cæsium vapor is 32×10^{-6} amps./cm.^{2} from which the vapor pressure is calculated, by the equation given above, to be 0.00166 bar.

The conditions near the critical temperature, where both the α and β surface phases may be present together, are probably analogous to those assumed in van der Waals' theory of the transition between liquid and gas. In the β phase near the critical temperature there is probably an atmosphere, extending out to a distance of several Ångstrom units from the surface of the filament, containing electrons and a slight excess of positive ions. If the temperature is lowered the attractive forces cause a condensation to the α phase which has a much higher concentration of positive ions. At still lower temperatures, the ions probably settle down into a definite monatomic adsorbed film. Under proper conditions the velocity of propagation of the boundary between the two phases has been observed experimentally.

If a thoriated tungsten filament is used in experiments with cæsium vapor it is found that both the electron emission and the ion generation disappear if the filament is first given a heat treatment by which an adsorbed film of thorium is brought to the surface. This result is in full accord with the theory outlined above, for the electron affinity of a fully active thoriated filament is only 2.94 volts. Since this is less than the electron affinity of the cæsium ion we should not expect the cæsium atoms to lose their electrons when they strike the surface. A quantitative study is being made of the phenomena occurring when various proportions of the surface are covered by thorium.

Similar effects to those described in this paper have also been observed with other alkali metal vapors, notably rubidium vapor. The ionizing potentials of these vapors are higher and the vapor pressures lower, so that the effects tend to be less marked. The results, however, confirm the theories which so well explain the behavior of cæsium.

Irving Langmuir
K. H. Kingdon.

Research Laboratory of the
General Electric Company,
Schenectady, N. Y.,
December 21, 1922

THE OXIDATION OF SELENIUM BY A NEW GROUP OF AUTOTROPHIC MICROORGANISMS

The discovery of the nitrifying and sulfur-oxidizing bacteria by Winogradsky added much to our knowledge on energy transformation in the metabolism of the living cell. Here were organisms that were able to obtain from the oxidation of purely inorganic substances all the energy necessary for their activities and for the assimilation of the carbon from the carbon dioxide of the atmosphere or from carbonates. The hydrogen, methane and iron bacteria were soon added to these groups of autotrophic microorganisms. However, some of these organisms seem to be able to exist also in the presence of organic matter, from which they can derive their energy, as pointed out by Niklewsky for the methane bacteria, Molish for the iron bacteria and purple sulfur bacteria, Beijerinck and Trautwein for the denitrifying colorless, sulfur oxidizing organisms.

Among the strictly (obligate) autotrophic bacteria, which derive their energy only from the oxidation of the inorganic materials, are the nitrite and nitrate bacteria, as pointed out by Meyerhof, and the sulfur oxidizing organism *Thiobacillus thiooxidans* described recently by the writers, which derives its energy from the oxidation of elementary sulfur, thiosulfates and sulfides.

Another group of organisms can now be added to the list of the autotrophic forms, namely, bacteria which are able to derive their energy from the oxidation of selenium. A small quantity of selenium mixed with fresh soil was slowly oxidized with an increase in soil acidity. When some of this soil was added to a culture medium, consisting of inorganic materials, with elementary selenium as the only source of energy, the medium became cloudy within a few days. There appeared in it a minute, rod shaped bacterium capable of oxidizing selenium to selenic acid. A detailed description of the organism as well as of the methods used in its isolation will be published later.

Jacob G. Lipman
Selman A. Waksman

New Jersey Experiment Station,
New Brunswick, N. J.