understanding of fossil reefs, ideas on genesis of the Cincinnati arch, and demonstration of the great stratigraphic-paleontologic principles. We have learned only recently, however, that the formations, thickening northward and all exposed, are, in ascending order, the Bradsfield limestone, Osgood- Laurel section (so-called), Waldron shale, Louisville limestone, Mississinewa shale, Liston Creek limestone, unnamed rocks, and equivalents of lower Salina rocks of Michigan. Rocks below the Waldron (Llandovery in age) are coextensive with most of the undifferentiated Niagaran and lower rocks in southernmost Michigan and with the Cedarville dolomite and lower rocks in western Ohio. Waldron and higher Niagaran rocks (Wenlock and Ludlow) mostly terminate northward in a reef bank crossing the northern quarter of Indiana. The type Huntington dolomite is a reefs facies of Mississinewa and higher Niagaran rocks, although “Huntington” has been applied throughout the Niagaran. The Salina equivalents partly abut against the bank and partly overlie and extend in two tongues south of the bank, partly complement in thickness the reef-bearing formations, and lie from north to south on a shelf up to upper Niagaran rocks.

We postulate southward Silurian expansion of the Michigan basin prototype and consider that lower and middle Silurian sediments were deposited in the subsiding basin in southernmost Michigan and northernmost Indiana and on a relatively stable shallow-water shelf at the south. During late Niagaran and then early Cayugan time, the basin margin became better defined by southward shelf-edge sharpening that resulted from continued relatively greater subsidence northward and extensive fringing bank growth. Bank growth resulted in near-restriction of sea-to-basin circulation to two inlets corresponding to present structural sags in Cass and Jasper Counties. Post-Silurian events helping to define the present basin and the flanking Cincinnati arch include interruption and renewal of basin subsidence; probable inlet and deposition of lower-middle Devonian evaporite-bearing sediments, whose southern boundary marks approximately the southern margin of the Michigan basin; and differential subsidence of the Illinois basin, which imparted the southwesterly dip to most of the basin in southernmost Michigan and northernmost Illinois. Post-Silurian events helping to define the present basin and the flanking Cincinnati arch include interruption and renewal of basin subsidence; probable inlet and deposition of lower-middle Devonian evaporite-bearing sediments, whose southern boundary marks approximately the southern margin of the Michigan basin; and differential subsidence of the Illinois basin, which imparted the southwesterly dip to most of the basin in southernmost Michigan and northernmost Illinois.

We conclude, not entirely facetiously, with the question: Is part of the Cayugan in Michigan and Indiana Niagaran in age, or is part of the Niagaran Cayugan?

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EVOlUTION OF CHAZYAN (ORDOVICIAN) REEFS OF EASTERN UNITED STATES AND CANADA

Chazyan (lower middle Ordovician) reefs from the Virginia, Vermont and New York, and Quebec show changes in organic composition through time. In the evolution of reef communities, these Chazyan reefs represent assemblages or organisms which are transitional in taxonomic composition and ecological setting between pre-Chazyan and Silurian reefs.

Early Chazyan trepostome (Baliosoma) and cyclostome (Chelioporella) byrozoans built linearly aligned reefs up to 10 feet high in shallow, agitated waters. The reef matrix of carbonate mud and skeletal debris differs markedly from the cross-bedded, mud-free skeletal carbonates adjacent to the reefs.

Middle Chazyan reefs show an evolution of reef assemblages from a laminar stromatoporoid (Cystostroma)—algal (Anthracoporella) composition to an assemblage with a higher percentage of tabulate corals (Biliungaria), sponges (Zittelidea), and a different stromatoporoid (Pseudostylodictyon). At the top of the Middle Chazyan, three separate assemblages (stromatoporoid-algal nautiloid, trepostome and cyclostome byrozoans, and stromatoporoid-sponge-coral) are all in close lateral contact with each other and appear to have been contemporaneous. In the Upper Chazyan, the trepostome byrozoans replace the stromatoporoids of the early assemblages and combine with the alga (Anthracoporella) to form a different assemblage. This succession of assemblages takes place with no apparent change in habitat.

The Lower Chazyan byrozoan reefs contain more detrital quartz, as well as pronounced cross-bedding in adjacent sediments than the younger Chazyan reefs, indicating that the byrozoans existed in more agitated conditions closer to land than the later assemblages. However, close proximity of oolitic and oncolitic carbonates, dislodged and tumbled corals and stromatoporoids, erosional channels and margins cut into the reefs, and the presence of blue, green, and red algae suggest that the Middle and Upper Chazyan reefs also developed in shallow water.

A spectrum of textures in the non-reef sediments, mudstones through well washed grainstones, represents most stages from restricted to open circulation, high energy conditions in their environments of deposition.

The sequence of diagenetic events that affected the limestones is: formation of rim cement in grainstones before and concomitant with pore-filling drusy cementation, dolomitization, lithification of carbonate mud, and finally grain growth in the aragonite skeletons and carbonate mud.

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AGE AND STRATIGRAPHIC SIGNIFICANCE FOR LYELLIAN CORRELATION OF THE VIGO FORMATION AND FAUNA, LUZON, PHILIPPINES

The late R. E. Dickerson, in 1921, put forward the theory that tropical Tertiary molluscan faunas evolve much more slowly than those from temperate regions; hence, that the percentage of Recent species in later Tertiary tropical faunas is considerably higher than in contemporaneous faunas from temperate regions. This theory, derived from analysis of a tropical fauna of inferred Miocene age from the Philippine Islands, has been frequently cited but has never been critically evaluated.

Studies of Philippine and Indonesian later Tertiary molluscan and foraminiferal faunas collected since Dickerson's time, and accurately placed stratigraphically, indicate that the Philippine molluscan faunas Dickerson believed to be of Miocene age are more probably later Pliocene in age, with a percentage of extinct species differing not very greatly from the percentages established by Lyell and Deshayes for contemporary faunas in Europe. The theory that tropical molluscan faunas evolve at a markedly different rate than those of temperate regions is therefore without basis and is probably erroneous.

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DIAGENESIS OF RECENT MARINE CARBONATE SEDIMENTS

The diagenesis of carbonate sediments can be ascribed conveniently and naturally to pene-depositional and post-depositional processes. Pene-depositional effects...
and is known as the Deville member of the Mannville

perspective of rock type in "residual beds," shales, siltstones,

Jurassic Ellis group. Where the Cretaceous overlies the
groups and are known locally as the Basal quartz,

sandstones, and (or) conglomerates.

main authigenic mineral fades developed largely irres­

pectively; all are generally considered Cretaceous in age and

Ellerslie, Sunburst, Cutbank and Dina sands, respec­
tively; all are generally considered Cretaceous in age and

the area occur at the base of the Blairmore or Mannville
group and are known locally as the Basal quartz,

sandstones, and (or) conglomerates.

The three diagnostic authigenic minerals are hema-
tite, siderite, and pyrite; other significant authigenic
minerals present are magnetite, iron-rich dolomite, cal-
cite, kaolinite, silica chlorite, and glauconite.

The presence of these authigenic minerals, together
with various physical features of the sedimentary rocks,
assists in elucidating the intricate paleographic pattern of
estuaries, rivers, lakes, and land surfaces.

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INTRUSIVE CARBONATE IN THE ICE RIVER COMPLEX,
BRITISH COLUMBIA

The Ice River valley is situated in Yoho National
Park in the westerly ranges of the southern Rocky
Mountains, British Columbia. The region is the site of a
nepheline syenite-ijolite-jacupirangite complex which is
intruded into Cambro-Ordovician sediments and is
dated (potassium-argon method with biotite) as De­
vanian in age.

Associated with the ijolite-jacupirangite differenti­
ates is a mass of brown-weathering carbonate (domi­
nantly iron carbonate with calcite and iron oxide) at
least 2 miles long and 900 feet across. This mass was
originally described as a "stopped block or roof pendant" 
but recent field observation indicates that the carbonate
is intrusive. Two traverses are described.

The carbonate is succeeded by an intensely fractured
and brecciated ferruginous zone, which merges into
carbonatized aegeirine-feldspar gneisses which in turn
merge into and alternate with ijolite or the aegeirine­
feldspar pegmatite dykes that cut the ijolite. Augen of
unaltered to partly altered pegmatite occur commonly
in the gneiss. Pods and lenses of carbonate (similar in
composition to that of the main mass and as much as
500 feet from it) are associated with the gneiss.

A 10-foot zenolith of aegeirine-feldspar pegmatite
occurs in the main mass of carbonate. Toward the periph­
erly of the zenolith the pegmatite merges into gneiss,
then gneiss with carbonate and finally carbonate.

The carbonate mass may be termed carbonateit.

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SILURIAN CONODONTS FROM CENTRAL KENTUCKY AND
THEIR RELATION TO EUROPEAN ZONES*

The Brassfield limestone and the overlying Crab
Orchard formation of Madison and Estill Counties,
central Kentucky, represent a nearly continuous se­
quence of strata of Llandover and early Wenlock age.

The conodont sequence very closely parallels that of
Europe, and zones I and II (Llandovery in age) and
zone III. Zone III conodonts have been considered to be
early Wenlock in age, but exact correspondence with the
graptolite zones is uncertain.

Northward in Ohio and west of the Cincinnati arch in
Indiana and Kentucky, the Brassfield also contains a
zone I fauna. As the Crab Orchard formation is traced

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