and anhydrite in certain cases has accentuated and improved pore structure.

ROSENFELD, MELVIN A., Pure Oil Company Research Center, Crystal Lake, Ill.

GEOLOGY REACHES COMPUTER AGE

That geology, at least in some areas, has reached the computer age is evidenced in the symposium we are holding at this time. The five symposium papers describe a variety of today's computer applications in geology and exploration. This paper attempts to provide a background of computer information as a framework for the other papers.

In this symposium we are using the word "computer" in its broadest sense to include the actual general-purpose electronic digital computer, its associated data processing equipment such as key punches, sorters, tabulators, and reproducers, and also specialized data-gathering input and graphical output equipment. Actually we are considering whole "systems." Much of geological work may be done on associated machines other than the actual computer.

The electronic computer itself is the core of any system; it is one of the most dramatic and significant developments of our time. Capable of performing arithmetical and logical operations at extremely high speeds and of storing vast quantities of data, the computer provides geologists with opportunities to solve problems unapproachable a decade ago.

It is estimated that there are 10,000 digital computers installed and in use today. Oil companies are well equipped and, in most cases, their computers are available for exploration work. Service bureaus and consultants provide computers and programming help for use of smaller companies and individuals. No geologist is very far from a computer today. These devices are easy to use and should present no learning problems greater than the use of any new exploration technique or equipment.

The computer is not a magic black box; it is thoroughly understandable. We may consider it simply an extension of part of the human mind just as we consider the geology hammer an extension of the hand, the microscope an extension of the eye and the seismograph an extension of the ear. Fear or resentment of the computer decreases as familiarity increases.

There have been raised in some quarters, however, real moral issues involving the dehumanizing effect of computers. These have been in particular reference to military work and should not be of concern in geology.

ROSS, CHARLES A., Illinois State Geological Survey, Urbana, Ill.

SABINS, FLOYD F., JR., California Research Corporation, La Habra, Calif.

FUSULINID ASSEMBLAGES FROM LATE PENNSYLVANIAN AND EARLY PERMIAN OF SOUTHEASTERN ARIZONA

The varied fusulinid faunas of the late Pennsylvanian (Virgilian) and early Permian (Wolfcampian) parts of the Naco Group and the Earp Formation can be divided into five assemblage zones. The lowest zone is characterized by *Triticites cullomensis* and occurs in early Virgilian strata disconformably overlying middle Desmoinesian beds. This early Virgilian sequence is overlain by a zone of middle to late Virgilian fusulinids, *Triticites ventricosus sacramentoensis* and *T.* cf. *T. plummeri*, that occurs in the uppermost beds of the Horquilla Limestone and ranges into the lower 20–235 feet of the Earp Formation. From the fusulinid distribution and the transitional lithologic features it appears that the top of the Horquilla Limestone and the base of the Earp intertongue laterally.

The succeeding 540 feet of the Earp Formation contain a fusulinid assemblage of *Triticites* and *Schwagerina* characteristic of the Bursum Formation of New Mexico, the Admire Group of Kansas, and Pueblo Formation of north-central Texas. Of particular interest is the nearly complete transition from *Triticites* into *Schwagerina* in the lower part of the Earp Formation. Overlying these beds are 1,200 feet of limestone and shale having a *Pseudoschwagerina* and *Triticites* assemblage closely similar to that from the Neal Ranch Formation (early Wolfcampian) of the Glass Mountains, Texas. The succeeding 300 feet of limestone beneath the red shale and cross-bedded sandstone at the top of the Earp Formation have *Pseudoschwagerina* and advanced species of *Schwagerina* that bear similarity to the fusulinid fauna from the Lenox Hills Formation (late Wolfcampian), Glass Mountains, Texas.

ROTHWELL, W. T., JR., Richfield Oil Corporation, Long Beach, Calif.

IMPORTANT FACTORS FOR MICROPALEONTOLOGIC INVESTIGATION IN PETROLEUM GEOLOGY

Three factors are vital in successful paleontologic investigations in petroleum geology. These are: (1) collection of the fossil groups by paleontologists with knowledge of the total fauna, its ecologic associations, and lithologies in which preservation is best; (2) processing of samples in laboratories closely supervised by paleontologists to insure effective recovery of fossils of each group; (3) accumulation and evaluation of data employing the whole spectrum of fossil and mineral content of the sediment, gathered by geologically and paleontologically trained personnel.

Diagrams and charts are presented showing (a) the fossils commonly used in petroleum geology grouped into surface and subsurface categories; (b) the environmental, lithologic, and bathymetric interrelations that affect the use of important fossil groups in stratigraphy; and finally (c) a procedure is suggested for paleontologic investigation, and reporting of data in petroleum exploration.

SABINS, FLOYD F., JR., California Research Corporation, La Habra, Calif.

STRATIGRAPHY, PETROGRAPHY, AND PALEOECOLOGY OF BISTI STRATIGRAPHIC TRAP, SAN JUAN BASIN

Bisti field produces from bar sands of the Gallup Sandstone (Upper Cretaceous), which consists of the following units. The non-productive Main Gallup Sandstone is a regressive sandstone that grades downward and laterally into marine Mancos Shale. The Main Gallup Sandstone contains the offshore sand facies and the beach sand facies. Overlying the offshore sand facies are three productive bar sands with a distinctive low SP interval at their base. The bars have flat bases, convex tops, and form a complex more than 30 miles long, 3 miles wide, and 40 feet thick. Seaward (northeastward) the bar sands grade into the fine-grained fore-bar facies. Landward (southwestward) they grade into the back-bar facies. Overlying the entire Gallup Sandstone is the "Upper" Mancos Shale.

The beach sand facies is medium-grained sandstone that lacks glauconite and primary dolomite grains. The offshore sand facies is very fine-grained sandstone with abundant primary dolomite grains. The low SP interval consists of sandy shale. The bar sands consist of sub-