in detail. Through investigations of Recent sediments in the Gulf of Mexico and elsewhere, it has been possible to define the major types of potential reservoir facies, including alluvial, deltaic, shoreline, shelf, and turbidite deposits in the deeper parts of modern basins. Each of these facies can be distinguished readily by a combination of features, including composition and lithologic character, sedimentary textures and structures, fauna and flora, lateral and vertical facies relations, and geometric form.

Knowledge of these characteristics, applied to ancient rocks, provides information of value not only in recognizing facies but also in locating porous facies and in predicting their probable trends, shapes, and dimensions.

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EARLY TERTIARY FORAMINIFERA FROM JASPER RIDGE, SAN MATEO COUNTY, CALIFORNIA

Thin-section and washed-residue examination of a well-indurated pebble conglomerate from the base of the Butano (?) Sandstone of Dibblee and about 15 feet stratigraphically above depositional contact of the conglomerate with a sill-like serpentine intrusion on Jasper Ridge, San Mateo County, California, reveals an extraordinary assemblage of plant and animal microfossils that date the stratum as the oldest marine Tertiary unit thus far recognized in the structurally complex southwestern part of the Palo Alto quadrangle.

Conspicuous in the microfauna which was isolated from the calcareous matrix are *Alabamina wilcoxensis* Toulmin of Mallory and *Discorbis baintoni* Mallory, both early Tertiary index foraminifers in California. These, together with several other rotaliines and a few miliolids, cibicidids, anomalinids, textulariids, and globigerinids, suggest that the Jasper Ridge conglomerate was laid down in neritic waters that had a limited access to the open sea in late Paleocene (Bulitian) or early Eocene (Penutian) time, according to Mallory's tabulation of these protozoans in Paleogene strata of the California Coast Ranges.

The conglomerate crops out about midway between the San Andreas fault zone and the distorted sedimentary section exposed in the trench for the Stanford linear accelerator. Therefore, the early Tertiary segment is in an area that has been profoundly affected by numerous diastrophic events. The lithologic character itself furnishes significant paleogeologic and paleogeographic data, because the pebbles appear to have been derived mainly from a Franciscan terrane. The dominant pebble type is greenstone, with relic basaltic and andesitic textures, and characterized by albite, chlorite, pumpellyite, and other low-grade metamorphic minerals. Pebbles in small amounts include chert, graywacke, limestone, felsite, quartzite, semi-schist, and metagabbro. About 95 per cent of the pebbles are well-sorted basalt and 3 per cent red radiolarian chert.

It could not be ascertained whether the serpentine layer was intruded during Cretaceous time into the Franciscan on Jasper Ridge as Dibblee reported in 1966. However, the fact that the serpentine was exposed at least during the early Tertiary is confirmed by its juxtaposition with the fossiliferous conglomerate. Correlation with the large, plug-like serpentine mass described in 1951 by Thomas from exposures 2–3 miles toward the northwest is postulated, although the Redwood City area ultrabasic body was considered by Thomas to be a cold re-intrusion into Eocene strata, emplacement having occurred between late Eocene and early Miocene.

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THE PLAY THAT DID NOT SELL

The play that did not sell is the play undrilled, the oil not found, the idea untested—an economic waste. The three factors governing the salability of prospects are miscellaneous exterior causes, attitudes and reactions of buyers, and the capabilities of the seller.

Miscellaneous exterior causes include economics, weather, location, land, and others. They can not be controlled by the geologist-salesman but awareness of these factors is essential in order that he may time his submittal so that the factors help rather than hinder.

The second factor, attitudes and reactions of buyers, suggests an abiding rule: KNOW YOUR BUYER! This means knowing his attitudes and prejudices, geological and personal, individual and corporate. These factors may not be controlled by the seller but proper timing and presentation may maximize the chances of a favorable reaction. If the seller, rightfully, can not control the buyer, he may in the long run influence buyers as a group. This educational job, done by individuals and organizations, makes these potential buyers aware of the capabilities, limitations, and professional stature of geologists.

The third factor, capabilities of the seller, includes his reputation, skill at presentation, and persistence. Reputation is the outward sum of scientific competence, personal integrity, and exploration ability, and is included in submittal evaluation consciously or subconsciously by any buyer. The proved oil-finder commonly need only draw on his reputation to sell, but the neophyte or dry-holer must keep working on his image and his presentation skill.

This skill at presentation is the one over which the geologist has the most control. Principal ingredients of this skill include good geology, logical presentation, brevity, clarity, use of graphic media, consideration of the buyers' needs, and a realistic evaluation of all facets of the proposal before submittal.

Persistence might be better labeled educated stubbornness. The play that might not sell today or this year might sell 10 years from now as a result of some change in any of the preceding factors. Geologists have a responsibility to be stubborn when they think a play has merit.

Finally persistence through time also allows for improvement of reputation and improvement of presentational skills. This professional association provides one of the most useful training grounds for developing these facets of the geologist's character. If one wishes to sell his plays, he must *practice*. He should practice by presenting good geologic papers and by defending those ideas in his forum of geologic thinking, the A.A.P.G.

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QUANTITATIVE ENVIRONMENTAL ANALYSIS OF LOWER CRETACEOUS REEF COMPLEX

Lower Cretaceous rudist reefs control facies distribution in the subsurface Edwards and Stuart City Formations in South Texas. An outcropping rudist reef of nearly equivalent age in Mexico, and the Florida reef tract-Florida Bay Recent model, facilitate definition of the subsurface facies. Dominant facies in

the Edwards and equivalent units include burrowed and algal mudstone, skeletal siltite, skeletal calcarenite, rudist reef, and planktonic foraminiferal carbonate mudstone. Comparing the Cretaceous and Recent models, a change in reef frame from rudists to corals is the principal difference but minor faunal components in back-reef sediments are similar.

Rock samples are described quantitatively and compared vectorially. A reduction in the dimensions of the vector space is accomplished by factor analysis. Sample composition of the reef and associated facies is determined from the resulting rotated factor matrix. A factor score, computed by post-multiplying the transpose of the standardized data matrix by the square of the rotated factor matrix, emphasizes important rock components controlling the various facies. Thus, the number of critical components needed to outline the environments is reduced.

Parameters for the analysis include components modified by textural and structural adjectives (excluding burrowed carbonate mudstone). A second factor analysis was run using only important faunal components as outlined by the factor score. Environments outlined by the two analyses are very similar notwithstanding this reduction in the number of descriptive parameters. However, micro-sedimentary structures and textures are important in environmental interpretation of facies containing extinct faunas.

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UNIT REGIONAL VALUE AS BASIS FOR DECISION-MAKING IN SELECTING AN EXPLORATION STRATEGY

In a private-enterprise economy it is necessary that the search for, and development of, the non-renewable natural resources lead to a profit. The United States has produced such resources in the amount of $458.101 billion in the period 1911–1964, or has returned $151,569 per square mile. The value per square mile by states (1911–1964) ranges from $\$1 \times 10^6$ for Pennsylvania to $\$1.09 \times 10^4$ for Maine. The returns for Oregon ($9,508)-Maine ($10,906) and Minnesota ($136,264)-Indiana ($166,251) are similar despite very different geological environments between the similar pairs.

The objective of decision-making in selecting alternate exploration strategies is to select an optimal one; the potential value of a region is one attractive criterion. For example, a return for Alaska of $3,483 per square mile is so far below the average expected value for the United States, and the geological environment of Alaska is sufficiently varied that a very large return from a systematic search procedure is almost guaranteed.

On this basis an examination of the value per unit area (or volume) of the earth's surface would pinpoint those areas which are over- and under-developed; coupled with broad geological comparisons among over- and under-developed areas this would indicate the areas of greatest future potential.

Systematic search procedure of a large region would supply an inventory of its natural resources and this may then be used for an orderly development of these resources; from the figures on past production per unit area of the United States, this search program also will almost certainly be a commercial success. Such a program would supply a wealth of geological information and rejuvenate local exploration for specific resources.

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STRATIGRAPHY AND PETROLOGY OF BECK SPRING DOLOMITE (PRECAMBRIAN), KINGSTON RANGE, SAN BERNARDINO COUNTY, CALIFORNIA

The Beck Spring Dolomite (Pahrump Group, upper Precambrian) has an average thickness of 1,300 feet in the type area, Kingston Range, San Bernardino County, California, where it is divided into three unnamed members. The lower member, 500–700 feet thick, is composed of alternating laminae of finely crystalline and medium-crystalline dolomite mosaic. Allochem ghosts are scarce but include intraclasts and pellets. The laminae are primary features modified by replacement and recrystallization. The middle member, a replaced oölite calcarenite, is 300–400 feet thick, composed of finely to medium-crystalline dolomite mosaic with abundant ghosts of oölites, pisolites, and pellet-lump intraclasts. Selective replacement by quartz is fairly common, as well as re-dolomitization in some places. The upper member, 400–500 feet thick, resembles the middle member, but is partly laminated, has been extensively replaced by chert, and is brecciated and recemented. Allochem ghosts are similar to those found in the middle member. Although contacts are gradational, the three members can be traced throughout the type area.

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HERITAGE OF PETROLEUM GEOLOGISTS

The heritage left us by the early petroleum geologists has been ignored and practically forgotten. Those geologists should be remembered not so much for their achievements, but for their methods of applying the geological science and their contribution to it. These methods and contributions should be "dusted off" and restudied, and once again used as guideposts for future thinking. Their intrepidity, firm persuasion, and complete dependence on sheer intellect created the basic concepts which were responsible for world-wide, successful petroleum exploration. It is stressed that, to meet exploration requirements of the future, the profession must develop more original ideas, and not be afraid to push those ideas forward into fruition. It is only then that modern geologists will emulate their predecessors, who, as pure scientists and free-thinkers, conquered their problems through their strong courage of conviction.

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GEOLOGIC SUCCESS AND ECONOMIC FAILURE (ARE WE HUNTING ROCKS OR DOLLARS?)

A geologic success that is an economic failure may range from a structurally high dry hole to a large and prolific gas discovery located in a sparsely settled area where there is neither a gas market nor prospects for getting one in the near future. If a project is not an economic success, it is, to some degree, an economic failure because there is no neutral ground. Economic success generally is measured by rate of return on invested capital and by total profit related to investment.

In addition to direct costs, the cost of money or capital and the cost of taxes are two very important factors affecting economic success, and must be considered in appraising a venture. The question, "How much oil or gas must be found for economic success?"