sumption. The test shows that rotational and magnetic poles of the Permian as seen from either North America or Eurasia differed by 45 degrees. Thus it appears on the basis of the paleoecological tests so far completed, that paleomagnetic measurements cannot yield valid data regarding the geographic latitude of continents in the Permian. It also seems that the presently accepted "dynamo" model for generation of the earth's magnetic field may require revision since it requires coincidence of the magnetic and rotational poles. In a general sense (but without real rigor) the test suggests that neither continental drift across latitude nor polar wandering is likely and that both the rotational poles and the latitudinal position of continents have probably remained unchanged at least since the Permian. If this is true, then the limits of tropical-subtropical conditions have varied videly through time, controlling as they varied the area of the globe suitable for reef development and in fact for extensive carbonate development (Stehli and Helsley, 1963; Stehli, McAlester and Helsley, 1967; Stehli, in press A, B).

A modification of the model used to test the hypothesis of continental drift and polar wandering shows promise for reconstructing the pattern of surface-oceanic currents of the deep sea. These currents are closely related to reef development which extends farther both to the north and south on the east side of continents than on the west because of them. The same technique suggests a possible means of learning more of the fundamental causes of glaciation if applied to glacial and interglacial patterns of oceanic circulation as revealed by variations in the diversity of planktonic foraminifera in deep sea cores (Stehli, 1965).

REFERENCES

1963—with Helsley, C. E., Paleontologic Technique for Defining Ancient Pole Positions: Science *142* (3595), 1057-1059.

1964—with Creath, W. B., Foraminiferal Ratios and Regional Environments: Amer. Assoc. Petrol. Geol. Bull. *48* (11), 1810-1827.

1965—Paleontologic Technique for Defining Ancient Ocean Currents: Science *148* (3672), 943-946.

1966—Some Applications of Foraminiferal Ecology: Proc. 2nd West African Micropaleon. Coll. (Ibadan, 1965), 223-240.

1967—with McAlester, A. L., and Helsley, C. E., Taxonomic Diversity of Recent Bivalves and Some Implications for Geology: Geol. Soc. Amer. Bull. *78*, 455-465.

A (in press)—A Paleoclimatic Test of the Hypothesis of an Axial Dipolar Magnetic Field: Proc. of N.A.S.A. Symp. on History of Earth's Crust.

B (in press)—Taxonomic Diversity Gradients in Pole Location: Part I—The Recent Model: Peabody Mus. Bull. Cent. Symp. Vol.

BASIS FOR RED FORK SANDSTONE EXPLORATION IN NORTHWEST OKLAHOMA

PHIL C. WITHROW*

The Red Fork Sandstone produces oil and gas over a large area of north central Oklahoma. There are indications that several oil fields comparable to the Burbank Field (one-half billion barrels) can be found in northwestern Oklahoma during the next few years by using available well control for detailed reconstruction of the depositional environments of the Red Fork Sandstone.

The Red Fork Sandstone was deposited west of the Nemaha Ridge during "Cherokee" (Des Moinesian) time in a large embayment called the Enid embayment. There were four fairly distinct phases of sand deposition: an early phase where channel sand was deposited; two phases of offshore bar deposition, followed by a brief period when seas receded from the area and channel sand was deposited. Using this interpretation, several unusual problems can be explained.

The Oakdale Field in southeastern Woods County has oil reserves of nearly 30 million barrels from the Red Fork Sandstone. The sandstone in this field is in two separate linear bands which include sand deposited during the first 3 phases. The Southwest Wakita Field in Grant County produces from two fairly distinct Red Fork Sandstone bodies that were deposited during phase 2. The Wakita Trend (Phase 3) in Grant County produces from a thin Red Fork Sandstone body slightly higher stratigraphically than that at Oakdale and Southwest Wakita. In the Cheyenne Valley Field in Major County, the Red Fork is interpreted as being a channel sand deposited during Phase 4, and it is higher stratigraphically than sandstone in the previously-mentioned fields. This channel-type deposit is productive and fairly widespread over the Enid embayment, and it has several distinguishing characteristics.

By reconstructing the depositional environments of the Red Fork Sandstone and by interpreting this interval as representing four fairly distinct phases, the Red Fork is seen to be a reservoir with great potential in the Anadarko basin. There are several good indications where undiscovered major producing areas are located, and they can be found by basing an exploration program on detailed reconstruction of depositional environments to explain the problems that arise, and to make interpretations necessary to find prospective Red Fork Sandstone trends.

* Consulting geologist, Oklahoma City, Okla.

GEOLOGIC HISTORY OF THE GULF BASIN

HUNTER YARBOROUGH*

The basin contains more than six million cubic miles of predominantly Mesozoic and Cenozoic sediments. It is underlain by a normal oceanic crust (and a normal upper mantle) which is buried in its axial depression by 45,000 feet of sediments, most of which were deposited in deep waters. It is a fragment of the "old" Pacific Ocean and not a part of the "new" Atlantic.

Late Paleozoic orogenies influenced the basin shape: the "buried" Llanoria (Ouachita) structural belt along the northern margin, the Chiapas-Guatemalan structural belt along the southern margin, and a "connecting" structural belt (now "buried") along the western margin. This latter margin was more strongly established by Nevadan (Jurassic) and Laramide (early Tertiary) orogenies. A complex system of transform faulting, created as the Gulf Basin (and Mexico) drifted westward, leaving the Caribbean "Pacific Tongue" behind, marks the southeastern margin. Great thicknesses of Jurassic salt occur in major depressions within the basin. Much of this salt was apparently deposited "abruptly" in deep waters. During salt deposition, the African continent probably marked the eastern margin of the Gulf Basin. The Nevavda orogeny restricted normal Gulf circulation from the Pacific, creating conditions favorable for salt sedimentation.

Post-salt sediments came from two major provenances: Mesozoic from the Appalachians and Cenozoic from the Rocky Mountains.

History of the Gulf Basin supports modern concepts of continental drift. The rising Mid-Atlantic ridge and westward drift dominated the sedimentary and structural history during Late Paleozoic and Mesozoic times, while the East Pacific rise controlled the Cenozoic history. The data indicate