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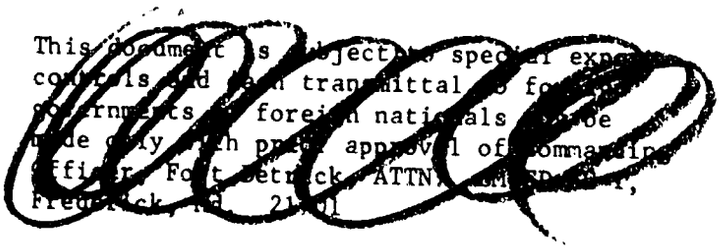

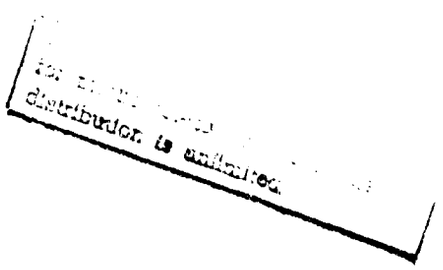

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EPIZOOTY OF PLAGUE IN THE SOUTHEAST KARA KUM IN 1964

[Following is the translation of an article by A. P. Vazhev, G. K. Tkachuk, O. P. Gel'dyev, A. A. Melanina, O. N. Nurgel'dyev, and V. F. Andreyeva, Turkmenskaya Antiplague Station, published in the Russian-language periodical Izvestiya Akademii Nauk Turkmenskoy SSR, Seriya Biologicheskikh Nauk (Bulletin of the Academy of Sciences, Turkmen SSR, Biological Sciences Series) No 1, 1968, pages 73--78. It was submitted on 20 Jun 1967.]

An epizooty of plague among rodents in the southeastern Kara-Kum was exposed for the first time in the spring of 1964. Up to this time the results of all the investigations in this region over a number of years (1955--1962) were always negative. The epizooty took place among great gerbils (Rhombomys Opimus Licht).

At first seven cultures of the plague microbe were isolated from 79 great gerbils which were supplied on 4 and 5 April from the vicinity of the Soyun-Kuyu well (Fig. 1) and six from 703 fleas which were taken from the wool of the great gerbils.

During a subsequent epizootological investigation 5 more independent microfoci were established. These were located in the regions of the wells at Yaban-Oy, Mollaroz, Kumyshly, Osman-Uyuk, and Teze-Kuyu. The total area covered by the epizooty comprised tens of thousands of hectares. The investigation of the epizootic territory continued without a break from 1 April through 1 December 1964 (with the exception of August). All the epizootic sectors were investigated repeatedly each month; the remaining territory of sand desert was investigated only once, and only in rare cases repeatedly. During the period of operation in the zone of the epizooty 7263 rodents were investigated (4759 of these were great gerbils), 32677 fleas and 15444 ticks taken from the rodents, and also 33099 fleas and 3390 ticks collected from the colonies and burrows of the rodents. All told 36 cultures of plague microbe were isolated. Of these 24 strains were from rodents, 11 from fleas, and one from ticks.

On the territory adjacent to the zone of the established epizootic 5416 rodents and 46595 ectoparasites were investigated, however, it was not possible to isolate a culture of plague microbe.

The epizooty of plague in the southeastern Kara-Kum bore a local microfocal nature. These local foci represented one or several colonies of great gerbils, the infectivity of which based on separate sectors fluctuated from 0.6 to 3.0%.

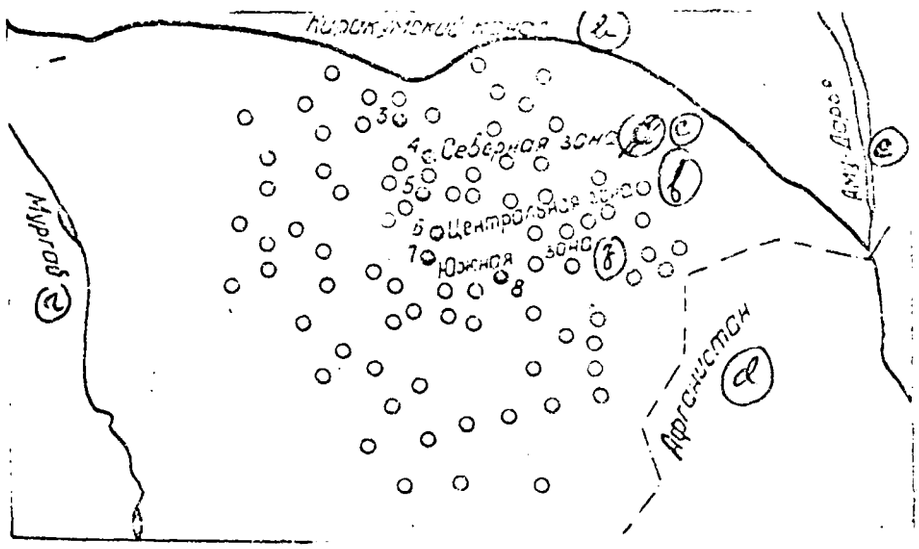

Figure 1. Schematic map of the plague epizooty in the southeastern Kara-Kum in 1964. ● - sites were cultures of plague microbe were isolated; ○ - investigated sectors; wells: 3 - Teze-Kuyu; 4 - Yaban-Oy; 5 - Mollaroz; 6 - Soyun-Kuyu; 7 - Kumyshli; 8 - Osman-Uyuk. Key: (a) Murgab; (b) Kara-Kum Canal; (c) Northern zone; (d) Afghanistan; (e) Amu-Darya; (f) Central zone; (g) Southern zone.

In this sector of the southeastern Kara-Kum the following species of animals are known: the suslik (Spermophilopsis leptodactylus Licht. 1823), porcupine, small jerboa, hairy-legged jerboa, tarboganchik [related to the marmot], house mouse, great, red-tailed, and midday gerbils, common mole-vole, Afghanistan vole, Central Asian hare, piebald shrew, long-eared hedgehog, mottled polecat, weasel, sand cat, corsac fox, and fox [4].

The great gerbil is the dominant species over the entire territory investigated.

On rodents and certain mammals of other species 19 species of fleas were detected: Pulex irritans, Echidnophaga gallinacea, E. oschanini, Xenopsylla gerbilli gerbilli, X. conformis, X. hirtipes, Synosternus pallidus, S. longispinus, Coptopsylla olgae, C. lamellifer, C. Bairamaliensis, C. l. Rostrata, Rostropsylla daca, Ceratophyllus laeviceps, C. turkmenicus, C. monstrosus, Paradoxopsyllus teretifrons, Rhadinopsylla cedestis, Stenoponia vlasovi.

The dominant species on the epizootic territory were the fleas X. gerbilli gerbilli, the numerical strength of which made up 81% in the collections.

An analysis of the materials makes it possible to divide the epizootic territory into 3 conditional sectors: north, central, and southern [1, 2, 3].

The northern sector borders the Kara-Kum Canal and is a low-hummocky sandy desert, in which takyr-like plains are impregnated (Tazly well). In places the flatland is stretched out from north to south with ravines 1--3 km in length and 100--200 meters in width. In the northern part of the sector (Yaban-Oy well) the flatlands are cut into by sand ridges with a height up to 10 meters and a length of 3--4 kilometers. The distance between these is 1--2 kilometers. These ridges serve as habitats of survival for rodents in unfavorable years. Here the predominant vegetation is a sazakovo-ilachnyy complex *. Colonies of great gerbils are scattered and rarely long and narrow (ravines, ridges). A characteristic for this sector is the considerable fluctuation in the number of rodents by seasons and years.

In 1964 the numerical strength of great gerbils per hectare was 0.4 animals in the spring and 3--4 animals in the fall with a colony density of 1--3 per hectare. In individual years (1965) the number reached 15 animals per hectare. The number of small gerbils (midday, red-tailed) was 0.1 animals in the spring and 10 in the fall (1964); sometimes in the spring (1965) it reached 15.

The central sector is characterized by ridge-hillock sands with a ridge height up to 10--15 meters. Important forms of microrelief are the shallow flat basins. Kandymo-ilachnyye associations of plants are predominant** The settlements of great gerbils are scattered. The central sector is the territory where the epizooty of plague among great gerbils proceeded most actively. The number of great gerbils in this region was also subject to fluctuations (8 in the spring and 5 in the fall), sometimes (1965) 12 in the spring with a colony density of 3--5 per hectare. The number of small gerbils fluctuates from 2 in the spring to 6 in the fall (1964) and up to 10 animals in the spring (1965) per hectare.

The southern sector represents a ridge desert (Predkarabilye). It is distinguished from the central region by higher (up to 50 m) and longer (up to 3--5 km) ridges. The most characteristic elements of the relief are the wide (up to 1000 meters) and deep basins. The slopes of the ridges and hillocks are steeper. Settlements of great gerbils have a scattered nature. Plant associations are represented by kyrtychno-kara-ilachnyy (in combination with kandymo-ilachnyy) complexes*** In this sector of the southeastern Kara-Kum the conditions for the existence of the great gerbil are most favorable, therefore their number here is the highest and the most stable. It reaches 16--24 animals with 4--6 colonies per hectare. The number of red-tailed and midday gerbils here is subject to fluctuations from 2 in the spring (1964) to 18 in the spring (1965) per hectare. The years preceding the epizooty (1962, 1963) were characterized by unfavorable conditions - drought, when the annual norm of precipitation of 152 mm dropped all told 105 mm in 1962 and 85.1 mm in 1963. The shortage of moisture seriously worsened the

food base for gerbils. After the drought of 1963 an unexpectedly snowly and cold winter set in. In the winter-spring period of 1963/1964 205 mm of precipitation fell, primarily in the form of snow. The number of days with a snow covering in this winter reached 33, while in the winter of 1962/1963 it was 3, and in the winter of 1961/62 it was 2. It is necessary to note the low winter air temperatures, dropping down to -25°, and soil temperatures to -10°. As a result of periodic thawings an ice crust was formed on the surface of the soil. This prevented the absorption of thawed water.

Water running off into the lowland flooded the colonies of great gerbils which concentrated here in years of drought. In the northern epizootic territory up to 80% of the colonies were flooded by thawing waters, and in the southern sector - 30%. As a result of this by the spring of 1964 the populations of great gerbils had died out. Surviving rodents resettled in higher places (slopes of ridges and hillocks).

Proof of this shifting is the number (up to 85%) of recently abandoned, eroded colonies which were located in basins without drainage. Almost in each of such colonies (more than 90%) the active migration of fleas and ticks of the genus Hyalomma was observed. In other recently abandoned colonies (apparently already in the fall of 1963) there was no migration of ectoparasites.

All of this testifies that the resettling of the animals took place in the winter of 1963/64. Such a concentration of great gerbils on elevated sectors of relief furthered the strengthening of intraspecies contacts.

In the northern sector of the territory the number of great gerbils was lowered in comparison with 1962 by 10 times and comprised less than 1 animal per hectare with a 50% occupancy of colonies. By the fall of 1964 their number increased to 3--4 per hectare with an occupancy of colonies up to 40%.

In the central sector of the epizootic territory the depression probably began with 1963. In 1962 the number of great gerbils in this region was equal to 14 animals per hectare with an occupancy of 90% of the colonies. In the spring of 1964 their number was reduced to 8 animals per hectare with an occupancy of colonies down to 60%, and by the fall to 4--5 animals with 30% of occupied colonies.

In the southern sector of the epizootic zone there were no significant changes in the number of great gerbils. Here in the spring of 1964 there were 16 animals per hectare with 90% occupied colonies, and in the fall only an insignificant lowering was noted in their numbers.

The epizootic of plague in the southeastern Kara-Kum in 1964 proceeded exclusively among great gerbils. An exception is a culture of the plague microbe, isolated from nymphs of ticks of the genus Hyalomma which were taken from a red-tailed gerbil. The animal was captured in a colony of great gerbils when the mass migration of ticks from the burrows to the surface of the colony was observed. A second culture of the plague microbe was isolated from fleas from the burrow of a fox which was also located in a colony of great gerbils.

Seasonal peculiarities of the epizootic are characterized in Table 1, from which it can be seen that the greatest number of cultures of the plague microbe was isolated in April (17 strains), when contamination of great gerbils reached 1.21%. In May their contamination comprised 0.64%, in June 0.56%, and in July - 0.30%. In October it was reduced to 0.07%, and in November - 0.16%.

Table 1

Plague infection of great gerbils in the southeastern Kara-Kum in 1964.

(a) Показатели	(b) Месяцы							
	III	IV	V	VI	VII	IX	X	XI
(c) Исследовано песчанок	76	1401	302	381	323	169	1487	617
(d) Выделено культур	0	17	2	2	1	0	1	1
(e) Процент зараженности	0	0,21	0,64	0,56	0,30	0	0,07	0,16

Key: (a) Indices; (b) Months; (c) Gerbils investigated; (d) Cultures isolated; (e) Percentage of infectivity.

The chronic course of the infectious process in great gerbils confirmed the dying away of the epizootic by the summer and fall of 1964. A peculiarity of the 1964 epizootic is also the low percentage of plague infected great gerbils on the whole over the entire epizootic territory.

If individual samples are taken from the population of great gerbils, then the average infection rate of animals increases considerably, which testifies to the strict limitation of sectors of the epizootic. Thus, in the northern sector the infection of gerbils with plague comprised 6.1%, in the central - 0.5--8.8, and in the southern - 1.6--5.9%.

Thus the epizooty proceeded most actively in the central sector, where the greatest number of cultures of plague microbe were isolated (15 strains) and where the highest percentage of infection of great gerbils was observed.

Figures for the abundance index of fleas in the fur of great gerbils in 1964 fluctuated within 3.1--20.2 in the spring and 7.1--11 in the fall. In places where cultures of the plague microbe were isolated from fleas taken from the wool of rodents these indices were usually noticeably higher, comprising, for example, in Soyun-Kuyu - 9.7; in Kumyshly - 12.1, and in Osman-Uyuk - 9.7.

In spite of the relatively high number of great gerbils in the epizootic zone (8--16 specimens per hectare) and their comparatively high percentage of infection (in April 1.2%), the percentage of infection among fleas was not high (in April 1.4%, in May 0.18%; Table 2). Subsequently on 28 April 1964 three cultures of plague microbe were isolated from fleas which were taken from the burrow of a fox (it was located in a colony of great gerbils in the region of Kumyshly well) and one from a colony of great gerbils in the region of the Teze-Kuyu well on 15 May 1964.

Table 2

Infection of fleas from the wool of great gerbils in the southeastern Kara-Kum in 1964

(a) Месяцы	(b) Исследовано посевов с разным количеством блох				(d) всего проб	(c) Зараженность посевов (%)				(e) всего в среднем
	1	2—10	11—30	31—50		1	2—10	11—30	31—50	
(f) Март	—	—	106 / 0	—	106 / 0	—	—	0	—	0
(g) Апрель	—	—	422 / 4	2 / 2	424 / 6	—	—	0,9	100	1,4
(h) Май	—	27 / 0	484 / 1	13 / 0	523 / 1	—	0	0,2		1,18
(i) Июнь	328 / 0	100 / 0	370 / 0	21 / 0	619 / 0	0	0	0	0	0
(j) Июль	92 / 0	158 / 0	50 / 0	16 / 0	316 / 0	0	0	0	0	0

Note: In the numerator - number of seedings from fleas, in the denominator - number of isolated cultures of plague microbe.
Key: (a) Months; (b) Investigation of seedings with various numbers of fleas; (c) Infection rate of seedings (%); (d) total samples; (e) on the average; (f) March; (g) April; (h) May; (i) June; (j) July.

With the dying off of the plague epizooty infected fleas were not detected at all, which apparently can be connected with the chronic course of plague in rodents and the absence of bacteremia in them.

The low infection rate of fleas and rodents during the epizooty of plague in southeastern Kara-Kum in 1964 can be explained by the absence of intercolony contacts due to the unusual high and thick grass (the height of ephemerals and perrenial ephemerals reached 60 cm and per 1 m^2 there were more than 700 plants), by the low numerical strength of red-tailed and midday gerbils, shifting of the population of fleas in May, and also by the chronic course of the infection process of plague in rodents. Thus, out of 24 strains of plague microbe, isolated from the organs of great gerbils, only in two cases (region of the Soyun-Kuyu well) was growth noted on seedings of blood, spleen, and liver, in six - on seedings of the spleen, and in three - on group seedings of a suspension of spleens.

Not in one case was profuse growth of the plague microbe noted (on agar from 1 to 11 colonies grew). All the remaining strains of plague microbe were isolated through bio-experimental animals. During the period of investigation only one carcass of a great gerbil was found (at the Mollaroz well) and two animals in an agonal state. The isolated cultures of the plague microbe grew in the rough form. They fermented glucose, maltose, mannitol, and glycerol with the formation of acid without a gas; they did not ferment lactose, saccharose, rhamnose, and urea; they were easily lyzed by plague and pseudotuberculosis phages; they were pathogenic for white mice and guinea pigs, however, they possessed various virulence. A large portion of them caused the death of laboratory animals (white mice and guinea pigs) following subcutaneous administration of 10 and 100 microbial bodies. However, several strains, isolated in the region of the Kumyshly, Soyun-Kuyu, and Mollaroz wells, possessed a somewhat lowered virulence. For these strains a dose of 100 thousand microbial bodies was letnal for guinea pigs. Along with the typical virulent strains of the plague microbe several atypical strains were isolated. They decomposed urea, were weakly lyzed by plague phage, and possessed selective virulence. Atypical cultures of the plague microbe were isolated in the southern sector, at the Artyk-Kuyu well, from seedings from the organs of great gerbils and fleas.

Conclusions

1. In 1964 in the southeastern Kara-Kum for the first time a local epizootic of plague was revealed among great gerbils. It had a microfocal nature. A factor promoting the epizootic was the unfavorable conditions of existence for rodents in the winter of

1963--1964 (prolonged standing of snow covering and low temperature).

2. The most active epizooty occurred in the central sector of the epizootic territory.

3. In spite of the high number of rodents on the territory of the epizooty in the spring of 1964, the average percentage of infection of great gerbils was low, which probably depended on the chronic course of the infectious process in the rodents, insignificant infection of fleas, and the absence of intercolony contacts due to the thick vegetation.

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*,**, *** Translator's note. The descriptive terms for the vegetation of the region are taken from local Turkmen terms. General meanings are as follows.

Sazak - Arthrophytum arborescens or saksaul, a tree growing in the sand deserts and saltmarshes of Central Asia.
Ilyak - Carex physodes, a sedge which grows between the bushes on hillock sands in the Kara-Kum desert along the Amu-Darya River.
Kandym - C. eriopodum, a tall bush or small tree up to 3--3.5 meters tall growing on hillock sands.
Kyrtych - kongurbash, Poa bulbosa v. vivipara.