

# **An Introduction to Corrosion**

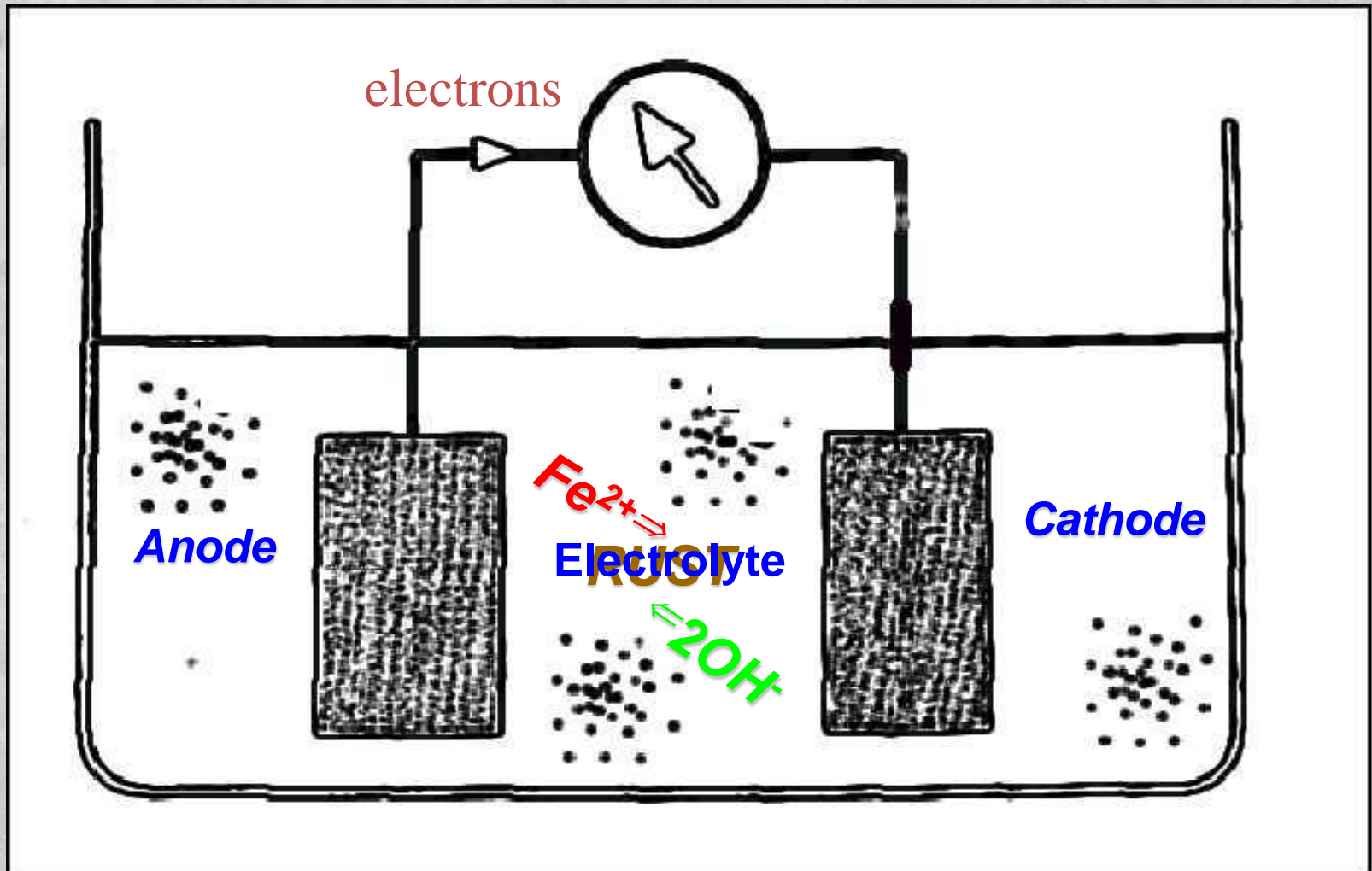
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# An Introduction.....

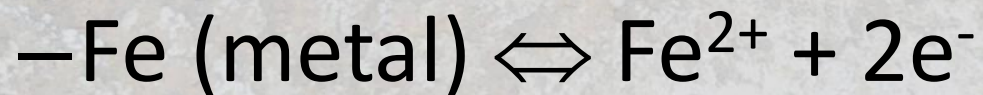


# A Simple Corrosion Cell



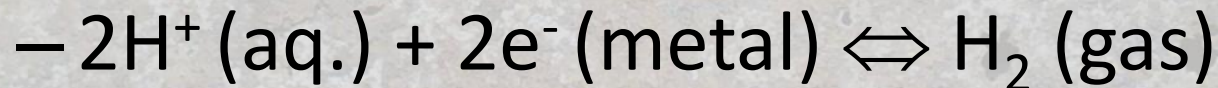
# Why does steel corrode ? (1)

- Differences in electrical potential on the surface form ANODIC and CATHODIC sites
- At anodic sites the metal oxidises:



# Why does steel corrode ? (2)

- Simultaneously, reduction occurs at cathodic sites, typically:



- Electrons are conducted through metal while ions travel through electrolyte

# Anodes & Cathodes



# General Corrosion

- Uniform attack of the metal surface
- Low rate of penetration
- Potentially greater degree of contamination
- 'Typical' rates are available for most metal/environment combinations
- Difficult to design against
- May require protection - e.g. coatings

# General Corrosion





# Pitting Corrosion

- Highly localised, high rate corrosion
- Rapid perforation of sections
- Several causes, including chloride ions
- Once initiated, pits can be self perpetuating
- Often associated with stagnant conditions
- Coatings can provide barrier but any defects can become active anodic sites

# Pitting Corrosion



# Crevice Corrosion

- Typically occurs in gaps between two surfaces
- Only one surface needs to be metal
- Surface deposits can also produce crevices
- Corrosion cell caused by differential oxidation
- The smaller the crevice, the more intense the corrosion
- Must be designed-out or filled-in

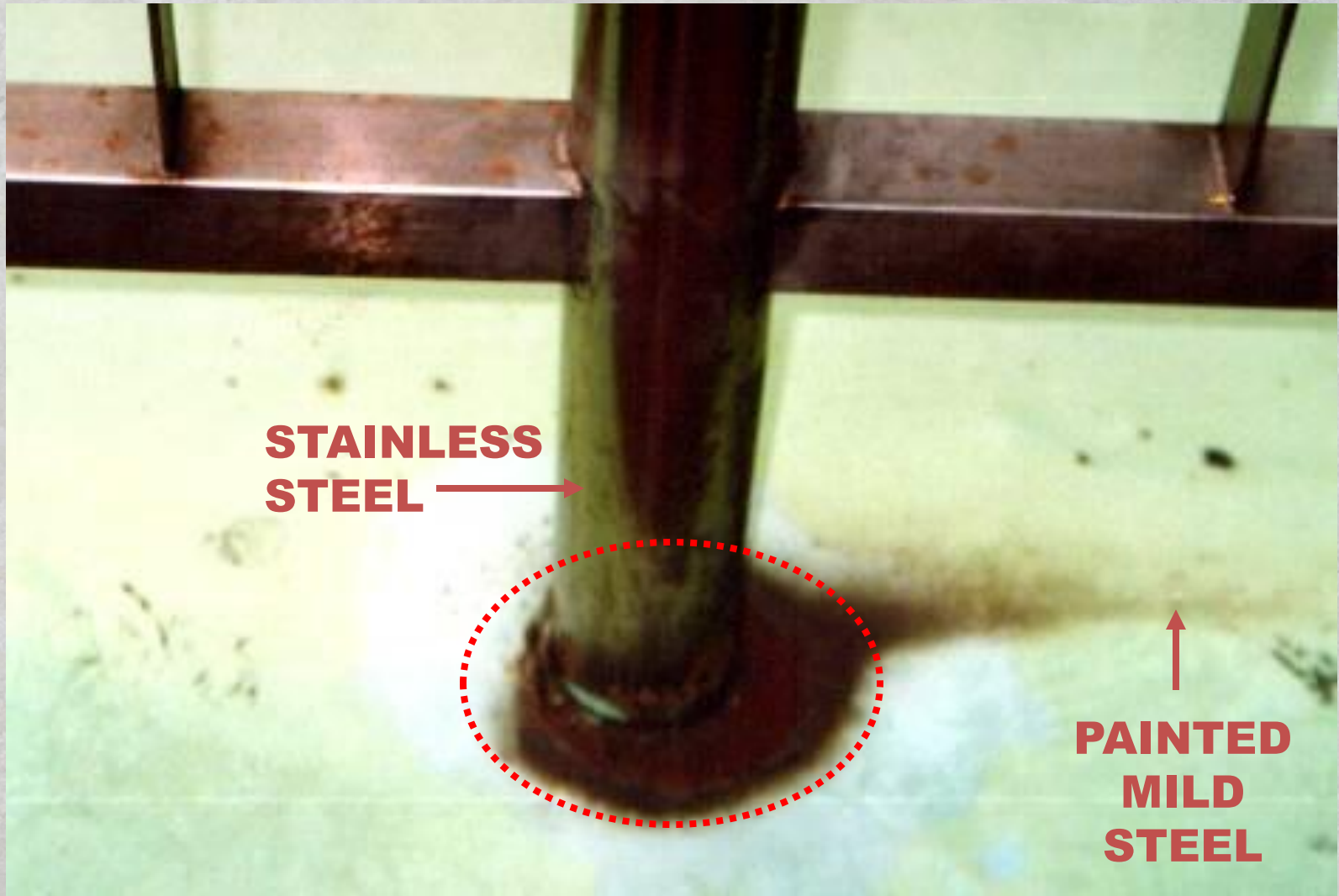
# Crevice Corrosion



# Bimetallic Corrosion

- Five conditions must be satisfied:
  - an environment in which the ‘anode’ can corrode
  - an electrolytic path
  - an electronic path
  - a large potential difference
  - no restriction of the reactions at the ‘cathode’
- Control involves preventing or interfering with one of these requirements

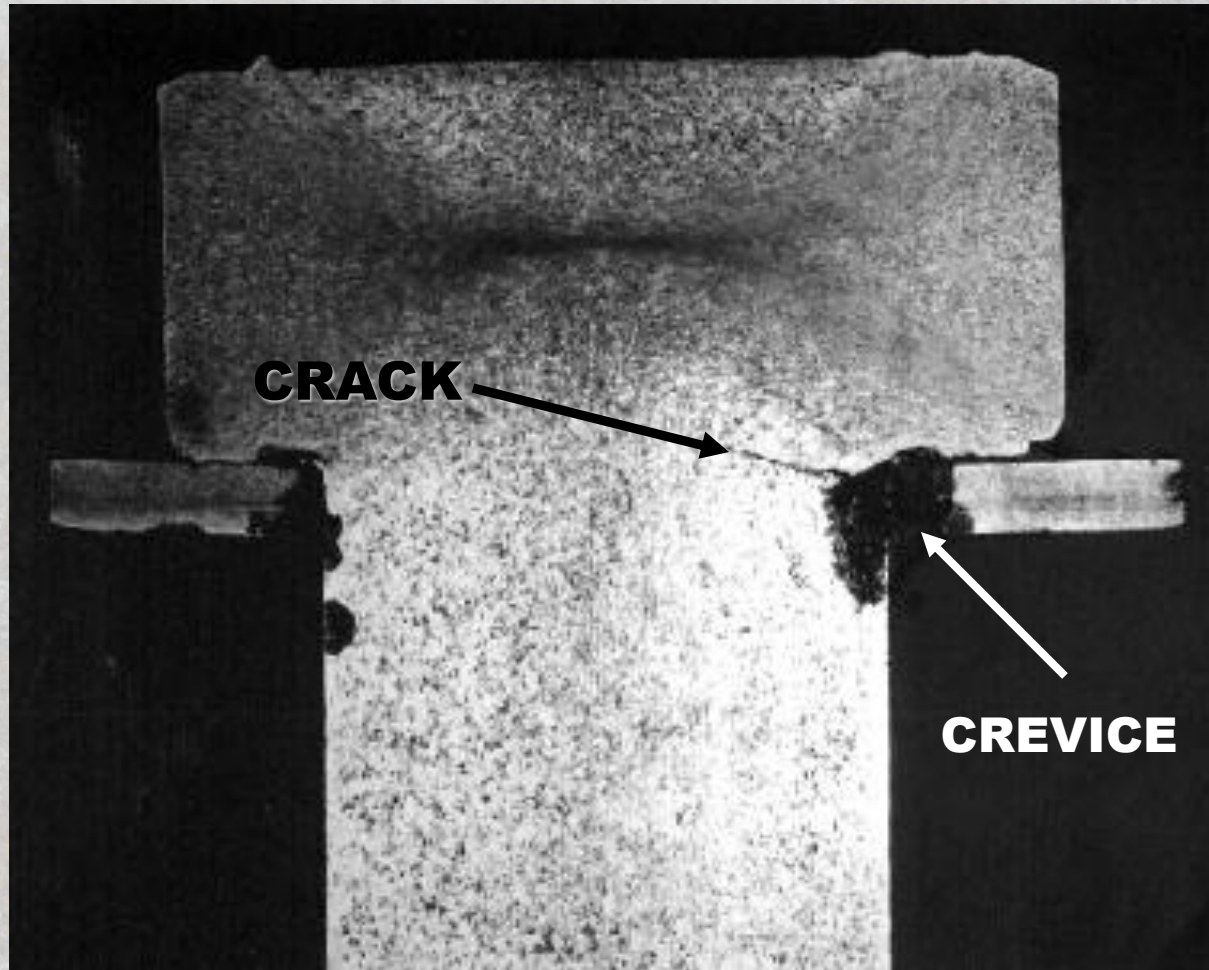
# Bimetallic Corrosion



# Stress Corrosion Cracking

- Requires both tensile stress and a specific corrosive medium
- Highly specific to alloy, environment and exposure conditions
- Stresses may be due to fabrication or service
- Coatings can exclude the environment

# Stress Corrosion Cracking





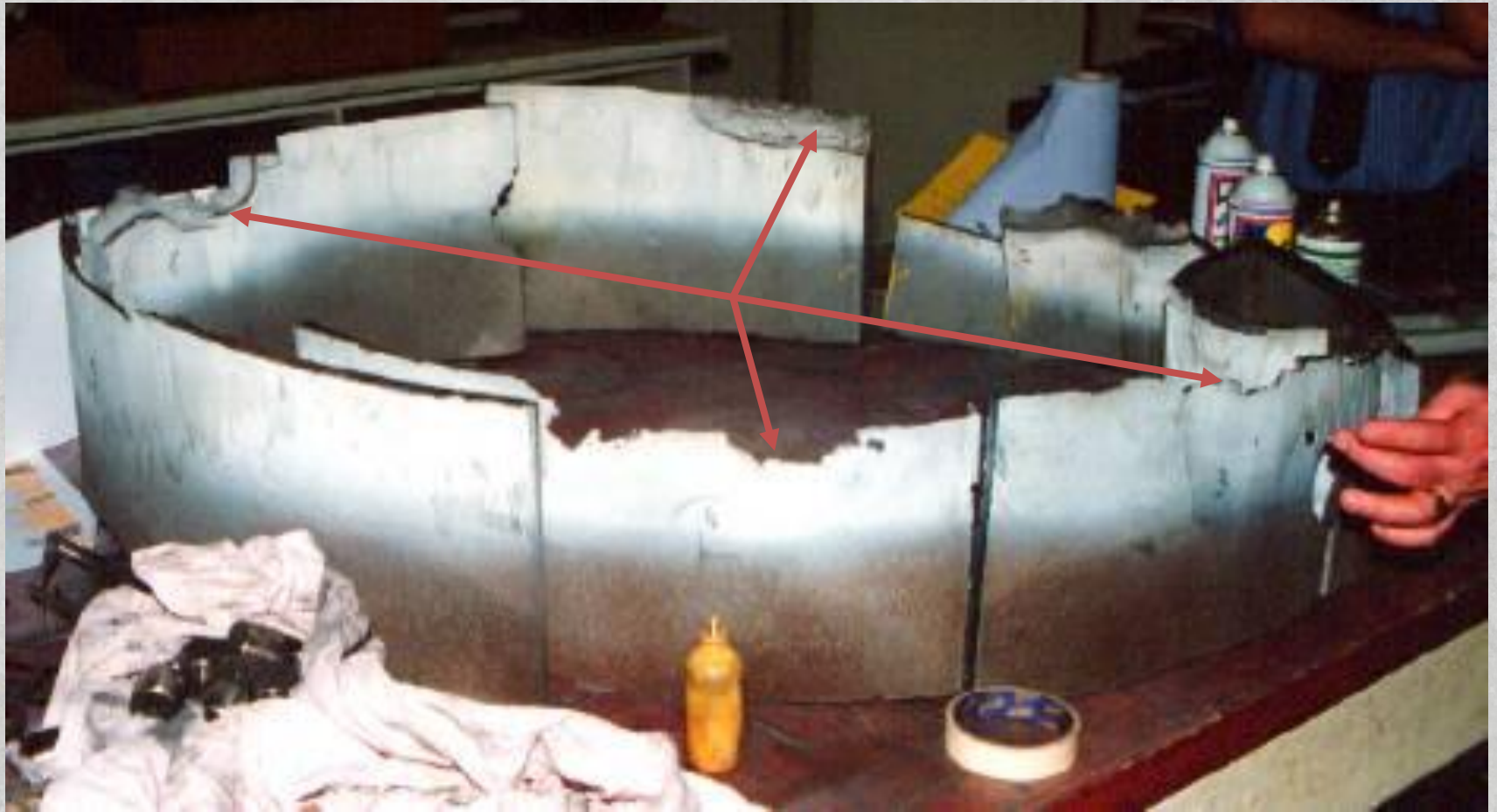
Fall down – go bang



# Corrosion Fatigue

- Caused by a combination of cyclic stress and a corrosive environment
- Hard to distinguish from plain fatigue
- Coatings can exclude the environment
- Techniques that improve plain fatigue resistance can also help with corrosion fatigue - e.g. carburising, nitriding, shot peening

# Corrosion Fatigue



# Other Forms of 'Corrosion'

- **EROSION-CORROSION**
  - synergy of erosive and corrosive decay
- **CAVITATION**
  - collapsing air bubbles erode surface
- **GRAPHITIC CORROSION**
  - preferential attack in grey cast iron
- **GALLING**
  - local cold welding and tearing (stainless steels)
- **FRETTING**
  - small movements generating fine debris