AERONIZATION IN MEDICINE

Aeronisation in Medicine. Edited by Professor A. L. TCHIJEVSKY and DR. G. A. LAPIDUS. Vol. III, Transactions of the Central Laboratory for Scientific Research of Ionification. Publishing House "Kommuna," Voronej, USSR. 1934.

IN the issue of SCIENCE for May 31 Professor Alexis L. Romanoff, of Cornell University, had a brief review of "Problems of Ionization" published in Moscow. Since several inquiries received by Professor Romanoff have been referred to me, as I had the privilege personally to know Professor Tchijevsky, and to visit him in Moscow, I believe the readers of SCIENCE will be glad to have additional information about the Central Laboratory for Scientific Research of Ionification.

A few days ago the writer had the pleasure of receiving a letter from Professor Tchijevsky, and also a copy of Volume III, entitled "Aeronisation in Medicine." This volume contains fifty-eight articles on aeronization in medicine, contributed not only by Dr. Tchijevsky and his associates in the Central Laboratory, but a number of experimenters in other medical institutions in Moscow, Voronej and other cities. Among the subjects treated are: Application of aeroions in physiotherapy; aeroionotherapy of wounds; influence of aeronization on the tubercular process in rabbits. There are also four articles on treatment of tubercular patients with inonized air, the reactive changes in the internal organs, and in the nervous system by aeronization, influence of aeronization on the growing organisms, also on the polyavitaminosic pigeons, etc. There are several chapters on apparatus for the production of pharmacological aeroions and for their count, method of producing highly ionized water, steam, medicinal solution, highly concentrated heavy ions in medical solutions produced by electrostatic pulverization. Several chapters are also devoted to aeronization of shops and factories. The work on ionization by Professor Dessauer and other European scientific men is discussed.

Dr. Tchijevsky writes that his apparatus for ionization is different from that used elsewhere, and that he has the invention patented in USSR.

Volumes II and IV are now in press. The tables of contents of all volumes are announced. Volume III has an English table of contents and a fifteen-page résumé in French by Dr. Tchijevsky.

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NEW YORK, N. Y.

SPECIAL ARTICLES

BACTERIAL CONTENT OF THE AIR AT HIGH ALTITUDES

NUMEROUS investigations of the upper air for the presence of bacteria and fungi have been made by several observers. Procter in Boston has made about forty flights, one up to the height of 20,600 feet, and has taken cultures from the air under diverse conditions. Meier, in Washington, in conjunction with the Naval Department, has made extensive studies but has confined himself mainly to the search for fungi. In the recent flight over the Atlantic by Lindbergh, glass plates covered with an adhesive material were exposed at different heights and under diverse conditions over land and water in order to catch the spores of fungi. These plates were studied by Meier.

On October 3, 1934, I made a flight to the height of 20,000 feet and exposed blood agar in Petri dishes at every 1,000 feet. Technical difficulties prevent the procuring of accurate data.

Prior to my recent flight the highest altitude at which this work had been done was 20,600 feet.

With the permission of General MacArthur, of the U. S. Army, a recently constructed bombing plane at the Glenn Martin Plant was put at my disposal for a flight above 20,000 feet.

This plane was selected more particularly on account of the compartment provided for the machine gunner, which formed a kind of a nose of the plane and the farthest point forward. The propellers and the other sections of the plane were behind this prominence. This compartment was encased in glass and aluminum framework and had a slit in the front through which the hands could be projected and the plates exposed. In this manner one could be certain that the air striking the plates was free from contamination from any other part of the plane.

Blood agar in Petri dishes and a special medium in other Petri dishes for fungi were used. These dishes were sterile on the outside and were wrapped in sterile gauze and sterile paper. They were packed in sterile containers and placed in a convenient location in the plane. After exposure the plates were again wrapped in the material which had been around them and put in a second sterile container.

I was alone in the compartment. The pilot, Captain Polk, occupied the pilot's seat and had charge of the plane. I had on a very thick flying suit and was definitely restricted in my movements.

The technique was as follows: The plates were taken out of their container and unwrapped. Sterile rubber

gloves were then put on and each plate was held with both hands outside the opening; the cover was then raised and the medium exposed to the wind for a half to one minute. The cover was then replaced and the dish was wrapped in gauze and paper and stored in the container. Cultures were taken in this manner every 1,000 feet, and in two instances where there was a fault in the technique a second culture was taken.

The wind coming in contact with the plates and with my hands had a velocity of 150 miles an hour. About 7,000 cubic feet of air passed over the plate in one minute. The calculated temperature at 28,500 feet was 34° F. below zero.

My hands soon became so numb and stiff that I could not carry out the technique as I had planned it. There were faults in opening and closing the plates and it was found impossible to protrude the hands far enough outside or to hold the plate longer than half a minute. It must be acknowledged that due to these errors there may have occurred possible contaminations from the inside of the plane. Then, too, it was found that the medium in several of the plates was completely frozen when I got back to the laboratory.

The plates were put in incubators and were examined very carefully during the next ninety-six hours by a competent bacteriologist.

The report was as follows:

A plate exposed	at 19,000 feet	was negative	
" " "	" 20,000 "	" "	
" " "	" 21,000 "	" "	
" " "	" 22,000 "	" "	
" " "	" 23,000 "	" "	
" " "	" 24,000 "	showed one colony of *Staphylococcus albus* (surely a contamination)	
" second plate	" 24,400 "	was negative	
" plate exposed	" 25,000 "	" "	
" " "	" 26,000 "	showed one colony of *Staphylococcus albus* (surely a contamination)	
" second plate	" 26,300 "	was negative	
" plate exposed	" 27,000 "	" "	
" " "	" 28,000 "	" "	

In two plates, one at 24,000 feet and the other at 26,000 feet, the colonies of staphylococci found were most probably due to a contamination, because in each one of them definite faults had been observed and a second plate had been exposed.

The work was not done with sufficient accuracy to claim the establishment of any new facts, but it suggests that the atmosphere from 20,000 feet to 28,500 feet is sterile.

In this flight we attained the highest altitude at which cultures had ever been taken and in this sense it is a record.

The plates for fungi were not exposed.

The flight demonstrated the impossibility of carrying out the technique as planned and showed the necessity of having some kind of a mechanical device for opening, exposing and closing the plates. I am now trying to devise such an apparatus.

It may be of interest to say that I began the use of oxygen at 21,000 feet and did not experience any embarrassment of respiration, but my hands suffered quite severely from the cold. My right index finger was frost-bitten and my right hand did not regain its normal feeling for several hours after I came down. The finger remained numb for about one week.

The pilot and I used a container holding five liters of liquid oxygen. One tube went to his compartment and a second came to mine. We were entirely separated in the plane and I was unable to make any signal to him. This was a marked disadvantage and a matter of considerable mental discomfort.

I wish to express my sincere appreciation to General MacArthur for the use of the plane and to Captain Polk for his hearty cooperation and for his high degree of skill as an aviator.

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ON THE NATURE OF FILTERABLE VIRUSES[1]

THE defining characters of filterable viruses appear to be ultramicroscopic size and obligate parasitism. They are the smallest units showing the reproductive property considered typical of life. While it is recognized that obligate parasitism does not necessitate their extreme smallness, there is apparently something related to the ultramicroscopic size of filterable viruses that obligates them to a parasitic existence. From information at hand we must conclude that the ultraviruses demand direct association with living cells to display the most characteristic property of life, that of reproduction.

It is of great significance that modern intense studies of microbiology have failed to discover any evidence of the existence of free-living microbes of ultramicroscopic size. In any case, where changes occur in an organic or inorganic solution that indicate definitely the presence of living microbes, they can always be demonstrated by direct microscopic examination. Even more critical experience has been gained by the use of bacteria-proof filters. Whenever filtered solutions show biological change indicative of microbic growth, visible microbes appear always to be present. There are, of course, bacteria that will regularly pass the usual bacteria-proof filters. Cultures of certain sulfur bacteria which grow on inorganic

[1] Presented before the North Central Branch of the Society of American Bacteriologists, June 26, 1935, meeting with the American Association for the Advancement of Science at Minneapolis.