen 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 18 (22%) flaviviruses not associated with a vector have been implicated in the production of human disease.

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, 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 121 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 Culicine mosquitoes, or both. 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.

Las Maloyas virus, which was registered within the last year, represents a new addition to the Anopheles A serogroup. This virus was isolated from Anopheline mosquitoes collected in Argentina, and very little is known concerning its behavior in nature.

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: With the exception of Main Drain virus, all other members of the Bunyamwera serogroup have been isolated from Culicine or Anopheline mosquitoes. In addition, Lokern and Main Drain viruses have been isolated from Culicoides insects. Maguari

virus has been recovered from livestock, Anhembi, Germiston and Kairi viruses from rodents, and Lokern, Main Drain and Tensaw viruses from lagomorphs. Kairi virus also was recovered from a monkey.

Bunyamwera, Germiston, Ilesha and Wyeomyia viruses have been isolated from man. In addition, these four viruses plus Calovo virus have been shown to be associated with human disease, either through infections acquired in nature or in the laboratory, or both.

Thirteen of the 19 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 (six viruses) and Africa (four viruses). Thus far, only one virus has been recovered in Asia, two in Europe and none in Australasia.

Playas virus was added as a new member of the Bunyamwera serogroup. The virus was recovered from mosquitoes collected in Ecuador. Very little is known concerning the properties of Playas virus.

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.

The Group C viruses have been closely associated with mosquito vectors and small animals, particularly rodents. 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. The recently registered Vinces virus was isolated from Culex sp. mosquitoes, and numerous isolations were made from sentinel hamsters. Thus far the virus has been found only in Ecuador.

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, Inkoo, and snowshoe hare viruses, have been associated with disease as a result of infections acquired in nature. Only Inkoo and Tahyna viruses have been isolated outside the continents 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.

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 now contains two additional newly registered members. Both Pueblo Viejo and San Juan viruses were isolated from Aedeomyia squamipennis mosquitoes collected in Ecuador. Thus, all virus members have been isolated exclusively from that particular mosquito species.

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. Cananeia and Itimirim viruses are new additions to the serogroup. Cananeia virus was isolated from Culex sp. mosquitoes and sentinel mice. Itimirim virus was recovered from the blood of a rodent (Oryzomys sp.). Both viruses were found in Brazil.

Both Koongol group viruses were isolated in Australia and very little is known about them.

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 the recently registered 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 some appear to be associated with mosquito vectors and rodent hosts. Babahoyo, Patois, Shark River, and Zegla viruses also were isolated from sentinel hamsters. Abras and Babahoyo viruses represent new additions to the Patois serogroup. Both viruses were recovered in Ecuador.

Table 15. Simbu serogroup viruses: 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). 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.

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).

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, Australasia, and Europe).

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 comprises the Phlebovirus genus within the Bunyaviridae family. Sicilian sandfly fever virus is the type virus for this genus.

The majority of the group members are associated with phlebotomine flies, while seven of these viruses have been isolated from man or have been implicated in the production of disease in man.

The arthropod-borne status of Rio Grande virus has been upgraded from Possible Arbovirus to Probable Arbovirus following a reevaluation of this virus' status by SEAS.

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. Recent serological studies have indicated that Zinga virus is closely related or identical to Rift Valley fever virus (2). Consequently Zinga virus has been placed in the Phlebotomus fever serogroup. 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 now 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 U.S.S.R. 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.

Members of the DGK serogroup have not been isolated from vertebrate hosts, nor from arthropod vectors other than 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.

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. 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 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 indicate 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 remain provisionally classified as bunyavirus-like, family Orthomyxoviridae (THO serogroup), or are unclassified (QRF serogroup).

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.

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. Last year's Annual Report referred to unpublished studies which indicated that the RNA species and polypeptides of Silverwater virus resembled those of uukuviruses (8). Additional confirming or clarifying information is not yet available.

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 indicated that its virion RNA species and structural polypeptides resemble those of members of the family Orthomyxoviridae (4).

The Upolu serogroup consists of Upolu and Aransas Bay viruses. Both viruses were isolated only from ticks. Neither virus has been associated with infections in man.

Quaranfil virus has been isolated from both man and rodents, 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 indicate that this virus may resemble viruses of the family Orthomyxoviridae (4). At this point, further verification is required. Little is known concerning the behavior of Johnston Atoll virus in nature.

Table 21. Minor antigenic groups of viruses: All the viruses listed in this table are members of minor antigenic groups, and are classified taxonomically as bunyavirus-like. Viruses of the Matariya and Nyando serogroups were provisionally classified as bunyavirus-like relatively recently. 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 is rated as a Probable Arbovirus while the other three virus members are 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 disease which resulted from that human infection was characterized as a febrile illness.

Table 22. Tick-borne serogroups other than serogroup B viruses: While the viruses listed in Table 22 also are tick-borne agents, they differ taxonomically from those in Tables 18-21 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.

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.

Tables 23, 24. 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; and EHD virus in deer. 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 seven serogroup members, only Irituia virus has not been isolated from an arthropod. All others, including Changuinola virus, appear to be associated with phlebotomine insects.

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.

Table 25. Minor antigenic groups of viruses: Members of the serogroups listed in this table and in Table 26 possess a "bullet-shaped" morphology and are classified as members of the family Rhabdoviridae. Table 25 now contains an expanded Mossuril group consisting of seven members and a rabies serogroup consisting of two rabies-related viruses.

All of the present 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 members of the Mossuril serogroup include Bangoran, Barur, Charleville, Kern Canyon and Marco viruses. Previously, these viruses were antigenically ungrouped but taxonomically classified as rhabdoviruses. Bangoran, Barur and Charleville viruses were isolated from arthropods as well as vertebrates while Kern Canyon and Marco viruses were isolated from vertebrate sources only. 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 the recently registered kotonkan virus and Lagos bat virus. Kotonkan virus was isolated from Culiocides spp. collected in Nigeria. It was rated as Probable Arbovirus by SEAS.

Table 26. Minor antigenic groups of viruses: All three viruses of the Sawgrass serogroup were isolated from ticks collected in North America. Both viruses of the Timbo serogroup were isolated from lizards, and neither virus was ever isolated from arthropods.

The VSV serogroup has increased in number and now consists of 11 vesiculoviruses. Jurona virus was added as a new antigenic member prior to last year's Annual Report; while Keuraliba, La Joya and Yug Bogdanovac viruses recently were antigenically linked to older members of the VSV serogroup (1). Keuraliba and La Joya viruses previously were listed as antigenically ungrouped viruses. Yug Bogdanovac virus was registered as a new virus within the last few months. Three VSV group viruses have been isolated from phlebotomine flies, and four others have been recovered from mosquitoes. VS-Indiana virus has been isolated from both types of vectors. Keuraliba, 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 have been shown to infect man. 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 27. 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. Recently published studies have indicated that Zingilamo virus resembles viruses of the family Togaviridae (9). 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 recently was found to possess a single-stranded RNA which was noninfectious upon extraction.

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 28. 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.

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.

Table 29. 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. Enseada virus represents a recent addition to those viruses listed in the bunyavirus-like set. It was found to be serologically unrelated to other registered viruses and was isolated from mosquitoes collected in Brazil.

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 recently 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 (5).

Cotia virus, a poxvirus, has been reported to produce disease in man. Previous morphologic studies had shown that Oubangui virus also has a poxvirus morphology (10).

Table 30. Ungrouped mosquito-associated viruses: These serologically ungrouped viruses have been associated with mosquito vectors, and the majority of them remain taxonomically unclassified. Only Gomoka virus has been recovered from another source in addition to mosquitoes. Two isolates were obtained from birds collected in the Central African Republic.

Table 31. Ungrouped tick-, Culicoides-, or Phlebotomus-associated viruses: One-half of the listed viruses are taxonomically unclassified. Except for bovine ephemeral fever, Inhangapi and Ngaingan viruses, all other agents listed in Table 31 are associated with tick vectors. Inhangapi virus, classified as a rhabdovirus, is associated with phlebotomine flies. Bovine ephemeral fever and Ngaingan viruses are associated with Culicoides insects. Only Bhanja, Issyk-Kul and Wanowrie viruses in Table 31 have been isolated from man. Bhanja virus has caused a laboratory-acquired infection. 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.

Following the isolation of Dhori virus from ticks collected in Portugal, its geographic distribution then included Europe as well as Africa and Asia. Formerly, the Bunyaviridae study group of the ICTV nad 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 (4,8).

Tettnang virus was shown to cross-react in CF tests with mouse hepatitis virus (MHV). It remains to be determined whether it is identical or closely related to MHV or whether it became contaminated with MHV subsequent to its isolation. It is also possible that it is a distinct coronavirus which is capable of infecting man and producing disease in man.

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 a man infected in nature. The infection was classified as a febrile illness.

Tables 32, 33. Ungrouped viruses, no arthropod vector known: None of the listed viruses have been isolated from an arthropod vector, and only Almpiwar virus is rated higher than Possible Arbovirus. Several of the viruses are 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, Hantaan and Le Dantec viruses were isolated from man. All three viruses have been associated with the production of human disease as a result of infections acquired in nature.

Approximately forty-two percent of the viruses listed in Tables 32 and 33 have been assigned a provisional taxonomic classification. Hantaan virus has been included with those ungrouped viruses in Table 32 which provisionally have been classified as "bunyavirus-like". The taxonomic classification of Hantaan virus was based on unequivocal electron microscopic evidence presented in three relatively recent publications (11-13). These publications showed that Hantaan virus particles had morphological features identical to those of viruses in the family Bunyaviridae.

Hantaan virus is the etiologic agent of 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.

Ibaraki virus has produced a "bluetongue-like" disease in the cattle of Japan; however, it has had little or no pathogenicity and low infectivity for experimental sheep. Furthermore, it has been shown to be antigenically related to EHD virus both by agar gel precipitin and indirect fluorescent antibody tests. An antigenic relationship has not been observed between Ibaraki virus and the four serotypes of bluetongue virus found in the United States.

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.

A majority of the unclassified viruses shown in Table 33 appear to be bird-associated viruses. Four viruses have been recovered from rodents, two from bats, and two others from other vertebrates. Sixteen of these viruses were recovered in Africa and Asia. The remaining two viruses were found in South America.

Table 34 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 85% have been isolated on a single continent only, while 19 or 4.1% have been found on three or more continents. The largest number of viruses have been isolated in Africa and South America.

Table 35 shows the number of viruses, according to antigenic group, which have been isolated from various classes of arthropods. About 50% have been recovered from mosquitoes, 21% from ticks, and 16% from all other classes. Ninety-four 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 (336 of 366, 91.8%).

Table 36 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 (181 of 260, 69.6%).

Table 37 lists the viruses in each antigenic group which cause disease in man. Approximately 24% 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 45% of all registered viruses. These viruses also account for 66% 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 38, and it shows that 243 registrations (53%) are rated as Possible Arbovirus. Clearly, additional data are required if we are to have a more precise rating of the arthropod-borne status of these viruses. Sufficient data are available for about 47% of all registered viruses so that 41% are rated Probable Arbovirus or Arbovirus, while 6% are rated Probably not Arbovirus or Not Arbovirus.

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Table 1

ALPHABETICAL AND TAXONOMIC LISTING OF 460 VIRUSES REGISTERED AS OF 31 DEC. 1982 WITH RECOMMENDED ABBREVIATIONS AND ANTIGENIC GROUPINGS

NAME	ABBR.	TAXONOMIC STATUS		ANTIGENIC GROUP
		FAMILY	GENUS	
ABRAS	ABR	Bunyaviridae	Bunyavirus	PAT
ABSETTAROV	ABS	Togaviridae	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	Togaviridae	Flavivirus	B
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 FAMILY	GENUS	ANTIGENIC GROUP
ANOPHELES B	ANB	Bunyaviridae	Bunyavirus	ANB
APEU	APEU	Bunyaviridae	Bunyavirus	C
APOI	APOI	Togaviridae	Flavivirus	B
ARAGUARI	ARA			
ARANSAS BAY	AB	Bunyaviridae	Bunyavirus-like	UPO
ARIDE	ARI			
ARKONAM	ARK			
AROA	AROA	Togaviridae	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	Togaviridae	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	Togaviridae	Flavivirus	B
BARMAH FOREST	BF	Bunyaviridae	Bunyavirus	TUR
BARUR	BAR	Rhabdoviridae		MOS
BATAI	BAT	Bunyaviridae	Bunyavirus	BUN

NAME	ABBR.	TAXONOMIC STATUS		ANTIGENIC 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	
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	Togaviridae	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
BURG EL ARAB	BEA	Bunyaviridae	Bunyavirus-like	MTY
BUSHBUSH	BSB	Bunyaviridae	Bunyavirus	CAP
BUSSUQUARA	BSQ	Togaviridae	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
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	Togaviridae	Flavivirus	B
CATU	CATU	Bunyaviridae	Bunyavirus	GMA
CHACO	CHO	Rhabdoviridae		TIM
CHAGRES	CHG	Bunyaviridae	Phlebovirus	PHL
CHANDIPURA	CHP	Rhabdoviridae	Vesiculovirus	VSV
CHANGUINOLA	CGL	Reoviridae	Orbivirus	CGL
CHARLEVILLE	CHV	Rhabdoviridae		MOS

NAME	ABBR.	TAXONOMIC STATUS		ANTI-GENIC GROUP
		FAMILY	GENUS	
CHENUDA	CNU	Reoviridae	Orbivirus	KEM
CHIKUNGUNYA	CHIK	Togaviridae	Alphavirus	A
CHILIBRE	CHI	Bunyaviridae	Phlebovirus	PHL
CHIM	CHIM			
CHOBAR GORGE	CG			
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	Togaviridae	Flavivirus	B
CRIMEAN HEM. FEVER	CHF	Bunyaviridae	Nairovirus	CHF-CON
D'AGUILAR	DAG	Reoviridae	Orbivirus	PAL
DAKAR BAT	DB	Togaviridae	Flavivirus	B
DENGUE-1	DEN-1	Togaviridae	Flavivirus	B
DENGUE-2	DEN-2	Togaviridae	Flavivirus	B
DENGUE-3	DEN-3	Togaviridae	Flavivirus	B
DENGUE-4	DEN-4	Togaviridae	Flavivirus	B
DERA GHAZI KHAN	DGK	Bunyaviridae	Nairovirus	DGK
DHORI	DHO	Orthomyxoviridae		
DOUGLAS	DOU	Bunyaviridae	Bunyavirus	SIM

NAME	ABBR.	TAXONOMIC STATUS FAMILY	GENUS	ANTI-GENIC GROUP
DUGBE	DUG	Bunyaviridae	Nairovirus	NSD
EAST. EQUINE ENC.	EEE	Togaviridae	Alphavirus	A
EBOLA	EBO			MBG
EDGE HILL	EH	Togaviridae	Flavivirus	B
ENSEADA	ENS	Bunyaviridae	Bunyavirus-like	
ENTEBBE BAT	ENT	Togaviridae	Flavivirus	B
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
FORT MORGAN	FM	Togaviridae	Alphavirus	A
FRIJOLES	FRI	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			
GORDIL	GOR	Bunyaviridae	Phlebovirus	PHL
GOSSAS	GOS			
GRAND ARBAUD	GA	Bunyaviridae	Uukuvirus	UUK
GRAY LODGE	GLO	Rhabodoviridae		

NAME	ABBR.	TAXONOMIC STATUS		ANTI-GENIC GROUP
		FAMILY	GENUS	
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	Bunyavirus-like	
HANZALOVA	HAN	Togaviridae	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	Togaviridae	Flavivirus	B
IBARAKI	IBA	Reoviridae	Orbivirus	
ICOARACI	ICO	Bunyaviridae	Phlebovirus	PHL
IERI	IERI	Reoviridae	Orbivirus	
IFE	IFE	Reoviridae	Orbivirus	
ILESHA	ILE	Bunyaviridae	Bunyavirus	BUN
ILHEUS	ILH	Togaviridae	Flavivirus	B
INGWAVUMA	ING	Bunyaviridae	Bunyavirus	SIM
INHANGAPI	INH	Rhabdoviridae		
ININI	INI	Bunyaviridae	Bunyavirus	SIM

NAME	ABBR.	TAXONOMIC STATUS FAMILY	GENUS	ANTI-GENIC GROUP
INKOO	INK	Bunyaviridae	Bunyavirus	CAL
IPPY	IPPY			
IRITUIA	IRI	Reoviridae	Orbivirus	CGL
ISFAHAN	ISF	Rhabdoviridae	Vesiculovirus	VSV
ISRAEL TURKEY MEN.	IT	Togaviridae	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
JAMANXI	JAM	Reoviridae	Orbivirus	CGL
JAMESTOWN CANYON	JC	Bunyaviridae	Bunyavirus	CAL
JAPANAUT	JAP	Reoviridae	Orbivirus	
JAPANESE ENC.	JE	Togaviridae	Flavivirus	B
JERRY SLOUGH	JS	Bunyaviridae	Bunyavirus	CAL
JOHNSTON ATOLL	JA			QRF
JOINJAKAKA	JOI	Rhabdoviridae		
JUAN DIAZ	JD	Bunyaviridae	Bunyavirus	CAP
JUGRA	JUG	Togaviridae	Flavivirus	B
JUNIN	JUN	Arenaviridae	Arenavirus	TCR
JURONA	JUR	Rhabdoviridae	Vesiculovirus	VSV
JUTIAPA	JUT	Togaviridae	Flavivirus	B
KADAM	KAD	Togaviridae	Flavivirus	B
KAENG KHOI	KK	Bunyaviridae	Bunyavirus	SBU

NAME	ABBR.	TAXONOMIC STATUS		ANTI-GENIC GROUP
		FAMILY	GENUS	
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	Togaviridae	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	Vesiculovirus	VSV
KEYSTONE	KEY	Bunyaviridae	Bunyavirus	CAL
KHASAN	KHA	Bunyaviridae	Bunyavirus-like	
KLAMATH	KLA	Rhabdoviridae		
KOKOBERA	KOK	Togaviridae	Flavivirus	B
KOLONGO	KOL			
KOONGOL	KOO	Bunyaviridae	Bunyavirus	KOO
KOTONKAN	KOT	Rhabdoviridae	Lyssavirus	RABIES
KOUTANGO	KOU	Togaviridae	Flavivirus	B
KOWANYAMA	KOW	Bunyaviridae	Bunyavirus-like	

NAME	ABBR.	TAXONOMIC STATUS FAMILY	GENUS	ANTIGENIC GROUP
KUMLINGE	KUM	Togaviridae	Flavivirus	B
KUNJIN	KUN	Togaviridae	Flavivirus	B
KUNUNURRA	KNA	Rhabdoviridae		
KWATTA	KWA	Rhabdoviridae		KWA
KYASANUR FOR. DIS.	KFD	Togaviridae	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	Togaviridae	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			
LEDNICE	LED	Bunyaviridae	Bunyavirus	TUR
LIPOVNIK	LIP	Reoviridae	Orbivirus	KEM
LLANO SECO	LLS	Reoviridae	Orbivirus	*
LOKERN	LOK	Bunyaviridae	Bunyavirus	BUN

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

NAME	ABBR.	TAXONOMIC STATUS FAMILY	GENUS	ANTI-GENIC GROUP
LONE STAR	LS	Bunyaviridae	Bunyavirus-like	
LOUPING ILL	LI	Togaviridae	Flavivirus	B
LUKUNI	LUK	Bunyaviridae	Bunyavirus	ANA
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
MARBURG	MBG			MBG
MARCO	MCO	Rhabdoviridae		MOS
MARITUBA	MTB	Bunyaviridae	Bunyavirus	C
MATARIYA	MTY	Bunyaviridae	Bunyavirus-like	MTY
MATRUH	MTR	Bunyaviridae	Bunyavirus	TETE
MATUCARE	MAT			
MAYARO	MAY	Togaviridae	Alphavirus	A
MELAO	MEL	Bunyaviridae	Bunyavirus	CAL
MERMET	MER	Bunyaviridae	Bunyavirus	SIM
MIDDELBURG	MID	Togaviridae	Alphavirus	A

NAME	ABBR.	TAXONOMIC STATUS FAMILY	GENUS	ANTI-GENIC GROUP
MINATITLAN	MNT	Bunyaviridae	Bunyavirus	MNT
MINNAL	MIN			
MIRIM	MIR	Bunyaviridae	Bunyavirus	GMA
MITCHELL RIVER	MR	Reoviridae	Orbivirus	WAR
MODOC	MOD	Togaviridae	Flavivirus	B
MOJU	MOJU	Bunyaviridae	Bunyavirus	GMA
MONO LAKE	ML	Reoviridae	Orbivirus	KEM
MONT. MYOTIS LEUK.	MML	Togaviridae	Flavivirus	B
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
MURRAY VALLEY ENC.	MVE	Togaviridae	Flavivirus	B
MURUTUCU	MUR	Bunyaviridae	Bunyavirus	C
NAIROBI SHEEP DIS.	NSD	Bunyaviridae	Nairovirus	NSD
NARANJAL	NJL	Togaviridae	Flavivirus	B
NARIVA	NAR	Paramyxoviridae	Paramyxovirus	
NAVARRO	NAV	Rhabdoviridae		
NDUMU	NDU	Togaviridae	Alphavirus	A
NEGISHI	NEG	Togaviridae	Flavivirus	B
NEPUYO	NEP	Bunyaviridae	Bunyavirus	C
NEW MINTO	NM	Rhabdoviridae		SAW

NAME	ABBR.	TAXONOMIC STATUS		ANTI-GENIC GROUP
		FAMILY	GENUS	
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	Togaviridae	Flavivirus	B
NUGGET	NUG	Reoviridae	Orbivirus	KEM
NYAMANINI	NYM			
NYANDO	NDO	Bunyaviridae	Bunyavirus-like	NDO
OKHOTSKIY	OKH	Reoviridae	Orbivirus	KEM
OKOLA	OKO			
OLIFANTSVLEI	OLI	Bunyaviridae	Bunyavirus	OLI
OMSK HEM. FEVER	OMSK	Togaviridae	Flavivirus	B
O'NYONG-NYONG	ONN	Togaviridae	Alphavirus	A
ORIBOCA	ORI	Bunyaviridae	Bunyavirus	C
OROPOUCHE	ORO	Bunyaviridae	Bunyavirus	SIM
ORUNGO	ORU	Reoviridae	Orbivirus	
OSSA	OSSA	Bunyaviridae	Bunyavirus	C
OUANGO	OUA			
OUBANGUI	OUB	Poxviridae		
OUREM	OUR	Reoviridae	Orbivirus	CGL
PACORA	PCA	Bunyaviridae	Bunyavirus-like	

NAME	ABBR.	TAXONOMIC STATUS FAMILY	GENUS	ANTIGENIC GROUP
PACUI	PAC	Bunyaviridae	Phlebovirus	PHL
PAHAYOKEE	PAH	Bunyaviridae	Bunyavirus	PAT
PALESTINA	PLS	Bunyaviridae	Bunyavirus	MNT
PALYAM	PAL	Reoviridae	Orbivirus	PAL
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	Togaviridae	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	Togaviridae	Flavivirus	B
PRETORIA	PRE	Bunyaviridae	Nairovirus	DGK
PUCHONG	PUC			MAL
PUEBLO VIEJO	PV	Bunyaviridae	Bunyavirus	GAM
PUNTA SALINAS	PS	Bunyaviridae	Nairovirus	HUG

NAME	ABBR.	TAXONOMIC STATUS		ANTI-GENIC GROUP
		FAMILY	GENUS	
PUNTA TORO	PT	Bunyaviridae	Phlebovirus	PHL
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	Togaviridae	Flavivirus	B
ROSS RIVER	RR	Togaviridae	Alphavirus	A
ROYAL FARM	RF	Togaviridae	Flavivirus	B
RUSS. SPR. SUM. ENC.	RSSE	Togaviridae	Flavivirus	B
SABO	SABO	Bunyaviridae	Bunyavirus	SIM
SABOYA	SAB	Togaviridae	Flavivirus	B
SAGIYAMA	SAG	Togaviridae	Alphavirus	A
SAINT-FLORIS	SAF	Bunyaviridae	Phlebovirus	PHL
SAKHALIN	SAK	Bunyaviridae	Nairovirus	SAK
SAKPA	SPA			
SALANGA	SGA	Poxviridae		
SALEHABAD	SAL	Bunyaviridae	Phlebovirus	PHL
SAL VIEJA	SV	Togaviridae	Flavivirus	B
SAN ANGELO	SA	Bunyaviridae	Bunyavirus	CAL
SANDFLY F. (NAPLES)	SFN	Bunyaviridae	Phlebovirus	PHL
SANDFLY F. (SICILIAN)	SFS	Bunyaviridae	Phlebovirus	PHL

NAME	ABBR.	TAXONOMIC STATUS		ANTI-GENIC GROUP
		FAMILY	GENUS	
SANDJIMBA	SJA			
SANGO	SAN	Bunyaviridae	Bunyavirus	SIM
SAN JUAN	SJ	Bunyaviridae	Bunyavirus	GAM
SAN PERLITA	SP	Togaviridae	Flavivirus	B
SANTA ROSA	SAR	Bunyaviridae	Bunyavirus	BUN
SATHUPERI	SAT	Bunyaviridae	Bunyavirus	SIM
SAUMAREZ REEF	SRE	Togaviridae	Flavivirus	B
SAWGRASS	SAW	Rhabdoviridae		SAW
SEBOKELE	SEB			
SELETAR	SEL	Reoviridae	Orbivirus	KEM
SEMBALAM	SEM			
SEMLIKI FOREST	SF	Togaviridae	Alphavirus	A
SEPIK	SEP	Togaviridae	Flavivirus	B
SERRA DO NAVIO	SDN	Bunyaviridae	Bunyavirus	CAL
SHAMONDA	SHA	Bunyaviridae	Bunyavirus	SIM
SHARK RIVER	SR	Bunyaviridae	Bunyavirus	PAT
SHUNI	SHU	Bunyaviridae	Bunyavirus	SIM
SILVERWATER	SIL	Bunyaviridae	Bunyavirus-like	KSO
SIMBU	SIM	Bunyaviridae	Bunyavirus	SIM
SIMIAN HEM. FEVER	SHF	Togaviridae		
SINDBIS	SIN	Togaviridae	Alphavirus	A
SIXGUN CITY	SC	Reoviridae	Orbivirus	KEM
SLOVAKIA	SLO			
SNOWSHOE HARE	SSH	Bunyaviridae	Bunyavirus	CAL

NAME	ABBR.	TAXONOMIC STATUS FAMILY	GENUS	ANTI-GENIC GROUP
SOKULUK	SOK	Togaviridae	Flavivirus	B
SOLDADO	SOL	Bunyaviridae	Nairovirus	HUG
SORONOCA	SOR	Bunyaviridae	Bunyavirus	BUN
SPONDWENI	SPO	Togaviridae	Flavivirus	B
ST. LOUIS ENC.	SLE	Togaviridae	Flavivirus	B
STRATFORD	STR	Togaviridae	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	
TEHRAN	TEH	Bunyaviridae	Phlebovirus	PHL
TELOK FOREST	TF			TR
TEMBE	TME			
TEMBUSU	TMU	Togaviridae	Flavivirus	B
TENSAW	TEN	Bunyaviridae	Bunyavirus	BUN
TERMEIL	TER			
TETE	TETE	Bunyaviridae	Bunyavirus	TETE

NAME	ABBR.	TAXONOMIC STATUS		ANTI-GENIC GROUP
		FAMILY	GENUS	
TETTNANG	TET	Coronaviridae		
THIMIRI	THI	Bunyaviridae	Bunyavirus	SIM
THOGOTO	THO	Orthomyxoviridae		THO
THOTTAPALAYAM	TPM			
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
TURLOCK	TUR	Bunyaviridae	Bunyavirus	TUR
TURUNA	TUA	Bunyaviridae	Phlebovirus	PHL
TYULENIY	TYU	Togaviridae	Flavivirus	B
UGANDA S	UGS	Togaviridae	Flavivirus	B
UMATILLA	UMA	Reoviridae	Orbivirus	
UMBRE	UMB	Bunyaviridae	Bunyavirus	TUR

NAME	ABBR.	TAXONOMIC STATUS FAMILY	GENUS	ANTI-GENIC GROUP
UNA	UNA	Togaviridae	Alphavivirus	A
UPOLU	UPO	Bunyaviridae	Bunyavirus-like	UPO
URUCURI	URU	Bunyaviridae	Phlebovirus	PHL
USUTU	USU	Togaviridae	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	Togaviridae	Flavivirus	B
WEST. EQUINE ENC.	WEE	Togaviridae	Alphavirus	A
WEST NILE	WN	Togaviridae	Flavivirus	B
WHATAROA	WHA	Togaviridae	Alphavirus	A
WITWATERSRAND	WIT	Bunyaviridae	Bunyavirus-like	
WONGAL	WON	Bunyaviridae	Bunyavirus	KOO

NAME	ABBR.	TAXONOMIC STATUS		ANTI-GENIC GROUP
		FAMILY	GENUS	
WONGORR	WGR			
WYEOMYIA	WYO	Bunyaviridae	Bunyavirus	BUN
YACAABA	YAC			
YAQUINA HEAD	YH	Reoviridae	Orbivirus	KEM
YATA	YATA	Rhabdoviridae		
YELLOW FEVER	YF	Togaviridae	Flavivirus	B
YOGUE	YOG			
YUG BOGDANOVAC	YB	Rhabdoviridae	Vesiculovirus	VSV
ZALIV TERPENIYA	ZT	Bunyaviridae	Uukuvirus	UUK
ZEGLA	ZEG	Bunyaviridae	Bunyavirus	PAT
ZIKA	ZIKA	Togaviridae	Flavivirus	B
ZINGA	ZGA	Bunyaviridae	Phlebovirus	PHL
ZINGILAMO	ZGO			BTK
ZIRQA	ZIR	Bunyaviridae	Nairovirus	HUG

Table 2. Antigenic Groups of 460 Viruses Registered in Catalogue

Virus Family and Genus	Antigenic Group	Abbreviation	No. Registered Viruses in Group	Percent
ARENAVIRIDAE				
Arenavirus	Tacaribe	TCR	9	2.0
BUNYAVIRIDAE				
Bunyavirus	Bunyamwera Supergroup		121	26.3
	Anopheles A	ANA	5	
	Anopheles B	ANB	2	
	Bunyamwera	BUN	19	
	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	5	
	Unassigned	SBU	1	
Nairovirus	CHF-Congo	CHF-CON	3	0.7
	Dera Ghazi Khan	DGK	5	1.1
	Hughes	HUG	4	0.9
	Nairobi sheep disease	NSD	3	0.7
	Qalyub	QYB	2	0.4
	Sakhalin	SAK	5	1.1
Phlebovirus	Phlebotomus fever	PHL	31	6.7

Table 2 (Continued)

Virus Family and Genus	Antigenic Group	Abbreviation	No. Registered Viruses in Group	Percent
BUNYAVIRIDAE				
Uukuvirus	Uukuniemi	UUK	5	1.1
"Bunyavirus-like" (Unassigned, probable or possible members)	Bakau	BAK	2	0.4
	Kaisodi	KSO	3	0.7
	Mapputta	MAP	4	0.9
	Matariya	MTY	3	0.7
	Nyando	NDO	1	0.2
	Upolu	UPO	2	0.4
	Ungrouped		15	3.3
REOVIRIDAE				
Orbivirus	African horsesickness	AHS	1	0.2
	Bluetongue	BLU	1	0.2
	Changuinola	CGL	7	1.5
	Colorado tick fever	CTF	2	0.4
	Corriparta	COR	2	0.4
	Epizootic hemorrhagic dis.	EHD	1	0.2
	Eubenangee	EUB	3	0.7
	Kemerovo	KEM	16	3.5
	Palyam	PAL	4	0.9
	Wallal	WAL	1	0.2
	Warrego	WAR	2	0.4
	Ungrouped		9	2.0
RHABDOVIRIDAE				
Vesiculovirus	Vesicular stomatitis	VSV	11	2.4
Lyssavirus	Rabies		2	0.4
Unassigned or possible members	Hart Park	HP	3	0.7
	Kwatta	KWA	1	0.2
	Mossuril	MOS	7	1.5
	Sawgrass	SAW	3	0.7
	Timbo	TIM	2	0.4
	Ungrouped		11	2.4

Table 2 (Continued)

Virus Family and Genus	Antigenic Group	Abbreviation	No. Registered Viruses in Group	Percent
TOGAVIRIDAE				
Alphavirus	A	A	25	5.4
Flavivirus	B	B	63	13.7
Possible members	Ungrouped		2	0.4
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	0.7
UNCLASSIFIED	Boteke	BTK	2	0.4
	Malakal	MAL	2	0.4
	Marburg	MBG	2	0.4
	Tanjong Rabok	TR	2	0.4
	Quaranfil	QRF	2	0.4
	Ungrouped		42	9.1
TOTAL			460	

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	Cameroon	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
		Sudan	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
		Iran	ISF*
		Korea	HTN
		Malaysia	CI,TF
		U.S.S.R.	BKN,CHIM,IK,KHA,KSI,PMR,RAZ,SOK,TDY
	Australasia	Australia	BF,DOU,GG,KNA,NGA,NUG,PEA,PIA,PR,SRE, TAG,TER,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,ENS,ITA,ITI,JAM,MQO,ROC, TUA
		Ecuador	ABR,BAB,NJL,PLA,PLS,PV,SJ,VIN
		French Guiana	INI,RBU,TON
		Venezuela	AROA
1980-82	S. America	Argentina	LM

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

Table 4. Initial Isolation of 460 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 -82	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	1	1		19
	Sudan					1			1
	Uganda		2	5	6	4			17
	Zaire						1		1
	Totals	4	4	5	28	44	26	0	111
ASIA	Cambodia					1			1
	India				12	9	2		23
	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	15	0	76
AUSTRAL-	Australia				1	25	17		43
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	17	0	49
EUROPE	Czechoslovakia			1	2	5	1		9
	Finland				1	2			3
	France					2			2
	West Germany					1	2		3
	Italy			2			1		3
	Scotland	1					2		3
	U.S.S.R. (West)				1		1		2
	Yugoslavia						1		1
	Totals	1	0	3	4	10	8	0	26
NORTH	Canada				1	1	3		5
AMERICA	Guatemala					1			1
	Mexico					2	1		3
	Panama				3	15	3		21
	U.S.A.	1	3	3	10	27	13		57
	Totals	1	3	3	14	46	20	0	87
SOUTH	Argentina				1			1	2
AMERICA	Bolivia					1			1
	Brazil			1	18	37	10		66
	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	22	1	111
	GRAND TOTALS	6	10	19	109	207	108	1	460

Table 5. Alphaviruses, Family Togaviridae

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																							
Aura	+														+						+			2	S	22	Alphavirus
Bebaru	+																+							2	S	22	"
Cabassou	+										+		+		+						+			3*V	1E	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	1E	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	1E	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 Togaviridae

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		
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	1E	21	"
Ntaya	+															+								2	S	21	"
Rocio	+							+			+				+						+	+	+	3*	S	20	"
Sepik	+																	+				+		3	1E	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 Togaviridae

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	1E	22	"
Tyuleniy			+														+			+				2	S	21	"

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

Table 8. Flaviviruses, Family Togaviridae:
No Arthropod Vector Demonstrated

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		
Apoi										+					+		+				+		+	2	S	22	Flavivirus
Aroa																								2	S	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																								
	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		
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	"
Ilesha		+						+								+						+		2	S	21	"
Kairi	+								+	+					+						+			3	A1	20	"
Lokern	+					+								+						+				2	S	20	"
Maguari	+	+												+	+						+			2	S	20	"
Main Drain						+								+						+				2	S	20	"
Northway	+														+					+				3	1E	21	"
Playas	+																				+					22	"
Santa Rosa	+																			+				3	1E	22	"
Sororoca	+																				+			2	S	22	"
Tensaw	+	+												+	+					+		+		2	S	20	"
Tlacotalpan	+	+																		+				3	1E	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																								
	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		
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	+														+											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																								
	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		
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	1E	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				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	Phlebotomine	Culicoides																					
GAMBOA GR.																											
Gamboa	+																			+				2	S	22	Bunyavirus
Pueblo Viejo	+																				+					22	"
San Juan	+																				+					22	"
GUAMA GR.																											
Ananindeua	+									+	+		+		+						+			2	A7	21	Bunyavirus
Bertioga															+						+			2	S	22	"
Bimiti	+									+					+						+			2	S	20	"
Cananeia	+														+						+					21	"
Catu	+	+						+		+		+	+		+						+	+		2	S	20	"
Guama	+				+			+		+		+	+		+					+	+	+		2	S	20	"
Guaratuba	+										+				+						+			3	1E	21	"
Itimirim																					+					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	+														+						+				21	"
OLIFANTSVLEI GR.																										
Botambi	+															+							2	S	22	Bunyavirus
Bobia	+															+							3	1E	22	"
Olifantsvlei	+															+							2	S	22	"
PATOIS GR.																										
Abras	+														+						+				22	Bunyavirus
Babahoyo	+														+						+				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																									
	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		
Aino	+					+											+	+						3	S	22	Bunyavirus
Akabane	+					+								+			+	+						3	S	21	"
Buttonwillow						+								+						+				2	S	20	"
Douglas						+								+	+			+						3	1E	21	"
Ingwavuma	+										+			+		+	+							2	S	20	"
Inini											+										+			3	1E	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	1E	22	"
Utinga														+							+			3	1E	22	"

* See footnote Table 5
** See footnote Table 5

Table 16. Bunyaviruses, Family Bunyaviridae:
Bunyamwera Supergroup, Tete, 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	1E	22	"
Matruh			+								+					+			+					2	S	22	"
Tete											+													2	S	22	"
Tsuruse											+						+							2	S	22	"
TURLOCK GR.																											
Barmah Forest	+																	+	+					2	A7	22	Bunyavirus
Lednice	+																		+					2	A7	21	"
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		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																							
Aguacate					+															+	+			2	S	21	Phlebovirus
Alenquer								+						+							+			3	1E	22	"
Anhanga														+							+			2	S	22	"
Arumowot	+									+				+		+					+			2	S	22	"
Buenaventura					+															+	+			3	1E	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	"
Gordil										+						+								3	1E	22	"
Icoaraci	+	+			+					+	+				+						+			2	S	21	"
Itaituba													+		+						+			3	1E	22	"
Itaporanga	+										+		+		+						+			2	S	20	"
Karimabad					+												+							2	S	21	"
Nique					+															+				2	S	22	"
Pacui					+					+											+			2	S	21	"
Punto Toro					+			+												+	+	+		2	S	21	"
Rift Valley fever	+							+							+	+						+	+	3*VX	S	20	"
Rio Grande										+										+				2	S	21	"
Saint-Floris										+						+								2	S	22	"
Salehabad					+												+							2	S	22	"
SF-Naples					+			+								+	+		+			+		2	S	20	"
SF-Sicilian					+			+								+	+		+			+		2	S	20	"
Tehran					+												+							2	A7	22	"
Toscana					+														+					2	S	21	"
Turuna					+																+			3	1E	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																							
	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		
CHF-CONGO GR.																										
Congo			+			+		+						+		+	+		+			+	+	4	A6	20	Nairovirus
Crimean hem. fever			+ +	+				+								+	+ +		+			+	+	4	A6	20	"
Hazara			+ +														+ +							2	S	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	"
Zirqa				+ +													+							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	1E	22	"
Sakhalin			+														+			+			2	S	22	"
Taggert			+															+					2	S	22	"

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

Table 20. Bunyavirus-Like, Family Bunyaviridae; Unclassified Viruses; Family Orthomyxoviridae; Uukuviruses, 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																							
KAISODI GR.																										
Kaisodi			+								+						+						2	S	22	Bunyavirus-like
Lanjan			+ +						+								+						2	S	22	"
Silverwater			+											+						+			2	S	21	"
QUARANFIL GR.																										
Johnston Atoll				+														+					2	S	20	Unclassified
Quaranfil				+				+			+					+						+	2	S	20	"
THOGOTO GR.																										
Thogoto			+					+						+		+			+			+	3	S	22	Orthomyxoviridae
UPOLU GR.																										
Aransas Bay				+																+			3	IE	22	Bunyavirus-like
Upolu				+														+					2	S	22	"
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	"

** See footnote Table 5

Table 21. 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	1E	22	"
Matariya											+					+							2	S	22	"
NYANDO GR.																										
Nyando		+						+								+					+		2	S	21	Bunyavirus-like

** See footnote Table 5

Table 22. 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 23. 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																								
	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		
AFR. HORSESICKNESS																											
Afr. horsesickness						+								+		+	+		+					X		20	Orbivirus
BLUETONGUE GR.																											
Bluetongue						+								+		+	+	+	+	+				2	S	20	Orbivirus
CHANGUINOLA GR.																											
Altamira					+																+			3	1E	22	Orbivirus
Caninde					+																+			3	1E	22	"
Changuinola					+			+												+		+		2	S	21	"
Gurupi					+																+			3	1E	22	"
Irituia					+					+											+			2	S	22	"
Jamanxi					+																+			3	1E	22	"
Ourem					+																+			3	1E	22	"
CORRIPARTA GR.																											
Acado	+															+								2	S	22	Orbivirus
Corriparta	+										+							+						2	S	21	"
EHD GR.																											
Epizootic hem. dis.														+		+				+				2	S	21	Orbivirus

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

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																							
EUBENANGEE GR.																											
Eubenangee	+?	+?																+						2	S	22	Orbivirus
Pata	+															+								2	S	22	"
Tilligerry		+																+						3	1E	22	"
PALYAM GR.																											
D'Aguilar						+								+				+						2	S	22	Orbivirus
Kasba	+																+							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 25. 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	"
KWATTA GR.																											
Kwatta	+																				+			2	S	22	Rhabdoviridae
MOSSURIL GR.																											
Bangoran	+										+					+								2	S	22	Rhabdoviridae
Barur			+							+							+							2	S	22	"
Charleville					+									+				+						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 26. 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	1E	22	Rhabdoviridae
New Minto			+																	+				3	1E	22	"
Sawgrass			+																	+				2	S	22	"
TIMBO GR.																										
Chaco														+							+			2	S	22	Rhabdoviridae
Timbo														+							+			2	S	22	"
VES. STOMATITIS GR.																										
Chandipura					+			+						+		+	+					+		2	S	20	Vesiculovirus
Cocal	+						+			+				+	+						+			3	A1	20	"
Isfahan					+												+							2	S	22	"
Jurona	+																				+			2	S	22	"
Keuraliba										+						+								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	1E	22	"

** See footnote Table 5

Table 27. 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	1E	22	"

** See footnote Table 5

Table 28. 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
Junin							+	+		+				+		+					+	+	+	4	A6	24	"
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 29. 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	+																				+					22	"
Kowanyama		+																+						2	S	22	"
Pacora	+																			+				2	S	22	"
Tataguine	+	+						+								+				+		+		2	S	21	"
Witwatersrand	+									+					+	+								2	S	20	"
Bocas	+											+								+	+					22	Coronavirus
Ieri	+																			+				3	1E	22	Orbivirus
Japanaut	+											+						+						2	S	21	"
Lebombo	+						+	+								+								2	S	21	"
Llano Seco††	+																			+				3	1E	21	"
Orungo	+	+														+						+		3	S	21	"
Paroo River	+																	+						3	1E	22	"
Umatilla	+										+									+				2	S	20	"
Nodamura	+																+							3	1E	23	Nodavirus
Cotia	+				+			+							+						+	+		2	S	24	Poxvirus
Oubangui	+															+								3	1E	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 30. 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		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																						
Aruac	+																				+			2	S	21	Rhabdoviridae
Gray Lodge	+																			+				3	1E	22	"
Joinjakaka	+																	+						2	S	22	"
Kununurra	+																	+						2	S	22	"
Yata	+															+								2	S	22	"
Triniti	+																				+			2	S	21	Togaviridae
Arkonam	+	+															+							2	S	22	Unclassified
Gomoka	+	+									+					+								2	S	22	"
Minnal	+															+	+							2	S	22	"
Nkolbisson	+															+								2	S	22	"
Okola	+															+								2	S	22	"
Picola	+																	+						3	1E	22	"
Rochambeau	+																				+			3	1E	22	"
Tanga		+														+								2	S	22	"
Tembe		+																			+			2	S	22	"
Termeil	+																	+						3	1E	21	"
Venkatapuram	+																+							2	S	22	"
Wongorr	+																	+						2	S	22	"
Yacaaba	+																	+						3	1E	22	"

** See footnote Table 5

Table 31. Families Bunyaviridae, Coronaviridae, Iridoviridae, Orthomyxoviridae, 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																						
Bhanja			+					+		+				+		+	+		+				+	3	S	22	Bunyavirus-like
Khasan			+														+							3	1E	22	"
Lone Star			+																	+				2	S	22	"
Razdan			+														+							3	1E	22	"
Sunday Canyon				+																+				2	S	22	"
Tamdy				+													+							3	1E	22	"
Tettnang			+																+					2	S	22	Coronaviridae
Afr. swine fever				+										+		+			+		+§			X		20	Iridoviridae
Dhori			+													+	+		+					3	S	22	Orthomyxoviridae
Bovine eph. fever						+								+		+	+	+						X		22	Rhabdoviridae
Inhangapi					+																+			3	1E	22	"
Aride			+													+								2	S	22	Unclassified
Batken	+		+														+							3	1E	22	"
Chim			+														+							3	1E	22	"
Chobar Gorge				+													+							2	S	22	"
Issyk-Kul				+				+				+					+					+		3	1E	22	"
Keterah				+								+					+							2	S	21	"
Matucare				+																	+			2	S	22	"
Ngaingan						+												+						2	S	22	"
Nyamanini				+							+					+								2	S	21	"
Slovakia				+															+					3	1E	22	"
Wanowrie	+		+					+								+	+							2	S	22	"

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

Table 32. 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		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																							
Bangui								+								+						+		2	S	22	Bunyavirus-like
Bobaya											+					+								3	1E	22	"
Hantaan								+		+							+					+		3§§	S	22	"
Agua Preta												+									+			3	1E	22	Herpesvirus
Ibaraki														+			+							3	1E	22	Orbivirus
Ife												+				+								3	1E	22	"
Nariva										+											+			3	1E	23	Paramyxovirus
Salanga										+						+								3	1E	22	Poxvirus
Almpiwar														+				+						2	S	21	Rhabdoviridae
Klamath										+										+				2	S	22	"
Mount Elgon bat												+				+								2	S	23	"
Navarro											+										+			2	S	22	"
Simian hem. fever									+								?			+				2	S	24	Togaviridae

** See footnote Table 5

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

Table 33. 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	1E	22	Unclassified
Belem											+ +					+ + +								3	1E	22	"
Bimbo												+					+ +							3	1E	22	"
Gossas										+	+ +					+ + + +								2	S	23	"
Ippy										+	+ + +						+ +							2	S	22	"
Kammavanpettai										+	+ + +					+ + + +								2	S	22	"
Kannamangalam										+	+ + +					+ + + +								2	S	22	"
Kolongo										+	+ + +					+ + + +								2	S	22	"
Landjia										+	+ + +					+ + + +								2	S	22	"
Le Dantec								+														+		3	S	22	"
Ouango										+	+ + +					+ + + +								3	1E	22	"
Sakpa										+	+ + +					+ + + +								3	1E	22	"
Sandjimba										+	+ + +					+ + + +								2	S	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 34. 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		25	6	8	5	2	7	10	17	6	0	1	1	0
AHS		1	1	1	0	1	0	0	0	0	1	0	0	0
B		63	19	23	13	7	12	9	48	11	3	1	0	0
BAK		2	0	2	0	0	0	0	2	0	0	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	19	4	1	0	2	8	6	17	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	5	1	1	1	1	1	1	4	1	0	0	0	0
	SBU	1	0	1	0	0	0	0	1	0	0	0	0	0
CGL		7	0	0	0	0	1	6	7	0	0	0	0	0
CTF		2	0	0	0	1	1	0	2	0	0	0	0	0
COR		2	1	0	1	0	0	0	2	0	0	0	0	0
EHD		1	1	0	0	0	1	0	0	1	0	0	0	0
EUB		3	1	0	2	0	0	0	3	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	6	1	14	1	1	0	0	0
KWA		1	0	0	0	0	0	1	1	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
MTY		3	3	0	0	0	0	0	3	0	0	0	0	0
MOS		7	3	1	1	0	1	1	7	0	0	0	0	0
Nairoviruses	CHF-CON	3	2	3	0	2	0	0	1	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
PAL		4	0	3	1	0	0	0	4	0	0	0	0	0
PHL		31	7	5	0	3	10	12	27	2	2	0	0	0
QRF		2	1	0	1	0	0	0	2	0	0	0	0	0
RABIES		2	2	0	0	0	0	0	2	0	0	0	0	0
SAW		3	0	0	0	0	3	0	3	0	0	0	0	0
TCR		9	1	0	0	0	1	7	9	0	0	0	0	0
THO		1	1	0	0	1	0	0	0	1	0	0	0	0
TIM		2	0	0	0	0	0	2	2	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		11	2	2	0	1	3	6	8	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		89	34	22	13	5	10	15	83	2	4	0	0	0
Totals		460	126	101	57	41	101	126	393	48	15	2	2	0

Table 35. 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		25	24	1	0	1	5	21	2	2
AHS		1	0	0	0	1	0	1	0	0
B		63	30	17	0	0	2	41	4	0
BAK		2	2	1	0	0	0	1	1	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	19	18	0	0	2	0	18	1	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	5	5	0	0	0	0	5	0	0
	SBU	1	0	0	0	0	1	1	0	0
CGL		7	0	0	6	0	0	6	0	0
CTF		2	0	2	0	0	0	2	0	0
COR		2	2	0	0	0	0	2	0	0
EHD		1	0	0	0	0	0	0	0	0
EUB		3	3	0	0	0	0	3	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
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		7	3	1	1	0	0	5	0	0
MTY		3	0	0	0	0	0	0	0	0
Nairoviruses	CHF-CON	3	0	3	0	1	0	2	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
PAL		4	3	0	0	1	0	4	0	0
PHL		31	6	0	18	0	0	20	1	1
QRF		2	0	2	0	0	0	2	0	0
RABIES		2	0	0	0	1	0	1	0	0
SAW		3	0	3	0	0	0	3	0	0
TCR		9	1	1	0	0	3	3	1	0
THO		1	0	1	0	0	0	1	0	0
TIM		2	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		11	5	0	4	1	2	5	2	1
WAL		1	0	0	0	1	0	1	0	0
WAR		2	0	0	0	2	0	2	0	0
Ungrouped		89	38	19	2	2	1	54	4	0
Totals		460	229	98	32	26	15	336	25	5

Table 36. 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	25	11	2	6	11	3	6	6	3	7	5	2	3	1	1
AHS	1	0	0	0	0	0	0	1	0	1	0	0	0	0	0
B	63	28	4	19	15	13	1	5	6	28	8	5	4	2	1
BAK	2	0	1	0	0	0	0	0	0	1	0	0	0	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
Bunyamwera Supergroup: ANB	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bunyamwera Supergroup: BUN	19	4	1	3	0	0	0	1	3	8	2	0	0	0	0
Bunyamwera Supergroup: BWA	2	1	0	0	0	0	0	0	0	1	0	0	0	0	0
Bunyamwera Supergroup: C	12	10	0	8	0	1	5	0	1	2	5	3	1	0	0
Bunyamwera Supergroup: CAL	13	3	0	4	0	0	0	0	1	4	2	0	0	0	0
Bunyamwera Supergroup: CAP	8	0	0	4	0	0	1	0	0	3	1	0	0	0	0
Bunyamwera Supergroup: GAM	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bunyamwera Supergroup: GMA	12	2	0	8	2	2	4	0	0	5	1	1	2	0	0
Bunyamwera Supergroup: KOO	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bunyamwera Supergroup: MNT	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bunyamwera Supergroup: OLI	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bunyamwera Supergroup: PAT	6	0	0	3	0	0	0	0	0	3	0	0	0	0	0
Bunyamwera Supergroup: SIM	21	2	1	0	4	0	0	8	4	13	3	0	0	0	0
Bunyamwera Supergroup: TETE	5	0	0	0	5	0	0	0	0	5	0	0	0	0	0
Bunyamwera Supergroup: TUR	5	0	0	0	2	0	0	0	1	1	1	0	0	0	0
Bunyamwera Supergroup: SBU	1	0	0	0	0	1	0	0	0	1	0	0	0	0	0
CGL	7	1	0	1	0	0	0	0	0	2	0	0	0	0	0
CTF	2	1	0	1	0	0	0	0	1	0	0	1	0	0	0
COR	2	0	0	0	1	0	0	0	0	1	0	0	0	0	0
EHD	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0
EUB	3	0	0	0	0	0	0	0	0	0	0	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
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	7	0	0	1	2	1	0	0	2	6	0	0	0	0	0
MTY	3	0	0	0	3	0	0	0	0	3	0	0	0	0	0
Nairoviruses: CHF-CON	3	2	0	0	0	0	0	1	1	1	1	0	0	0	0
Nairoviruses: DGK	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nairoviruses: HUG	4	0	0	0	1	0	0	0	0	1	0	0	0	0	0
Nairoviruses: NSD	3	3	0	1	0	0	0	2	1	1	1	1	0	0	0
Nairoviruses: QYB	2	0	0	1	0	0	0	0	0	1	0	0	0	0	0
Nairoviruses: 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
PAL	4	0	0	0	0	0	0	1	0	1	0	0	0	0	0
PHL	31	8	0	8	2	0	2	1	2	14	4	0	0	0	0
ORF	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
SAW	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCR	9	3	0	8	0	1	0	0	1	6	2	1	0	0	0
THO	1	1	0	0	0	0	0	1	0	0	1	0	0	0	0
TIM	2	0	0	0	0	0	0	0	2	2	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	11	4	0	2	0	0	1	3	2	2	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	89	9	1	10	14	9	1	4	4	43	2	1	0	0	0
Totals	460	99	13	90	70	32	21	36	37	181	49	15	10	3	2

Table 37. 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
Group A		25	11	8	12	48.0
Afr. horsesickness		1	0	0	0	
Group B		63	28	25	31	49.0
Bakau		2	0	0	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	19	5	2	6	31.6
	Bwamba	2	1	0	1	50.0
	C	12	10	2	10	83.3
	California	13	6	0	6	46.2
	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	5	0	0	0	
	SBU	1	0	0	0	
Changuinola		7	1	0	1	14.3
Colorado tick fever		2	1	1	1	50.0
Corriparta		2	0	0	0	
Epizoot. hem. dis.		1	0	0	0	
Eubenangee		3	0	0	0	
Hart Park		3	0	0	0	
Kaisodi		3	0	0	0	
Kemerovo		16	1	1	1	6.3
Kwatta		1	0	0	0	
Malakal		2	0	0	0	
Mapputta		4	0	0	0	
Marburg		2	2	2	2	100.0
Matariya		3	0	0	0	
Mossuril		7	0	0	0	
Nairo-viruses	CHF-Congo	3	2	2	2	66.7
	Dera Ghazi Khan	5	0	0	0	
	Hughes	4	0	0	0	
	Nairobi sheep dis.	3	3	2	3	100.00
	Qalyub	2	0	0	0	
	Sakhalin	5	0	0	0	
Nyando		1	1	0	1	100.00
Palyam		4	0	0	0	
Phlebotomus fever		31	7	1	6	22.6
Quaranfil		2	1	0	1	50.0
Rabies		2	0	0	0	
Sawgrass		3	0	0	0	
Tacaribe		9	3	5	5	55.6
Tanjong Rabok		2	0	0	0	
Thogoto		1	1	0	1	100.0
Timbo		2	0	0	0	
Upolu		2	0	0	0	
Uukuniemi		5	0	0	0	
Vesicular stom.		11	4	3	5	45.5
Wallal		1	0	0	0	
Warrego		2	0	0	0	
Ungrouped		89	7	1	8	9.0
Totals		460	100	56	108	23.5

Table 38. Evaluation of Arthropod-Borne Status of 460 Registered Viruses (SEAS)

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.	%
A		25	16	5	4	0	0	21	84.0	0	
AHS		1	1	0	0	0	0	1	100.0	0	
B		63	30	10	16	2	5	40	63.5	7	11.1
BAK		2	0	1	1	0	0	1	50.0	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	19	8	5	6	0	0	13	68.4	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	5	1	2	2	0	0	3	60.0	0	
	SBU	1	0	0	1	0	0	0		0	
CGL		7	0	1	6	0	0	1	14.3	0	
CTF		2	1	0	1	0	0	1	50.0	0	
COR		2	0	1	1	0	0	1	50.0	0	
EHD		1	0	1	0	0	0	1	100.0	0	
EUB		3	0	0	3	0	0	0		0	
HP		3	0	1	2	0	0	1	33.3	0	
KSO		3	0	1	2	0	0	1	33.3	0	
KEM		16	0	3	13	0	0	3	18.8	0	
KWA		1	0	0	1	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		7	0	0	6	1	0	0		0	
MTY		3	0	0	3	0	0	0		1	14.3
Nairoviruses	CHF-CON	3	2	0	1	0	0	2	66.7	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 38 (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	
PAL	4	0	0	4	0	0	0		0	
PHL	31	4	10	17	0	0	14	45.2	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	9	0	0	0	0	9	0		9	100.0
THO	1	0	0	1	0	0	0		0	
TIM	2	0	0	2	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	11	3	0	8	0	0	3	27.3	0	
WAL	1	0	0	1	0	0	0		0	
WAR	2	0	0	2	0	0	0		0	
Ungrouped	89	3	11	69	4	2	14	15.7	6	6.7
Totals	460	109	82	243	9	17	191	41.5	26	5.7

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 Department of Medical Sciences, Rayong Provincial Hospital; Rayong Provincial Health Office; Division of Epidemiology, Ministry of Public Health, Bangkok, Thailand and Department of Tropical Medicine and Medical Microbiology, University of Hawaii School of Medicine, Honolulu, Hawaii

Epidemiological Studies on Dengue in Rayong, Thailand, 1980

A five year WHO-supported prospective study of risk factors in dengue shock syndrome has been established in Rayong, Thailand. Here we report results from the first year of the study, 1980.

Study Design. Rayong is the capital of Rayong Province, 200 kilometers southeast of Bangkok. The study area consists of the municipality and contiguous suburban villages, having a 1980 population of 52,935. The area is served by a single Provincial Hospital. Early in 1980, filter paper blood samples were obtained from 3171 children ages less than one to fourteen years, including 965 first graders who comprised a cohort for monitoring annual dengue infection rates. In January 1981, one year later, 881 of these first grade children were rebled.

Pair serum samples were collected from children admitted to Rayong Hospital in 1980 with a diagnosis of dengue hemorrhagic fever/dengue shock syndrome (DHF/DSS). Acute phase blood samples were processed for virus isolation in tissue cultures and Toxorhynchites mosquitoes. Paired sera were tested for hemagglutination-inhibition antibodies and for neutralizing antibodies against dengue 1-4 viruses.

The study strategy is to relate dengue infection experience in the open population of Rayong children to the infection experience in children who are hospitalized for DHF/DSS. In this study special emphasis was placed on dengue shock syndrome because data from hospital charts permitted reliable identification of this syndrome.

Results

Past dengue activity. An analysis of past dengue activity was made possible from the patterns of neutralizing antibodies present in the sera of children of varying ages. Figure 1 shows type specific and heterospecific (two or more infections) neutralizing antibodies by age and year of birth. Stepwise increments in the prevalence of antibodies seen in children born in 1978, 1977, 1975 and 1972, correspond with DHF/DSS epidemics in Rayong (1978=158; 1977=285; 1976=40; 1975=212; 1974=57; 1973=277; 1972=533). There is evidence of a recent predominance of dengue type 2 activity (1979-1977) and apparently, an absence of dengue 1 transmission since 1975. With time, there is a steady increase in the number of children who had experienced two or more dengue infections. Despite endemic activity of all four dengue viruses, over 30% of 8 year-old children had failed to ever have a dengue infection. Typical neutralization test data illustrating monotypic and heterotypic dengue neutralizing antibodies are given in Table 1.

Disease. In 1980, Thailand experienced 43,578 cases of DHF/DSS; 127 of these were in residents of the Rayong study area. Of 105 with adequate diagnostic specimens, 55 who had a recent dengue infection had clinical evidence of DHF with or without shock. Twenty-two of these were shock syndrome; all with a secondary-type antibody response. Nine dengue viruses were isolated from patients with dengue syndromes; 8 of these were dengue 2. Of 15 children with DSS and isolation specimens available, 5 dengue 2 viruses were recovered.

Of 22 children with DSS, 8 had been bled in January 1980, prior to their hospitalization. In that blood sample each of these children had monotypic dengue neutralizing antibody: five to DEN 1; two to DEN 3 and one to DEN 4. None had dengue 2 antibodies despite the fact that these were the most prevalent antibodies in the population (in the first eight years of the age-stratified survey, 2.2% of children had DEN 1 antibodies, 13.8% had DEN 2 antibodies, 4.6% DEN 3, 5.3% DEN 4 and 18.4% had evidence of two or more infections - data from figure 1). Each of the eight children with DSS experienced a secondary antibody response. Two children with initial DEN 1 infections had DEN 2 viruses recovered during DSS.

An unexpected finding was evidence for "original antigenic sin", i.e., the highest neutralizing antibody titers following second infections were directed toward the initial infecting antigen (Table 2). Using the highest titer to identify initial infecting type, 60 actue and convalescent paired sera were tested for neutralizing antibody titers to dengue 1-4 viruses. As shown in Figure 2, children with initial DEN 1 predominantly experienced severe disease; those with initial DEN 2 predominantly experienced mild disease; those with DEN 3 were intermediate and DEN 4 initial infections were under-represented in the sample. Initial dengue 1 infections were associated with 62% of shock cases studied (8/13). Again, it was notable that in the age-stratified sero survey, DEN 1 was the least frequently occuring dengue antibody.

Population based infection rates. Each of the four dengue serotypes were transmitted in Rayong in 1980. Seroconversions in antibody-negative children are shown in Table 3. The dominant type circulating was DEN 1, followed in descending order by DEN 2, 4 and 3. Using 1980 type-specific seroconversion rates and the fraction of 7 year-old children who were immune to the various dengue viruses in January 1980, the number of individuals who were infected in the various sequences of two infections were calculated (Table 4). Numerator data assume that the serologic history of all 7 year-olds hospitalized with DSS was similar to that of the 8 children bled prior to DSS. A very high percentage of children infected in the sequence DEN 1 - DEN 2 were admitted to hospital with DSS, data which are in agreement with the study illustrated in Figure 2.

Assuming that children monotypically immune to DEN 1, Den 3 or DEN 4 are at risk to DSS, it was of interest to plot the age distribution of these antibodies in the childhood population. This is shown in Figure 3. The distribution of DEN 1+3+4 immunes shows a remarkably similar shape to the age distribution of DHF and DSS cases in 1980.

Summary.

1. The dominant dengue virus type infecting children in Rayong in 1980 was DEN 1.

2. The dominant dengue type recovered from children with DHF/DSS in 1980 was DEN 2.

3. All patients with DSS had a secondary dengue infection despite the fact that of children through age 8 years, 55.5% were still susceptible to dengue virus in January 1980.

4. Over 60% of children immune to DEN 1 who experienced a second dengue infection in 1980 (presumably DEN 2) developed dengue shock syndrome. Secondary infections in persons immune to DEN 3 or DEN 4 were pathogenic, but less so.

5. Initial DEN 2 infections were relatively protective against severe dengue disease.

Risk factors to DSS

1. Initial DEN 1, 3 or 4 infection.

2. Secondary DEN 2 infection.

Conclusions

1. A monovalent DEN 2 vaccine may protect against dengue shock syndrome.

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Table 1. Representative dengue neutralization patterns in age stratified sera. Rayong, Thailand 1980.

Serum No.	Age	DEN 1	DEN 2	DEN 3	DEN 4	Interpretation
310	5	96	0	0	0	
1076	6	91	0	0	0	Dengue 1
1562	8	86	0	0	0	immune
137	1	0	76	0	0	
86	1	0	100	0	0	Dengue 2
1421	5	0	100	0	0	immune
89	3	0	0	98	0	
13	3	0	0	71	0	Dengue 3
306	5	0	0	98	0	immune
128	2	0	0	0	84	
A-052	3	0	0	0	99	Dengue 4
112	3	0	0	0	85	immune
163	3	98	98	0	76	
296	5	0	82	52	96	immune to 2
1260	7	100	100	100	100	or more dengue
1591	7	0	59	88	82	viruses

Table 2. Dengue Shock Syndrome. Dengue neutralizing antibody in children bled prior to illness and in acute and late convalescent sera, Rayong, Thailand, 1980.

	Reciprocal PRNT 50												
	Pre-illness				Day After	Acute Phase				Month After	Late Convalescent			
Subject	D 1	D 2	D 3	D 4	Onset	D 1	D 2	D 3	D 4	Onset	D 1	D 2	D 3	D 4
1	30	0**	0	0	-		ND			-			ND	
52	32	0	0	0	-		ND			3	420	320	110	30
84	46	0	0	0	7	1920	310	1520	240	3	2500	720	1401	200
86	158	0	0	0	3	2500	1920	2000	450	5	240	100	130	80
94	144	0	0	0	4	1920	600	920	80	4	2400	300	1920	80
120	0	0	31	0	6	160	1920	2000	110	3	600	700	4000	380
49	0	0	71	0	4	1700	1700	2300	680	5	40	80	3500	86
6	0	0	0	56	-		ND			8	0	80	0	98

* Cohort Study, 7 years old, January 1980.

** o = <30

Table 3. Dengue Virus transmission rates calculated from neutralizing antibody seroconversions in 251 susceptible children, ages <1-12 years, Rayong, Thailand, 1980.

Seroconversion to		Number	%	
DEN 1*	=	38	15.1	
DEN 2*	=	28	11.2	
DEN 3*	=	5	2.0	39.4%
DEN 4*	=	12	4.8	
DEN X2**	=	16	6.4	
No Infection	=	152	60.6	
Total		251		

* Defined as ≥50% plaque reduction seroconversion to one type at 1:30 serum dilution.

** Defined as ≥90% plaque reduction seroconversion to 2 or more types at 1:30 serum dilution.

Table 4. Predicted sequential infection experience in one thousand 7 year-olds with matching dengue shock syndrome cases. Rayong, Thailand, 1980.

	DSS Cases/Predicted secondary dengue infections						
Pre-outbreak Immune Status	DEN 1 (15.1%)	DEN 2 (11.2%)	DEN 3 (2.0%)	DEN 4 (4.8%)	DEN X2 (6.4%)	Total	P value vs. DEN 2
Susceptible (335)	0/47	0/35	0/6	0/15	0/20	0/123	<0.001
DEN 1 imm. (48)	--	4/6*	0/1	0/2			
DEN 2 imm. (129)	0/19	--*	0/3	0/6			
DEN 3 imm. (113)	0/17	2/13	--	0/5			
DEN 4 imm. (65)	0/10	1/7	0/1	--			
Total	0/44	7/25	0/5	0/13			
P value vs DEN 2	<0.001		>0.05	<0.05			

* Cases included in cohort bleeding:

No. 1 7 yrs. 4 mos. pre-illness immune status - dengue 1 see table 2
52 7 yrs. 9 mos. " " " " " " "
84 7 yrs. 10 mos. " " " " " " "
49 8 yrs. 2 mos. " " " " " 3 " "

Cases not included in cohort bleeding: Nos. 7, 15, 73

FIGURE 1.

PREVALENCE OF DENGUE NEUTRALIZING ANTIBODY
RAYONG, JANUARY 1980

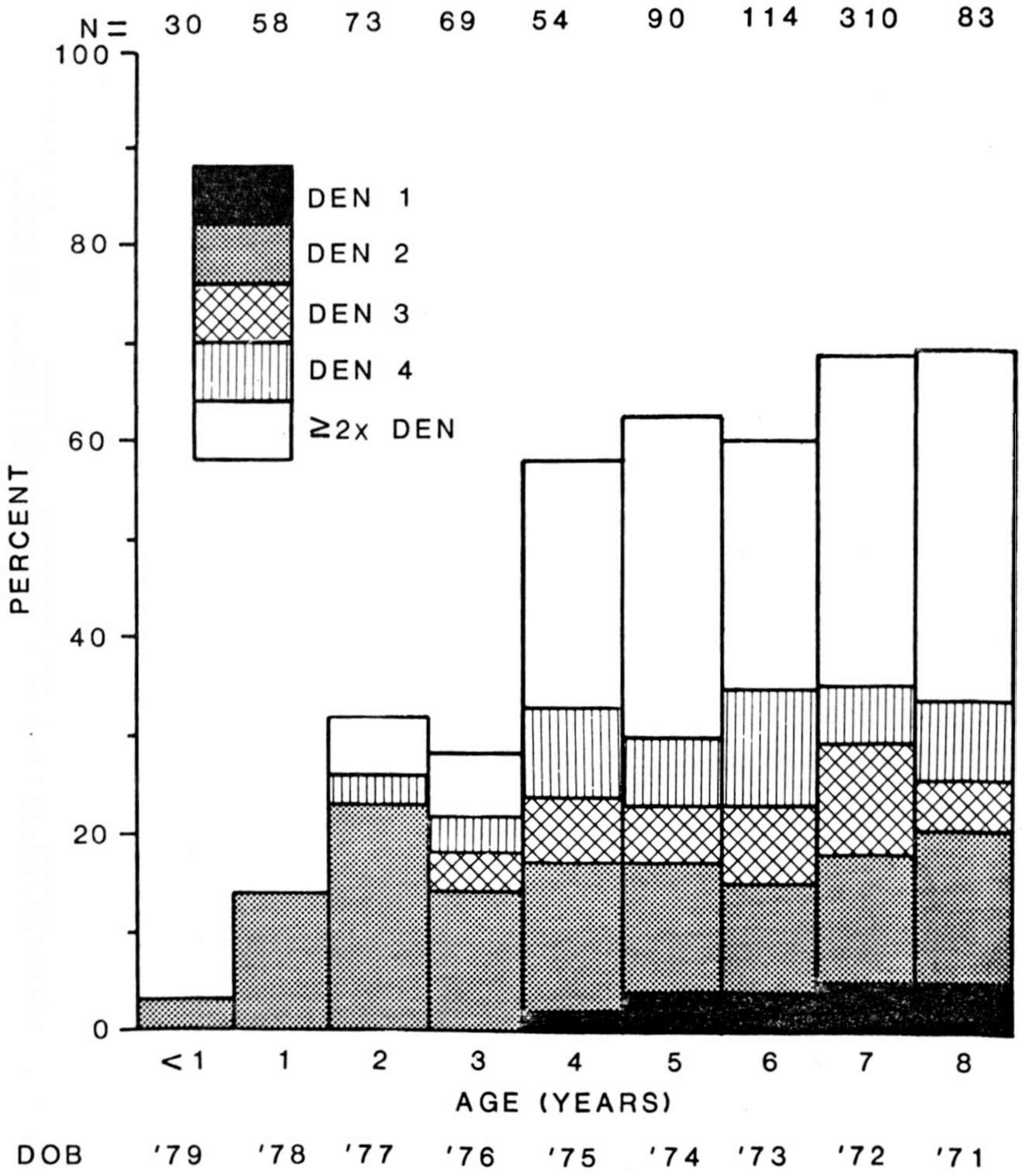


FIGURE 2.

SEVERITY OF 2° DENGUE INFECTION IN RELATION TO 1° INFECTION.

Rayong, Thailand 1980

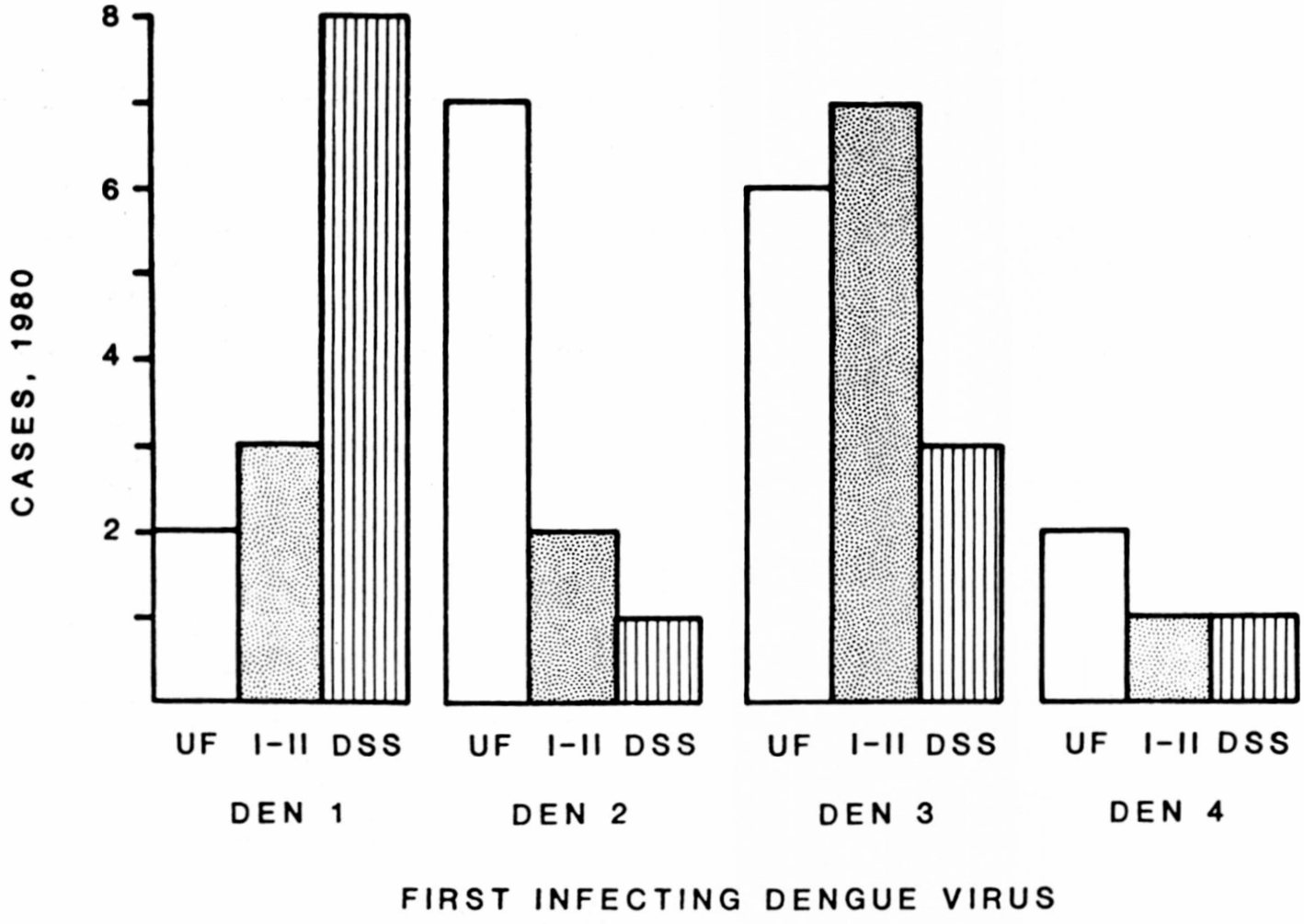
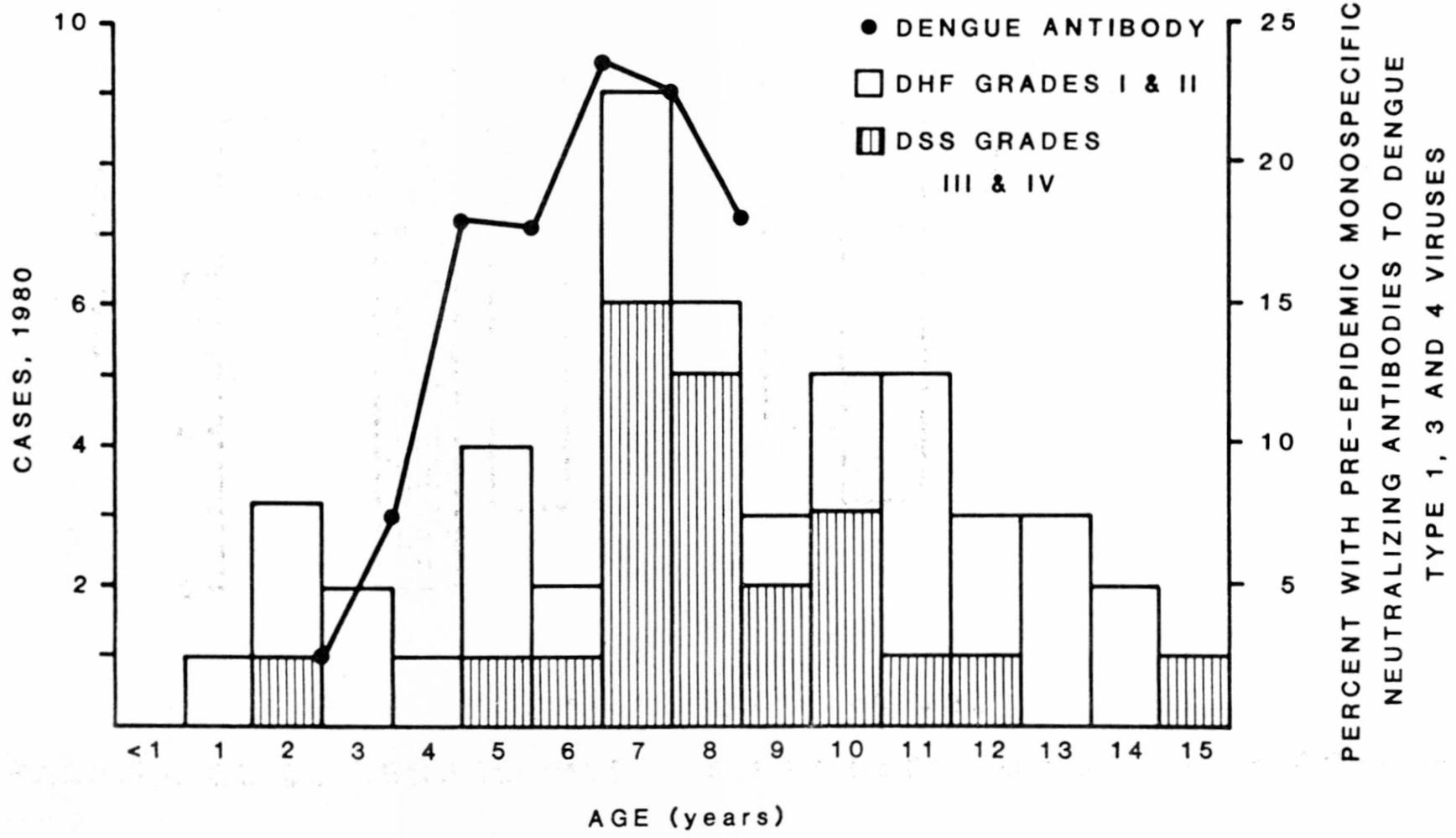


FIGURE 3.

DISTRIBUTION OF PRE-EPIDEMIC D1+D3+D4 ANTIBODY RELATED TO AGE OF DHF/DSS CASES.

Rayong, Thailand 1980



REPORT FROM THE ARBOVIRUS RESEARCH UNIT, SCHOOL OF MICROBIOLOGY, UNIVERSITY OF NEW SOUTH WALES, SYDNEY 2033, AUSTRALIA.

Arbovirus studies in New South Wales (NSW)

A large number of arboviruses has now been isolated in NSW from arthropod vectors, but a gap in current knowledge is the significance of these viruses in human infections. Although much information is available on Australian encephalitis (Murray Valley encephalitis - MVE) and some knowledge has accumulated on the pathogenesis of Ross River virus and its role in epidemic polyarthritis, the clinical significance of most of the newly isolated arboviruses is unknown. This lack of knowledge also extends to the distribution of the viruses within the State of New South Wales. Most of the viruses have been isolated in the western river system of the State and their distribution elsewhere is largely conjectural.

Our initial approach to this problem is seroepidemiological.

(1) Surveillance.

We obtain well documented sera from strategic locations throughout the State (map), especially from young patients who have had blood collected for other purposes and from selected blood donors who can be bled sequentially for evidence of intercurrent arboviral infections (human sentinels). This aspect of the work may provide evidence for the possible inter-epidemic persistence of MVE in south-eastern Australia.

(2) Clinical Investigations

We also obtain sera from patients of all ages who present with clinical diseases of probable infectious aetiology but for which no specific microbial entity has been implicated.

We screen sera from all sources for antibodies to a wide range of arboviruses firstly by haemagglutination-inhibition (HI) (togaviruses) and immunodiffusion tests (orbi- and bunyaviruses) and carry out quantitative estimations on positive sera. Neutralisation and ELISA tests are also carried out where appropriate. The antigens used are listed in Table 1.

Results

Serological Surveillance

To date 17,000 sera have been collected throughout New South Wales (NSW), 13,000 from blood donors and 4,000 from other sources. About 11,000 of these have been screened for antibodies to 11 togaviruses and positive sera titrated. Tests for orbivirus and bunyavirus antibodies have begun.

The results so far indicate that:

a. Regional differences exist in the prevalence of the togaviruses which infect humans. Some areas have high activity (e.g. Griffith, Narrabri, Parkes, Broken Hill), some areas have very low activity (e.g. Inverell, Orange, Mudgee) and some areas fall between these extremes.

b. The types of viruses infecting humans vary from area to area.

c. There are viruses infecting humans which have yet to be isolated and characterised. (This is discernible from antibody titre patterns.)

d. Some viruses may now be excluded from the panel to be used diagnostically because no evidence has been found for their capacity to infect humans in NSW (e.g. Getah, Sepik, Saumarez Reef). This finding will be of great help in reducing costs in the clinico-virological phase of the project.

(C.R. Boughton, R.A. Hawkes, H. Naim, L. Rathswohl)

TABLE 1.

ARBOVIRUSES USED IN THE STUDY

TOGAVIRIDAE:

Alphavirus genus

- Sindbis (SIN)
- Ross River (RRV)
- Getah (GET)

Flavivirus genus

- Sepik (SEP)
- Saumarez Reef (SRE)
- Murray Valley encephalitis (MVE)
- Kunjin (KUN)
- Alfuy (ALF)
- Stratford (STR)
- Kokobera (KOK)
- Edge Hill (EH)

REOVIRIDAE:

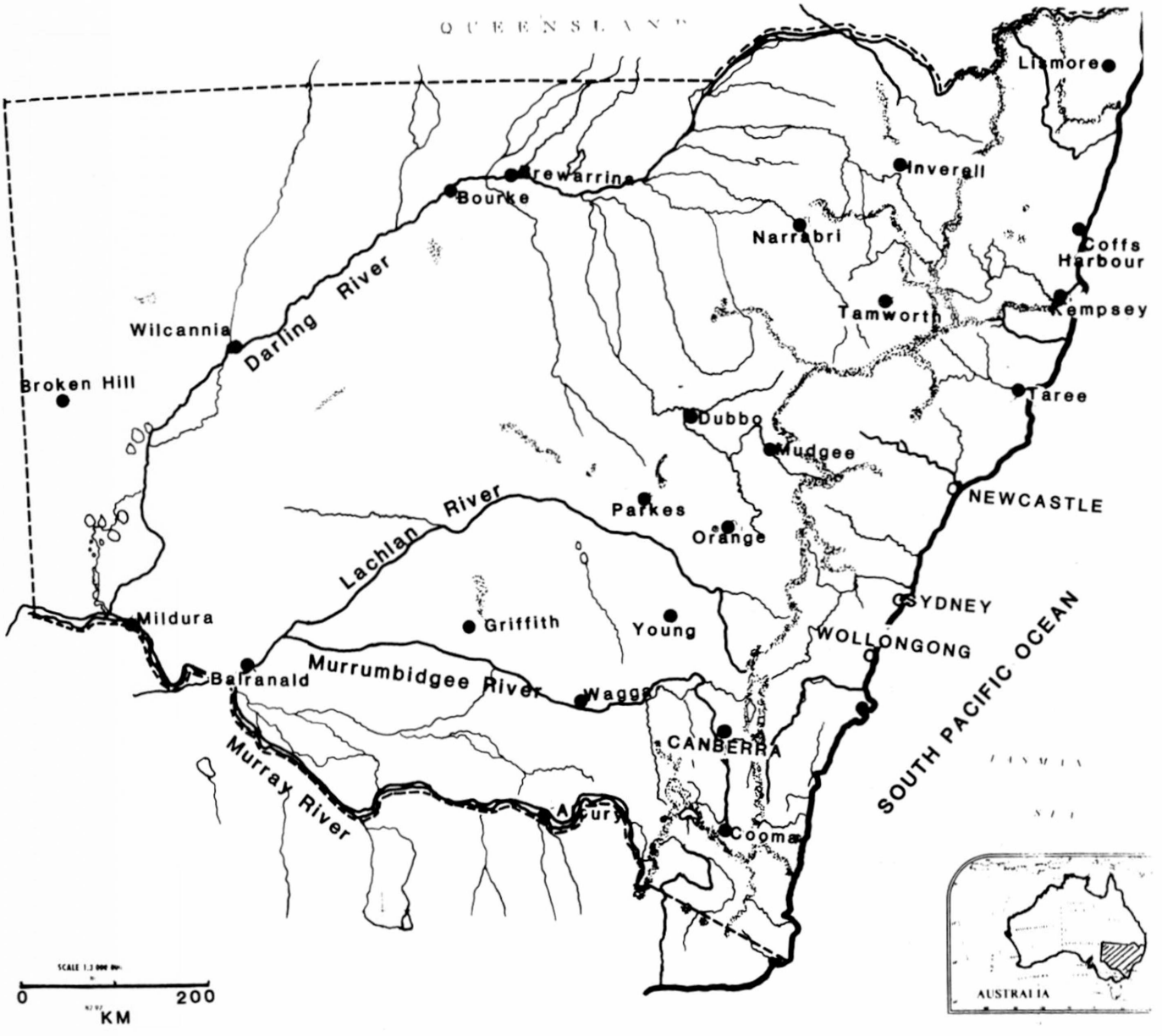
Orbivirus genus

- Corriparta MRM1 (COR)
- Eubenangee CS23 (EUB)
- Wallal CS44 (WAL)
- EHD CS402
- Palayam CS12 (PAL)
- Warrego (WAR)
- Paroo River

BUNYAVIRIDAE:

Bunyavirus genus

Simbu serogroup	Tinaroo CS153 (TIN)
	Douglas CS150
	Facey's Paddock CL16129
Ungrouped	Mapputta (MAP)
	Belmont (BEL)
	Kowanyama (KOW)
	CSIRO 10 (new virus)



MAP

Map of New South Wales, with major rivers (solid lines) and mountains (stippled)

REPORT FROM CSIRO LONG POCKET LABORATORIES
DIVISION OF TROPICAL ANIMAL SCIENCE,
INDOOROOPILLY, QUEENSLAND 4068, AUSTRALIA.

A biting midge Culicoides brevitarsis Keiffer has been the focus of much of the investigation into arbovirus infection of domestic animals in Australia. This insect is widely distributed in the oriental region and is almost certainly a relatively recent introduction. (Cattle and sheep were first introduced to Australia 1788). It is closely tied to herbivores as it breeds in their dung. Cattle and buffalo (Bubalis bubalis) dung is most efficiently colonised and records of 1,000 or more insects emerging from one pat are common. It has been recovered in small numbers only and then very infrequently from horse, sheep and deer dung and not at all from marsupial dung.

C. brevitarsis feeds mainly on vertebrate species not indigenous to Australia. Cattle, buffalo, sheep and horses have been identified as sources of blood meals either by direct observation of insects feeding on these hosts or by the identification of the gut contents of wild caught females. There is indirect evidence that C. brevitarsis feeds on deer but there are no records of feeding on marsupials.

The range of viruses isolated from the species at the Long Pocket Laboratories is listed in Table 1.

TABLE 1. Isolations of Arboviruses from approximately 167,114 Culicoides brevitarsis and cattle in Australia.

	Number of Isolates from	
	C. brevitarsis	Cattle
Simbu Group		
Akabane	38	36
Aino	26	1
Peaton	16	4
Tinaroo	5	0
Douglas	4	2
Palyam Group		
D'Aguilar	20	33
CSIRO Village	67	158
Bunyip Creek	24	76
EHD		
CSIRO 157	12	11
CSIRO 753	2	4
Rhabdovirus		
Tibrogargan	3	0
	217	325

This amounts to 11 different viruses in the Simbu, Palyam, EHD and rhabdovirus groups. Of the eleven viruses only two (Tinaroo and

Tibrogargan) have not been isolated from cattle however, neutralising antibody to both of these viruses have been demonstrated on numerous occasions in sentinel cattle (Table 2).

TABLE 2. Species of vertebrates with antibodies to viruses carried by Culicoides brevitarsis.

Virus	Antibodies		Vertebrates	
	Cattle	Horses	Deer	Buffaloes
Akabane	+	+	+	+
Aino	+	-	+	+
Peaton	+	+	+	+
Tinaroo	+	-	+	+
Douglas	+	-	+	+
D'Aguilar	+	-	+	+
CSIRO Village	+	-	+	+
EHD (CSIRO 157)	+	-	+	+
EHD (CSIRO 753)	+	-	+	NT
Tibrogargan	+	-	-	+

\+ = neutralising antibodies detected
\- = no neutralising antibodies detected
NT = not tested

It will be noted that in the results listed in Table 2, neutralising antibody to only two (Peaton and Akabane) of the eleven viruses was demonstrated in horses, despite the fact that antibody to the eleven viruses was demonstrated in cattle on the same properties. C. brevitarsis is known to feed avidly on horses and is the cause of an allergic dermatitis (Queensland itch) in these animals. It should also be noted that although antibodies to ten of the viruses have been demonstrated in deer no antibody to Tibrogargan virus was detected despite its occurrence in cattle on properties nearby.

It should not be assumed that C. brevitarsis is the sole vector of any of the viruses listed in Table 1. There is some evidence that there are other vectors of Palyam and EHD group viruses in the far north of Australia. However C. brevitarsis is certainly the most important Culicoides species in terms of arbovirus transmission. It is significant that no isolations of these viruses have been made from approximately 184,000 Culicoides of 22 other species or from the 68,000 mosquitoes of 45 species collected in association with livestock, and processed for virus at these laboratories.

Only Akabane and Aino viruses have been linked firmly to disease producing teratogenic effects in sheep and cattle. There is no information as to whether these viruses, or the other three Simbu group viruses isolated from C. brevitarsis could produce teratogenic effects in humans. Natural infection of humans with these viruses in Australia is unlikely as C. brevitarsis rarely, if ever, feeds on man.

(T.D. St.George, H.A. Standfast, A.L. Dyce, M.J. Muller and D.H. Cybinski).

REPORT FROM THE A.L. ROSE VIROLOGY LABORATORY,
DEPARTMENT OF PRIMARY PRODUCTION, DARWIN. N.T. 5794. AUSTRALIA

VIRUSES RECOVERED FROM SENTINEL CATTLE 1981-82

Herds of sentinel cattle for the monitoring of arboviruses have been maintained in the Northern Territory by the Commonwealth Scientific and Industrial Research Organisation for several years. In 1981 the new A.L. Rose virology laboratory took over this monitoring program. The heparinised bloods were collected weekly and inoculated to cell cultures in Darwin and any viruses recovered were identified by the laboratory of Dr T.D. St George, C.S.I.R.O. Brisbane.

Table 1 lists those viruses recovered in 1981 and 1982. Two types of Bluetongue (DPP 90 and DPP 192), apparently different to the known Australian types (1,20 and 21), were isolated in 1982. Three of the 5 known Australian types of EHD and 4 Palyam types were recovered from these cattle. The 2 as yet unidentified Palyam viruses isolated in 1981 may be a single type new to Australia. The 3 known types of BEF were isolated in 1981 but surprisingly none were recovered in 1982. Conversely no Simbu group viruses were isolated in 1981 while Akabane, Aino and Tinaroo viruses were recovered in 1982. Two 1981 isolates have still to be grouped.

The difference in viruses recovered over the two years could reflect a variation in activity or could be the result of modifications to the isolation technique introduced in 1982. In 1981 the plasma-buffy coat - rbc interface of the centrifuged heparinised blood was inoculated to 2 BHK tube monolayers while in 1982 this inoculum went to 2 BHK and 2 Vero tubes and occasionally to 2 pig kidney tube monolayers. The isolation methods used in 1982 certainly appeared more sensitive, especially for orbiviruses. In 1981 no virus was recovered from the consecutive bleeds of an animal while in 1982 consecutive weekly bleeds of the same animal yielded Palyam group viruses on 14 occasions, Bluetongue viruses twice and the EHD virus, DPP 59, once. Two cattle each yielded D'Aguilar virus 7 and 14 days after the initial recovery.

The Aino virus recovered in 1982 is believed to be only the second isolation of this virus from a vertebrate.

STABILITY OF VIRUSES IN REFRIGERATED HEPARINISED BLOOD

Virus reisolation was attempted from some of the heparinised bloods yielding the arboviruses listed in Table 1. The bloods had been held at refrigerator temperature since collection. Reisolation was attempted in several instances in order to validate an unexpected virus recovery and on other occasions during investigations of the optimal cell culture combination and post-inoculation maintenance variation for virus recovery.

In all, reisolation was successful in 26 of 41 attempts (Table 2). The residual infectivity of some of these bloods no doubt is a reflection of the levels of virus (and antibody) at bleeding; however the relative stability of the orbiviruses in blood was expected, but the results obtained with the BEF and Simbu viruses were not.

(Geoff Gard, Janet Shorthose and Richard Weir)

Table 1: VIRUSES RECOVERED FROM SENTINEL CATTLE 1981-82

VIRUS			ISOLATIONS	
GROUP	TYPE		1981	1982
Bluetongue		1	1	0
		21	3	8
	DPP	90	0	6
	DPP	192	0	1
Epizootic Haemorrhagic Disease of Deer (EHD)	CSIRO	157	1	1
	CSIRO	439	2	0
	DPP	59	2	16
Palyam*	D'Aguilar		0	25
	CSIRO	11	2	6
	CSIRO	58	2	22
	CSIRO	82	0	7
	Unidentified		2	0
Bovine Ephemeral Fever (BEF)	Standard		2	0
	CSIRO	368	1	0
	DPP	63	1	0
Simbu	Akabane		0	7
	Aino		0	1
	Tinaroo		0	2
Unknown			2	0
			21	102

* The Palyam viruses CSIRO 11, CSIRO 58 and CSIRO 82 have been named CSIRO Village, Bunyip Creek and Marrakai respectively.

Table 2: RESULTS OF ATTEMPTED REISOLATION OF VIRUSES FROM REFRIGERATED HEPARINISED BLOODS

VIRUS		TIME (DAYS) FROM COLLECTION TO ATTEMPTED REISOLATION	
GROUP	TYPE	REISOLATION SUCCESSFUL	REISOLATION UNSUCCESSFUL
Bluetongue	21	107; 217	45; 45; 210; 210; 222
	DPP 90	111; 209; 209	202; 209; 216
	DPP 192		170
EHD	CSIRO 439	108; 108	
	DPP 59	93; 102; 125; 210	125; 209
Palyam	D'Aguilar	152	
	CSIRO 11	114; 168	
	CSIRO 58	83; 150; 158	
BEF	Standard	101; 108	
	CSIRO 368	142	
Simbu	Akabane	202; 219; 244; 251	198; 226; 226
	Aino		99
	Tinaroo	219; 251	

REPORT FROM THE DEPARTMENT OF MICROBIOLOGY, FACULTY OF SCIENCE,

MAHIDOL UNIVERSITY, RAMA VI ROAD, BANGKOK 10400, THAILAND

STUDIES ON DENGUE-2 VIRUS REPLICATION IN *AEDES AEGYPTI* MOSQUITO, AND MOSQUITO DERIVED INHIBITORY FACTORS AGAINST VIRUS BIOLOGICAL ACTIVITIES.

Dengue serotype 2 (DEN-2) virus replicated in both male and female *Aedes aegypti* mosquitoes after intrathoracic inoculation with 300-3,000 PFU of virus per mosquito. The virus multiplied to titers of 10^4-10^5PFU per mosquito within 4-5 days incubation period at either 28 C or 32 C, and the titer remained nearly constant thereafter. DEN-2 CF antigen was detected in the extracts of 100 and 1,000 infected mosquitoes and the titer was 1:4 and 1:16 respectively, when measured against anti DEN-2 hyperimmune mouse ascitic fluid and 5 units of complement. This CF antigen seemed to associate with infectious virus particles in sucrose gradient analysis. Dengue virus hemagglutinin (HA) could not be detected in the infected mosquito extract.

Inhibitory factors against infectivity, hemagglutinating (HA) activity, but not complement fixing (CF) activity of DEN-2 virus were found in the extracts of uninfected *A. aegypti* mosquitoes. The factor inhibiting viral infectivity was in a particulate form and could be precipitated by centrifugation at 12,000 x g for 30 min. The inhibitor of HA activity was found also in the supernate and was not precipitated by ultracentrifugation at 10,500 x g (Spinco Ti60 rotor) for 2.5 hours, by which the viral HA was pelleted. Attempts to withdraw DEN-2 HA from the infected mosquitoes by sucrose acetone extraction, by elution and precipitation or by purification through sucrose gradient failed.

(K. Kasemsuksakul, C. Kittigul and P. Sinarachatanant)

REPORT FROM THE DEPARTMENT OF MEDICAL ZOOLOGY,

KOBE UNIVERSITY SCHOOL OF MEDICINE, KOBE, JAPAN

Rapid Enzyme-Linked Immunosorbent Assay System for Epidemiological Surveys of Japanese Encephalitis Virus.

An applicability of the rapid system of enzyme-linked immunosorbent assay was studied to quantitate antibodies to Japanese encephalitis virus in large-scale epidemiological surveys, especially in testing under the field conditions. We constructed the assay system with 15 min for the first reaction and 30 min for each of the second and the third reactions, because about 80% of the first reaction was completed in 15 min and about 70% of the second reaction in 30 min, assuming the reaction for 60 min to be 100%.

This rapid system was highly reproducible: coefficients of variation with swine positive sera were less than 5.8%. And a significant correlation was observed with the ordinarily-used assay system with 1 hr for each reaction: the correlation coefficient was 0.960. As compared with the hemagglutination inhibition test, the rapid system gave correlation coefficient of 0.916 and qualitative agreement of 96.1%.

Whole blood was substituted for serum in the first reaction not only to save the serum separation process but also to apply this system to antibody quantitation in animals from which sufficient amount of sera cannot be easily obtained. As little as 2 µl of whole blood taken with a micropipette was immediately diluted in 100 µl of the diluent which had been distributed in microplate wells. The results obtained with this 51-fold diluted whole blood had a linear relationship to those obtained with 100-fold diluted sera in swine and men.

Spectrophotometer used in this study was modified to work with a portable 12-voltage battery, which will be necessary to get quantitative results in field testing where electric source is not available. For qualitative results, judgement by eyes was reliable, revealing high qualitative agreement with spectrophotometry.

(This study was conducted by E. Konishi and M. Yamaoka)

(Reported by T. Matsumura)

REPORT FROM DEPARTMENT OF VIROLOGY AND RICKETTSIOLOGY
NATIONAL INSTITUTE OF HEALTH, TOKYO, JAPAN

Human overt Japanese encephalitis in the summer 1982 in Japan

Japanese encephalitis surveillance committee of the Ministry of Health and Welfare, Japan could confirm 20 cases of human overt Japanese encephalitis (JE) in whole Japan in 1982. The first case occured August 4, 1982 and the last September 28. Twenty cases included 3 deaths showing the mortality ratio 15.0%. All cases were confirmed serologically. The mortality ratio 15.0% was extremely lower than those in the ordinary years. Cases were consisted of 11 males and 9 females. The age distribution was under 5: 4, 6 to 9: 1, 10 to 19: 1, 20 to 29: 0, 30 to 39: 2, 40 to 49: 3, 50 to 59: 1, 60 to 69: 3 and over 70: 5. Eight cases out of 20 were cured completely. However, mental or physiological sequellae were noted in 9 cases.

Geographically, 20 JE cases were distributed throughout Japan. Four cases were from Kyushu district, 6 cases from Shikoku island, 3 from Chugoku, 2 from Kinki, 2 from Chubu and 3 from Kanto districts. As for vaccination history, 12 had not received JE immunization and 7 were unknown. Only a 6 years old girl replied to receive a single shot of vaccine which is imcomplete in the routine schedule. (A. Oya)

REPORT FROM DEPARTMENT OF VIROLOGY, INSTITUTE FOR TROPICAL MEDICINE, NAGASAKI UNIVERSITY
NAGASAKI, JAPAN, 852

1. Isolation of Japanese encephalitis (JE) and Getah viruses from Culex tritaeniorhynchus and slaughtered swine blood

In collaboration with Nagasaki Prefectural Institute of Public Health and Environmental Sciences, isolation of viruses was performed from field-caught C. tritaeniorhynchus and swine blood collected at a slaughter house in central part of Nagasaki Prefecture during epidemic seasons of 1981 and 1982. Mosquito specimens were inoculated to Aedes albopictus, clone C6/36, cells as well as suckling mouse brains (SMB). Swine blood was collected as heparinized specimen (B) and was fractionated into lymphocyte (L) and plasma-platelet (P) fractions before inoculation to C6/36 cells. After overnight incubation, medium was replaced with maintenance medium and the cells were further incubated at 28°C for altogether 7 days. Presence of the infective virus in the medium was screened by inoculation to C6/36 cells grown on 8-chamber slides using immunoperoxidase staining of intracellular viral antigens 3 days later by anti-JE and anti-Getah virus rabbit serum.

In 1981, the first JE virus isolation was from C. tritaeniorhynchus collected on July 27, and the isolation rate increased to 55 % on August 11, and then declined. The virus was isolated from 6 out of 30 swine blood collected on August 4. Getah virus was isolated from 8 out of 30 swine bloods collected on July 7, however, the virus was not detected from C. tritaeniorhynchus during observation period from July 2 to September 17.

In 1982, swine blood was not fractionated, and the serum was used to inoculate to C6/36 cells. The first JE virus was isolated from 1 out of 30 swine blood collected on July 13, then July 28 (3/30), August 3 (8/30), August 17 (1/30). On the other hand, the virus was detected from C. tritaeniorhynchus on July 28, and the virus was detected until August 24, with its highest isolation rate on August 3 (20 %). However, Getah virus was not detected in 1982. The low infection rates of the viruses in 1982 may partly be due to unusual climate, especially heavy rain fall on and around July 23.

2. Application of enzyme-linked immunosorbent assay (ELISA) to serodiagnosis and seroepidemiology of JE.

We have been working out simple micro ELISA to calculate endpoint titer of each test serum from ELISA-OD at a single dilution, by comparing the OD with those developed by serial dilution of a standard positive serum of known endpoint titer. The system has been applied to measure antibody levels in JE patients, as well as healthy inhabitants in JE-endemic and nonendemic areas. The method was also used to measure anti-JE antibodies in swine sera in order

to know antibody prevalence among the principal amplifier vertebrate host of JE virus.

By comparing the ELISA titer among healthy inhabitants in endemic and nonendemic areas with the titer of proven JE patients, we postulated a tentative diagnostic criteria for JE by the ELISA. Following cases will be considered as infected by JE virus: (1) paired sera with 4-fold or more increase in ELISA titer. (2) single serum with IgM-ELISA titer over 100. On the other hand, when total immunoglobulin (T-Ig) ELISA titer is under 800 throughout the course of the disease JE can be excluded.

Comparison of the ELISA titer with the titer by hemagglutination inhibition (HI) gave a certain correlation between these 2 titers of swine sera, and also the cut-off value of IgM-ELISA of 300, and T-Ig-ELISA of 400. By using these cut-off values, antibody-positive rate among swine sera collected in 1981 and 1982 agreed very well with that by the HI. However, more specimens were detected to have IgM antibodies by the ELISA than by the HI combined with 2-mercaptoethanol treatment.

3. Virological and epidemiological studies on encephalitis in Chiang Mai area, Thailand

This study was supported by an Overseas Research Grant from Ministry of Education, Science and Culture of Japan and was conducted by Drs. T. Ogata (NIH, Tokyo), N. Fujita (Kobe University), T. Fukunaga (Osaka University), A. Mori, Y. Uzuka and A. Igarashi (Nagasaki University), in collaboration with Chiang Mai University Faculty of Medicine, and Ministry of Public Health of Thailand.

During the study period from July 19 to August 17 in Chiang Mai, we examined 174 cases of encephalitis (50), dengue (71), unknown fever (13) and other diseases (40). JE virus was isolated from one out of 3 postmortem brains, while dengue viruses were isolated from 11 out of 177 peripheral bloods (8 type 1, 2 type 2, and 1 type 3). Virus isolation from 50 healthy human bloods and 23 swine sera with negative HI antibodies turned out to be negative. Two strains of JE-related unidentified viruses and 59 unknown filtrable agents were detected from 125 pools of Culex mosquitoes collected at pigpens in 4 different sites around Chiang Mai.

Serological examination on patients sera was performed both by the HI and ELISA, and IgM ELISA appeared to detect some recent infection by JE virus with secondary type of HI antibody reactions. However, diagnostic criteria on JE worked out in Japan should be revaluated in areas where multiple flavivirus infections coexist, because of the cross-reactivity.

Seroepidemiological surveillance was performed (1) on healthy human specimens collected at 5 locations in Chiang Mai and Lampoon Provinces. The specimens were collected from approximately 20 individuals in each of the 9 age groups at each collection site, totalling 985. The antibody prevalence was examined by the HI using JE and dengue type 1 antigens, as well as by the ELISA against JE. The result gave age-dependent prevalence of flavivirus antibodies, with significant difference in northern part of Chiang Mai Province (Fang). IgM-ELISA appeared to detect recent flavivirus infections and the results seem to indicate the inhomogeneity of the virus spread in the study areas. On the other hand, T-Ig-ELISA seems to indicate past flavivirus infections. (2) Serological surveillance among several vertebrates was performed by the HI using sera from swine (102), horses (50), mules (50), sheep (14), dogs(15), monkeys (21), ducks (24), sparrows (94), chickens (25), and lizards (34). Prevalence of anti-JE HI antibodies was high in swine, horses, mules, sheep, dogs, and low in monkeys, ducks, chickens, sparrows, and negative in lazards.

Results obtained in Chiang Mai study should be fortified by further studies in Japan, for example, antibody prevalence in healthy inhabitants in terms of neutralizing antibodies, ELISA against dengue antigens, entomological studies on some mosquito specimens, immunological and molecular epidemiological investigations on virus isolates.

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(Reported by A. Igarashi)

Report from the Institute of Virology, Chinese Academy of Medical Sciences, Beijing, People's Republic of China

Production of Monoclonal Antibodies Against Japanese B encephalitis (JE) by using the Mouse Hybridoma Technique

Three monoclonal antibodies against JE virus were obtained by fusion of SP2/0 myeloma cells with spleen cells from BALB/C mice immunized with the SA I4 strain of JE.

Monoclonal antibody "32" showed antibody activity against JE and other group B arboviruses (Kunjin and West Nile virus) as determined by the HI test.

Monoclonal antibody "51" demonstrated activity in neutralization and indirect immunofluorescent antibody assay only with JE virus, but not with other group B arboviruses.

Monoclonal antibody "43" showed only activity against JE (SA I4) which was used for immunization of the animal and its avirulent 2-8 strain but not with other JE (JaK-2 strain).

It is interesting to find out that monoclonal antibody "51" neutralized avirulent 2-8 strain two to fourfold more than its parent SA I4 strain.

Chen Bo Quan, Zhou Guo Fang and Liu Qin Zhi (Institute of Virology, Chinese Academy of Medical Sciences, Beijing)

Pu Xiu Zhen and Li Guo Chui (Beijing First Infectious Disease Hospital)

Tian Ye (Institute of Epidemiology and Microbiology, Chinese Academy of Medical Sciences)

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

Temperature marker study of a few Japanese encephalitis (JE) virus strains of West Bengal and a reference Nakayama strain of Japan.

A number of JE Strains isolated from human brains in different epidemic years of 1973, 1976 and 1978, as well as a reference Nakayama strain from Japan were subjected to temperature sensitivity in Vero cell system, according to the method advocated by Benyesh and Melnick (1956).

Serial tenfold dilutions of each of the JE strains (5th mouse brain passage of local strains and 150th passage of the Nakayama strain) were inoculated in "Vero" cell system in two different sets of tubes and incubated at two different temperatures of incubation viz 37° C and 40° C. The media of the tubes were changed on every alternate days and the tubes were examined daily for appearance of cytopathic effect (CPE). Vero cells were maintained in the laboratory in Hanks" Basal Salt Solutions supplemented by 3% goat serum (heat inactivated) and 5% Lactalbumin hydrolysate and adequate amounts of antibiotics and antifungal agents.

The tissue culture infectious dose ($TCID_{50}$) of different JE strains at two different temperature (37° C and 40° C) were calculated (Reed and Muench, 1938). The difference in titers obtained at two different temperatures was expressed as $Log_{10}I_{40}$ or Log intibition titer at 40° C (e. g. $Log_{10}I_{40}$= $Log_{10}TCID_{50}$ at 37° C - $Log_{10}TCID_{50}$ at 40° C). The experiments were repeated and the results are summarized in the following table.

Table

Comparison of different JE isolates by "T" marker study in vero cell.

JE isolates	$TCID_{50}$ at 37° C	$TCID_{50}$ at 40° C	$Log_{10}I_{40}$	Remarks
1973	$10^{4.2}$*	$10^{1.0}$	$10^{3.2}$	ts **
1976	$10^{5.2}$	$10^{4.0}$	$10^{1.2}$	tr ***
1978	$10^{4.8}$	$10^{3.5}$	$10^{1.3}$	tr
Nakayama	$10^{4.0}$	$10^{1.0}$	$10^{3.0}$	ts

* Figures represent $TCID_{50}$/0.2 ml.
** ts = temperature sensitive
*** tr = temperature resistant

It was observed that 1973 JE strain as well as the Nakayama one were "ts" e.g., temperature sensitive, the $Log_{10}I_{40}$, being equal to or more than 3.0. In contrast 1976 and 1978 JE strains were temperature resistant (tr), the $Log_{10}I_{40}$ being less than 1.5, indicating that these viruses multiplied well both at 37° C and 40° C.

Important variations thus could be observed between different local JE isolates and Nakayama strain in terms of their "T" marker character. JE strains of 1976 and 1978 thus appeared to be more biologically resistant to thermal inactivations by their ability to replicate at higher temperatures of 40° C than the two other counterparts.

(K. K. Mukherjee, S. K. Chakravarti, M. S. Chakraborty and Malabika Bhattacharjee).

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REPORT FROM THE LABORATORY OF THE ECOLOGY OF VIRUSES, THE D. I. IVANOVSKY INSTITUTE OF VIROLOGY, ACAD. MED. SCI. USSR

Identification of Viruses of the Bunyamviridae Family

During inspection of the territory of the USSR some viruses were isolated. These were considered as unclassified new viruses.

Caspiy virus was isolated from a sick nestling of a sea-gull, Larus argentatus, and from the ticks, Ornithodoros coniceps and O. capensis, on the Eastern and Western Caspian coast in the same islands where formerly Baku virus (orbivirus) had been isolated.

Artashat virus was isolated from the ticks, Ornithodoros alactagalis, collected in a burrow of Allactaga elater in Artashat region, Armenia.

Zevashen virus was isolated from the ticks, Hyalomma asiaticum, collected from sheep in Artashat region in Zevashen village, Armenian SSR.

The morphology and some stages of morphogenesis of Zevashen, Caspiy, and Artashat viruses were studied by electron microscopy. The virions, 90-110 nm in diameter, were shown to have lipoprotein membranes with visible peplomers. The spiral RNP about 8 nm in diameter on transections was revealed in the internal cavity of some particles. In the last stages of morphogenesis the virions were budded from the membrane of the Golgi complex and endoplasmic reticulum. The study of morphology and morphogenesis of the above viruses demonstrated that they are the representatives of the Bunyamviridae family.

Serological study of Khasan virus attributed according to their morphology to the Bunyamviridae family permitted to reveal its antigenic relationships with Crimean hemmoragic fever (CHF) virus.

ANTIGENIC RELATIONSHIPS BETWEEN KHASAN AND CHF VIRUSES

Immune Mouse Ascitic Fluid (IAF)	CF Titer of IAF Viral Antigen			Neutralization Index in Mice	
	CHF	KHASAN	KHAZARA	CHF	KHASAN
CHF	1:128	1:8	0	2.0	1.8
Khasan	1:16	1:256	0	0.5	2.8
Khazara	0	0	1:32	Not Done	Not Done

The data obtained permit to place Khasan virus to the Nairovirus genus of the Bunyamviridae family.

A strain of virus which identified in CF test as Clo-Mor virus was isolated from the ticks, Ixodes uriae, collected in the birds nestings in Tjuleniy island in Sakhalin. These date considerably extend the distribution area of this virus.

The data were obtained on pathogenicity of ungrouped Issyk-Kul virus isolated in 1970 from the bats in Kirghizia. In Tadzhikistan two strains of the virus were isolated from the blood of the patients with fever. The investigation of 4186 human blood sera showed that the immune barrier was 2.9 per cent.

(D. K. Lvov, V. L. Gromashevsky and T. M. Skvortsova)

Report from WHO Collaborating Center for Arbovirus Reference and Research
Insitutue of Virology, Bratislava, Czechoslovakia

Since the isolation of La Crosse virus in 1972 from Aedes triseriatus larvae collected in nature and from the first description of transovarial transmission of this virus under laboratory conditions, the vertical transfer of arboviruses in mosquitoes has been repeatedly confirmed. Our work was aimed at elucidating the extent of Tahyňa virus transmission to the progeny of infected Aedes aegypti mosquitoes including changes in the ratio of infectious progeny from one gonotrophic cycle to another. We were also interested in ascertaining the localization of the virus within the oocytes of mother generation to gain additional support for the concept of transovarial transmission.

Out of 50 selected mosquitoes (numbered 1-50) engorged on viraemic newborn mice 31 became infectious (infectivity rate 62%). Of them, at least a single transmission appeared in 27 cases (87%). As detected in 4 independent subsequent experiments, mosquitoes No. 11, 14, 17, 18, 26, 35 and 42 transferred the virus 3 times, the mosquito No. 22 four times. In the first gonotrophic cycle established after the mosquito sucking on infected mice, 41 egg batches originating from the 50 females were investigated: 27 batches were found coming from 31 viruliferous mosquitoes. After the first trial to transfer the virus to newborn mice, 25 egg batches were counted from 39 females, from which 13 were deposited by 24 viruliferous mosquitoes. In the second trial (the 3rd gonotrophic cycle) 21 batches of eggs were obtained from 32 females out of which 11 came from 19 viruliferous mosquitoes. In the third trial, 11 egg batches were gained from 24 mosquitoes; of these, 6 were from 15 viruliferous individuals. Finally, in the last trial (the 5th gonotrophic cycle) 5 egg batches were obtained from 7 viruliferous mosquitoes left (some mosquitoes not viruliferous but still alive were succumbed at the 3rd trial for infectivity control). Together out of 103 batches of eggs, 62 originated from viruliferous females. Of the latter, 1587 mosquitoes of F_1 generation were examined in 146 isolation experiments. Out of these, 16 were positive, namely 8 in 2nd, 5 in 3rd, 1 in the 4th and 2 in the 5th gonotrophic cycles (Table 1).

The progeny nursed from eggs of the first cycle was negative. The lowest minimal filial infection rate (MFIR), i.e.,the lowest rate between the number of positive suspensions to the total number of progeny tested, reaching the value of 1:28.5 was found in the 2nd gonotrophic cycle (Table 1). The 16 positive suspensions coming from 7 females out of 31 viruliferous mosquitoes (22.6%) of these, mosquito No. 33 yielded infected progeny twice, namely in the 2nd and 3rd cycles. Four females had infected progeny in the 2nd, two in the 3rd, one in the 4th and one in the 5th cycle (Table 2). The MFIR ranged from 1:12.2 to 1:77.

All 24 trials on the virus tranfer by females of F_1 generation were negative, although some females were positive in infectivity titrations later performed.

The ovaries of viruliferous females were electron microscopically examined after oviposition, and 24 hr after sucking; 7 and 19 days post infection. The cytoplasm of oocytes repeatedly contained round shaped virus particles 100-110 nm in diameter. Ultrastructural changes characteristic for bunyavirus replication were found. The smooth endoplasmic reticulum and the Golgi complex formed numerous proliferating vesicles. The particles were situated either in cytoplasm rich of free ribosomes or in the smooth membrane bound vacuoles. The particles in cytoplasm were mostly electron translucent;

occasionally more electron-dense particles were present in different proportion. The electron translucent cytoplasmic particles had a denser limiting membrane, 5 nm thick, and were covered with 10-11 nm long more electron-translucent spikes. The particles within the smooth membrane bound vacuoles had a more dense core than those found in cytoplasm. These particles were budding on the vesicle wall inside the smooth cytoplasmic membranes.

Virions in the oocyte cytoplasm were mostly free or they were seen less frequently in the granular matrix inside vacuoles. In the course of yolk accumulation, virions were seen in the vicinity of membrane bound vesicles not only in cytoplasm of oocytes but also in that of follicular epithelium cells.

(M. Labuda, F. Čiampor, O. Kožuch)

Table 1. Survey of F_1 generation progeny from 31 viruliferous mosquitoes

Gonotrophic cycle	Number of suspensions	Number of progeny	MFIR
1	0/79[x]	871	-
2	0/24	228	1:28.5
3	5/28	302	1:60.4
4	1/10	124	1:124.0
5	1/5	62	1:31.0
Total	16/146	1587	1:99.1

[x]Positive out of examined.

Table 2. Survey of the progeny of F_1 generation from viruliferous "families"

Parent mosquito No.	Gonotrophic cycle	No. of suspensions	No. of progeny tested	MFIR
15	2	1/3[x]	28	1:28
23	2	1/4	41	1:41
26	2	2/3	27	1:13.5
33	2	4/6	65	1:16.2
20	3	4/6	49	1:12.2
33	3	1/4	77	1:77
18	4	1/1	16	1:16
22	5	2/2	40	1:20

[x]Positive out of examined.

REPORT FROM THE INSTITUTE OF VIROLOGY, UNIVERSITY OF VIENNA,
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Dissection of the antigenic structure of the tick-borne encephalitis (TBE) virus glycoprotein by monoclonal antibodies.

Monoclonal antibodies against the TBE virus glycoprotein were prepared from hybridomas of mouse myeloma cells (X63-Ag8-653) and spleen cells from Balb/c mice immunized with purified glycoprotein complexes. Hybridomas were screened for antibody production in an enzyme immuno assay using purified TBE virus as well as purified glycoprotein as a solid phase. By this means a panel of glycoprotein-specific monoclonal antibodies was obtained. To select for such antibodies which define different antigenic sites and to functionally characterize these sites we employed variant analysis, haemagglutination inhibition (HI) tests, neutralization tests, passive mouse protection tests, and competitive binding assays for the analysis of the spatial relationships between different antigenic determinants. By these discriminatory means 8 monoclonal antibodies were selected which differ in at least one functional or operational criterion and each therefore defines a unique epitope on the glycoprotein.

These results allowed us to establish a model showing the spatial relationships, functions, and serological specificities of 8 distinct epitopes on the TBE virus glycoprotein (HEINZ et al, 1983). Although 5 independent nonoverlapping antigenic determinants were identified, two major antigenic domains are formed by overlapping epitopes. Domain A is defined by 3 HA-inhibiting antibodies, two of which are flavivirus group-reactive whereas the third is TBE virus subtype-specific. From these only the subtype-specific antibody is protective and neutralizes the virus. The presence of such antigenic determinants is compatible with the fact that neutralization tests with flaviviruses are more specific than HI-tests and that HI-tests can be made type- and subtype-specific by absorption with appropriate heterologous antigens. Domain B is defined by 3 TBE complex-specific HA-inhibiting and neutralizing antibodies and by one type-specific antibody showing none of these activities. The same holds true for an independent epitope defined by a subtype-specific antibody.

Characteristically therefore these domains are inhomogeneous with respect to serological specificity and contain epitopes which differ with respect to their involvement in HA, neutralization, and passive protection. The effect of antibody binding (e.g. neutralization or HA-inhibition) seems to depend critically on the exact location of the epitope in the three-dimensional structure of the protein. Four of the 8 epitopes do not seem to be involved in neutralization or protection. Special consideration has to be made for 2 antibodies which are both non-neutralizing and non-protective but are capable of blocking the binding of neutralizing antibodies.

All 8 epitopes are indistinguishably present on the glycoprotein of European TBE virus strains isolated in different countries from different hosts in different years which confirms previous results obtained by peptide mapping and competitive radioimmunoassay (HEINZ and KUNZ, 1982).

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J. Gen. Virol. 57, 263-274.

(F. X. HEINZ, Ch. KUNZ)

REPORT FROM THE ARBOVIRUS LABORATORY, MEDICAL INSTITUTE OF ENVIRONMENTAL HYGIENE, AUF'M HENNEKAMP 50
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1. Tahyna Virus Surveillance in Central Europe during 1980 and 1981 (Further Details)

After a preliminary report in issue No. 43, Sept. 1982, we can now submit the definitive numbers and the species identification of captured mosquitoes, the number of isolated TAH virus strains, and the description of the regions of capture.

Regions of capture:

A) Lower Rhine area: various sites: old cellars with hibernating females; mixed forests, partially marshy; rain-water basins, where larvae were collected.

B) Middle Rhine area (Germersheim-Bingen): dead Rhine branches surrounded by meadows and forests, which are inundated several times in the year by floods from the Rhine river.

C) Upper Main area (north of Bamberg): flat meadows and wooded slopes in the Main valley, where inundations had occurred during the last years.

D) Lake Neusiedl (eastern shore), Austria: steppe and meadow biotopes with multiple shallow lakes and marshes.

E) Isonzo River Delta, Northern Italy: cornfields and meadows with partially dry ditches and with groves along the branches of the Isonzo river delta.

F) Amper Moos (west of Munich): meadows and forests on the eastern bank of the small river Amper.

For collecting mosquitoes insect nets and exhaustors were used. Immediately after catching the mosquitoes were frozen at -70°C until identification. They were inoculated intracerebrally into suckling mice in pools of about 100 individuals. The virus was identified by the indirect immunofluorescence technique in tissue cultures inoculated with the infectious mouse brain suspension (see our report in issue No. 41, Sept. 1981).

The results are given in table 1.

The isolation of TAH virus at the eastern shore of Lake Neusiedl is in accordance with previous findings of ASPÖCK (2). Although in the Upper Main (4) and Isonzo (3) areas TAH virus strains have been isolated previously, we have not found any virus during our investigation period in these regions. In the Middle Rhine area however no TAH virus strains had been isolated until 1980, although SPIECKERMANN and ACKERMANN (5) had tested 19,800 mosquitoes, which were caught during 1969 and 1970 in this region.

Anopheles								
claviger		2/<1	2/<1	3/<1		1/<1	1/1	
maculipennis		2/<1		849/10	2/<1		2/2	
plumbeus	7/<1		2/<1		2/<1			
Culex								
modestus				264/31	26/1			
pipiens	2057/72	1/<1	12/<1	724/9	146/5		5/5	
territans				6/<1				
species				42/<1				
Culiseta								
annulata	34/<1	11/<1		912/11	2/<1			
subochrea		1/<1						
Mansonia								
richiardii	27/1			1706/20	17/1			
Total identified females	2859/100	4511/100	6506/100	8417/100	2744/100	625/100	104/100	2211/100
Unidentified females		700	693	672	4			2241●
Total females	2859	5211	7199	9089	2748	625	104	4452
Males	195	150		1825	1034	31	7	19
Unidentified mosquitoes				4244	6119			1595●●
Total mosquit.	3054	5361	7199	15158	9901	656	111	6066
TAH virus str.				1				5
MIR				0.07				0.82

n = number % = percentage of identified females MIR = minimum infection rate per 1000 mosquitoes
● = isolated TAH virus strain

TABLE 1: MOSQUITOES CAPTURED RFOM JANUARY 2, 1980, TO SEPTEMBER 10, 1981, IN CENTRAL EUROPE (GERMANY, AUSTRIA, ITALY) AND ISOLATED TAHYNA VIRUS STRAINS

Species	Lower Rhine 2.1. - 25.7.1980 n/%	Middle Rhine 21.7. - 15.8.1980 n/%	Upper Main 13.8. - 12.9.1980 n/%	Lake Neusiedl 17.8. 30.8.1981 n/%	Isonzo River Delta 1.9. - 5.9.1981 n/%	Amper Moos 6.9.1981 n/%	Upper Main 7.9. - 8.9.1981 n/%	Middle Rhine 9.9. - 10.9.1981 n/%
Aedes								
annulipes	31/1							
cantans	299/10	3/<1	28/<1					
caspius		3/<1	4/<1	219/3●	2511/91	4/1		
cataphylla			2/<1					
cinereus	321/11	11/<1	129/2	2/<1		7/1	3/3	112/5
communis	6/<1		24/<1					
dorsalis			1/<1					
excrucians			3/<1					
flavescens				7/<1				
geniculatus	1/<1		7/<1					
punctor	42/1		4/<1					
refiki	1/<1							
rossicus	1/<1	73/2	5/<1	2/<1				249/11
sticticus	22/1	321/7	410/6	113/1		46/7	5/5	23/1
vexans	10/<1	4083/91	5877/90	1186/14	38/1	567/91	86/84	1827/83●●

Our results add proof to the thesis that TAH virus is indigenous to the Middle Rhine area as postulated by ACKERMANN and coworkers on the basis of serological findings in humans (1) and sentinel rabbits (5).

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(J. Pilaski and H. Mackenstein)

2. Occurrence of CO_2-Sensitivity in Aedes vexans Mosquitoes Infected with Tahyna Virus

The first report of CO_2-sensitivity occurring in mosquitoes was given by ROSEN for Toxorhynchites, Culex, and Aedes species infected with a variety of rhabdoviruses by intrathoracic inoculation (1). Its natural occurrence in laboratory-reared and wild-caught mosquitoes then led to the isolation of the Matsu agent, presumably a rhabdovirus as well (2). The known range of viruses which cause CO_2-sensitivity in mosquitoes was extended to include the California encephalitis virus (CE; Bunyaviridae) by TURELL and HARDY, who observed this phenomenon after inoculation of the CE-agent into Aedes tarsalis, Ae. melanimon, Ae. triseriatus, and Culex tarsalis and also after pledget feeding to Aedes melanimon and Ae. dorsalis (3).

In our studies with another Bunyavirus, Tahyna (TAH), and the mosquito Aedes vexans CO_2-sensitivity was also observed. Two extraneurally passaged strains of TAH virus were used to infect females from a laboratory colony of Aedes vexans by pledget feeding. Groups of mosquitoes were tested for CO_2-senitivity according to the method described by ROSEN (2) at intervals of 7, 9, 11, 15, 20, 25, 41, and 43 days after the infectious bloodmeal. The mosquitoes were then assayed singly for the presence of virus using a combination of cell-culture and immunofluorescence technique (see our

report in issue No. 41, Sept. 1981). The results are shown in the table below:

days after feeding	quantity of infected mosquitoes	CO_2-sensitive
7	5	-
9	6	1
11	10	4
15	6	-
20	4	3
25	9	5
41	5	-
43	2	-
Total	47	13 = 27%

Of 83 not-infected mosquitoes none showed CO_2-sensitivity (no false-positive results).

In these tests CO_2-sensitivity did not prove to be a very efficient method of identifying virus infected mosquitoes since only about a quarter of the infected specimens actually was CO_2-sensitive. However it was a highly reliable method insofar as none of the CO_2-sensitive mosquitoes was free of virus.

The failure of the CO_2-sensitivity-test to identify all infected mosquitoes may be well explained, if a particular organ (e. g. the thoracic ganglia) has to be penetrated by the virus to render the insect CO_2-sensitive (1).

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(F. Nelles and J. Pilaski)

REPORT FROM ARBOVIRUS UNIT, DEPARTMENT OF VIROLOGY, ISTITUTO SUPERIORE DI SANITA', ROME, ITALY

New isolations of Phleboviruses from sandflies in Italy: identification of a new serotype.

The role of phlebotomine sandflies as vectors of sandfly fever viruses in the Mediterranean region has been well documented in the past and more recent studies suggest that many different viruses are transmitted by these insects. The isolation of a new Phlebovirus (Toscana virus) from Phlebotomus perniciosus collected in 1971 in a central Italian region (Toscana, Grosseto province) prompted us to investigate the vector potential of these insects in our country as well as possible public health importance of the new virus.

During 1980 and 1981, following serologic evidence of a presumptive association of Toscana virus with acute CNS diseases, a further 5 strains of Toscana virus were recovered, all from Phl.perniciosus collected in Florence province (Toscana region). In addition, 4 strains of a presumably new viral agent (ISS.Phl.18) were isolated from the same sandfly species.

During 1982, new areas in Toscana region (Siena province) were investigated for the presence of vectors and foci of phlebotomus-associated viruses following new serologic evidence of Toscana virus infection in patients with aseptic meningitis and encephalitis. Sandfly collections were carried out between June and Semptember at 28 different areas in Siena province by means of light traps. After collection, insects were frozen in dry ice for transport to the laboratory and then stored at -70°C until being processed. At that time, the insects were separated by sex and representative samples were used for species identification. It was found that most of the insects (97%) were Phl.perfiliewi and only a few were Phl.perniciosus. In the majority of the collection sites only one sandfly species (Phl.perfiliewi) was found. (Collection and identification of sandflies were done by M.Coluzzi and G.Sabatinelli of the Institute of Parasitology of the University of Rome). All virus isolation attempts were performed in Vero cell cultures.

Table 1 summarizes sandfly collection and virus isolation results. A total of 9,351 sandflies was processed as 128 pools for virus isolation. A total of 41 viral strains was obtained. Virus isolates were identified by CF test using MIAFs prepared against Toscana and ISS. Phl.18 viruses. Fifteen isolates have been identified as Toscana virus. As in CF test broad cross-reactivity is observed with Toscana and Sandfly fever Naples (SFN) antigens, final identification of the isolates will be obtained only by PRN test. However, on the basis of growth characteristics in Vero cells, all isolates are presumably strains of Tosca-

na virus. Twenty-six isolates resulted similar by CF test to the new viral agent (ISS.Phl.18) recovered from Phl.perniciosus in Florence province. Most of the virus isolates were obtained from sandflies collected during July corresponding to the highest observed sandfly density. Nearly 17% of all sandflies processed were males from which one strain of Toscana and three strains of ISS.Phl.18 viruses were isolated. These findings confirm the results obtained with previous isolations of both agents in previous years and further support the hypothesis that sandfly-associated Phleboviruses can be maintained in nature by transovarial transmission.

The new agent (prototype ISS.Phl.18) failed to react in CF test with MIAFs prepared against Toscana, SFN and SFS viruses. Further identification tests were kindly performed by Dr.R.B.Tesh at YARU, New Haven. Initially, ISS.Phl.18 antigen was screened by indirect fluorescent antibody test against the following MIAFs: phlebotomus fever group, Toscana, SFN, Arumowot, Gordil, Saint Floris, SFS, Rift Valley Fever, Karimabad, Salehabad, Gabek Forest, VSV group, Isfahan, Chandipura and Jug Bogdanovac. Positive reactions were obtained in this test with Toscana, SFN, Gordil, Saint Floris, Salehabad, Gabek Forest and the phlebotomus fever group antisera. ISS.Phl.18 antigen and antiserum were then tested by CF method against Salehabad, Gordil, Gabek Forest, Saint Floris, Toscana and SFN antigens and MIAFs. As shown in Table 2 positive reactions were obtained between ISS.Phl.18, Salehabad and Gabek Forest. In Table 3 the results of PRN test between ISS.Phl.18 and Salehabad viruses and antisera are shown. The results indicated that ISS.Phl.18 was a new member of the Phlebotomus fever group of arboviruses, which was related to but distinct from Salehabad virus.

For this virus we suggest the name of Arbia virus, after the small river flowing across both Florence and Siena provinces from which the isolates came. A possible human significance of Arbia virus has to be established. Only a few human sera were tested by PRN method against it with negative results.

The reported isolations of two different Phlebovirus serotypes (Toscana and Arbia) from different areas and from two different sandfly species (Phl.perniciosus and perfiliewi) suggest that the evaluation of the vector potential as well as public health importance of phlebotomine sandflies in Italy warrant further studies.

(P.Verani, S.Caciolli, M.G.Ciufolini, A.Marchi, L.Nicoletti and M.Balducci[+])

[+]Field Epidemiologist, Toscana Region

Table 1. Virus isolation obtained from Phlebotomus perfiliewi collected in Siena province (1982)

Collection period	N° sandflies processed/ N° pools	N° of isolates		Total
		Toscana	Arbia (ISS.Phl.18)	
June	555/ 14	2 (0.4[+])	3 (0.5)	5 (0.9)
July	8,278/ 93	13 (0.1)	22 (0.3)	35 (0.4)
August	428/ 14	0	1 (0.2)	1 (0.2)
September	90/ 7	0	0	0
Total	9,351/128	15 (0.2)	26 (0.3)	41 (0.4)

[+]Isolation rate per 100 sandflies

Table 2. Results of CF tests with ISS.Phl.18

Antigen	Antiserum		
	ISS.Phl.18	Salehabad	Gabek Forest
ISS.Phl.18	256/≥256[+]	128/ ≥64	0
Salehabad	64/≥128	256/≥128	0
Gabek Forest	16/4	0	≥256/≥128

[+]Reciprocal of highest positive antiserum dilution/highest positive antigen dilution

0 = <4/4

Table 3. Results of PRN tests with Salehabad and ISS.Phl.18 viruses

Virus	Antiserum	
	ISS.Phl.18	Salehabad
ISS.Phl.18	160[..]	<10
Salehabad	<10	320

[..]Reciprocal of highest antiserum dilution producing ≥90% plaque inhibition

Report from the Institute of Tropical Medicine, Nationalestraat 155, Antwerp, Belgium

Enzyme Linked Immunosorbent Assay for Determination of Antibodies against Marburg, Ebola and Lassa Viruses using Formaldehyde Inactivated Extracellular Virus as Antigen

So far, antibodies against MBG, EBO, and LAS were determined with the indirect immunofluorescent antibody test. There is a need for other methods to confirm these results. We present here a solid phase enzyme linked immunosorbent assay (ELISA) which can be used outside a maximum containment laboratory. The antigen consisted of a buffered formaldehyde (0.02%, 24 h 37° C, 1 week 4° C) inactivated supernatant of infected Vero cells, whereas the control antigen was a parallel treated supernatant of non-infected cells. The serum to be tested is serially diluted, and 0.05 ml of each dilution is incubated in each of four wells, two containing antigen and two containing an equal amount of control antigen.

Antibodies were detected by addition of horse-radish peroxidase labeled anti-human IgG. Readings were performed at 493 nm. The mean value of absorbance of serum bound to the control antigen is subtracted from the mean absorbance of serum bound to the viral antigen at each serum dilution. The titer of antibody is defined as the reciprocal of the highest dilution of serum that yields a significant difference in absorption evaluated by t test at the level of $p < 0.05$.

(G. Van Der Groen and Cl. Soetens)

REPORT FROM THE VIRUS LABORATORY, FACULTY OF MEDICINE, BREST, FRANCE

ANTIGENIC VARIANTS AMONG STRAINS OF SOLDADO (SOL) VIRUS ISOLATED IN DIFFERENT PARTS OF THE WORLD

Soldado (SOL) virus, a tick-borne virus of the Hughes serological group is associated mainly with seabirds colonies and it structuraly belongs to the *Nairovirus* genus of *Bunyaviridae* family.

SOL virus has one of the widest geographical distribution among arboviruses, affecting five of the six large zoogeographical regions of the world. Comparatively, other viruses of the Hughes serological group have more restricted geographical distribution than SOL virus, making this latter virus a likely candidate for antigenic variation.

By means of CF and gel immunodiffusion (ID) reactions, we therefore attempted to demonstrate the existence of geographical antigenic variants amongst strains of SOL virus of various origin.

The results showed that such variants do indeed exist (Chastel et al, 1982, 1983), which implies that SOL virus is not a single virus, but rather a complex of strains which are more or less closely related antigenically.

MATERIAL AND METHODS

Nine strains of SOL virus were used in this study: the Trinidad reference strain (TR 52214) from Y.A.R.U. (Doctor J. Casals); the Ireland, South Africa, Hawaii and Texas strains, from R.M.L. (Doctor C.E. Yunker); the Brest/Ar/T13 (Cape Frehel, 1977), T101 (Cape Frehel, 1978), T247 (Cape Sizun, 1979) from France, and the Brest/Ar/T234 from Morocco, all isolated by Brest Virus Laboratory from *Ornithodoros (Alectorobius) maritimus* ticks.

The antigens were prepared from infected suckling mice brains by sucrose-acetone method and immune ascitic fluids were prepared by R.M.L. or by Brest Virus Laboratory.

For the CF reactions, we used a micromethod on plates. Two units of antigen of each strain were introduced into successive tenfold dilutions of the homologous and heterologous antibodies of the nine strains. The results were expressed as the reciprocal of the strongest dilution of antibodies still giving a positive reaction.

In addition we determined the coefficient 'r' which makes it possible to express, by a ratio, the antigenic relationship existing between two viruses 1 and 2, according to the formula:

$$r = \sqrt{r_1 \times r_2}$$

in which r_1 expressed the ratio of the heterologous titer to the homologous titer of a virus 1 and r_2 expresses this ratio for a virus 2.

For the ID reactions, we used the microtechnique of Chan (1965). The antigens and antibodies were introduced undiluted into wells. The assessment was made five days after diffusion and the results were quoted according to the number of clearly identifiable lines of precipitation.

Each CF or ID reaction was made in duplicate or triplicate.

RESULTS

They are shown in tables 1, 2 and 3.

1. Results of CF reactions

The results presented in table 1 were sometimes difficult to interpret because some heterologous reactions were stronger than the homologous ones, this type of abnormal reaction would be fairly frequent with the viruses of the Hughes group (C.E. Yunker, pers.com., 1981).

However, when we used the coefficient 'r' it was possible to see more clearly the antigenic relationships existing between the various strains:
a. The Texas strain and, to a lesser extent, the Hawaii strain, both isolated from *O. (A.) capensis* ticks, are related though distantly to the reference strain Trinidad, itself isolated from a mixture of *O. (A.) capensis* + *O. (A.) denmarki*.
b. The Ireland strain, isolated from *O. (A.) maritimus* appears to be the leader of the various strains isolated from the same tick in France (T13, T101, T247) and in Morocco (T234).
c. The South Africa strain, isolated from *O. (A.) capensis* cannot be clearly classified relative to other strains.

2. Results of ID reactions

They first seemed to us aberrant or at least difficult to interpret.

In fact, some heterologous reactions were entirely negative. In other reactions, two lines of precipitation were observed in the heterologous reactions, whereas there was only one line in the homologous reaction. Thus the ID reaction seemed to be of little value in our purpose.

In a second stage, and according to the results of CF reactions, we classified the ID reactions *a priori* according to two subgroups: a sub-group C comprising the strains isolated from *O. (A.) capensis* and a sub-group M including the strains isolated from *O. (A.) maritimus*. We then calculated the ratio of the total number of precipitation lines to the total number of ID reactions carried out, for each of the sub-groups C and M, and this was done in respect to the homologous and heterologous antibodies. From table 3 it is clearly seen that this reaction is higher in the case of the homologous reactions (0.93 and 0.84), than in the case of the heterologous reactions (0.60 and 0.55). This is in favour of the existence of two antigenic sub-groups of strains, associated with geography and the type of vector ticks.

COMMENTS

The existence of antigenic variants amongst several strains previously classified as SOL or SOL-like virus is not too surprising: such variants exist for a number of arboviruses and the very large geographical distribution of SOL virus made their existence very likely.

Of greater interest is the fact that we were able to establish a clear separation between the strains originating from the New World isolated from *O. (A.) capensis* and *O. (A.) denmarki*: Trinidad, Texas and Hawaii (sub-group C), and the strains originating from the Old World, transmitted by *O. (A.) maritimus*: Ireland, Cape Frehel 1977 (T13) and 1978 (T101), Cape Sizun 1979 (T247) and Essaouira (T247), Morocco (sub-group M).

Although the South Africa strain was not assigned clearly to one or other sub-group with the methods which were used, we think the clear separation of other strains according to the vectors and the geography has a biological significance.

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Table 1. Cross relationships of some Soldado complex viruses in CF tests.

	Hyperimmune serum or ascite titer*								
Antigen	Trinidad	South Africa	Ireland	Hawaii	Texas	T13	T101	T234	T247
Trinidad	64	8	16	128	1024	<8	8	<8	8
South Africa	8	1024	16	16	1024	16	64	<8	32
Ireland	8	64	1024	64	1024	256	1024	512	1024
Hawaii	16	8	16	1024	1024	8	16	8	16
Texas	8	<8	16	64	1024	<8	32	<8	8
T13	4	16	1024	16	16	256	1024	512	1024
T101	<8	<8	8	<8	16	8	128	8	32
T234	8	16	1024	16	128	16	1024	64	128
T247	<8	8	64	<8	8	16	1024	16	64

*Highest dilution of immune fluids fixing complement with two units of antigen.

Table 2. Cross relationships of some Soldado complex viruses in CF tests.

	Value of r ⁂								
Antigen	Trinidad	South Africa	Ireland	Hawaii	Texas	T13	T101	T234	T247
Trinidad	1	0.03	0.04	0.17	0.35	<0.01	<0.01	<0.01	<0.01
South Africa		1	0.03	0.01	<0.01	0.04	<0.01	<0.01	0.06
Ireland			1	0.03	0.12	1	0.25	1	1
Hawaii				1	0.25	0.02	<0.01	0.04	<0.01
Texas					1	<0.01	0.06	<0.01	0.03
T13						1	0.5	0.70	1
T101							1	1	1
T234								1	0.70
T247									1

⁂ $r = \sqrt{r_1 \times r_2}$ (r_1 = heterologous to homologous titer ratio of virus 1 with virus 2; r_2 = heterologous to homologous titer ratio of virus 2 with virus 1).

Table 3. Cross relationships of some Soldado complex viruses in precipitin tests.

	Hyperimmune serum or ascite								
Antigen	Trinidad	South Africa	Hawaii	Texas	Ireland	T13	T101	T234	T247
Sub-group C:									
Trinidad	1[:]	1	1	1	-	-	1	1	1
South Africa	1	1	-	-	-	1	-	-	1
Hawaii	1	2	1	2	1	1	2	1	1
Texas	-	1	1	1	-	-	-	1	-
	15/16 = 0.93[::]				12/20 = 0.60				
Sub-group M:									
Ireland	-	2	1	2	2	1	2	1	1
T13	1	-	1	-	1	1	1	1	1
T101	1	-	-	-	-	1	1	-	1
T234	1	1	-	-	-	-	1	1	-
T247	-	1	-	-	-	1	1	1	1
	11/20 = 0.55				21/25 = 0.84				

[:] Number of precipitin lines: all tests were performed in duplicate.
[::] Ratio of number of precipitin lines observed / number of performed tests.

MONOCLONAL ANTIBODY TO JAPANESE ENCEPHALITIS VIRUS P74 ALSO REACTS WITH A MINOR 150,000 M_r COMPONENT OF INFECTED CELLS

Report from Special Pathogens Reference Laboratory, PHLS Center for Applied Microbiology and Research, Porton Down, Salisbury Wiltshire, SP4 OJG, UK

An IgM class monoclonal antibody, JE 62.4, raised against Japanese encephalitis virus gives diffuse cytoplasmic fluorescence with infected cells and also speckled nuclear fluorescence in both infected and uninfected mammalian cells. The antibody is capable of binding to nitrocellulose transfers of cell proteins separated by SDS-polyacrylamide gel electrophoresis. As shown in Fig. 1 the major component detected in virus-infected cells corresponds to the non-structural protein P74 (formerly NV4). Further minor virus-specific proteins, including one with a mol. wt. of about 150,000, can also bind the antibody, and are more prominent when the cells are lysed late in the infection cycle. The antibody also binds weakly to proteins seen in infected and uninfected cells, most prominently to one with a mol. wt. of about 56,000. One or more of these host-specified proteins may be responsible for the nuclear fluorescence.

The existence of the 150,000 kDa virus-specific cross-reacting protein may offer an interesting insight into the synthesis of P74. Since pulse-chase labelling experiments have revealed no large precursor to the non-structural proteins it seems unlikely that the large protein is an intermediate in the synthesis of P74. It may rather represent some aberrant read-through product of translation from a polycistronic mRNA which includes the P74 sequence plus one or more of the other viral proteins. It would thus be of considerable interest if monoclonal antibodies specific for other JEV proteins could be found which were capable of binding to it.

This antibody may also be useful in studies of the function of the flavivirus large non-structural proteins. It has been suggested that either or both P93 or P74 are components of the virus-specific RNA-dependent RNA polymerase required for replication of the flavivirus genome. Antibody 62.4 could be used to test this possibility by attempting to inhibit in vitro virus-specific RNA synthesis or for the purification of P74-containing structures by immuno-affinity chromatography.

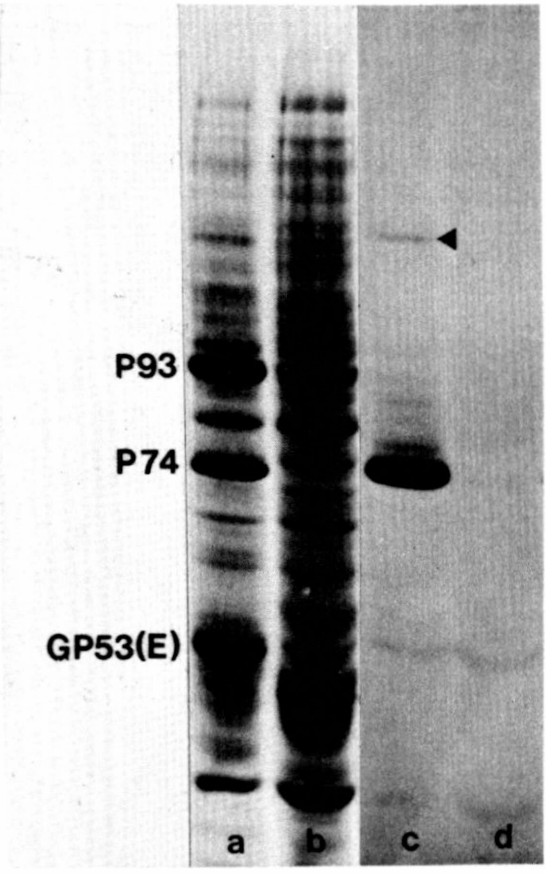

Fig. 1

Infected (tracks a and c) or mock-infected (tracks b and d) cells were labelled with ^{35}S methionine 7 days after infection, the proteins analysed on an 8-15% polyacrylamide gel, and transferred to nitrocellulose. Polypeptides capable of binding antibody were located by sequential incubation with 62.4 monoclonal antibody, peroxidase-conjugated rabbit anti-mouse globulin and aminoethylcarbazole substrate (tracks c and d). The position of labelled proteins were revealed by autoradiography (tracks a and b).

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REPORT FROM THE NERC INSTITUTE OF VIROLOGY, MANSFIELD ROAD, OXFORD, UK, AND THE DEPARTMENT OF ZOOLOGY, UNIVERSITY COLLEGE, CORK, EIRE.

ORBI- AND BUNYAVIRUSES INFECTING TICKS AND SEABIRDS.

Ticks were collected on 26, 27, 28 June 1980 from seabird nesting sites on Great Saltee (52°.07N, 6°.36W), a small island 5.6km off the south-east coast of Eire. Blood samples were collected from several seabird chicks on which ticks were feeding and from a pigeon which frequented our camp on the island. Viruses were isolated by inoculating homogenised tick pools into 2 day-old mice and into a variety of cell lines. Isolated viruses were characterised by electron microscopy, serological and physico-chemical tests. Orbiviruses of the Kemerovo serogroup, and bunyaviruses of the Uukuniemi and Hughes serogroups were isolated from the tick pools (table 1). Except for GS80-3, -5 and -6, these viruses were re-isolated from the original tick pools (stored at -70°C) up to 6 months after the initial isolations were made; GS80-4 yielded a virus which differed from that originally isolated. GS80-11 appears to be the first reported isolation of a virus from Ixodes rothschildi. Neutralising antibodies to each of the virus serogroups were detected in sera from seabird chicks (table 2); at least 3 sera contained neutralising antibodies to all 3 serogroups. The results show the prevalence of mixed infections with tick-borne viruses in a seabird colony.

(Nuttall, P.A., Kelly, T.C., Carey, D., Moss, S.R. and Harrap, K.A.)

Table 1. Details of ticks examined for viruses and results

Code No. GS80-	Tick pool	Collection details[1]	Virus[2]
	Ixodes uriae		
1	10 nymphs	site 2, soil	-
2	20 larvae	site 2, soil	-
4	5♀♀	site 2, soil	KEM, bunya
7	5♂♂	site 2, soil	KEM, bunya
8	10♀♀	site 2, soil	KEM
9	3♀♀, engorging	site 3, *U.aalge* chick A	KEM
10	1♀♀, engorging	site 6, *R.tridactyla* chick A	UUK
13	5♂♂	site 2, soil	UUK
14	2♀♀, engorging	site 6, *R.tridactyla* chick B	-
15	1♀♀, engorging	site 6, *R.tridactyla* chick C	-
20	1♀♀, engorging	site 3, *U.aalge* chick C	-
21	4♀♀, engorging	site 3, *U.aalge* chick B	-
	Ixodes rothschildi		
11	9 nymphs, engorging	site 8, in burrows	UUK
	Ornithodoros maritimus		
3	5♂♂	site 1, soil	HUG
5	approximately 100 eggs	site 1, soil	KEM
6	5♂♂,	site 1, soil	KEM
12	5♀♀, engorging	site 1, soil	-
16	8 larvae, engorging	site 1, *P.aristotelis* chick B	-
17	2 nymphs, engorging	site 7, under stones	-
18	2♀♀, engorging	site 7, under stones	-
19	1♂♂, engorging	site 7, under stones	-
22	2 larvae, engorging	site 1, *P.aristotelis* chick C	-

[1] Ticks collected in different nesting sites on the cliffs of Great Saltee island. Shags (*Phalacrocorax aristotelis aristotelis*) were the dominsnt host species at site 1, guillemots (*Uria aalge aalge*) at sites 2 and 3, guillemots and kittiwakes (*Rissa tridactyla*) at site 6, and razorbills (*Alca torda*) in site 8. Where indicated ticks were collected from chicks.

[2] Kemerovo (KEM), Uukuniemi (UUK) and Hughes (HUG) serogroups as indicated by complement fixation tests; bunyavirus (bunya) observed by electron microscopy.

Table 2. Results of neutralisation tests[1] with avian sera

virus isolate[2]	seabird chick sera[3]								pigeon serum
	2	3	4	6	7	8	11	19	
GS80-3 (HUGHES)					>128	64	(<128)	(<128)	
GS80-6 (KEM)		<8	128	(<64)	16	128	(<64)	(<64)	<8
GS80-9 (KEM)			>128<256		>128	>128	(<64)	<16	<16
GS80-10 (UUK)	64	64		64					<16

[1] plaque reduction neutralisation tests carried out in Linbro plates using either Vero (for orbiviruses) or Xenopus laevis (for bunyaviruses) cell lines. Titres expressed as the reciprocal of the serum dilution which reduced the number of plaques by 50% compared with controls. Titres in parenthesis indicate dilution below which sera were toxic.

[2] virus grown in cell culture; Hughes, Kemerovo, and Uukuniemi serogroups.

[3] 2: R.tridactyla chick A in site 6 on which GS80-10 ticks were feeding
3: R.tridactyla chick C in site 6
4: U.aalge chick A in site 3 on which GS80-9 ticks were feeding
6: R.tridactyla chick B in site 6
7: U.aalge chick B in site 1
8: U.aalge chick A in site 1
11: P.aristotelis chick A in site 1
19: P.aristotelis chick C in site 1

REPORT FROM THE VIRUS RESEARCH CENTRE (KENYA
MEDICAL RESEARCH INSTITUTE),
P.O. Box 20752
NAIROBI, KENYA

Haemorrhagic Fever Virus Surveillance: In 1982 the virus Research Centre investigated 27 acutely ill patients who were suspected of suffering from viral haemorrhagic Disease. No haemorrhagic fever virus was isolated and no convalescent serum sample was found positive for Marburg Ebola, Congo haemorrhagic fever, Rift Valley Fever or Lassa viruses. In the course of these and other studies two cases of trypanosomiasis were detected after blood was subjected to ion exchange chromatography. Contagious pustular dermatitis (orf) virus was recovered from one fever patient and one case proved rabies positive by fluorescence on corneal impressions.

Populations from five areas of differing geographical, ethnic and ecological characteristics were sampled to determine antibody prevalence rates against Marburg, Ebola, Congo haemorrhagic fever, Rift Valley fever and Lassa fever viruses (see map). Ebola virus antibodies were detected in all regions and the highest antibody prevalence rates were found among the Turkana and Samburu samples from Northern Kenya (see table). These groups also had the highest antibody prevalence rates against Marburg virus. Rift Valley fever virus antibodies were detected from the Lodwar, Laisamis and Coast populations whilst Congo virus antibodies were rare and no Lassa virus antibodies were detected.

Comparative antibody titrations revealed that in all areas but coastal Kenya, positive sera exhibited an affinity for the Zaire strain of Ebola virus. The coast samples showed higher titres against the Sudan strain of Ebola virus.

Dengue fever at the Kenya coast: A virus strain recovered from the serum of a Canadian tourist who fell ill during a visit to Malindi in March, 1982, was identified as dengue type 2 by indirect immunofluorescence using monoclonal antibodies. Five additional strains of dengue 2 virus have been isolated from human serum from Malindi, Mombasa, Nairobi and Mogadishu, Somalia.

Serological surveys were conducted in the Malindi/Kilifi area in June, July and October, the results of which suggest that an epidemic of dengue fever was occurring in the area (see figure).

Entomological investigations showed the presence of Aedes aegypti, Aedes albocosta and Aedes albocephalus. Virus isolation attempts on entomological material proved negative.

Poliomyelitis virus in a colony of colobus Colobus guereza monkeys: The Arbovirus Division has been collaborating with the Institute of Primate Research at Tigoni in screening newly captured primates for the presence of virus or virus antibodies. In December, 1982, an outbreak of paralytic disease occurred among the small colony of colobus monkeys. Four of the eight monkeys were effected and either died or were destroyed. Wild strains of polio I virus were recovered from faeces, lung, liver kidney or nervous tissues from three of the sick animals. No polio virus antibodies were detected in any of the four remaining colobus monkeys. One of nine de Brazza's Cercopithecus neglectus monkeys held in an adjacent cage was positive for polio antibodies.

(B.K. Johnson, D. Ocheng, A. Gichogo,
D. Libondo and P.M. Tukei)

TABLE

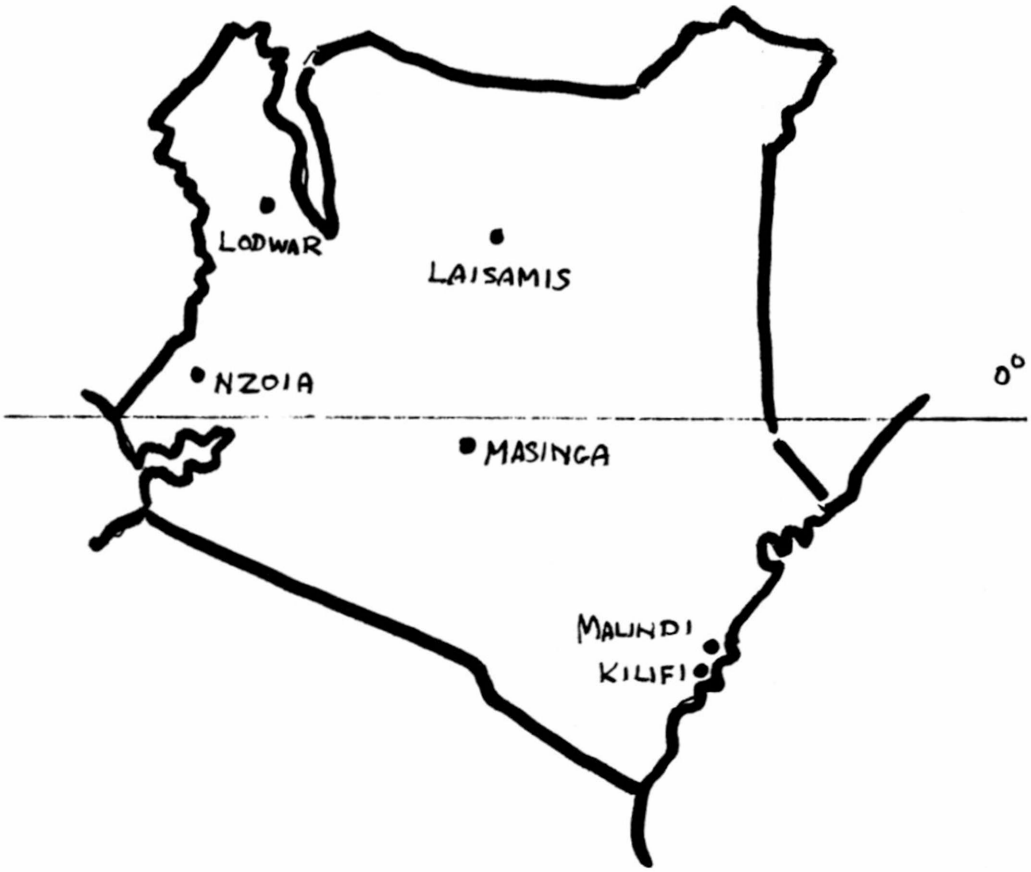
Human viral haemorrhagic fever serology in different areas of Kenya.

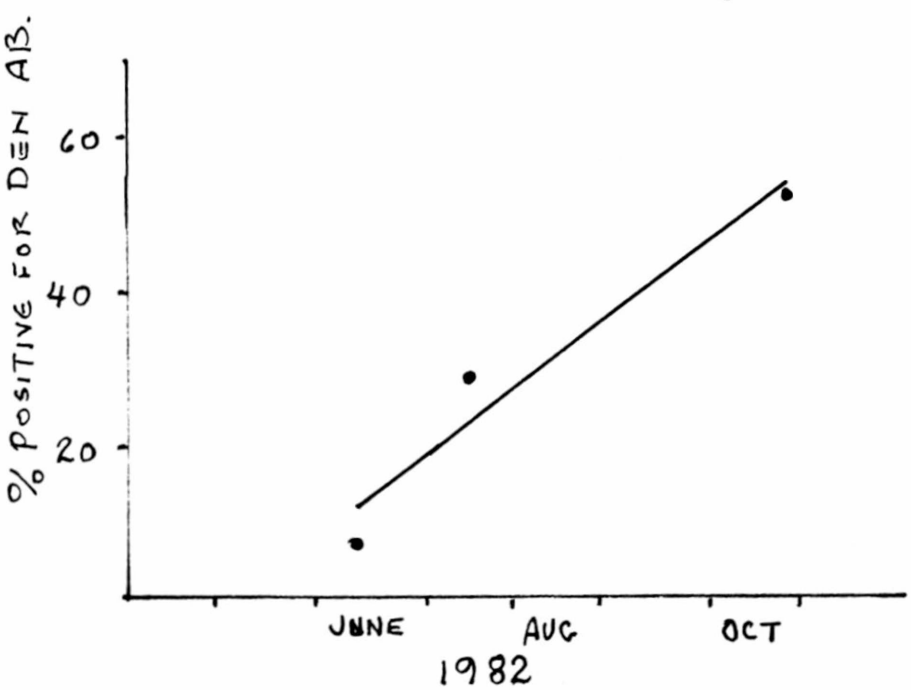
	ANTIGENS				
Area	MBG	EBO	CON	RVF	LAS
Nzoia (western)	0/841*	9/841	2/841	1/841	0/841
Laisamis (north-central)	2/174	5/174	1/174	2/174	0/174
Masinga (central)	2/251	2/251	1/251	0/251	0/251
Lodwar (north-west)	3/77	6/77	NT'	7/77	0/77
Malindi/Kilifi (coast)	1/556	5/556	0/556	7/556	0/556
TOTALS	8/1899	27/1899	4/1823	17/1899	0/1899

* Number positive/number tested

' Not tested

Geographic areas sampled for the presence of antibodies against haemorrhagic fever viruses.





Immunofluorescent antibodies against dengue - 2 antigen in outpatients from Malindi/Kilifi, 1982. June N=184, July N=176, October N=196.

REPORT FROM TANDIL VIRUS RESEARCH LABORATORY, FACULTY OF VETERINARY SCIENCES, NATIONAL UNIVERSITY OF CENTRAL BUENOS AIRES PROVINCE (UNCPBA), ARGENTINA

A virus strain named Larroque was isolated from the spleen of a horse sacrificed because it was affected with equine infectious anemia (EIA). A complement-fixing system was developed. By CF Larroque strain lacks antigenic relationships with any of the viruses already handled in the laboratory and is also different than mouse viruses like LCM, ectromelia, etc.

Serial serum samples from a horse experimentally infected with blood from a horse with EIA showed serological convertion by CF for Larroque strain. Other two sera comming from horses suffering at the time or short after with EIA also were positive against Larroque antigen by CF with titers 1:32 and 1:8 respectivally. The antigen was also good for immunodifussion using the same base and buffers described for Coggins test at least with two sera tested.

Details on virus isolation and behavior of the strains in mice will appear in Gaceta Veterinaria de Buenos Aires, where the report is in press. If the virus is really EIA it will be the first report of a Retroviridae in hand of arbovirologist working with mice using regular techniques.

(Mettler Norma E., Pardo Daniel A., Di Santo Mónica I.)

REPORTED FROM THE DEPARTMENT OF EPIDEMIOLOGY, SCHOOL OF PUBLIC HEALTH, UNIVERSITY OF SÃO PAULO, AV. DR. ARNALDO 715, SÃO PAULO, BRAZIL AND EVANDRO CHAGAS INSTITUTE, F.S.E.S.P., CP. 621, 66.000, BELÉM, PA, BRAZIL.

Serological surveys for arbovirus antibodies have been carried out, since 1977, on people living in Ribeira Valley, southeastern Brazil in forested area of 15.987 km², where an epidemic of Rocio virus (flavivirus) first occurred in 1975.

Hemagglutination inhibition (HI) tests were performed using antigens of Eastern equine encephalitis (EEE) Western equine encephalitis (WEE) Mayaro, Mucambo, Yellow fever, Bussuquara, Ilhéus, St. Louis encephalitis, Rocio, Caciporé, Caraparu, Guaroa, Oropouche, Utinga, Tacaiuma, Icoaraci and Iaco. Neutralizing (N) antibodies were determined in the positive sera.

This epidemiological study was conducted in three different human groups:

I - In 83 men living on three camp sites close to forest, working in road construction. A serological follow-up was made for a period of one year when the blood samples were collected every two months. In 51 workers it was possible to make a study before and after the rainy season.

II - In 516 people of 9 to 82 years of age, living in 15 out of 16 districts of the region, in urban and rural zones. They were patients of the biggest local hospital and presented different diseases, but not encephalitis.

III - In households of 23 cases of Rocio encephalitis, living in the urban zone of four cities of the region.

The results of these tests showed the following facts:

1 - A large circulation of arbovirus in the human population surveyed, since 39,8% of the residents in the forested area and 23,4% of residents in rural and urban zones have antibodies to one or more of 17 arbovirus tested.

2 - A progressive increase of positive sera related to the people's age (from 11,9% below 15 years of age until 40,4% above 65 years), revealing that the contact of men with arbovirus has been happening for a long time.

3 - Antibodies to alphavirus Mucambo and bunyavirus Caraparu were the most frequent in group I (men living in forested areas) and to flavivirus St. Louis encephalitis, alphavirus EEE and bunyavirus Caraparu in the group II (people living in urban and rural zones).

4 - A small proportion of persons with Rocio antibodies (4,2% and 6,1%) and flavivirus antibodies (9,8% and 13,2%) which, in view of the recent epidemic, was surprising. There is no difference at the 0,05 level of significance between the prevalence of Rocio antibodies in people of group I and group II, suggesting that the Rocio transmission has been occurring in and outside the forest (Table 1).

5 - Presence of two past cases of encephalitis that had only neutralizing antibodies against EEE. That virus was isolated in the area from Culex Melanoconion sp. (Calisher et al., 1982), but so far had never been responsible for human or equine diseases.

6 - Only neutralizing antibodies to St. Louis encephalitis or to yellow fever virus were detected in some people, not vaccinated against yellow fever, who have always lived in the region. These virus have never been isolated in Ribeira Valley.

7 - Between the residents in urban and rural zones, men, especially fishermen among other professions, who generally work in the evening an at night, outside forest environment, presented the highest risk of arbovirus infection, suggesting that the arbovirus transmission increases then and there.

8 - During the period of observation of road workers, a serological conversion to a flavivirus, which was not Rocio, accurred in two men, residents in the same camp site.

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(L.B. Iversson, A.P.A. Travassos da Rosa and J.F.S. Travassos da Rosa).

TABLE 1

Frequency of Rocio hemagglutination inhibition antibodies in sera of three human groups residents in Ribeira Valley, São Paulo, Brazil.

Serological responses \ Human groups	I	II	III
monotypic	0/83[d]	10/502[d]	2/82[d]
heterologous cross-reations			
specific[a]	0/83	1/502	1/82
non specific[b]	2/83	9/502	2/82
heterotypic[c]	3/83	1/502	0/82
T o t a l	5/83	21/502	5/82

a ≥ fourfold higher titre to Rocio than to other flavivirus tested.

b ≤ twofold difference in titre.

c title ≥ fourfold higher to a flavivirus other than Rocio.

d $\frac{\text{positive}}{\text{tested}}$

Figure 1 - Aspect of the forested area in Ribeira Valley.

Report from the Institute Evandro Chagas, F. Sesp. Brazilian Ministry of Health, P.O. Box 621, Belem, Para, Brazil

Dengue Outbreak in Boa Vista, Roraima Territory, Brazil

Beginning in early 1982, cases of a febrile illness (some with exanthema) were noticed in Boa Vista, the capital of Roraima Territory, and were subsequently confirmed to be dengue.

Roraima Territory is located in the northernmost portion of Brazil. It borders Venezuela and Guyana to the north, the State of Amazonas to the south, Guyana and the state of Para to the east, and the State of Amazonas and Venezuela to the west. Its geographic location is important since it shares 958 km of international border with Venezuela and 964 km with Guyana. Boa Vista is located on the banks of Rio Branco and has a population of 71,492 inhabitants: 47,291 in the urban area and 24,201 in the rural area.

The most important findings of studies carried out in Boa Vista by a team of experts from the Instituto Evandro Chagas (IEC) between 29 April and 6 May 1982 are described below. Included is a summary of events preceding this period.

On 15 March 1982 the Para Institute of Neurology, in Belem, requested the IEC to identify a possible virus agent responsible for the clinical picture presented by a patient from Boa Vista. She had been hospitalized the day before and, for the previous 10 days, had been suffering from muscle pain, nausea, vomiting, dizziness, chills, and headache.

On 21 March another patient, who had arrived from Boa Vista on 14 March, contacted the IEC. During the previous eight days she had the following symptoms: onset with high fever, intense headache, chills, retro-orbital pain, asthenia, and generalized pains. This person reported that, in Boa Vista, dozens of persons had manifested the same clinical symptoms since February.

Results of the serologic tests made on both patients were similar: secondary response to group B arbovirus (flavivirus) and negative for 13 other types of arbovirus used in the same hemagglutination-inhibition (HI) test.

On 25 March the Boa Vista Health Secretariat sent five blood and serum specimens to the IEC for identification of a possible rubella outbreak occuring in Boa Vista. The principal symptoms of the cases were intermittent fever, headache, constant back and head pain, pyrosis and, in some cases, exanthema. In serologic tests, three specimens showed high titers to the group B arbovirus (flavivirus) and two proved negative. In mouse inoculation, one specimen from a person with negative serologic tests, yielded a virus which was identified as a group B arbovirus by HI tests. When the complement fixation test (CF) was made, the virus proved to be different from the flaviviruses known up to that time in Brazil (yellow fever, Bussuquara, Ilheus, St. Louis, Rocio and Cacipacore). The virus also reacted in HI and CF tests with dengue 1, 2, 3 and 4 immune sera provided by the United States National Institutes of Health. Nevertheless, it was not possible to type the virus. Subsequently, monoclonal antibodies were used in immunofluorescence and HI tests and the agent was identified as dengue-4.

A request was made for a second serum specimen from the patients; three were received, including one from the person from whom the dengue-4 virus had been isolated. Seroconversion for flavivirus was observed both in that specimen and in the other two specimens studied.

On 29 April, a team from the IEC was sent to Boa Vista. In cooperation with the technical personnel of the Health Secretariat and the Campaigns Department (SUCAM) of the Ministry of Health, studies were conducted up to 5 May. During this time, 7,519 mosquitoes were captured, of which 1,478 (19.65 percent) were identified as Aedes aegypti (Table 1). To isolate the virus, all the material was inoculated in A. albopictus cells and in suckling mice. It is of interest to note that A. aegypti was captured in the residence of the patient from whose blood specimen dengue-4 had been isolated. Two isolations of dengue-4 and one of dengue-1 were made from A. aegypti pools.

Concurrently, an active search of recent suspect dengue cases was carried out. Thirty-one cases were selected; their principal clinical manifestations were as follows: intense headache, fever, retro-orbital pain, generalized pains, lack of appetite, anorexia, chills, exanthema, dizziness, epigastric pains, pains in the joints, nausea, vomiting, runny nose, itching and, in one case, petechia. Blood specimens from these patients were also inoculated into A. albopictus cell cultures and suckling mice. A total of 13 dengue isolations were obtained: nine of type 1 and four of type 4 (Table 2).

To study the frequency of arbovirus and rubella antibodies, 359 serum specimens were obtained from contacts and convalescents in various districts of the city. High percentages of group B arbovirus (flavivirus) antibodies were found in several districts (Figure 1). The antibody levels for the other types of arbovirus used in the test was not significant (Table 3).

The frequency of rubella antibodies was appreciable, but was not correlated with the serology which suggested recent flavivirus infection. It should be noted that most of the cases had been diagnosed by physicians in Boa Vista as rubella or Oropouche fever. However, only two of the 359 serum specimens examined showed Orovirus antibodies, in low titers (1:40), which, consequently, did not suggest recent activity by that virus.

On the basis of the findings described, it was concluded that dengue flavivirus types 1 and 4 had been active in Boa Vista, especially downtown, where large numbers of A. aegypti were also found.

(Source: Ministry of Health, Epidemiological Division, Brazil, Boletim Epidemiologico 14(9), 1982).

(A.P.A. Travassos da Rosa, C. Nakauth, E. Salbe, J.F.S. Travassos da Rosa and J. P. Herve.)

Table 1. Mosquitoes captured in Boa Vista, Roraima Territory, Brazil, 30 April-5 May 1982.

Mosquitoes captured	Male	Female	Total
Aedes (Ochlerotatus)sp.	61	1	62
A. (O) fulvus	-	1	1
A. (O) hortator	-	5	5
A. (O) scapularis	-	133	133
A. (O) serratus	31	193	224
Aedes (Stegomyia) aegypti	978	500	1.478
Haemagogus (Haemagogus) Celeste	-	8	8
Psorophora (Janthinosoma) albipes	1	176	177
P.(J). ferox	26	32	58
Culex spp.	231	1.367	1.598
Culex (Culex) sp.	1.067	129	1.196
C. (C.) coronator	35	64	99
C. (C) declarator	-	19	19
C. (C.) pipiens quinquefasciatus	946	1.396	2.342
C. (Melanoconion) sp.	-	69	69
C. (M,)spissipes	-	1	1
C. (M.)taeniopus	-	6	6
Coquillettidia (Rhynchotaenia) sp.	-	1	1
C. (R.) venezuelensis	-	6	6
Mansonia (Mansonia) titillans	-	1	1
Limatus sp.	-	9	9
Trichoprosopon (Trichoprosopon) digitatum	-	1	1
Wyeomyia sp.	-	21	21
Uranotaenia (Uranotaenia) sp.	-	2	2
U. (U.) calosomata	-	2	2
Total	3.376	4.143	7.159

Table 2. Distribution of 13 isolations of dengue virus, by age and sex of the patients, Boa Vista, Roraima Territory, Brazil, 1982.

Age	Sex	Nº of isolations	Type	Total
0 - 4	-	-	-	-
5 -10	M	1	D - 4	2
	F	1	D - 1	
11 -20	M	3	D - 1	4
	F	1	D - 4	
21 -30	M	1	D - 4	2
	F	1	D - 1	
31 -40	M	-	-	2
	F	2	D - 1	
41 -50	M	2	D - 1	2
	F	-	-	
50+	M	-	-	1
	F	1	D - 4	
Total	M	7	9 D - 1	13
	F	6	4 D - 4	

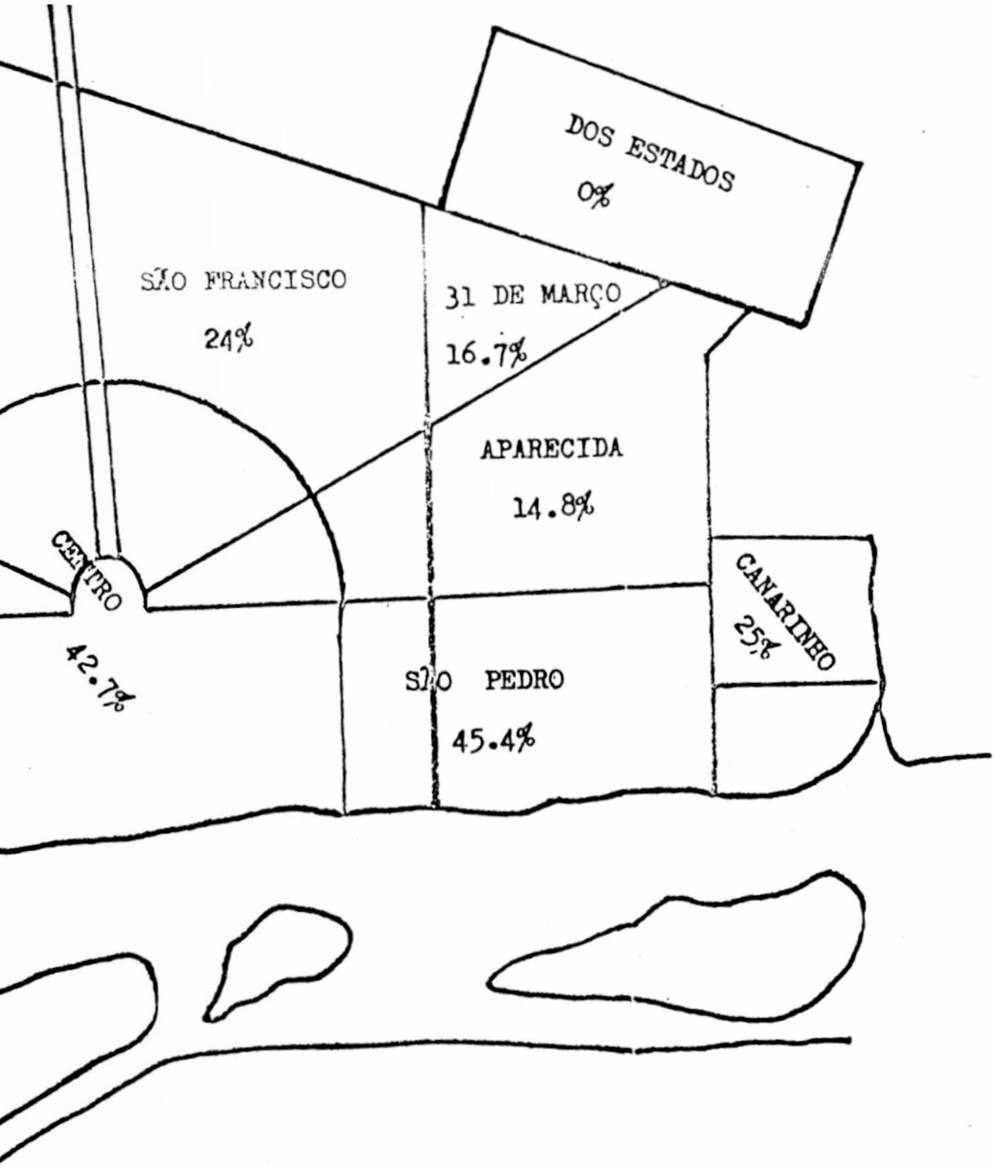
Table 3. List of 19 arbovirus antigens used in the hemagglutination-inhibition tests.

Serologic group	Type	Prototype
A	EEE	BE AN 7526
	Mucambo	BE AN 10967
	Mayaro	BE AR 20290
	WEE	BE AN 70100
B	Yellow Fever	BE H 111
	Yellow Fever	17 D (vaccine)
	Ilheus	BE H 7445
	St. Louis	BE AR 23379
	Rocio	SP H 34675
	Cacipacore	BE AN 327600
	Dengue-4	BE H 402276
	Dengue-1	N.I.H.
C	Caraparu	BE AN 3994
Bunyamwera	Guaroa	BE H 22063
	Xingu	BE H 388464
	Iaco	BE AR 314206
Simbu	Oropouche	BE AN 19991
	Utinga	BE AN 84785
Anopheles A	Tacaiuma	BE AN 73


MECEJANA
33.3%
SÃO VICENTE INDUSTRIAL
0%
SÃO VICENTE
13 DE SETEMBRO
0%
RIO BRANCO

Figure 1

PREVALENCE OF HI FLAVIVIRUS ANTIBODIES AMONG RESIDENTS FROM BOA VISTA, BRAZIL, ACCORDING TO DISTRICTS.
APRIL 29 - MAY 5, 1982



REPORT FROM SAN JUAN LABORATORIES, DVBVD, CID, CDC
SAN JUAN, PUERTO RICO 00936

Serotype specific monoclonal antibodies provide a simple and rapid method for identification of dengue viruses. To date, however, these monoclonal antibodies have been used primarily for experimental purposes and not for routine identification of newly isolated viruses from human serum. We have used them to identify dengue viruses of all 4 serotypes from the Caribbean, Asia and Africa, as a part of a routine virologic surveillance system in our laboratory.

Viruses were isolated by inoculation of the C6/36 clone of Aedes albopictus cells and the presence or absence of viral antigen was determined by the direct fluorescent antibody test (DFAT) using a conjugate prepared from high titered human sera. Virus identification was by the indirect fluorescent antibody test (IFAT) using serotype specific monoclonal antibodies and by complement fixation (CF) test using antigen prepared from infected mosquitoes.

The results of virus identification by monoclonal antibodies and by CF along with the geographic origin and the source of the isolate are presented by serotype in Tables 1 to 4. One hundred and twenty-four dengue 1 viruses from the Caribbean, Central and South America and Asia (Table 1), ten dengue 2 viruses from the Caribbean, Asia and Africa (Table 2), twenty dengue 3 viruses from the Caribbean and Asia (Table 3), and four hundred and seven dengue 4 viruses from the Caribbean and Asia (Table 4) were isolated in C6/36 cell cultures and identified by monoclonal antibodies. All but the three dengue 3 viruses from Thailand were primary isolations from human serum.

A blind comparison of the identification of eighty-nine isolates by the monoclonal antibody IFAT and the CF test showed 100% agreement. Some viruses grew slowly in the cell cultures, however, and even after 10 days incubation, only a few cells were infected. Early in these studies, this occasionally led to misidentification using the monoclonal antibody IFAT because cells in the periphery of the wells on which the conjugate had dried were mistakenly identified as positive. Once this was recognized as a source of error, however, cultures with low levels of cell infection were examined more carefully and those with uninterpretable results were passed for amplification of the virus. There was no problem in identification of viruses which had been passed for amplification.

This is the first extensive use of serotype specific monoclonal antibodies for routine identification of newly isolated dengue viruses. Our experience with 561 isloates from widely scattered geographic areas shows that the monoclonal antibody IFAT is reliable for dengue virus identification and that antigenic variation among strains of virus is not a major problem with monoclonal antibodies.

The use of mosquito cell lines for isolation and monoclonal antibodies for identification of dengue viruses form the basis for a new virologic surveillance system being developed in Puerto Rico. Acute sera from cases with dengue-like illness from all parts of the island are processed for virus isolation on a weekly basis. The ease with which large numbers of specimens can be handled and the sensitivity of the system allows us to monitor the

types of dengue viruses being transmitted and should allow us to detect, with only minimal delay, the introduction of new serotypes of dengue virus. This system should also be effective in detecting the introduction of other viruses such as yellow fever and may provide the predictive capability needed to prevent epidemic dengue.

(D.J.Gubler, G. Kuno, G.E. Sather, M. Velez, A. Oliver, I. Rios)

Table 1

Comparative identification of dengue 1 viruses
by monoclonal antibodies and by complement fixation

Country of Origin	Source	Passage History	Number Identified by Monoclonal Ab	Number Identified by CF*
Puerto Rico	Human serum	None	112	25
Mexico	Human serum	None	7	7
Venezuela	Human serum	None	1	1
Indonesia	Human serum	None	3	3
Sri Lanka	Human serum	None	1	1
Totals			124	37

Table 2

Comparative identification of dengue 2 viruses
by monoclonal antibodies and by complement fixation

Country of Origin	Source	Passage History	Number Identified by Monoclonal Ab	Number Identified by CF*
Puerto Rico	Human serum	None	3	3
Jamaica	Human serum	None	1	1
Indonesia	Human serum	None	3	3
Sri Lanka	Human serum	None	1	1
Upper Volta	Human serum	None	2	2
Totals			10	10

*All viruses identified by CF were also identified by monoclonal antibodies.

Table 3

Comparative identification of dengue 3 viruses
by monoclonal antibodies and by complement fixation

Country of Origin	Source	Passage History	Number Identified by Monoclonal Ab	Number Identified by CF*
Puerto Rico	Human serum	None	5	5
Indonesia	Human serum	None	6	6
Malaysia	Human serum	None	3	3
Thailand	Human serum	SMB-5, Tox-2	3	3
Sri Lanka	Human serum	None	3	3
Totals			20	20

Table 4

Comparative identification of dengue 4 viruses
by monoclonal antibodies and by complement fixation

Country of Origin	Source	Passage History	Number Identified by Monoclonal Ab	Number Identified by CF*
Puerto Rico	Human serum	None	406	21
Indonesia	Human serum	None	1	1
Totals			407	22

*All viruses identified by CF were also identified by monoclonal antibodies.

Report from the Department of Arboviruses, Tropical Medicine Institute "Pedro Kouri", Havana City, Cuba

Dengue 2 Virus Isolation in Fatal Cases of DHF/DSS in Cuba

A clinical-virological study was carried out in 13 children under 12 years of age who died during the Hemorrhagic Dengue Fever epidemic of 1981 in Cuba. These cases were clinically diagnosed as Hemorrhagic Dengue.

34 visceral samples (liver, spleen, lung, brain, ganglion) were inoculated in suckling mice for isolation. One viral isolation was obtained from a liver sample and identified as Dengue 2 by the indirect immunofluorescence technique using monoclonal antibodies.

The main signs and symptoms presented by these patients can be observed in Table I. As can be seen, fever, different types of bleeding, shock and thrombocytopenia occurred in all cases (100%).

Table II presents the different types of bleeding, with upper digestive tract bleeding the most frequently reported.

(Ma. G. Guzman, G. P. Kouri, L. Morier, M. Soler, S. Vazquez, and A. Fernandez)

Table I

MAIN SIGNS AND SYMPTOMS OBSERVED IN 13 FATAL CASES (CHILDREN)

# of case	1	2	3	4	5	6	7	8	9	10	11	12	13*	Total (%)
Fever	x	x	x	x	x	x	x	x	x	x	x	x	x	13 (100)
Headache	x	x	x	x			x	x						6 (46)
Asthenia	x	x	x	x	x		x				x			7 (53.8)
Anorexia		x					x				x			3 (23)
Rash									x		x			2 (15)
Hepatomegaly	x	x	x	x				x		x	x	x		8 (61.5)
Splenomegaly												x		1 (7.6)
Vomiting	x	x	x	x	x	x	x	x	x	x	x	x		12 (92)
Diarrhoea						x		x					x	3 (23)
Nausea	x		x			x								3 (23)
Cough	x			x									x	3 (23)
Abdominal pain	x	x	x	x			x	x				x		7 (53.8)
Ascites	x		x	x		x	x	x	x		x		x	9 (69)
Pleural Bruising	x			x			x	x			x	x		6 (46)
Retrorbital pain			x											1 (7.6)
Bleeding	x	x	x	x	x	x	x	x	x	x	x	x	x	13 (100)
Shock	x	x	x	x	x	x	x	x	x	x	x	x	x	13 (100)
Thrombocytopenia	x	x	x	x	x	x	x	x	x	x	x	x	x	13 (100)

% Number of cases/total deaths
* Isolation of Dengue 2 virus

Table II

HEMORRHAGIC MANIFESTATIONS OBSERVED IN 13 FATAL CASES (CHILDREN)

# of case	1	2	3	4	5	6	7	8	9	10	11	12	13	Total (%)
Petechiae				x	x	x	x					x	x	6 (46)
Melena									x					1 (7.6)
High digestive bleeding	x	x		x	x	x	x	x	x	x	x	x	x	12 (92)
Gingival bleeding	x		x										x	3 (23)
Nasal bleeding	x										x		x	3 (23)
Otic bleeding									x					1 (7.6)
Oral bleeding	x													1 (7.6)
Vesical bleeding				x				x						2 (15)
Venipuncture bleeding			x				x				x		x	4 (30.7)
Haematuria				x							x	x		3 (23)
Enterorrhage					x									1 (7.6)
Purpura					x				x			x		3 (23)

% Number of cases/total deaths
* Isolation of Dengue 2 virus

Study of Patients Clinically Diagnosed as Dengue Hemorrhagic Fever and Dengue Shock Syndrome

114 paired sera from hospitalized patients diagnosed as Hemorrhagic Dengue during the 1981 DHF epidemic in Cuba, were processed for IHA to detect antibodies to Dengue Virus.

103 cases (90%) were considered positive, 5 (5%) of which were classified as primary cases and 98 (95%) as secondary.

Table I presents the sex and race distribution of positive cases.

Of these, a higher frequency was observed in the female sex and white race.

Table II demonstrates the main signs and symptoms observed. Fever, different hemorrhagic manifestations, vomiting and headache were the most frequent.

Table III gives the different types of bleeding, with petechia as the most frequent. In the female population, 37.5% presented vaginal bleeding.

Of the 21 shock patients, 1 was serologically a primary infection. This was a 2 year old boy of the white race.

(Ma. G. Guzman, G. P. Kouri, J. Bravo, M. Soler, and S. Vazquez)

Table I

SEX AND RACE DISTRIBUTION OF PRIMARY AND SECONDARY CASES

	Total (%)	Primary (%)	Secondary (%)
Male	40/103 (39)	1/5 (20)	39/98 (40)
Female	63/103 (61)	4/5 (80)	59/98 (60)
White	80/113 (78)	3/5 (60)	77/98 (79)
Mulatto	19/103 (18)	1/5 (20)	18/98 (18)
Black	4/103 (4)	1/5 (20)	3/98 (3)

Number of cases/total (%)

Table II

FREQUENCY OF SIGNS AND SYMPTOMS IN PRIMARY AND SECONDARY CASES

Symptoms	P O S I T I V E C A S E S		
	Total (%)	Primary (%)	Secondary (%)
Headache	73/103 (70)	4/5 (80)	69/98 (70)
Adenopathy	13/103 (13)	2/5 (40)	11/98 (11)
Hepatomegaly	20/103 (19)	-/5 (0)	20/98 (20)
Splenomegaly	3/103 (3)	-/5 (0)	3/98 (3)
Mialgia	63/103 (61)	3/5 (60)	60/98 (61)
Fever	100/103 (97)	5/5 (100)	95/98 (97)
Rash	30/103 (29)	1/5 (20)	29/98 (30)
Vomiting	76/103 (74)	3/5 (60)	73/98 (74)
Diarrhoea	24/103 (23)	3/5 (60)	21/98 (21)
Bleeding	92/103 (89)	3/5 (60)	89/98 (91)

Number of cases/total (%)

Table III

FREQUENCY OF DIFFERENT BLEEDING MANIFESTATIONS IN PRIMARY AND SECONDARY CASES

Bleeding	P O S I T I V E C A S E S		
	Total (%)	Primary (%)	Secondary (%)
Echymosis	9/103 (9)	1/5 (20)	8/98 (8)
Enterorrhagia	7/103 (7)	1/5 (20)	6/98 (6)
Melaena	3/103 (3)	-/5 (0)	3/98 (3)
Petechiae	39/103 (38)	1/5 (20)	38/98 (39)
Haematemesis	31/103 (30)	1/5 (20)	30/98 (31)
Gum bleeding	7/103 (7)	1/5 (20)	6/98 (6)
Vaginal Bleeding	24/103 (23)	1/5 (20)	23/98 (23)
Nasal Bleeding	6/103 (6)	-/5 (0)	6/98 (6)
Oral Bleeding	1/103 (1)	-/5 (0)	1/98 (1)
Epistaxis	14/103 (14)	-/5 (0)	14/98 (14)
Haematuria	3/103 (3)	-/5 (0)	3/98 (3)

Number of cases/total (%)

REPORT FROM THE SPECIAL PATHOGENS BRANCH, VIROLOGY DIVISION,
CENTER FOR INFECTIOUS DISEASE, CENTERS FOR DISEASE CONTROL,
ATLANTA, GA. 30333, USA.

HUMAN SEROLOGIC EVIDENCE OF EPIDEMIC DENGUE VIRUS IN UPPER VOLTA, AND ISOLATION OF TWO STRAINS OF DENGUE 2 VIRUS .

During November 1982, 12 human cases of arboviruses with a dengue-like syndrome were observed in Ouagadougou (*). All of these persons were European and had lived in Upper Volta at least for several months. Each was bled during the acute phase of the illness and the blood sent to the CDC (Atlanta) for testing.

Two strains of Dengue 2 were isolated in Vero E6 cells after the first passage and identified with monoclonal antibodies (Table 1). All these sera were tested for immunofluorescent antibody (IFA) against Yellow Fever and Dengue 2 antigens. The Virus isolates and the presence of IgG and IgM antibody (Table 2) strongly suggest a recent epidemic of Dengue 2 virus.

(J.P. GONZALEZ, J.B.Mc CORMICK, D. DU SAUSSAY* and J.C. GAUTUN**)
*Centre Medico Social de la Mission de Cooperation Francaise, Ouagadougou.
**ORSTOM, Ouagadougou.

Table 1 Dengue 2 human strains from Upper Volta IFA test with monoclonal antibodies against the 4 Dengue Types

Lab Number	I.F.A.T.				
	D2*	D1**	D2**	D3**	D4**
0183	+	-	+	-	-
0184	+	-	+	-	-

*Monoclonal antibody against Dengue type2 (NIH)
**Monoclonal antibody against the 4 types of Dengue (T.P.MONATH, CDC, Fort Collins Col.).

Table 2 Human sera from Upper Volta testedagainstYellow Fever and Dengue antigens by IFA.

Lab Number	Yellow Fever*		Dengue 2**	
	IgG***	IgM***	IgG	IgM
0176	256	8	4096	16
0177	256	16	2048	-@
0178	256	-	-	16
0179	512	-	4096	8
0180	64	-	8192	64
0181	128	-	8	4
0182	64	-	512	-
0183	128	-	8	128
0184	8	-	16	-
0185	-	-	512	-
0186	-	-	8	-
0187	128	-	nt#	nt

*Yellow fever antigen.
**Dengue 2 antigen, strain 0183 from Upper Volta.
***Specific Conjugates anti IgG and anti IgM .
@ Negative.
# Non tested.

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

Arbovirus Surveillance in New Jersey, 1982

During the 1982 surveillance period, from May through November, 2797 mosquito pools containing up to 125 mosquitoes each, were tested for viruses in chicks. There were seventy-four (74) mosquito pools positive for Eastern equine encephalitis (EEE) and Western equine encephalitis was isolated from fifty-eight (58).

Table I summarized the collection area totals, species of mosquito and time of collection for the EEE isolates. Activity began with mid-July collections and continued into October. There were seventy-one (71) isolates from Culiseta melanura pools at seven (7) sites and three (3) from Aedes sollicitans pools at two (2) sites.

WEE mosquito activity is summarized in Table II. The July collections yielded the first isolates with continued observation of WEE activity into November. All the isolates were from Culiseta melanura pools at six (6) collection sites.

EEE isolates were also made in August from six (6) horses in Gloucester, Atlantic and Cape May Counties and in October from a pheasant flock in Ocean County.

Sentinel chicken flocks of ten (10) cockerals were placed at five (5) sites throughout the State in June. The flocks were bled bi-weekly on a rotating schedule through October and St. Louis encephalitis hemagglutination inhibition tests were conducted. There were no conversions observed in the 490 sera collected.

(David Kirsh, Bernard Taylor and Wayne Pizzuti)

TABLE I

1982

EE MOSQUITO POOL ISOLATES

AREA COLLECTED	MOSQUITO SPECIES	FOR WEEK ENDING														AREA TOTALS
		7/15	7/23	7/30	8/6	8/13	8/20	8/27	9/3	9/10	9/17	9/24	10/1	10/8	10/15	
Bass River	Cs.melanura						1	1								2
Burlington Co.	Cs. melanura				1									1		2
Burlington Co.	A. sollicitans					1										1
Cold Springs	Cs. melanura								1							1
Dennisville	Cs. melanura	1		1	1	11	1	3		1	4	1	3	1	1	29
Dennisville	A. sollicitans				1							1				2
Green Bank	Cs. melanura				1			1	2		1			2		7
New Gretna	Cs. melanura					1			4	1	1					7
Woodbine	Cs. melanura	1			2	9	4	1			2	1	1	2		23
Weekly Totals		2	0	1	6	22	6	6	7	2	8	3	4	6	1	74

TABLE II

1982
WE MOSQUITO POOL ISOLATES
FOR WEEK ENDING

AREA COLLECTED	MOSQUITO SPECIES	7/23	7/30	8/6	8/13	8/20	8/27	9/3	9/10	9/17	9/24	10/1	10/8	10/15	10/22	10/29	11/5	AREA TOTALS
Bass River	Cs. melanura			3	2	2	2		1	1								11
Burlington Co.	Cs.melanura		1	1		1												3
Dennisville	Cs.melanura		1	1	2	1				1		1	1					8
Green Bank	Cs.melanura		1	1			1		1	1	1					1	1	8
New Gretna	Cs.melanura			5	6	3	3	3	2									22
Woodbine	Cs.melanura	1		1		1		1	1	1								6
Weekly Totals		1	3	12	10	8	6	4	5	4	1	1	1	0	0	1	1	58

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

During the summer of 1982 sera from 327 patients with signs of central nervous system infection were tested for HI antibodies to EEE, WEE complex (McMillan and Highland J (HJ)), SLE, POW and two subtypes of the California (CAL) serogroup: La Crosse (LAC) and Jamestown Canyon (JC). In addition, all sera were screened for neutralizing antibody to LAC and JC viruses. Diagnostic findings for the CAL serogroup were obtained in 26 patients and their sera were further studied in an attempt to subtype and to detect specific IgM (Table 1).

Table 1

Results of Assay for Antibody to California Serogroup Viruses on Sera from 327 Patients with Signs of Central Nervous System Infection, New York State 1982

Diagnostic Category	Case				Subtyping by SDPRN Test*
Confirmed i.e. ≥4-fold rise by HI and/or SDPRN and specific IgM	3 cases:				
	Age	Sex	Onset	County	
	3 yrs	F	7.20	Rensselaer	LAC
	2 mos	M	8.1	Rensselaer	LAC
	24 yrs	M	7.15	Westchester	JC
Presumptive i.e. HI ≥10 and NI ≥3.0					
a. With specific IgM	8 cases				8 cases: JC
b. No specific IgM detected	9 cases				8 cases: JC 1 case: not determined
c: QNS for specific IgM	6 cases				3 cases: JC 2 cases: not determined 1 case: QNS
Infection at undetermined time i.e. HI 10 and NI 2.0 to <3.0 or HI <10 and NI >2.0	7 cases				4 cases: not determined 3 cases: QNS
No evidence of past or current infection i.e. negative in HI and neutralization tests	294 cases				

Key: SDPRN: serum dilution plaque reduction neutralization; HI: hemagglutination inhibition; QNS: quantity not sufficient.

*A subtype is indicated by a SDPRN titer of ≥40 which in cases with multiple reactions is at least 4-fold higher than the titer to any of the other test viruses: snowshoe hare, keystone, trivittatus. Cases not meeting these criteria are listed as "not determined".

Neutralizing Antibody to Jamestown Canyon Virus in White-tailed Deer

Sera collected from 81 deer on Howland Island, Cayuga County in 1980 were tested by serum dilution plaque reduction neutralization for antibody to JC and LAC viruses (Table 2):

No. Animals	Age	Antibody to Jamestown Canyon Titer Rate	Range	(Mean)	Antibody to La Crosse Titer Rate	Range	(Mean)
34	≥1 yr 5 mos	93%	10-1280	(78)	54%	2-640	(7.8)
47	5-6 mos	54%	2-320	(7.5)	4%	2	(2)

None of the deer sera reacted monotypically for LAC; with the exception of one deer which had a high LAC titer of 640 (JC 1280); in the other deer the low LAC titers in the presence of usually 8-16 fold higher JC titers reflect probably a slight antigenic relationship between these two subtypes of the California serogroup.

The data implicate white-tailed deer as an amplifying host for JC virus in New York State.

On the initiative of the Bureau of Disease Control, 1411 pools of mosquitoes, collected in 4 regions (Albany, Syracuse, Buffalo and White Plains) and plasma from 427 birds trapped in the Syracuse region, where previous EEE outbreaks had occurred, were submitted for laboratory studies. Virus isolation attempts on all mosquito pools and 175 bird plasmas were performed in Vero cell cultures. Seven isolates of CAL serogroup were obtained from 155 pools of Aedes communis mosquitoes (Albany region: 5 isolates; Buffalo region: 2 isolates); five of the 7 isolates were identified by CF as JC virus. In addition, isolates of WEE complex were obtained from 5 of 255 pools of Culiseta melanura mosquitoes and from 8 of 175 bird plasmas tested; in HI tests all isolates resembled the HJ virus (Table 3).

Table 3

Isolation Attempts on Wild-Caught Mosquitoes and Avian Specimens

	No. Tested		No. Isolates
	Pools	Specimens	
Mosquitoes:			
Aedes communis	155	17519	7 CAL serogroup (JC: 5; not determined: 2)
Other *Aedes* sp.	619	40136	0
Culiseta melanura	255	18497	5 WEE complex (HJ: 5)
Other species	382	22226	0
Subtotal	1411	98378	
Birds:			
Morning dove		1	1 WEE complex (HJ)
Solitary vireo		1	1 WEE complex (HJ)
Rufous-sided towhee		7	1 WEE complex (HJ)
White-throated sparrow		25	3 WEE complex (HJ)
Swanson's thrush		12	1 WEE complex (HJ)
Gray catbird		50	1 WEE complex (HJ)
Others (38 species)		79	0
Subtotal		175	

Plasma from the 427 birds were tested by HI for antibody to EEE, WEE complex (McMillan and HJ) and SLE viruses. Thirty-two birds of 14 species had antibody to the WEE complex test viruses; twenty-nine of the 32 plasmas reacted with both strains and the remaining 3 only with the HJ strain (titers 20, 40 and 80). In support of the virus isolations, HJ virus was implicated as the infecting agent by the higher antibody titers: HJ range 20 to 5120; mean 560; McMillan 10-1280, mean 160.

Only 6 birds of 4 species had HI antibody to EEE and none of the plasmas reacted with SLE antigen.

(Sunthorn Srihongse, Margaret A. Grayson and Rudolf Deibel)

Report from the Rabies-Arbovirus Unit, Bureau of Laboratories, Texas Department of Health, Austin, Texas

Summary of arbovirus surveillance, September 1982 to February 1983

Approximately 2,085 mosquito pools were tested during this period (Sept., 1982-Feb., 1983) representing approximately 267 litters of mice inoculated. Three isolates were recovered:

SLE	Leon County
WEE	Amarillo (Playa Lake)
Hart Park	El Paso (City)

Of 1,297 avian serologies tested, 44 were positive for WEE from the Dallas and Lubbock areas.

Although minimal arboviral activity was noted, surveillance will be continued through the 1983 period at the same or at increased levels.

(Ronald W. Johns)

REPORT FROM THE VIRAL AND RICKETTSIAL DISEASE LABORATORY, STATE OF CALIFORNIA, DEPARTMENT OF HEALTH SERVICES, BERKELEY, CA 94704

SELECTION OF SEED VIRUS FOR THE PREPARATION OF NON-NEUROADAPTED STRAINS OF ST. LOUIS ENCEPHALITIS (SLE) AND WESTERN EQUINE ENCEPHALOMYELITIS (WE) VIRUS

The discovery of a method for the production of monoclonal antibodies and the role of individual lymphocytes in the production of specific antibodies will result in profound changes in the production of viral vaccines and the choice of standard viruses to be used for diagnostic work. It would be appropriate for the AVIE to appoint a committee to recommend which seed viruses should be used for the production of monoclonal antibodies. We are aware of the phenotypic variation that occurs when a virus is subpassaged in different hosts using various routes of inoculation and in cell cultures maintained at different temperatures. One can expect hybridization with other viruses which may be present in the cell culture system or in the animals used for maintaining the virus. Certain characteristics derived from the host systems may be incorporated into the virus. Factors such as these evidently operate in nature and are responsible for the variation observed in strains of the common arboviruses. It is preferable to have a seed virus available for general distribution so that each laboratory can make up a large stock of passage one from this seed virus. Passage one from this stock can be used for identification and classification of other strains of the same virus.

Poliomyelitis virus and rabies virus once were regarded as strictly neurotropic viruses because i.c. passage of these viruses had selected for tropism for the nervous system. However, the heterogeneity of the virus was maintained to some extent because the viruses could be cultivated in non-nervous tissue in cell culture systems. Arthropod-borne viruses such as WE virus and SLE virus, isolated and maintained by i.c. passage in laboratory animals showed the same neurotropic characteristic, that is, one could not demonstrate significant pathological change or viral multiplication in non-nervous tissue obtained from the experimentally infected animals. Acid and bile resistant enteroviruses such as poliomyelitis virus have a marked tropism for the mucosal cells of the intestine but they may be found also in non-nervous tissue such as the kidney if the animals are inoculated with a non-neuroadapted strain of the virus. Rabies virus derived from naturally infected dogs has a special tropism for the salivary glands, the virus in the saliva having been selected phenotypically so that it would be transmitted by biting and be able to invade the brain and produce a form of insanity, that increases the natural tendency to bite. This seems to be the ultimate type of variant that could succeed in maintaining the infection in a species that exhibits such a high mortality. Rabies virus is found in the kidney and pancreas of naturally infected dogs but the frequency of involvement of these organs is low and there is little virus in them. Rabies virus isolated from skunks has a greater tropism for non-nervous tissue. It is found in muscle, kidneys, lungs, pancreas, mammary glands and salivary glands. The titer of the virus in the salivary glands may be greater than 10^{-6}. Some virus strains found in skunk salivary glands have little pathogenicity for

adult mice and only the 10^{-1} dilution of the tissue will produce illness in the adult mice inoculated by the i.c. route. The mice that sicken from such strains of rabies virus usually recover. When killed during the onset of symptoms they show a moderate amount of rabies virus antigen. When killed at one and two months after the symptomatic infection, viral antigen usually is demonstrable by the FRA test, but infectious virus cannot be isolated by subpassage. The adult mice that received more than 100 infant mouse LD_{50} are immune when challenged with virulent rabies virus. Tadarida bats that now are involved in the epizootic of bat rabies in Western United States maintain a variety of rabies virus that had a unique tropism for the lungs. This furnishes an explanation for the occurrence of non-bite transmission of this virus in foxes exposed in a cave harboring infected bats and in foxes held under laboratory conditions.

The significance of viscerotropism of arthropod-borne viruses was recognized during the early studies of yellow fever. The Asibi strain of yellow fever was isolated and maintained by s.c. inoculation in rhesus monkeys, using infected blood as the source of the virus. In the natural disease the pathology produced by the virus in the liver is responsible for the symptom of jaundice associated with the name of the virus. It is the pathology produced by the virus in the kidneys that is a major cause of death in this disease.

Birds naturally infected with WE virus are apt to show gross changes in the pancreas such as edema and discoloration. Microscopic examination confirms the gross evidence of pathology produced by the virus. The titer of the virus in this organ may be more than 10^{-4}. The clinical symptom of upper abdominal pain observed in young children infected with WE virus indicates involvement of the pancreas. Mother mice, infected with WE virus from eating their young that die following inoculation with field specimens, sometimes sicken and die. The brain usually is found infected under such circumstances, but virus may be found only in the pancreas or kidneys, indicating that the infection of such organs was the prime cause of death. Viremia is demonstrable in nearly all the mother mice that eat the infected young. This can be demonstrated by bleeding the mother mice 48 hours after they have been observed eating the infected infant mice. The viremic mother mice, when held for 10 days and then tested, usually have virus in the mammary glands as well as in organs such as the brain, lungs, kidneys and pancreas.

Viruses as they occur in nature are heterogeneous and the route of transmission determines which population of virions will be most successful in growing in the brain. Modoc virus as it exists in the lung, kidney, or mammary glands of Peromyscus maniculatus mice exhibits little pathogenicity for infant or adult mice. In primary passage in infant mice inoculated by the i.c. route, the mice show minor illness at about 6-10 days after inoculation. If they are not killed at that time they usually recover. Impression preparations of the brain taken during the first day of symptoms and stained with Giemsa stain will show small foci of neuroglial degeneration, infiltrated with polymorphonuclear white blood cells. On subpassage by the i.c. route the virus will kill both infant and adult mice into the 10^{-8} dilution. One can imagine the difference in the population of virions after i.c. passage compared to that of the natural virus.

When we select standard strains of viruses in this laboratory we try to develop non-neuroadapted strains by reisolation of the virus by i.m. inoculation and passage of infected blood. In the studies of WE virus and SLE virus we established non-neuroadapted strains by reisolation in chicken embryos inoculated via the yolk sac. High passage strains of these viruses using the embryo body without the spine and head were still pathogenic for adult mice. A second passage line of SLE virus, using the yolk sac for passage instead of the embryo, resulted in a decrease in pathogenicity for mice after 34 passages. By passage 47 the virus was not pathogenic for adult mice when inoculated by the i.c. route. Table I shows the titration of this virus in adult mice and the results of subsequent challenge one month later with virulent SLE virus given by the same route. The challenge virus was a 10^{-2} dilution of a non-neuroadapted strain of SLE virus, isolated and maintained in hamster kidney cell culture. Six control mice of the same age were inoculated with this dilution of the challenge virus. The challenge virus was titrated in infant mice after the vaccinated and control mice had been inoculated. It will be noted that the mice that had received the 10^{-1} through 10^{-3} dilutions of the vaccine virus remained well and there was some evidence of immunity in the mice given the 10^{-5} dilution. One cloning was done at the CE47 passage, i.e. CECC1 and CECC2. This strain is referred to as Sutter Mosquito Pool MP34 of 8/5/57 CE47-CECC2-CE1.

We have a non-neuroadapted strain of WE virus of low pathogenicity which was obtained by cloning in chicken embryo cells. This study has been published. The strain is referred to as Kern B628 sparrow of 7/29/57 HKCC4-CECC31 (15 clonings for low pathogenicity) CE2-CECC2. This strain is not pathogenic for horses or rhesus monkeys when inoculated by the i.c. route. A total of 1600 horses were vaccinated with a live virus vaccine prepared from this stock virus and there was no illness attributable to the vaccine virus. It has not been licensed for immunization of horses.

These are the seed viruses of non-neuroadapted strains of WE virus and SLE virus we have selected for use as standard test viruses in cross immunity tests such as the one described in Table I. They are available for use as antigens for serological tests and for use as live virus vaccines for classification of WE virus and SLE virus strains, isolated in different geographic regions and from different species of animals and birds.

(Harald N. Johnson, M.D.)

ARBOVIRUS SURVEILLANCE IN CALIFORNIA DURING 1982

During 1982, there were approximately 200 patients suspected of having encephalitis who were tested for western equine encephalomyelitis (WEE) and St. Louis encephalitis (SLE) at the California Department of Health Services' Viral and Rickettsial Disease Laboratory (VRDL) or at one of the six county public health laboratories which provide this testing service. In addition to the serologic survey, 13 human brain samples were tested for arboviruses by inoculation into suckling mice.

One case of WEE was detected during the year: a 14 year old boy from San Bernardino County who became ill July 21 while in Florida. He was hospitalized July 23 in Ft. Lauderdale, then was transferred to San Bernardino County in late August. Tests by the San Bernardino County public health laboratory and the State VRDL confirmed rising WEE antibody titers as follows: CF - <1:8 - 1:16 - 1:32; IFA - <1:8 - 1:2048 - ≥ 1:8192; and IFA/IgM - <1:8 - ≥ 1:8192 - 1:128. The boy had traveled extensively in the month prior to onset of illness: the Colorado River near Parker, Arizona; Ft. Worth, Texas; back to Big River, San Bernardino County on the California side of the Colorado River opposite Parker, Arizona; then to Miami and Ft. Lauderdale, Florida, where he became ill. It cannot be stated with certainty where infection was acquired, but the Colorado River area is probably the more likely site.

There were 28 clinically suspect equine cases of WEE, from 15 counties, which were tested serologically during the year. In addition, 12 equine brain samples were tested in suckling mice. Four cases were determined to be due to WEE, 3 from California, and 1 from Arizona. The CF and IFA methods were utilized to demonstrate antibody titer rises.

Research continues in the VRDL to try to develop an indirect FA test for WEE IgM antibody in equines which would help distinguish between current and past infections, analogous to its utility for diagnosing current human cases of various viral diseases.

The mosquito surveillance program and sentinel chicken flock program were again possible during 1982, due to the assistance of the University of California School of Public Health, Arbovirus Research Unit. There were 122,498 mosquitoes in 2,592 pools collected from 24 California counties and 1 Arizona county which were tested for virus. Sampling was concentrated on Culex tarsalis, Culex pipiens complex, and Aedes melanimon, which made up 98% of the pools. There were 477 viral isolates from the mosquito pools: 227 WEE, 109 Hart Park, 125 Turlock, and 16 California encephalitis group. The low level of SLE virus activity, as reflected in failure to isolate any SLE viruses, was also shown by the low seroconversion rate in sentinel chickens.

Sentinel chicken flocks were located at 25 sites in the state. Seroconversions for WEE antibody (IFA technique) were detected in 11 flocks, with high seroconversion rates concentrated in the southern half of the state. Only 3/24 (13%) of chickens in 1 flock in Imperial County seroconverted to SLE.

Individual reports of surveillance findings were made promptly by telephone, and a weekly surveillance bulletin (25 issues) was mailed to program participants. In addition, summaries of mosquito surveillance results tabulated according to Mosquito Abatement District boundaries were prepared weekly by the California Department of Health Services' Center for Health Statistics and were distributed to those participating groups.

(Richard W. Emmons, M.D., Ph.D.)

TABLE I

ANTIGEN-EXTINCTION TEST-SUTTER MP34-CE47 SLE Virus

Challenge Virus Dilution	Adult Mouse Vaccinated i.c. Mortality	Challenge Virus 10,000 LD_{50} i.c.	Infant Mouse Titer of challenge virus
-1	1/6	0/5	8/8
-2	0/6	0/6	8/8
-3	0/6	0/6	8/8
-4	0/5	1/5	8/8
-5	0/6	4/6	5/8
-6	0/5	5/5	1/8
-7	0/5	5/5	1/8
Adult control mice		6/6	

Note: Challenge Virus - Non-neuroadapted SLE Virus isolated from mosquitos and maintained in Hamster kidney Cell Culture. (H6608 C.tar. HKCC3)

REPORT FROM THE DIVISION OF MEDICAL MICROBIOLOGY

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Between 2 June and 27 July 1982, snowshoe hare (SSH) virus was isolated from 5 of 6,986 unengorged adult female mosquitoes within 4 species which were collected at roadside locations within the boreal forest of the Yukon Territory, Canada, between latitudes 61° and 67°N. Virus isolations were achieved at the following locations thus: 1 of 21 Aedes hexodontus at Marsh Lake (61°N, 134°W) on 27 June, 2 of 99 Ae. nigripes near Kusawa Lake (61°N, 136°W) plus 1 of 26 Ae. nigripes at Haines Junction (61°N, 137°W) on 8 July, 1 of 22 Ae. communis near Kusawa Lake on 12 July. In plaque reduction neutralization tests, all 5 isolates from 1982, together with representative mosquito isolates from 8 of 10 years from 1972 through 1981, showed no appreciable antigenic difference from 1974 and 1976 Yukon topotypes of SSH virus.

(D.M. McLean)

REPORT FROM THE NATIONAL ARBOVIRUS REFERENCE SERVICE

DEPARTMENT OF MEDICAL MICROBIOLOGY

UNIVERSITY OF TORONTO,

TORONTO, ONTARIO, CANADA.

Multiple California Group Virus Activity in Southern Ontario

Previous studies have resulted in the identification of a focus of California, CAL, group virus activity in Dunnville, Ontario. A study site was identified in 1979, in which six sentinel rabbit conversions were noted and seven CAL group isolates were obtained from mosquito pools.

Neutralization tests on CAL positive sentinel rabbit sera indicated that the rabbits had been infected with snowshoe hare, SSH, virus. Isolates from mosquitoes were identified as CAL group viruses by complement fixation tests against arbovirus grouping ascitic fluids supplied by NIH. No specific typing of the isolates was undertaken at the time.

Studies were resumed in 1981, with sentinel rabbits placed in varying terrain (forest, scrub vegetation and open lawn) within a three-quarter mile radius of the 1979 study site. In addition, mosquito collections were made at all sentinel rabbit sites. Recurrent CAL group virus activity was demonstrated in 1981 with activity at all study sites including seven rabbit conversions and one CAL group isolate from a mosquito pool. Neutralization tests indicated that six rabbits converted to SSH and one rabbit converted to trivittatus, TVT, virus.

Neutralization typing was undertaken of CAL group isolates obtained from mosquitoes in 1979 and 1981. Typing was done by tissue culture infective dose 50 (TCID50) in vero cells using mouse ascitic fluid prepared against SSH, TVT, LaCrosse, LAC, and Jamestown Canyon, JC, viruses. Mouse ascitic fluids were prepared to JC and TVT by hyperimmunization of mice whereas SSH and LAC ascitic fluids were prepared by a single shot immunization of mice followed by tapping 17 days post infection.

Results of neutralization typing are presented in Table 1. It may be seen that three of the isolates were SSH while three others were JC virus. Two of the 1979 CAL group isolates were lost on storage and could not be typed. As shown in Table 2, two SSH isolates were obtained from pools of *Aedes canadensis* and one SSH isolate from a pool of *Ae. stimulans-fitchii*. All three JC isolates were from pools of *Ae. stimulans-fitchii*.

This study provides the first clear documentation of JC virus in Ontario and complements the diagnosis of a clinical case of California encephalitis in Ontario in 1981 due likely to the JC serotype (1). In addition it identifies a site in which two CAL group serotypes, SSH and JC,have been active over a period of at least two years and at which a third serotype, TVT, appears also to be circulating. This provides a setting for the potential generation of CAL group re-assortants under natural conditions.

Reference

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(H. Artsob, L. Spence, C. Th'ng and V. Lampotang, National Arbovirus Reference service, Toronto in collaboration with G.A. Surgeoner and J. McCreadie, University of Guelph).

Table 1. Neutralization Typing of California Group Isolates from Dunnville

Isolate Typed	ANTIBODY TITER				Probable Serotype
	Snowshoe hare	LaCrosse	Jamestown Canyon	Trivittatus	
Snowshoe hare	320[1]	40	20	< 20	
LaCrosse	40	640	40	< 20	
Jamestown Canyon	< 20	< 20	160	< 20	
Trivittatus	< 20	< 20	< 20	160	
9-178	< 20	< 20	80	< 20	Jamestown Canyon
9-180	320	40	40	< 20	Snowshoe hare
9-192	640	40	40	< 20	Snowshoe hare
9-237	< 20	< 20	320	< 20	Jamestown Canyon
9-312	160	20	40	< 20	Snowshoe hare
1-237-81	< 20	< 20	80	< 20	Jamestown Canyon

[1] Reciprocal of antibody dilution that neutralized 100 TCID50 of virus.

Table 2. California Group Isolates from Dunnville, 1979-81

Isolate Number	Date Collected	Mosquito Species	Serotype Isolated
9-178	July 4, 1979	Ae. stimulans-fitchii	Jamestown Canyon
9-180	July 4, 1979	Ae. canadensis	Snowshoe hare
9-192	July 4, 1979	Ae. canadensis	Snowshoe hare
9-237	July 17, 1979	Ae. stimulans-fitchii	Jamestown Canyon
9-252	July 17, 1979	Ae. stimulans-fitchii	California group-untyped
9-254	July 17, 1979	Ae. canadensis	California group-untyped
9-312	July 31, 1979	Ae. stimulans-fitchii	Snowshoe hare
1-237-81	June 16, 1981	Ae. stimulans-fitchii	Jamestown Canyon

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

Epizootic of Equine Encephalitis in Argentina

An epizootic of equine encephalitis in Santa Fe Province resulted in more than 100 reported clinical cases during October, November, and December, 1982. Intensive investigations were carried out during December. Samples of horse sera, horse brains, wild bird sera, domestic bird sera, human sera, and mosquitoes were collected from farms and ranches where horse cases were occurring. Some samples are being processed at the CDC laboratory in Fort Collins and others at the Virology Institute Laboratory at the University of Cordoba. Dra. Marta Sabattini has shown specific fourfold or greater rises in HI antibody to WEE virus (CBA-87 and AG80-646) in more than 20 pairs of sera from clinically ill horses from which appropriate acute and convalescent sera were obtained. The prevalence of HI antibodies in human, horse, and domestic fowl sera tested in Fort Collins is shown in Table 1. The data indicate that the WEE antigen from Argentina (AG80-646, isolated from Culex (Melanoconion) mosquitoes in Chaco Province during 1980) is more sensitive than the WEE Fleming antigen in detecting antibody. A one-way antigenic difference between AG80-646 and WEE Fleming has been found in N tests (see DVBVD 1980 Annual Report). The low prevalence of alphavirus HI antibodies in domestic fowl from premises where serologically confirmed cases of WEE in horses were occurring is somewhat surprising in view of the results from similar studies in temperate North America.

Virus has not been isolated from specimens collected during the present outbreak and tested thus far. Specimens tested for virus include 7 horse brains and sera from 450 wild birds principally in he families Columbidae, Tyrannidae, Furnariidae, Fringillidae, and Ploecidae. Approximately 100,000 mosquitoes remain to be tested.

Carl J. Mitchell and Thomas P. Monath, Division of Vector-Borne Viral Diseases, Fort Collins, Colorado; Marta S. Sabattini and Jose F. Daffner, Institute of Virology, Faculty of Medical Sciences, National University of Cordoba; and Anna Maria Briggiler and Cristina Ceccoli, National Institute for Studies on Haemorrhagic Viruses, Pergamino.

Prevalence of HI Antibodies in Humans, Horses, and Domestic Fowl from Santa Fe Province, Argentina, Oct.-Dec. 1982

Antigen	Humans		Horses		Domestic Fowl	
	No. Pos./ No. Tested	% Pos.	No. Pos./ No. Tested	% Pos.	No. Pos. No. Tested	% Pos.
EEE (NJO)	0/49	0	6/46	13.0	7/151	4.6
WEE (Flem.)	0/49	0	9/46	19.6	1/151	0.7
WEE (AG80-646)	1/49	2.0	11/46	23.9	7/151	4.6
VEE (Trinidad)	5/49	10.2	10/46	21.7	6/151	4.0
SLE (TBH-28)	21/49	42.9	31/46	67.4	4/150	2.7

NOTE: Mammal sera were tested at a 1:10 dilution and bird sera were tested at 1:20.

Isolation of Vesicular Stomatitis Virus-New Jersey from insects collected in Colorado during an epizootic, 1982.

The New Jersey serotype of Vesicular Stomatitis virus (VSV-NJ) was responsible for a large epizootic in Colorado during 1982. The epizootic was first detected in the southern part of the state near Durango, became apparent on the western slope of the Rockies and eventually materialized along the front range, from Pueblo north to the Wyoming border. Both dairy cattle and horses were affected. Extensive epidemiological investigations were conducted during the epizootic. As a part of these investigations, a large number of arthropods representing a number of orders and families were collected and processed for virus isolation.

Collection procedures were varied and included use of CDC light traps supplemented with CO_2, sweep net collections, malaise traps and aspiration of insects from animals, primarily horses. Processing of such a broad array of insects was stimulated by the lack of definitive information on the mode of spread of VSV-NJ. Insect-borne transmission has long been mentioned as a likely mechanism for virus dispersal and infection of vertebrates. Support for incrimination of insects as vectors comes from observations that outbreaks usually occur in late summer, are terminated by killing frosts and the fact that affected premises frequently are somewhat randomly scattered (Hanson, 1952). It has also been observed that outbreaks tend to occur in river valleys, suggesting the involvement of insects such as black flies. There are only four previous records of VSV-NJ isolations from insects (one isolate from each of the following: Hippelates pusio (USA); Simulium sp. (Colombia); Mansonia indubitans (Ecuador); and Culex nigripalpus (Guatemala)).

The insects tested in 1982 and isolations of VSV-NJ are summarized in Table 1. There were 6 orders represented, 32 families, and a total of 93,205 specimens. Slightly over one-fifth of the specimens tested were mosquitoes with no isolations of VSV, although a number of arbovirus strains were recovered from mosquitoes (Table 2). VSV-NJ was most frequently recovered from house flies. The flies were primarily collected using sweep nets around barn walls and feed bunkers during an epizootic in horses; some flies were aspirated directly from affected horses. There were seven additional VSV-NJ strains recovered from non-blood-sucking flies with habits similar to house flies. The only isolations from hematophagous dipterans were the two strains recovered from black fly pools. The two isolations came from small pools of unengorged flies collected in light traps. One of the black fly pools contained a relatively large amount of virus on primary isolations, suggesting virus multiplication. Additional unidentified isolations were made including an isolate from a pool of Lygacidae (Hemiptera), although none are VSV.

Pooled insects were tested by inoculation of suspensions onto monolayer cultures of primary duck embryo (DE) and Vero cells and into tube cultures of Aedes albopictus (C6/36) cells. The DE and Vero cells were overlaid with an agar containing neutral red, and flasks were observed daily for plaques. The

Ae. albopictus cell cultures were incubated at 28°C for three days, harvested by a single freeze-thaw cycle, and the suspension then inoculated onto DE and Vero cell cultures. The relative sensitivities of the cell culture systems for recovery of VSV from field specimens are summarized in Table 3. Approximately 60% of the VSV-NJ strains were recovered only by means of the amplifying passage in C6/36 cell cultures.

Relatively small amounts of virus were usually recovered on primary isolation from the non-hematophagous flies. This suggests that these insects were externally contaminated with virus and may have been involved in mechanical transmission of virus from clinical VS cases to susceptible animals. As mentioned earlier, a relatively large amount of virus recovered from one of the black fly pools on primary isolation suggests the possibility that black flies may serve as biological vectors of VSV-NJ. The vector status of the various insects from which VSV was isolated remains to be resolved through laboratory studies.

D.B. Francy, C.G. Moore, G.C. Smith, D. Inglish, and W.L. Jakob

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Table 1. Arthropods tested for viruses during the Vesicular Stomatitis virus epizootic, Colorado, 1982.

Order	Family	Genus/Species	Common Name	No. Tested	(Pools)	VSV-NJ Isolations	MIR/1,000
DIPTERA	Psychodidae		sand flies, etc.	27,905	(58)		
	Ceratopogonidae	Culicoides	midges	21,533	(127)		
	Simuliidae		black flies	1,356	(70)	2	1.5
	Culicidae	Aedes	mosquitoes	14,652	(350)		
		Anopheles		110	(11)		
		Culex		5,040	(129)		
		Culiseta		794	(59)		
	Chloropidae	Hippelates	eye gnats	64	(12)	1	15.6
	Anthomyiidae		anthomyid flies	926	(54)	4	4.3
	Muscidae	Musca domestica	house flies	6,833	(185)	25	3.7
		M. autumnalis	face flies	10	(3)	2	200
		Other spp.		2,081	(131)		
	Other (12 families)			3,921	(134)		
HEMIPTERA	(5 families)			749	(90)		
HOMOPTERA	Cicadellidae		leaf hoppers	4,970	(86)		
	Aphidae		aphids	2,000	(32)		
	Delphacidae		plant hoppers	172	(8)		
	Other (4 families)			27	(13)		
HYMENOPTERA			bees, wasps	25	(9)		
COLEOPTERA	Meloidae		blister beetles	33	(11)		
ORTHOPTERA			grasshoppers	4	(1)		
TOTALS				93,205	(1,573)	34	

Table 2. Viruses isolated from mosquitoes during Vesicular Stomatitis field investigations in Colorado, 1982.

Species	No. tested	No. strains isolated			
		WEE	TUR	HP	Unid.
Culex tarsalis	3,866	4[a)]	4	8	2
Aedes vexans	7,179			1	1
Culex p. pipiens	1,159		1	2	

a)Three strains from Boulder County and one strain from Adams County.

Table 3. Laboratory isolation pattern for VSV strains.

Primary isolation in:	No. strains	% total
Primary DE only	1	2.9
Vero CC only	-	-
Ae. albopictus (C6/36) only	20	58.8
DE + Vero	-	-
DE + C6/36	3	8.8
Vero + C6/36	-	-
All three	10/34	29.4

Summary of Human Arboviral Encephalitis - 1982 - United States

Table 1 shows the numbers and geographic distribution of reported human arboviral encephalitis in 1982. A total of 174 cases were reported, and California encephalitis (CE) cases (123) accounted for 71% of the total. The state of Ohio had the most cases of CE with a total reported of 37 to date, followed by Wisconsin with 24 cases. Cases were concentrated in the eastern half of the United States with the majority occurring in states around the Great Lakes. A further interesting development during the year was the confirmation by the New York State Laboratories that Jamestown Canyon (JC) virus was the etiologic agent producing encephalitis in a generally elderly population. JC virus is a member of the CE virus complex.

The second most important etiologic agent for arboviral encephalitis in 1982 was St. Louis encephalitis (SLE) virus which caused 33 cases (18%). The majority of SLE cases were reported from Texas (14 cases), Mississippi (7) and Louisiana (4). The remaining cases were in Illinois and the southeastern U.S. At least 2 cases were fatal and possibly more since information on clinical outcome was not provided for 8 cases.

Eastern equine encephalitis (EEE) was reported in 12 patients from 5 states. The largest number of cases (4) occurred in Georgia, and the cases were concentrated in the southern part of the state. Two of the 12 cases (17%) were reported to be fatal - 1 in Florida and 1 in Georgia.

Eight human cases of western equine encephalitis were reported during 1982. All of the cases occurred in the western United States. The largest number of cases (4) occurred in Texas. No fatalities due to WEE were reported during 1982.

The temporal distribution of human encephalitis cases in 1982 is shown in Table 2 for those cases for which an onset date was provided. The majority of cases (86%) had onsets from July through September and no cases with onsets after October have been reported. These data are consistent with the periods where peak vector density would be expected to occur. The age and sex distribution of reported U.S. cases of encephalitis by etiologic agent is typical of previous years with SLE and EEE cases occurring in the young and elderly age groups and CE cases mainly affecting the younger age groups (Table 3). Reported cases of human encephalitis since 1955 are detailed in Table 4.

A major epizootic of EEE involving horses, pheasants and quail occurred on the East and Gulf coasts of the U.S. during the summer months. Reported WEE cases in equines in the west were sporadic whereas the epizootic of EEE in the East involved hundreds of horses.

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Table 1. Geographical Distribution and Number of Reported Cumulative Cases of Human Arboviral Encephalitis by viral Type - 1982.

State	Cum. SLE	Fatal Cases	Cum. WEE	Fatal Cases	Cum. EEE	Fatal Cases	Cum. CE	Fatal Cases	Cum. Total
Arkansas	2		0		0		0		2
California	0		1		0		0		1
Colorado	0		2		0		0		2
Florida	1		0		2	(1)	0		3
Georgia	2		0		4	(1)	9		15
Illinois	2	(1)	0		0		8		10
Indiana	0		0		0		6		6
Iowa	0		0		0		7		7
Louisiana	4		0		0		0		4
Maryland	0		0		2		1		3
Massachusetts	0		0		2		0		2
Minnesota	0		0		0		11		11
Mississippi	8		0		0		0		8
Missouri	0		0		0		2		2
Nebraska	0		1		0		0		1
New York	0		0		0		11		11
North Carolina	1		0		2		6		9
Ohio	0		0		0		37		37
South Carolina	0		0		0		1		1
Tennessee	0		0		0		2		2
Texas	14	(1)	4		0		0		18
Washington	0		1		0		0		1
Wisconsin	0		0		0		24		24
TOTALS	34 (19%)		9 (5%)		12 (7%)		125 (69%)		180
	2 fatal (6%)		0 fatal (0%)		2 fatal (17%)		2 fatal (2%)		

Table 2. The Temporal Distribution of Arboviral Encephalitis Cases with Reported Onset Dates - 1982.

Month	Confirmed or Presumptive Etiology and No. of Cases				
	SLE	WEE	EEE	CE	Total
May	0	0	1	4	5
June	2	1	0	7	10
July	4	1	6	18	29
August	9	1	2	50	62
September	8	1	3	28	40
October	1	0	0	4	5
November	0	0	0	0	0
December	0	0	0	0	0
TOTALS	24 (15%)	4 (2%)	12 (8%)	111 (75%)	151 (100%)

Table 3. Distribution of Patients with Arboviral Encephalitis by 5 Year Age Intervals, Sex and Infecting virus.

	SLE		EEE		WEE		CE	
	M	F	M	F	M	F	M	F
0- 4	0	0	2	1	0	0	17	12
5- 9	0	0	0	0	0	0	26	8
10-14	0	2	2	0	1	0	8	6
15-19	0	1	0	0	0	0	1	0
20-24	0	0	0	0	0	0	0	1
25-29	1	0	0	0	0	0	1	1
30-34	0	1	0	0	1	0	0	0
35-39	0	0	1	0	0	0	0	0
40-44	1	1	0	0	1	0	0	1
45-49	2	0	1	1	0	0	0	0
50-54	0	0	0	1	0	0	0	0
55-59	3	1	0	0	0	0	0	0
60+	3	4	1	1	0	0	2	0
	10	10	7	4	3	0	55 (65%)	29 (35%)

Table 4. U.S. Cases of Arboviral Encephalitis Reported to the Centers for Disease Control 1955-1981[a]

Year	No. of Cases by Etiology[b]					
	SLE	WEE	EEE	CE	Other	Total
1955	107	37	15			159
1956	563	47	15			625
1957	147	35	5			187
1958	94	141	2			237
1959	118	14	36			168
1960	21	21	3			45
1961	42	27	1			70
1962	253	17	0			270
1963	19	56	0	1	1[c]	77
1964	470	64	5	42		581
1965	58	172	8	59		297
1966	323	47	4	64		438
1967	11	18	1	53		83
1968	35	17	12	66	1[d]	131
1969	16	21	3	67	1[d]	108
1970	15	4	2	89		110
1971	57	11	4	58	20[e]	150
1972	13	8	0	46	3[f]	70
1973	5	4	7	75		91
1974	74	2	4	30		110
1975	1,815	133	3	160	2[g]	2,113
1976	379	1	0	47		427
1977	132	41	1	65		239
1978	26	3	5	109		143
1979	32	3	3	139		177
1980	125	0	8	49		182
1981	15	19	0	91		125
1982	34	9	12	125		180[h]
Total	4,999	972	159	1,435	28	7,593

a Modified from Monath, St. Louis Encephalitis. American Public Health Association, Washington, D.C., 1980.

b SLE, St. Louis encephalitis; WEE, Western equine encephalitis; EEE, Eastern equine encephalitis; CE, California encephalitis.

c Tensaw.

d Venzuelan equine encephalitis (VEE).

e VEE, 19 cases; Powassan encephalitis (POW), 1 case.

f VEE, 2 imported cases; POW, 1 case.

g POW, 2 cases.

h Data preliminary.

*U.S. GOVERNMENT PRINTING OFFICE: 1983--646-010/8279