quantities of muddy and sandy sediments but such condition does not insure that calcareous sediments will be deposited. Calcareous sediments are precipitated in many ways; some chemical, some physico-chemical, and, most important generally, organic. Organic precipitation is done by both plants and animals, the latter generally readily identified, the former generally indeterminate. Sea bottoms beneath shallow marine waters and protected against entrance of muddy and sandy sediments either because provenances of the sediments are unable to supply such either by reason of being very low or the surface being excellently protected by vegetation, or the sites of deposition being a long way from shore, are the environments that permit the accumulation of widespread deposits of shallow-water marine calcareous sediments. Elevated places on bottoms beneath shallow marine waters may permit calcareous sediments to be deposited in the midst of muddy and sandy sediments. Deep bottoms so far from land that muddy and sandy sediments do not commonly enter are also places of deposition of calcareous sediments.

7. DAN E. FERAY and WILLIAM A. JENKINS, Magnolia Field Research Laboratories, Dallas, Texas. Carbonate Facies of Pennsylvanian Sediments, North Central Texas

Two large limestone masses, in the Canyon series of the Pennsylvanian, crop out in north-central Texas. One of these masses crops out in Wise County and has been referred to as the Chico Ridge reef, the other crops out in Palo Pinto County and has been referred to as the Possum Kingdom reef. During the past 3 years these two limestone masses have been the subject of detailed surface mapping, sampling, coring, and laboratory analyses. Both of these limestone masses change laterally into equivalent shale and sandstone. The surface and subsurface evidence indicates that these two bodies of limestone are of non-reef origin. These limestone masses are examples of stratigraphic-trap carbonate reservoirs.

8. CHARLES A. RENFROE, Columbian Carbon Company, Amarillo, Texas. The Novinger Pool

The discovery well of the Novinger pool was drilled in the latter part of November, 1950, on the T. B. Novinger lease, Sec. 26, T. 33 S., R. 30 W., Meade County, Kansas. At the present time 32 wells have been drilled, of which 27 produce from the Marmaton, 3 from the Morrow, 1 from the Chester, and 1 gas well from the Atoka. Initial potentials on the wells range from 2,204 to 49 barrels of oil per day. The average monthly production of the field is 42,000 barrels of oil. Total accumulative production to the first of August, 1953, is approximately 475,000 barrels of oil. Most of the oil produced is from a porous limestone of Marmaton age. This reservoir is an elongate reef-like body with a north-south trend. Lithologically, it is a relatively coarse textured oölitic limestone with a large percentage of organic debris. The northern limits of the field have been delimited by three wells that cored dense shaly limestone in the stratigraphic interval represented by the Novinger pay on the south. The southern limits of the field are not known. Pay from the Atoka is from a relatively tight shaly sandstone of erratic distribution that apparently marks the Morrow-Atoka unconformity. A small amount of gas has been found in the Atoka. Morrow production is from lenticular sands that occur at various levels throughout the Morrow interval. Although 12 wells have been drilled through the Morrow, only 3 in the north end of the pool have had sufficiently well developed sands to be commercial. These 3 are all oil productive with fairly high gas-oil ratios. Chester production is from porosity developed in coarsely-crystalline crinoidal limestone at or near the Pennsylvanian-Mississippian boundary. Porosity appears to be secondary and was probably developed by weathering of the Chester limestone during the post-Mississippian-pre-Pennsylvanian erosional interval. Only one well is now producing from the Chester, but another was gauged at 14,000,000 cubic feet of gas per day with a spray of oil before it was completed higher in the hole as a Marmaton producer. No wells have been drilled through the Mississippian.

9. EARL MCCRACKEN, Missouri Geological Survey, Rolla. Correlation of the Insoluble Residue Zones of the Upper Arbuckle of Missouri and Southern Kansas

Insoluble residues are used in the Canadian (upper Arbuckle) of Missouri to segregate diagnostic residues and zonal units and to establish, by zonal sequences, the composite order of superposition within formations.

The standard pre-St. Peter geologic column of Missouri, based on residue zones, may be used in Kansas as well as other Mid-Continent states by residue methods.

10. WALLACE LEE, State Geological Survey of Kansas, Lawrence. Thickness Maps as Criteria for Regional Structural Movements

A map, recording the thickness of a sequence of rocks between surfaces that were once flat or relatively flat, records the structural movements that occurred between the development of the limiting surfaces. Such an isopachous map is essentially a structure map of the first surface at the time of the second. The accuracy with which such maps reveal the structural movements that took place during the interval depends on how closely the limiting surfaces approached a plane. They are most accurate where the confining surfaces were depositional. Beveled erosional surfaces are useful where the topographic relief was low with respect to the regional deformation but, in some cases, may reveal the structural movements only over broad areas. The relation of the sequence to underlying and overlying formations is important in evaluating the structural significance of the isopachs. Isopachous maps that include formations whose thickness was affected by conflicting patterns of folding express a composite of both movements and reveal neither.

11. GRAYDON L. MEHOLIN, Sinclair Oil and Gas Company, Amarillo, Texas. Report on the New West-East Cross Section Prepared by the Panhandle Geological Society

This paper consists of a discussion of the stratigraphy of the Texas Panhandle district as revealed by a west-east cross section prepared by the Stratigraphic Committee of the Panhandle Geological Society. The cross section includes seventeen wells and extends from Union County, New Mexico, to Ellis County, Oklahoma, crossing their previously constructed north-south cross section at the Sinclair No. 1 Lips in Roberts County, Texas.

12. FRANK A. MELTON, Consulting Geologist, Norman, Oklahoma. The Use of Aerial Photographs for Geological Exploration and Detailed Mapping in Regions of Low Dip

"Linears" (linear arrangements of drainage lines) many miles in length are common in the plains and low-strata-bench-lands, and are frequently aligned with deep-seated faults, flexures, and synclines. They may be useful in locating buried anticlines of regional size that are not otherwise visible. They may assist the geomorphologist and aero-geologist in the proper interpretation of geomorphic features, such as hogbacks, cuestas, consequent streams, angular or trellis drainage, etc., by means of the stereoscopic study of aerial photos. They themselves, however, are hardly to be classed with such features. They, no doubt, represent the effects of erosion and repeated slight movements along pre-Cambrian faults, and are more regional in scope than ordinary geomorphic features.

Aerial photographs may be studied stereoscopically for a number of reasons which may or may not include associated field work. They have justified their use for many purposes. Their most rewarding use in the flat-lands is for discovery of hitherto unknown structures. Though it is difficult, if not impossible, in the continental United States to find large structures not hitherto known to someone, many structures of smaller size have been discovered by use of aerial photos.

Prismatic and magnifying spectacles are preferred for geological study in the plains regions, the prismatic correction varying from 2 to 5 diopters, base out. The smaller prism is useful for strike and dip determinations and makes it possible to recognize dips as low as one-third of one degree. The larger prism is better for tracing resistant beds. The magnification found most useful by the writer is ½ of one diameter.

In plains regions the problem of securing aerial photographs that are good enough for use by geologists is one that requires special knowledge and experience. The 7-inch by 9-inch vertical photos with which most of the United States was photographed 10–15 years ago by the U. S. Department of Agriculture are better for geological purposes than the 9-inch by 9-inch photos now being made. The lens focal-length of 8¼ inches is barely long enough; a 10- or 12-inch focal-length would be much better for dip determinations. Photos made with a 4-inch focal-length are practically worthless. The flight photo-scale of 3.1 inches per mile, being used by the Department of Agriculture, is much to be preferred to scales of less than 2 inches per mile, which are usually employed by the U. S. Geological Survey and some private aerial photographers. The Geological Survey, being, no doubt, aware of the needs of geologists, will presumably one day take the lead in the choice of suitable flight-scale, focal-length, and size of aerial photographs. Aerial photographers who try to sell geologists vertical photos where a square mile is approximately the size of a 3-cent postage stamp are, in effect, presuming that drainage is much more significant than it really is in the discovery of geological structure anomalies. Photo-enlargements made from these small-scale negatives are seldom very useful either, because of the lack of sufficiently sharp definition in the outcropping beds.

13. D. F. MOORE, Stanolind Oil and Gas Company, Oklahoma City. Occurrence of the Permian Salt—Western Kansas

As generally known, large Permian salt deposits occur in parts of western Kansas. The distribution and thickness of these deposits are of primary importance to the exploration geologist and seismologist as well as the petroleum engineer. Specifically, major salt bodies at shallow depths lend themselves well to the storage of L.P.G. petroleum products, providing there exist effective seals above and below the salt. The Wellington, Cimarron-Stone Corral, and Blaine salt sections may all be used for storage purposes; however, their geographic localities differ somewhat. Salt, varying in thickness and purity, is present in each of the latter groups. Subsequently, this paper will discuss and outline the general thickness and distribution of the Permian salt in each group.

14. G. H. LANCASTER, Stanolind Oil and Gas Co., Ellinwood, Kansas. Formation of Salt Cavities for Storage of LP-Gas Products

Underground storage of LP-Gas in salt cavities has developed rapidly during the past 2 or 3