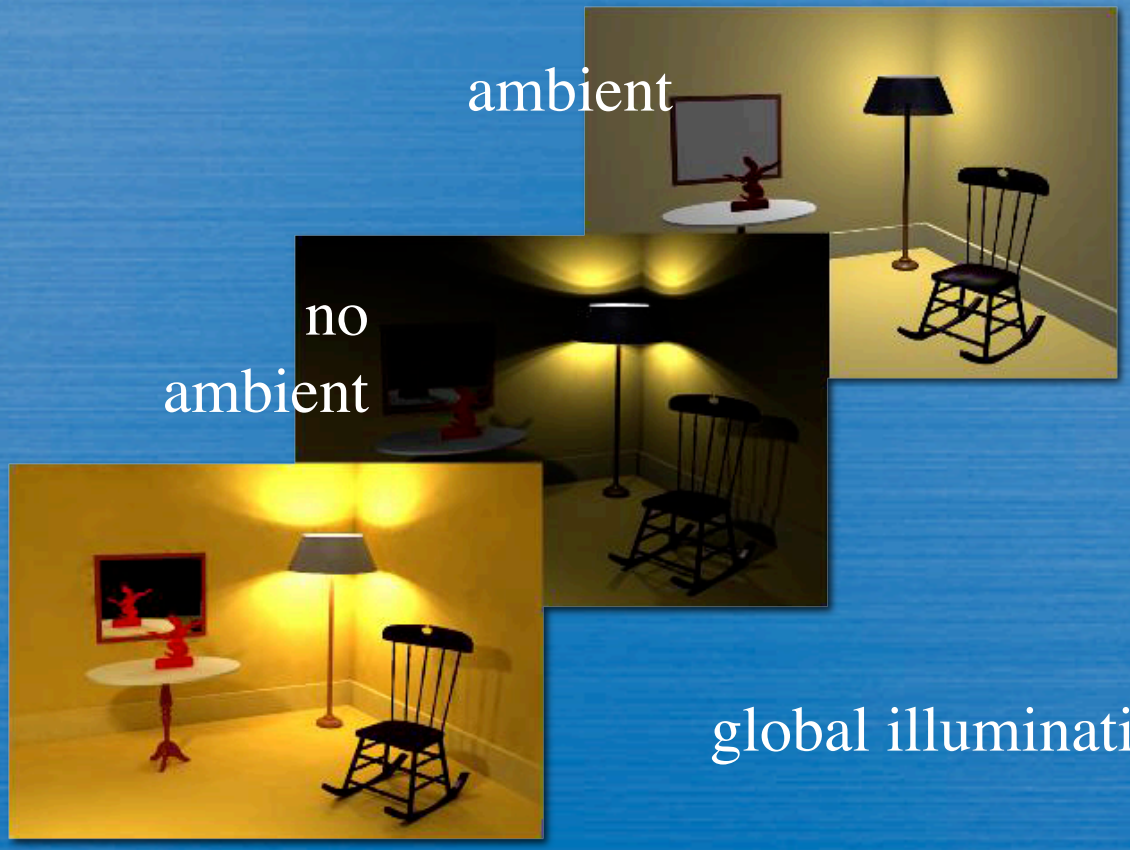
# CMSC 435/634

## Global Illumination

# Global Illumination

- Local Illumination
  - light – surface – eye
  - Throw everything else into ambient
- Global Illumination
  - light – surface – surface … – eye
  - Multiple bounces

# Global Illumination



# "Backward" algorithms

- Follow light transport: eye to light
  - Traditional ray tracing
    - Follow primary reflection
  - Path tracing
    - Follow other rays
    - Monte-carlo integration

# "Forward" algorithms

- Follow light transport: light to eye
  - Lights are emitters
  - Everything else both emitter & receiver
  - Integrate bounce to bounce
    - All surfaces for each bounce (radiosity)
    - All bounces for one photon (photon map)

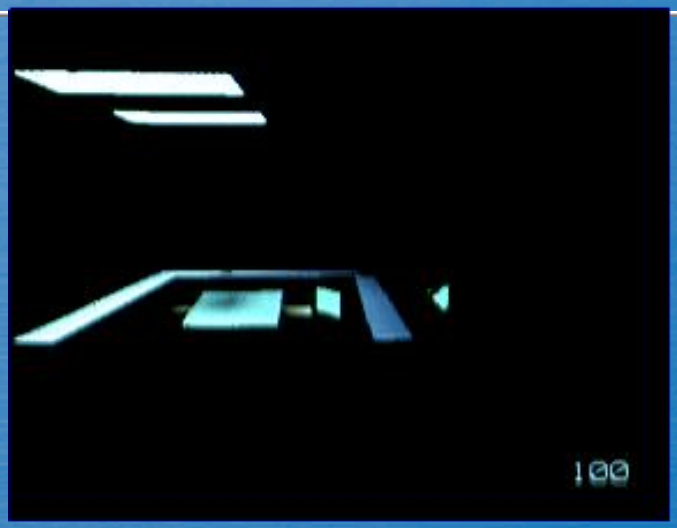
# Radiosity Approach

- Assume all surfaces are ideal diffuse reflectors; light sources all diffuse emitters
- Consider all interactions between lights and surface elements
- Based on theory from radiative heat transfer

## PROGRESSIVE SOLUTION

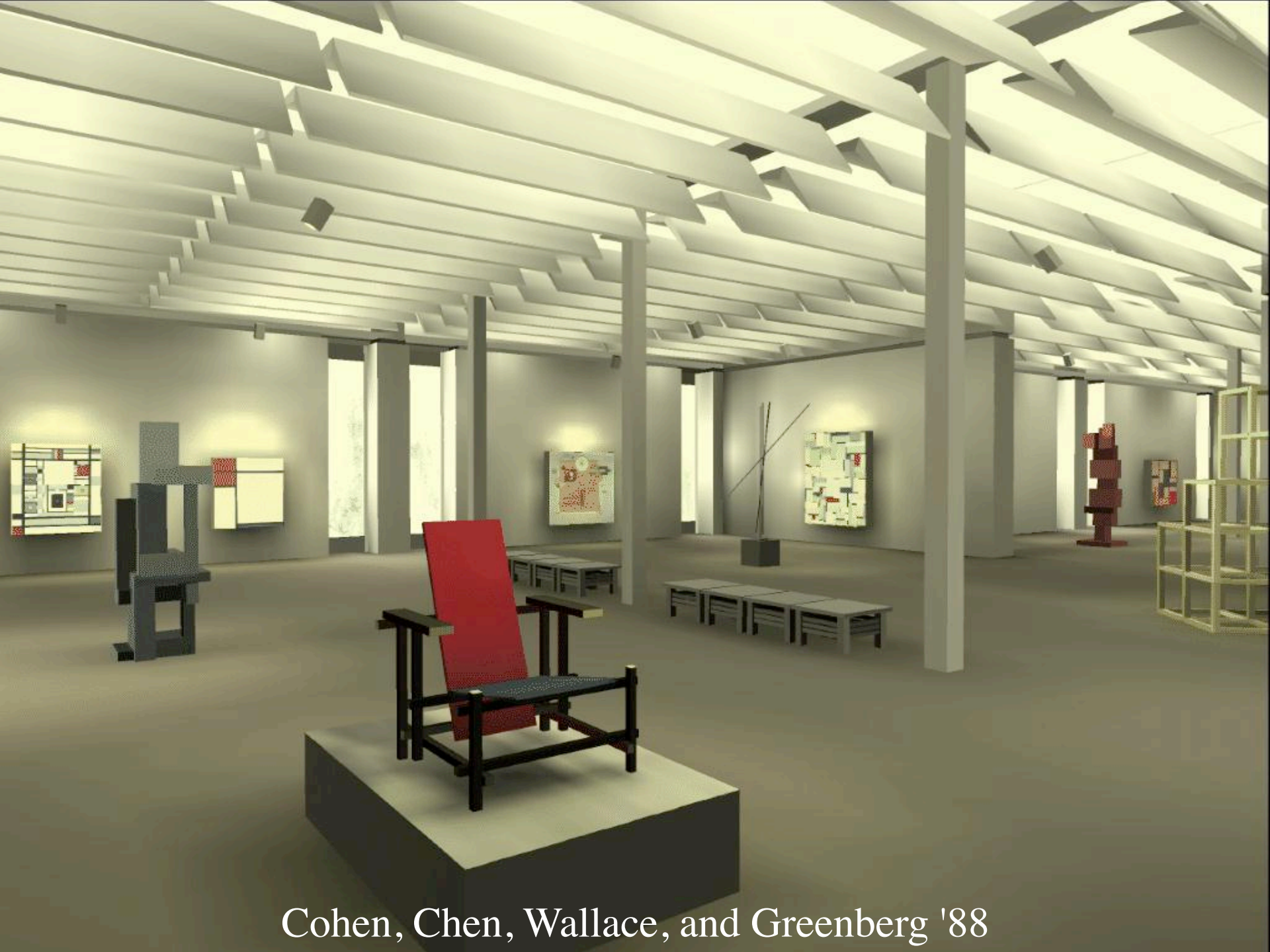
The above images show increasing levels of global diffuse illumination. From left to right:  0 bounces, 1 bounce, 3 bounces.

# Progressive Solution






Michael F. Cohen, Shenchang Eric Chen, John R. Wallace, Donald P. Greenberg



Cohen, Chen, Wallace, and Greenberg '88

# More Radiosity Topics

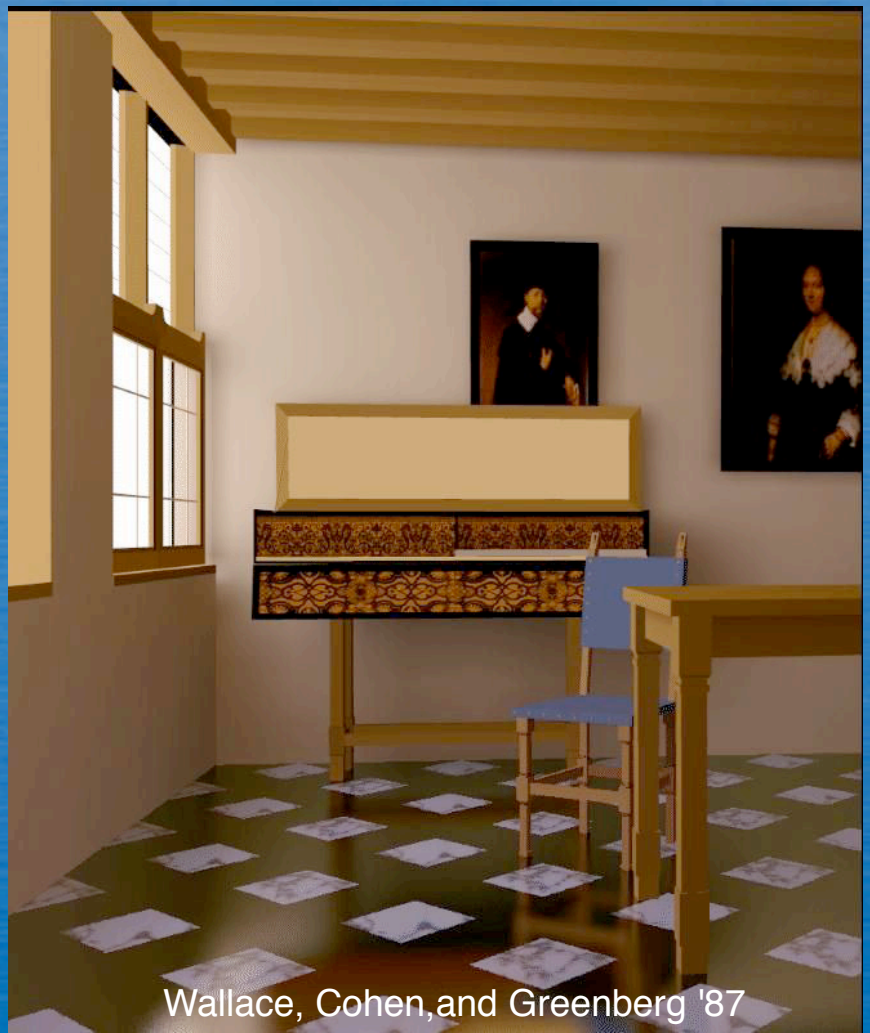
- Participating Media
  - Rushmeier and Torrance‘87
- Specular Reflections
  - Immel, Cohen, and Greenberg ‘86
  - Wallace, Cohen, and Greenberg ‘87
  - Sillion ‘89
- Discontinuity Meshing
  - Baum, Mann, Smith, and Winget ‘91
  - Lischinski, Tampieri, Greenberg ‘92

# Participating Medium

Rushmeier 1993

# Participating Medium

# Radiosity + Specular



Wallace, Cohen,and Greenberg '87

# Discontinuity Meshing

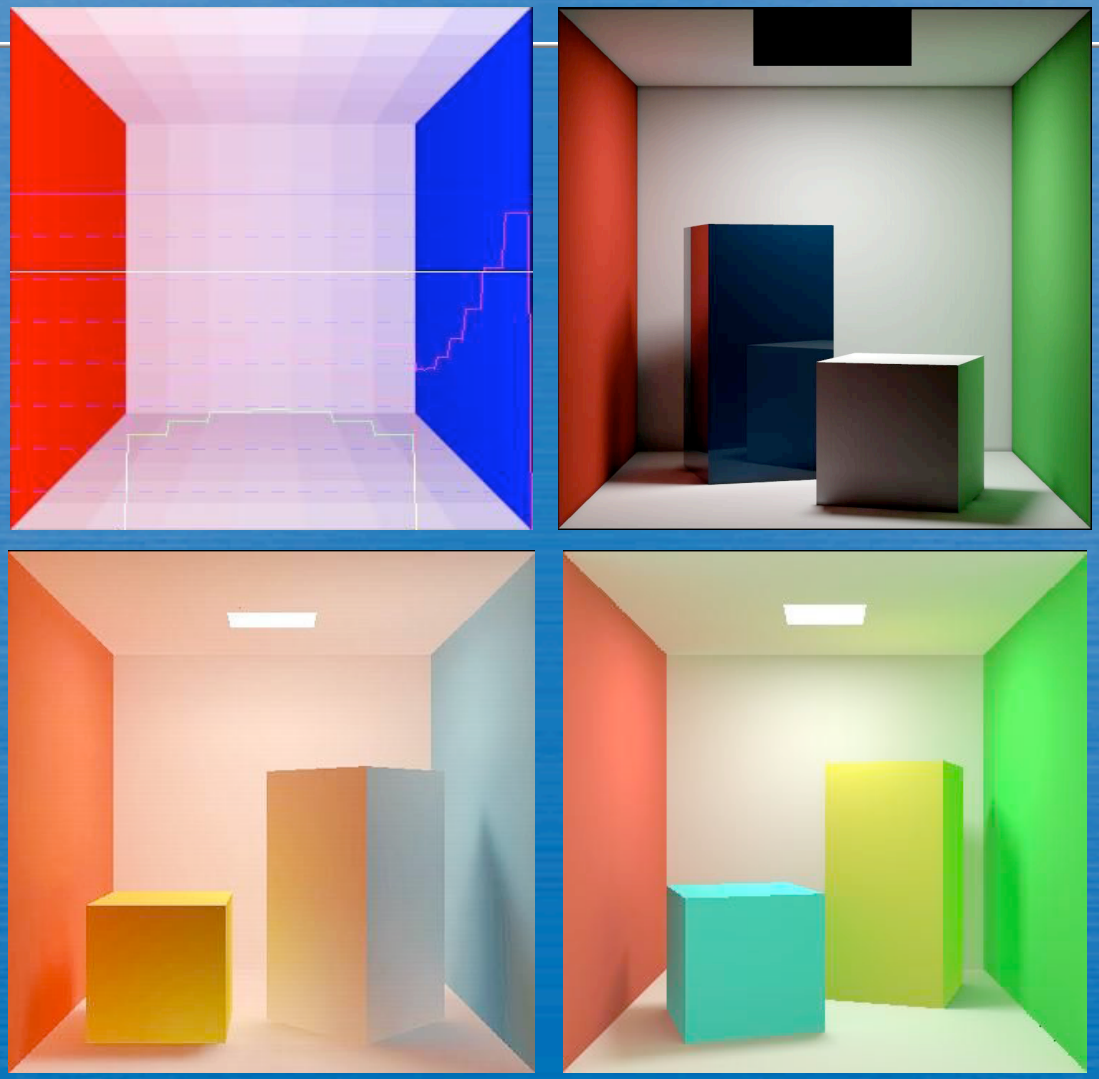
Lischinski, Tampieri, Greenberg '92

# More Global Illumination Topics

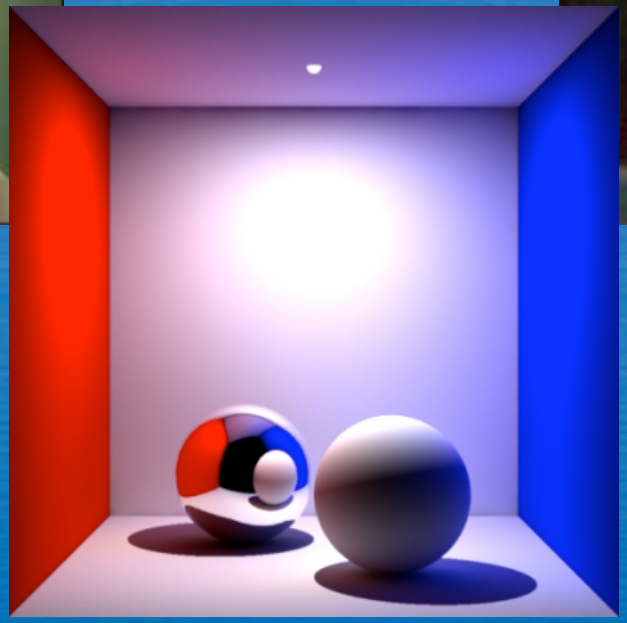
- Monte Carlo Methods
  - Lafortune and Willems '93
  - Veach and Guibas '97
- Error Estimates
  - Arvo, Torrance, and Smits '94
  - Lischinski, Smits, and Greenberg '94

# Bidirectional Path Tracing & Metropolis Light Transport

# The Cornell Box



# More Cornell Boxes



# Interactive Rendering

- Diffuse surfaces only
  - viewpoint independent
- Pre-compute and store radiosity
  - As patch/vertex colors
  - As texture
- Separate solution for each light
  - Linear combination to change lights

# Two pass

- Radiosity for diffuse
- Ray tracing for reflection
- Doesn’t handle radiosity of specularly reflected light