Viral Infection of Cynomolgus Macaque (*Macaca irus*)
Survey of Antiviral Antibodies in 178 Sera

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ABSTRACT The antiviral antibody against 14 viruses was studied with sera from 178 cynomolgus macaques. The viruses were employed, taking into consideration the probability of natural infection with the viruses in the habitats of the macaques and by contact with humans.

Results on influenza and group B arboviruses were significant. 1) No hemagglutination inhibition (HI) antibody against influenza A2 (Adachi) was found but antibody against influenza B (Setagaya) was found in about 50% of the sera tested every year. 2) The results of the HI test with group B arboviruses indicated that macaques were infected with dengue type 2 and Japanese encephalitis viruses. Macaques also showed a high proportion of sero-positive cases and high antibody titers against herpes simplex, measles, and SV5 viruses.

Antibody against at least one of the viruses tested was present in 170 of the 178 sera tested.

INTRODUCTION

Recently, nonhuman primates have been used for research not only in medical science but also in other fields. For many of the advances made in virology in medical science, macaques in nonhuman primates have proved very suitable as experimental material. The reports of LANDSTEINER et al. (1909) and DULBECCO et al. (1954) are interesting in this connection. The former workers infected monkeys with poliovirus and in this way obtained important clues on the mode of infection of man with this virus. Later, it found that monkeys were susceptible to various other kinds of virus, such as measles (BLAKE et al., 1921), Japanese encephalitis (JE) (HAYASHI, 1935), and dengue viruses (ROSEN, 1958). DULBECCO et al. (1954) reported that the technique of primary monkey kidney (PMK) cell culture could be used for quantitatively virological study. This technique has also been used for isolation of a number of animal viruses and for development of various viral vaccines and studies on viral genetics (ROWE et al., 1965). In 1955, simian viruses were isolated from PMK cell cultures by RUSTIGIAN et al. and then many findings have been summarized by HULL et al. (1958). Subsequently, virus isolation of monkey origin from PMK cell cultures, feces, throat swabs, and various other tissues of monkeys has been reported by many investigators (MALHERBE et al., 1957; FUENTES-
MARINS et al., 1963; BLACK et al., 1963; MELNICK et al., 1964; BHATT et al., 1966a; DANIEL et al., 1967).

These reports have clarified the characteristics of each virus isolated. However, there is little information available about viral infection of monkeys, the viruses which infect monkeys naturally in their habitat or the viruses transmitted to monkeys by contact with human (KALTER et al., 1967). On the other hand, recent advances in laboratory animal science have shown the importance of monkeys as experimental animals, so a good understanding on viral infection of monkeys has become necessary.

Accordingly we surveyed viral infection of cynomolgus macaques, and this study also contributes to knowledge on viral ecology.

This paper reports studies on the sera of 178 cynomolgus macaques employed for PMK cell culture at our virus laboratory in a survey of their antiviral antibodies against 14 viruses.

MATERIALS AND METHODS

Monkeys
The monkeys used for PMK cell culture were 178 cynomolgus macaques. Details of their geographical habitats and the number of them examined each year are shown in Table 1. The macaques were trapped and put into an animal cage near the trapper's village and then transported to Osaka by plane through animal traders (Chang Brothers Co. and Takano Co.). Most of the monkeys were sacrificed within two weeks after arrival in Osaka. They were not vaccinated against any kind of bacteria or virus.

Monkey sera
Serum was obtained from each monkey by cardiac puncture under ether anesthesia and was stored at \(-20^\circ\text{C}\) until tested. All sera were single specimens.

Viruses
The viruses employed as antigens for serologic tests and the method of preparation of antigen for each virus are shown in Table 2. Two respiratory viruses, two enteroviruses, and five arboviruses were used, because it was possible from geographic origin of the monkeys and the geographic distribution of these viruses that the monkeys might have come into contact with these viruses by contact with man.

The viruses except these nine were used for consideration of the probability of natural infection with the viruses of monkey source in the habitat of the monkeys. Herpes simplex (HSV), measles, and reo type 1 (ECHO 10) viruses were employed in place of a simian virus of monkey origin since each of these three viruses was closely