Poliomyelitis Antibodies in Inhabitants of the Society Islands, French Oceania. (22189)

JOHN F. KESSEL, VICTOR J. CABASSO, AND MAX R. STEBBINS.

Institut de Recherches Medicales de l'Oceaine Francaise, Papeete, Tahiti, Department of Infectious Diseases, School of Medicine, University of California, Los Angeles; and Research Division, Lederle Laboratories, American Cyanamid Co., Pearl River, N. Y.

In 1950, a study had been planned of the distribution of poliomyelitis serum-antibodies among inhabitants of the Society Islands, French Oceania. Unfortunately, the first serum samples obtained were lost in transit to the United States. Then, in March 1951, an unexpected outbreak of the disease occurred in Tahiti, largest of the islands. Collections of new specimens from this and other islands, therefore, had to be conducted during and after the epidemic period. This was the first poliomyelitis epidemic reported from the region, although several sporadic cases of the disease were known to have occurred prior to 1951(1,2).

The accompanying map (Fig. 1) shows the relative position of the Society Islands and distances between them. There is daily boat service between Tahiti and Moorea, while only weekly service operates between Tahiti, Huahine, Raiatea and Bora-Bora. Irregular service takes place in smaller boats by special arrangement between Bora-Bora and Maupiti —perhaps every 2 weeks or only once a month. Maiao is not in direct line of travel between Tahiti and the larger islands and, because of its small population and inadequate pass, boats do not call there more than 3 or 4 times a year, and always by special arrangement from Tahiti. Tahiti, where the epidemic began, reported 109 cases of the disease, and the other Society Islands, only 2 cases: one from Huahine and another from Raiatea. No paralytic cases were observed in Maiao, Maupiti or Moorea. The high paralytic rate of 360 per 100000 (1,2) was recorded during this epidemic.

The object of this communication is to present results of attempts to isolate virus from stool specimens collected from several frank cases of the disease and to measure complement-fixing and neutralizing antibodies in serum specimens from Tahitian patients as well as from the general populations of Maiao, Maupiti, Moorea and Huahine.

Materials and methods. Stool specimens

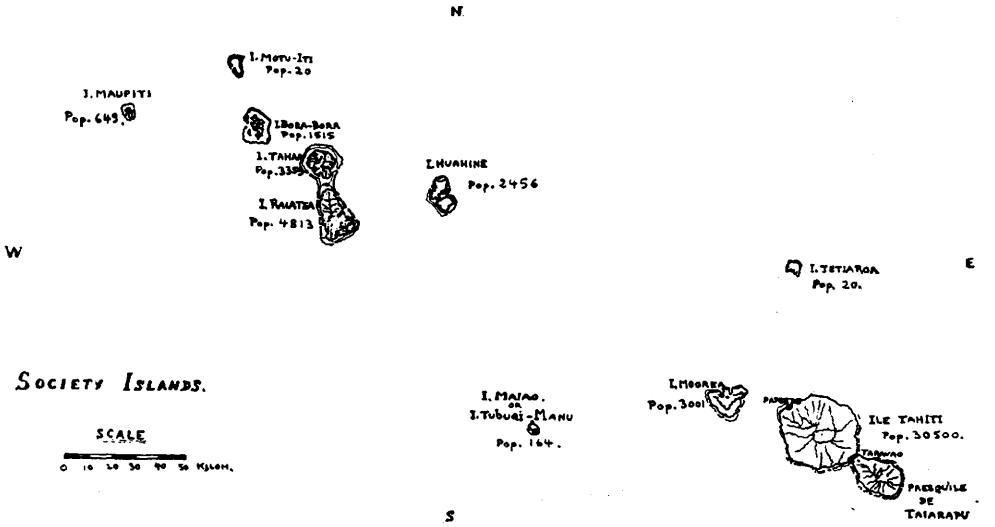

FIG. 1.

TABLE I. Schedule of Collection and Testing of Serum Specimens from the Society Islands.

Island	Total No. of sera collected		No. of specimens tested			
	Polio patients	Others	Polio patients C.F.	Polio patients S.N.	Others C.F.	Others S.N.
Tahiti	10	31	8	6	31	6
Maiao		21			20	12
Maupiti		71			46	12
Moorea		76			55	12
Huahine		72			65	15
Totals	10	271	8	6	217	57

were secured from 7 sick patients in Tahiti and all were processed for virus isolation.* A total of 281 serum samples were collected from 5 islands (Tahiti, Maiao, Maupiti, Moorea, and Huahine). Because of breakage upon arrival at the laboratory, only 217 of these were tested for Type 2 antibodies by the C.F. method. Of these, a great number were found anticomplementary, and data reported below pertains to 131 individuals. In addition, 57 specimens were tested for all 3 types of antibodies by the serum-neutralization method (Table I). *Complement-fixation.*† The technic used was essentially the Kolmer-Boerner test(4) which utilizes overnight icebox incubation. Inactivated serum specimens were diluted in normal saline in serial 2-fold dilutions from 1:2 to 1:16. Duplicates of the 1:2 and 1:4 dilutions were also made. Addition of 2 units of Type 2 antigen to the complete line of tubes and of a corresponding volume of saline to the duplicates followed. After distribution of 2 full units of complement, incubation was carried out at 4°C for almost 18 hours. Two per cent sheep cells and 2 units of hemolysin were then added, and the tubes were read after further incubation for 15 minutes at 37°C. The antigen used was derived from acetone-extracted material from suckling hamster brains infected with the MEF_1 strain of Type 2 virus. *Serum Neutralization.*† This was done by mixing equal amounts of inactivated, undiluted serum with each of 3 tissue culture suspensions containing about 200 tissue culture doses of Type 1, 2, or 3 virus, giving final concentrations of 1:2 serum and 100 infective doses of virus. In a few cases, where the amount of serum available was limited, initial 1:2 dilutions were used in the mixtures. Adequate normal serum control mixtures were also prepared. All mixtures were incubated in water bath at 37°C for one hour before inoculation into monolayer, monkey kidney culture tubes—3 or 4 per mixture—in medium 199(5). Virus titrations were performed simultaneously. The tubes were observed for cytopathic action for 4 days, at which time the cells of control tubes were completely destroyed.

Results. Of the 7 stool specimens tested, only one yielded poliomyelitis virus of Type 1. This was from the same patient also found to be positive by Dr. Horstmann(3) with whom each of the specimens had been divided.

Results of neutralization tests against all 3 types of poliomyelitis virus on sera collected from individuals on the islands of Maiao, Maupiti and Huahine; and on sera from paralytic cases in Tahiti, obtained from one to 5 weeks after onset of illness, are shown in Fig. 2. It must be remembered that Maiao (column 1) has the least communication with Tahiti and the other Society Islands, whereas Maupiti (column 2) has slightly more, and Moorea and Huahine (columns 3 and 4) are visited by ships at daily or weekly intervals.

Since Maiao remained isolated early in the epidemic, it may be assumed that the neutralization pattern for sera from this island is representative of that which prevailed in all of the Society Islands prior to the 1951 epidemic. Types 1 and 2 viruses were neutralized by less than 30% of the serum samples from Maiao while Type 3 virus was neutralized by 75% of the samples. In addition, analysis of the Maiao results by age groups reveals a total absence of Type 1 neutralizing antibodies in individuals below 25 years of age.

Tahiti presented a different picture, with 93% of the sera from recognized cases of poliomyelitis collected during the epidemic,

* Courtesy of Dr. Charles F. Pait and Dr. Penti Kokko, Virus Laboratory, Los Angeles County Hospital.

† These tests were performed by the Research Division, Lederle Laboratories, Pearl River, N. Y.

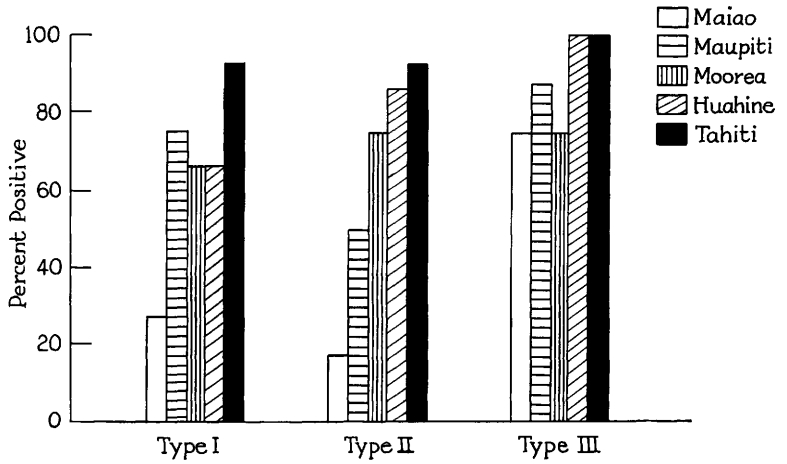

FIG. 2. Types I, II and III neutralizing antibodies in Society Islands.

neutralizing Types 1 and 2 viruses, and 100% neutralizing Type 3 virus. As might have been expected, specimens from other islands showed patterns intermediate between those found for Maiao and Tahiti.

The isolation of Type 1 virus from the stool specimen of one of the patients with paralytic poliomyelitis suggests that this virus was active at the time and that an increase of antibodies to Type 1 virus was to be expected during or after the epidemic. That this occurred is indicated by the fact that 93% of the blood samples collected from post-paralytic cases showed neutralizing antibodies to Type 1 virus, the highest rate in any group tested. It is of interest that the rate of Type 2 neutralizing antibodies was also high in the same group of specimens—93%. In addition, when these sera were tested for complement-fixing antibodies, 75% were found positive for Type 2 virus.

Distribution of neutralizing antibodies by age groups for the 3 types of virus, and of complement-fixing antibodies for Type 2 among sera tested, is depicted in Fig. 3. Specimens from active cases of poliomyelitis infection were excluded from this Figure. It will be observed that, except for the youngest age group, 0-4 years of age, the percentage of Type 3 neutralizing antibodies was higher than of Type 1 or 2; and that the patterns of neutralizing antibodies for Types 1 and 2 were similar to each other.

It is of interest that, shortly after the epidemic of poliomyelitis in Tahiti, Type 2 complement-fixing antibodies were present in normal sera collected from all islands surveyed. Since Casals and others(6) have shown that an increase of complement-fixing antibodies to Type 2 virus may be stimulated by the heterologous Type 1, it is possible that the presence of complement-fixing antibodies to Type 2 virus in the Society Islands at this time was stimulated by Type 1 virus which was active in these islands.

Summary and conclusions. Early in 1951, an epidemic of poliomyelitis occurred in Tahiti during which Type 1 virus was recovered from feces of a paralytic case. Tests on 131 serum samples collected from inhabitants of Tahiti and others of the Society Islands, during and after the outbreak, yielded the following results: 1. A higher percentage of Type 3 than of Types 1 and 2 neutralizing antibodies was found in sera from persons living in the outer Society Islands. On the other hand, higher percentages of neutralizing antibodies against Type 1 and 2 viruses were present in sera of residents of Tahiti during and after paralytic attacks of poliomyelitis than in normal serums from the outer islands. 2. After the epidemic, complement-fixing antibodies for Type 2 virus were present in sera of individuals from the outer islands, and in even higher percentages in sera of post-paralytic patients in Tahiti. Since complement-

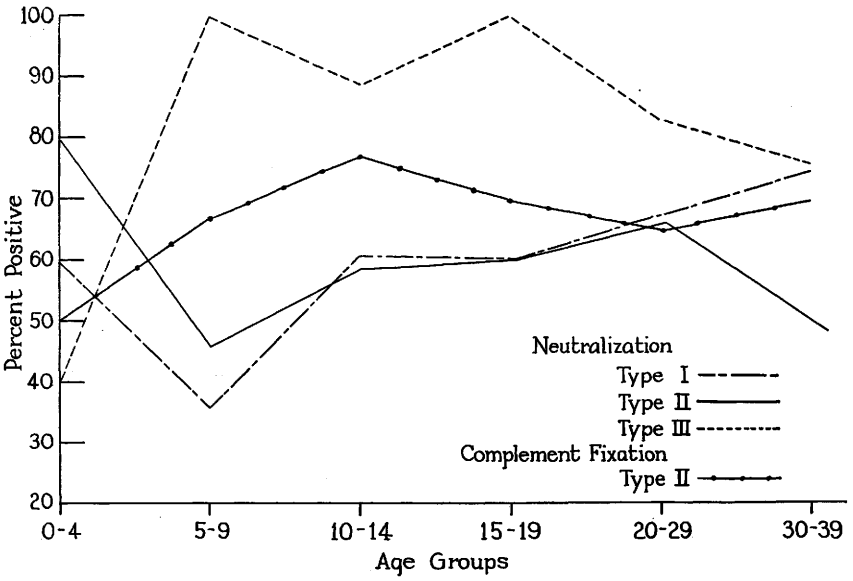

FIG. 3. Neutralizing antibodies by age groups for Types I, II and III and complement fixing antibodies for Type II virus.

fixing antibodies to Type 2 virus may indicate serologic response to the heterologous Type 1 virus, widespread dissemination of Type 1 virus probably occurred at this time. 3. These observations suggest that immunity to poliomyelitis in the Society Islands prior to the epidemic of 1951 was greater to Type 3 virus, and that the outbreak resulted from recent introduction of Type 1 virus, a new type for the area. It is possible that Type 2 virus was present coincidentally.

1. Thooris, G., and Rosen, L., *Presse Med.*, 1952, v80, 1712.

2. Rosen, L., and Thooris, G., *Am. J. Hyg.*, 1953, v57, 237.

3. Horstmann, D. M., and Kraft, L. M., *J. Immunol.*, 1955, v75, 249.

4. Kolmer, J. A., and Boerner, F., *Approved Laboratory Technic*, ed. 3, 1941, D. Appleton Century Co., Inc., New York, 616.

5. Morgan, J. F., Morton, H. J., and Parker, R. C., PROC. SOC. EXP. BIOL. AND MED., 1950, v73, 1.

6. Casals, J., Olitsky, P. K., and Anslow, R. O., *J. Exp. Med.*, 1951, v94, 123.

Received December 6, 1955. P.S.E.B.M., 1956, v91.

Modification of Radiation Injury in the Rabbit. (22190)

L. O. JACOBSON, E. K. MARKS, AND E. O. GASTON.

Argonne Cancer Research Hospital and Department of Medicine, University of Chicago, Ill.

Heterologous tissue transplants or cell suspensions of hematopoietic origin have been reported by Lorenz and his associates(1,2) and Jacobson *et al.*(3) to have a significant effect on survival and hematopoietic regeneration of irradiated rodents. Jacobson first described evidence that suggested the effectiveness of mouse spleen transplants for hastening recovery of the blood-forming tissue of irradiated rabbits(4). Congdon and Lorenz (5) reported that rat bone marrow and rat bone had a significant effect on survival of irradiated mice and that guinea pig marrow likewise afforded a significant increase in survival of irradiated mice. Jacobson and coworkers(3) and more recently Cole *et al.*(6)