tain the animals alive in the laboratory are encouraging. Experimental work on the biology of these animals, heretofore virtually impossible, should now become a practical matter. Techniques are now being developed and physiological investigations are beginning at the Institute of Marine Science, University of Miami. Because the tubes of many individuals contain living larvae, a source of material for developmental studies is likewise available.

CLAUS NIELSEN*
Institute of Marine Science, University of Miami, Miami, Florida

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* Present address: Marine Biological Laboratory, Helsingör, Denmark.

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Airborne Particulates in Pittsburgh: Association with p,p'-DDT

Abstract. *The DDT associated with samples of airborne particulates was measured by gas chromatography. Because of possible vaporization of DDT during sampling, concentrations reported represent minimum values but demonstrate that DDT can be present in an urban atmosphere that is distant from any large-scale agricultural activity.*

Acree, Beroza, and Bowman (*1*) demonstrated that there is significant codistillation of DDT with water at 25° to 35°C. More than half of DDT in aqueous suspension (0.001 to 0.100 ppm) at 25°C was lost in 1 day by this mechanism. Because of the codistillation of DDT with water in the use of insecticides and the disappearance of DDT from the soil (*2*) and the coats of treated livestock, we undertook this study to determine the amount of DDT associated with airborne particulate pollutants in Pittsburgh air.

Air samples were collected on the roof of the Graduate School of Public Health in Pittsburgh at intervals from June to December 1964. A two-stage sampling system described by Shanty and Hemeon (*3*) was used to separate airborne dust into two fractions which deposit in the upper and lower respiratory tracts. Particles which would be trapped in the nasopharyngeal chamber of deposit in the upper respiratory tract of man are collected by sedimentation on 71 horizontal trays. Particles which penetrate through this section of the sampler are collected on an MSA 1106B glass fiber filter; these particles deposit in the lower respiratory tract, terminal airways, or alveoli in man. The latter fraction of particulates is referred to as "respirable" and is presumed to represent the risk to health, if any, of persons breathing the materials (*4*). Each sample of particulates was obtained by continuous sampling at an average rate of flow of 1.22 m^3/min, the range being 0.86 to 1.34 m^3/min, for 14 consecutive days and nights. The larger particles were washed from the trays with benzene, which had been purified by distillation through a column containing 27 theoretical plates. The purified benzene, when analyzed by gas-liquid chromatography at the conditions given below, exhibited no peaks in the area of interest. The washings were collected in a large evaporating dish, filtered, and then reduced to a volume of 2 to 3 ml by evaporation at reduced pressure. The filter with collected particulates was extracted with benzene in a Soxhlet extractor for 15 hours. The extractant was filtered and concentrated to a volume of 2 to 3 ml by vacuum evaporation on a heated water bath. Samples were then stored in the absence of light to eliminate the possibility of chemical interaction catalyzed by ultraviolet light (*5*). Sample analyses were performed in an F & M model 810 gas chromatograph with an electron-capture detector (*6*). The detector, injection port, and oven temperatures were 200°C. A glass column (4 mm inside diameter) packed with SE-52 (3.8 percent by volume) on Diatoport S was used. The pulse rate was 150 μsec, and a mixture of 95 percent argon and 5 percent methane was the carrier gas. Portions (0.1 μl) of the benzene concentrates were introduced to SE-52 columns by on-column injection. Sample chromatograms were compared with chromatograms of purified DDT prepared by recrystallization of technical grade material from ethanol. The chromatograms of benzene extracts of particulate samples which were characterized by peaks which coincided with *p,p'*-DDT also showed at least one other peak, characteristic of either DDD [1,1-bis(*p*-chlorophenyl)-2,2-dichloroethane], DDE [1,1-bis(*p*-chlorophenyl) 1,1-dichloroethylene], or *o,p'*-DDT [1-(*o*-chlorophenyl)-1-(*p*-chlorophenyl)-2,2,2-trichloroethane], which had relative retention times of 0.47, 0.64, and 0.78, respectively. A value of 1.0 for *p,p'*-DDT (DDT) was used as the standard. Only peaks characteristic of *p,p'*-DDT were quantitatively assessed.

Table 1. Concentrations (μg/1000 mm^3) of *p,p'*-DDT associated with suspended particulate matter in Pittsburgh air in 1964.

Sample period	Particulate	
	Respirable	Nonrespirable
6/22 to 7/6	0.00	0.10
7/6 to 7/20	1.14	1.22
7/20 to 8/3	0.23	<*
8/4 to 8/18	.06	<
8/31 to 9/14	<	<
9/15 to 9/29	0.13	<
10/2 to 10/16	.10	<
10/19 to 11/2	<	<
11/3 to 11/17	<	<
11/18 to 12/2	0.11	<

* The symbol, <, indicates less than a detectable amount.

After chromatographic analysis of two of the samples, the remainder of the benzene extract was evaporated under vacuum, recrystallized from hot ethanol, filtered, and made up to 100 ml with isooctane. Absorbances at 216 to 320 mμ by the sample were determined with a Beckman DB spectrophotometer with cells of 40-mm path length. An absorption band from 232 to 238 mμ was obtained, which is the principal absorption band reported for *p,p'*-DDT (*7*). Standards prepared from purified DDT were characterized by this absorption band and peak.

The results of the analysis are shown in Table 1. Because of the vaporization of *p,p'*-DDT that occurs during the sampling period, the concentrations reported here must be regarded as minimum values, and only demonstrate that airborne DDT can exist in a heavily industrialized urban area. Tabor (*8*) reported higher minimum concentrations of airborne DDT in agricultural communities (range up to 23 μg/1000 m^3, mean = 5 μg/1000 m^3). Our results also suggest that condensed liquids, adsorbed or absorbed by suspended particulates, are present in larger quantities in association with the smaller particles. Similar results were obtained when the association between suspended particulate matter in Pittsburgh and polynuclear aromatic hydrocarbons was studied (*9*). The respirable particulate fraction of Pittsburgh air has been consistently lower in weight than the nonrespirable fraction of the same sample, but the specific surface (cm^2/g) of particulate

matter increases as particle size decreases, and the smaller particles presumably offer more sites for vapor condensation.

PHILLIP ANTOMMARIA
MORTON CORN
LAWRENCE DEMAIO
University of Pittsburgh
Graduate School of Public Health,
Pittsburgh, Pennsylvania

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Spectral Sensitivity of Color Mechanisms: Derivation from Fluctuations of Color Appearance near Threshold

Abstract. *A method for determining the spectral sensitivity of the different color mechanisms of the human eye uses the pattern of color names applied to small, brief, dim, monochromatic flashes. Such responses are often due to the activation of single neural units. Preliminary spectral sensitivity curves for two color mechanisms have been obtained.*

Data from electrophysiologic and microspectrophotometric studies indicate that discrete units subserving color vision in primates can be isolated and their spectral sensitivities measured (*1*, *2*). Under suitable experimental conditions single neural units can be activated in the intact living eye. Since the optics of the eye impose an uncertainty as to the exact retinal position of an incident photon, the same neural unit cannot be activated repeatedly; hence fluctuations in color perceptions at the threshold of vision appear (*3*). Preliminary measurements of the spectral sensitivities of two classes of neural units, based on analysis of these fluctuations, are presented in this report.

In a preliminary experiment an observer was asked to match the hues of small, brief, dim, flashes of monochromatic light at a wavelength of 580 mμ by adjusting the wavelength of a larger steady field of light generated by a monochromator. The results are shown in Fig. 1. The matches were clearly bimodal, with no overlap. The stimuli were verbally described as "orange-red" or "red" for the long wavelength and "blue-green" for the short wavelength. No "yellow" matches were made. Sometimes the flashes could not be matched because they were not seen or because they appeared "white." This experiment indicates that under suitable conditions members of only one class of neural unit may be activated.

To develop a quantitative account of these results, consider the visual system as composed of N independent neural units organized in such a way that activation of any unit is sufficient to generate a perception. By simple binomial theory the probability of activation of k neural units is

$$\frac{N!}{k!(N-k)!}\ P^k(1-P)^{N-k}$$

where P is the probability of activation of a single unit. The probability of nonactivation of neural units (that is, the probability of not seeing) is obtained by setting $k = 0$. The fraction of perceptions based on the activation of one, two, or either one or two neural units as a function of probability of seeing is plotted in Fig. 2. These are limiting values reached as N approaches infinity. The fraction of single neural unit activations is greater than that shown if the probability of activation of single neural units is not uniform, as would occur if two or more classes of neural units existed.

This analysis can be extended to the case where several classes of neural units (that is, red, green, blue) are to be considered. Denoting the classes by subscripts, the probability of activation of neural units of class x only is:

$$\sum_{k=1}^{\infty} \frac{N_x!}{k!(N-k)!} P_x^k$$

$$(1-P_x)^{N_x-k}(1-P_y)^{N_y}(1-P_z)^{N_z}\ldots$$

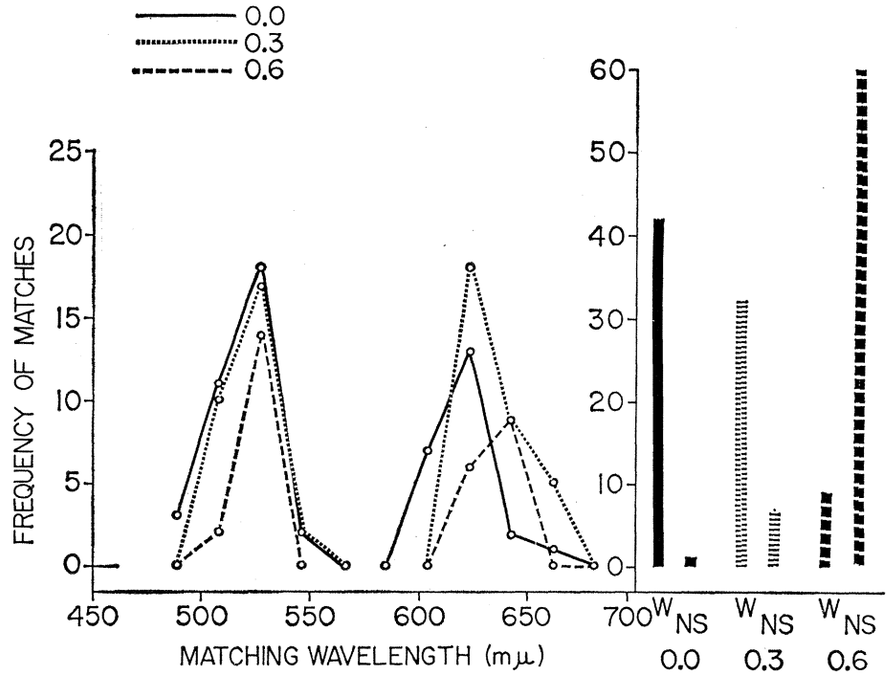

Fig. 1. Matches made to brief, small, low-energy stimuli; wavelength, 580 mμ. Ordinate, frequency of matches; abscissa, wavelength of matching light. Bar graph at right gives frequency of "white" (*W*) and "not seen" (*NS*) judgments. Data for the test stimulus at relative intensities of 0.0, 0.3, and 0.6 log units.