The Geology of Sculpting Stone

Indiana Limestone

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Outline

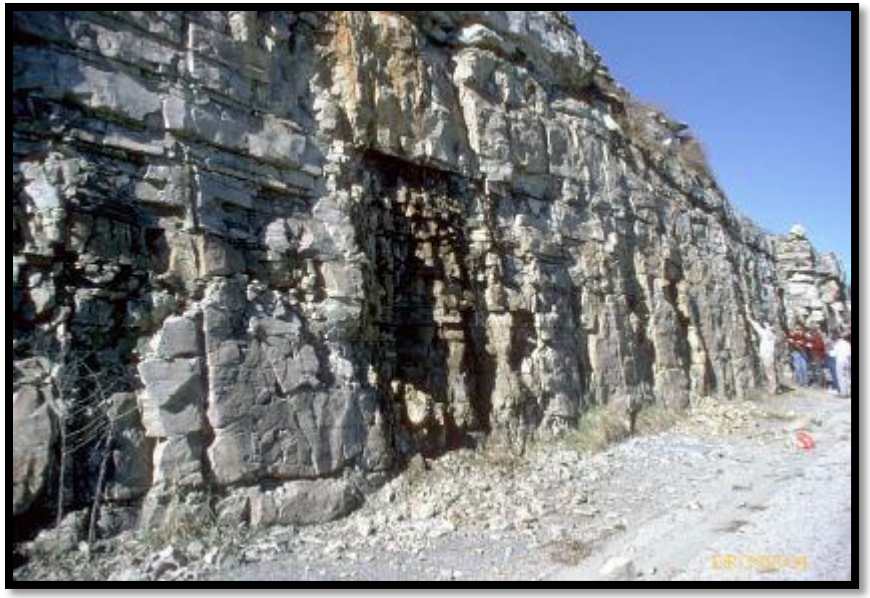
- The Stone Defined
  - General Description, Physical/Chemical Properties and Historic Use
  - Specimens (macro and thin section)
  - Specific Occurrences
- Geology
  - Age and Geologic Description
  - Formation Environment and Processes
  - Global Paleogeographic Setting
  - Modern Analogs
- Select Creations
  - Art
  - Architecture

General Description, Physical/Chemical Properties and Historic Use

- Indiana Limestone is the common name given to the Salem formation limestone, which is fine grained, buff and gray in color and crops out in southwest Indiana
- Where quarried, the Salem Formation varies from 8 to 18 meters in thickness, and is unusually massive (i.e., lacks major bedding planes and/or stylolites (pressure dissolution surfaces))
- Chemically pure, relatively soft and easily worked when quarried, but once the quarried and dries, becomes case-hardened: harder and more resistant to weathering
- No preferential direction of cleavage, therefore can be easily shaped by machine and hand
- Quarrying of Indiana Limestone began in 1827 with the opening of the Richard Gilbert Quarry.
  - Quarried stone was produced for local use only prior to the building of railways in the 1850's.
  - By 1900, Indiana limestone represented 1/3 of the total U.S. dimension limestone industry, and increased to 80% by 1920.
  - Currently 9 active quarries that produce 76,000 cubic meters of Indiana Limestone each year

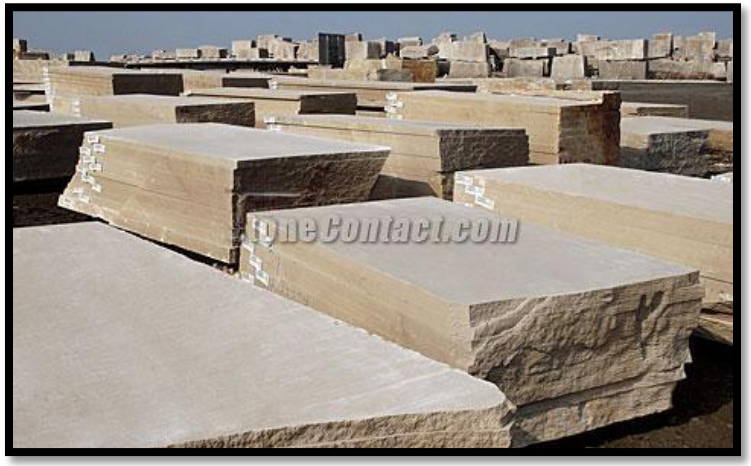
Chemical Composition of Indiana Limestone	
$CaCO_3$	97.3%
$MgCO_3$	0.4%
Al_2O_3	0.5%
SiO_2	1.7%

Specimens: Macro



Outcrop

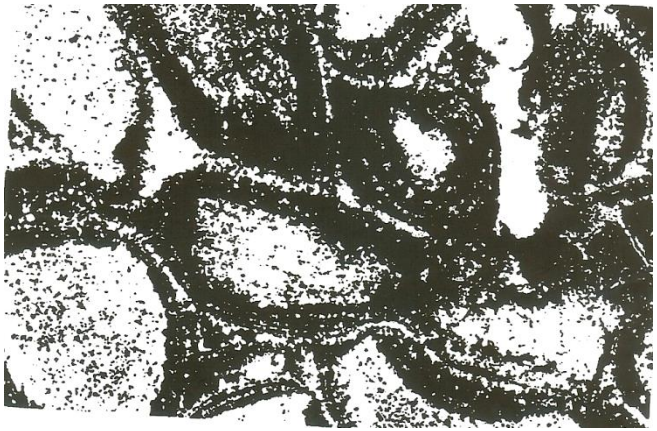
Hand
Specimen



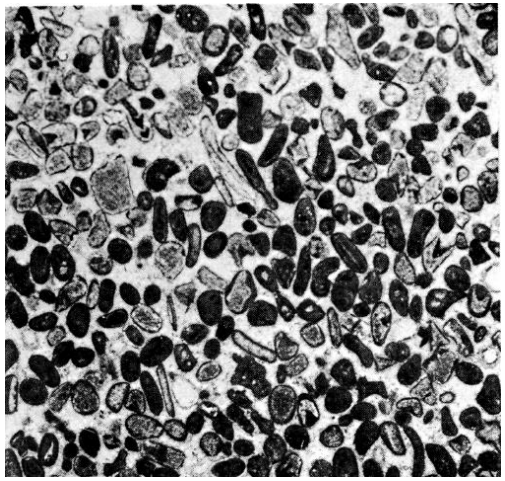
Prepped Blocks and Slabs

Rough Blocks

Specimens: Thin Sections
(About 20X Magnification)



Ooids showing the beginning of pressure dissolution and micrite formation



Well-sorted, circular shell/test fragments

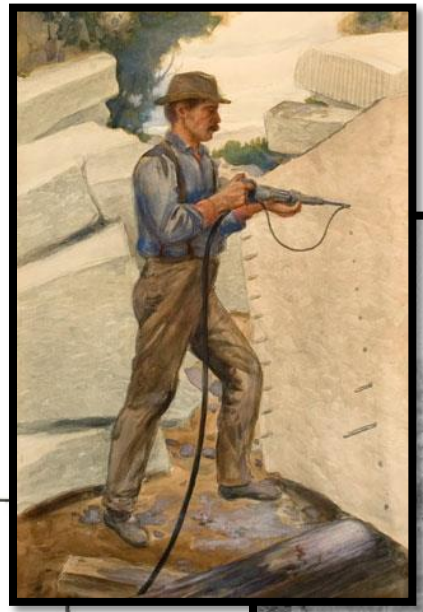
High energy shoal facies
Fenestrate bryozoan fronds and echinoderm columnals

Shoal facies
Bryozoan and echinoderm fragments

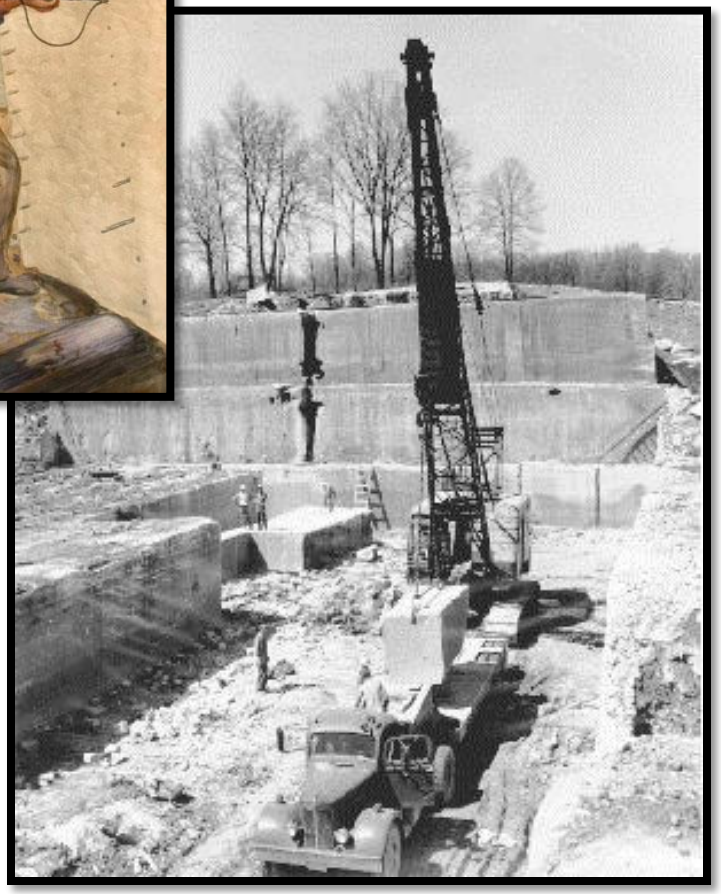
Intershoal facies
Globoendothyrid Foraminifera (transported in)

Specific Occurrences

Salem formation (Indiana Limestone) outcrop



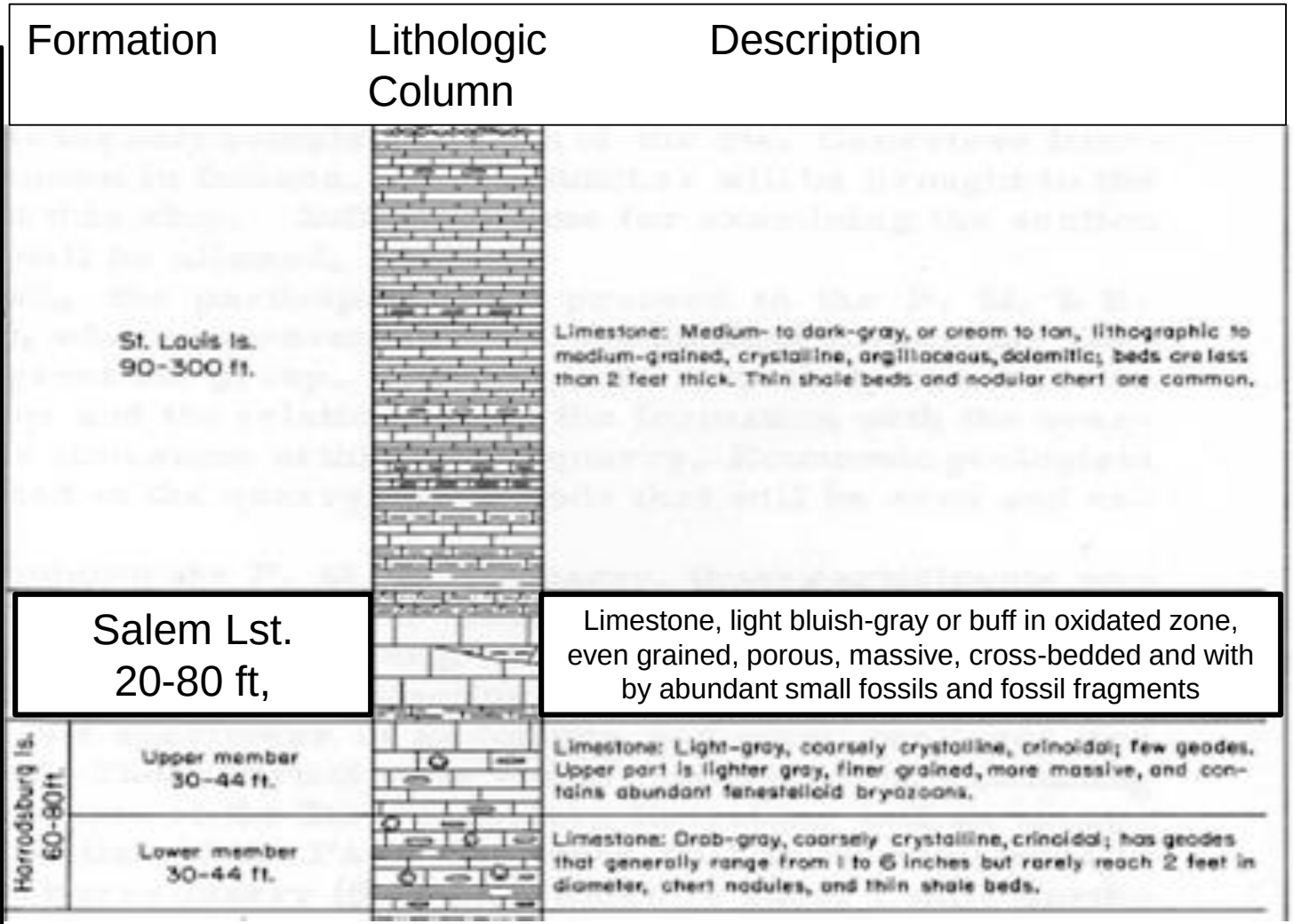
Mid 20th Century Quarrying



Active Modern Quarries

Age and Geologic Description

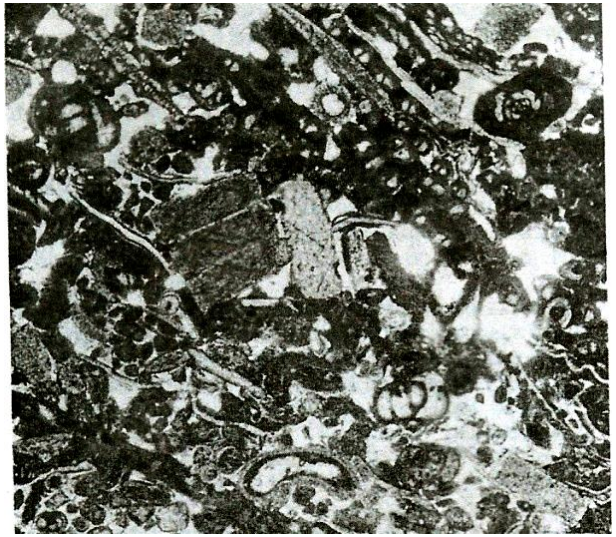
Mississippian/Valmeyeran (~160MYA)




QUATERNARY
ST. LOUIS
SALEM
Building stone
HARRODSBURG

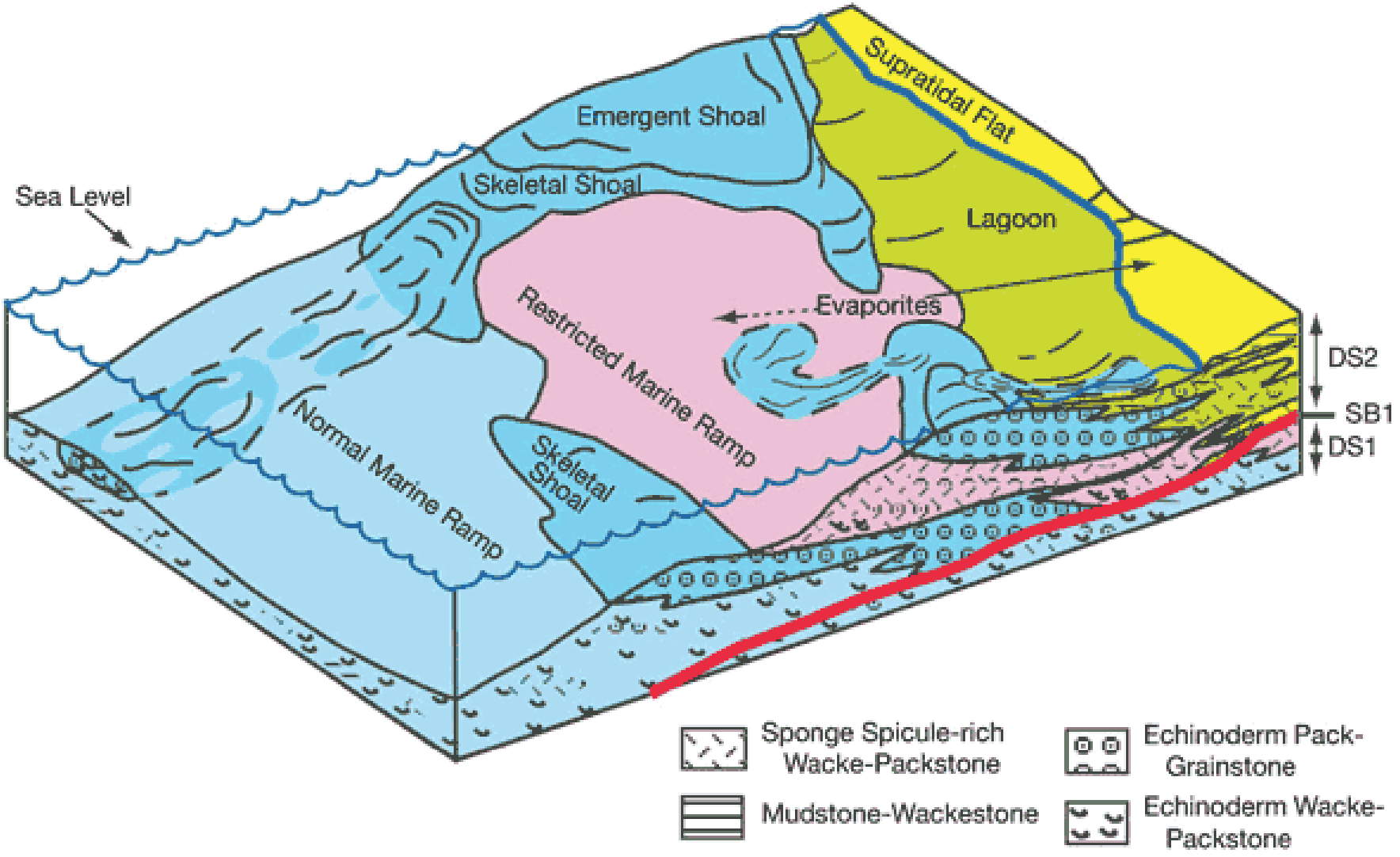
Age and Geologic Description

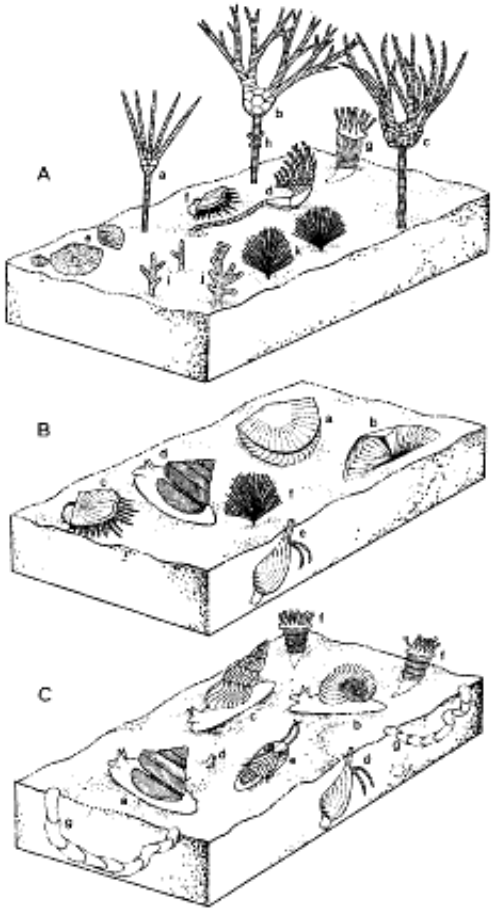
- Crossbedded calcarenite: medium to coarse grained, tan, gray tan, and light gray, porous, and fairly well sorted
- Occurs in exceptionally thick beds is the most widely known rock type of the Salem Limestone and is the internationally known budding-stone facies
- Individual grains are mostly microfossils (including especially the foraminiferid *Globoendothyra baileyi),* macrofossil fragments, and whole diminutive forms of macrofossils; coated grains are also common
- Other lithologies, besides the shale of the Somerset, include much finer and coarser calcarenites, biocalcirudites: very fine grained argillaceous dolomite commonly containing wavy black carbonaceous laminae
- Very fine grained to dense limestone in places including oolites, and dense argillaceous dark-gray to dark-brown limestone (Pinsak, 1957).



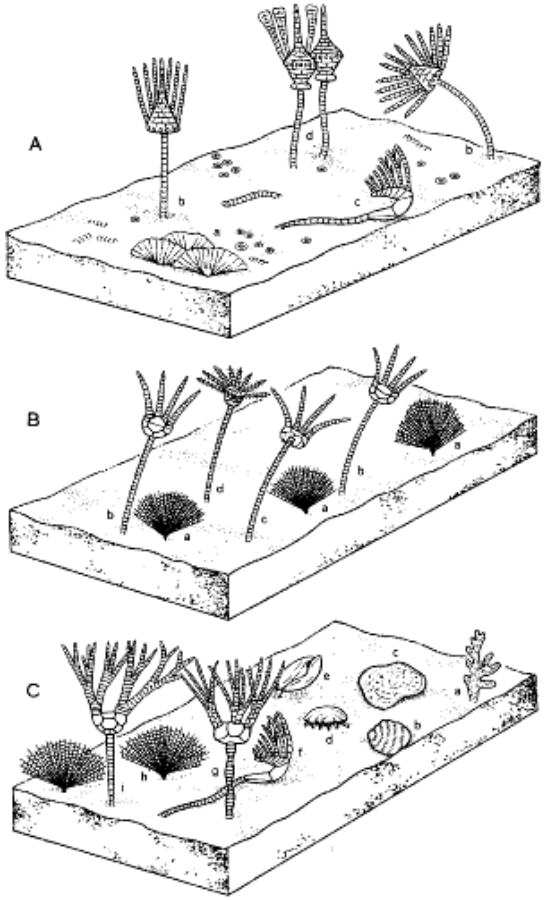
Endothyra baileyi Foraminifera fragments in Indiana Limestone

Formation Environment and Processes

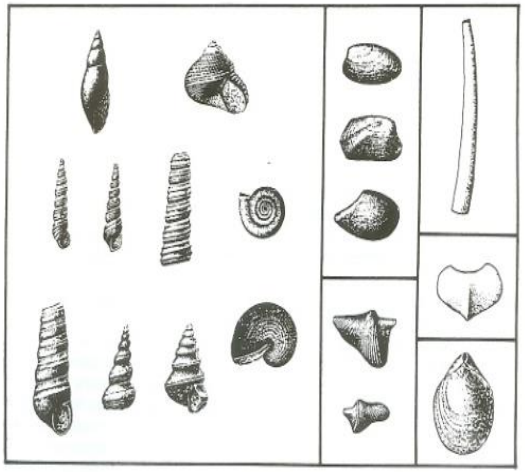


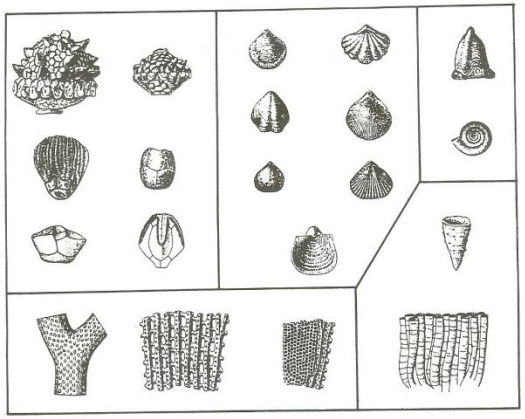


TEXT-FIG. 7—Diagrammatic representation of prodelta and delta slope communities. *A*. Prodelta, base of slope community, a. *Synbathocrinus*, b. *Barycrinus*, c. *Platycrinites*, d. *Halysiocrinus*, e. *Rhipidomella*, f. productoid brachiopod, g. *Cyathaxonia*, h. *Cladoconus*, i. *Rhombopora*, j. *Cystodictya*, k. *Fenestella*. *B*. Delta, basin floor community, a. *Bembexia*, b. *Sinuitina*, c. *Loxonema*, d. *Phestia*, e. *Griffithides*, f. *Amplexus*, g. *Scalarituba*. *C*. Prodelta slope community, a. *Orthotetes*, b. *Syringothyris*, c. *Marginatia*, d. *Bembexia*, e. *Phestia*, f. *Fenestella*.

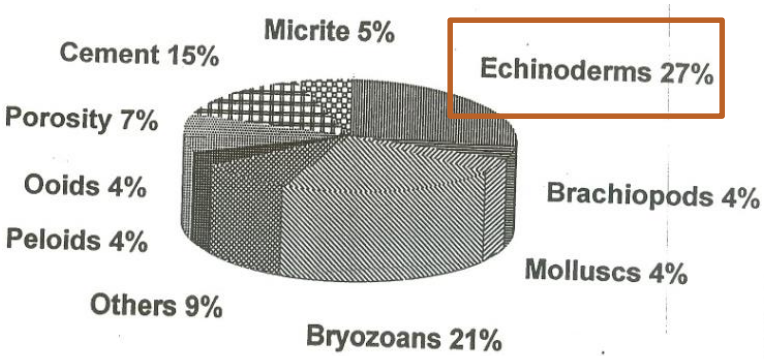


TEXT-FIG. 6—Diagrammatic representation of delta platform communities. *A*. Carbonate bank community, a. *Spirifer, Imbrexia*; b. *Alloprosallocrinus*; c. *Halysiocrinus*; d. *Eretmocrinus*. *B*. Distributary channel community, a. *Fenestella*, b. *Scytalocrinus*, c. *Abrotocrinus*, d. *Cribanocrinus*. *C*. Interdistributary mudstone community, a. *Cystodictya*, b. *Cleiothyridina*, c. *Fistulipora*, d. *Rugosochonetes*, e. *Composita*, f. *Halysiocrinus*, g. *Platycrinites*, h. *Fenestella*, i. *Cyathocrinites, Barycrinus*.

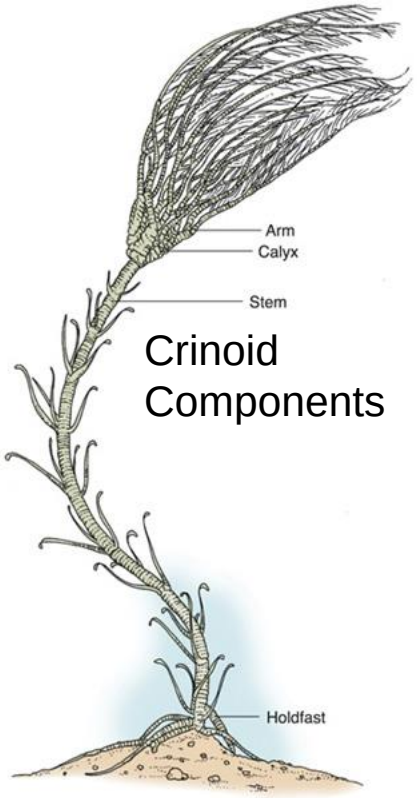




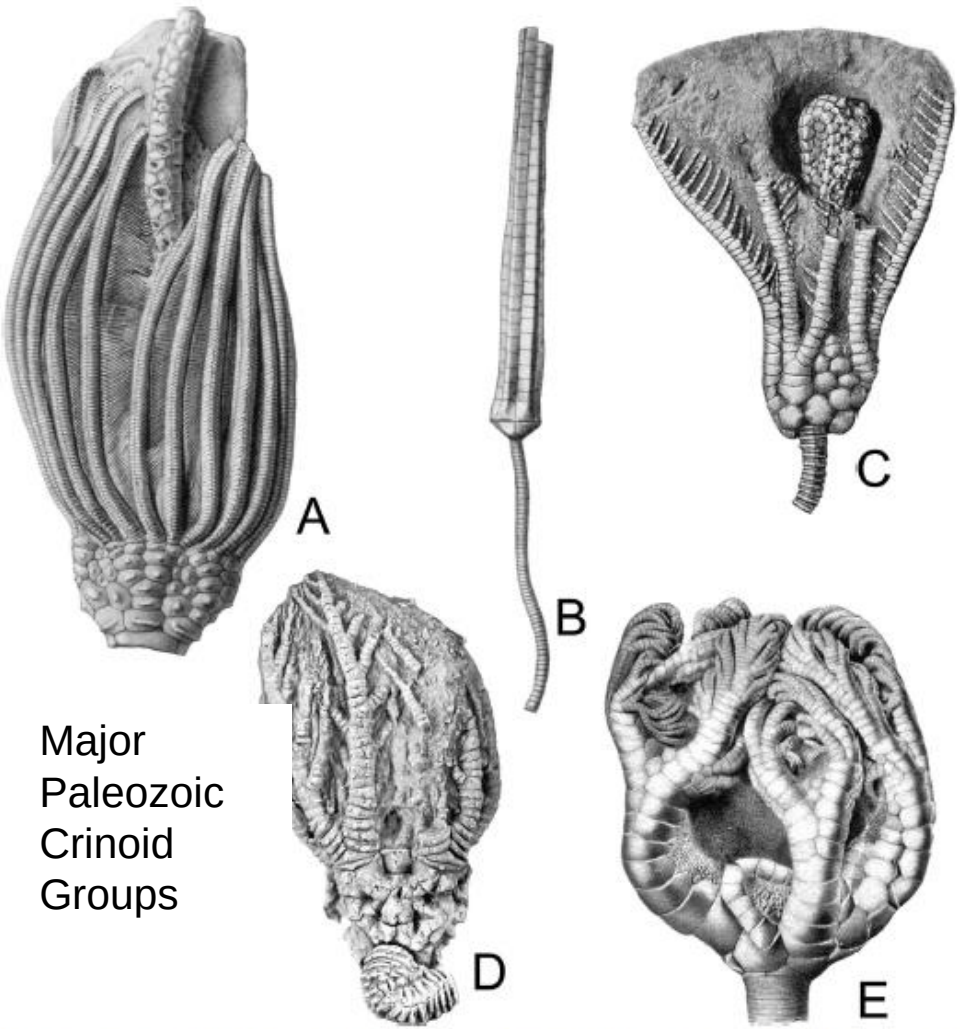
Formation Environment and Processes



Limestone Composition



Crinoid Components

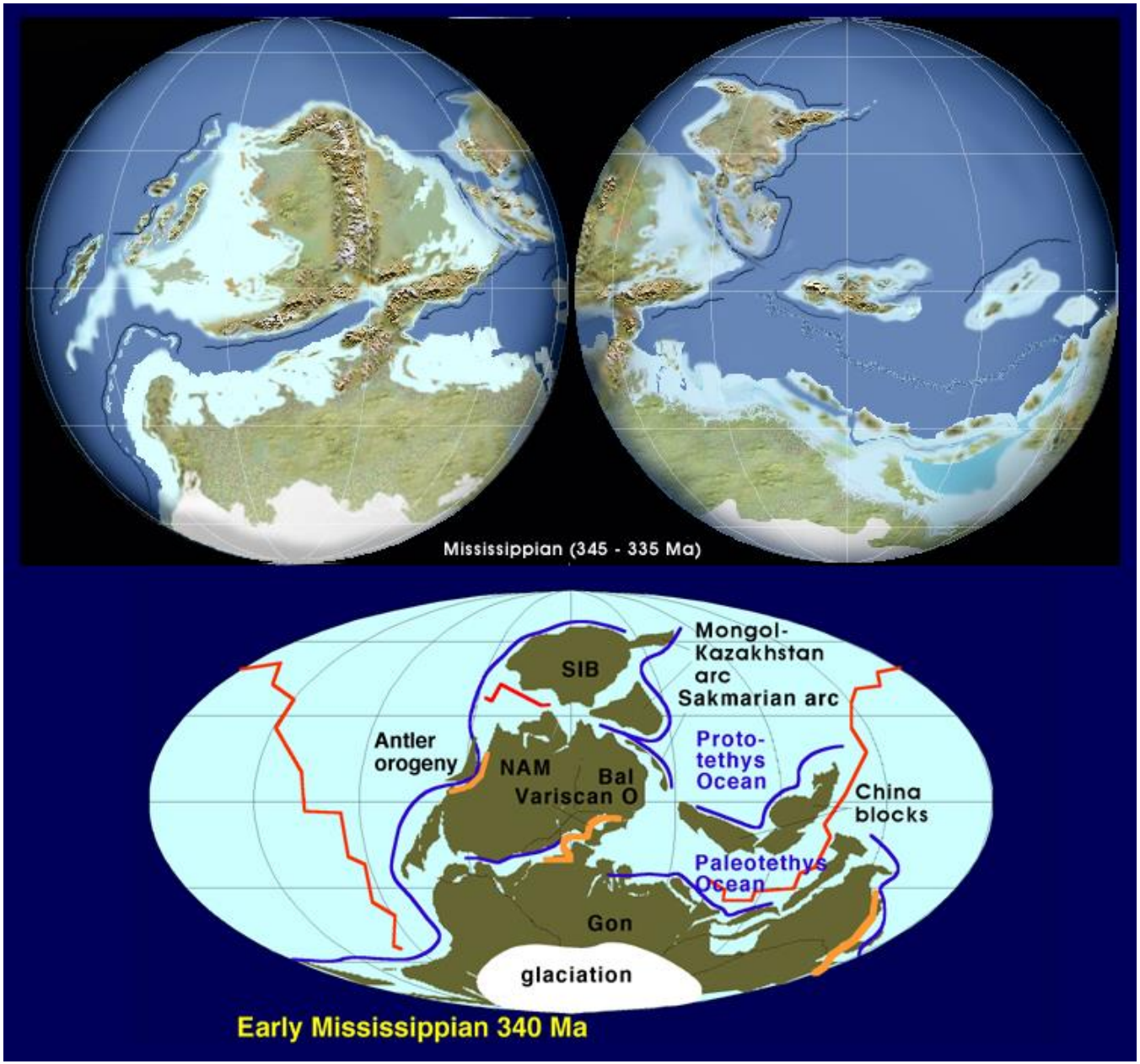


Major Paleozoic Crinoid Groups

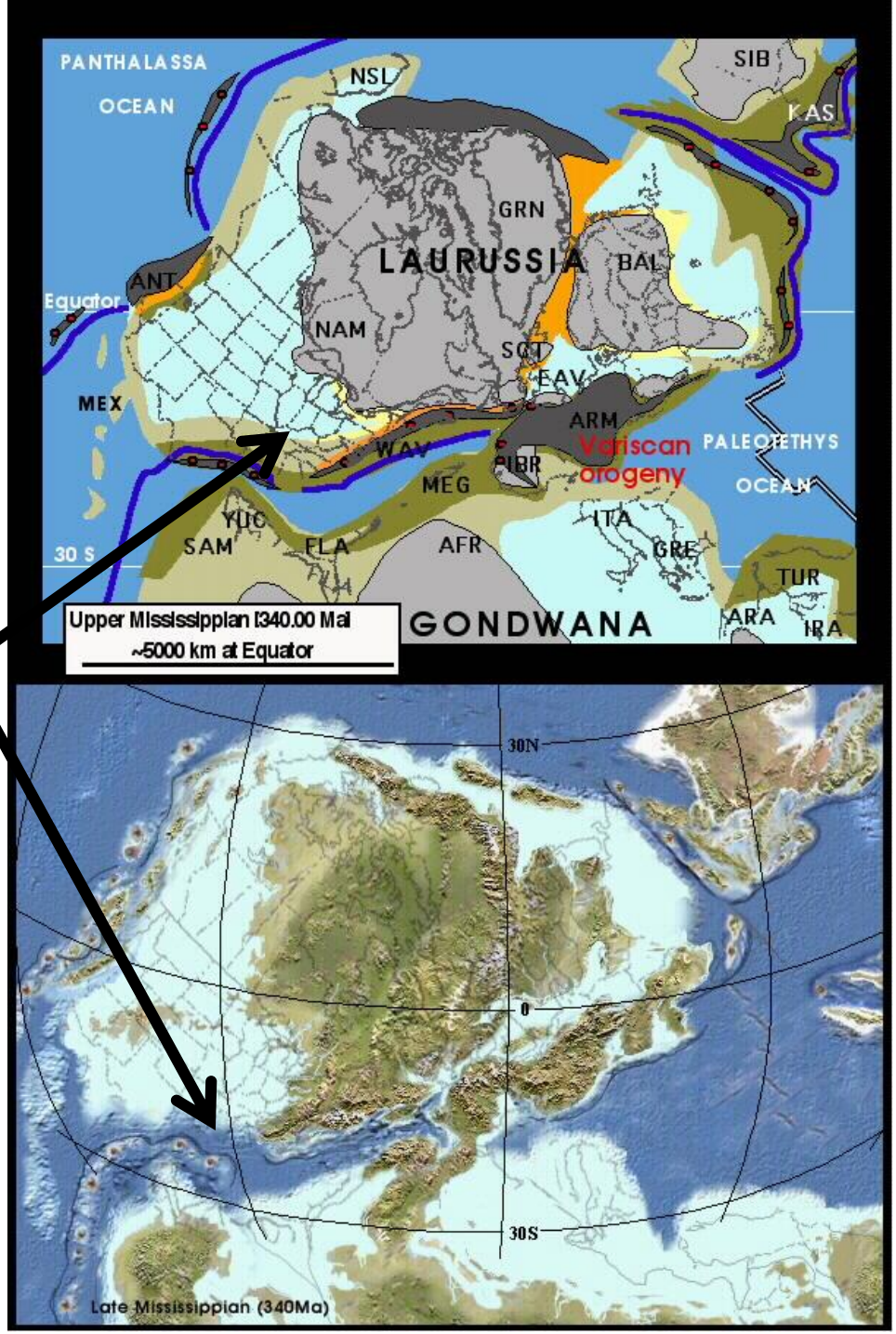
FIGURE 2—Mississippian (Visean) examples of the five major groups of Paleozoic crinoids; all ×1.0, except for D, which is ×0.5. (A) *Abatocrinus grandis* (Lyon), a camerate from the Edwardsville Formation, Crawfordsville, Indiana (Wachsmuth and Springer, 1897, pl. 27, fig. 1a); note dense, fine pinnules. (B) *Synbathocrinus swallovi* Hall, a disparid from the Harrodsburg Limestone, Canton, Indiana (Wachsmuth and Springer, 1897, pl. 8, fig. 7). (C) *Decadocrinus tumidulus* (Miller and Gurley), an advanced cladid from the Edwardsville Formation, Indian Creek, Indiana (Springer, 1926, pl. 17, fig. 6); note large, coarse pinnules. (D) *Barycrinus spectabilis* Meek and Worthen, St. Louis Limestone, Otter Creek, Illinois (Gahn and Kammer, 2002, fig. 1.15); note the ramulate arms. (E) *Onychocrinus ulrichi* Miller and Gurley, a flexible from the Edwardsville Formation, Indian Creek, Indiana (Springer, 1920, pl. 66, fig. 2); note ramulate arms.

Reconstruction of a Mississippian Marine Environment

Global Paleographic Setting

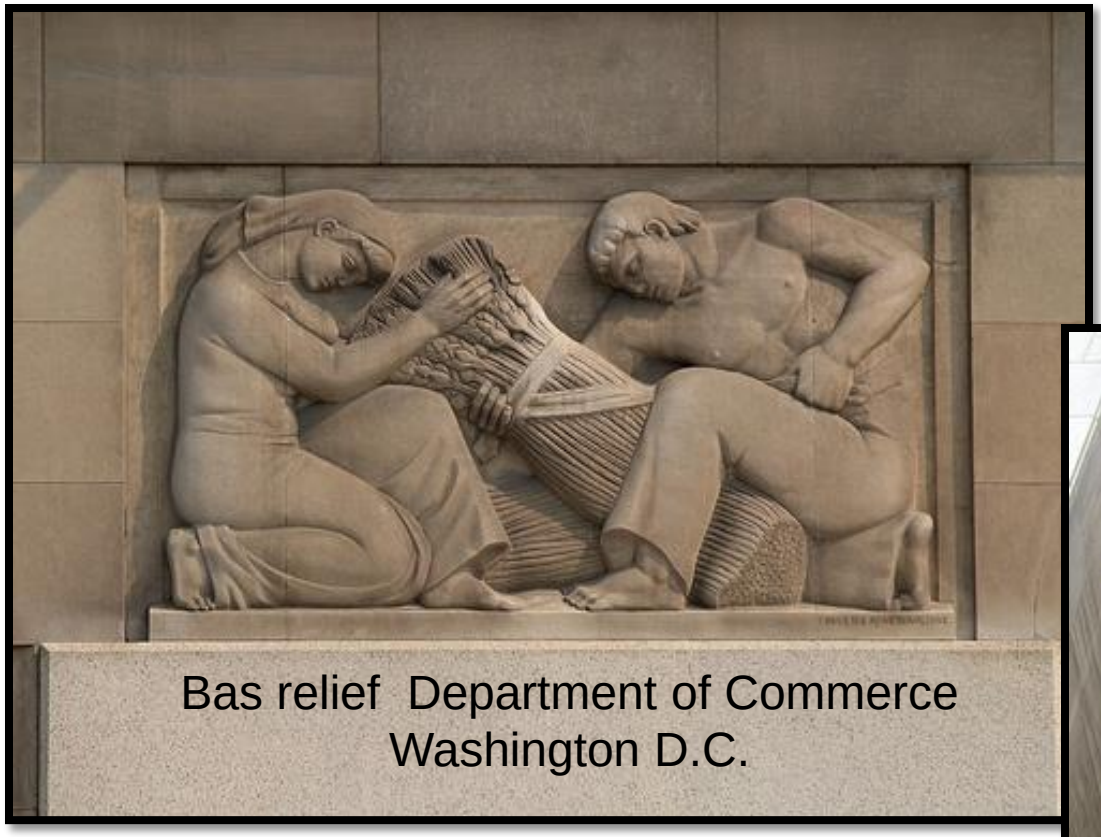


Indiana Limestone Paleographic Location



Modern Analogs

Art



Bas relief Department of Commerce
Washington D.C.

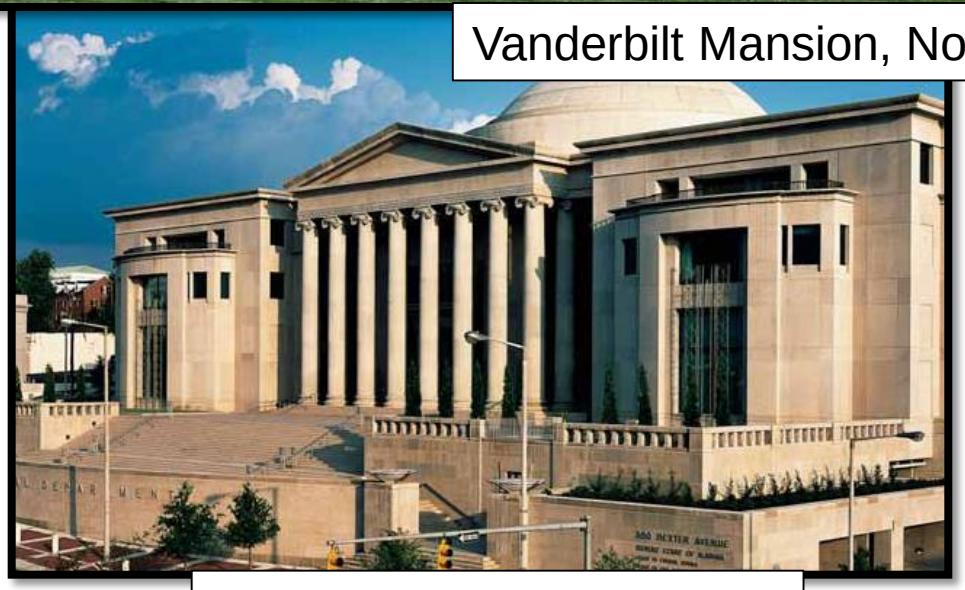
Art Deco bas relief
Rockefeller Center, New
York

Grand Central Terminal New York

“Small” Totem

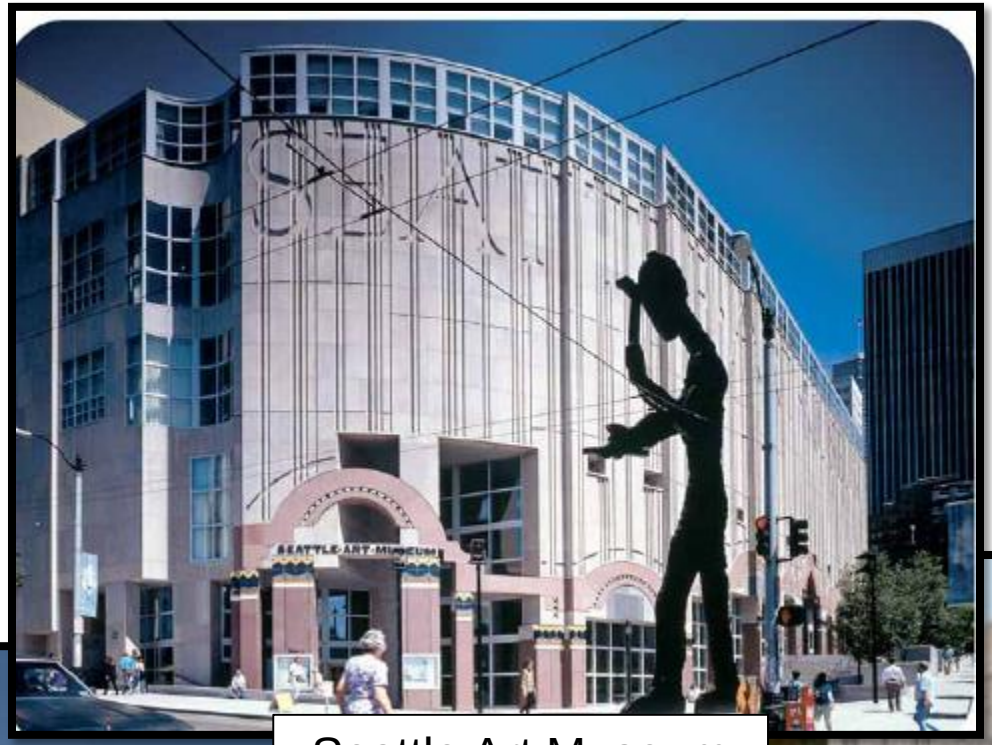
Architecture

Vanderbilt Mansion, North Carolina



Alabama Judicial Center

Empire State Building
New York



Seattle Art Museum

Washington D.C. Convention Center

Simon Hall Indiana University