of the temperature rise reduced the fever and restored the temperature to approximately normal.

Reports of the action of LSD in intact animals and human beings have been conflicting and undependable. Forrer and Goldner (*2*) report that two of five patients showed a slight rise in oral temperature after LSD. Reports of other actions of LSD on the cardiovascular system (*2*), central nervous system (*4*), and autonomic system (*5*) are likewise variable and equivocal. The pyretogenic effects reported here are reproducible and dependable, and so there is a possibility of taking advantage of this effect as an end-point in the investigation of the pharmacology of LSD. On the one hand, this effect may be part of the predominant central action. On the other hand, it may be simply a side action of this agent unconnected with its predominant central nervous system effects. Studies are being continued to determine the mechanism of this pyretogenic effect of LSD and to explore its usefulness in general pharmacologic studies of this agent.

Conclusions. Lysergic acid diethylamide produces a rise in body temperature of normal rabbits, cats, and dogs. This rise in temperature is antagonized by the administration of sodium pentobarbital but not by antipyrine or adrenergic blocking agents.

References and Notes

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Studies on *Pasteurella pestis* in Fleas: II. Experimental Blocking of *Xenopsylla cheopis* with an Avirulent Strain of *P. pestis*

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The classical findings (*1*) that fleas blocked with a proventricular mass of *Pasteurella pestis* were particularly significant plague vectors have been confirmed by numerous investigators (*2*). Nevertheless, to account for certain epidemiologic phenomena, some workers have suggested, without direct evidence, that the bacteria may undergo a loss of virulence in the flea (*3*). On the other hand, it is generally assumed that virulence of the plague bacillus cannot be increased in the flea. Nothing appears to be known about the fate of a completely avirulent strain of *P. pestis* in the flea. It is this problem that forms the basis for the preliminary observations reported here.

The development of an apparatus for the artificial feeding of fleas (*4*) made it possible to exert a high degree of control upon the number of bacteria ingested by the flea and to provide an efficient *modus operandi* for infecting fleas with avirulent plague strains. Thus by means of *in vitro* feeding of fleas, the oriental rat flea, *Xenopsylla cheopis,* could be given blood meals containing *P. pestis*. The data presented in Table 1 show the quantitative transfer of avirulent *P. pestis* strain A1122 (*5*) from the heparinized blood meal in the feeding apparatus to the flea. After infection, the fleas were maintained on white rats and removed when desired.

As was demonstrated by bacteriologic cultures, the plague bacilli multiplied rapidly after the first day in the ventriculus of the flea (Fig. 1). In the five female fleas that were macerated and plated out 2 days after infection, the bacteria count ranged from 1.1 to 6.0 million viable plague bacilli and averaged 3.0 million. In the five male fleas the range was from less than 5000 to more than 350,000, the average, 2.2×10^5 and the median, 2.6×10^5. The medians observed on any particular day did not represent as much as a twofold difference from either the averages or the actual bacterial counts of those fleas immediately above and below the median value.

The Indian Plague Commission (*6*) estimated the average stomach capacity of the rat flea, *X. cheopis,* to be 0.5 mm³. In the present study, the determinations made both by weighing the fleas and by counting the bacteria in them immediately after feeding show that the male has a greater body density but a smaller stomach capacity than the female *X. cheopis* (Table 1).

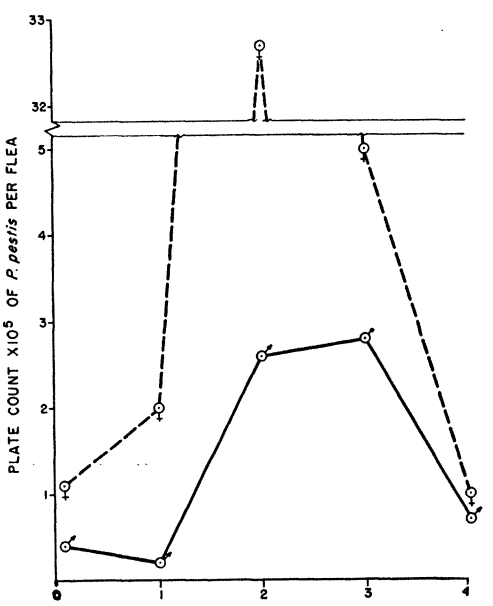

Fig. 1. The median *P. pestis* count in infected *X. cheopis* during the first 4 days after the infectious meal (each point represents the median of five fleas per sex).

Table 1. Numbers of *P. pestis* (avirulent strain A1122) and quantity of blood ingested by *X. cheopis*.

Fleas	Weight* (mg)	Blood vol. ml × 10^{-4} (calc.) †	Bacterial count‡ × 10^4 (actual)	(calc.)
Unfed ♂ ♂	0.30			
Fed ♂ ♂	.40	0.9	5.7	6.5
Unfed ♀ ♀	.27			
Fed ♀ ♀	.42	1.4	10.1	10.1

* Weights of fleas, average of 50 per sex; 1.0×10^{-4} ml blood meal weighs 0.1068 mg and contains 7.2×10^4 plague bacilli.
† Calculated on basis of average weight of blood ingested.
‡ Bacterial counts of fleas based on average of five per sex.

The calculated minimum concentration of plague organisms necessary to infect *X. cheopis* has been estimated at 10,000 bacilli per milliliter (*6*). With the avirulent plague strain used in the present experiments, a much higher concentration is necessary to establish successful infection in fleas. In an early test when a blood meal containing 400 million bacilli per milliliter was given to the fleas all the fed insects initially harbored bacteria. After 5 days, however, only two fleas out of 32 yielded microorganisms when they were macerated and cultured. When the bacteria count of the blood meal was increased to 720 million or more, more than 80 percent of the fleas remained infected with plague for more than 5 days.

Definite proventricular blocks associated with empty and constricted stomachs occurred as early as the second day after the infectious meal, but the rate of blocking did not attain 30 to 40 percent until after 6 to 9 days. Typical ventricular plague masses were observed on the third day and were found in more than half of the fleas examined from the fifth day on.

The *P. pestis* strain A1122, used for these studies, was tested before and after its use in infecting fleas and was found completely avirulent. The white rats, on each of which 60 or more infected fleas fed continuously for 15 days, showed no ill effects. Studies are in progress to challenge the immunity of these animals.

As expected, these preliminary results do not demonstrate any change of virulence after one passage in the flea, but they do establish the fact that a completely avirulent strain of plague multiples forms typical plague masses, and produces proventricular blocks in *X. cheopis* identical to those produced by virulent strains of plague. The blocking of the fleas appears to have a threshold requirement of concentration of microorganisms. This requirement, which may be different for each sex, has not been established, and it is also uncertain whether the quantity of bacteria would have any relationship to the virulence of different strains of plague. Furthermore, it is not known whether other bacteria and other avirulent plague strains will behave similarly to strain A1122 in the flea. These and other problems are now under investigation and will be reported in detail elsewhere.

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Communications

Echinococcosis on St. Lawrence Island, Alaska

Parasitological investigations undertaken on St. Lawrence Island (North East Cape) during part of the summer of 1954 revealed a high incidence of alveolar echinococcosis. Of 198 field mice *Microtus oeconomous* Pallas, *Clethrionomys rutilus* (Pallas) examined, 33 harbored the *Echinococcus* parasite. Such infections, usually confined to the liver, ranged in appearance from a focus that was barely perceptible to an infection that almost completely filled the abdominal cavity. The right lobe of the liver of one *Microtus* contained multilocular cysts whose over-all dimensions are 40 mm in length by 25 mm in width. In another *Microtus*, the entire body cavity was nearly filled with cystic formations. The cysts, aside from infecting both the right and left lobes of the liver, were scattered throughout the intestinal mesenteries and over the stomach and heart surfaces.

Two of 12 ground squirrels *Citellus undulatus* (Pallas) were infected with *Echinococcus*. In one of these animals, a massive infection had destroyed three-fourths of the right lobe of the liver. The general appearance of the multilocular cysts in ground squirrels differed only slightly from that in field mice, being somewhat whiter and with larger (3 to 6 mm) and less granular individual cysts. Of four shrews *Sorex jacksoni* (Hall and Gilmore) examined, one was heavily infected with *Echinococcus*. The appearance of the cystic formations in this animal was similar to that observed in field mice.

We have been unable to find records in the literature of alveolar *Echinococcus* occurring naturally in