2. *Very slow sediment accumulation rates.*—This is apparent in several ways: occurrence of manganese nodules and crusts on bedding planes; very thin but complete stratigraphic sections representing long time intervals; and cosmic spherule abundances in the rocks. Average sediment accumulation rates on the order of 0.1 to 2.0 cm./10^3 years are suggested by rough calculations; however, it is evident that the actual rates changed considerably within the time intervals considered.

3. *Solution effect.*—Solution of all or nearly all calcium carbonate minerals produced the radiolarian chert as an insoluble residue; this is believed to be analogous with certain areas of the present deep-sea floor below the depth of complete $CaCO_3$ dissolution. In other parts of the Jurassic section, aragonitic skeletal parts (ammonite shells) were dissolved; calcitic parts (ammonite aptychi) are well preserved. The latter situation is believed to be analogous with certain present deep-sea areas where dissolution of aragonitic pteropods occurs at shallower depths than calcite dissolution.

4. *Subsidence rates.*—This can be fairly well established for the Triassic Period in the Austrian Alps because the total thickness of the shallow-water Triassic deposits (reefs, evaporites, *etc.*) is indicative of total subsidence. If projected unchanged into the Jurassic Period, this rate establishes at least minimum depths during the Jurassic and indicates that subsidence rates greatly exceeded sedimentation rates. Other evidence suggests that the subsidence rate actually increased during Jurassic time, at least in the beginning.

Together these criteria suggest maximum water depths of 4,500–5,500 meters in the northern Limestone Alps during Jurassic time.

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FLORAL SUCCESSION IN A PENNSYLVANIAN COAL SWAMP AS INDICATED BY PALYNOMORPHS

Distribution of palynomorphs in segment samples taken in six outcrop sections of the Iron Post coal (Desmoinesian) of eastern Oklahoma shows prominent successional aspects. The variety of palynomorphs is small in the underclay and basal third of the coal, but is great in the top of the seam at all sections collected.

Underclay of the Iron Post coal contains a mircoflora dominated by *Calamospora*. Subordinate associations include *Lycospora* and *Laevigatosporites*. The spores *Lycospora* and *Calamospora* are dominant in the overlying basal third of the coal seam, everywhere except in the sections near the pinch-out of the coal. ***Granulatisporites*** and ***Triquitrites*** are locally important subdominants within this level.

The middle third of the coal seam is marked by a decline in *Lycospora* and the dominance of *Laevigatosporites*. A section located near the southern pinch-out of the coal is dominated at the same stratigraphic level by the saccate forms ***Wilsonites*** and *Florinites*. The upper third of the coal seam is everywhere characterized by a dominance of *Triquitrites* and *Verrucosisporites*.

Roof shale yields microfloras similar to those of the lower coal intervals except that there is a general decrease in most spore groups. This decrease is associated with a relative increase in saccate spores.

Palynomorph distributions within the Iron Post coal suggest that most spore groups were derived from plants indigenous to the swamp. However, palynomorph variety plotted with respect to position in the seam indicates that succession within the Iron Post coal swamp is somewhat irregular. A major decrease in microfloral variety at the base of the upper third portion of the seam indicates that some important event harmful to floral succession had occurred at the time represented by this level. It is suggested that relatively major fluctuations in palynomorph variety may be useful in stratigraphic correlation.

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QUANTITATIVE ANALYSIS OF PROSPECT TO DETERMINE WHETHER IT IS DRILLABLE

Thirty-one models were constructed in an attempt to represent all conceivable types of structural, stratigraphic, and structural-stratigraphic traps. Combinations of 52 parameters constitute these traps and define their proximity to hydrocarbon accumulation.

A trap is defined with 100 per cent certainty where all parameters necessary for its constitution can be demonstrated. Where only a part of the total parameters can be demonstrated, the per cent chance that a trap is present is reduced in a linear manner according to equations and graphs prepared by the writer. The same relation applies in defining the chance that a hydrocarbon accumulation exists, provided a trap is present.

The Composite Chance Factor (CCF) is the product of the Percentage Chance for a Trap and Percentage Chance for Hydrocarbon Accumulation. It is mathematically related to economics by the following formula:

Number of wells that must be drilled for any particular Composite Chance Factor, to eliminate statistically all but 1 per cent chance for failure as a result of bad luck, and find profitable amounts of hydrocarbons	×	Absolute minimum desired return on investment	=	Profit to Risk Investment

A graph was prepared showing the interrelations of the parameters in the above formula.

The statistical number of wells that must be drilled to find at least one economically successful prospect for a particular CCF, based on the minimum desired return, was calculated using probability equations and tables.

A summary sheet was designed to record all the data pertinent to the analysis of a prospect. A formula on this sheet yields a numerical prospect grade. These grades can then be used to select objectively the required number of drillable prospects commensurate with the allocated drilling budget.

By using the proposed system, the user can reduce considerably the monetary speculation when prospecting for oil, and he can invest, fully expecting to realize at least the desired minimum return on his investment.

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SEDIMENTARY FACIES AND THEIR IMPORTANCE IN OIL FINDING

In today's search for oil, industry has become increasingly aware of its need for information that will permit more accurate prediction of porous and permeable facies. Such information is important in exploring for both structural and stratigraphic accumulations.

To obtain the data desired, research geologists have directed their efforts to modern ocean basins and contiguous land areas where both sedimentary facies and the environments that produced them can be studied 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