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OPEN DISCUSSION

Moderator: Dr. Horwitz

Dr. Fox: I would like to return to the data that Drs. Wisseman and Gamarra presented about Bolivia. (Dr. Wisseman's information was actually about Peru and collected by my group there in the mid-1950's.) What impresses me is that the Bolivian serology data are virtually identical to those we gathered in the Puno and Cusco areas of Peru 17 years previously. The Peruvian-Bolivian border scarcely exists as far as the inhabitants of the two countries are concerned and the conditions on the two sides of the border are about the same; they were, at least, in 1955-56, and I doubt that they have changed much. At that time we estimated the louse prevalence in the Puno and Cusco populations to be about 95 per cent.

It would seem that there has been a stable pattern of typhus infection in the Peruvian and Bolivian populations. We made a few simple arithmetic calculations from the progression of positive sera by ages and figured that there must have been infection rates of 3 per cent per year in the population under age 30. This, together with our best reported cases, suggested that it took 27 to 30 infections to produce one case that would be recognized. We assumed that this probably reflected the fact that there were almost no physicians in the area and that overt cases were actually occurring but were simply not being seen medically and therefore were not being reported.

When we were doing our work in the mid-1950's, we set up our E strain vaccine trial on the assumption that typhus was being grossly underreported. We took rather stringent precautions to make sure that any clinically evident case among the 30,000 people we had under surveillance would come to our attention. We divided the area

into about 17 districts and in each stationed a sanitarian who made household checks on a 10- to 12-day cycle. In addition, people were invited to come in and be seen by an available physician if they had any illness.

When we finished our data collection we had too few cases to form a statistically significant judgment that E strain vaccine had been effective in preventing disease. We were able, however, to get some sera three and a half years after the start of the trial from people who had received the placebo vaccine and who had been antibody-negative at the beginning of the trial. This let us estimate how much infection had actually been occurring in the population, and, somewhat to our surprise, it was still about 30 infections for each case that we had been able to identify.

According to Dr. Wisseman's data, the antibody prevalence was lower in all age groups in the population of the Arequipa area of Peru. In that area the louse prevalence was only about 60 per cent and the infestations were somewhat lighter. I gather from conversations with Drs. Wisseman and Fabrikant that the louse infestation in Bolivia may not be this high now. I am a little puzzled by the persistence of high antibody prevalence despite what may be a reduced louse prevalence.

Dr. Wisseman: The antibody distribution pattern in the Peruvian area had been rather stable for 15 years, which must mean that a great deal of typhus transmission was occurring, especially since reported cases were declining in the area in the same period.

Dr. Traub: Dr. Fox's point about national boundaries is an important one. The people in the mountains of Pakistan who were found to be louse-infested were mostly shepherds

who, with their sheep, goats, and cattle, wander around the mountains of Pakistan and Afghanistan without paying any particular attention to the border. If there is a typhus outbreak in Pakistan, the tendency is to say it came from Afghanistan, and vice versa. In all probability some of these mountain people wander into Iran and the Central Asian republics of the Soviet Union too. In this entire remote area typhus cases generally go unrecognized because there are no doctors.

Dr. Fabrikant: Dr. Fox, when you made your louse surveys in Peru, were they in areas accessible by road or in relatively inaccessible areas? I ask because we always looked for lice in Bolivia in communities that were fairly well served by roads. From the appearance of people we saw from areas not so readily accessible, I would say that they probably have a much, much higher incidence of lousiness.

Dr. Fox: I don't know how you define "accessible." We got there by jeep over what the maps showed were roads, though they were a little rough. The communities we surveyed were remote, but we did not have to reach them by donkey.

Dr. Reeves: Dr. Murray, have you used computers and statisticians to develop a stochastic model for identifying critical threshold levels for vector populations and determining the proportion of carriers in the human population so that we could see if modification of one factor might be more effective than of another?

Dr. Murray: We haven't done anything of that kind and will probably have to leave it to others. The data that are emerging are largely about Dr. Gaon's fine louse counts, which give some indication of what kind of louse density and prevalence must exist for the disease to pass from a Brill-Zinsser

patient to a susceptible person or from a susceptible person who has contracted the disease to another susceptible person.

Dr. Wiseman: You were talking about an area in Yugoslavia where typhus was fairly widespread but has now declined below the threshold level you mentioned. That is an important concept. In the United States we also have all the components needed for typhus transmission, but the failure of typhus to take hold here is not due so much to threshold levels as to compartmentalization within the society. Hippies do not react with the people who have recrudescing typhus; the two belong to different subcultures that do not interact. This is another factor that ought to be considered in developing models and projections of typhus potential.

Dr. Gaon: Someone asked if it would be possible to attract body lice by feeding them on patients with typhus or Brill-Zinsser disease. I once got a clinician to let me feed 25 or 30 hungry lice on one of his patients, after which he had to start treating him with antibiotics. Later I examined the feces of each louse and if they were positive I opened the louse, took out the gut and spread it, using Weyer's technique, and looked for *Rickettsia quintana*. Between 62 and 80 per cent of the lice had become infected after only one feeding.

I also fed 38 lice on 38 trench fever patients—i.e., a total of 1,444 feedings—between five and eight days after the onset of their disease. No lice became infected. We concluded that lice will not become infected if they are fed on patients after the second day following disease onset.

It is necessary to feed many more lice on Brill-Zinsser patients than on primary typhus patients. We know that between 1 and 5 per cent of lice fed on Brill-Zinsser patients during the first week of their illness can be infected.