

Trichromatic vision in man may depend upon the presence in the cones of three distinct photo-labile pigments, differing in absorption characteristics<sup>9</sup>. In the chicken retina three groups of colour filters provide a possible basis for hue differentiation. It is unnecessary, therefore, to assume more than a single cone photo-pigment in this animal.

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<sup>1</sup> Boll, F., *Arch. Physiol.*, 1, 4 (1877).

<sup>2</sup> Kühne, W., *Unters. physiol. Inst. Heidelberg*, 1, 15 (1877).

<sup>3</sup> Kötting, E., and Abelsdorff, G., *Z. Psych. u. Physiol. Sinnesorg.*, 12, 161 (1896).

<sup>4</sup> Garten, S., *Arch. Ophth.*, 63, 112 (1906); Hosoya, Y., and Bayerl, V., *Arch. ges. Physiol.*, 231, 563 (1933). Chase, A. M., *J. Gen. Physiol.*, 19, 577 (1936). Wald, G., *NATURE*, 139, 587 (1937). Lythgoe, R. J., *J. Physiol.*, 89, 331 (1937).

<sup>5</sup> Wald, G., *NATURE*, 139, 1017 (1937).

<sup>6</sup> Hecht, S., and Williams, R. E., *J. Gen. Physiol.*, 5, 1 (1922).

<sup>7</sup> Honigsmann, H., *Arch. ges. Physiol.*, 189, 1 (1921).

<sup>8</sup> Wald, G., and Zussman, H., *NATURE*, 140, 197 (1937).

<sup>9</sup> Hecht, S., *J. Opt. Soc. Amer.*, 21, 615 (1931).

#### Hæmodynamic Factors in the Uterus during the Latter Part of Gestation

ACCORDING to the data of Barcroft, Herkel and Hill<sup>1</sup>, a critical change takes place in the rate of blood flow through the uterus of the rabbit after the twenty-second day of pregnancy. The rate of flow diminishes approximately one third between this and the twenty-fifth day, although it increases again by the twenty-seventh day of gestation. In an earlier paper by Barcroft and Rothschild<sup>2</sup>, measurements were made of the volume of blood contained within the maternal vessels of the uterus on different days of pregnancy. The data of this study show that the volume of blood increases to a maximum by the twenty-eighth day and diminishes by fifty per cent during the next two days. The volume of the placental tissues during this time follows a parallel curve, so leading these investigators to the reasonable conclusion that the volume of blood in the uterus increases as the extent of the placental vascular bed increases. The cause of the changes in the rate of blood flow through these vessels has not, however, been described. When the foregoing data were used to estimate the efficiency of the uterine circulation during the latter part of gestation as certain growth changes take place, an insight was gained into some of the hæmodynamic factors operating at this time, providing a basis for interpreting the effects which Barcroft and his associates have reported.

The percentage of the blood volume which changes each minute (that is, the efficiency of the maternal circulation in the uterus) has been calculated from the data cited above with the result shown in the accompanying table:

Day of pregnancy	Blood volume of uterus	Minute-volume of blood	Efficiency (% turn-over)
14	8.0 c.c.	5.0 c.c./min.	62.5
18	12.3 "	13.5 "	109.7
20	14.5 "	20.0 "	137.1
22	16.2 "	29.0 "	179.0
25	21.5 "	19.0 "	88.3
27	29.0 "	27.5 "	94.8
28	32.0 "	28.5 "	89.0

Here, it will be seen, a marked increase takes place in the turn-over of the blood each minute until the twenty-second day, as the blood volume increases coincidentally. By the twenty-fifth day a marked decrease occurs in the efficiency of the local circulation. This fall parallels that which takes place in the circulation rate. From this point on, so far as the data go, this level of efficiency in the uterine circulation is maintained. The level at this time equals that found on the seventeenth day of pregnancy when the embryos are almost inappreciable in size, whereas by the twenty-fifth day they are comparatively large and are growing at a nearly maximum rate<sup>1</sup>. The oxygen requirement of the embryos is met by greater oxygen unsaturation of the blood as it flows through the uterus<sup>1</sup>.

The significance of these considerations is shown by the recent discovery that a critical change occurs in the relationship between the rate of growth of the uterus and the growth of the products of conception about the twenty-second day of gestation. Between the twenty-second and the twenty-fourth days the uterus commences to grow less rapidly, from causes already described<sup>3,4</sup>. At the same time, the products of conception grow at a rate almost as rapid as at any time during pregnancy<sup>3,4</sup>. The foetuses and their associated structures must act, therefore, as an impeding influence to the maternal circulation and so serve as a factor which diminishes the quantity of blood flowing through the maternal vessels of the uterus at this time. This resistance to the local flow of blood in the maternal circulation of the uterus is transient, however, as shown by the data of Barcroft, Herkel and Hill.

It is therefore clear that the rate and efficiency of the blood flow in the maternal circulation of the uterus are adversely affected as the influence of distention first becomes manifest, but with increasing degrees of distention as pregnancy nears term, some compensating adjustment takes place which maintains the efficiency of this local circulation of blood. The pumping action of the increasing muscular movements which are known to take place at this time<sup>5</sup> would serve such a purpose. The efficiency and forcefulness of these contractions would likewise be enhanced by the increasing distention resulting from the disproportion in the rates of uterine and fetal growth respectively.

These considerations suggest, therefore, that the increasing distention which the uterus undergoes in the latter part of gestation first brings about a diminution in the efficiency of the maternal circulation through the uterus. As the degree of distention becomes greater, however, it becomes *pari passu* the means by which the efficiency of this circulation is maintained, mainly by virtue of the influence which distention has upon the contractility of the myometrium.

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<sup>1</sup> Barcroft, J., Herkel, W., and Hill, S., *J. Physiol.*, 77, 194 (1935).

<sup>2</sup> Barcroft, J., and Rothschild, P., *J. Physiol.*, 76, 447 (1932).

<sup>3</sup> Reynolds, S. R. M., *Amer. J. Obst. Gynecol.*, 33, 968 (1937).

<sup>4</sup> Reynolds, S. R. M., Symposium on Quantitative Biology, The Biological Laboratory, Cold Spring Harbor, Long Island, N.Y., volume 5 (1937).

<sup>5</sup> Wijsenbeek, I. A., and Grevenstuk, A., *Nederl. Tijdschr. v. Geneesk.*, 2, 2155 (1922).