

Some Experiments on Rice's Blue Material: Colours on Jupiter

Clarke and McTurk¹ have recently claimed that Rice's blue material can be prepared by passing ammonia through an electrical discharge tube and partially freezing out the decomposition products on a cold finger, placed about 2 cm. from the nearest electrode.

Since this observation conflicts with the results of extensive experiments carried out earlier by Rice and Freano², we repeated the work of Clarke and McTurk; but, in spite of intensive effort, we have been unable to produce the blue material from ammonia. We realize, of course, that the negative results reported in this communication, as well as those of Rice and Freano, do not prove conclusively that the blue material cannot be formed from ammonia using the above technique, since the conditions may be very critical and difficult to duplicate.

In our experiments we used tank anhydrous ammonia as supplied by the Matheson Co. The ammonia was passed, at pressures varying from 0.1 to 2.0 mm. of mercury, through an a.c. discharge powered by a transformer rated at 10,000 V. and 50 m.amp. current. The power supply to the discharge tube could be diminished at will by means of a Variac placed between the primary coil of the transformer and the power source. The products from the discharge were partially frozen out on a cold finger at 77° K., which was about 2 cm. from the nearest electrode. In each series of experiments a discharge tube of different dimensions was used, the length being varied from 9 in. to 8 ft., the diameter from 1 to 3 cm. The electrodes were of iron except for a few experiments in which aluminium electrodes were used.

If hydrazoic acid were substituted for ammonia, we always obtained the characteristic blue deposit on the cold finger except when the current density was sufficiently high to decompose all the hydrazoic acid. Whenever this occurred, we could always obtain the blue colour by diminishing the voltage supplied to the primary of the transformer.

Since Clarke and McTurk report: "In one experiment the uncondensed gas was sampled and found by mass spectrograph to be largely hydrogen, with small amounts of nitrogen and oxygen in the ratio of 4:1", we assumed that air leaked into their apparatus, and that possibly nitrogen trioxide was formed; this is blue when condensed on a surface cooled with liquid nitrogen. We, therefore, did a whole series of runs in which mixtures of ammonia and air were passed through the discharge tube, but we never succeeded in obtaining a blue deposit. We did a few experiments in which we mixed nitric oxide with small quantities (about 10 per cent) of air and passed the gas mixture, without any discharge, on to the cold finger. Under these conditions we did obtain a blue deposit of nitrogen trioxide which in colour and in its behaviour on warming could have been mistaken for the blue material. However, we never succeeded in finding any conditions under which nitrogen trioxide could be frozen out from mixtures of ammonia and air or nitrogen and water vapour on passage through a discharge tube.

These experiments on nitrogen oxides are of some importance in connexion with colours on Jupiter³. Recently, Kiess *et al.*⁴ have shown that oxides of nitrogen are present on the atmosphere of Mars,

and the suggestion has been made that the colours on Jupiter are due to frozen-out oxides of nitrogen, even though Jupiter is a 'reduced' planet. It is conceivable that non-equilibrium conditions exist on Jupiter and that the violent electrical storms might possibly result in the freezing-out of oxides of nitrogen formed by reaction of nitrogen atoms and oxygen atoms. The oxygen atoms would presumably result from the dissociation of water which may be whirled about in the turbulent Jovian atmosphere as tiny ice particles.

F. O. RICE
D. P. COSGRAVE

Chemistry Department,
Georgetown University,
Washington, 7, D.C.

¹ Clarke, J. W., and McTurk, G., *Nature*, **184**, 2014 (1959).

² Rice, F. O., and Freano, M., *J. Amer. Chem. Soc.*, **75**, 548 (1953).

³ Rice, F. O., *J. Chem. Phys.*, **24**, 1259 (1956).

⁴ Kiess, C. C., Karrer, S., and Kiess, H. K. (to be published in "The Publications of the Astronomical Society of the Pacific".)

BIOCHEMISTRY

Metabolism of β -Sitosterol and Other Lipids in the Presence of Acetate-2-¹⁴C by Blowfly Larvæ

It has been shown recently that the ability to convert C₂₈₋₂₉ sterols to cholesterol is likely to be a general attribute of phytophagous insect larvæ¹. In the case of β -sitosterol, this conversion could occur either by removal of the side-chain and *de novo* synthesis of the cholesterol side-chain or by elimination of the supernumerary carbon atoms to yield the *iso*-octyl side-chain. Enzymes capable of cleaving the side-chain of sterols are known to occur in mammals² and certain bacteria³.

Although blowfly larvæ are not as efficient in converting sitosterol into cholesterol as obligatory plant feeders, they were selected for the present work because they grow sufficiently rapidly to avoid randomization of the isotopic carbon; they also grow readily on a synthetic diet and under aseptic conditions.

Larvæ of *Calliphora erythrocephala* were reared at 29° aseptically⁴ at a density of seven animals per 10 gm. of a synthetic diet⁵ in which cholesterol was replaced by purified β -sitosterol (m.p. 140°; [α]_D²⁰-36). Sodium acetate-2-¹⁴C was diluted with carrier acetate and 2.5 mgm. added to 40 gm. of this diet, amounting to a concentration of 6.25 mgm. per cent; the specific activity of the sodium acetate was 12 μ c./mgm. The diet was continuously aerated with air free from carbon dioxide and kept in darkness during the 6 days of larval growth. At the end of this period the 27 surviving animals had attained their maximum body-weight (mean larval weight, 92 mgm.) and were used for analyses; the radioactivity of the samples was measured with a thin end-mica window tube with an accuracy of \pm 5 per cent and corrected for self-absorption in the usual manner.

The desiccated larvæ (578 mgm.) contained 19.7 per cent of ethylether - chloroform - acetone-extractable lipids, of which 83.6 per cent consisted of fatty acids and 11.5 per cent of unsaponifiable matter; of the latter, 10.7 per cent were recovered as sterols, precipitable by digitonin. Table 1 shows the radioactivity of the various fractions. The most