changes occur among oxygens more distant than 2.6 A from sodium. These changes require that sodium in reedmergnerite be considered as either five- or sevenfold coordinated, in contrast to the sixfold coordination assigned to sodium in low albite (2). When bond strengths to the oxygens in reedmergnerite are calculated over each tetrahedral site, on the basis of a simple ionic model, and compared with those so determined for albite (2), a charge imbalance is found in reedmergnerite (Table 2) that at best is almost double any found for albite. In our opinion such calculations serve merely to underline the inadequacy of the ionic model in treating the complex feldspar structures. This study strongly suggests that any new theory dependent on results from such a model should be considered speculative until more experimental evidence becomes available (6).

JOAN R. CLARK
DANIEL E. APPLEMAN
U.S. Geological Survey, Washington, D.C.

References and Notes

1. R. B. Ferguson, *Can. Mineralogist* **7**, 145 (1960).
2. ———, R. J. Traill, W. H. Taylor, *Acta Cryst.* **11**, 331 (1958).
3. C. Milton, E. C. T. Chao, J. M. Axelrod, *Am. Mineralogist* **45**, 188 (1960).
4. J. R. Clark and C. L. Christ, *Z. Krist.* **112**, 213 (1959).
5. J. V. Smith, *Acta Cryst.* **7**, 479 (1954).
6. We are indebted to Prof. R. B. Ferguson, University of Manitoba, for providing us with atomic parameters of low albite in advance of publication, and to our colleague, C. Milton, for supplying the crystals of reedmergnerite. Publication was authorized by the director, U.S. Geological Survey.

30 August 1960

Detection of Boundary Films

Abstract. Results, obtained with a photoelectric refractometer and sucrose solutions, indicate that a concentrated surface layer rapidly builds up when sucrose solutions are allowed to stand under conditions where evaporation can occur from the surface. The phenomenon is similar to the formation of a cool boundary film which has recently been shown to occur on the surface of the ocean.

Ewing and McAlister have recently reported experiments showing the existence of a cool boundary film on the surface of evaporating water (*1*). We have observed a similar phenomenon during investigations carried out to develop a photoelectric refractometer for use in the sugar industry. The effect is particularly marked when the U-bend type of refractometer first described by Karrer and Orr (*2*) is used. This consists of a U-bend of solid glass rod down one limb of which parallel light is shone. The intensity of the light emerging from the other limb, which is easily measured photoelectrically, is dependent on the refractive index of the medium in which the curved part of the U-bend is immersed.

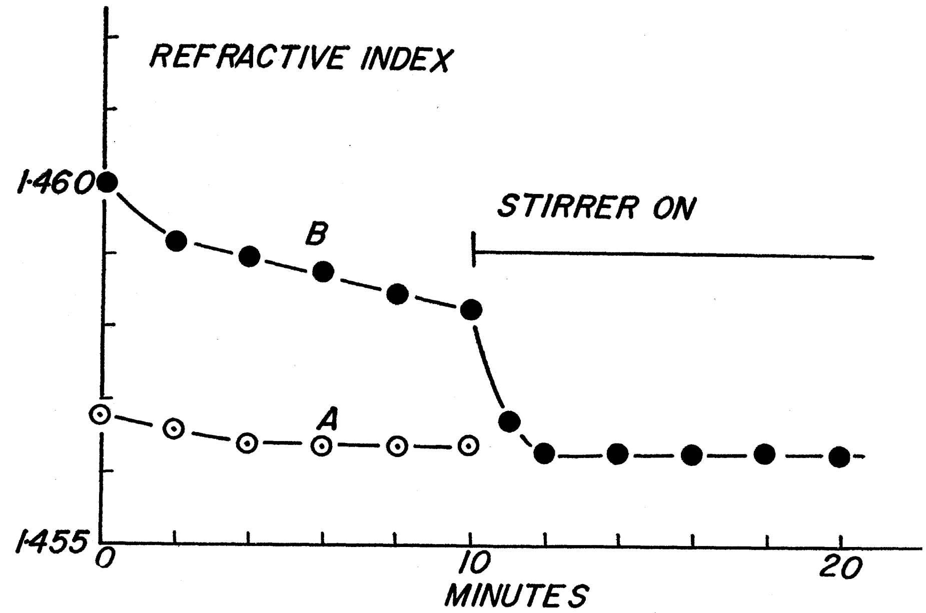

Fig. 1. Graphs of refractive index, as determined by the U-bend photoelectric refractometer, against time. Curve *A* was obtained when the U-bend was introduced into a freshly stirred sucrose solution; curve *B* was obtained when the U-bend was introduced into the sucrose solution which had been allowed to stand for 1 minute. After 11 minutes, this solution was stirred with an ordinary laboratory-type stirrer.

Typical results are shown in Fig. 1, which is a graph of the refractive index indicated by the photocell output against time. These particular results were obtained with a rod 8 mm in diameter bent into a U with a radius of 2.5 cm at the curved end. The solution used was a pure, aqueous sucrose solution of concentration 67 percent by weight; the measurements were made in a darkened room at a temperature of 24°C and a relative humidity of 75 percent.

Curve A shows that when the dry U-bend is immersed in the freshly stirred solution, the refractive index is almost constant. If, however, the sucrose solution is allowed to stand for 1 minute before the U-bend is introduced (curve B), the indicated refractive index is initially higher but begins to drift downwards; if the solution is then stirred, the indicated refractive index drops rapidly to a constant value equal to that found in a freshly stirred solution.

The explanation of these effects appears to be that when sucrose solutions are allowed to stand under conditions where surface evaporation can occur, a boundary film of concentrated solution builds up; this film adheres to the U-bend when it is passed through the surface but can be dispersed by mild agitation. This explanation is similar to that given by Ewing and McAlister for their experiments, although we have postulated a concentration rather than a temperature gradient; to ascribe the phenomenon to temperature effects alone would require the surface film to be some 20°C cooler than the bulk of the liquid.

The effect is so marked with sucrose solutions probably because the diffusion constant for sucrose solutions diminishes rapidly at high concentrations (*3*). In agreement with this, the effect is small at moderate concentrations of sucrose but is larger than that shown in Fig. 1 when molasses is used. It is of some interest that the boundary film can build up so quickly when a sugar solution is handled in the atmosphere; the need for care in carrying out precision refractometry with concentrated sugar products is clear.

W. S. WISE
R. E. C. MUNRO
P. P. KING
Sugar Technology Research Unit, University College of the West Indies, St. Augustine, Trinidad, British West Indies

References

1. G. Ewing and E. D. McAlister, *Science* **131**, 1374 (1960).
2. E. Karrer and R. S. Orr, *J. Opt. Soc. Am.* **36**, 42 (1946).
3. A. van Hook and H. D. Russel, *J. Am. Chem. Soc.* **67**, 370 (1945).

5 July 1960