RESEARCH AND RESEARCH NEEDS
IN ARTHROPOD-BORNE VIRUSES DISEASES
IN LATIN AMERICA

Ref: RES 1/9
28 MAY 1962
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Two classical epidemic arthropod-borne virus diseases, urban yellow fever and dengue fever, have been conquered in the Americas. These advances were made largely through intensive control programs designed to eradicate urban vectors or to immunize exposed human populations. It must now be recognized, however, that these two diseases and the programs for their study and control, though milestones of scientific and public health advance, are only initial aspects of a much larger problem. Epidemics, epizootics and uncounted sporadic cases of fever, encephalitis and other as yet poorly defined illnesses will continue to occur until equally intensive and successful control programs result from research directed at a large number of additional arthropod-borne viruses.

The Pan American Health Organization (PAHO), interested in an evaluation of the current knowledge and research needs concerning arthropod-borne viruses in the Western Hemisphere, appointed these consultants to appraise the problem and relate it to future research. The specific objective of this evaluation was to define activities which PAHO might best develop to further research and eventually to develop control programs for arthropod-borne viruses of medical and veterinary importance. This report is directed specifically at problems and programs concerning arthropod-borne viruses in

*Prepared for the first meeting of the PAHO Advisory Committee on Medical Research, 18-22 June 1962, by the PAHO Consultants in Arthropod-borne Virus Diseases Research, Dr. William C. Reeves, School of Public Health, University of California, and Dr. William F. Scherer, School of Medicine, University of Minnesota, following their field trip in Latin America, April-May, 1962. A review of activities and resources in the research laboratories that were visited by the Consultants is found in the Addendum to RES 1/9, pages 30 - 46.
Middle and South America and is based on visits to 19 research laboratories in 8 countries and review of activities in 6 additional laboratories in 5 countries (fig. 1 - Page 6).

The recent (1961) report of a study group of the WHO on "Arthropod-borne Viruses" (Technical Report No. 219, attached) supplies a comprehensive background of the world situation and recommendations for specific program activities on a world-wide basis. In analyzing activities and a program in the Western Hemisphere, attention has been given to their coordination with the WHO Arthropod-borne Virus Program.

It is a pleasure to acknowledge the enthusiastic reception and cooperation given in the preparation of this report by the small number of dedicated scientists currently working on this problem in widely separated areas of Latin America.

CURRENT STATUS OF KNOWLEDGE AND UNSOLVED PROBLEMS

Sixty-eight arthropod-borne viruses are currently known to exist in the Western Hemisphere (Table 1 - Page 23). Ten viruses have caused human epidemics (Eastern, Western, Venezuelan and St. Louis encephalitis, Mayaro, yellow fever, dengue II, Guaroa, Oropouche and Junin) and five have produced epizootics in domestic animals (Eastern, Western and Venezuelan encephalitis, blue tongue and vesicular stomatitis). Human encephalitis caused by up to six different arthropod-borne viruses occurs in 13 of 24 countries in the Western Hemisphere (Table 2 - Page 27) and the failure to recognize this disease syndrome in certain other countries is undoubtedly related to an absence of viral investigations. Yellow fever continues to occur in an
enzootic jungle cycle in tropical countries (Table 2 - Page 27) and its geographic extension remains a threat to adjacent regions. In 1958, hemorrhagic fever, apparently mite-borne, rose to epidemic proportions in rural Argentina near Buenos Aires. An antigenically related virus exists in Trinidad and the possibility of a more northern distribution of this disease must be considered. At least 15 arthropod-borne viruses produce mild to moderately severe febrile illnesses in man (Table 2 - Page 27) and one of these viruses is related antigenically to Naples sandfly fever virus. Animal diseases also result from infection by arthropod-borne viruses. Epizootic equine encephalitis caused by three different arthropod-borne viruses exists throughout the entire Western Hemisphere, and recent isolations of vesicular stomatitis viruses from arthropods suggest that this economically important disease may involve arthropod transmission. Also blue-tongue virus, transmitted by Culicoides, exists in the U.S.A.

In addition, it is probable that:

1. Considerable number of human cases of febrile disease in the tropics, currently of unknown etiology, are caused by arthropod-borne viruses;

2. There are arthropod-borne viruses as yet undiscovered in the Americas;

3. The geographic distribution of many viruses is much wider than presently recognized.

Thus, the importance of these viruses in human and animal health has yet to be fully evaluated. The occurrence of epidemics caused by newly discovered arthropod-borne viruses (e.g. hemorrhagic fever in Argentina, Oropouche fever in Belem, and Mayaro fever in Bolivia and Brazil) indicates that the diseases they cause are not limited to the well-known arthropod-
borne viral encephalitides, yellow fever and dengue. Moreover, the continued occurrence of encephalitis epidemics and equine epizootics indicates that much still remains to be learned about these viruses.

Major unsolved research problems related to arthropod-borne viruses in the Western Hemisphere include:

1. Full evaluation of their importance in human and animal health.
2. Knowledge of their geographic distribution and thus their danger to humans and domestic animals moving into unsettled areas.
3. Recognition of virus types (new representative viruses are still being discovered throughout the Americas).
4. Understanding of the natural cycles for each virus.
5. Evaluation of the possibility of geographic movement of viruses by migratory birds, humans, domestic animals, vectors, airplanes, etc.
6. Development of effective control and therapeutic measures.

CURRENT RESEARCH ACTIVITIES

Although more arthropod-borne viruses and their related diseases exist in Middle and South America than in North America, the majority of research laboratories in this field are currently located in the Northern part of the Hemisphere. Over 50 virologists, 30 entomologists and 15 zoologists are now involved in arthropod-borne virus research in Canada and the United States whereas throughout Latin America there are only approximately 38 virologists, 18 entomologists and 6 zoologists working in this field of
VIRUS RESEARCH LABORATORIES WITH CURRENT ACTIVITIES OR RESEARCH INTERESTS IN ARTHROPOD-BORNE VIRUSES

Fig. 2

2.- Children's Hosp.
3.- Gorgas Mem. Lab.
4.- Univ. Panama Med. Sch.
5.- Mid. Amer. Res. Unit [MARU]
6.- Univ. Valle Med. Sch.
7.- Carlos Finlay Inst.
8.- Nat'l. Inst. Health
9.- Bact. Inst.
10.- Catholic Univ. Med. Sch.
11.- Pan Am. Zoonoses C.
13.- Univ. B.A. Med. Sch.
16.- Adolfo Lutz Inst. and Sch. Hyg. and PH
17.- São Paulo Univ. Med. Sch.
18.- Oswaldo Cruz Inst.
19.- Inst. Microb. Univ. Brazil
20.- Pan Am. Foot-and-Mouth Dis. C.
21.- Univ. Biol.
22.- Evandro Chagas Inst., and Rockefeller Found. Lab.
23.- Trinidad Regional Virus Lab.
24.- Univ. West Indies
25.- Nat'l. Inst. of Hyg.
26.- Venezuelan Inst. Scient. Invest. [IVIC]

LABORATORIES VISITED DURING APRIL-MAY 1962
research (Table 3 - Page 28). In Canada and the United States, most provincial or state laboratories offer routine diagnostic services for these diseases whereas similar services are almost non-existent in Middle and South America, except in scattered research laboratories. In addition, space, equipment and experimental animals are often inadequate in quantity and quality to meet research needs.

Despite the scarcity of trained personnel interested not only in virology but especially in entomology and zoology, and limitations in facilities, considerable research is underway or being initiated throughout Latin America (Table 3 - Page 28). Studies are chiefly oriented toward discovering which arthropod-borne viruses exist in different countries, and relating the to human disease. In Panama, Belem, São Paulo and Trinidad, staff and facilities allow considerable additional attention to be given to ecologic studies. Summaries of activities and research of the 25 laboratories of Middle and South America surveyed (Fig. 1 - Page 6) during April and May, 1962, are given in Table 3 and in the Addendum to RES 1/9.

POSSIBLE PAHO ACTIVITIES IN RESEARCH SUGGESTED BY INVESTIGATORS IN MIDDLE AND SOUTH AMERICA

During this survey the following suggestions were expressed by research workers and administrators concerning appropriate areas of PAHO activity, essential to further development and improvement of arthropod-borne virus research.
1. There is an urgent need to bring research workers in this field into closer contact with each other to increase exchange of information and to develop more effective collaborative research.

2. If virus research is to continue or expand in the Americas, there is a continuing need for the development of a larger pool of trained scientists in virology, epidemiology, entomology and vertebrate zoology.

3. An effective regional reference and training laboratory or laboratories should be developed in the southern part of the Western Hemisphere. The functions envisaged are those outlined in detail in WHO Technical Report No. 219 and include: identification of virus strains, arthropods, vertebrates and plants; production and supply of reference sera and antigens; maintenance of prototype and reference virus strains for the region; consultation and advice to laboratories in the region; personnel training (in virology, entomology and vertebrate zoology); serologic surveys, and assistance in investigations of epidemics. Present workers in most areas of South America feel a definite need for one or more such regional laboratories. More specific comments concerning potential locations, facilities, and staff will be made under Recommendations.

One essential aspect of PAHO activity in supporting any reference centers will be to assure and support the rapid and uninterrupted movements of scientific specimens from each country to reference centers without unnecessary delays by the countries involved, provided such movements are compatible with the safety
of the countries or personnel concerned.

4. A number of laboratories were found to be well-equipped and to have well-trained personnel but were not being productive because of limitations in current budgets for operational expenses and supplies. While PAHO is not an agency which directly grants large sums of money for research purposes, it might serve as an effective intermediary between research granting agencies in different countries and research institutions.

5. Ministries of health in Latin American countries should be kept informed of the value and need for quick and adequate investigations of epidemics possibly caused by arthropod-borne viruses. Programs are currently underway or are being planned in several countries for the movement and resettlement of human populations in previously uninhabited areas. The largest program which came to our attention was in Peru where it is planned to move over one million people from overpopulated highland areas into the Amazon Basin. In any program of this type it can be anticipated that non-immunes are being moved into areas enzootic for a number of arthropod-borne viruses, and other infectious agents. Most such population movements have been and are based on economic and land development needs of the country with little consideration for the immediate public health problems until epidemics occur. Movements of these groups represent unusual and unique opportunities for productive studies if planned in advance rather than as studies of epidemics after they occur.
6. In almost every country and research laboratory an urgent plea was made for careful consideration of possible mechanisms to assure adequate salaries and stable tenure of positions for full-time research workers. Evidence of advances and improvements in these situations was observed in a few laboratories. However, in general these two disturbing factors have been most detrimental to productive research and to maintenance of well-trained, capable persons in research. Unfortunately, a solution to this problem is not obvious despite its importance. It is urged that PAHO wherever possible take action to influence and improve administrative attitudes towards this problem.

7. It would be most desirable to know the exact incidence of morbidity and mortality by diseases due to arthropod-borne viruses in the Americas. Unfortunately there are few accurate data, except for the United States where these agents undoubtedly are of less importance than in other parts of the hemisphere. Current statistics, as accumulated and presented by the PAHO and FAO/OIE, are, to all intent, worthless as accurate indices of the frequency or importance of arthropod-borne virus diseases. With the exception of yellow fever, the International Statistical Classification Code has not allowed for separate identification or reporting of individual representatives of this group of virus diseases. The modifications proposed at the recent Advisory Committee Meeting on International Classification of Diseases (PAHO Scientific Publication No. 53) would rectify this situation insofar as it is currently practical. However, there will continue to be a serious problem in obtaining accurate
data in most of Latin America due to the following factors:

a) Most clinical cases are not seen by a physician.

b) Most cases seen by physicians are not subjected to adequate diagnostic tests for etiological identification.

c) Even if adequate samples were submitted on all suspected cases, the diagnostic facilities would be inadequate in most areas to permit definitive diagnostic tests.

d) Most arthropod-borne viruses have not been clearly associated with a definable clinical disease and thus the proper definitive laboratory test is difficult to select.

In spite of these drawbacks, every effort should be made to utilize the existing laboratories that are currently prepared to offer diagnostic services. Laboratories (Fig. 1 - Page 6) scattered over Latin America indicated they were prepared and willing to perform diagnostic services.

8. There is an urgent need for fuller development and utilization of reference museums and research facilities for the vertebrates, arthropods and even plants of the southern portion of the Western Hemisphere. For adequate studies and understanding of arthropod-borne viruses these resources are equally or at times more important than the public health or virologic facilities. Infections of man with these viruses are usually secondary to basic cycles in nature which cannot be adequately understood without taxonomic and ecologic information. Arthropod-borne virus research units are in serious need of a hemispheric consolidation of available knowledge in the above fields, and will
continue to need support and services of such specialists. As the majority of trained zoologists, entomologists and ecologists are employed by agencies in fields other than public health, and there are few such specialists in Latin America, each research unit has had to locate a collaborator or to train a specialist. This emphasizes the need for an increased number of such specialists for work in arthropod-borne viruses and the need for increased collaboration and communication. Future studies on the relationship of bird migrations or ectoparasite movements in the Western Hemisphere to virus movements and evaluations of the dependence of the various viruses on certain ecologic circumstances for endemic maintenance will depend on an increased utilization of specialists in these biological fields working in close collaboration with virologists and epidemiologists. The PAHO should consider determining the extent, distribution, capability and future interests of biologists in the above fields in Latin America and the facilities and potentials for training of additional specialists. This information will also be of value in future field studies on the zoonoses.

RECOMMENDED PAHO ACTIVITIES

From the preceding suggestions, we recommend that the following activities receive priority consideration:

1. **Exchange of Information Among Research Workers**

   a) Development of a continuing system of annual or biannual informal
meetings of active workers in the Americas should be considered a vital PAHO activity. As a beginning, PAHO should consider the organization of an informal meeting for exchange of information among active workers in arthropod-borne virus research in Latin America at the time of the next International Congress for Tropical Medicine and Malaria, to be held at Rio de Janeiro in July or August 1963. A similar meeting at the last Congress in Lisbon in 1958 was highly successful and of great assistance in formulating the current WHO program.

b) PAHO should assume responsibility for bringing new research groups into association with the current world-wide Information Exchange and Arthropod-borne Virus Catalogue activities and should offer whatever support is required to assure effectiveness of these forms of information exchange. However, all investigators visited during the survey believed that the current Information Exchange activities should be continued in their present informal and unpublished format.

c) PAHO should make regular contributions to the Information Exchange to provide current information regarding arthropod-borne virus epidemics and epizootics, development of new laboratories, availability of Reference Centers, etc., in the Western Hemisphere.

2. Training of Research Personnel

a) Development of short term intensive courses in basic laboratory and/or field techniques, particularly at regional reference centers (see Recommendation 3). These could be patterned after the present PAHO training activities of the Aftosa and Zoonoses Centers and should be based on students performing procedures rather than merely viewing demonstrations.

b) Placement of research workers and educators in Middle and South American laboratories to train local personnel. An example is the current
PAHO entero virus training program at the Oswaldo Cruz Institute in Brazil. University faculty on sabbatical leave might also be interested in this activity.

c) Development of agreements with institutions carrying out active research programs in Latin America for acceptance of well-prepared trainees for periods of at least 6 months to 1 year to obtain further laboratory and field training by active participation in field and laboratory research programs.

d) Similar agreements for shorter training periods are also needed, but they should be limited to learning specific techniques essential for immediate incorporation in a current research project.

e) For people who are to be or are already responsible for research programs, one or more years of advanced study in an educational institution obtaining advanced training in a special field. Training outside of Latin America will be required for many of these persons, but only experienced, highly capable and mature individuals should be selected.

f) Research workers, instructors or technical personnel of PAHO should participate in an intensified follow-up system, to visit the trainees in their laboratory or field program area, to review their success in utilizing the training provided, and to assist them in solving problems which may develop.

3. Development of Regional Reference and Training Center or Centers for South and Middle America

It is recommended that early consideration be given to the establishment of a Center in São Paulo, Brazil, in collaboration with the Institute Adolfo Lutz and the School of Hygiene and Public Health. This location has the following advantages:
a) Geographically, it is centrally located to serve Argentina, Chile, Brazil, Uruguay, Paraguay and Bolivia and it has excellent air transportation connections to these areas and to most northern areas. This region is the most isolated with reference to existing reference centers.

b) The Instituto Adolfo Lutz has an excellently equipped and housed virologic research unit, which is active in arthropod-borne virus research. The administration of the Institute is sympathetic to increased research and service functions, and there is adequate financing of the local activities on a current basis.

c) There is reason to believe the Director of the Institute would enthusiastically and effectively support the establishment of a reference center in association with this institution.

d) There is an active program of medical entomologic research and teaching in the School of Hygiene and Public Health, which offers a service and training facility essential to a reference center.

e) There are facilities for microbiology teaching in both the School of Hygiene and Public Health and the Medical School, which could be used for short-term courses in virus laboratory procedures.

f) There are good library facilities covering literature in virology and medical entomology.

g) There is a combined atmosphere of active research and academic programs in virology, entomology and vertebrate zoology which are essential to a reference center type of activity.

h) Almost all of the arthropod-borne viruses that are currently known in South and Middle America have been recovered in Brazil, and thus can be worked with in this country with a minimum of restrictions on importations.

i) Field areas, where arthropod-borne viruses are active, are readily
available within short distances of the city. This offers opportunities for field training, demonstrations of investigative procedures, and the development of short or long term participation of trainees and fellows in active research projects on virologic, entomologic or vertebrate aspects of investigations.

The proposed center would require the obtaining of adequate laboratory space to house the virologic aspects of the reference center. As in the beginning this activity will be concerned primarily with the identification and characterization of a wide range of viruses and preparation of antisera, it should be separated physically from the existing field investigative unit of the Institute, which is currently isolating new strains of virus from the field. This could be accomplished by utilization of space in a separate section of the virology laboratories or by assignment of space in a separate building. The minimum space required would include a large serology room, 3-6 small isolation cubicles, 3-6 small independent animals rooms, a small cell culture and preparation room, and space for general services.

At the onset, personnel should include one or two competent virologists interested in the identification and characterization of arthropod-borne viruses, two to four competent technicians and three to five supporting personnel for animal care and other auxiliary services.

Later staff needs may include an entomologist, vertebrate zoologist and epidemiologist, and will be dependent on the demonstrated needs for such staff to carry out service or investigational activities in the region.

Equipment needs are those standard for a virologic laboratory and do not include numerous expensive or specialized items.

Training courses would, of necessity, require supplementary personnel
for the time they were in session. It would be anticipated that staff could be available as consultants from the several active research centers in the region.

While interests and needs were expressed for a regional reference laboratory in Northern South America or Middle America, the majority of the present laboratories in these regions are self-sufficient at this time, are closely allied with parent laboratories in North America, or are effectively exchanging reference material on a current basis. The Middle American Research Unit (MARU) of the USPHS may serve in part as a sub-regional laboratory for the surrounding area if sufficient staff is assigned that are competent in virology and the necessary biologic fields. It is not prepared to do so currently.

None of the other laboratories that were visited offered sufficient space, interests in this type of activity, coverage of the necessary fields for services and training, stability of personnel, or other potentials to be given serious consideration as a regional center at this time. It would seem undesirable to consider the development of a regional center as an independent unit geographically isolated from a currently active research program or the auxiliary biologic sciences and educational facilities essential for a center.

4. **Provision of an Intermediary Information Service between Investigators in Latin America and Granting Agencies in the United States or other Countries**

   a) PAHO might offer services for translation of grant application from Spanish or Portuguese into English.

   b) Properly oriented PAHO staff might offer guidance and assistance to
Latin American research workers to assure proper and complete understanding of the material expected in specific sections of research grant applications.

c) PAHO Staff could assure understanding of the specific types of research which are acceptable for support by granting agencies.

With reference to these activities, PAHO might wish to inquire into the possibility of training scientists from its staff by placing them in the new Research Grant Training Fellowship Program of the National Institutes of Health, United States Public Health Service.

5. **Facilitation of Investigations of Epidemics**

PAHO can assist by:

a) Stimulating Ministries of Health and Agriculture to welcome and support such investigations.

b) Organizing international and national rosters of individuals and agencies capable of and interested in making such investigations, and inviting them to do so.

c) Obtaining and maintaining a small reserve fund to finance transportation and field subsistence of investigators sent on such research missions.

d) Facilitating movement of investigators across international boundaries.

6. **Assistance in Rapid and Uninterrupted Movements of Scientific Specimens Between Countries and to Reference Centers**

PAHO should develop a scheme to accomplish this objective.

7. **Development of Improved Diagnostic and Reporting Systems**

a) A joint endeavour by PAHO and FAO to assure that public health and veterinary health agencies promptly report and support investigations of
outbreaks by research groups is badly needed.

At the present time, the only data which are published are those reporting large outbreaks or sporadic cases from which a virus is isolated that is new for a geographical area. All other records are lost or buried in laboratory files. In the present survey the few recorded, sporadic epidemics or epizootics of arthropod-borne viruses, other than yellow fever, in the Southern Hemisphere of the Americas were reviewed and it is obvious they were all incompletely recorded or investigated due to the lack of adequate reporting, inadequate case finding, difficulties of investigations or shortage of adequate personnel or facilities for study. Full recognition or evaluation of the public health or veterinary importance of this group of agents will be dependent on a constantly increasing level of awareness of their potential importance and increased application of diagnostic measures to suspected cases.

b) It is suggested that some mechanism should be developed for an annual computation of the confirmed human and animal cases that are diagnosed by the research and diagnostic laboratories. These data are lost or become diluted in official morbidity and mortality statistics (except for yellow fever). An expression of interest in such computations would be concrete evidence of support of the laboratory programs and would stimulate increased activity and utilization of such facilities.

The above suggestions are compatible with prior suggestions in Tech. Report 219 of WHO and Scientific Publication No. 53 of PAHO considerations of the same problem

8. **Utilization of the Foot-and-Mouth Disease Center**

Arthropod-borne virus research units in Middle and South America should
be notified of the availability of virus identification services for the vesicular stomatitis viruses at the Foot-and-Mouth Disease Center in Rio de Janeiro. Field laboratories have been making increased numbers of isolations of viruses in this group and have had difficulty in their identification and characterization, but they have not effectively utilized the services of this regional center, which are excellent.

9. **Support of Present Research Units**

While the number of research groups concerned with arthropod-borne viruses in South America is limited, these reviewers do not feel there is an urgent need for a program to accelerate development of additional new research groups or organizations. It is undoubtedly of more importance to encourage the continuation of interests of the present groups, to assist them in obtaining adequate financial and administrative support and stability from their parent organizations, and to assure adequate training and reference center support for the present and future personnel of these units.

Peru is the only country which may be an exception to the above, and a new research group is presently being trained and organized to fill the need for this area. Those countries that have no active research programs have been receiving attention from established research groups. Studies in Ecuador have been supplemented by Colombian research units. The Middle American Research Unit is making exploratory surveys in Bolivia and this group is willing to perform studies throughout Middle America. Paraguay and Uruguay could be and have been assisted by laboratories in Argentina. The Guianas are covered by the Trinidad Regional Virus Laboratory.

Inevitably, additional universities and research institutions will become interested in arthropod-borne viruses and should not be discouraged.
Support of such new groups by PAHO should be concerned primarily with training, consultation and advice and assistance in recruitment of personnel. Such new research units may wish, initially, to orient their activities toward serologic surveys. PAHO should encourage this attitude, but should emphasize that, to be meaningful, arthropod-borne viruses serologic surveys must be followed by isolation of viruses and by ecologic studies.

10. **Collaborative Studies in the Amazon Basin**

PAHO should encourage collaborative studies by groups interested in the Amazon Basin in an effort to consolidate knowledge of the distribution of viruses in this area and the similarities or differences to be found in arthropod vectors and vertebrate hosts in the areas that have been studied.

The Amazon Basin comprises one of the largest underdeveloped land masses in the world. Studies of the arthropod-borne viruses along the periphery of this area clearly indicate that this Basin, with its particular ecologic characteristics, is unusually suited for the enzootic maintenance of a large number of arthropod-borne viruses. Existing research units in Bogotá and Cali, Colombia, the proposed unit in Lima, Peru, the University of Cordoba in Argentina, the Institute Adolfo Lutz and Belem Virus Laboratory in Brazil provide a circle of active research groups all with an interest in future research work in various portions of this Basin and its adjacent regions.

In addition, human population groups are being moved into this Basin in increasing numbers by the Brazilian and Peruvian Governments. These largely susceptible populations offer unique opportunities for epidemiologic studies of a wide variety of infections and non-infectious diseases. PAHO, by arrangements with the various governmental agencies, should make every
effort to assure that competent and interested research groups have an adequate opportunity to make such studies of these pioneering groups.

Extensive ecologic studies are indicated to consolidate the knowledge of arthropod-borne virus distribution and movements in the Amazon Basin. These studies will have to include professional workers from the fields of entomology, vertebrate zoology, botany, climatology and geography as well as virology. Establishment of such studies cannot be planned at the present time; however, they should be anticipated. A vast array of altitudinal, climatic and floral habitats are encompassed in this area. Final understanding of the natural cycles of arthropod-borne viruses, limits on their distribution and dissemination, and the utilization of this land mass for human habitation and development without undue risk of disease, will be dependent on such ecologic studies. Similar studies in other basins, such as those of the Orinoco and Parana rivers could be considered when conditions for such investigative efforts appear promising.

A specific example of a study requiring international research coor-
dination and cooperation is that of the movements of birds along the eastern slopes of the Andes, and along the Atlantic Sea Coast and the degree to which interchange occurs across the vast expanses of the Amazon Basin. It has long been suspected that bird movements might be effective in dissemination of these viruses, but indisputable evidence awaits further collaborative investigations.
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<th>Virus</th>
<th>Countries in Western Hemisphere</th>
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<tr>
<td>A (7)</td>
<td>Western encephalitis</td>
<td>Argentina, Brazil, British Guiana, Canada, Mexico, U.S.A., Uruguay</td>
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<tr>
<td></td>
<td>Eastern encephalitis</td>
<td>Argentina, Brazil, British Guiana, Canada, Dominican Rep., Mexico, Panama, Trinidad, U.S.A.</td>
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<td>Venezuelan encephalitis</td>
<td>Argentina, Brazil, Colombia, Ecuador, Panama, Trinidad, Venezuela</td>
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<td>Mayaro</td>
<td>Brazil, Bolivia, Trinidad</td>
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<td></td>
<td>Aura</td>
<td>Brazil</td>
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<td>Una</td>
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<td></td>
<td>Pixuna</td>
<td>Brazil</td>
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<td>B (8)</td>
<td>Yellow fever (jungle)</td>
<td>Brazil, Panama, Trinidad, Venezuela</td>
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<td></td>
<td>Dengue II</td>
<td>Trinidad</td>
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| Turlock           | Turlock   | Brazil, U.S.A.                           | (Continues)
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<td>Tecorix</td>
</tr>
<tr>
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<td>Mensantea</td>
</tr>
<tr>
<td>Panama</td>
<td>JM 10x</td>
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<tr>
<td>Brazil</td>
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<td>Pennt</td>
</tr>
<tr>
<td>Brazil</td>
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<tr>
<td>Brazil, Panama - &quot;Non-Phytophthora&quot; agent</td>
<td>Pennt</td>
</tr>
<tr>
<td>Brazil</td>
<td>fry</td>
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<tr>
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<td>Tecorix</td>
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<td>Mensantea</td>
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<tr>
<td>Colombia</td>
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Miscellaneous

Yeast strains
Table 2

NUMBERS OF DISTINCT ARTHROPOD-BORNE VIRUSES RECOVERED IN THE WESTERN HEMISPHERE BY MAJOR DISEASE CATEGORY AND BY COUNTRY

<table>
<thead>
<tr>
<th>Country</th>
<th>Human Encephalitis</th>
<th>Yellow fever</th>
<th>Hemorrhagic fever</th>
<th>Febrile illness with recovery</th>
<th>Horse encephalitis</th>
<th>Vesicular stomatitis</th>
<th>Disease unidentified; recovery only from arthropods or wild animals</th>
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<tbody>
<tr>
<td>North of Tropic of Cancer</td>
<td></td>
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* Also blue tongue virus.

** One of them is related to Naples sandfly fever virus.
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<th>Personnel</th>
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<th>Zoologists</th>
<th>Facilities</th>
<th>Financial Support</th>
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<td><strong>38</strong></td>
<td><strong>18</strong></td>
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</table>

*Other areas in Latin America were not surveyed because no arthropod-borne virus research is known to be underway.

**Govt. = Federal or State Government
USPHS = National Institutes of Health of the US Public Health Service
PAHO = Pan American Health Org.
OAS = Organization of American States
Rock.Fn. = Rockefeller Foundation
UN/TA = United Nations Technical Assistance Program
Univ. = Local University
UK = United Kingdom Colonial Research and Develop. Scheme

X = Very limited activity
Blank spaces indicate that no information is available.
REVIEW OF RESEARCH LABORATORIES VISITED*

1. MEXICO

National Institute of Virology, Mexico City (Drs. C. Campillo and J. de Mucha)

1. ACTIVITIES.

A. Research In the past year research in arthropod-borne viruses has been initiated in conjunction with personnel from the University of Minnesota. This has involved serologic surveys and attempts to isolate viruses from mosquitoes and birds in the states of Veracruz and Morelos.

B. Training Limited to new employees.

C. Services Diagnostic services for virus diseases are available on a national reference basis.

II. RESOURCES

The laboratory has excellent space and increasingly adequate equipment for research on arthropod-borne viruses. Equipment has recently been supplemented through a cooperative program with the University of Minnesota. A mouse colony was established during the past year, which is increasing in size, and currently is providing sufficient weanling mice for performance of neutralization tests.

2. PANAMA

Middle America Research Unit (MARU) of the National Institutes of Health, Panama Canal Zone (Drs. H. Beye, R. Mackenzie and P. Peralta)

1. ACTIVITIES.

A. Research Principal activities of this unit have been collaborative studies with the Gorgas Memorial Laboratory designed to isolate and identify viruses from arthropods, vertebrates and humans from various ecologic environments of Panama.

* Names in parentheses indicate persons interviewed.
This program has revealed 12 distinct and a number of unidentified arthropod-borne viruses. Of particular current interest are continuing studies on human cases of Venezuelan encephalitis and viruses transmitted or potentially transmitted by Phlebotomus, including agents related to sandfly (papataci) fever and vesicular stomatitis (New Jersey type) viruses. Current studies of the mites of Panama have revealed over 80 species but no relationship to viruses.

Serologic tests of cross sectional samples of human populations in various representative ecologic habitats of Panama have been initiated and will be repeated periodically. Resulting data should be of value as a measure of the prevalence and incidence of human infections over a period of years. Military groups on jungle maneuvers are being followed for evidence of viral disease. Intensive studies of acutely ill patients in 12 hospitals and clinics of Panama and the Canal Zone should provide information on the frequency of arthropod-borne virus diseases in this population.

B. Training This laboratory has served as a training facility for American and staff personnel.

C. Services The cooperative studies with the Gorgas Memorial Laboratory and the backing of the parent Tropical Virology Laboratory Section in Bethesda represent service functions to a considerable extent. In addition, this laboratory has offered its assistance to the Ministries of Health of Panama and other Middle American countries in the study of epidemics of acute infectious diseases including arthropod-borne virus diseases, e.g., the recent study of Venezuelan equine encephalitis in Panama. A study is currently underway in Bolivia, in cooperation with INCAF, to carry out a serologic survey for antibodies to arthropod-borne viruses in this relatively unexplored area.

II. RESOURCES

Facilities are quite adequate as to space, equipment and animal colonies for the type of studies currently underway. The mouse colony is in good condition, provides 50 litters per week and will be expanded. Currently an additional building is available for expansion of laboratory facilities if indicated.

Gorgas Memorial Laboratory of Tropical and Preventive Medicine, Panama City, Panama (Drs. C. Johnson, P. Galindo and P. Grayson)

I. ACTIVITIES

A. Research Principal activities have been detailed biologic studies in a variety of ecologic habitats. The entomologic and zoologic details of these field studies are probably as complete
as any in Middle or South America. The entomologic staff and facilities are outstanding and serve as a reference center for tropical America. (It was brought to our attention that Dr. Belkin of the University of California Los Angeles, is beginning an extensive study of the mosquitoes of Middle America). Of the 184 virus isolations made in the last 27 months from arthropods and vertebrates, 21 isolations of viruses from Phlebotomus emphasize the importance of this group of arthropods beyond their well known relationship to leishmaniasis. Chief current interests in arthropod-borne virus research are concerned with ecologic studies in Panama and investigations on bird migration to the north from Panama. However, the laboratory would be willing to loan staff for short-term investigations of unusual situations or epidemics in nearby countries.

B. Training The laboratory accepts short-term fellows in tropical medicine sponsored by a number of agencies; they would welcome trainees for six months or more in entomology and vertebrate zoology. As their staff enlarges, trainees in virology and epidemiology could also be accepted.

C. Services Identification of neotropical arthropods and vertebrates is provided. Specimens in their museum are available for study; many have been sent to the U.S. National Museum to provide, upon return, a documented collection in Panama. The museum could be enlarged if more support were available. The diagnostic service is active in Tropical Diseases other than arthropod-borne viral diseases.

II RESOURCES.

Excellent new laboratories are under construction. Principal personnel needs are for additional virologists and medical epidemiologists.

3. COLOMBIA

Yellow Fever Section, National Institute of Health (previously known as Carlos Finlay Inst. Bogotá). (Drs. A. Gast-Galvis, H. Groot and E. Prias)

I. ACTIVITIES

A. Research Continuing detailed studies in the Magdalena Valley and Villavicencio have included serologic surveys, human biting collections of mosquitoes, netting of birds and use of sentinel mice. Venezuelan encephalitis virus has been isolated from sentinel mice and Guaroa virus from humans.
During a 2 week period of bird netting, 11 of 193 species collected represented migrants from North America, thus emphasizing again the possibility that birds might carry viruses upon migration.

B. Training  Limited to new employees.

C. Services  Yellow fever vaccine is produced and a diagnostic service for yellow fever is available. This group is interested in experimentation to improve stability of vaccine, to insure its administration to populations at risk, i.e., working males in rural environments, and to determine the results obtained by administering the vaccine by scarification.

II. RESOURCES

Present building is old but plans are underway for the new Institute of Health to house this laboratory (completion possible in two years). Mouse colony provides 200-600 litters per week. A large proportion of the budget concerns production of yellow fever vaccine; if there were income from its sale, more funds would be available for research.

Department of Preventive Medicine and Public Health, Faculty of Medicine, University del Valle

I. ACTIVITIES

A. Research  Serologic surveys have been done in western and coastal Colombia and Ecuador from Buenaventura south to Peru; currently underway is a survey from Buenaventura north to Panama. A jungle field station has just been established near the coast south of Buenaventura to collect arthropods and vertebrates from virus studies. Construction of a field clinic in Buenaventura to recover viruses from febrile humans is planned.

B. Training  The department teaches preventive medicine to medical students, and could accept fellows for specialized training.

C. Services  Viral diagnostic services are provided on an individual and research basis.

II. RESOURCES

The virus department has facilities for work on a variety of viruses. The space currently available for arthropod-borne virus research may prove to be inadequate as their field program expands. The mouse colony provides from 6 to 50 litters daily.
Addendum
RES 1/9

and some space is available for expansion. A zoologist from Texas, presently teaching at the University, is collaborating in the arthropod-borne virus research program. An experienced ornithologist is available in a local University for consultation and collaboration. A full-time entomologist is urgently needed.

4. PERU

National Institute of Health (Dr. Miro-Quesada) and Anglo-American Clinic (Dr. Cabieses)

Currently Dr. José Madalengoitia from the Instituto Nacional de Salud is completing his second year of training in virology at the University of Minnesota. He will return to Lima in September 1962 and plans to initiate a research program on arthropod-borne viruses. Discussions were carried out with Dr. Miro-Quesada and Dr. Cabieses to describe the necessary facilities required for an arthropod-borne virus research program. Assurance was given that facilities and support would be available at the Instituto. In the future if for any reason a program could not be continued there, it could be reinitiated at the Anglo-American Clinic. Research in arthropod-borne viruses in Peru is indicated not only because essentially none has been undertaken but also because large-scale movements of over a million humans are planned into the tropical eastern region of Peru where arthropod-borne viruses undoubtedly exist.

5. CHILE

Bacteriological Institute of Chile, Santiago (Drs. R. Palacios and O. Avendano)

I. ACTIVITIES

A. Research Limited to provision of human and animal sera for antibody surveys by laboratories in the U.S.A. However, horse brains are routinely tested in mice for rabies virus and such a procedure should reveal the equine encephalitis viruses.

B. Training None in this field.

C. Services None in this field.

II. RESOURCES

Apparently no resources are currently devoted to arthropod-borne virus research. However, the laboratories would be adequate for this purpose if interest develops. There are two mouse colonies providing 20 litters per day to the virus department.
Department of Microbiology, Catholic University, Santiago
(Dr. M. Rodriguez)

I. ACTIVITIES

A. Research  Currently no studies on arthropod-borne viruses are being made but in the past over 20 human brain specimens from encephalitis cases in Santiago were negative in suckling mice.

B. Training  Limited to teaching microbiology to medical students.

C. Services  Some diagnostic service in central nervous system diseases, principally concerning enteroviruses.

II. RESOURCES

Small and inadequate for expansion into the field of arthropod-borne viruses.

6. ARGENTINA

National Institute of Microbiology, Buenos Aires (Drs. Pirosky and Dunayevich)

I. ACTIVITIES

A. Research  Principal activities in arthropod-borne virus research have occurred since 1958 and have concerned the association of Junin virus with human hemorrhagic fever. This virus is currently the only arthropod-borne virus thought to be transmitted by mites (Haemolaelaps glasgowi) in the Western Hemisphere. With the recent return of trained personnel from abroad, this laboratory is now capable of and interested in continuing research related to Junin virus and initiating studies of other arthropod-borne viruses. Of particular interest to them, are continued field investigations of the movements of hemorrhagic fever. For example, in Rojas, adjacent to the Junin region, there were no cases in 1958 but over 200 cases in 1960-61. Also of interest is the presence of neutralizing antibody in a person with history of disease as far back as 1941. Plans are underway for studies in the river delta area near Buenos Aires including serologic surveys, entomologic studies and virus isolations. Sera are also being collected from all provinces of Argentina for virus antibody survey, including arthropod-borne viruses. Diagnostic investigations of cases suspected to be of arthropod-borne viral etiology are also planned in the Buenos Aires area. The group is sufficiently staffed and has facilities to study human epidemics, provided the reporting of epidemics is sufficiently prompt to enable studies to be carried out.
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B. Training Courses are conducted for personnel from provincial laboratories and in-service training of new employees is carried out. This institution is somewhat unique in that approximately 40 full-time professional personnel from the laboratory of microbiology have been or are undergoing specialized training in other countries so that a core of well-trained young persons now exists for training of others in Argentina.

C. Services This institute is responsible for producing a variety of vaccines. The only arthropod-borne virus vaccine has been experimental batches of formalized suckling mouse brain Junin virus vaccine. Some 70,000 doses have been tested in approximately 20,000 people but to date the vaccine has apparently been unsatisfactory since serologic tests on approximately 2,000 people have failed to reveal antibody development and hemorrhagic fever has occurred in vaccinated persons. The virus reaches relatively low titers in mice and this may account for difficulties in preparing satisfactory vaccines.

II. RESOURCES

The various departments of this institute are large and have well trained, full-time people in a variety of fields of virology. There are approximately 40 employees in the department of virology of which 16 or 17 are full-time professional people. The facilities for arthropod-borne virus research are quite adequate in space and equipment. Thirty to 40 litters of mice are available for arthropod-borne virus research daily.

This laboratory has a close association with one of the largest groups of entomologists in South America under the direction of Dr. Eduardo del Ponte. There are 10 professional entomologists in this group, and their interests cover all groups of arthropods of medical importance. The institute also has established collaborative relationships with a mammalogist from La Plata Natural History Museum and ornithologists from the National Museum, for participation in their field research projects.

The major problem in this institute is instability of personnel related to fluctuations in Government.

Zoonoses Institute, INTA, Ministry of Agriculture, Buenos Aires (Dr. Lucio Villa)

I. ACTIVITIES

A. Research This group has been concerned with horse disease
and Junin virus disease in humans. They estimated that the 1958 and 1959 horse epizootics in Argentina involved approximately 100,000 cases each year with a 20 per cent case fatality rate. Presumably the etiologies were Western and Eastern encephalitis viruses. An isolation of Venezuelan encephalitis virus from a horse and antibodies in another horse, both of which had been recently vaccinated with a presumably killed vaccine allegedly containing only Western encephalitis virus, raised the question of possible contamination of the vaccine with Venezuelan virus and its introduction into nature by this mechanism. This was substantiated in part by recovery of Venezuelan encephalitis virus from a lot of Western equine vaccine submitted to the laboratory for evaluation in 1948. This group has been carrying out small scale serologic surveys for antibodies to Eastern, Western and Venezuelan encephalitis viruses in migratory water fowl. This work is done in collaboration with an ornithologist and also includes bird banding. Studies of mosquito-borne viruses were initiated in the past year or so north of Cordoba and Santa Fe and are planned to continue in conjunction with an entomologist. This group also has been working on Junin virus in the field together with a mammalogist and an entomologist with the objective of comparing areas with and without Junin virus activity. They are not convinced that hemorrhagic fever is caused by a virus. (This is the only group encountered that expressed these reservations).

B. Training
Limited to new employees.

C. Services
Diagnostic services for encephalitis and rabies viruses are routine functions but not an overload upon laboratory facilities.

II. RESOURCES

Transportation difficulties in Buenos Aires at the time prevented a visit to the laboratory. However, the Chief of the Virus Section indicated that the research facilities were limited and only 50 litters of mice or less were available per week. The colony is supervised by the Foot and Mouth Disease Section of the Institute.

Department of Microbiology, School of Medicine, University of Buenos Aires, Buenos Aires (Dr. A. Parodi)

I. ACTIVITIES

A. Research
Junin virus and its hemorrhagic fever syndrome in man have concerned this group since 1958 although insofar as could be determined, no active field research is now being carried out. In the past the virus has been recovered from humans and
rodents and these workers have reported that the vector mite of Junin virus is Echinolaelaps echidninus. Research is now concerned with attempts to attenuate Junin virus by passage in guinea-pigs and mice. It was stated that a mouse brain adapted virus has been developed that does not uniformly kill guinea-pigs but does infect and immunize this host.

B. Training. Medical students are trained in microbiology; training in arthropod-borne viruses is limited to new laboratory employees and fellows. One staff member is currently at the Rockefeller Foundation Laboratory in New York and will be returning shortly to Buenos Aires.

C. Service  Apparently there are no routine service functions in this laboratory.

II. RESOURCES

The department is spacious but equipment is somewhat limited. Twelve department members are full-time. Evidently the guinea pig supply is adequate. Since mice are used in relatively small numbers, there is no mouse colony and mice are obtained commercially.

Institute of Virology, Córdoba University, Córdoba
(Dr. José Vanella and staff).

I. ACTIVITIES

A. Research  This group has two major activities, viral diagnostic services to the state, and research on arthropod-borne viruses. Field research is in areas to the east and northeast of Córdoba. In 1958 this group made two isolations of Western encephalitis virus and one of Eastern encephalitis virus from horse brains. These isolations were made before any laboratory strains of either virus were used in this unit. In addition, this laboratory has identified (but did not participate in the isolation of) two viruses as Western encephalitis and two viruses as Venezuelan encephalitis from Buenos Aires province. Serologic tests for arthropod-borne viruses and attempts to isolate such viruses from central nervous system fluids and tissues of human cases in the Cordoba area have been negative. Four agents were recovered from sentinel mice exposed in the field and these are currently under study.

This group has an ambitious field project in arthropod-borne virus research in Central and Northern Argentina, directed toward clarification of the natural cycles of transmission and discovery of the viruses endemic in these regions. With proper financial support they would be willing to extend studies into Paraguay and
Bolivia which would supplement very well the information from the several environments of Brazil currently under investigation.

B. Training Virology is taught to medical students at the University. Also training of fellows and new laboratory employees is carried out. The laboratory would welcome fellows from other countries and faculty from other universities on sabbatical leave.

C. Services A major function of this laboratory is its diagnostic service in virology for the state and particularly for local hospitals.

II. RESOURCES

Laboratory facilities are well designed and provide adequate space for a variety of virologic activities. Equipment is excellent, the mouse colony is productive and there is land available for expansion and construction of new buildings. The relative isolation of these buildings from human habitation and other activities of the University provides excellent security and safety for work with infectious agents. Two entomologists are currently in training in São Paulo, Brazil, as Rockefeller Foundation fellows, and will return to Cordoba soon.

Pan American Zoonoses Center, Azul (Dr. Benjamin Blood)

I. ACTIVITIES

A. Research At present this group is performing no research on arthropod-borne viruses. Its activities concern brucellosis, tuberculosis, rabies, hydatid disease and currently increased activities on leptospirosis.

B. Training Regular courses are given in veterinary and microbiological aspects of zoonoses.

C. Services Consultative and diagnostic laboratory services are provided under special circumstances and new research and control approaches are developed for the diseases under study.

II. RESOURCES

The laboratory is well equipped and designed and plans are underway for expansion. There is an excellent teaching laboratory and lecture-seminar room. A nearby farm, which is
part of the unit, provides a facility for raising experimental animals, and adjacent isolation units permit the study of infectious diseases in small domestic animals under controlled conditions. There is an adequate mouse colony for current needs; this could easily be expanded for more extensive use.

7. BRAZIL

Adolfo Lutz Institute, São Paulo, (Drs. A.B. Souto, Ribeiro do Valle and O. de Souza Lopes)

I. ACTIVITIES

A. Research This group has an active research program in arthropod-borne viruses. Three field areas are currently under study, all within one to several hours traveling time from the laboratory in São Paulo. The areas encompass a variety of habitats ranging from coastal forest at sea level to nearby upland forest, and to essentially tropical rain forest near São Paulo. Field investigations started in February 1961 and have been productive of 41 strains of and as yet unidentified virus, at least one group C arthropod-borne virus, a probable new Group C virus, and 10 to 12 other viruses presently under study. Entomologic aspects are under intensive investigation in conjunction with personnel at the School of Hygiene and Public Health, who carry on parallel and collaborative entomologic and biologic field studies on mosquitoes and other possible arthropod vectors. Zoological aspects of research are covered by an additional cooperative arrangements with zoologists in the University.

Extensive serologic surveys of humans for antibodies to arthropod-borne viruses have been carried out involving representative samples of urban populations in various regions of the State of São Paulo.

B. Training There are formal teaching activities of personnel from provincial laboratories. The groups would be interested in having fellows in the laboratory and field program.

C. Services As a state laboratory, this unit offers diagnostic services to the State of São Paulo.

II. RESOURCES

There is a new three-story building devoted to virology and rickettsiology (principally the former). Facilities for
arthropod-borne virus research are spacious and excellent; equipment of all essential types is available. The mouse colony provides 20 litters per day, but there is a need to expand this facility. The medical library is very complete and well organized.

A major adjunct to the arthropod-borne virus unit in the Institute is the close association with Dr. Forattini in the Department of Parasitology, School of Hygiene and Public Health. The unit has an active teaching program involving a four month full time course in medical entomology. This course is one of the most comprehensive in medical entomology in the Western Hemisphere. In the past four years, approximately 70 students have enrolled from various parts of South and Middle America. For example, the last course enrolled 18 students of which 6 were professionals from Venezuela, Brazil, Chile and Argentina. This department is interested in increasing the number of professional students in the course and is willing to modify the course contents to give further emphasis to the field of arthropod-borne viruses. The department has one of the most extensive collections of arthropods of medical importance in South America and a number of monographs covering these vectors have and are continuing to come from this group. They are willing to serve as a reference resource for identification of arthropods from any part of Latin America. More complete future utilization of this facility would benefit the field of arthropod-borne virus research.

Oswaldo Cruz Institute, Rio de Janeiro (Dr. H. Penna)

I. ACTIVITIES

A. Research  Research in arthropod-borne viruses is currently limited to zoologic work in collaboration with the Evandro-Chagas Institute and the Virus Laboratory in Belem.

B. Training  There is an active enterovirus and tissue culture laboratory which is training personnel, some of which might eventually become involved in arthropod-borne virus research.

C. Services  The major arthropod-borne virus project at this institute is production of yellow fever vaccine. A relatively new building is devoted to this purpose.

II. RESOURCES

The building, used many years ago by the Rockefeller Foundation for research on yellow fever, remains in relatively good condition. With the exception of the enterovirus laboratory, this building is not utilized actively for virus research at this time. A new
microbiology building is under construction and might offer additional facilities for virus research. Also remaining from past Rockefeller Foundation activities is a large building and abundant equipment for mouse production. Were this unit utilized to its fullest extent, it could easily become the largest and most productive mouse colony in South America. However, mice are now used only in relatively small numbers for yellow fever virus and other vaccine evaluations. Mouse production is currently 50 to 70 litters per day.

The entomology section of this Institute is one of the largest taxonomic units in Latin America and offers a valuable reference museum for assistance in identification of arthropods of medical importance; this museum could be utilized on a greatly expanded scale. The availability of an excellent medical library at this Institute provides a basis for certain phases of education.

Pan American Foot-and-Mouth Disease Center, Rio de Janeiro
(Dr. R.da Cunha)

I. ACTIVITIES

A. Research This Center is devoted entirely to research on foot-and-mouth and vesicular stomatitis viruses. However, the recent recovery of vesicular stomatitis viruses from arthropods in a number of areas may bring this unit into the field of arthropod-borne virus research. The records of this laboratory on geographic distribution of vesicular stomatitis viruses are probably the most complete in South and Middle America. Their recent finding that Cotias circulate and excrete vesicular stomatitis (and foot and mouth virus) has stimulated this group to plan a field study of the role of wild rodents in the ecology of these viruses.

B. Training Organized courses are conducted at regular intervals for persons concerned with foot-and-mouth disease and vesicular stomatitis viruses from various countries in South and Middle America.

C. Services An active identification service for foot-and-mouth and vesicular stomatitis viruses is maintained. This service should be of increased value to the field of arthropod-borne virus research for identifying vesicular stomatitis viruses isolated from arthropods. They provide a current reference listing and abstract service on selected virus diseases to collaborating laboratories.
II. RESOURCES

This unit has excellent laboratories and in the future, when new buildings are completed, they will be beautifully equipped for research on foot-and-mouth disease and related viruses. Isolation of the laboratory in the country and the presence of multiple small laboratory buildings provides maximum security and safety for work with highly infectious agents. The unit has a large mouse colony producing from 100 to 120 litters per day. There is also a large guinea-pig colony which might be expanded and utilized for antiserum production. This unit is unique in having screened facilities for large animals which would permit experimental investigations of arthropod-borne viruses in such animals.

Institute of Microbiology, University of Brazil
(Dr. Cury in the absence of Dr. P. de Goes)

1. ACTIVITIES

A. Research  Virus research currently concerns respiratory and enteroviruses and interest has been expressed in arthropod-borne virus research. In past years, personnel, some of whom are no longer at this unit, have carried out investigations concerning Eastern and Western encephalitis viruses in the Rio de Janeiro area. These studies resulted in isolation of Eastern encephalitis virus from horse brain.

B. Training  This unit teaches microbiology to medical science students, and offers postgraduate courses and degrees.

C. Service  No service activities are currently available for arthropod-borne viruses, but the unit expressed an interest in providing diagnostic services to nearby hospitals.

II. RESOURCES

A new building, on the university campus, is devoted to all phases of the microbiology departments' activities. The staff is entirely full-time. One suite of laboratories in this building, available for virology research, is adequate for investigation of a single group of viruses, but would not permit simultaneous study of multiple virus groups. The mouse colony currently provides only 1 to 5 litters per day, but could be expanded perhaps fivefold. The current mouse colony facilities would be inadequate for an arthropod-borne virus field research program.
Rockefeller Virus Laboratory and Instituto Evandro Chagas,
Belem, (Drs. O.R. Causey, C.E. Causey and M.B. Lobo)

I. ACTIVITIES

A. Research In the past eight years this unit has discovered more new arthropod-borne viruses than any other laboratory in the world. Its activities have been those of isolating viruses from wild animals, febrile humans and arthropods. These agents have been submitted to the New York Rockefeller Foundation Laboratory for further study, identification and classification. In recent years, identification facilities have been developed in Belem so that more and more of these activities are done locally rather than in New York. Over the years, the large numbers of virus isolations have provided considerable insight into natural virus cycles and the ecology of arthropod-borne viruses. In addition to studying human arthropod-borne virus diseases in sentinel human populations living in forested environment, this unit has witnessed at least two epidemics of febrile human disease caused by arthropod-borne viruses (Mayaro and Oropouche), as well as studying sporadic cases of yellow fever. Recent isolations of viruses from lizards reveal the need for study of this group of vertebrate hosts which have been given relatively little attention. Similarly, the recent isolation of vesicular stomatitis virus from Gigantolaelaps mites focuses attention on a new group of vectors for this agent.

B. Training A number of short-term fellows and visitors have benefited by experience at this laboratory. It would be desirable in the future for trainees to spend longer periods. Arrangements are underway to transfer the Microbiology Department from the local medical school to new buildings under construction at the Institute. When this occurs, medical students will be taught microbiology at this laboratory.

C. Services The laboratory provides virus diagnostic services for physicians in and near Belem. Recently, by exchange of antisera with other laboratories (Panama and Trinidad), this laboratory has assisted in identification of newly-isolated arthropod-borne viruses from Middle America.

II. RESOURCES

The laboratory has multiple buildings which are well equipped for virus research and production of mice. A new unit in the Institute is nearly completed for cell culture-virus research. The buildings for the microbiology staff of the medical school will provide excellent laboratory facilities for research in a variety of microbiologic fields.
A building to be started in the next month or so will provide laboratory and classroom space and plans include renovation of an existing building into living quarters for trainees. The highly-productive and well-organized mouse colony supplies from 100 to 120 litters for use each day. Facilities are available for visiting scientists to produce arthropod-borne virus antisera for their own use.

8. TRINIDAD

Trinidad Regional Virus Laboratory, Port of Spain, (Drs. T.H.C. Aitken, C.B. Worth, and A.H. Jonkers)

1. ACTIVITIES

A. Research  This has been an extremely productive research unit in the period since its establishment in 1954. The objectives of its program have been to determine which arthropod-borne viruses occur in Trinidad, to carry out detailed ecologic studies of the circumstances which support virus maintenance in enzootic cycles, and to investigate the occurrence of human diseases associated with these viruses. For example, cases of yellow fever, dengue fever and Mayaro virus disease have been studied. Associations between various viruses and their arthropod vectors and vertebrate hosts are becoming clarified by their investigations. They plan to continue detailed ecologic studies in various habitats of Trinidad in an attempt to understand better the circumstances and conditions essential to arthropod-borne virus activity.

B. Training  This unit has had several fellows assigned to it for period of several years each, and numerous short-term trainees and visitors.

C. Services  At the moment the laboratory provides diagnostic services to Trinidad and the West Indies. There is an interest in extending this activity beyond the field of arthropod-borne viruses, at first to involve enteric viruses. The laboratory has performed serologic surveys for arthropod-borne virus diseases in certain islands of the Caribbean and in Venezuela and the Guianas. Investigation of an epizootic in horses in British Guiana resulted in recovery of Eastern and Western encephalitis virus. The laboratory has also participated in exchange of antisera with laboratories at Belem, Panama and Jamaica to assist in the identification of newly-isolated arthropod-borne viruses. There is an effective collaborative
program with the Gorgas Memorial Laboratory for studies on
mosquitoes and other arthropods; entomological materials
are provided to other research workers for study.

II. RESOURCES

This unit has recently moved into a newly-renovated
laboratory which provides excellent space and facilities for
research on arthropod-borne viruses. The Rockefeller Foundation
supplemented the existing buildings with space for animals and
offices for staff. From the research viewpoint, this facility
was among the best visited in Middle and South America; however,
it is not suited for educational purposes, because it provides
no classroom or teaching laboratory space. There is a large
mouse colony, which, over the years, has produced adequate mice
for local research needs.