Report on the Recent Outbreak of Jungle Yellow Fever in Panama


Coördinator, Yellow Fever Control Program, and Assistant to the Chief Health Officer, Chief Health Office, The Panama Canal, Balboa Heights, Canal Zone

Prior to the recent outbreak, the last confirmed case of yellow fever originating in the Canal Zone or the Republic of Panama was reported by Gorgas 1 May 22, 1907. From that date it was believed that yellow fever was nonexistent in Panama, until Kumm and Crawford 2 in 1943 reported the finding of ten Panamanian rural or jungle localities near the Colombian border where positive mouse protection tests 3 were secured in 27 children born since 1925. All but 2 of these were on Indians or Mestizos (Indian-Spanish mixture) living in the jungles near the Colombian border. This area is about 120 miles from the Canal Zone and the two principal cities of the Republic of Panama. Two positive reactors were found in the jungle 50 miles away. In view of the remoteness of these areas, and because no yellow fever cases or deaths had been reported since 1907, little concern was felt relevant to a possible outbreak or epidemic of yellow fever in Panama.

In mid-January, 1949, the Chief Health Office of The Panama Canal and the Office of the Director of Health, Republic of Panama, were informed of 5 deaths of a questionable nature which had occurred among natives who had lived near the village of Pacora, Republic of Panama, 18 miles east of Panama City. Inquiry revealed that during the months of November and December, 1948, these men had died in the large Panamanian Government hospital in Panama City (Map 1). All died of an acute, febrile disease of less than 7 days' duration and were reported to have had other symptoms (headache, icterus, and black vomitus) which occur in yellow fever. Liver tissue specimens on three of these cases were examined and found to be histopathologically typical of yellow fever. Specimens were sent to the Army Medical Research and Graduate School, Washington, D. C., and to the Rockefeller Laboratory, Rio de Janeiro, Brazil, for confirmation. Both of these laboratories reported 4, 5 these specimens as typically positive for yellow fever.

The day following local verification that these deaths had resulted from yellow fever, field investigations were made.

The second of these 5 cases to die, a Panamanian male (T. R.), is illustrative of the findings encountered in the other 4 cases. This man had lived and worked on his farm, a mile east of the middle of the Cabra River. The farm consisted of a clearing in first-growth jungle. He had been working in the rice field near the forest margin when he became ill. After 3 days of illness, he was admitted to the hospital, where he died 2 days later, November 14, 1948.

It was further ascertained that in this immediate area several other men had

been ill during this period with a similar febrile disease. Some were reported to have had jaundice, and 2 had black vomitus.

Local hunters reported that black howler (Alouatta palliata-inconsonans) and white-faced (Cebus capucinus-capucinus) monkeys were seen in surrounding forests during this approximate period.

With the histopathological record of positive liver specimens and the findings of the field investigations to confirm the outbreak of jungle yellow fever, all official local and international health authorities were immediately notified.

COÖPERATIVE PROGRAM

A conference of the Chief Health Officer of the Panama Canal and his assistants; the Director of Health of the Republic of Panama; the Surgeons of the Army, Navy, and Air Forces of the Canal Zone; and two advisers from the Pan American Sanitary Bureau; was held to determine a plan of action. It was agreed that the “Yellow Fever Control Program” should be coördinated under one office. A coördinator was nominated by this group. The Health Departments of the Panama Canal and the Republic of Panama requested and received from their respective Governments special appropriations to effect the program.

In the ensuing three weeks, while supplies were being obtained from the United States, teams of vaccinators and mosquito inspectors were trained. Yellow fever immunizations were given to the inhabitants of the cities of Panama and Colon, the communities of the Canal Zone, the Armed Forces establishments in the Canal Zone, and the rural populations in the area where the yellow fever cases had occurred. All incoming and outgoing airplanes were checked for mosquitoes and were sprayed with DDT and pyrethrum in aerosol.

PLAN OF CONTROL PROGRAM

During this same period, plans for an
overall Yellow Fever Control Program were drawn up and accepted. The plan embodied three major objectives:

(1) **Immunizations**: It seemed of primary importance, in order to prevent an epidemic in communities where *Aedes aegypti* might be prevalent, and to minimize the number of sporadic rural or jungle cases which might occur in the future, to immunize, as rapidly as possible, as many of the inhabitants of the Republic of Panama and the Canal Zone as was practicable and economically feasible. Such immunizations were mandatory only for persons living on Armed Forces installations and in the locality where the yellow fever outbreak had occurred.

(2) **Aedes aegypti Eradication**: Because of the proximity of endemic yellow fever areas in near-by South American countries, the rapid transport of persons by commercial and military airplanes between these areas and Panama, and the recently proven presence of the virus in the jungles of Panama, it was agreed that the only assurance of protecting the populations of Panama and the Canal Zone against an epidemic of yellow fever would be to eradicate completely the *A. aegypti* mosquito from the country.

Two previously established public health measures were now to pay added dividends by accelerating the *A. aegypti* eradication program. These were:

(a) In 1943, an *A. aegypti* control program was initiated in the cities of Panama and Colon and throughout the Canal Zone. From 1944 until this outbreak, an *A. aegypti* index of less than 0.5 per cent had been maintained.

(b) In 1947, the Department of Health of the Republic of Panama inaugurated an anti-malarial program of adult anopheline mosquito control by spraying the interiors of all houses in malarious regions throughout the Republic with residual DDT. By 1949, 205 towns and villages were being sprayed at regular intervals.

---

![Map 2](Map2.png)

A MAP OF THE REPUBLIC OF PANAMA

- Capital of the Republic of Panama
- Cities of 5000 or more population

MAP NO. 1

0 W.I.S. 10
As the _A. aegypti_ mosquito is known to be much more susceptible to DDT than the anopheline mosquito, it was reasoned that the towns and villages already under the anti-malarial spray program would be relatively free of _A. aegypti_ mosquitoes. Therefore, it was decided that the most effective and economical method of prosecuting the eradication program would be to augment this already well functioning organization in equipment and personnel. This organization would spray additional towns and villages where _A. aegypti_ were either thought to be present, or were actually found by our inspection teams.

In addition, trained inspection teams would check all communities not covered by the initial spray program and would inspect all sprayed areas 5 to 6 months after treatment.

To prevent the reintroduction of the _A. aegypti_ mosquito, all costal boats would be inspected each time they entered the principal harbors, and at 6 month intervals treated with a 90 per cent wettable powder DDT residual spray. No special measure would be required for airplanes, as all incoming craft were being sprayed in accordance with international agreement.

(3) Epidemiologic Studies: In order to determine in what areas the yellow fever virus was active, the direction of its movement, as well as the extent of the jungle reservoir, epidemiologic studies would be made. These studies would include: (a) Blood surveys of the human population; (b) Blood surveys of the monkey population; (c) Viscerotony service; (d) Entomological studies; (e) Field investigations of suspected yellow fever cases and deaths.

**Progress of Program up to September 15, 1949**

Before reporting any of the results of this program, a few facts should be disclosed concerning the geography and terrain of the country.

Because of the geographical location of the Republic of Panama, the long axis of the country runs east and west, rather than north and south. Thus, the region from the Panama Canal to the Colombian border will be called Eastern Panama; and the region from the Panama Canal to the Costa Rican border will be referred to as Western Panama (Map 2). The only all-weather roads in the country are: a paved Trans-Isthmian Highway between Panama and Colon cities; and one road extending from the west bank of the Canal opposite Balboa, for 350 miles, west to the city of David, in the Province of Chiriqui. This road is excellent for approximately 140 miles, but it is only irregularly passable for the remaining 210 miles. There is but one branch road. It is 40 miles long and is in poor condition. One other poor road extends from Panama City eastward for 28 miles to the town of Chepo, near the Bayano River. There is a mountain range—the Continental Divide—with altitudes ranging from a few hundred feet to over 9,000 feet, which bisects the country from the Colombian to the Costa Rican border. The entire length of this range is bordered by forests and dense jungles, which in turn terminate in tropical swamps washed by the Caribbean Sea on the north and by the Pacific Ocean on the south. From this brief description of the topography of the country, it is readily apparent that one major problem which has been encountered in prosecuting the Yellow Fever Control Program is that of transporting personnel and equipment. The most recent combined population figure for the Republic of Panama and the Canal Zone is approximately 600,000. Of these, one-half (300,000) live in the cities of Panama and Colon, the townsites of the Canal Zone, and the towns and villages along the road previously described. The remaining 300,000 (con-
sisting of aboriginal Indians and Mestizos) are scattered throughout the country, living either in tiny villages or communal groups in the jungle marshes, tropical forests, high mountain plateaus, or on extensive archipelagos. To reach these people, every possible form of transportation, including airplane, helicopter, motor boat, dugout canoe, horse, and foot travel, is required. For example, in order to reach the Guaymi Indians (approximately 3,000 in number) on the northern slopes of the mountains of the Province of Bocas del Toro, it was necessary to make a 12 hour sea voyage in a tugboat to the mouth of the Cricamola River; thence 3 hours by motor launch up the river; 4 hours more on the river by dugout canoe; followed by a 2 hour horseback trip; and, finally, 2 additional hours on foot.

Such difficulties of transportation immediately presented us with another serious problem, for although we were able to get our personnel and equipment to these nearly inaccessible areas, inability to provide adequate field refrigeration made it impossible to use the 17D yellow fever vaccine. It was, therefore, decided that the only practical solution was to use the dry Dakar yellow fever vaccine. This vaccine does not require field refrigeration, and application is made cutaneously—in a manner similar to smallpox vaccination. A supply of this vaccine, which has been accepted for international certification by the World Health Organization, was obtained by air from the Pasteur Institute, Dakar, Africa.

It is believed that this is the first time that the Dakar vaccine has been used for mass immunizations on the American Continent.

The progress which has been made in the three objectives of this program is as follows:

(1) **Immunizations:** The vaccination program was initiated February 1, 1949, and concluded September 15, 1949. In this period, it was frequently necessary for the Coördinator to make advance visits to various semi-wild Indian tribes for the purpose of overcoming supersti-
tions and competitive interference of the medicine men so that our vaccinating teams would be permitted to perform yellow fever immunizations.

During these 7½ months, 500,000 (83 per cent) of a population of 600,000 were immunized against yellow fever. It was considered nearly physically impossible and economically unsound to attempt to immunize the remaining 100,000.

(2) *Aedes aegypti Eradication:* From the beginning of the *A. aegypti* eradication program in mid-February, until mid-September, a total of 193 villages and towns were sprayed. *A. aegypti* foci (larval breeding places) were found in 31 towns and villages (Map 3). All buildings in these communities were treated with DDT residual spray and the foci were eliminated.

During the 11 weeks, from July 1 to September 15, 1949, only 2 foci were found. These foci were eliminated and the communities sprayed.

(3) Epidemiology.

(a) *Blood surveys of the human population:* Prior to inoculations, representative samplings of blood were obtained from young males (15 to 35 years of age) who gave a record of either working or living in the jungles. By September 15, 1949, a total of 732 human bloods had been tested and 100 (13 per cent) found to have positive mouse protection tests. These were from residents dispersed throughout the Republic (Map 4).

(b) *Blood surveys of the monkey population:* A systematic monkey blood survey (for mouse protection tests) was inaugurated in the Cabra River and Pacora forest areas, where the original 5 cases occurred.

Additional bloods have been, and are yet to be, obtained from the monkeys in the forests, east to west, as far as the Colombian and Costa Rican borders.

From ten areas, a total of 100 monkey bloods were collected, with 30 (30 per
### Table 1

**Locality Where Primates Immune to Yellow Fever Were Found**

<table>
<thead>
<tr>
<th>Locality</th>
<th>Specie</th>
<th>Sex</th>
<th>Weight lbs.</th>
<th>Age Estimated</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Bayano River</td>
<td><em>Ateles geoffroyi</em> Kuhl (Spider monkey)</td>
<td>M</td>
<td>5</td>
<td>Young adult</td>
</tr>
<tr>
<td>2. Middle Cabra River</td>
<td><em>Alouatta palliata inconsonans</em> (Goldman)—(Black howler monkey)</td>
<td>M</td>
<td>19</td>
<td>Old adult</td>
</tr>
<tr>
<td>3.</td>
<td></td>
<td>F</td>
<td>14½</td>
<td>Adult (fetus 3½ lbs.)</td>
</tr>
<tr>
<td>4.</td>
<td><em>Leontocebus geoffroyi</em> (Pucheran)—(Marmoset)</td>
<td></td>
<td></td>
<td>Adult</td>
</tr>
<tr>
<td>5.</td>
<td><em>Cebus capucinus capucinus</em> (Linnaeus)—(White-faced monkey)</td>
<td>M</td>
<td>1</td>
<td>Adult</td>
</tr>
<tr>
<td>6. Bayano River near Canita</td>
<td></td>
<td>F</td>
<td>3</td>
<td>Juvenile</td>
</tr>
<tr>
<td>7. Pacora</td>
<td><em>Ateles geoffroyi</em> Kuhl (Red spider monkey)</td>
<td>M</td>
<td>1</td>
<td>Young adult</td>
</tr>
<tr>
<td>8. Naranjal (midway between Pacora and Chepo)</td>
<td><em>Leontocebus geoffroyi</em> (Pucheran)—(Marmoset)</td>
<td>M</td>
<td>6</td>
<td>Young adult</td>
</tr>
<tr>
<td>9. Upper Cabra River</td>
<td></td>
<td>F</td>
<td>12</td>
<td>Adult</td>
</tr>
<tr>
<td>10.</td>
<td></td>
<td>F</td>
<td>9</td>
<td>Adult</td>
</tr>
<tr>
<td>11.</td>
<td></td>
<td>M</td>
<td>9</td>
<td>Adult</td>
</tr>
<tr>
<td>12.</td>
<td><em>Alouatta palliata inconsonans</em> (Goldman)—(Black howler monkey)</td>
<td>F</td>
<td>13½</td>
<td>Adult</td>
</tr>
<tr>
<td>13.</td>
<td></td>
<td>F</td>
<td>13</td>
<td>Adult</td>
</tr>
<tr>
<td>14.</td>
<td></td>
<td>F</td>
<td>12½</td>
<td>Adult</td>
</tr>
<tr>
<td>15.</td>
<td></td>
<td>F</td>
<td>8</td>
<td>Young adult</td>
</tr>
<tr>
<td>16.</td>
<td></td>
<td>F</td>
<td>12</td>
<td>Adult</td>
</tr>
<tr>
<td>17.</td>
<td></td>
<td>F</td>
<td>13</td>
<td>Adult</td>
</tr>
<tr>
<td>18.</td>
<td></td>
<td>F</td>
<td>9</td>
<td>Adult</td>
</tr>
<tr>
<td>19.</td>
<td><em>Cebus capucinus capucinus</em> (Linnaeus)—(White-faced monkey)</td>
<td>M</td>
<td>9</td>
<td>Adult</td>
</tr>
<tr>
<td>20. Mid-basin Chagres River, near Santa Rosa</td>
<td><em>Cebus capucinus capucinus</em> (Linnaeus)—(White-faced monkey)</td>
<td>M</td>
<td>5</td>
<td>Young adult</td>
</tr>
<tr>
<td>21.</td>
<td></td>
<td>F</td>
<td>3</td>
<td>Juvenile</td>
</tr>
<tr>
<td>22. Santa Rosa</td>
<td></td>
<td>F</td>
<td>5</td>
<td>Young adult</td>
</tr>
<tr>
<td>23. Las Guacas (opposite Santa Rosa, Chagres River)</td>
<td><em>Potos flavus isthmicus</em> (Goldman) (Kinkajou or Cusimbi)</td>
<td>M</td>
<td>7½</td>
<td>Adult</td>
</tr>
<tr>
<td>24. Tonosi</td>
<td><em>Alouatta palliata inconsonans</em> (Goldman)—(Black howler monkey)</td>
<td></td>
<td></td>
<td>Adult</td>
</tr>
<tr>
<td>25. West bank of Canal, rear of Barro Colorado, near Abejon Is.</td>
<td><em>Potos flavus isthmicus</em> (Goldman) (Kinkajou)</td>
<td>M</td>
<td>7½4</td>
<td>Adult</td>
</tr>
<tr>
<td>26. Quebrada Grande</td>
<td><em>Alouatta palliata inconsonans</em> (Goldman)—(Black howler monkey)</td>
<td>F</td>
<td>16</td>
<td>Old adult</td>
</tr>
<tr>
<td>27.</td>
<td></td>
<td>F</td>
<td>12</td>
<td>Adult (3-in. fetus)</td>
</tr>
<tr>
<td>28.</td>
<td></td>
<td>F</td>
<td>10</td>
<td>Young adult (2-day baby)</td>
</tr>
<tr>
<td>29. Rio Gigantito</td>
<td><em>Leontocebus geoffroyi</em> (Pucheran)—(Marmoset)</td>
<td>M</td>
<td>1</td>
<td>Adult</td>
</tr>
<tr>
<td>30. Orchid Island</td>
<td><em>Alouatta palliata inconsonans</em> (Goldman)—(Black howler monkey)</td>
<td>F</td>
<td>5</td>
<td>Juvenile</td>
</tr>
</tbody>
</table>
cent) having positive tests (Map 5 and Table 1).

(c) Viscerotomy service: For additional alert stations, twenty-six viscerotomy posts have been established to obtain liver specimens from persons who die from undiagnosed fevers of 10 days' or less duration. Based upon centuries of Indian and Latin mores, there has been a natural reluctance of the relatives to allow viscerotome punctures on the deceased. Consequently, this service has not been too productive. However, with the additional support of the officials of the Republic, this service should operate more efficiently in providing information concerning yellow fever deaths which otherwise would remain unknown. A total of 40 viscerotome liver specimens have been examined, and, to date, all have been negative for yellow fever.

(d) Entomological studies: Although studies of the forest mosquitoes have been in progress, we have not yet been able to establish which mosquito is our local sylvan vector.

To date, we have found no Haemagogus capricornii in our forests. H. spegazzinii falco and A. leucocelaenus mosquitoes (both proven sylvan vectors of yellow fever in nature—Kumm 6) have, only since the onset of the rains, been found in forests near the areas where the yellow fever deaths occurred. We are now in the process of making viral studies of these two mosquitoes to determine which is our local vector.

(e) Field investigations of suspected yellow fever cases and deaths: Four such investigations were made subsequent to the investigation of the original 5 deaths. The first 2 were not yellow fever.

The third investigation was made August 9, 1949, following a report from a hospital in Panama City of an Indian (C. R.) who had died August 7, 1949, and whose liver, upon autopsy the following day, revealed typical histopathologic findings of yellow fever. Investi-
gation revealed that 3 days prior to becoming ill, this Indian had gone to work clearing land on a small farm situated in the jungle on the Atlantic slope of the Continental Divide, 14½ miles south of Colon, and 3 miles west of the Trans-Isthmian Highway. At noon of the 4th day of work, he became ill and was forced to leave his work and seek his bed. The 2nd day of his illness he complained of high fever and severe post-orbital headaches. The next day he was icteric and vomited coffee ground material. He was admitted to the hospital the following morning, and died the night of the day following admission. The total duration of the illness was 5 days.

The farm on which this man had worked is located in the midst of first-growth forest, where he had been clearing additional land on the margin of the farm.

It was reported that a band of black howler monkeys had been noticed in this same forest area two to three weeks prior to our investigation. Seven monkeys were sighted on the ridge across from the farm, and 6 were shot and bled. Three of these monkey bloods showed positive mouse protection tests.

It is important to note that this man had never been immunized against yellow fever. This proven case of yellow fever would appear to have been acquired in the aforementioned area.

The fourth investigation was made Sunday, August 21, 1949, following notification that a patient had been hospitalized in Panama City on August 18, 1949, with a clinical diagnosis of yellow fever. The patient, a Panamanian male (A. B.), aged 20, had been clearing first-growth jungle in preparing land for a banana plantation on a mountain slope at Quebrada El Pato, in the same general forest area as the preceding case. Field investigation revealed a similar pattern to that described in the third investigation.

SUMMARY

1. Herewith, the first proven outbreak of jungle yellow fever in Panama is presented in a preliminary report.
2. Seven known yellow fever deaths have been recorded, 5 of which were verified by liver tissue specimens which demonstrated classical yellow fever histopathology.
3. In 7 ½ months, 500,000 (83 per cent) of a population of 600,000 were immunized against yellow fever.
4. Positive mouse protection tests on blood sera from monkeys and young humans have been presented from widely scattered jungle and forest regions of the Republic of Panama and the Canal Zone.
5. Presented, also, is the current status of the A. aegypti eradication program in the Republic of Panama and the Canal Zone.
6. As far as can be ascertained, this is the first time that Dakar yellow fever vaccine has been used for mass vaccinations on the American Continent.

7. In conclusion, the remark of Rae concerning yellow fever outbreaks is, as elsewhere, equally applicable here: "The history of yellow fever—to anyone who has to do with outbreaks of the disease—has two phases. The first during the outbreak is one of extreme fear and perturbation, but this is followed when the emergency ceases by an unwarranted feeling of complacency. We can never afford this complacent attitude."

Acknowledgments are made to the following:

Minister of Labor, Social Hygiene, and Public Health and the Director of Public Health, Republic of Panama; for their ever-ready encouragement and official assistance with this program.

Dr. Herbert C. Clark, Director, Gorgas Memorial Laboratory, Panama, Republic of Panama; for his timely advice and guidance, as well as his never-tiring efforts in obtaining monkey bloods for our epidemiologic studies.

Dr. Manuel Roca Garcia, Director, Carlos Finlay Institute, Bogota, Colombia; for the invaluable assistance of him and his staff in performing mouse protection tests on the human and monkey bloods obtained for these studies.

Dr. Pedro Galindo, Director, Anti-Malarial Service, Republic of Panama; for effecting DDT spraying of A. aegypti positive villages, as well as his work in connection with the study of our jungle mosquitoes for identification of the sylvan mosquito vector in Panama.
The Pan American Sanitary Bureau; for promptly providing experts to train our yellow fever vaccinators and mosquito inspectors. The United States Army, Caribbean Command; the United States Air Force, Caribbean Air Command; and the Fifteenth Naval District of the United States Navy; for providing transportation (air and other forms) and for initiating A. aegypti eradication in their respective areas.

Others: Rockefeller Laboratory, Rio de Janeiro, Brazil; Pasteur Institute, Dakar, Africa; U.S.P.H.S. Laboratory, Montana; Board of Health Laboratory, Gorgas Hospital, C. Z.; other divisions of The Panama Canal; for very courteous and prompt assistance in supplying vaccine and confirmatory laboratory reports for our studies.

REFERENCES

Mid-Century Conference on Children

The November Journal (p. 1503) had a brief news item on the Mid-Century White House Conference on Children, the fifth in a series that has been held in each decade of the 20th century. Each has had a specific emphasis. That of the 1950 Conference to be held in December is the mental, emotional, and spiritual growth of children into happy adults and responsible citizens, "toward a mature generation," as it were.

Among the four advisory councils of the Conference is one on Participation of National Organizations. Dean Roberts, M.D., represents the A.P.H.A. on this Council's steering committee, made up of representatives of 59 national agencies.

"Toward a Mature Generation" has been prepared as a questionnaire or guide for state committees in gathering information for the White House Conference. The Conference is planned so that the three stages, pre-conference, conference, and post-conference, shall all contribute to the advancement of child welfare. The data gathered by state and local groups and the various committees will be the basis of Conference conclusions and recommendations. In the post-Conference era the same groups will be the channels for citizen implementation of recommendations.

It is expected that the information on current practices in child health conferences gathered by the A.P.H.A.'s Committee on Child Health will be of use to the Committee on Fact Finding of the White House Conference. Dr. Atwater is a member of the Conference Program Committee. The National Health Council has been asked to serve as liaison between the Conference and the member agencies of the Council.