Table 1

Phthalocyanine	Specific resistance (ohm/c.c.)
Metal-free	*c.* 10^{13}
Manganous	4×10^{8}
Ferrous	4×10^{9}
Cobalt	9×10^{9}
Nickel	6×10^{10}
Copper	2×10^{11}
Zinc	3×10^{9}

the other members of the series have specific resistivities lying between 10^{9} and 10^{13} ohms/c.c.

Secondly, while the photoconductive action spectra of compounds other than manganous phthalocyanine were generally similar, having two or more peaks in the region 5000 Å–8500 Å, and another, usually weaker, peak in the region 10000 Å–12000 Å, manganous phthalocyanine showed its spectral response over the range 7000 Å–20000 Å (the limit of our monochromator) with broad maxima at 13500 Å and 16000 Å. The photocurrent in the infra-red was stronger in this compound than in any of the others.

Thirdly, the photocurrent is depressed in a remarkable way by gases. We have used dry electrolytic oxygen, dry oxygen-free nitrogen and water-vapour, and find all three, but particularly water-vapour, to have a marked effect on the photocurrent. A pressure of 1 cm mercury of any of these gases was sufficient to depress the photocurrent to the value in air, which is less by a factor of forty than its value at 10^{-5} mm mercury. The effect of evacuation or the introduction of gases was, as far as could be measured, instantaneous, and was repeatable, apparently indefinitely.

We could find no evidence of absorption bands corresponding to the spectral response of manganous phthalocyanine in its diffuse reflexion spectrum. However, a series of three peaks was found in the solution spectrum in *o*-dichlorobenzene, at 8500 Å, 10900 Å, and 13500 Å, the last being the most intense and corresponding to one of the maxima of the action spectrum. The extinction coefficients of these absorption bands are less by a factor of at least one hundred than the extinction coefficient in the very intense first singlet absorption band of the phthalocyanines. We are, as yet, unable to assign these bands definitely; but one possibility is that they are due to triplet transitions. Low optical absorption can give inordinately large photocurrents if they lead to an efficient photoconductive mechanism.

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Differential Isotope Effects in the *Ortho*- and *Para*-Bromination of Dimethylaniline

An account of the kinetic isotope effect observed in the bromination of dimethylaniline in aqueous acid containing added bromide ions has been given previously[1]. We now report that the observed isotope effect varies with the bromide ion concentration, but not with the acid nor with the amine concentration. The relative rates of bromination of dimethylaniline and its 2,4,6-trideutero derivative (0·005–0·0125 M) in sulphuric acid (6·4 M), measured by Bell and Ramsden's method[2], are:

$[Br^-]$ (M)	0·0125	0·025	0·050	0·100	0·250
k_H/k_D	1·9	1·7$_5$	1·5	1·3	1·1

Under comparable conditions, similar isotope effects are found for 2,6-dideuterodimethylaniline, whereas 3- and 4-deuterodimethylaniline give no isotope effect at any bromide concentration in the foregoing range. These results, together with the observation[3] that the *ortho*/*para* ratio for the bromination of dimethylaniline in aqueous acid is 2·3 and 0·15 at bromide concentrations of 0·025 and 0·5 M respectively, indicate that the isotope effect is 2·6 for the *ortho*-bromination and unity for the *para*-bromination of dimethylaniline under the conditions described.

The isotope effects obtained imply either that the *ortho*- and the *para*-substitutions proceed by different mechanisms, the rate-determining step involving the fission or the lengthening of the *C–H* bond in the *ortho*-, but not in the *para*-bromination, or that steric effects supervene in the *ortho*-deutero compounds, owing to the smaller amplitudes of *C–D* vibrations compared with the corresponding *C–H* vibrations. The red complexes formed by dimethylaniline and bromine, with molar ratios of 1 : 1 and 1 : 2, may be intermediates in the reaction, since the colour of aqueous bromine deepens on the addition of dimethylaniline, giving a band with an absorption maximum at 4650 Å. *Ortho*-deuterium atoms may stabilize such complexes by allowing fuller conjugation between the dimethylamino group and the benzene ring, resulting in a slower subsequent reaction between the complex and additional bromine. Using an arsenite titration method, which avoids the uncertainties connected with the particular electrode processes involved in the potentiometric method[2], the reaction order is found to be 1·3 in titratable bromine, suggesting that the transition state of the reaction contains more than one molecule of bromine with each dimethylaniline molecule.

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BIOCHEMISTRY

Chromatography of Infective Ribonucleic Acid from Foot-and-mouth Disease Virus on Calcium Phosphate

Although it is fairly generally accepted that the molecular weight of the infective unit of several ribonucleic acid-containing plant and animal viruses is approximately 2×10^{6}, there is still some objection to this conclusion. For example, Fraenkel-Conrat and his colleagues[1] consider that the infective ribonucleic acid of tobacco mosaic virus may be an aggregate of smaller polynucleotide sub-units. Furthermore, Vizoso and Burness[2], using the technique of chromatography on calcium phosphate, have shown that the infective material obtained by phenol extraction of Krebs-2 ascites tumour cells infected with mouse encephalomycarditis virus is eluted at phosphate molarities ranging from 0·01 to 0·21 M. As this method separates ribonucleic acids according to their molecular weights, the smaller molecules being eluted first[3], it appears that the infectivity is associated with components of several molecular sizes, some with molecular weights considerably smaller than 10^{6}. This finding is of considerable importance. It seemed of interest, therefore, to apply the same method to the examination of the ribonucleic acid of another virus. Consequently, the chromatographic behaviour of the infective ribonucleic acid obtained by phenol extraction of both pig kidney tissue culture cells and the vesicular fluid from guinea pigs infected with the virus of foot-and-mouth disease has been investigated. Two strains of the virus have been used for the preparation of the infective ribonucleic acid: (*a*) strain 1 (type *O*) from the fluid from vesicular lesions of guinea pigs infected with the virus, and (*b*) strain 997 (type *C*) passaged more than