SICKLE-CELL ANÆMIA

INVESTIGATIONS into sickle-cell anæmia in Nigerian children by R. G. Hendrickse, of University College, Ibadan, shows significant differences from experiences recorded by American research workers (*Central African Journal of Medicine*, 6, No. 2; February 1960).

In Africa the age at onset of severe symptoms is earlier; anæmia tends to be more severe; the incidence of splenomegaly is higher, and spleens seem to be larger; gross hepatomegaly and evidence of hepatic dysfunction generally occur at an earlier age; limb swellings, especially those involving the hands and feet, are common in the early years of life, whereas they are rarely reported by American authors; radiological evidence of bone involvement is more frequent and the ultimate prognosis appears to be worse.

These differences in general reflect the more rigorous conditions under which children live in Africa, but certain features of the disease may be attributed to specific environmental factors. Spleen sizes are probably related to endemic malaria, and the earlier onset of liver dysfunction may be related to dietary protein deficiency. The characteristic swellings in the hands and feet of African infants may well result from the customary manner in which African mothers carry their babies. The child is placed astride the mother's back, its legs encircling her waist. The position is maintained by a wrapper which covers the child and is tied in front of the mother. In this position the child's limbs are pinioned to the mother and subjected to steady pressure which probably slightly impairs the peripheral circulation. Such impairment, while of no consequence in normal children, may be sufficient in sickle-cell anæmia to provoke intravascular sickling in the extremities, with resultant capillary blockage and reactionary swelling.

While differences in the clinical picture of sickle-cell anæmia in Africa and America may be attributed to environmental factors, the apparent difference in the severity of the disease in different parts of Africa cannot be readily explained in the same way. Differences in the age incidence in the Belgian Congo and Nigeria are of particular interest. In the Belgian Congo more children show signs of the disease between the ages of three months and one year than at any other period. It has been shown that for infants in hyperendemic malarial areas the mean parasite-rate rises from about 2 per cent at three months to 80 per cent at one year. In the Belgian Congo, therefore, it appears that the period during which children acquire their first infection with malaria coincides with the age during which sickle-cell anæmia is most frequently diagnosed. This suggests that malaria should be considered as a possible factor determining the age at which sickle-cell anæmia presents in the Belgian Congo. Another possible explanation of these age relationships is that some of the cases in the Belgian Congo were examples of primary malarial anæmia in persons with the sickle-cell trait. The clinical and hæmatological findings in such cases can closely simulate those encountered in sickle-cell anæmia. None of the cases reported from the Belgian Congo by the Lambotte-Legrandes was confirmed by electrophoretic studies of the hæmoglobin.

The apparent differences in the clinical manifestations of sickle-cell anæmia in different parts of Africa merit closer study. There are no grounds at present for contending that these differences have a genetic basis, though this possibility should be borne in mind.

ORIGIN OF TEKTITES

Solar Furnace Glass

TO explore the suggestion that tektites are formed by fusion of terrestrial material we have fused some rock samples in a solar furnace. These samples were collected from the regions where tektites have been found in Texas and Georgia in the United States. The Texas sandstone was taken from a stratum in the Wellborn formation in which embedded tektites reportedly had been seen. The black top-soil was taken from a location where tektites had been found in Grimes County, Texas. The Georgia sandstone was collected immediately below the top soil near a place where several tektites were discovered.

The sediments were fused in the solar furnace of the U.S. Army Quartermaster and Engineering Center, Natick, Massachusetts[1], made available to us through the courtesy of Mr. Eugene S. Cotton. At the time of the experiment, November 20, 1959, 1000 a.m., E.S.T., the flux of energy at the focus was 83 calories cm.^{2} sec.$^{-1}$, as determined from the rise in temperature of a blackened metal disk. Each specimen was placed in a graphite crucible in the form of a plug. To make the plug the material was crushed, mixed with water, moulded and then baked at a temperature of approximately 150° C. We added 5 per cent by weight of ferric oxide to samples 2 and 3. Sample 1 weighed 100 gm., samples 2–5 weighed 50 gm.

The exposure time of the samples varied from 59 to 240 sec., the Georgia samples being heated for a longer period of time than those from Texas. Immediately after the water-cooled shutter of the solar furnaces opened, vapour could be seen rising from the sediment, while the front surface of the material became luminous and reached white heat in approxi-

Table 1

Sample	Exposure (sec.)	Weight loss (per cent)	Weight glass (gm.)	Fusion (erg/gm.)
(1) Texas sandstone	59	11·1	20·9	$1·9 \times 10^{11}$
(2) Texas sandstone	72	13·6	14·9	$1·7 \times 10^{11}$
(5) Texas topsoil	70	11·6	10·2	$2·3 \times 10^{11}$
(3) Georgia sandstone	120	20·6	14·6	$2·9 \times 10^{11}$
(4) Georgia sandstone	240	20·4	28·2	$2·9 \times 10^{11}$

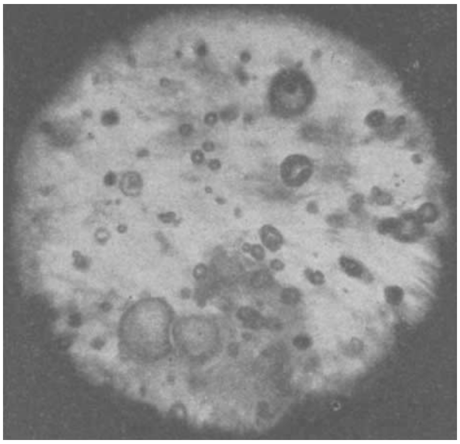

Fig. 1

mately 10 sec. Bubbling began after approximately 20 sec. followed immediately by a forward slumping of the viscous material. In sample 1, where the glass was allowed to pour out of the radiation beam, the drips stiffened and solidified within 2 or 3 sec. The results of the experiment are summarized in Table 1.

It can be seen that the Texas material decreased in weight by 12 per cent and the Georgia material by 20 per cent owing to the vaporization of water and other constituents. The energy required to fuse 1 gm. of glass varied between $1 \cdot 7$ and $2 \cdot 9 \times 10^{11}$ ergs gm.$^{-1}$. After fusion each sample showed a glassy surface with large bubbles, underneath which was a hard porous layer. There was also a considerable quantity of soft, dry material that had not been fused. The specific gravity of the glass droplets, including bubbles, from sample 1 was $1 \cdot 980$ gm.$^{-3}$. The scoriacious layer was considerably lower in density; but no measurements were made on this or the partially fused material.

There is, of course, no definite temperature at which glass melts, and no definite latent heat of fusion. We may define the heat of fusion as the energy required to raise the temperature of 1 gm. of silica glass from 20° C. to 2,000° C., at which temperature the glass would be liquid and incandescent. This heat of fusion may be estimated by extrapolating the tabulated values of specific heat[2] and performing an integration. We find the heat of fusion to be $2 \cdot 1 \times 10^{10}$ erg/gm. The values determined in the solar furnace experiment are ten times higher, the difference being largely due to the losses of heat involved in the fusion process by radiation, conduction, convection and vaporization of material. Nevertheless the effect of heat of fusion as determined here is of considerable interest to any theory of the formation of tektites by external application of heat because it is the value one might expect when radiation and other heat losses occur.

A photomicrograph (reduced to $\frac{1}{2}$) of a thin section of the solar furnace glass, taken with crossed polarization at × 60, is shown in Fig. 1. The glass showed flow lines and bubbles, but we have, as yet, found no evidence for lechatelierite particles. Light was still transmitted through the specimen when viewed with crossed polarization, indicating that the solar furnace glass was under considerable strain. Texas and Philippine tektites, on the other hand, show extinction when viewed with crossed polarization. The tektite glass may have cooled more slowly than solar furnace glass, or may have annealed at ordinary terrestrial temperatures over the long period of time that it had rested in the sediments.

Taking the effective heat of fusion as 2×10^{11} ergs/gm., one finds that approximately 5 min. must elapse before a sphere some 2 cm. in diameter could be fused by passage through the upper atmosphere at a velocity of 10 km./sec. Single tektites could not be fused in the atmosphere, therefore, since an object of this size would decelerate in a matter of a few seconds. There is sufficient energy for tektites to form as drops from the surface of a much larger object, but glass objects have never been recovered from the 590 stone falls already observed[3]. A meteorite with velocity of 20 km./sec. has a kinetic energy of 2×10^{12} ergs/gm. Thus a meteorite of mass m striking the Moon would produce about $10\, m\, (1 - x)$ gm. of glass, where x is the fraction of energy dissipated in shock waves, crater formation and vaporization of the meteorite. A study of terrestrial craters shows that x is close to unity. Only a small quantity of glass would be produced on the Moon and only a portion of this would reach the Earth. Nor do the craters seem to be deep enough for the meteorite to have uncovered molten material below the Moon's crust. It is more probable for an energy of 2×10^{11} ergs/gm. to be supplied by terrestrial phenomena such as volcanic activity or lightning.

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High-Temperature Fusion of Possible Parent Materials for Tektites

BAKER[1] has recently presented very strong evidence for an extra-terrestrial origin for australites and, by implication, for all true tektites. Once an extra-terrestrial origin is established, then the localized distribution of tektites (particularly the australites) is most readily explained if they have originated close to the Earth[2,3]. In these circumstances, the most likely origin for tektites is that they are portions of the Moon's crust which were fused during large meteorite impacts and then ejected from the lunar surface to fall on the Earth[4].

Certainly as far as their very young ages, most physical properties and terrestrial distributions are concerned, a lunar origin for tektites would seem to be preferred. However, the most serious stumbling block to this theory[3] is the rather unusual composition of tektites, which some authors consider shows that tektites are most likely to be fused sediments[5]. The most probable terrestrial sediment from which tektites might have formed is a shale, and if terrestrial-type shales are the only likely parent materials then a lunar origin would seem to be out of the question. On the other hand, other authors have shown that certain acid igneous (granitic) rocks could well have been suitable parent