where within the reservoir bed. The flocculation or dissociation of these colloids appears to be greatly affected by the Donnan-equilibrium-controlled anion-exclusion and cation-absorption properties of high-electrical-charge-density materials such as shales.

When the migration is terminated by either dissociation or flocculation, the resulting finely dispersed unstable organic particles or oil droplets will start to aggregate. Consequently, buoyancy will cause them to rise (or fall) through the water phase to the top (or bottom) few inches of the porous reservoir. If the oil or oil-forming material accumulates in the top few inches of the reservoir bed in sufficient concentration to subsequently produce extensive oil-phase continuity, then additional migration by the continuous-phase flow mechanism can occur.

The third mechanism, molecular solubility in water, may be a significant factor in selectively transporting certain hydrocarbon fractions and thereby modifying the oil characteristics.

If only the first mechanism were operative, source beds should be detectable by their high residual hydrocarbon content. If the second mechanism were commonly operative, such source beds could not be identified simply by measuring the residual oil saturation; and if source beds of this type are throughout most marine sedimentary sections, the limited occurrence of major oil production must be related to conditions required for continuous entrapment and preservation of oil since the time of origin.

The entrapment of oil is primarily controlled by the first mechanism—continuous-phase flow. Therefore, a critical evaluation of this mechanism under both hydrodynamic and hydrostatic conditions throughout the geologic history of an area is recommended for finding both broad oil provinces and specific oil fields.

Prospecting for Stratigraphic Traps

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Stratigraphic traps are directly related to their respective environments of deposition. An understanding of the depositional environment is essential to successful prospecting for oil or gas from this type of reservoir. Isopach studies of shale units directly above or, both above and below a lenticular reservoir sandstone, are of considerable value in reconstructing depositional environments. Such shale intervals, either directly above a reservoir sandstone, or embracing it, are genetic units and variations in thickness are completely independent of present-day structural configuration. Isopach maps of such genetic units serve as realistic indicators of where certain lenticular sands were deposited. Depositional trends of beach sands, offshore bars, and strike valley sands are readily determined from such studies. Structural maps, constructed on a reliable time marker within the genetic interval, serve as a means of localizing oil or gas accumulation within any of these reservoir types. In all such studies electrical log data are essential, since arbitrarily selected genetic units are seldom named formational units. The thinner the genetic interval, the greater the necessity for accurate "picks" from electrical log data.

Deltaic reservoirs are poorly understood and only rarely recognized by the geologist. This type of reservoir is, nevertheless, abundantly preserved in the sedimentary section. Regional isopach studies of deposition environment are an essential prerequisite for the construction of meaningful exploration maps of this type of reservoir. An understanding of the trends of distributary fingers and the influence of differential compaction in producing drape structures, likewise, is important.

Educating Future Earth Scientists

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With knowledge expanding at a quickening pace, there is obvious necessity for broad and substantial preparation in mathematics and the physical sciences as a basis on which to build the derivative earth sciences. Three of these earth sciences—geology, geophysics, and geochemistry—are of special concern to explorationists of the petroleum industry. Institutions trying to train students for future professional work in the earth sciences are confronted with difficult educational problems. Certain of the more important and critical of these problems are discussed.

The student who is to become the imaginative and successful explorationist of the future must know the fundamental facts and principles of the earth sciences. He must know how to do field work, for exploration is still a combination of field science and art, but he must also understand the place of theory and experiment, of laboratory investigation and careful measurement. He must know enough mathematics to understand the laws and principles of physics and chemistry, so that he is reasonably knowledgeable about the work of his earth science associates. And he had better be able to speak clearly and forcefully, to write succinctly and to the point, and to press or yield as occasion demands when dealing with situations or people.

This is a big order to fill. It will hardly ever be filled by any single person. Assuming nevertheless, that we should attempt to train the best possible earth scientists, even though few will approach the specifications given, how shall we solve the problems now with us which bear directly on this question?

Should we go to a five-year program for a bachelor's degree, and correspondingly increase the time necessary for more advanced degrees? How many bachelors, masters, and doctors should we train? Is there a possibility of an oversupply in the coming decade? How can some of our best younger scientists be attracted into the earth sciences? How can the ambitious and capable ones without adequate funds get financial help? Can the best professors, especially the younger ones, afford to continue to be professors, in the face of more inviting positions in industry? How can the great Ph.D.-producing institutions maintain quality in staff and students in the face of inflation? Should the petroleum industry support educational effort even more generously than at present and possibly share some of their abler scientists and engineers with educational institutions? Finally, should the endowed institutions look to increased federal support?

Early Prospecting in West Texas Permian Basin (1919–1925)

Ben C. Belt, Houston, Texas

Interest was drawn to West Texas Permian basin by discovery of oil in the Bend formation at Ranger in October, 1917.

Stratigraphy of the area as understood by geologists of that day was discussed in Bulletin No. 44 of the University of Texas.

In an unpublished opinion, J. A. Udden thought that the Marathon folding would have a northeast expression in Reagan, Glasscock, Sterling, and Mitchell counties.

The discovery well of the Westbrook pool in Mitchell County was completed at approximately 2,500 feet in the early part of 1921 in a limestone pay of lower Double Mountain age.

The Big Lake pool was discovered by the Texon Oil and Gas Company's University No. 1, which found 50 bbls. of oil in the Big Lake limestone (lower Double Mountain) from a depth of 3,600 feet.

Subsequent wells showed the east side of the basin to be a rather featureless monocline, very much as it appears today.

In 1925 little was known about the central part of the West Texas Permian basin. There was some meager evidence of the existence of the West Texas structural platform as follows: the northwest-southeast alignment of the Cretaceous escarpment extending from King Mountain in Upton County northwestward across to Ector County; rolled Edwards fossils in caliche hills of western Winkler County; possible Triassic inliers in Crane and Ector counties; shallow salt in northwestern Crane County; Big Lake lime-