chroism especially pronounced in the short-wave portion of the visible spectrum. Brown biotite-phlogopite from Old Chelsea, P.Q. is optically similar. The effect is caused by a broad transmission maximum for light vibrating parallel with the mica sheet and a narrow transmission maximum for light vibrating across the sheet. Green phlogopite from Old Chelsea shows less marked reverse pleochroism. With thick sheets transmission maximum Y is at 6200 Å and Z at 5800 Å. No absorption maxima were noted in these varieties. Chemical data suggest the reverse pleochroism may be associated with ferric iron in tetrahedral sites.

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Succession of Tornoceras and Related Genera in the Devonian of New York and Adjacent States

A study of the species of *Tornoceras*, *Parodiceras*, and a *Tornoceras* and *Epitornoceras* from the western U.S.A. provides an independent stratigraphical zonation for the New York State Devonian. It also provides a study of allomorphosis in *Tornoceras*. Comments are made on the protoconch and the significance of the metamorphosis marked by the nepionic constriction in *Tornoceras*.

Where possible in twenty successive faunas, ontogenetic details have been elucidated, and this has been possible from protoconch upward at eleven successive stratigraphic levels. These successional ontogenies shed light on the evolution of the stock. Faunas at each level may be defined morphologically, but few consistently maintained evolutionary trends have been observed. Shell form seems particularly subject to independent, and probably phenotypic, variation. Through the equivalents of the Middle Devonian to the Lower Frasnian, protoconch width appears to increase progressively. Similarly, the suture becomes more undulating, particularly with regard to the ventrad face of the lateral lobe. Later species show reversion to early characters in these respects.

The origin of *Tornoceras* from *Parodiceras* is argued, and it is considered that *Tornoceras* gave rise to all later members of the Tornoceratidae.

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Montoya Group (Ordovician) Carbonate Petrology of Texas and New Mexico

The Montoya Group (Middle and Upper Ordovician) of west Texas and New Mexico consists of several carbonate types including crinoidal calcarenite with a microcrystalline matrix, crinoidal calcarenite with sparry calcite cement, calcilutite with abundant chert, chert-free calcilutite, shell limestones, calcirudites, and completely or partly dolomitized equivalents of the former.

Dolomitization and silicification are volumetrically important. Recrystallization and (or) replacement obscure much of the original texture and fossils. Dolomitization begins with the formation of sporadic small crystals, which increase in number until a complete dolomitic mosaic results. Coarse fossil debris becomes progressively reduced in texture as the process advances to completion. Texture and degree of silicification are not related in many places. Fluctuating silica supply in the sea water is strongly indicated. Intervals of abundant chert are separated by less cherty strata.

Study of the unaltered rocks show considerable range in environment from high-energy, shallow-water to low-energy, deep-water conditions. Montoya sedimentation can be compared with correlative strata deposited during the Middle and Upper Ordovician submergence of the North American continent. Montoya deposition in the Cincinnatian is estimated to be 320 feet in 10 million years—very slow when compared with 4,500 feet in 10 million years for the Cayugan autogeosyncline of Michigan (Kay, 1951).

Present lithologic and stratigraphic data support rejection of a disconformity within the Montoya Group, although several minor erosional breaks occur.

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Penecontemporary Dolomite in the Persian Gulf

Carbonate sediments dominate the shallow waters along the arid southwest side of the Persian Gulf. In the more protected parts of the west coast of the Qatar Peninsula, the processes of near-shore sedimentation have created lagoons and embayments with high chlorinity (30–35 g/l) and reduced tidal range; they are separated from the normal Gulf waters (22–24 g/l) with their average 4-foot tides, by many miles of sea less than 2 fathoms deep.

The lowest parts of the lagoonal shores are fringed by salt flats—"sebkhas"—varying in width from a few tens of yards to several miles. The sebkhas pass seaward into the intertidal zone, commonly via an intermediate algal flat. This is just covered by normal high tides, but only with favourable winds can very occasional spring tides reach far onto the sebkha surface which is a few inches higher.

Sedimentation is gradually filling the lagoons by the seaward advance of the environmental belts, so that sebkha sediment overlies stromatolitic algal laminae, and these are underlain by intertidal mud-pellet sands resting on lagoon muds.

The chlorinity of the pore waters increases landward and upward in response to surface evaporation losses. It increases rapidly within the algal flat (50–130 g/l), where small selenite crystals form beneath the higher, landward parts. Together with the continuing precipitation of aragonite, this causes an increase in the Mg/Ca ratio of the pore waters from the normal marine value of 3 in the lagoon to more than 10 at the sebkha edge. Within the sebkha, the ratio falls gradually to below 5, while the chlorinity continues to rise slowly to more than 150 g/l. The water table is close to the sebkha surface, and, beneath the uppermost layer subject to large daily temperature changes, the wet sediment reaches well over 40°C. in summer time. Its pH is low (around 6.7) and decreases downward.

These warm magnesium-rich brines cause diagenetic changes in the aragonite sebkha sediment. Dolomite appears. It occurs as a stiff, sticky, tan or tan-gray mud composed of rhombs 1–5 microns in size. Associated with it are turbid flattened crystals of gypsum up to 5 inches across, enclosing, displacing and sometimes replacing aragonite sediment. Depositional textures tend to become obscured, but both macro- and microscopic evidence of relic structures and the changing chemistry of the pore waters make it clear that both the dolomite and the associated coarse platy gypsum are replacing aragonite. They increase in abundance away from the lagoon until they make up the bulk of the sebkha sediment. The dolomite normally appears a few inches beneath the surface, increases rapidly, and almost disappears again in a more irregular fashion within a depth of 2–4 feet.

Carbon-14 determination on two dolomite samples collected within 9–18 inches of a sebkha surface gave