unlikely. The reaction might also be compared with the effect of higher organic anions on proteins studied by Steinhardt[12], where an increased proteolysis was produced.

The experimental details of these investigations are being prepared for publication elsewhere.

[Sept. 11.

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DISINFECTANTS

A SYMPOSIUM on "Disinfectants" took place at a joint meeting of the Society for Applied Bacteriology and the Microbiology Group of the Society of Chemical Industry held at the Institute of Structural Engineers, Upper Belgrave Street, London, on the afternoon of January 9. Papers were contributed by Prof. H. Berry (School of Pharmacy, University of London), Dr. P. Maurice (Imperial College of Science and Technology, London), Dr. L. A. Allen (Water Pollution Research Laboratory, Watford) and Mr. J. C. L. Resuggan (British Hydrological Corporation, London). Dr. S. E. Jacobs (Imperial College of Science and Technology, London) was unable to present his paper owing to illness.

Prof. Berry, discussing the bactericidal action of phenols in aqueous solutions of soaps, said that phenolic bodies, sparingly soluble in water, can be readily solubilized in soap solutions, quoting as an example benzylchlorophenol in potassium laurate solution. This increased solubility is due to micelle formation, since it has been shown that practically none of the phenol is in the free aqueous phase. Solubility increases with soap concentration until a maximum is reached, representing a maximal size of complete micelle formation. Beyond this point, the micelles are apparently unable to solubilize any more of the phenol. Bactericidal action is postulated as the result of adsorption of the micelle on the cell walls. Bactericidal efficiency is found to be at a maximum at the 'critical concentration' of the soap, that is, when the completely formed micelles are saturated with the phenol. It is dependent on the proportions of soap and phenol present, but independent of concentration of the mixture, since dilution may give rise to increased rates of kill. Prof. Berry directed attention to errors which may be inherent in the usual methods of determining bactericidal efficiencies, due to bacterial clumping by the surface-active agents, and described a technique which was designed to overcome this.

Dr. Maurice described the results of studies on the action of antibacterial substances on the permeabilities of bacterial cells, and suggested a method based on these findings for determining bactericidal activity. When a basic dye, such as basic fuchsin or safranin, is added to a bacterial suspension there is a progressive increase in turbidity, due to absorption of the dye into the cell cytoplasm. Addition of bactericides, such as phenol or cetrimide, results in a rapid rise in the rate of increase of turbidity. Turbidities are measured on a Spekker absorptiometer, and the graph of the logarithm of drum reading against time yields a straight line. Selection of a dilution of the test substance which gives the same response as a standard phenol solution affords a means of calculating a 'phenol equivalent activity'. The advantage claimed for the method is that a more precise physical measurement is made in place of the usual biological end-point determination.

The presence of certain cations influences considerably the response. Calcium ions at concentrations as low as $M/10,000$ inhibit to some extent the dye absorption, and trivalent ions are even more inhibitive; monovalent ions and all cations examined were apparently without effect.

In his paper on the bactericidal action of chlorine, Dr. Allen dealt with some of the factors affecting its efficiency. Bactericidal action is related to the degree of ionization of the hypochlorous acid formed when chlorine is dissolved in water. The pH value is highly important, greatest activities being found in acid media. This observation is important in dealing with sewage effluents, which often have pH values of about 9, and with waters of about pH 8, when longer contact times are necessary to achieve disinfection. Efficiency is not unduly affected by the concentration of chlorine, but is increased considerably with temperature, this being more marked with the chloramines than with chlorine solutions.

The presence of organic matter is generally considered to reduce the bactericidal activity of chlorine; but a review of the information available shows that comparatively few organic compounds react under conditions naturally encountered. Moreover, reactive compounds do not all have the same adverse effect. For example, peptone and sewage of the same chlorine demand behave differently; the former brings about complete loss of the bactericidal action of the chlorine, but the latter produces at first only a slight effect. This is attributed to the ammonium ions present in sewage, which combine to give chloramine.

Chloramine is highly active as a bactericide, but not as rapid in its action, or reactive with other compounds, as chlorine. Solutions of chlorine and ammonia give a typical 'break-point' in the dose-response curve, and thus with the same level of residual chlorine it is possible to obtain three different bactericidal effects.

Mr. Resuggan, describing some of the anti-bacterial properties of the quaternary ammonium compounds, first considered their general configuration and their physico-chemical properties. An outstanding characteristic is their high surface activity, and this parallels to some extent their high anti-bacterial activity, although at the same time it is responsible for difficulties in determining such activity. Quaternary ammonium compounds are used extensively in the hygiene of the various branches of the food industry; but, owing to their sensitiveness to organic matter, should be used only for disinfecting relatively clean surfaces. Mr. Resuggan claimed that their toxicities, chronic or acute, are far above the levels which would be encountered normally, and thus their continued use would not prove harmful in practice.

The excessively high bactericidal values at first claimed for these compounds have now been disproved, having been shown to be due to micelle formation, clumping and residual bacteriostatic effects. These arise from their high surface activity and consequent intense adsorption to bacterial cells and other surfaces, an effect not easily removed by simple washing or dilution. Only by the use of suitable quenching agents, usually anionic compounds, can the effect be eliminated. The compounds generally are more active against Gram-positive than Gram-negative organisms. Suggested explanations of the mode of action of the quaternary ammonium compounds include the preferential destruction of the bacterial enzyme proteins, cytolysis of the cell with escape of intracellular substances, and final lysis resulting from surface action.

GASEOUS ELECTRONICS

CONFERENCE AT SCHENECTADY

THE fourth Conference on Gaseous Electronics, sponsored by the Division of Electron Physics of the American Physical Society, was held during October 4–6 in the new Research Laboratory at Schenectady of the General Electric Co. In the field of fundamental processes three main problems were discussed, namely, the role of rare-gas molecular ions, the formation of negative ions and photo-ionization in gases.

Using a new mass-spectrometer in which the kinetic energy of the ions is measured by applying retarding potentials after deflexion, H. D. Hagstrum (Bell Laboratories) reported that he has studied the critical energies necessary for electrons to produce various reactions by colliding with diatomic molecules, namely, carbon monoxide, nitrogen, oxygen and nitric oxide, and the nature of the ions formed. From the results, dissociation and electron attachment energies were derived. When a Townsend discharge, for example, in argon, is initiated by a light pulse of duration 10^{-7} sec. striking the cathode, it is found that the current as a function of the time decays in several steps. J. A. Hornbeck (Bell Laboratories) has shown that this phenomenon is associated with the neutralization of molecular and atomic ions at the cathode. From the measurements follows the ratio of the number of excitations to ionizations in various noble gases, as well as the product of the life of certain atomic states and the cross-section for excitation by electrons in a given field E/p. In the presence of molecular ions, similarity relations like Paschen's law fail.

M. A. Biondi (Westinghouse) has observed by microwave measurements the decrease with time of the concentration of negative ions in a decaying gas-discharge and derived from it the cross-section for thermal electrons of $0 \cdot 04$ eV. to become attached to oxygen molecules. In the pressure range 10–30 mm. of mercury, the cross-section seems to be independent of the pressure, and its value ($\sim 10^{-22}$ cm.^{2}) agrees with the theoretical one for radiative capture. A similar problem has been attacked by M. Harrison and R. Geballe (Washington University), who measured ionization currents in uniform fields between $E/p = 30$ and 80. The sharp apparent decrease of the ionization coefficient α/p with falling E/p at low fields is ascribed to the attachment of

electrons to oxygen molecules which dissociate into O and O^-. This seems to be the case even in strong fields. T. Holstein (Westinghouse) said that he has treated theoretically the dissociative attachment by applying the Franck–Condon rule. For example, $O_2 + e \rightarrow O + O^-$ is such a process. It occurs in two stages : an electron is captured and the molecular ion dissociates. However, when dissociation occurs, the electron can become detached. The cross-section for the process has been calculated and agrees in order with the one computed for light atoms ; it contains the probability of auto-detachment which as yet is not known.

In order to determine photo-ionization cross-sections of molecular gases, G. L. Weissler and N. Wainfan (University of Southern California) use a spark source in helium at low pressure, producing lines of constant intensity in a vacuum spectrograph, and irradiate nitrogen and oxygen at low pressure. The ionization in the gas as a function of the wave-length is measured with an ionization chamber, and the energy of the radiation with a thermocouple. Preliminary results show that ionization in nitrogen occurs only below 800 A., corresponding to the ionization potential of the nitrogen molecule. A. O. McCoubrey (Westinghouse) reported on the band fluorescence of mercury vapour. Irradiation at 2537 A. produces atoms in the resonance state which collide with unexcited atoms and form metastable ones. These, too, collide with normal atoms, as a result of which metastable molecules are produced in a state that decays either by spontaneous or by collision-induced radiation. The former process is slow and gives rise to the ultra-violet band ; the latter produces the visible band. The ratio of the band intensities has been found to be proportional to the square of the vapour density, confirming the above processes.

C. F. Hendee (North Western University) has investigated the decay of the positive bands of nitrogen. A condenser charged to 10 kV. was discharged through a tube with external electrodes producing light-flashes. The emission of the first positive band is preceded by a transition from a metastable (singlet) into a normal (triplet) state. The decay involves collisions and thus takes ten times as long as the decay of the second positive band, which involves a normal singlet–triplet transition.

An account was given by A. V. Phelps (Massachusetts Institute of Technology) of his investigation of the ambipolar diffusion in a helium discharge by determining the electron density from the change of the resonant frequency of a cavity and the type of ions by means of a mass spectrometer. Below a pressure of 1 mm. of mercury, He$^+$ ions are formed which diffuse to the wall, and above 5 mm. of mercury, He$_2^+$ ions are formed. The large electron recombination coefficient is due to the molecular ions.

J. Slepian and L. S. Frost (Westinghouse) reported that they have found that measurements on the ambipolar diffusion in a decaying plasma can give results which do not agree with Schottky's theory. This is the case if the decay-rate is counteracted by ionization in the gas, or if the probe emits electrons, or if the charge density is not large enough to produce ambipolar flow, or if the pressure is so low that the mean free ionic path becomes comparable with the tube radius.

A series of papers dealt with questions concerning the discharge plasma. D. Gabor (Imperial College of Science and Technology, London) discussed the