propionate (5mM) without a lag and at about the same rate as do propionate-sensitive (wild-type) organisms. Propionate tolerance is a stable character, since prolonged subculture of tolerant organisms in the absence of propionate does not result in the loss of resistance to propionate.

The biochemical basis of propionate resistance was investigated in experiments with cell suspensions and cell-free extracts. Suspensions of wild-type organisms assimilate $[2-^{14}\text{C}]$ propionate and $[1-^{14}\text{C}]$ acetate in the light under an atmosphere of air + CO_2 (95:5); in contrast, suspensions of propionate-resistant organisms do not incorporate significant amounts of either organic compound into cell material under identical conditions. Dialysed extracts of wild-type *A. nidulans* contain readily detectable acetate and propionate thiokinase activity, whereas extracts of propionate-resistant organisms do not contain these activities.

It is proposed that the loss by spontaneous mutation of the enzyme acetate thiokinase is the biochemical basis of propionate resistance in the blue-green alga *A. nidulans*.

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Inhibition of Photosynthetic Electron Transport by 1,1,1-Trichloro-2,2-bis-(*p*-chlorophenyl)ethane (DDT) at a Site before Photosystem 2

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The inhibitory effect of DDT* on photosynthesis by susceptible barley varieties is shown by a decrease in the rate of O_2 evolution and by diminished Hill activity, paralleled by loss of cyclic and non-cyclic photophosphorylations (e.g. see Lawler & Rogers, 1967; Owen, Rogers & Hayes, 1970).

A site of inhibition of electron transport by DDT before photosystem 2 was identified from spectrophotometric studies on tris-washed chloroplasts in which electron donation from water, and O_2 evolution, have been eliminated (Yamashita & Butler, 1968). In this system artificial electron donors such as diphenylcarbazide were used to donate electrons beyond the site of tris inhibition (Yamashita & Butler, 1969), and electron flow through photosystem 2 was measured by use of 2,6-dichlorophenol

indophenol or ferricyanide as electron acceptor from the intermediate electron-transport chain.

The properties of chloroplasts from DDT-treated susceptible barley, where electron transport from water, as evidenced by photoreduction of dichlorophenol-indophenol, was inhibited some 50%, were compared with those of untreated controls. In both cases washing with tris almost completely inhibited electron donation from water, although electron transport could be restored to the control (untreated barley) value by diphenylcarbazide. Thus with electron transport from diphenylcarbazide no inhibition of electron transport to dichlorophenol-indophenol was observed in chloroplasts from DDT-treated barley. This indicates that a site blocked by DDT in the electron-transport chain before photosystem 2 is by-passed by electron donation from diphenylcarbazide. In contrast with work on spinach chloroplasts no electron donation beyond the tris block from benzidine or semicarbazide (Yamashita & Butler, 1969) was observed.

Studies of electron donation by Mn^{2+} or ascorbate to the electron-transport chain before photosystem 2 (Ben-Hayyim & Avron, 1970) were made by measuring O_2 consumption in the oxygen electrode with paraquat or diquat as electron acceptor from photosystem 1 (Izawa, Connolly, Winget & Good, 1966; Böhme & Trebst, 1969). There was no change in relative rates of electron donation from the artificial donors compared with donation from water in chloroplasts isolated from DDT-treated or untreated susceptible barley. This suggests that the sites of electron donation from Mn^{2+} or ascorbate are before the target site for DDT in the electron-transport chain before photosystem 2, since in chloroplasts from treated barley some alleviation of the observed inhibition of electron transfer from water might be expected if the DDT-sensitive site were by-passed.

The interpretation of this latter result was made in the knowledge that the inhibition observed in electron donation from Mn^{2+} or ascorbate is a function of inhibitions by DDT of both a site before photosystem 2 and a further site that preliminary results locate in the intermediate electron-transport chain (W. J. Owen & L. J. Rogers, unpublished work).

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* Abbreviation: DDT, 1,1,1-trichloro-2,2-bis-(*p*-chlorophenyl)ethane.

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Partial Purification from Rat Liver of an Enzyme Catalysing the Sulphurylation of Dehydroepiandrosterone

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The sulphotransferases of mammalian tissues catalyse the transfer of the sulphuryl group of adenosine 3'-phosphate 5'-sulphatophosphate to a variety of acceptors, which include phenol, dehydroepiandrosterone, oestrone, L-tyrosine methyl ester and serotonin. None of these sulphotransferases has been obtained in a pure state, but Banerjee & Roy (1966) described the partial separation from guinea-pig liver of a number of sulphotransferases. They achieved a 20- and 70-fold increase in the specific sulphurylating activities towards dehydroepiandrosterone and oestrone respectively, but both of these fractions were active towards phenol. Mattock & Jones (1970) purified from female rat liver an enzyme that catalysed the sulphurylation of L-tyrosine methyl ester, but this purified preparation also catalysed the synthesis of *p*-nitrophenyl sulphate. McEvoy & Carroll (1970) described the isolation from male rat liver of an enzyme that catalysed the sulphurylation of phenols but had no activity towards steroids, L-tyrosine methyl ester or serotonin. Adams & Poulos (1967) isolated from bovine adrenals an oestrogen sulphotransferase that lacked activity towards 3 β -hydroxy steroids and *p*-nitrophenol. The present communication describes the partial purification from rat liver of a steroid sulphotransferase with high activity towards dehydroepiandrosterone and weak or no activity towards other acceptors.

Livers from female Wistar rats were homogenized in 0.15M-potassium chloride with a Potter-Elvehjem homogenizer, and centrifuged at 100 000g for 1 h. The resulting supernatant was made 1mM with respect to 2-mercaptoethanol and diluted to a protein concentration of 10mg/ml. The sulphotransferase was precipitated by the addition of cold ethanol to a concentration of 25% (v/v). The precipitated protein was dissolved in 5mM-tris-HCl buffer, pH 8.0, and stirred at 2°C for 1 h. After centrifugation at 25 000g for 15 min, the supernatant was collected and adjusted to 55% saturation with respect to ammonium sulphate. The precipitated protein was dissolved in 5mM-tris-HCl buffer,

pH 8.0, and dialysed against large volumes of the same buffer. During the dialysis inactive protein was precipitated and was discarded. Further purification was achieved by chromatography on columns of DEAE-cellulose and phosphocellulose P-11, and gel filtration on Sephadex G-200. The specific activity towards dehydroepiandrosterone of this partially purified sulphotransferase was 60-fold higher than that of the crude supernatant, and the enzyme had negligible activity towards *p*-nitrophenol, L-tyrosine methyl ester and serotonin.

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A Heparan Sulphate Sulphotransferase of Ox Lung

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Suzuki & Strominger (1960) first showed that a preparation from hen oviduct could catalyse the sulphation of heparan sulphate by adenosine 3'-phosphate 5'-sulphatophosphate. Suzuki, Trenn & Strominger (1961) reported the partial purification and stability of the enzyme. Using similar methods, we have extended their studies. In seeking a more convenient source of the enzyme, a study was made of its distribution in rat tissues. Marked activity was detected in lung and brain homogenates only. For purposes of purification, ox lung was the sole source of the enzyme.

Experiments were designed to determine whether the enzyme was responsible for synthesizing *N*-sulphate or *O*-sulphate groups in heparan sulphate. [Both types of sulphate ester are present in this glycosaminoglycan (Brown, 1957).] Chemically de-*N*-sulphated heparan sulphate is a better substrate for the enzyme than is heparan sulphate, suggesting that enzymic *N*-sulphation is more likely. [³⁵S]Sulphate was enzymically transferred from adenosine 3'-phosphate 5' [³⁵S]-sulphatophosphate to de-*N*-sulphated heparan sulphate. The product was purified, and unsubstituted amino groups were acetylated, before incubation with a crude 'heparinase' from *Flavobacterium heparinum*. A paper-chromatographic separation of the resulting incubation mixture in an isobutyric acid-ammonia solvent system (Suzuki & Strominger, 1960) revealed only two radioactive areas. The major ³⁵S-labelled component had the same *R_f*