of droplet-steam flow. At fixed distances from the nozzle, the greater the pressure of steam in the boiler before exhaust, the greater is the potential gradient which occurs. Also noteworthy is the fact that the electrification of the air takes place not only along the axis of flow, but also in a direction perpendicular to this axis, and the higher the pressure in the boiler the stronger this effect. During the exhaust of compressed air from a compressor within the limits of 1 to 6 atm no electrification at all was observed. The error in the measurement of the potential gradient in all cases did not exceed 50 V. The sign of the charge which the droplet-steam jet transmitted to the air was positive in all the measurements. The measurements were carried out in a room having the dimensions 12 x 6 x 2.75 m^3 at a height of 1 m from the surface of the stone floor. Water pipes were used for grounding. The velocity of the droplet-steam flow was measured by an anemometer at various distances from the nozzle and at different pressures, while all the measurements were carried out along the axis of symmetry of the flow. The results of measurement of the velocity of flow are presented in Fig. 3.

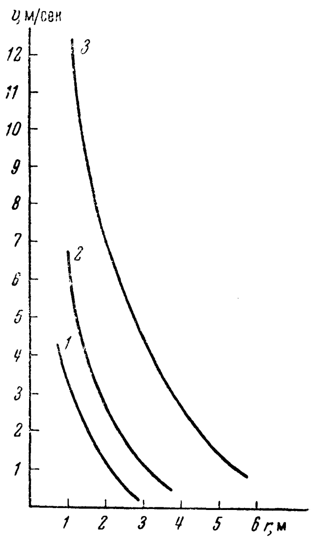

FIG. 3. Dependence of the velocity of flow v on the distance r from the nozzle along the axis of flow at steam pressures within the boiler of: *1* – 1 atm. *2* – 2 atm. *3* – 6 atm.

The electrical properties of water and ice which we investigated provide supplementary materials for the understanding of phenomena connected with the process of development of storms.

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The Question of the Formation of a Cellular Structure in a Layer of Fog or Smoke

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IN the literature, cases of the formation of a cellular structure in the layers of a liquid or a gas are described by an unsteady state, for example by heating underneath and by cooling from above.[1,2]

In addition, cases are described of the formation of a cellular structure in two-phase systems (for example in spermaceti, which contains a suspended aluminum powder,[3] in a layer of smoke, which is introduced into a chamber which is heated from below and cooled from above).[4,5] As cause of formation of a cellular layer in a two-phase system (similarly for one-phase) it is acceptable to assume a convection, determined by the difference of temperature between the lower and upper boundaries of the layer. However, as observations carried out by us show, the formation of a cellular structure in a layer of fog is possible in conditions when the gas is cooled from below and heated from above or when in general a temperature gradient is absent. The horizontally situated layer of fog of variable thickness is easily obtained in a diffusion-condensation chamber by means of a gaseous discharge. Cylindrical and rectangular chambers were employed with a bottom which is cooled and with glazed walls, differing little from the one described earlier.[6]

The chamber was filled with air or argon. A surface of ethyl alcohol gave rise to a vapor which is collected in a tube which is placed near the top. For the creation of a continuous process of diffusion near the walls at the bottom of the chamber a porous membrane was inserted which is moistened with alcohol. Under the action of the capillary force the alcohol, being at the bottom, was raised through the membrane to the top and thereupon, having evaporated, diffused downwards. Other sources of the vapor were absent in this case.

In the presence of a gaseous discharge between points which were located near the top and at the bottom of the chamber the ions, striking a sensitive layer, formed a fog, developing a heterogeneity of saturation in the space of the chamber. Such heterogeneities arise, for example, as a result of a local absence of saturation which was brought about by condensation of the charged nuclei which were created by the ionizing particles or as a result of convection currents in the volume of the chamber, subjected to the correctly chosen thermal process.

In the presence of a point discharge, a completely homogeneous layer of fog arises which, in the course of 1-2 sec., decomposes producing a cellular structure (Fig. 1) at a depth of the sensitive

FIG. 1

layer of 1.5 cm. The size of the cells is about 1 cm^2. The cellular structure, if its formation is caused by the motion of the gas in the chamber, having existed up to the formation of the fog, is obliged to be non-homogeneous. Heat transfer to the walls appears to be the cause of the convective motion of the gas in the chamber, therefore the circulation in the cells must slowly die out along the dimension of withdrawal from the walls of the chamber. Nevertheless the dependence of the size and shape of the cells upon their place of location was not ascertained.

If the walls of the chamber have a higher temperature than the gas then the cells are moved in a direction towards the walls. In addition to the deformation of the cells the following is observed: the depth of them is reduced, and the transverse dimensions increased (the walls are stretched laterally by the motion of the gas). The diminished depth of the cells is explained by the motion of the gas downward in the volume of the chambercompensating the upward motion of the gas at the walls. In the cooling of the walls, the convection current changes its direction. The gas is moved along the walls and the bottom to the center of the chamber. Moreover a diminishing of the lateral dimensions and an increase in the depth of the cells are observed; the cells "are shrunk", but, in the general features the cellular structure arising is not changed by the transition from one thermal condition to another.

Near the walls the circulation in the cells has one and the same direction, regardless of the direction of motion of the gas, i.e., in one case the circulation in the cell coincides with the direction of motion of the gas at the wall, and in another –opposite to it. Therefore, the formation is also decomposed drop by drop onto the ions after the passage of an ionized particle (Fig. 2), whereupon the boundary between the cells is almost always perpendicular to the direction of the track regardless of its orientation relative to the walls.

All of the empiracle data enumerated above shows that the cellular structure, being formed in the diffusion chamber, was not linked with motion of the gas, having existed until the appearance of the fog.

If the formation of the cellular structure was linked with the presence of a temperature gradient, then a dependence of the size or shape of the cells on the temperature distribution in the volume of the chamber should exist. Meanwhile, a detailed investigation showed thatsuch a dependence does not exist.

With a view to this exclusion of the effect of condensation on the distribution of the temperature the behavior of a layer of smoke was investigated, which was introduced into the space of the chamber which was cooled, being filled with air. In all cases after the formation of a layer of smoke the latter decomposes into the cells. Further investigation showed that the cellular structure arises also in the decomposition of a layer of smoke which was produced above a plane horizontal surface, in the absence of a temperature gradient. The behavior of a layer of smoke of different origin was investigated (Nh_4 Cl, Nh_4 NO_3, tobacco smoke).

It should be noted that it is easy to obtain a homogeneous layer of smoke above the cooled surface. This, apparently, is explained by the fact that the gas near the cooled surface is found in a stable state. If however the layer of smoke is formed, its further behavior does not depend upon the temperature gradient. In all cases the layer of smoke decomposes into cells.

For a more detailed explanation of the behavior of a layer of fog, which is formed by the neutral centers of condensation, the emergence of a cellular structure is observed in a diffusion chamber with an expansion, differing negligibly in construction from the one previously described[7]. The chamber was cylindrical with glazed walls. The bottom of the chamber was cooled by dry ice. Vapor ethyl alcohol was used as a source, being poured into a pipe which was fastened to the upper lid with openings, through which the expansion took place. The operating volume of the chamber was separated from the spaces communicating with the atmosphere by a rubber diaphragm. The chamber was filled with air or argon. Supersaturation in the volume of the diffusion chamber is not constant with height. Therefore, upon rapid expansion, the fog forms itself into a layer the height of which depends on the degree of expansion, and consequently be easily varied over wide limits. The layer of fog decomposes into cells in 2 sec. The size of the cells depends on the height of the layer. The higher the layer the larger the cell size. For an increase of the layer up to a certain critical size (depending on the pressure and the properties of the gas in the chamber) the emergence of a second layer of cells is observed. The cells of the first layer, being deformed, form the cells of the second layer. The number of cells in the second layer is substantially larger than in the first.

FIG. 2

For reduced pressures of the gas in the chamber the size of the cells increases and the time of formation and deformation is shortened. At a total pressure of the gas of the order of several millimeters of mercury, the cells disappear: a completely homogeneous fog settles onto the bottom in the course of 1-2 sec without the formation of a cellular structure.

The effects of the nature of the centers of condensation (charged or uncharged centers) on the phenomenon were not discovered.

The formation of a cellular structure in a layer of smoke or fog was also observed under natural conditions. Usually the formation of the cellular structure of clouds is explained by the circulation of the gas which was caused by a temperature gradient. The observations carried out by us show, however, that the formation of a cellular structure is possible under conditions when a layer of gas is found in a comparatively stable convective state. Therefore it is natural to suppose that the cellular structure of clouds in a series of cases also arises only after the formation of a homogeneous fog as a result of a precipitation of drops in the gravitational field.

The observations show that a homogeneous foggy trail, which was formed by an airplane in the upper layers of the atmosphere, in all cases produces a cellular structure. This agrees with the proposal which is expressed concerning the possibility of the formation of a cellular structure of clouds in the process of precipitation of the fog.

In conclusion I express thanks to M. S. Kozodaev and Prof. M. F. Shirokov for interest in the work

and discussion.

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Metal-to-Semiconductor Contact Resistance at High Contact Potential Differences

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IT is well known that at the interface between a metal and a semiconductor under certain conditions[1] there appears a layer with additional resistance R_k which is related to the contact potentail difference (*cpd*) by Davydov's equation[2]

$$R_k = (2\varkappa / \sigma)(\exp\{eV_k / kT\} - 1),$$

where R_k is the supplementary resistance, $1/\varkappa$ is the Debye screening thickness, σ is the conductivity of the semiconductor, and V_k is the *cpd* between the semiconductor and the metal. This equation is applicable for small V_k (when there is no intersection of the Fermi level and the impurity level), but it does not take into account a number of secondary phenomena: screening of the field by the space charge, tunnel effect, etc. For large V_k, when the above mentioned intersection takes place, Davydov's equation is entirely unacceptable, since a layer with reversed resistivity now appears on the surface of the semiconductor and thus dependence of R_k on V_k is different than in the case of small V_k. The degree to which the surface levels are filled with electrons must also affect the magnitude of the contact resistance

We have measured the dependence of R_k on the *cpd* V_k by the method of clamped contacts for different degrees of filling of the surface levels of samples of copper oxide[3]. The copper oxide was prepared by the standard method of heating in a high-temperature furnace followed by quenching in boiling water. The copper oxide was not separated from the copper base in order to increase the strength of the sample. Different metals were deposited on the same sheet of nickel, measuring $10 \times 15 \times 0.05$ mm. The measurements were taken at room temperature. The contact potential difference was measured by the vibration method with an accuracy to within 0.005 v; R_k' was measured by a direct current bridge with an accuracy to within 0.5%.

The filling of the surface levels was changed through adsorption on the semiconductor surface of water, alcohol, acetone and benzene vapors (as

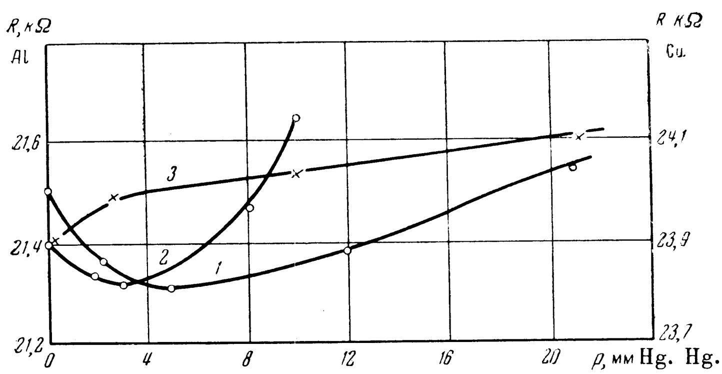

FIG. 1. Change of metal-to-semiconductor contact resistance with air pressure: *1* and *2* — copper oxide — aluminum (V_k = 1.18 v), two samples; *3* — copper oxide — copper (V_k = 0.22 v).