unavoidable inaccuracy in the selection for measurement of the reticulated nuclei. Indeed because these cells are very pale, it is difficult to ascertain by manipulating the fine adjustment of the microscope whether or not a more or less important part of the nucleus has been cut. This difficulty therefore may have led to the measurement of incomplete reticulated nuclei. As suggested by the symmetry of their histogram, the selection of the leptotenes, which are much darker, was more precise.

(2) The extinction values in the reticulated group oscillate around 10–12% and in the leptotene group around 30%. Since the minute extinctions of the reticulated nuclei often fall just beyond the range of the linear section of the cytophotometer's absorption curve, these measurements are less accurate and, moreover, bring about an underestimation of the Feulgen-DNA content[8].

(3) In reticulated nuclei, many of the fine chromatin granules are studded against the inner surface of the nuclear membrane and may have escaped measurement since we had to keep the projection screen diaphragm clear of the nuclear membrane. Thus this particular distribution of DNA brings about another underestimation of extinction in the reticulated nuclei. Summarizing, error (1) causes the insertion of measurements over incomplete nuclei into the calculation of the mean Feulgen-DNA content, thus lowering the mean of the reticulated nuclei. It also accounts for the asymmetrical shape of their histogram. Errors (2) and (3) provoke an overall underestimation of the Feulgen-DNA content in the reticulated nuclei.

These limitations of the technique in this material may suffice to explain that the mean Feulgen-DNA content of the reticulated nuclei is less than half that of the leptotenes.

Conclusion. The results of the present quantitative study show that the germ cells at the leptotene stage contain at least twice as much nuclear Feulgen-DNA as the germ cells with reticulated nuclei. Considering the sources of error in this material, a simple 2/1 (tetraploid/diploid) rate is suggested, but could not be ascertained. Our data, however, indicate that during the DNA synthesis at the preleptotene stage, the Feulgen-DNA content in the germ cells of the female chicken is at least doubled. The germ cells appear to go through a period of premeiotic doubling of their DNA content, analogous to the S-phase of a regular cell cycle. Our data neither support nor rule out the possibility of a concomitant DNA synthesis of other origin at this stage of premeiosis[9].

Résumé. Chez l'embryon de poulet femelle nous avons comparé à l'aide de la technique cytophotométrique de Lison la teneur en ADN des cellules germinales à noyau réticulé à celle des cellules au stade leptotène. Comme pendant la phase S d'un cycle cellulaire régulier, la quantité de DNA au cours du stade préleptotène, semble au moins doubler. Néanmoins nos résultats ne permettent pas d'affirmer ou d'exclure la possibilité d'une synthèse de DNA supplémentaire d'autre origine.

M. CALLEBAUT[10] and J. L. BERNHEIM[11]

Laboratorium voor Anatomie en Embryologie, R.U.C. Antwerpen and Laboratorium voor Pathologische Ontleedkunde, Rijksuniversiteit, Gent (Belgium), 28 April 1969.

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[10] Laboratorium voor Anatomie en Embryologie, R.U.C. Antwerpen (Belgium).

[11] Laboratorium voor Pathologische Ontleedkunde, Rijksuniversiteit Gent (Belgium).

Monoamine Oxidase- and Catechol-*O*-Methyltransferase Activity in Umbilical Vessels of the Human Fetus[1]

Catecholamines may be inactivated by monoamine oxidase (MAO) or by catechol-*O*-methyltransferase (COMT). Since noradrenaline penetrates the human placenta[2] it was considered of interest to assess the activity of noradrenaline inactivating enzymes in the vessels connecting the placenta with the fetus. Special interest was focused on the ductus venosus, which has an adrenergically innervated sphincter mechanism[3], the physiological significance of which is not yet properly understood.

The material consisted of 25 fetuses, classified according to their crown-heel length as noted in the Table. Immediately after legal abortion, the tissue was prepared from: (1) the umbilical arteries from the umbilicus down to the level of the urinary bladder, (2) the free intraabdominal part of the umbilical vein, and (3) the entire ductus venosus. 2 transverse sections (3–4 mm in length) of the umbilical cord (4 and 5) were prepared at 1 and 5 cm distance from the skin level thus consisting of both venous and arterial vessels including the Wharton jelly. Liver tissue (6) was simultaneously removed for analysis. (Numbers in brackets refer to the Figure.) Material from each site within each group of fetuses had to be pooled for analysis. Tissue of the ductus venosus was only available in sufficient amounts in fetus group II.

All the legal abortions were performed by laparatomy. For anaesthesia the patients received the following drugs: thiopental sodium, fluothane, and nitrous oxide together with suxamethonium chloride to secure muscular relaxation.

The tissue was removed within 15 min after the operation, and then stored at -70 °C for up to 12 days. Control analysis showed no decrease in COMT or in MAO activity within this period. The supernatant ($8000 \times g$, 15 min) of tissue homogenate in 40 volumes (w/v) of ice-cold isotonic KCl solution served as enzyme solution.

COMT was measured by a modification of a method described by AXELROD et al.[4]. Instead of radioactive

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substrate the isotope labelled cofactor S-adenosyl-methionine-C^3H_3 (NEN-Chemicals) was used. Duplicate tests were done.

The MAO activity (oxidation of kynuramine to 4-hydroxy-quinoline) of the tissue was measured fluorimetrically in the way described by KRAJL[5]. The protein content of the tissue preparations was determined by the method of LOWRY et al.[6].

MAO activities (nmol formed product per milligram protein per 60 min incubation) registered in the following areas fell within the same low range (1.5–3.7): umbilical cord 1 cm from umbilicus, umbilical cord 5 cm from umbilicus, and umbilical artery. There was no difference within the 3 fetus groups. The MAO activity found in the umbilical vein in any of the 3 groups of fetuses was 3 times as high (9.1–10.3) as in the 3 former locations. The highest activity (27.4) was obtained in the ductus venosus. The MAO activity of the liver varied between 5.7 and 14.1 nmol formed product under standard conditions (Table).

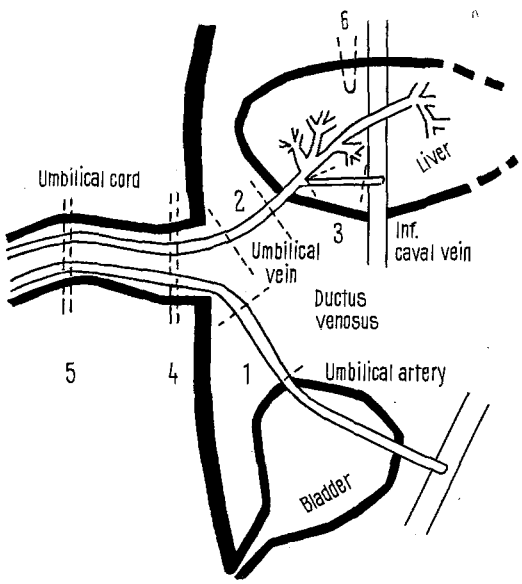
Very little or no COMT activity was found in the vessels in contrast to liver tissue. The values found for COMT activity (cpm formed ^{14}C-metadrenaline per milligram protein during 60 min incubation) are listed in the Table.

The difference observed between various parts of the fetal afferent vessels cannot be ascribed to contamination with surrounding tissues. The umbilical vein investigated, which exhibited a high MAO activity, transverses the abdominal cavity quite freely. The ductus venosus, on the other hand, is surrounded by liver tissue, and contamination with liver cells during preparation was difficult to avoid. In spite of this the MAO activity in the ductus venosus was definitely higher than that in the liver tissue.

MAO activity is widely distributed in the adult human body[7] and its occurrence in vessels has also been reported[8].

What is the physiological significance of the differences found in MAO activity between various vessels in the human fetus? The different MAO patterns reported here may reflect the developing adrenergic innervation of the vessels, just as the development of MAO activity during ontogenesis of the chick is regarded as reflecting the appearance of sympathetic innervation in this animal[9]. An earlier histochemical study of adrenergic nerves in 20–24 week old human fetuses revealed no innervation in the umbilical cord, a conspicuous adrenergic ground plexus in the ductus venosus (especially in the spincter region), and no nerve terminals in the free-running intra-abdominal part of the umbilical vein[3]. There is thus no parallelism between the sympathetic terminal innervation and the MAO activity in the umbilical vein. The vascular MAO activities in the region investigated were of the same magnitude in the three age groups.

On the other hand, there is reason to regard the high MAO activity in the umbilical vein and the ductus venosus as a necessary protective mechanism unrelated to the local inactivation of adrenergic transmitter substance. The vasoconstrictory action of circulating noradrenaline and 5-hydroxytryptamine on the vessels may be counteracted by metabolic degradation by the enzyme to secure a satisfactory flow of blood to the fetus.



Schematic drawing showing the portions (1–6) of vessels and tissues removed for analysis.

Monoaminoxidase and catechol-*O*-methyltransferase activity in various parts of fetal vessels and liver

Monoaminoxidase activity
(expressed in nmol formed product per mg protein per 60 min incubation)

Fetus group	Localisation (numbers 1–6 refer to the Figure) Umbilical cord					
	5 5 cm from umbilicus	4 1 cm from umbilicus	1 Umbilical arteries	2 Umbilical vein	3 Ductus venosus	6 Liver
I	1.5	2.3	3.1	10.3	–	6.0
II	2.9	1.6	3.1	9.0	27.4	5.7
III	2.7	3.7	2.7	9.1	–	14.1

Catechol-*O*-methyltransferase activity
(expressed in cpm formed product per mg protein per 60 min incubation)

I	1,080	4,103	0	796	–	79,741
II	0	0	362	1,662	–	63,336
III	0	889	0	0	–	78,699

Group I = 7 fetuses (length: 12–17 cm). Group II = 11 fetuses (length: 18–23 cm). Group III = 7 fetuses (length: 24–31 cm).

Zusammenfassung. Die MAO-Aktivitäten menschlicher Feten verhielten sich in folgender, abnehmender Reihe: Ductus venosus, Vena umbilicalis = Leber, Arteria umbilicalis = Nabelstrang. Die COMT-Aktivität hingegen erwies sich in allen untersuchten Gefässen als unbedeutend und war nur im Lebergewebe auffallend hoch.

G. GENNSER and W. v. STUDNITZ

Department of Obstetrics and Gynecology and Clinical Chemistry, General Hospital of Malmö, University of Lund, S21401 Malmö (Sweden),
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