It has been known that anoxia stimulates the normal bone marrow to increase its production and release of erythrocytes.

At birth the polycythemia is evidently due to the fact that in utero the foetal blood derives oxygen from the placental circulation and not from the aerated lung as it does after birth.

During the neonatal period the polycythemia is readily corrected (HARRIS, 1965 and SCHALM, 1965), and some marked features occur in the red cell population. Thus, in Thoroughbred foals, the number of erythrocytes decreases during the first 3 weeks of life, as the fetal corpuscles are replaced by the adult ones (MEDEIROS et al., 1970 a and MEDEIROS et al., 1970 b); thereafter, the count gradually increases until about the fifth and sixth months of life, when the adult values are closely approximated (MEDEIROS et al., 1970 b; MARTINS et al., 1969). Nevertheless, during this period the hematocrit shows a different behaviour and does not correlate with erythrocyte counts because of, perhaps, the mean corpuscular volume (MCV) which shows a continuous decrease (MEDEIROS et al., 1970 b).

According to MOLLISON (1948) the post-natal period is characterized by a physiological hemolysis which is correlated with replacement of large red cells by smaller ones.

Concerning Thoroughbred newborn foals this replacement appears to be very marked because of the degree of red cell destruction and, on the other hand, the continuous MCV decrease from birth to five months of age (MEDEIROS et al., 1970 a and MEDEIROS et al., 1970 b) which is accomplished by a physiological anisocytosis.

In the present paper an effort is made to evaluate this replacement of erythrocytes during the post-natal period in order to analyse its influence on erythrogram values, especially on the erythrocyte sedimentation rate (ESR).
Material and Methods

A total of 50 blood samples was taken from the jugular vein of 5 healthy male Thoroughbred foals. Each animal was bled at 1, 7, 14, 21 and 30 days of age and again monthly until six months old.

From each animal 10 smears were made with blood “in natura” and, as soon as possible stained according to ROSENFELD (1947).

Collections were made in the morning before the foals were fed and anything that could excite them was avoided.

For red cell measures, weight parameter was employed as follows: from each animal 3 smears were chosen at random and from each smear 5 photomicrographs were taken. Thus, for each foal 15 microscopic fields were available, but only 3 or 4 of them were selected at random. All red cells that appeared in these 3—4 chosen fields were measured. The mean number of erythrocytes measured for each foal was 100 (90—110). Then, for foals of each age the total number of red corpuscles was 500.

Negative photographs were projected onto a screen and a picture of each red cell was drawn on a very homogeneous transparent paper (Diamant Extra-Special; glatt 70/75 g./qm. made in Germany). Each erythrocyte picture was cut out and weighed on an H15 METTLER balance.

Statistical computations were used according to SNEDECOR (1956) to obtain the arithmetic averages, standard deviations and coefficient of variability of each group. As there were no statistical differences from individual to individual,
individual when the t-test was employed, the animals were grouped into age groups. The analysis between age groups was performed with the $x^2$ test.

**Results**

The absolute range of the erythrocyte paper weight was 0.080 to 0.200 mg. As it is tedious to analyse all individual determinations, the results were summarised into six arbitrary intervals, as in Table 1.

Figure 1 shows a graph of red cell distribution with age to point out the differences between erythrocyte sizes as the animal gets older.

**Discussion**

It is of interest to note that this is perhaps the first time that the quantitative method described here has been employed in blood studies. It is an easy and simple method which gives a good idea of circulating erythrocyte distribution according to size.

Blood smears may show red cell shape modifications resulting from technical artefact. Thus, the method employed in the present paper has the advantage over the micrometric one, that the whole red corpuscles area is measured, despite the inequality in shape.

In this discussion we shall consider as "microcytes" erythrocytes having a weight within 0.080 to 0.100 mg. range, and as "macrocytes" those of 0.160 to 0.200 mg. Thus, macrocytes have about twice the weight of microcytes. The intermediary group of cells is represented by 0.100 to 0.160 mg.

ROSENFELD's stain (1947) was used because of its very slight influence on erythrocyte shape when compared with other stains.

Table 1 shows that, as the animal ages, microcytes tend to increase, whereas macrocytes tend to disappear from the blood stream. On the other hand, the intermediary group of cells, despite some oscillations, does not vary greatly from birth to six months of life.

Thus, in Thoroughbred foals, anisocytosis is normal to a slight degree, with an occasional erythrocyte being twice the size of the smallest cells. Normal anisocytosis has been observed also in calves (HOLMAN et al., 1952) as well as in caprines (HOLMAN and DEW, 1964).

The anisocytosis observed is of great interest to explain some previous findings in the Thoroughbred foal erythrogram (MEDEIROS et al., 1970 a and MEDEIROS et al., 1970 b). In these previous articles we noted that the MCV declines from birth to about 5 or 6 months of age, and that the decline is continuous. Now we can state that the MCV diminishes because the macrocytes are readily removed from the peripheral circulation, and especially because the youngest erythrocytes released from the bone marrow are much smaller.

The release of microcytes appears to begin at 2 weeks and the peak occurs at six months.

These observations are seen in Figure 1 where the curves show that from 1 day to 3 months microcytes and macrocytes present an opposite behaviour.

As we can see in Table 1 and Figure 1, the microcytes percentage at birth is about 10 %, at 2 weeks about 20 % and at six months about 50 %.

On the other hand, macrocytes practically disappear from the blood at 3 months. At birth the macrocyte number is higher than the microcyte number and in the first week the levels are about equal. At 2 weeks microcytes are more numerous than macrocytes.

The most important finding is the significant rise of microcytes observed at 2 weeks of age which appears to be correlated with the reported stimulus of
erythrocytosis at that age (MEDEIROS et al., 1970 a). Another point of interest
is the fact that, despite the erythrocytosis mentioned, the erythrocyte sedimenta-
tion rate (MEDEIROS et al., in course) remains very accelerated; the micro-
cytosis observed appears to be enough to explain this phenomenon.

It is important to remember also that the erythrocyte sedimentation rate
in foals is about 3 or 4 times faster than in adults (MARTINS et al., 1969) and
that the MCV in foals is much smaller than in adults.

It is important to bear in mind that the red cell size, especially in Tho-
roughbred horses, plays an important physiological role, but it is not clear yet
why the MCV in foals is so much smaller than in adults.

We know that smaller size leads to an increase in total surface area of the
erthrocyte population, which in turn enhances the rapid exchange of the
performing racehorse has a high red cells count and small MCV. The question
respiratory gases in the lungs and body tissues (HARRIS, 1965).

Our own observations (MARTINS et al., 1969) showed that the best
could be posed: are microcytosis and erythrocytosis adaptations to the way of
life, as thought by NESER (1923), or a purely hereditary factor?

The present work reinforces MACLEOD and PONDER’s (1946) theory which
considers that the microcytosis and the large number of red cells of Thoro-
bred horses are genetic in origin. These characteristics of the adult erythrogram
do not appear to be acquired by training because the foals studied in the
present paper were not yet in training, but they also have the erythrocyte
counts and small minor MCV of adult trained horses.

MILLER et al. (1961) had considered that erythrocyte size diminishes after
birth because the plasma proteins increase and produce a rise in plasma osmo-
tic pressure. Recent studies (MEDEIROS et al., in publication) showed that, after
birth, Thoroughbred horses have a significant increase in total serum protein
and of the albumin-globulin ratio.

Curiously, as we have discussed, the MCV declines while these protein
changes occur.

Nevertheless, if the MCV and protein correlation is real, a genetic influ-
ence may be possible because the high albumin-globulin ratio encountered in
Thoroughbred horses is an hereditary factor as suggested by MARZORATI and
MICHI (1956).

We may thus suggest, on purely theoretical grounds, that microcytosis in
Thoroughbred horses is an hereditary correlated factor and is not influenced
by training or the way of life of the animals.

Summary

The degree of physiological anisocytosis was measured in Thoroughbred
foals from 1 day to 6 months of life. The method employed determines the
relative weight of the erythrocytes in peripheral blood. At birth macrocytes
predominate over microcytes; thereafter a microcytosis is observed. The
authors suggest that the known microcytosis of this species is more a charac-
teristic correlated with hereditary factors than a simple adaptation of the
animal to training.

Zusammenfassung

Änderung der Erythrozytengröße im peripheren Blut bei Vollblutfohlen

Bei Vollblutfohlen wurde vom 1. Lebenstag bis zum 6. Monat der Grad
der physiologischen Anisozytose durch Wägen von Erythrozyten aus periphe-
rem Blut bestimmt.
Beim neugeborenen Fohlen waren mehr Makrozyten vorhanden, später dominierten die Mikrozyten.

Die Autoren glauben, daß die bei dieser Rasse beobachtete Mikrozytose eher genetisch bedingt ist, als eine Folge der Anpassung des Organismus an vermehrte Arbeitsleistung.

Résumé
Les auteurs ont déterminé le degré d'anisocytose physiologique sur chevaux pur sang anglais, avec l'âge d'un jour à six mois. La méthode employée détermine la différence de grandeur suivant le poids relatif de les erythrocytes du sang circulant. Au naissance le numero de macrocytes est plus grand, cependant de suite on observe une intense microcytose.

Les auteurs suggèrent que la connue microcytose de cette espèce est une caractéristique héréditaire et non une adaptation à la manière de vivre.

Resumen
Fue hecha la determinación del grado de anisocitosis fisiológica en equinos pura sangre inglés entre 1 día y 6 meses de edad. El método empleado determina la desigualdad de tamaño según el peso relativo de los hematies circulantes. Al nacimiento el número de macrocitos es mayor, pero luego se observa una intensa microcitosis. Los autores llaman la atención sobre la conocida microcitosis observada en esta especie animal que parece una característica correlacionada a factores hereditarios y no es una simple adaptación a las condiciones de entrenamiento.

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