blood stream is hastened and possibly its absorption from the bowel is even increased. Because iron is not made available for use by the bone marrow, the reaction

$$\text{Protoporphyrin} + \text{Iron} \xrightarrow{Cu^{++}} \text{Heme}$$

cannot proceed and anemia develops.

The fault in iron metabolism cannot be corrected by the administration of iron. This is probably because of the persistent and urgent demand for iron to fulfill some function in relation to infection, which has a greater priority for iron than hemoglobin formation.

These experiments are to be reported in detail in the near future.

References

1. MENKIN, V. *J. exp. Med.*, 1930, **51**, 879.
2. MENKIN, V., and MENKIN, M. F. *J. exp. Med.*, 1931, **53**, 919.
3. SCHAFER, K. H. *Klin. Wschr.*, 1940, **19**, 979.
4. SCHAFER, K. H. *Z. ges. exp. Med.*, 1942, **110**, 678, 697, 713. (In *Chem. Abstr.*, 1944, **38**, 2384.)
5. SCHAFER, K. H. *Klin. Wschr.*, 1943, **22**, 98.

An Observation on the Red Cell Content of the Blood of the Thoroughbred Horse[1]

JOHN MACLEOD
Cornell University Medical College

ERIC PONDER
The Nassau Hospital, Mineola, New York

While making observations of the blood of the horse, we noticed consistent differences between the thoroughbred and the cold-blooded horse with regard to the red cell count per cubic millimeter and the hemoglobin content in grams per 100 ml. of blood. The average values obtained in the thoroughbred animal have also a relation to age, as is shown in Table 1, which includes standard errors and average values for the mean corpuscular hemoglobin.

TABLE 1

Group	Number in group	Red cells millions/mm.^{3}	Hemoglobin grams/100 ml.	Mean corpuscular hemoglobin, $\gamma\gamma$
Thoroughbreds				
Foals	8	12.91 ± 0.73	13.86 ± 0.31	10.7
Yearlings ..	12	12.50 ± 0.74	14.13 ± 0.46	11.3
2–3 years ..	12	10.80 ± 0.25	14.10 ± 0.46	13.1
Older horses.	8	11.55 ± 0.74	15.37 ± 0.78	13.3
Cold-blooded horses	10	7.94 ± 0.28	12.63 ± 0.33	16.0

The differences between the means of the red cell counts of the two- to three-year-old horses and those of the foals and of the yearlings are significant, as also is the larger difference between the means of the counts of the two- to three-year-olds and those of the counts of the cold-blooded horses.

Table 1 shows that the red cell count and hemoglobin content in the thoroughbred are higher than the count and hemoglobin content in the cold-blooded horse, the red cell count for which is usually given as between 6 and 8.5 million.[2] At the same time the quantity of hemoglobin per cell is smaller. Table 2, which gives the average hemoglobin content, mean cell volume, and mean corpuscular hemoglobin concentration in 5 thoroughbred and 5 cold-blooded horses, shows that the cells of the thoroughbred carry less hemoglobin per cell because the cells are a little smaller and because the hemoglobin concentration is a little less. The thoroughbred, nevertheless, carries more hemoglobin per milliliter of blood than does the cold-blooded horse because there are more red cells per unit volume.

TABLE 2

	Thoroughbred	Cold-blooded
Red cells, millions/mm.^{3}	10.35	8.21
Hemoglobin, grams/100 ml.	13.89	12.06
Mean cell volume, μ^3	42.2	43.6
Mean corpuscular hemoglobin concentration, per cent	32.7	33.5
Mean corpuscular hemoglobin, $\gamma\gamma$	13.4	14.7

This combination of an increased red cell count, a decrease in red cell volume, a decrease in mean corpuscular hemoglobin concentration, but an increase in the hemoglobin content per milliliter of blood, is met with in animals (rabbits) subjected to low atmospheric pressures (*1*) and in other states in which the bone marrow is hyperactive, such as polycythemia vera in man. Since it is most improbable that thoroughbred horses suffer from an oxygen lack sufficient to keep their bone marrows in a state of hyperactivity, the higher red cell counts and hemoglobin contents in the blood of these animals is probably a genetic characteristic, as polycythemia sometimes is in man. The probability of the genetic explanation being right is increased by the fact that the high red cell counts are present at birth and are maintained in the weanling, yearling, and ensuing age periods. The elevated counts are therefore not the result of training or conditioning processes which prepare the animal for racing. It may very well be, of course, that the increased hemoglobin content and slightly smaller cell size confer an advantage on the thoroughbred when running at high speeds, and so these may be characteristics which have become accentuated in the process of the "improvement of the breed."

Reference

1. DUBIN, M. *Quart J. exp. Physiol.*, 1933, **23**, 31.

[1] This study was made on the horses of Col. C. V. Whitney, to whom we are indebted for his courtesy. The expenses of the investigation were defrayed by the Grayson Foundation.

[2] Several references are given in Appendix A of Wintrobe's *Clinical hematology* (Philadelphia: Lea and Febiger, 1942).