Two "Fast" Hemoglobin Components in Liberian Blood Samples

By Abner R. Robinson, Wolf W. Zuelzer, James V. Neel, Frank B. Livingstone and Max J. Miller

In the course of a survey of the hemoglobin types of Liberian natives, two previously undescribed hemoglobin components have been encountered.* These unusual hemoglobin components migrate more rapidly than hemoglobin A on paper electrophoresis at pH 8.6. For the purposes of this report, the strictly provisional designation of Liberian 1 has been chosen for the faster of the two, and Liberian 2 for the slower. In a total of 920 blood samples, Liberian 1 has been encountered seven times, and Liberian 2, twice.

Three known hemoglobin components have thus far been described which migrate more rapidly than hemoglobin A on paper electrophoresis at pH 8.6. Two of these have been designated as hemoglobin H1,2 and the third is hemoglobin I.3 The hemoglobin X4 found by Bergren and Sturgeon has been established as identical5 with Rigas’ hemoglobin H. Through the kindness of Dr. Rucknagel and of Dr. Bergren, we have obtained samples of blood for comparison with our components, in which hemoglobin I and hemoglobin H occur in combination with A.

On paper electrophoresis in a horizontal type apparatus described previously by the authors4 and using hemolysates prepared by the method of Itano6 with veronal buffer pH 8.6, ionic strength 0.05, the following results were obtained: Liberian 2 had a mobility intermediate between hemoglobin I and hemoglobin A and closer to hemoglobin A; Liberian 1 had a mobility clearly different from Liberian 2 and approximately midway between Liberian 2 and hemoglobin I (fig. 1). When paper electrophoresis was done with pH 6.5 phosphate buffer, ionic strength 0.05, the following results were obtained: all hemoglobins with the exception of H migrated towards the cathode; hemoglobin H migrated towards the anode, as can be seen in figure 2. Neither Liberian 1, 2 nor I hemoglobins separated distinctly from A at this pH. However, from the trailing of the spots, hemoglobin I is nearest the site of application, hemoglobin A farthest, with Liberian 1 and 2 intermediate.

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* Since this manuscript was submitted, Thorup and his associates8 have described a hemoglobin J. Through the courtesy of Col. William H. Crosby, we have been able to compare our specimens with a specimen of blood containing hemoglobin A and J, obtained from a Caucasian individual of French-Canadian ancestry. On paper electrophoresis at pH 6.5 and 8.6, the mobilities of Liberian 1 and hemoglobin J are identical.
Moving boundary electrophoresis, after saturation with carbon monoxide, using sodium cacodylate buffer at pH 6.5 and ionic strength 0.1, revealed the unknown component designated as Liberian 1 to have a mobility of $1.68 \times 10^{-5}$ cm$^2$/sec/volt. This component is as slow as hemoglobin 1 and definitely slower than hemoglobin A. The Liberian 2 blood sample had a component with a mobility of $1.96 \times 10^{-5}$ (fig. 3). One difficulty encountered in running Liberian 1 and 2, using the moving boundary method, was the appearance of a precipitate when the hemolysate was mixed with cacodylate buffer. Table 1 summarizes the available data on fast moving hemoglobin components.
"Fast" hemoglobin components in Liberian samples

Fig. 3.—a. Tiselius pattern of Liberian 1 showing two distinct peaks. The larger peak, being 60 percent of the pattern, has a mobility of $1.68 \times 10^{-4}$ cm$^2$/sec/volt. The small peak appearing in the center of the pattern is anomalous, due apparently to incomplete removal of the precipitate formed when the hemolysate is mixed with pH 6.5 buffer.

b. Tiselius pattern of Liberian 2 showing three peaks with one distinctly slower, having a mobility of $1.96 \times 10^{-4}$ cm$^2$/sec/volt, and comprising 26 percent of the pattern. The other two peaks had mobilities of 2.4 and $2.2 \times 10^{-4}$ cm$^2$/sec/volt.

<table>
<thead>
<tr>
<th>Hemoglobin</th>
<th>pH 8.6 paper*</th>
<th>pH 6.5 paper*</th>
<th>pH 6.5 moving boundary, $10^{-4}$ cm$^2$/sec/volt</th>
<th>Alkali denaturation†</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>-1</td>
<td>+4</td>
<td>2.4</td>
<td>&lt;1</td>
</tr>
<tr>
<td>Liberian 2</td>
<td>-2</td>
<td>+3</td>
<td>2.00</td>
<td>&lt;1</td>
</tr>
<tr>
<td>Liberian 1</td>
<td>-3</td>
<td>+2</td>
<td>1.68</td>
<td>&lt;1</td>
</tr>
<tr>
<td>I</td>
<td>-4</td>
<td>+1</td>
<td>1.7</td>
<td>&lt;1</td>
</tr>
<tr>
<td>H</td>
<td>-4</td>
<td>-1</td>
<td>-</td>
<td>&lt;1</td>
</tr>
</tbody>
</table>

— designates movement towards the anode; + designates movement towards the cathode.

* Relative positions of abnormal components; all samples of abnormal hemoglobin contained hemoglobin A.

† According to the method developed by Singer, Chernoff and Singer.

It thus appears that neither of the two rapidly migrating components encountered in Liberia is either hemoglobin I or the hemoglobin H of Rigas. The relationship of these two hemoglobins to the H of Cabannes cannot be stated at present due to the unavailability of a sample for comparison.

It was possible to study several members of the immediate family of one of the individuals found to have Liberian 1. This led to the discovery of two additional persons with this hemoglobin component. Figure 4 indicates the findings on this particular family. On the basis of the admittedly scanty information, it would appear that the presence of this hemoglobin is determined by a single gene. The effect of this gene when homozygous remains to be determined. The genetic basis of Liberian 1 appears to be different from that of hemoglobin H of Rigas.

The nine individuals whose abnormality was detected in the course of survey studies are all adult males employed as laborers on the Firestone Plantation. Their hemoglobin values ranged from 10 to 15 grams. Through the courtesy of
the Firestone Plantation Hospital, it was possible to obtain erythrocyte determinations on some of these individuals. Blood films were also obtained and read in the United States. No cytologic abnormalities were apparent. The findings on four individuals with Liberian 1 are shown in Table 2.

The abnormal hemoglobins were encountered in five different tribes. This incidence of fast-moving components restricted to several tribes in a small area is of considerable interest. It is already apparent that the Liberian tribes as a rule are also distinguished from those of the surrounding countries by a relatively low frequency of the genes responsible for hemoglobins S and C.\textsuperscript{8}

Blood group, anthropologic, and more complete hematologic studies are now in progress.

**SUMMARY**

Two abnormal hemoglobins, at least one of which has not previously been described, were encountered with appreciable frequency in Liberian blood samples. Some properties of these components are described.

**SUMMARIO IN INTERLINGUA**

Duo anormal hemoglobinias, del quales al minus le un ha non previsemente essite describite, esseva incontrate con frequentias appreciable in specimenis de sanguine liberian. Certe proprietates de iste componentes es describite.
“FAST” HEMOGLOBIN COMPONENTS IN LIBERIAN SAMPLES

REFERENCES

4. Bergren, W. R. and Sturgeon, P.: Personal communication to the authors.
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