cussed and evidence is presented demonstrating the presence of a Permian section nearly as complete as that of the Glass Mountains, as well as a fairly complete Pennsylvanian sequence.

10. LOUIS V. OLSON, assistant director, Agricultural Research Department, American Smelting and Refining Company, El Paso: Aerial Photography for Geological Exploration.

The use of aerial photographs has gradually increased until at the present time no important surface geological work or any other surface exploration work, such as for power lines, canals, or pipe lines, is undertaken without the preliminary of an aerial survey. The sensitivity of the modern photographic materials is such that by the proper use of light filters slight color changes may be detected denoting changes of bedding planes which could not be detected by the eye. Stereoscopes have been developed that make it possible to detect even minor changes in elevation. Sketching of contours on the photograph tends to eliminate laborious ground survey work. Of course, the stereoscope also indicates the relative hardness of adjacent terrain, which is very important in tracing rock formation.

11. CARY P. BUTCHER, geologist, Tide Water Associated Oil Company, Midland: The Guadalupe Mountains as They Look to the Aerial Geologist.

Stratigraphy in the Guadalupe Mountains is definitely related to contemporaneous structural movements. These relationships become obvious to the aerial observer. They become a part of his permanent record when they are photographed. Initial ground reconnaissance is advisable, and subsurface data should be given careful consideration. Such procedure has been followed in the Guadalupe area. Aerial observation is of great value even prior to surface or subsurface study. Thus time is saved, especially as the observer gains in experience. Hence these progressive aerial obliques of the Guadalupe Mountains are presented in the hope that they will be of value in better understanding subsequent papers and field trips. They culminate work begun in 1928. Views are east-northeast, and the progression is in a northwesterly direction. A simple cross section is added in further explanation.

12. RONALD K. DEFORD, geologist, Argo Oil Corporation, Midland, GEO. D. RIGGS, consulting geologist, and NEIL H. WILLS, consulting geologist, Carlsbad, New Mexico: Surface and Subsurface Formations, Eddy County, New Mexico.

This is a preliminary report on incomplete surface and subsurface studies in Eddy County and adjacent areas. Results so far are as follows.

The Yates sand has been traced from subsurface into the surface outcrop, and the top of the Yates mapped from Carlsbad to McKittrick Canyon.

The subdivision of the Whitehorse-Capitan is simplified, making it more suitable for daily use by subsurface (and also field) geologists. From top downward it is subdivided into Carlsbad, Yates, Seven Rivers, Queen. This involves redefinition of the Carlsbad.

The gradation of Whitehorse into Capitan disposes of the untenable theory that the Whitehorse is Triassic. Yates sand passes beneath beds containing Permian (Guadalupian) fossils.

Even the youngest Carlsbad grades laterally into massive Capitan limestone, and all the Capitan limestone grades into the upper 800 feet of the

Delaware Mountain sandstone. The Lower Castile formation is younger than the Capitan, which it overlaps.

In the vicinity of Carlsbad the Rustler rests directly on the Carlsbad limestone. Evidence of the Pleistocene age of the Pierce Canyon beds is presented.

13. GEORGE A. KROENLEIN, geologist, Lovington, New Mexico: Salt, Potash, and Anhydrite in the Castile Formation of Southeast New Mexico.

Continual accumulation of concentrated saline water beneath the surface water in the Delaware basin raised the level of the highly concentrated water to the point where it caused two epoch-making events to occur in Upper Permian history. First, it stopped Capitan reef building and associated petroleum deposition. Second, it diminished the inflow of marine water and started deposition of evaporites in the Delaware basin. This point marks the close of Capitan time and the beginning of Castile time.

Subsurface study of the lower Castile formation discloses many hundred feet of depositional relief on the basin floor. This condition is responsible for unsuccessful attempts to run a structural correlation across the Delaware Basin on the base of the upper Castile (Main Salt).

At present, potash is the mineral with greatest economic importance in the Castile formation. Two mines are producing from one of the finest potash deposits in the world.

Two subsurface cross sections show many interesting features about the deposition and occurrence of evaporites.

14. PHILIP B. KING, associate geologist, Geological Survey, U. S. Department of Interior, Washington, D. C.: Relation of Permian Sedimentation to Tectonics in Guadalupe Mountain Region.

This paper is based on observations in the areas of Permian outcrop of northern trans-Pecos Texas, and especially in the Guadalupe Mountains and the Sierra Diablo. The two regions are mutually supplementary in that the first exposes the higher Permian and the second the Lower Permian and pre-Permian rocks.

The stratigraphy of the Permian series is complex, for it is characterized by great and abrupt changes in faunal and lithologic facies and in thickness of beds. The most striking features are limestone reefs, of which one of the largest is formed by the Capitan limestone. These are thicker and less elastic than adjacent contemporaneous deposits. Other less striking but no less significant changes are common, including lateral gradation of limestone into clastic rocks or evaporites, and of one variety of limestone into another.

These complex relations were produced by variations from place to place of physical-chemical and ecological environments at the inner end of an embayment of the sea. The variations resulted from many causes, the relative importance of which is not easy to evaluate. Some barriers, such as the reef masses, produced largely by sedimentation, restricted the inwash of clastic sediments and caused differences in depth and salinity on opposing sides. Similar effects have been caused by buried hills that are erosional relics of pre-Permian disturbances. The author believes, however, that some structural features arising on the sea floor during Permian sedimentation were also the direct cause of variations in environment and that they were an indirect cause of variations by their effect on the placing of the reefs and hills. The fundamental control of the complex Permian deposits thus appears to be tectonic.