The clay mineral assemblage at the playa surface is dominated by illite with less than 5 per cent expansible phases present. Illite also is the predominant mineral in the source area; however, significant amounts of montmorillonite, chlorite, and kaolinite are being generated in the drainage basin. Discrepancies between the clay minerals of the lake bed and those of its source area are best explained by selective removal of finer colloidal material at the playa surface. The coarse sediment fraction contains detrital quartz, feldspar, heavy minerals, authigenic calcite, and ostracod valves. Saline minerals occur only as crusts at the playa surface.

Authigenic analcime is an ubiquitous constituent of the −2-micron fraction in amounts of the order of 10 per cent by weight. The absence of tuffaceous sediments in the core precludes alteration of volcanic glass to form analcime. Evidence is presented which suggests that analcime is a reaction product of kaolinite in the diagenetic sedimentary environment.

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SEDIMENTATION IN ANDAMAN BASIN, NORTHEASTERN INDIAN OCEAN

The northeastern corner of the Indian Ocean is contained in the Andaman basin which has an area of 900,000 square kilometers. The northern and eastern third of the Andaman basin is composed of the shallow Irrawaddy delta shelf and Malay shelf, respectively 200 and 170 kilometers broad from the coasts to the 200-meter deep-shelf break. Along this terrace the bottom drops to the topographically complex basin floor with a maximum depth of 4,400 meters east of the Andaman-Nicobar Ridge.

Principal sediment source for the basin is the load of the Irrawaddy River, estimated during the last century at 265,000,000 metric tons per year, a figure which may be in error by a large amount. The subaerial delta is accumulating very little of the sediment, which reaches the sea and is displaced eastward by monsoon-driven currents. A 12,000-square-kilometer area southeast of the subaerial delta is the main depositional site. Marked shoaling of this area during the past century is too great to be explained by sediment accumulation alone, and it is suggested that localized tectonism is distorting the delta shelf. Deposition also is localized in the disturbed area, as sedimentation strives to re-establish and maintain a stable delta-shelf gradient of less than 0°01′.

A radiocarbon date from a basin core and foraminiferal data indicate a deep-basin depositional rate of 15 centimeters per 1,000 years. Sediment carbonate contents provide a rough comparison of relative depositional rates for the basin floor and the delta, indicating that sediment accumulates on the delta shelf at least 10 times faster than in the deep basin, or at a rate of from 100 to 200 centimeters per 1,000 years. Approximately 90 per cent of the Irrawaddy's load is deposited on the delta and only 10 per cent reaches depositional sites beyond the delta.

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CONCEPTS IN LATE PALEOZOIC CORRELATIONS

Correlation of late Paleozoic strata presents two contrasting sets of concepts, one of intra-regional correlation and the other of inter-regional correlations. Correlation within a region, exemplified by a basin, segment of a geosyncline, or an epicontinental shelf, follows most of the classical procedures developed during the last 180 years. Where abundant well-log data or surface exposures permit the tracing of individual beds, development of three-dimensional facies analysis, key beds, and recognition of individual cycles within cyclical deposits provide accurate and detailed information for lithologic correlation. Where lithologic data are sparse, correlation based on fossil occurrence and abundance furnishes an additional type of correlation. Attempts to quantify fossil correlation include (1) presentation of the percentage of forms that two different localities have in common and (2) an analysis of the population in terms of the number of individuals. Individual guide fossils or sets of guide fossils with overlapping stratigraphic ranges also are widely used. Many of the most widely used guide fossils are pelagic, *e.g.*, the ammonoids. However, some benthonic fossils also are excellent guide fossils, particularly along depositional strikes.

Inter-regional correlations in the late Paleozoic, in contrast, are challenging in other aspects, because the tectonic and fossil history in one region may have virtually no similarity with nearby regions. Nevertheless, fossils still are the most reliable criteria for inter-regional correlation in late Paleozoic strata although the fossil yardstick as a time-stratigraphic scale commonly seems considerably less precise. One problem of particular concern is the development of faunal provinces and subprovinces in what appear to be isolated and semi-isolated regions segregated by late Paleozoic orogenic activity. Threshold levels of evolutionary adaptation and changes in physical environments seem to have enabled sporadic and irregular dispersal of different parts of these semi-isolated biotas, so that first appearances of one group in an adjacent region may have little relation to the first appearance of other groups.

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EXPLORATION IN AUSTRALIA

(Abstract not submitted.)

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VILLAFRANCHIAN AGE AND ITS RADIOMETRIC DATING, II

The Villafranchian, though identified by non-marine phenomena, was one of the most precisely typified of the commonly used European Cenozoic Stages-Ages. Pareto (1865) gave exact geographic location and characteristic rocks of his stratotype for Villafranchian and listed the fossils that were known (three proboscidean species).

Villafranchian has been applied throughout Eurasia and Africa on the basis of a characteristic array of species of mammals. These species were obtained first from sites in Italy and France that were believed to be the same age as Pareto's Villafranchian. Validity and utility of the Villafranchian, as recognized through most of the Eastern Hemisphere, are not vitiated because some of its characterizing mammalian assemblages are younger than the type or because its lower boundary may not coincide with the currently accepted lower boundary of the Quaternary.

Large mammals now known from the stratotype, together with small mammals, mollusks, and plants

recently collected, will provide a more secure paleontologic basis for correlation with type-Villafranchian ecology.

Although no materials suitable for radiometric dating of type Villafranchian has been found, volcanic rocks associated with the correlative Etouaires fauna near Issoire, France, have yielded a K/Ar date of 3.4 m.y. The nearby younger Villafranchian fauna of Roca Neyra is 2.5 m.y. In beds from a zone between these two faunas is the fossil flora of Boissac, of perimediterranean type dominated by deciduous trees and containing bamboo.

The oldest geological indications of cold climate that have been dated in the Auvergne of France are at Coupet (solifluction), 1.9 m.y., and Vazeills (crioturbated earth), 1.8 m.y. Coupet also has a fauna, thought by Bout to be mid-Villafranchian.

The oldest glacial deposit dated from the Northern Hemisphere (Sierra Nevada) is 2.7 m.y., whereas the oldest evidence of Pleistocene cold climate in the Southern Hemisphere (New Zealand) is slightly older than 2.5 m.y.

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GEOLOGIC QUANTIFICATION: DESCRIPTION → NUMBERS → SUCCESS RATIO (THE NUMBERS GAME, OR EVALUATING OUR WORK WITHOUT ACTUALLY USING DICE)

Continually increasing emphasis on the economic aspects of risk/return ratio is essential in a successful oil-exploration program. Such an economic analysis attempts to predict the ultimate financial return from the original investment based on (1) various estimated, largely dimensional parameters, and (2) the assumption that the wildcat test will be a discovery. In the past, probability of success, *the* fundamental element in any drilling decision, commonly has been determined subjectively by the geologist. His means of making such a determination has been based largely on his "feel" for the area, his experience, and perhaps a desire to take advantage of an element of luck where positive supporting evidence is lacking. The geologist rarely recommends a prospect with a risk factor less than 1 in 4, or 1 in 5, yet statistical results of domestic wildcat drilling, considering only those tests in which technical advice has been used, are about 1 in 8. This poor record in prediction, based on subjective factors, must be supplanted by some system of estimation in which descriptive geology is translatable into numbers that may be converted into a measurable probability of success.

An exploration prospect check list is presented to illustrate the evaluation method. This list is organized into three primary classes of fundamental geologic data essential to any prospect. The absence of favorable development of any one of these ordinarily results in a wildcat failure. Each primary class is subdivided into categories, some of which are separated further into sub-categories. The ultimate division in the classification is a check list of 210 geologic elements. Up to 38 elements are considered in the evaluation of any prospect. Translation of geologic description to numbers is accomplished by relating the geologic details with each of the above elements that is pertinent to the objective. From careful consideration of the check list, the expected condition of development of each element that is essential to the prospect is compared with what might be considered optimum development of that element for the area. The sum of the percentages of optimum development of all pertinent elements under each of the primary classes of data is a measure of the probability of optimum development of any major trapping factor. According to the probability theory, the percentage chance of geologic success is the product of the percentage chance of development of the three trapping factors. Examples taken from actual case histories, considering the state of knowledge prior to drilling, demonstrate how percentage probability of success and risk is determined.

If the geologists' largely descriptively oriented profession is to survive as a provider of significant technical advice to the highly competitive and cost-conscious domestic oil industry, the geologist must seek to translate his determinations into tangible terms more suited to comprehension by a non-geologically oriented management. Quantification, as presented here, is one approach toward that end. It is hoped that this approach will stimulate continued improvement of the system, or provide the impetus for the spawning of others, which may result in substantial improvement in the selection of prospects which result in economic successes. If the present domestic 1 in 8 discovery-to-dry-hole ratio is reduced to the desired 1 in 5, exploration costs would almost be cut in half; this might result in a complete rejuvenation of our domestic oil industry.

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SILICA: SOURCE AND DISTRIBUTION IN SOUTHEASTERN ALASKA

The area of investigation lies between lat. 56°–59° N. and long. 134°–137° W. This coastal region consists of a complex of fiords, estuaries, channels, and straits. Samples from standard hydrographic depths were collected from 50 stations occupied every 2 months during 1965–1966. Cores and grab samples also were retrieved to study the lithologic character and interstitial water composition. Samples from major rivers and streams were also collected.

The period of collection included two seasons when blooms of diatoms were noticed in the inlet waters. Silica concentration between blooms varied at different depths with the maximum at the surface and minimum at the bottom. The silica-salinity ratio diagram indicated fresh water as a minor source for silica during summer months. However, during winter months, the silica seems to recycle from deeper waters to replenish surface silica removed by siliceous organisms.

Approximate estimations of silica utilization during diatom blooms were made by silica-salinity ratio diagrams. The removal of silica during the September, 1965, bloom appeared to be 12 per cent of the total amount of silica present in the system during the month of November, 1965 (low biological activity).

The vertical distribution of silica in glacially-fed areas such as Glacier Bay showed a homogeneous mixing with no sharp halocline throughout the year. Chatham Strait, on the other hand, was stratified during the summer, and there was no sharp halocline during the winter months.

The silica concentration in interstitial waters showed a higher concentration in basins with finer sediments and lower concentrations in basins located near the source with coarser detrital sediments. No relation between silica and major ion concentration in interstitial waters was observed.