at 22° C. The time interval between perfusion and the appearance of trains is related to the DDT concentration perfused (Table 1), and comparison of the figures suggests that the DDT concentration in the aqueous solution was between 0.1 and 0.01 ppm. Although the trains take longer to appear at very low concentrations, they may be marked and persistent.

TABLE 1

	Diluted emulsion			DDT suspension in saline				Saline saturated with DDT
DDT in ppm	16.0	1.6	0.16	10.0	1.0	0.1	0.01	?
Individual	3.0	4.0	16.0	3.0	10.0	13.0	43.0	20.0
times (in	7.0	8.0	9.0	2.0	3.0	21.0	52.0	42.0
minutes) from			13.0	3.0	2.0	32.0	36.0	35.0
perfusion to			25.0	4.0	12.0	19.0	32.0	12.0
appearance				3.0	10.0	23.0	27.0	30.0
of trains					16.0	31.0	31.0	
					18.0		29.0	
					17.0		32.0	
					9.0			
Av. times			16.0	3.0	9.6	23.1	35.2	27.8

The sensitivity of the sensory response is such that the DDT concentrations reached within the body of a cockroach receiving the minimum lethal dose would be more than sufficient to generate similar trains of impulses in the afferent nerves. It is concluded that in the cockroach the tremors characteristic of DDT poisoning are due to an intense and patternless bombardment of the motor neurones by trains of impulses originating in sensory endings.

It has not been possible to identify the sensory structures upon which the DDT acts. Progressive amputation of the leg reveals that both normal electrical activity and DDT trains disappear if the trochanter is removed, although a considerable length of nerve 5, including several motor branches, remains intact in the coxa. Removal of the trochanter would eliminate all the groups of campaniform sensilla described by Pringle, and the general impression gained is that the proprioceptive sense organs are the structures in which the DDT trains originate. A similar series of trains can be obtained if DDT is injected into the cut cercus, and the electrical activity in the cercal nerve is recorded. The DDT trains are much less marked in this nerve and are somewhat masked by a large, spontaneous background of electrical activity which seems to be unaffected by DDT. Although campaniform sensilla are located on the cercus, they are greatly outnumbered by hair sensilla sensitive to air currents and sound vibrations (*2*). This suggests that DDT does not have its characteristic effect on all sensory structures, but acts to some extent specifically on a particular group of sense organs, as yet unidentified.

SUMMARY

(1) Although DDT undoubtedly affects motor nerves and muscle fibers in concentrations greater than 1,000 ppm, this action cannot be directly responsible for the clonic tremors in the DDT-poisoned cockroach which can be produced by internal concentrations of the order of 5 ppm.

(2) DDT has no significant action on the cockroach central nervous system.

(3) DDT emulsion perfused through the leg of the cockroach in concentrations as low as 0.01 ppm causes the appearance of a series of high frequency trains of axon spikes in the afferent fibers.

(4) It is concluded that the tremors characteristic of DDT poisoning are due to an intense afferent bombardment of the motor neurons.

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Molecular Weights and Other Properties of Viruses as Determined by Light Absorption

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Virus solutions exhibit visible opalescence due to light scattered by the virus particles, and this results in a decrease in light transmission. It can be shown by an application of Einstein's theory of light-scattering of mixtures (*1*) that the molecular weight, M, of uniform spherical particles, small compared with the wave length of light, λ, is given for dilute solutions by the expression $M = 1.69 \times 10^{22} \dfrac{D\lambda^4}{c\left(\dfrac{\partial n^2}{\partial c}\right)^2}$, where c is the concentration of the particles expressed in grams per milliliter of solution, D is the optical density (the absorption coefficient divided by 2.303 for a cell of 1 cm. thickness) of the solution, and n is the index of refraction of the solution. Since $\dfrac{\partial n^2}{\partial c}$ is nearly equal to $2n_0 \left(\dfrac{n-n_0}{c}\right)$, where n_0 is the index of refraction of the medium, the latter expression can be used. Therefore, it is possible to secure molecular weight values if, for dilute solutions, the change in optical density with wave length and the indices of refraction of the solvent and solutions are known. In the present experiments the indices of refraction were determined by means of a Zeiss dipping refractometer, and the light absorption of the solutions was measured in a spectrophotometer at various wave lengths and concentrations. From the slope of the straight-line portion of the curve of D *versus* $\frac{1}{\lambda^4}$ extrapolated to infinite dilution and from the index of refraction of the solution, the molecular weight of the particles in solution is obtained.

The method just described was used in studies with two virus preparations known to possess quite different particle sizes. One of these was the PR8 strain of influenza virus, which has been found to consist of particles about 100 mμ in diameter (*3*), and the other was tomato bushy stunt virus, which has been found to consist of particles about 26 mμ in diameter (*7*). The influenza virus was obtained from infectious allantoic fluid of the developing chick embryo and was purified by a combination of the methods of adsorption on, and elution from, chicken red cells and differential centrifugation recently described by Knight (*2*). The bushy stunt virus was obtained from diseased *Datura stramonium* plants and purified by differential centrifugation as described by Stanley (*6*). The results for aqueous solutions of the two highly purified virus preparations are given in Figs. 1 and 2. The absorption, expressed in terms of the optical density, D, is referred to water as the zero value. For longer wave lengths, D is linear in $\frac{1}{\lambda^4}$, indicating that the absorption is due to Rayleigh light scattering. For shorter wave lengths, where the influenza virus particles are comparable in dimensions with the wave length, there is a decrease in scattering with a deviation from Rayleigh's law as predicted by a theory of Mie (*4*). In the case of the much smaller particles of bushy stunt virus, where the particles are small compared with the shorter wave lengths, there is an increase in absorptions above that of the Rayleigh law because of the high percentage of nucleic acid in this virus (*6*). This component has an absorption spectrum which extends into the visible region.

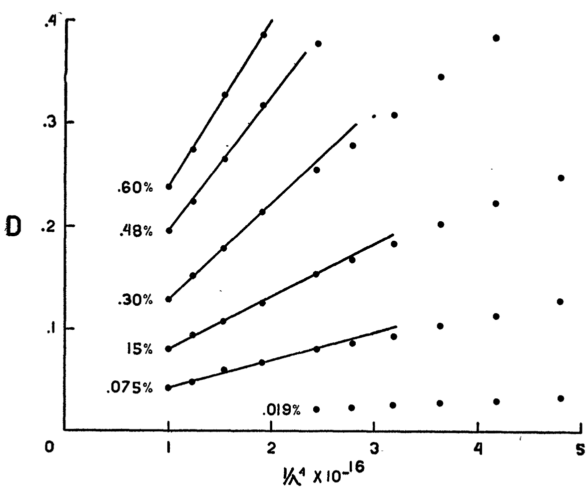

FIG. 1. Light absorption of aqueous solutions of influenza virus as a function of inverse fourth power of the wave length.

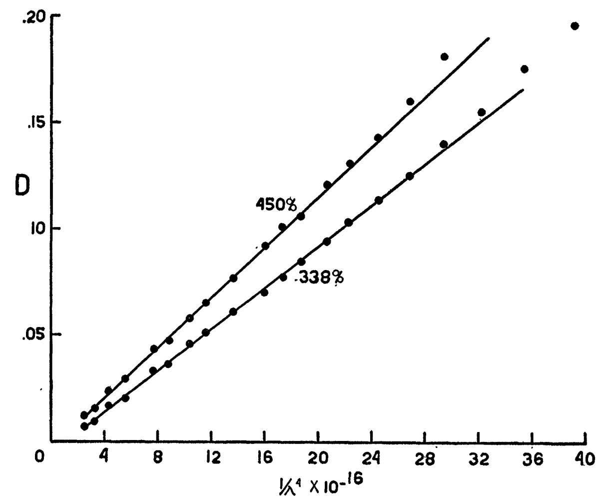

FIG. 2. Light absorption of aqueous solutions of tomato bushy stunt virus as a function of inverse fourth power of the wave length.

From the slopes of the straight-line portion of the curves of D *versus* $\frac{1}{\lambda^4}$ for influenza virus and bushy stunt virus, shown in Figs. 1 and 2, and from the indices of refraction of the virus solutions, molecular weight values of 322 million and 9.0 million, respectively, can be calculated. In this method no assumptions need be made about the percentage of hydration of the particles. Lauffer and Stanley (*3*) found the density of influenza virus to be about 1.1. Using this density and the value of the molecular weight of influenza virus determined by the light absorption method, a diameter of 97 mμ is obtained. This value agrees well with estimates of the size of the virus obtained in ultracentrifugation and electron microscope studies (*6*). The molecular weight of bushy stunt virus obtained from the light absorption method agrees well with estimates made by Neurath and Cooper (*5*) and by Stanley and Lauffer (*7*) from ultracentrifugation and diffusion studies.

The light-scattering, and therefore light-absorptive, powers of solutions are very sensitive to changes in particle size, shape, and interaction. For example, the method was used to determine the isoelectric point from the point of maximum coagulation of the virus particles. A typical curve is illustrated in Fig. 3, which shows the absorption as a function of volume of 0.001 molar HCl added to 5 cc. of a 0.2-per cent solution of tobacco mosaic virus in water. The solution corresponding to the maximum in the curve has a pH of 3.9, which agrees with the isoelectric point as measured with the same solutions by means of a microelectrophoresis apparatus. It is also possible, by using the light-absorption method, to distinguish between the isoelectric points of tobacco mosaic virus and many of its strains. The optical method is being used to study irreversible polymerization and the formation of liquid crystals of tobacco mosaic virus. The method seems to show promise in studies on antibody-antigen reactions involving viruses as the antigens.

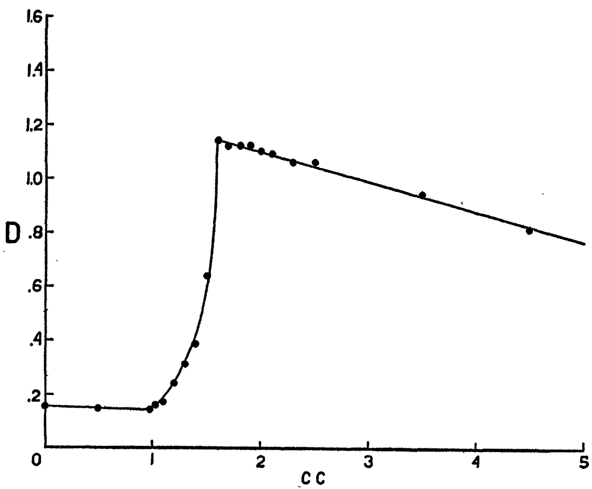

FIG. 3. Light absorption at a wave length of 400 mμ of 5 cc. of a 0.2-per cent aqueous solution of purified tobacco mosaic virus upon addition of 0.001 M HCl.

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News and Notes

AAAS Meeting Notes

The Council on Methodology of Science under the chairmanship of Paul Weiss, University of Chicago will hold a Friday morning session, 29 March, 9:30 A.M. in private dining room 6, Jefferson Hotel. A group of invited scientists will discuss some of the emerging problems which, with the rapid expansion of scientific domain, confront investigators, educators, editors, and administrators. The discussion will center on such subjects as the relation between fundamental and developmental research, standards of research performance, and independent versus directed research.

The Conservation Council under the chairmanship of Charles C. Adams, New York State Museum, Albany will hold a Saturday afternoon session, 30 March, 2:00 P.M.; private dining room 5, Jefferson Hotel. An informal conference has been called by the temporary officers of the Conservation Council to discuss suggestions and plans for the formation of a permanent organization devoted to the integration of active interest in organizations within the general field of conservation.

The Society for the Study of Speciation will hold a Saturday morning session, 30 March, 8:30 A.M. in private dining room 2, Jefferson Hotel under the chairmanship of Alfred E. Emerson. The Society for the Study of Speciation is a new group first organized in 1941 for those interested in the dynamics of evolution. In preparation for a fresh start, following an inactive period during the war, this meeting is called to discuss organization and objectives and to elect officers.

About People

Dr. Carlyle F. Jacobsen, formerly professor of psychology and assistant dean of the Washington University School of Medicine, St. Louis, has been appointed dean of the Graduate College at the State University of Iowa, effective 1 April.

Dr. Roger Adams, head of the Department of Chemistry in the University of Illinois and member of the *Science* policy committee, has been awarded the Davy Medal of the Royal Society of London. Dr. Adams, who spent the war years in Washington with NDRC, is now in Berlin as special adviser to Lt. Gen. Lucius D. Clay, deputy military governor of the American occupation zone in Germany.

Dr. Adams served the AAAS on the Executive Committee 1940–1945, has been vice-president of Section C, was president of the American Chemical Society in 1935, and is now chairman of its Board of Directors.