diethylstilboestrol *in vivo* 24 hr. before testosterone injection does not appear to affect the overall pattern of metabolism.

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- Farnsworth, W. E. & Brown, J. R. (1963). *Monogr. nat. Cancer Inst.* no. 12, p. 323.
 Jensen, E. V. (1965). In *Mechanisms of Hormone Action*, p. 245. Ed. by Karlson, P. New York: Academic Press Inc.
 Menini, E. & Norymberski, J. K. (1965). *Biochem. J.* **95**, 1.

Changes in Glutathione Reductase and Glutathione Peroxidase Activities in Rat Liver Related to Age and Sex

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Enzyme activity of many enzymes has been studied during the development of the rat (Herrmann & Tootle, 1964; Dawkins, 1966; Taylor, Bailey & Bartley, 1967; Vernon & Walker, 1968a). Differences in activities of some enzymes due to sex are also known (Glock & McLean, 1953; Taylor *et al.* 1967; Roux & Tordet-Caridroit, 1967; Vernon & Walker, 1968b), although glutathione reductase and glutathione peroxidase have not been studied. Glutathione reductase (Rall & Lehninger, 1952) is an important enzyme for the maintenance of glutathione in the reduced form and possibly for controlling the redox state of NADP⁺/NADPH in tissues through glutathione peroxidase (Mills, 1960). Glutathione oxidation (Pinto, 1961) depends on xanthine oxidase activity (Jocelyn, 1964; Christophersen, 1966) or other enzymes associated with the formation of hydrogen peroxide or organic peroxides (Christophersen, 1966) that are possible substrates for glutathione peroxidase (O'Brien & Little, 1968).

This communication reports changes in glutathione reductase and glutathione peroxidase activities in rat liver from foetal to adult life and during the oestrous cycle, and also differences of enzyme activities between pregnant and non-pregnant females.

The average glutathione reductase activities in male and female rat livers were 10.4 ± 0.8 and 9.0 ± 1.3 units respectively. Glutathione peroxidase activities were 48 ± 5 units (males) and 81 ± 15 units (females). The larger scatter in females is due to the oestrous cycle. Glutathione reductase activity in dioestrus was 10.3 ± 1.1 units and in oestrus 8.1 ± 0.7 units. Glutathione peroxidase activity in dioestrus was 64 ± 7 units and in oestrus 96 ± 7 units. Intermediate values for both enzymes activities were found during pro-oestrus and metoestrus.

Pregnant rats had about the same activities as in oestrus.

Glutathione reductase activity in the foetus increased till birth (7 units). After birth the activities showed two maxima at about 2 (11 units) and 32 days old (13 units), and one minimum at about 16 days (5.8 units). Glutathione peroxidase activity in the foetus increased till birth (18 units) and continued to increase till maturity when there was a sharp increase to adult values in the female. Differences due to sex appeared after 32 days.

These enzyme changes are associated with changes of diet and hormones during development.

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- Christophersen, B. O. (1966). *Biochem. J.* **100**, 95.
 Dawkins, M. J. R. (1966). *Brit. med. Bull.* **22**, 27.
 Glock, G. E. & McLean, P. (1953). *Biochem. J.* **55**, 400.
 Herrmann, H. & Tootle, M. L. (1964). *Physiol. Rev.* **44**, 289.
 Jocelyn, P. C. (1964). *Nature, Lond.* **202**, 1115.
 Mills, G. C. (1960). *Arch. Biochem. Biophys.* **81**, 1.
 O'Brien, P. J. & Little, C. (1967). *Biochem. J.* **103**, 31P.
 Pinto, R. E. (1961). *Biochem. J.* **79**, 43.
 Rall, T. W., Lehninger, A. L. (1952). *J. biol. Chem.* **194**, 119.
 Roux, J. M. & Tordet-Caridroit, C. (1967). *Ann. Endocrin.* **28**, 781.
 Taylor, C. B., Bailey, E. & Bartley, W. (1967). *Biochem. J.* **105**, 717.
 Vernon, R. G. & Walker, D. G. (1968a). *Biochem. J.* **106**, 321.
 Vernon, R. G. & Walker, D. G. (1968b). *Biochem. J.* **106**, 331.

Lipid Solubility and the Low Biliary Excretion of 3-Aminophenyl Sulphate and 4-Aminophenyl Glucuronide by the Rat

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Previous studies on the biliary excretion of foreign compounds indicate the importance in this process of several factors, namely molecular size, polarity and metabolism (Abou-El-Makarem, Millburn, Smith & Williams, 1967; Millburn, Smith & Williams, 1967a). For extensive biliary excretion in the rat a minimum molecular weight (about 325 ± 50) and a polar ionizable group appear to be necessary.

We decided to try to find out why low-molecular-weight benzene derivatives are excreted poorly by rats in bile. We therefore studied the biliary excretion and the distribution between plasma, liver and bile in biliary-cannulated rats of two such compounds, namely 3-aminophenyl sulphate (mol.wt. 189) and 4-aminophenyl glucuronide (mol.wt. 285). The findings were compared with