port to the theory that screw-worms might be eradicated from Florida through the use of sterilized flies. Screw-worms did not exist in the Southeast until they were introduced through shipment of infested livestock about 1933. In normal winters the insects survive only in peninsular Florida. If the overwintering population could be extirpated, the Southeast might be kept free of an insect that annually does millions of dollars' worth of damage to livestock in that region.

R. C. BUSHLAND
A. W. LINDQUIST
E. F. KNIPLING

Entomology Research Branch, Agricultural Research Service, USDA, Beltsville, Maryland

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New Hemoglobin in Normal Adult Blood

Occasional reports have appeared suggesting the presence of small components other than normal adult hemoglobin in hemolyzates from normal human red blood cells (*1–3*). These have generally been considered nonpigmented proteins (*1*), but the technique of electrophoresis in free solution employed did not provide a definitive conclusion. The present paper is concerned, primarily, with the finding of a hemoglobin other than the main hemoglobin A, which has different electrophoretic properties, and is consistently found in normal adult blood in small amounts.

Zone electrophoresis in a starch slab covered with polyethylene sheeting by procedures described previously (*4*) permitted clear-cut separation in barbital buffer *p*H 8.6 $\Gamma/_2$ 0.05 or 0.1 of hemoglobin A from a slower migrating colored component. The hemoglobin solutions were prepared from oxalate or heparin blood by the method of Drabkin (*5*) but without employing $AlCl_3$. These were usually converted to carbonmonoxyhemoglobin and 0.4 ml of a 5- to 10-percent crystal-clear solution applied to a thin slit in the starch slab.

Figures 1*a, c* and 2*a* illustrate photographs taken with transmitted light on orthochromatic film of the separated red components of the blood from three different normal young adults. A component is clearly visible between the origin and the main hemoglobin-A spot.

It was possible to isolate this material from the starch block in preparative experiments in which 15 ml of dialyzed hemoglobin solution at 8-percent concentration was applied in long slits. Figure 2*b* illustrates one fraction isolated by displacement filtration (*4*) and concentrated by ultrafiltration. It is essentially free of hemoglobin A. The absorption curve in the visible region for this component was the same as that for hemoglobin A. No significant differences were found in the ultraviolet spectrum (*8*). The component was found, regardless of whether oxyhemoglobin, carbonmonoxyhemoglobin, or uncombined ferrohemoglobin in the presence of dithionite ions was employed. Hemoglobin A isolated free of this material did not give rise to this component, despite various harsh procedures. In the ultracentrifuge it showed an S rate indistinguishable from hemoglobin A. Comparison of this component with the known abnormal hemoglobins indicated that it showed a mobility in various buffers similar to that of hemoglobin E (*6*).

Figure 1*b* shows dilute hemoglobin E and A from a patient with hemoglobin E trait (*7*) separated on the same slab with the hemoglobin from two normal individuals. The unknown component in normal blood definitely migrated faster than hemoglobin C and more slowly than hemoglobin S (Fig. 2*d*). Electrophoresis in free solution (*8*) in barbital buffer *p*H 8.6 $\Gamma/_2$ 0.05 also demonstrated this component when a hemoglobin concentration of 3 percent or more was employed. The mobility calculated from the descending pattern was -1.94×10^{-5} compared with -3.48×10^{-5} for the main A component. In phosphate buffer *p*H 6.5, $\Gamma/_2$ 0.05 it also resembled hemoglobin E very closely, migrating to the cathode just ahead of hemoglobin A. Quantitative analyses of this slow component in the blood of 26 individuals, including normal persons and patients with a variety of chronic diseases, indicated a mean value of 2.6 percent of the total hemoglobin with a range of 1.8 to 3.5 percent.

Normal adult blood showed, in addition, small amounts of hemoglobin migrating faster than hemoglobin A in barbital buffer. This heterogeneous fraction is partially visible as an asymmetrical projection from hemoglobin A in Fig. 1*a, c*. It could also be isolated and concentrated and, upon repeated separation, always showed the same rapid mobility (Fig. 2*c*).

The slow component was a more clearly definable entity, differing markedly from hemoglobin A in respect to mobility. It was found in the blood of

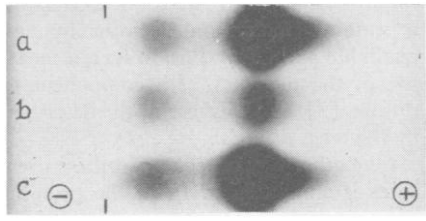

Fig. 1. Red pigments from normal red blood cells (*a* and *c*) and from E trait cells (*b*) separated on a starch block by electrophoresis in barbital buffer *p*H 8.6, $\Gamma/_2$ 0.05. The lines indicate the site of application.

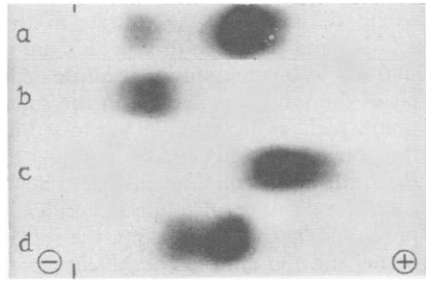

Fig. 2. Separation of four different hemoglobin preparations on the same starch block. (*a*) Hemoglobins from normal red blood cells. (*b*) Slow component isolated from normal hemoglobins. (*c*) Fast components isolated from normal hemoglobins. (*d*) Hemoglobins from blood of a patient with sickle cell trait.

all normal individuals and patients with a variety of anemias. The only exception was the blood of newborn infants with predominantly fetal hemoglobin; in these cases it was either absent or greatly reduced. Increased levels were encountered in patients with thalassemia minor but not in thalassemia major when considerable fetal hemoglobin was present. It probably is identical with the small component noted by Singer and associates (*9*) in thalassemia blood and not identified previously as a hemoglobin.

H. G. KUNKEL
G. WALLENIUS

Rockefeller Institute for Medical Research, New York, N.Y.

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8. The aid of Herbert Jaffe with the spectrophotometric measurements and of Gertrude Perlmann in obtaining the results by moving-boundary electrophoresis is gratefully acknowledged.
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