history spanning at least 5,000 years. Amidst the bands are intervals of translucent green gel, with white granular inclusions in places. One section of gel occupies an interval of nearly 10 cm, and the uppermost is within 20 cm of the rock/water interface. Three hypotheses describing the structure of the gel seemed plausible: that it was a proteinaceous gel, a polysaccharide gel, or a silica gel. Infrared spectroscopy of a sample which had separated during storage revealed no absorption at 6 μ, precluding the presence of peptide bonds. There was little in the spectra to suggest that saccharides were present, but strong absorption between 9 and 10 μ suggested abundant silicon. X-ray diffraction of samples soaked in distilled water gave strong indications of halite, which would mask the presence of silicon. D.C. arc emission spectroscopy showed the sample to be rich in silicon, sodium, calcium, and magnesium, and to contain trace amounts of other elements normally present in seawater. We conclude that the sample is a silica gel, hydrated with seawater and containing microcrystals of sodium and magnesium salts.

The gels formed on the bottom of a lake which is now 30 m deep and with a salinity of 52 ‰, or half again as salty as seawater. The lake is highly productive so that reducing conditions with free sulfides prevail at the bottom. This fertile condition is apparently maintained by a large input of guano from the immense colonies of seabirds which inhabit the island. Study of diatoms and other fossils incorporated in the gels, and of the pigments preserved in them, is enabling us to reconstruct the environment in which a silica gel forms under the waters of this crater lake. These conclusions may prove useful when seeking to explain the origin of cherts.

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GEOLOGY AND DEVELOPMENT OF HEWETT GAS FIELD, UNITED KINGDOM NORTH SEA AREA

The Hewett gas field is 15 mi off the Norfolk coast, and has an estimated 3.5 Tcf of recoverable gas contained in 2 Triassic Bunter sandstones. The field was discovered late in 1966 and placed on production in July 1969. By that time 22 wells had been drilled, permanent offshore and onshore facilities installed, unitization negotiations concluded, and market secured. The contract with the purchaser calls for a gradual increase in daily production to an average rate of 600 MMcf by 1974. The 2 reservoirs are largely coextensive, and the field, roughly elliptical in outline, has a length of 18 mi and a maximum width of 3 mi. Average depth to the middle Bunter Sandstone is 3,000 ft and to the lower Bunter Sandstone is 4,150 ft. Maximum observed gross pay thicknesses are 323 ft (middle) and 202 ft (lower). Both reservoirs have excellent porosity and permeability. The Hewett structure is apparent on seismic profiles and at both Bunter levels a fault-bounded, NW-SE-trending anticline is present. The gas in the lower Bunter differs from that in the middle Bunter in that it is free of hydrogen sulfide, but whether this implies different sources has not been demonstrated conclusively. The lower Bunter Sandstone has a limited distribution in the North Sea area. Since the discovery of Hewett several North Sea wells have found gas in the middle Bunter, but follow-up wells have been unsuccessful. The Hewett field may remain unique.

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GEOLOGY, OIL FIELDS, AND FUTURE PETROLEUM POTENTIAL OF SANTA BARBARA CHANNEL REGION, CALIFORNIA

The Santa Barbara Channel region is the westerly part of the Transverse Ranges geomorphic province of California. It includes the submerged seaward extension of the Ventura basin and the continental slope to a distance of 70 mi offshore. A nearly complete post-Jurassic sedimentary section is present. The total section ranges in thickness from 19,200 to 67,600 ft. Potential reservoir rocks range in thickness from 4,600 to 25,400 ft. The section is 30% arenaceous.

Geologic structures are generally west trending. Anticlinal trends with steeply dipping flanks (up to 75°) are prominent. Numerous nearly vertical lateral faults and high-angle reverse faults are also prominent. Vertical displacements in excess of 10,000 ft and lateral displacements of more than 3 mi are recognized.

Twenty-three oil or gas fields are present in the region. Of these 5 have been discovered on Federal lands in the past 2 years, but only 1 was being developed in August 1970. Cumulative production from all fields is more than 1 billion bbl of oil and nearly 300 Bcf of gas.

Statistical approaches to the determination of original oil in place in the region have yielded varying results in the magnitude of 25–35 billion bbl. However, comparisons with other sedimentary basins of the California Coast Ranges indicate that an estimate of 10–15 billion bbl of oil in place is more likely to be in the right order of magnitude.

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THE PETROLEUM GEOLOGIST—TOMORROW

The successful petroleum geologist of tomorrow will have to be a well-trained individual with a degree (preferably higher) in geology in its broadest sense. The future degree might better be "rounder" than "higher," with mineral law, mineral economics, reservoir engineering, and geophysics as integral parts. The petroleum geologist will have to be a man who follows the precepts of AAPG, namely, be a professional person with scientific interests. Bearing in mind that not all geologists well based in scientific theory are successful oil finders, he must achieve judgment, balance, and decision, in addition to knowledge. These he must do in his technical field by not only properly weighing geologic data, but he also must be able to relate his professional work to industry in particular, and society in general. To the questions of what are an explorationist's responsibilities to the public, to the environment, and to the nation, he must have positive answers. If tomorrow's petroleum geologist is to be inspired to do these things for self proficiency he must have: (1) political acceptance of his credibility, and a willingness on the part of others to establish honest dialogue on issues affecting his profession; (2) governmental recognition of the essential role his profession plays in energy resource exploration and development by making workable leasing and development policies on all energy mineral fields—oil, gas, oil shale, uranium, and coal—so there will be a multiplicity of continuing opportunities

for his exploratory talents; (3) a realization that pricing policies must recognize and accept the changes in cost accounting brought about by increasing concern for the environment and preventing its pollution; and (4) stability of employment prospects, so that he not only obtains a position upon graduation from college, but has assurance in middle life, if he proves competent. It is not only necessary to be a well-trained geologist initially, but he must have continuing curiosity, self discipline, and enthusiasm. He must continue to assert the difference between being a professional and a hired hand.

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SOME CONCEPTS ON CEMENTATION OF SANDSTONES

(No abstract submitted)

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PETROGRAPHIC ANALYSIS OF SANDSTONES IN STRATIGRAPHIC EXPLORATION

All the fundamental rock properties (composition, texture, and sedimentary structure) are required to determine the depositional environments of sandstone bodies. Once depositional environments have been established, however, petrography alone can be a significant factor in identifying environments. Petrography is particularly useful if only small samples are available, such as core chips or side-wall cores. Thin-section analysis of such samples yields compositional and textural data which can be environmentally sensitive.

This is confirmed by a study of the Muddy Sandstone in the subsurface of the eastern Powder River basin. In this area, barrier bars are characterized by high quartz content (>90%) and low matrix (<10%); delta destructional bars by moderately high quartz (60–90%) and matrix (10–40%); and fluvio-deltaic sediments by low quartz (45%) and relatively high matrix (35%) and rock fragments (20%). The vertical sequence of mean grain-size change in each environment is significant, but maximum grain size is also a key value and is generally a grade coarser in fluvio-deltaic than barrier or delta-destructional sandstones. Plots of quartz mean size versus quartz content are environmentally sensitive, and from only a few thin sections an estimate may be made of depositional environment when other data are not available.

Indirect tools, such as electric logs, appear unreliable for identification of environment, unless the environment is established first on the basis of fundamental rock properties.

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SEDIMENTATION OF PLIOCENE SANDSTONES IN SANTA BARBARA CHANNEL, CALIFORNIA

Pliocene rocks in the Ventura basin, including the part under the Santa Barbara Channel, provide an excellent area to study a strongly deformed but essentially intact turbidite basin. Conglomeratic beds, containing typical turbidites, are present along the northern margin of the basin.

Isopach, sand-isolith, and sand-percentage maps of the Pliocene Repetto and Pico Formations in the east-west Central basin show thick deposits bounded on both sides by thinner deposits in the Rincon trend on the north and the Montalvo trend on the south. Deposition was controlled by partly effective fault barriers on the north and south margins of the Central basin. Sand-isolith and sand-percentage maps indicate local increases in sand in the north on the Rincon trend suggesting the presence of ancient subsea fans in the Repetto and lower Pico. The overall decrease in sand on the west denotes a major influx of sand from the east down the Central basin axis. The first influx of sand from the southern margin of the basin is found on the sand-percentage map of the middle Pico "A." Deposition of sand was also affected by topographic highs associated with growing faults and anticlines.

Distribution, textural properties, primary structures, and microfauna of sandstones in the Ventura basin are comparable to the modern deposits in the nearby Santa Monica basin. Stratigraphic maps reveal Pliocene subsea fans, and observations of outcrops and cores show the same type of beds as described in the Santa Monica basin. Hence, sedimentation was controlled by sand deposition in and at the foot of submarine canyons in the form of subsea fans.

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BEACH AND NEARSHORE PROCESSES AND MORPHOLOGY IN NONTIDAL ENVIRONMENT

Recent detailed studies of the beach and nearshore environments of eastern Lake Michigan have revealed almost no significant differences compared with similar marine environments, except for the absence of marine tidal fluctuations. The morphology and the processes operating in both areas are remarkably similar; however, the rates at which these processes operate appear to be more rapid in Lake Michigan.

Beach profiles reflect environmental conditions which may or may not be associated with seasonal cycles. Storm conditions yield nearly identical flat profiles in both areas with characteristic lag deposits of heavy minerals in the back-beach zone. Quiescent conditions produce accretionary beaches except when lake levels rise gradually for prolonged periods.

The inner nearshore profile in both Lake Michigan and marine areas is commonly characterized by an ephemeral bar which migrates shoreward and is welded to the beach. The bar forms during the waning phase of a storm and migrates shoreward during low-energy conditions. Migration of the bar generally proceeds more rapidly in Lake Michigan than in tidal areas. The crest of the bar is not exposed in Lake Michigan until welding occurs, whereas, it is exposed during low tide in comparable marine environment.

Farther from shore are relatively stable bars whose number and position are controlled largely by the slope of the nearshore bottom. These features also show generally comparable morphology in both areas, although they seem somewhat less stable in the marine environment.

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