tive petrography and thence, via a model, to petrogenesis; (2) the data analysis leads to specification of the relationships between reservoir behavior and variation in the petrographic properties; (3) the analysis, suitably extended, leads to a measure of relationship between logging responses and variation in the petrographic properties; and (4) the analysis may be used to identify reservoir rocks and differentiate them from similar appearing barren rocks. Such objectives encompass an interpretative petrology, a means for predicting and controlling reservoir behavior, a means for selecting the important logging parameters and a possible interpretation of their role in reflecting variation in rock properties and, by identifying the reservoir rock, may form the basis for an exploration program.

This program has been used for the analysis of eleven sands either actual or potential reservoir rocks from the Appalachian Province; they include representatives of the Devonian (Chipmunk, Bradford, Lewis Run, and First Venango sandstones), Mississippian (Berea, Weir, and Maxton sandstones), Pennsylvanian (two Cow Run sandstones, and a middle Kittaning sandstone), and Permian (the Waynesburg sandstone) systems.

The most important properties in each case are grain size, size-sorting, and the cementitious constituents, carbonate and silica cement. There are two dominant types of sandstone, the one in which grain size and (or) size-sorting act as the main controls and the other in which the size and size-sorting is subordinate in importance to the cementitious materials. When the dominant properties are size and size-sorting, channeling is the most important problem in production and secondary recovery. When the dominant features are the cements, then combinations of acidizing and hydraulic fracturing are likely to be important palliatives.

Those sandstones in which the cements are most important are sporadic in occurrence and, under present conditions, would be difficult to impracticable to locate, whereas, in those sandstones in which grain size and size-sorting are the dominant characteristics, it should be possible to detect gradients which could form exploration guides.

GUTSCHICK, R. C., University of Notre Dame, Notre Dame, Indiana

Comparison of the Devonian-Mississippian Boundary Sequence of Western Montana with the Appalachian Basin

There is remarkable similarity between the Devonian-Mississippian Sappington formation of western Montana and the Ohio shale-Bedford shale-Berea sandstone-Sunbury shale sequence of the Appalachian basin. The comparison is based on composition, color, and ordered succession of lithologic types, sedimentary structures such as channeled sand- and siltstones, ripple marks (oscillation, current, and interference), and cross-stratified sand- and siltstones, flow rolls (ball and pillow structures), paleogeographical and paleoecological interpretations, and fossils. Both areas bear a similar relation to the Cordilleran and Appalachian geosynclines, respectively.

In each case the strata involve a lower dark shale of late Devonian age, intermediate light-colored shales and siltstones or sandstones of Mississippian age, and an upper dark shale. This relationship can be summarized as follows:

	Cordilleran Geosyncline W. Montana			*Appalachian Basin*
Mississippian	Sappington Fm.	Unit I	Black shale	Sunbury Sh.
		H	Siltstone	Berea Ss.
		G F	Shales and Siltstones	Bedford Sh.
Devonian		E	Algae (oncolites)	
		D	Shale (thin)	
		C B A	Black shale Black shale Black shale	Ohio Sh.

One significant difference is in the presence of an algal (oncolite)—sponge biostrome (Unit E) which has wide distribution in the western area that is apparently absent in the Appalachian basin.

GWINN, V. E., and BAIN, D. M., McMaster University, Hamilton, Ontario, Canada

Penecontemporaneous Dolomite in Upper Silurian Cyclothems, South-Central Pennsylvania

Composition of carbonate rock units in carbonate-mudstone cyclothems in the Tonoloway and Wills Creek formations (Swartz, 1955) appears to be positively correlated with types of primary structures, amount of organic material, state of oxidation of iron, relative abundance of fossils, and presence or absence of evaporite mineral pseudomorphs.

Dolomitic carbonates have a preferred association with the following: thin bedding and internal lamination, cut-and-fill structures, mud-cracks, and possible algal-mat lamination; higher proportions of siliciclastic detritus; and a low organic matter content as expressed by light color and usually an absence of fossils. Some dolomite beds have carbonate pseudomorphs after anhydrite and halite.

Limestone elements of the cycles, on the other hand, have these general characteristics: thicker bedding, general absence of thin laminae, and other structural evidence of shallow water or subaerial exposure seen in the dolomites; less siliciclastic detritus; more frequently fossiliferous, with more varied fauna; darker color with higher organic content; and iron generally present in the form of pyrite.

The excellent correlation of four features, primary structures, organic content, oxidation-reduction phenomena, and the amount of non-carbonate detritus, with carbonate composition appears to point to the operation of two causal factors in the repeated depositional-compositional cycle from calcareous to dolomitic carbonate: (1) shoaling of the water; and (2) a concomitant increase of salinity. Following this tentative conclusion, it appears that the dolomite are penecontemporaneous in development. The necessary Mg^{++} may have been derived from the relatively more saline waters present at the end of most of the cycles, with the dolomite forming while the carbonate debris was bathed in the basin waters during or immediately after deposition during earliest diagenesis. No "typical" criteria of secondary dolomitization have been observed.

Additional study will be directed to analysis of boron content of clays in the intercalated mudstones, perhaps to carbon isotope fractionation in the cycles, and to the origin of a bed-thickness cycle superimposed on the compositional cycles (Lacey, 1960), which is not obviously correlated with the compositional cycle.