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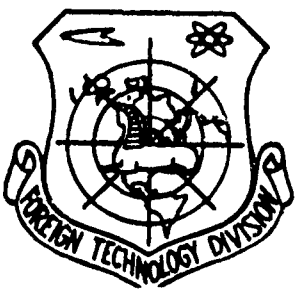
FOREIGN TECHNOLOGY DIVISION

RESULTS OF THE TESTS OF A NEW TYPE OF BACTERIA TRAP

by

N. M. Rudenko



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Block	Italic	Transliteration	Block	Italic	Transliteration
А а	*А а*	A, a	Р р	*Р р*	R, r
Б б	*Б б*	B, b	С с	*С с*	S, s
В в	*В в*	V, v	Т т	*Т т*	T, t
Г г	*Г г*	G, g	У у	*У у*	U, u
Д д	*Д д*	D, d	Ф ф	*Ф ф*	F, f
Е е	*Е е*	Ye, ye; E, e*	Х х	*Х х*	Kh, kh
Ж ж	*Ж ж*	Zh, zh	Ц ц	*Ц ц*	Ts, ts
З з	*З з*	Z, z	Ч ч	*Ч ч*	Ch, ch
И и	*И и*	I, i	Ш ш	*Ш ш*	Sh, sh
Й й	*Й й*	Y, y	Щ щ	*Щ щ*	Shch, shch
К к	*К к*	K, k	Ъ ъ	*Ъ ъ*	"
Л л	*Л л*	L, l	Ы ы	*Ы ы*	Y, y
М м	*М м*	M, m	Ь ь	*Ь ь*	'
Н н	*Н н*	N, n	Э э	*Э э*	E, e
О о	*О о*	O, o	Ю ю	*Ю ю*	Yu, yu
П п	*П п*	P, p	Я я	*Я я*	Ya, ya

* ye initially, after vowels, and after ъ, ь; e elsewhere. When written as ё in Russian, transliterate as yё or ё. The use of diacritical marks is preferred, but such marks may be omitted when expediency dictates.

RESULTS OF THE TESTS OF A NEW TYPE OF BACTERIA TRAP

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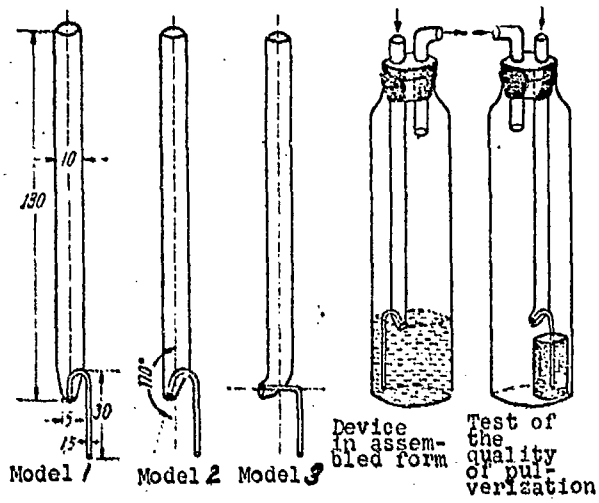
Simplicity of construction and a high degree of effectiveness of trapping various concentrations of microflora are the important properties of devices with a liquid system for the entrapment of microorganisms in the air. Also the samples of bioaerosols which are taken in a liquid medium are convenient for the concentration and identification of microorganisms. Therefore during the development of bacteria traps serious attention is given to the filtration of air through various liquids, and also through a droplet aerosol. The high degree of effectiveness of trapping aeroplankton with these devices was shown by many investigators (Emmerich, 1883; Milyavskaya, 1945; Shafir, et al., 1957; Albrecht, 1958; Karpukhin, 1962; Rudenko, 1966, 1967; Artenstein and Cadigan, 1968).

The vessels with sprayer type pulverizers described in this report are a further improvement of the devices developed by us jointly with Boykov in 1956. They combine several mechanisms for the trapping of aerosols: ortho- and parakinetic coagulation, bubbling through a liquid column in descending and ascending directions, and sedimentation. The layout and dimensions of the new pulverizers for bacteria traps are given in the drawing.



Arrangement, dimensions, and testing of sprayer type pulverizers.

For the work we selected pulverizers with capillary walls which were parallel for their entire extent. The inner opening of the capillary should be uniform and located in the center of the narrowed opening of the lead-in tube. The observation of these conditions ensures the uniform distribution of a droplet aerosol in the central and peripheral sections of the air flow and the most complete capture of microorganisms.

For the purpose of evaluating the effectiveness of pulverization of the liquid preliminary tests of the pulverizers were made using the method which was developed. Here it was established that the time of pulverization of 2 ml of liquid depended on the rate of aspiration of air and was expressed by the formula:

$$T = \frac{K}{A - A_0},$$

where T - time of pulverization (in seconds); K - coefficient, characteristic for the particular pulverizer; A - rate of movement of air (in l/min); A_0 - rate of movement of air at which the onset of pulverization of liquid began (in l/min).

In particular from the formula it follows that $K = T(A - A_0)$. Thus the value K is the mathematical characteristic of functioning of the pulverizers and it should be used in the selection of the best models for work. In our investigations the K value was equal to 1.15-1.20.

Up to the present time we have conducted several series of comparative tests of the retaining capacity of a number of bio-aerocollectors and the degree of passage in respect to natural fine-dust (closed accommodations), artificial - bacterial (Serratia marcescens), and virus-containing - aerosols (Sendai virus).

From the sprayer type pulverizers described above model No. 2 was selected. In the preliminary tests the best results were obtained with it. For intake of the air samples the discharge tube of the bacteria trap was connected successively to a rheometer and an aspiration mechanism. During the investigation of the artificial aerosols the bacteria trap was connected to a Sinitskiy aerosol chamber (Shafir et al., 1957). The dispersed composition of the aerosol was the following: particles with dimensions of 1-5 microns made up 64.7%, and 6-10 microns - 32.1%. The bulk of the microbial suspension which was expended for the creation of the aerosol and was trapped by the device being tested was recorded on a scale in the lower part of the aerosol chamber which was preliminarily calibrated. The microflora from the sample of seeded fluid was concentrated on a No. 3 membrane filter and subsequently sown over the surface of agar in 3 Petri dishes (Boykov and Rudenko, 1957). After incubation at 37° for 18-20 hours a count was made of the colonies which grew.

During the calculation of the percentage of passage of bacteria the number of colonies which grew following the inoculation of fluid from the first and second bacteria traps, which were connected in series, was added together and the sum taken conditionally as 100%. The number of bacteria which were

retained by the second device, expressed in percentages, made up the extent of passage of bacteria through the first device.

During the investigation of the virus-containing aerosol with the fluid from the devices the hemagglutination reaction was set up in the generally accepted method. This made it possible to judge on the presence of virus antigen and how much of it. The titer of the diagnosticum was checked ahead of time. The calculation of the virus-retaining capacity of the device (A) was done using the formula:

$$A = \frac{B_{бр} \cdot T_{рга} \cdot 10^5}{C_в \cdot T_д},$$

where $B_{бр}$ - volume of buffer solution taken in the device (ml); $C_в$ - volume of passed air (in liters); $T_{рга}$ - titer of the hemagglutination reaction; $T_д$ - titer of the diagnosticum (dilution at which agglutination no less than ++ was observed), for the calculations the degrees of dilutions expressed in whole numbers - 1, 2, 4, 8, etc. were taken; 10^5 - coefficient.

The results of the investigations were processed mathematically and are shown in an abbreviated form in the table. From the table it is evident that the highest effectiveness of trapping bacteria and viruses is established in two-chamber devices, bacteria traps with sprayer type pulverization, the Rechmenskiy siphon, and the Nikitin bioaerocollector. The rate of intake of air by our bioaerocollectors was the highest. The optimum rate of passage of air through devices with pulverizers was 35-40 l/min. In the case of necessity the volume of input air can be increased by placing two or more pulverizers in the bacteria trap. In Yefremov adapters a high resistance to the air current was observed, during the taking of samples the liquid which impregnated them sometimes ran out, and the microflora was not completely freed from the filter materials. The highest extent

Trapping Capacity of Bacteria Traps

Device	Number of tests	Fine-dust aerosol			Artificial aerosols		
					Bacterial		Viral
		Speed of air (in l/min)	Effectiveness of retention (In %)	Extent of passage of microbes (In %)	Effectiveness of retention (In %)	Extent of passage of microbes (In %)	Effectiveness of retention (conditional values)
Two-chamber	13	26.8	340.1	0.5	140.6	0.3	—
Vessel with sprayer type pulverizer	15	48.9	347	0.6	124.8	0.6	27.5
Vessel with straight double pulverizer	16	33.3	169.5	4.5	134.1	4.6	24.9
Rechmenskiy siphon	15	20.5	100	25.6	100	25.3	20.4
Nikitin bioaerocollector	16	13.7	86.4	23	107.9	22.4	5.7
D'yakonov device	15	13.6	70.3	40.6	80.5	39.9	10.9
Rozberi impinger	15	10.3	67.3	34.4	89.8	34.4	10.3
Yefremov adapter							
Cotton + 50% glycerin	8	11.4	91.3	—	—	—	—
Cotton + glycerin	8	10.8	69.1	—	—	—	—
Selikatel + glycerin	8	11.3	59.9	—	—	—	—
Selikatel + 50% glycerin	8	12.4	43.4	—	—	—	—
Krotov apparatus	16	25	50	42.7	—	—	—
Koch method	24	5	22.1	—	—	—	—

[Note: Selikatel' - word not verified].

of passage of microorganisms was noted in the devices of Krotov, D'yakonov, and Rozberi, and the least - in bacteria traps with pulverizers.

Conclusions

The proposed model of a pulverizer for bacteria traps possesses a number of advantages in comparison with other devices: it ensures the highest percentage of retention and the least passage of microorganisms, is simple in arrangement, and is the most suitable for standardization in the case of series production.

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