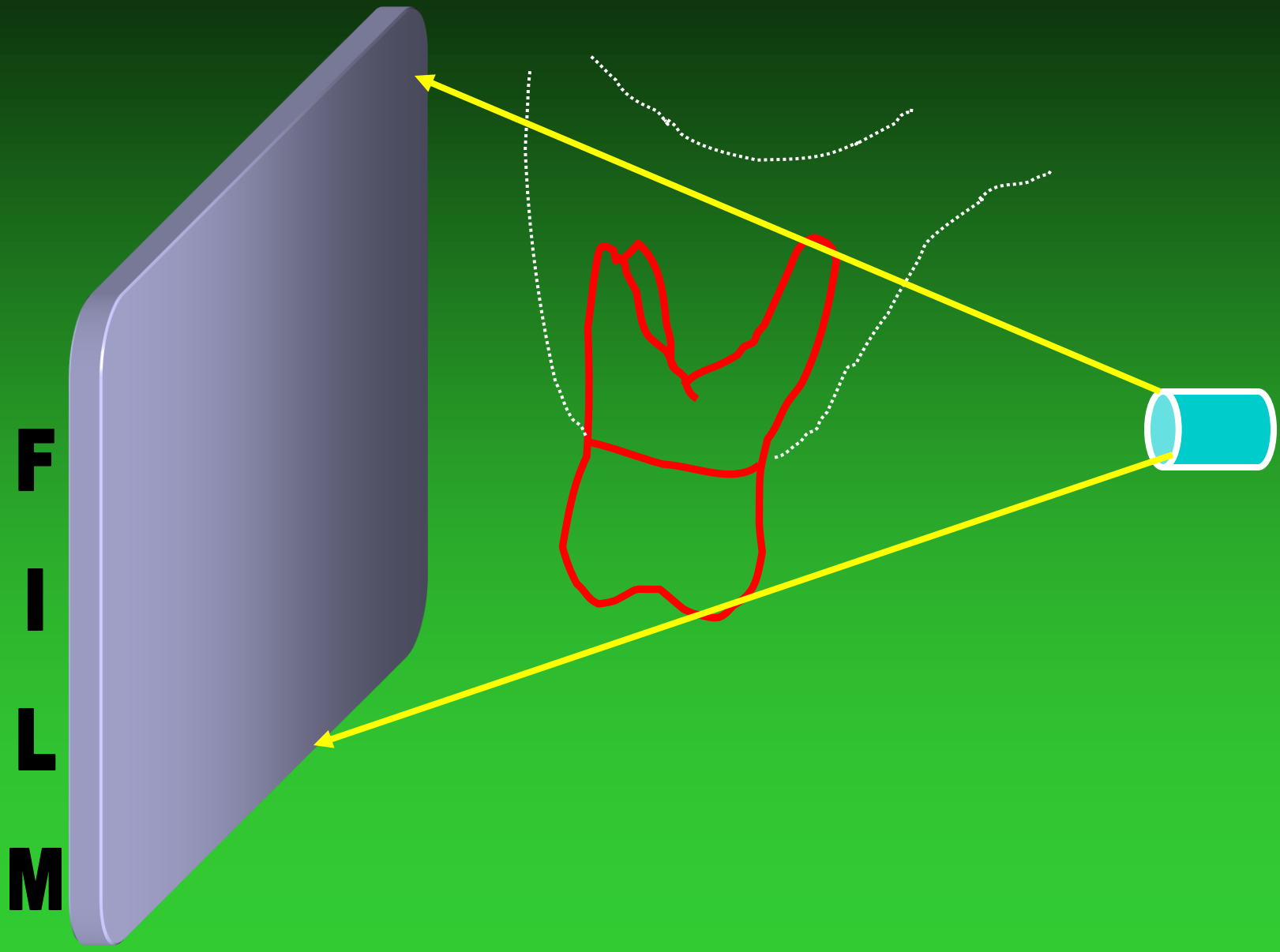
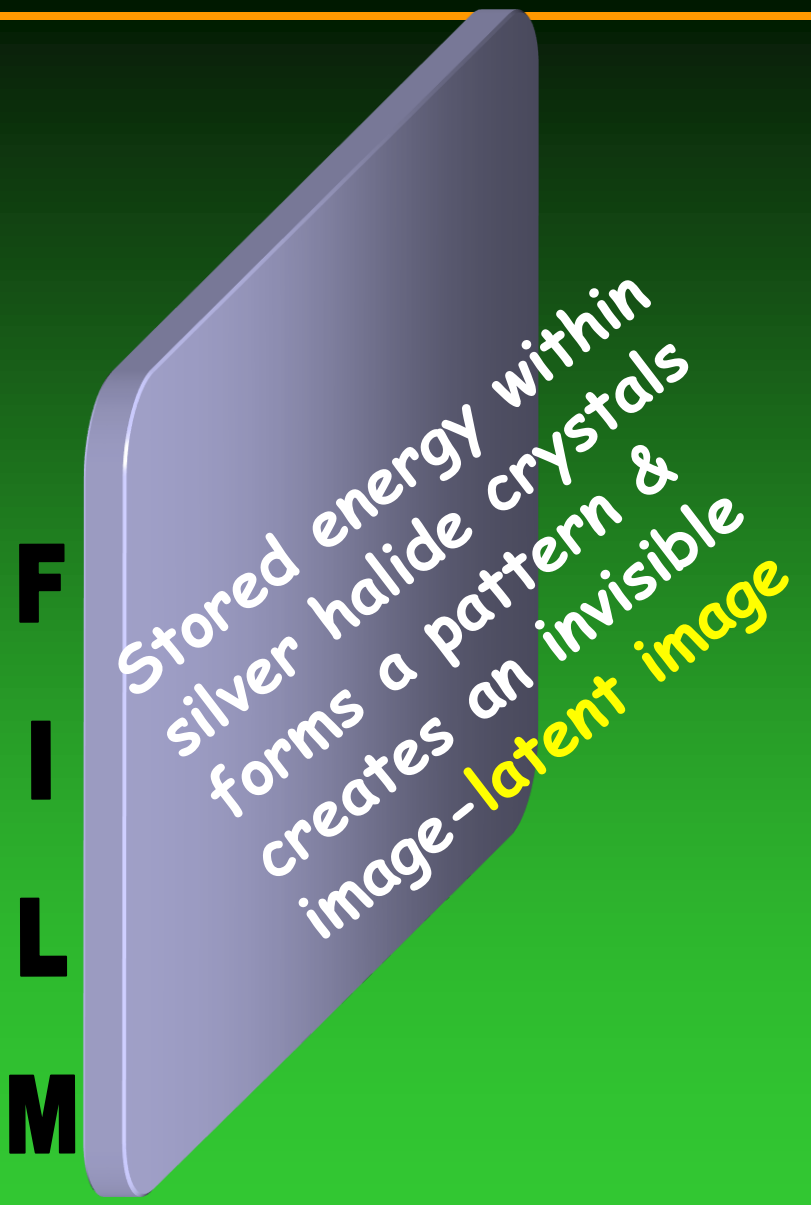
PROCESSING

OF

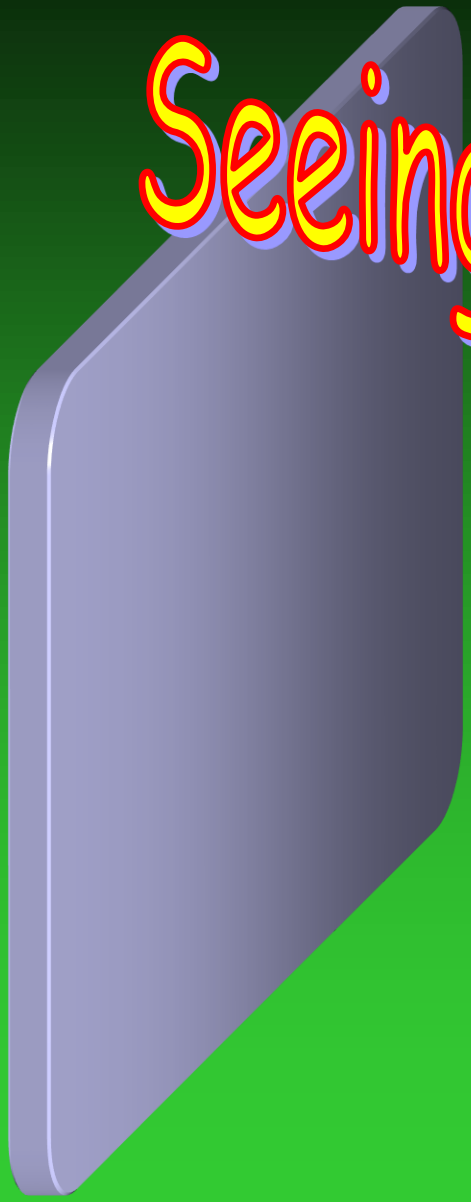
RADIOGRAPHS

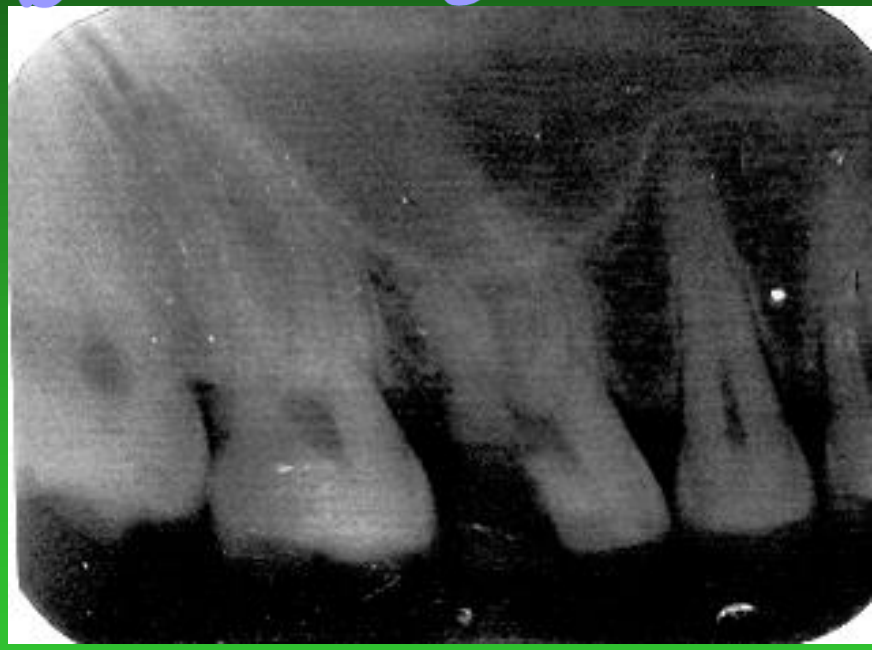
Processing - AVS

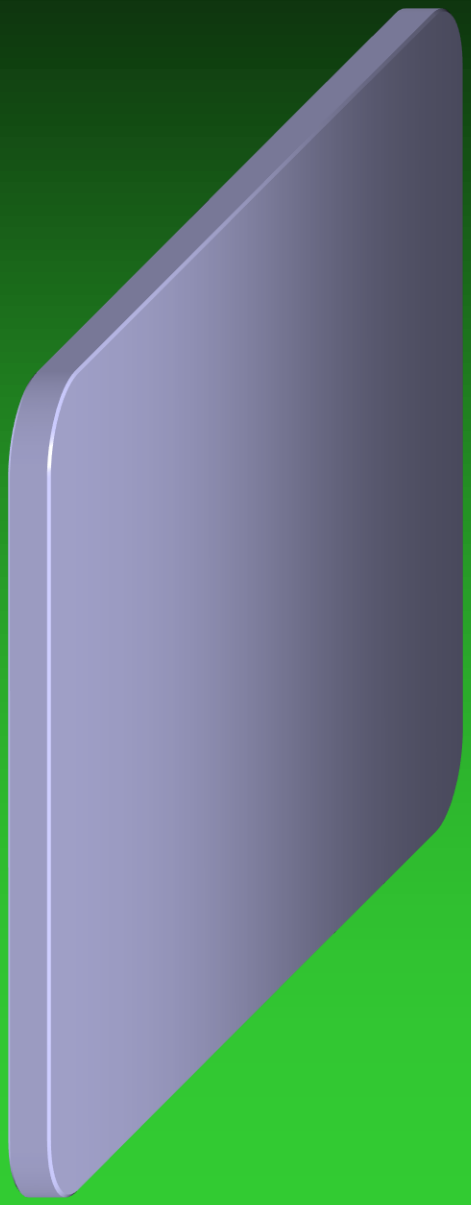


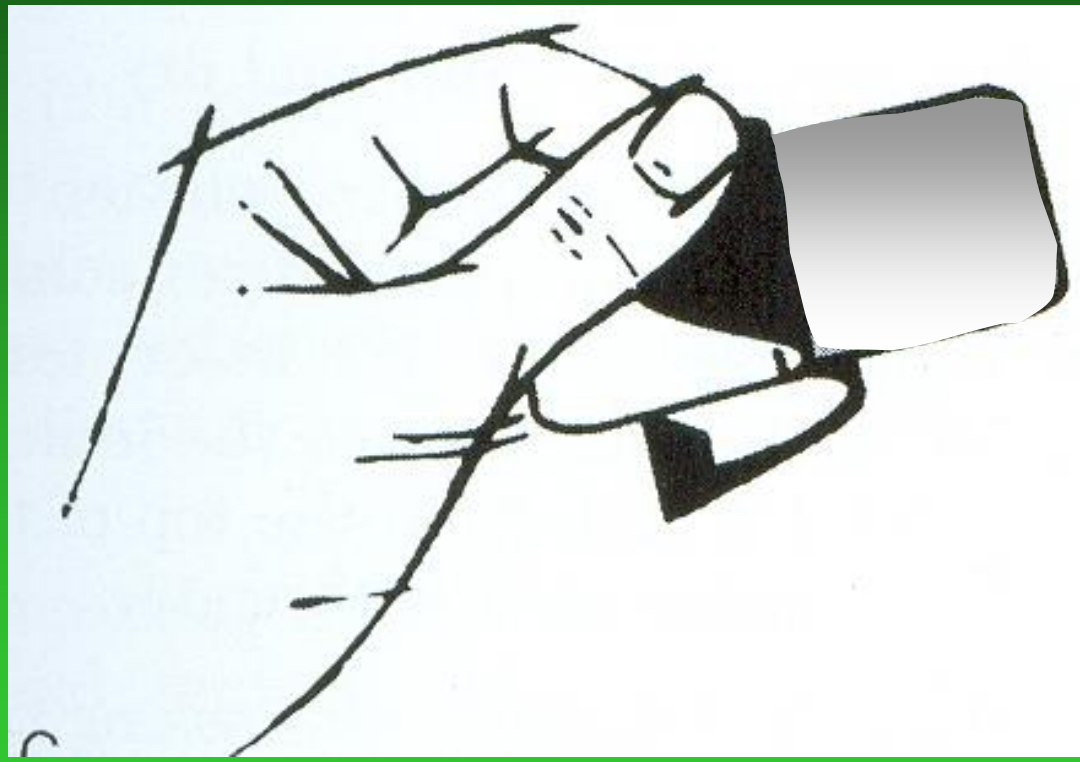

F
I
L
M
Stored energy within silver halide crystals forms a pattern & creates an invisible image-latent image

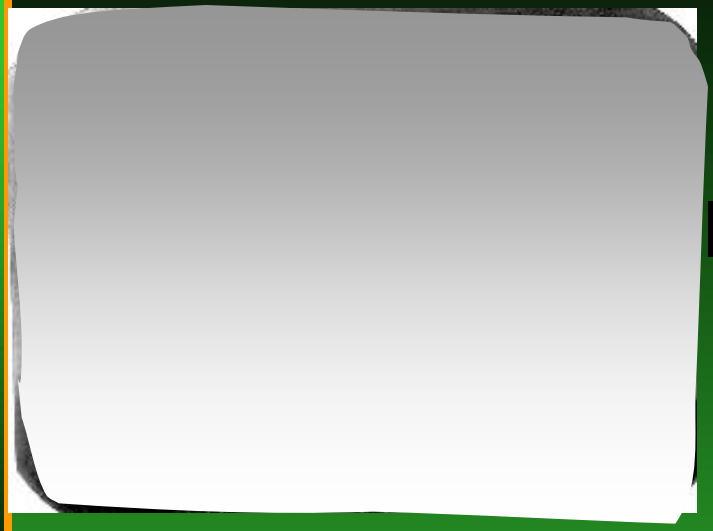
Seeing is believing !!



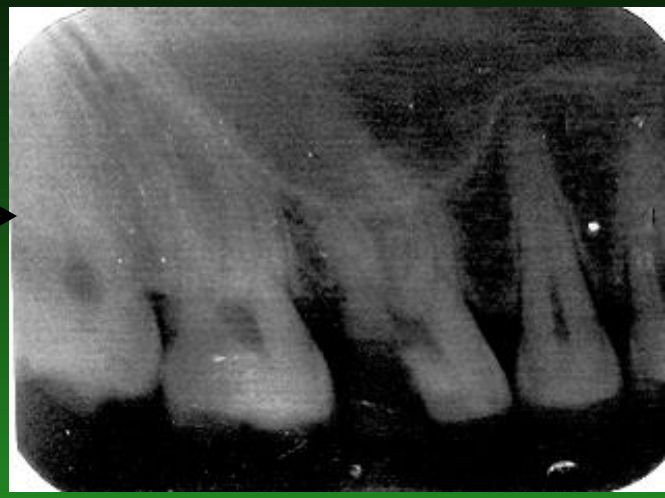








processing

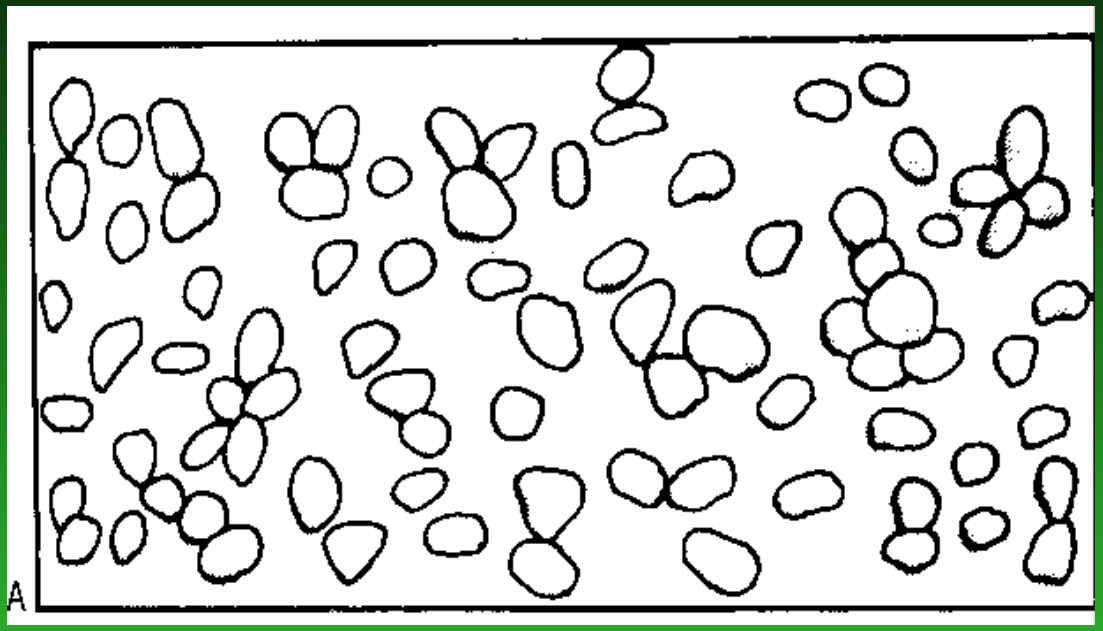


A series of steps that collectively produces a visible permanent image on dental Radiograph

AIMS OF PROCESSING

- To convert latent(invisible) image on the film into a visible image
- To preserve the visible image so that it is permanent and does not disappear from Rg

How is this latent image formed ?



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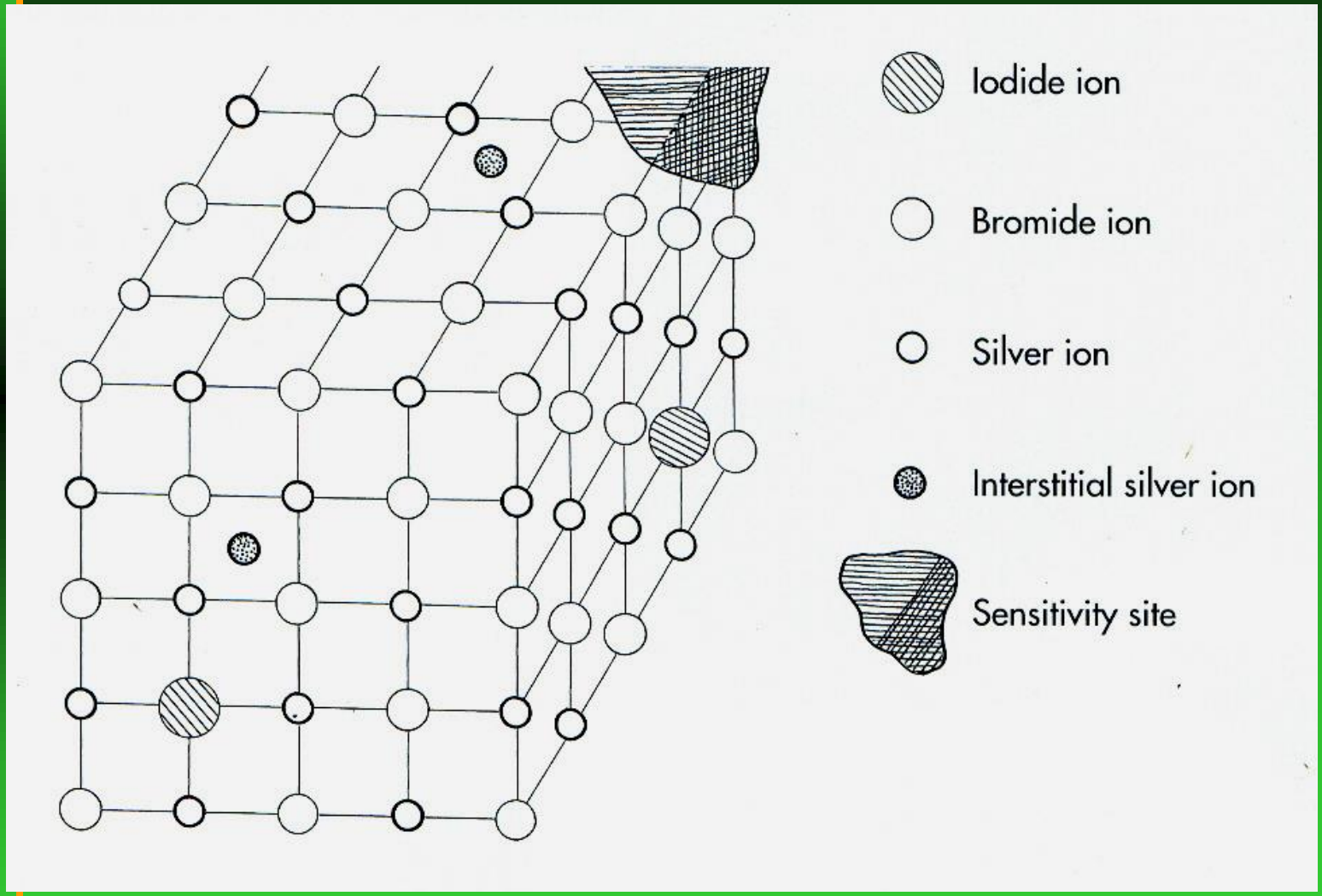

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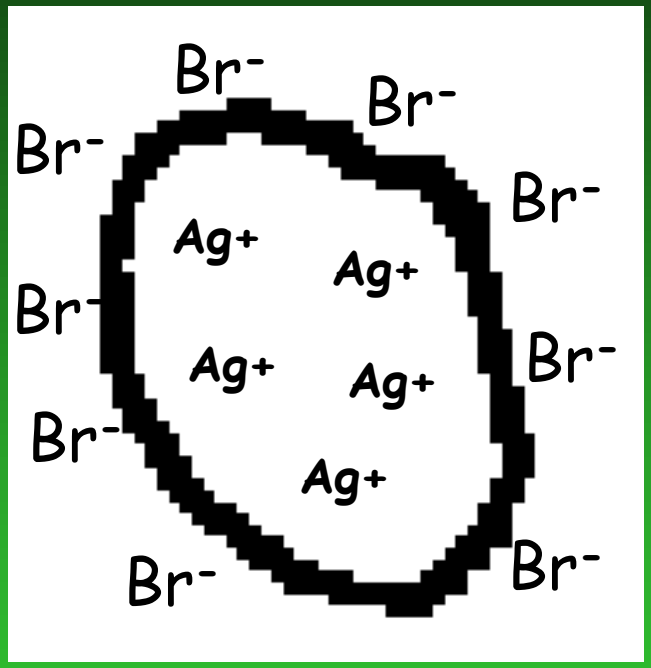

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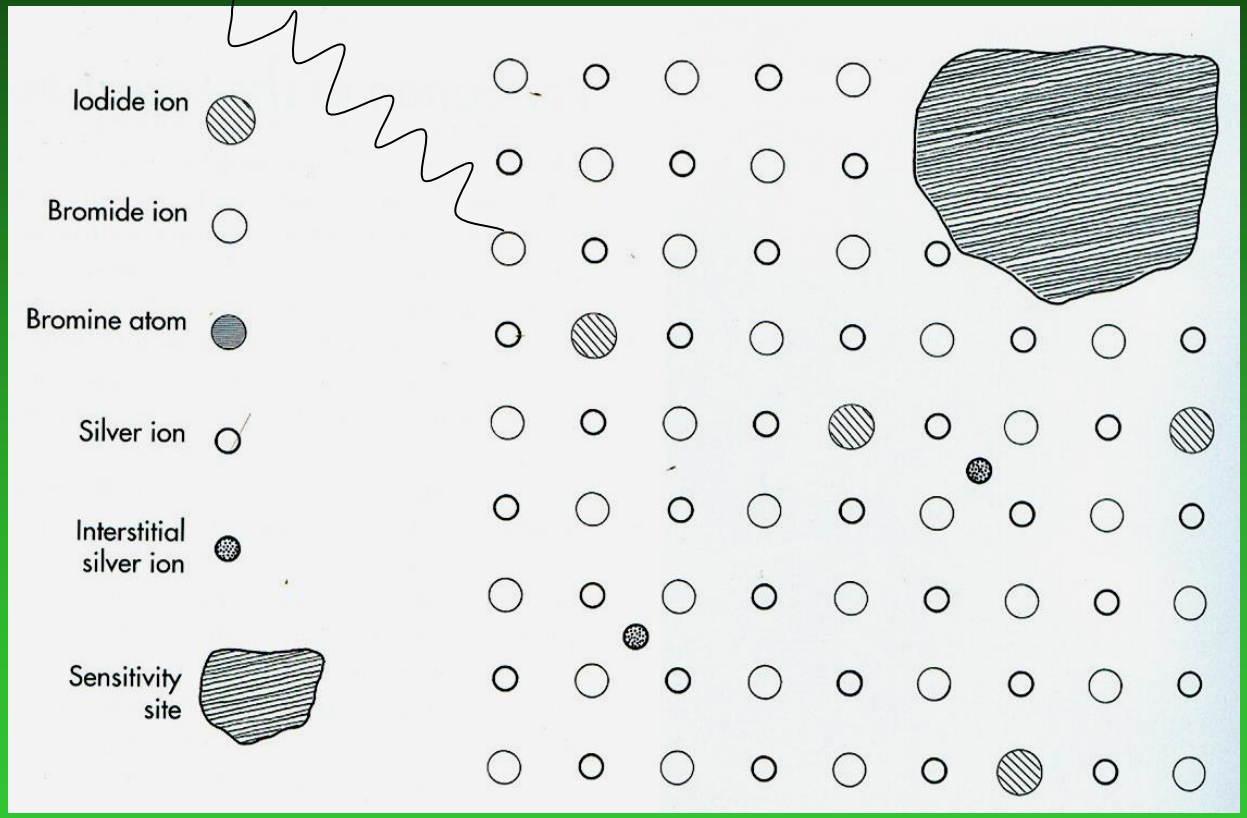
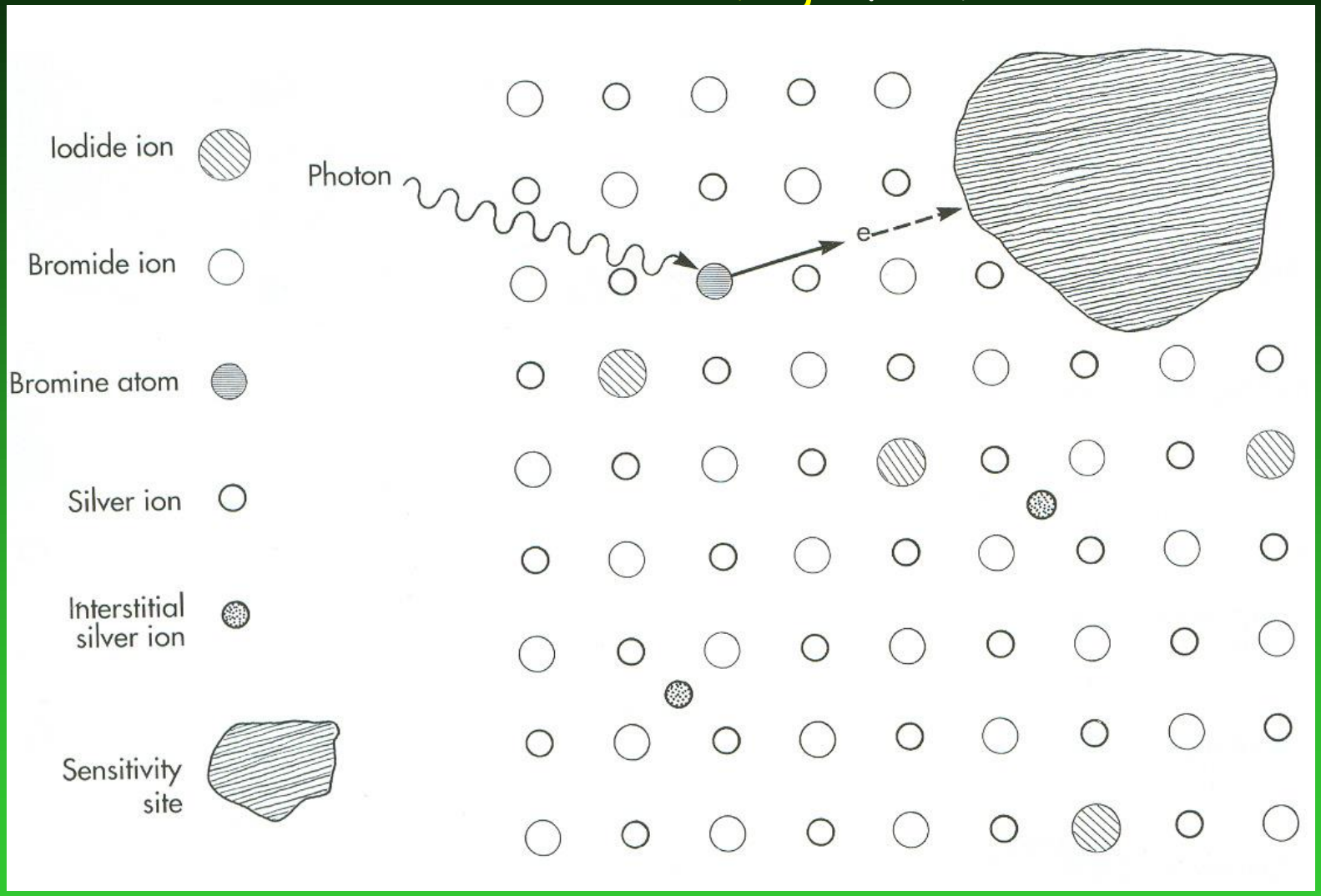


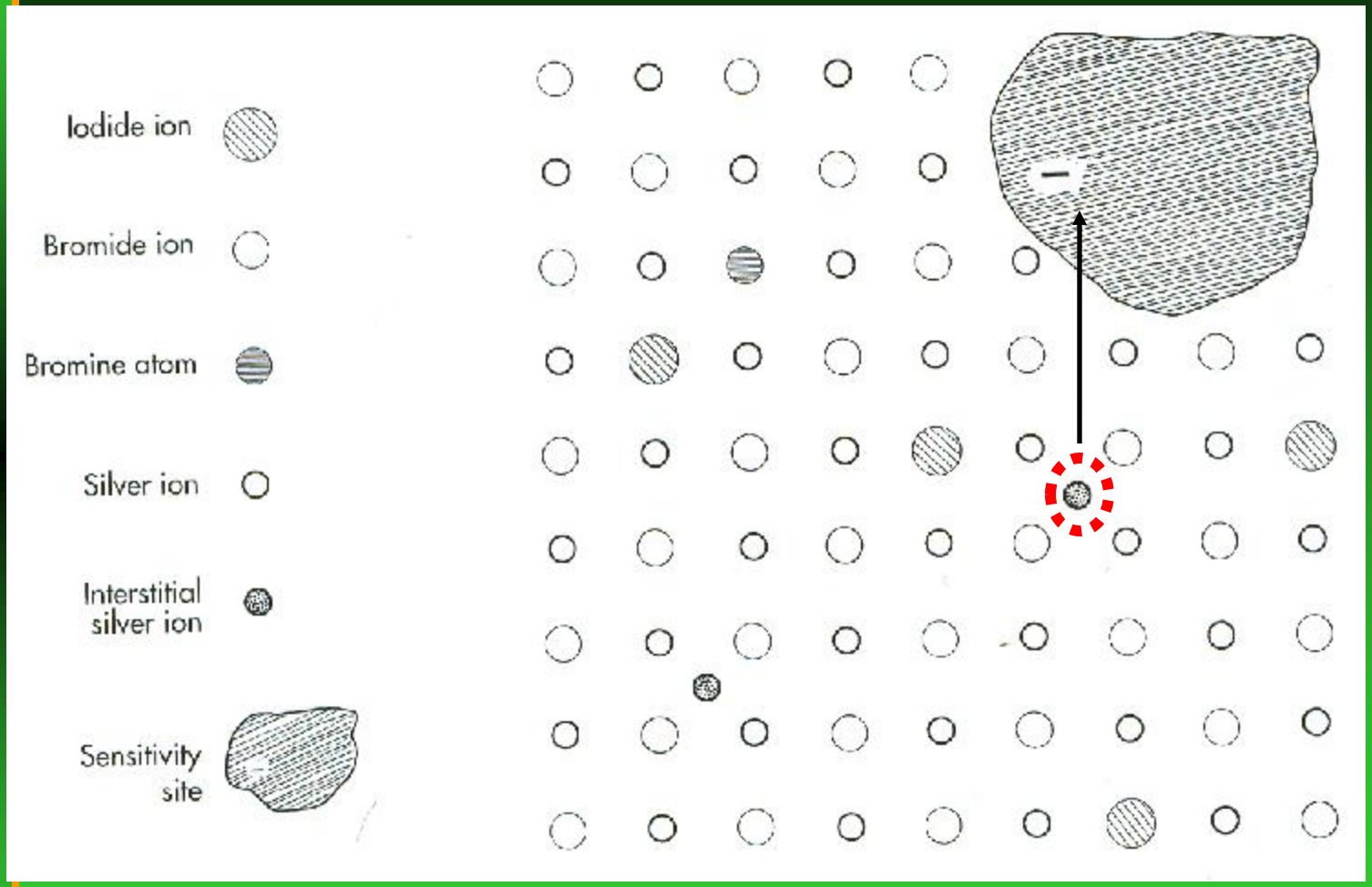
Br^- + photon ⟶ Br atom + electron (recoil)

How is this latent image formed ?



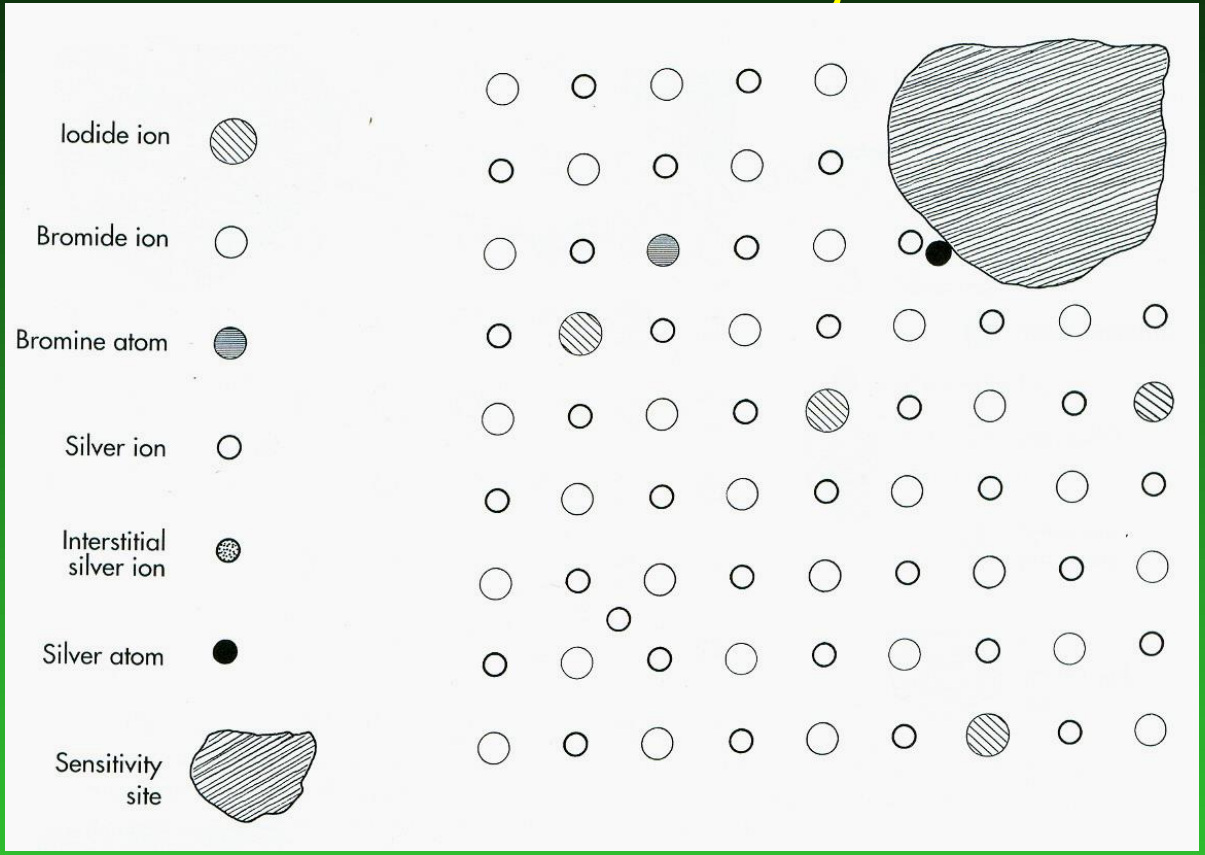
'recoil' electron goes to interstitial site

How is this latent image formed ?



$e^- + Ag^+ \longrightarrow$ Ag atom

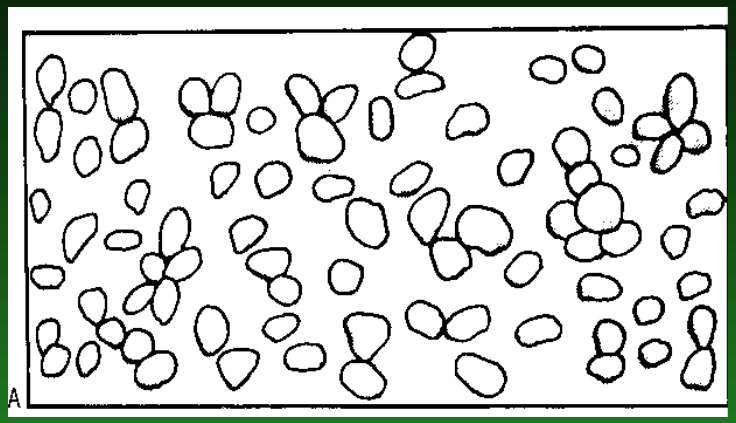
How is this latent image formed ?

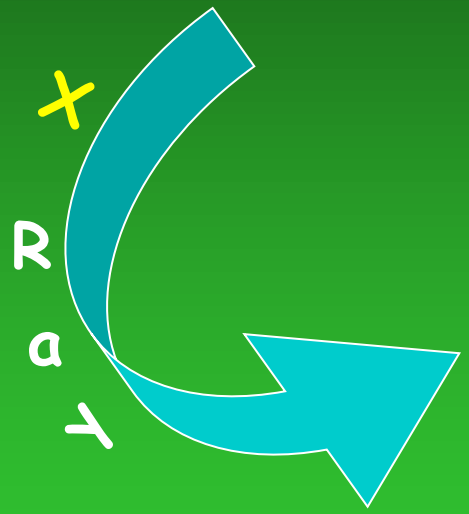


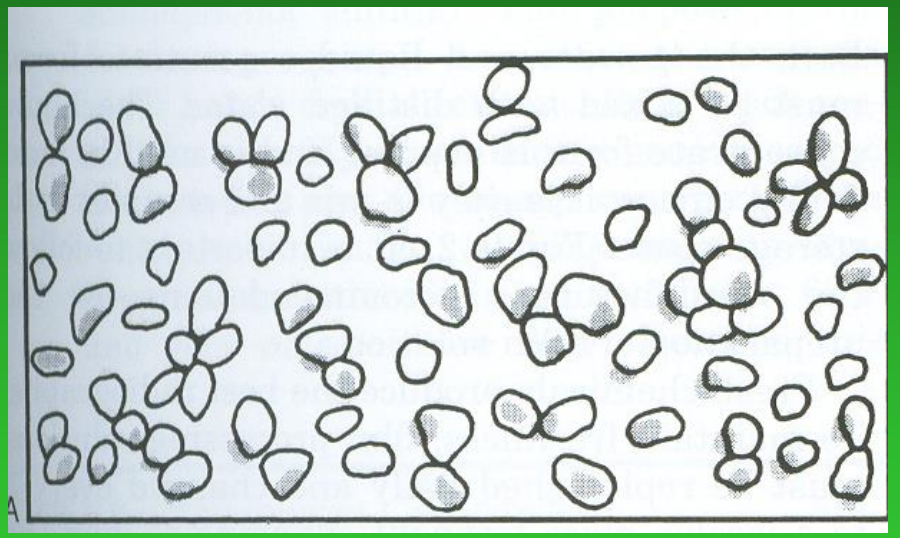
This process occurs many times at a single site within a crystal

These neutral silver atoms forms latent image site

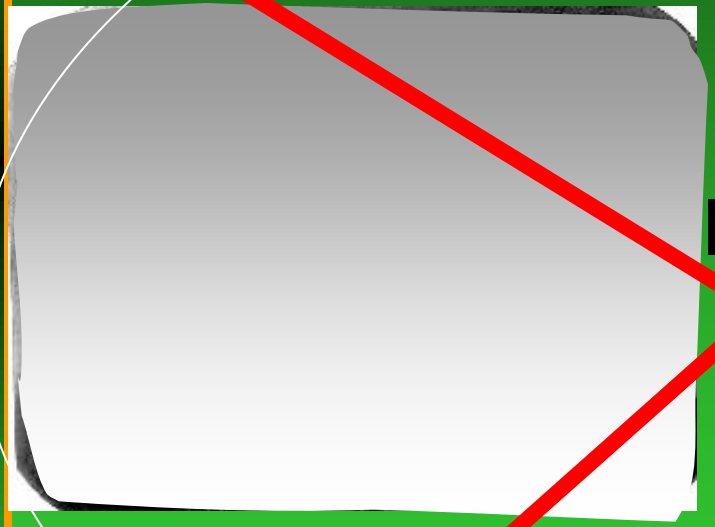
Processing - AVS

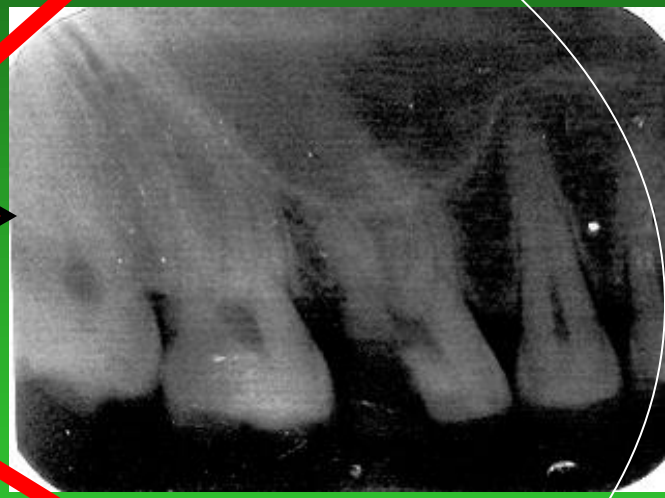


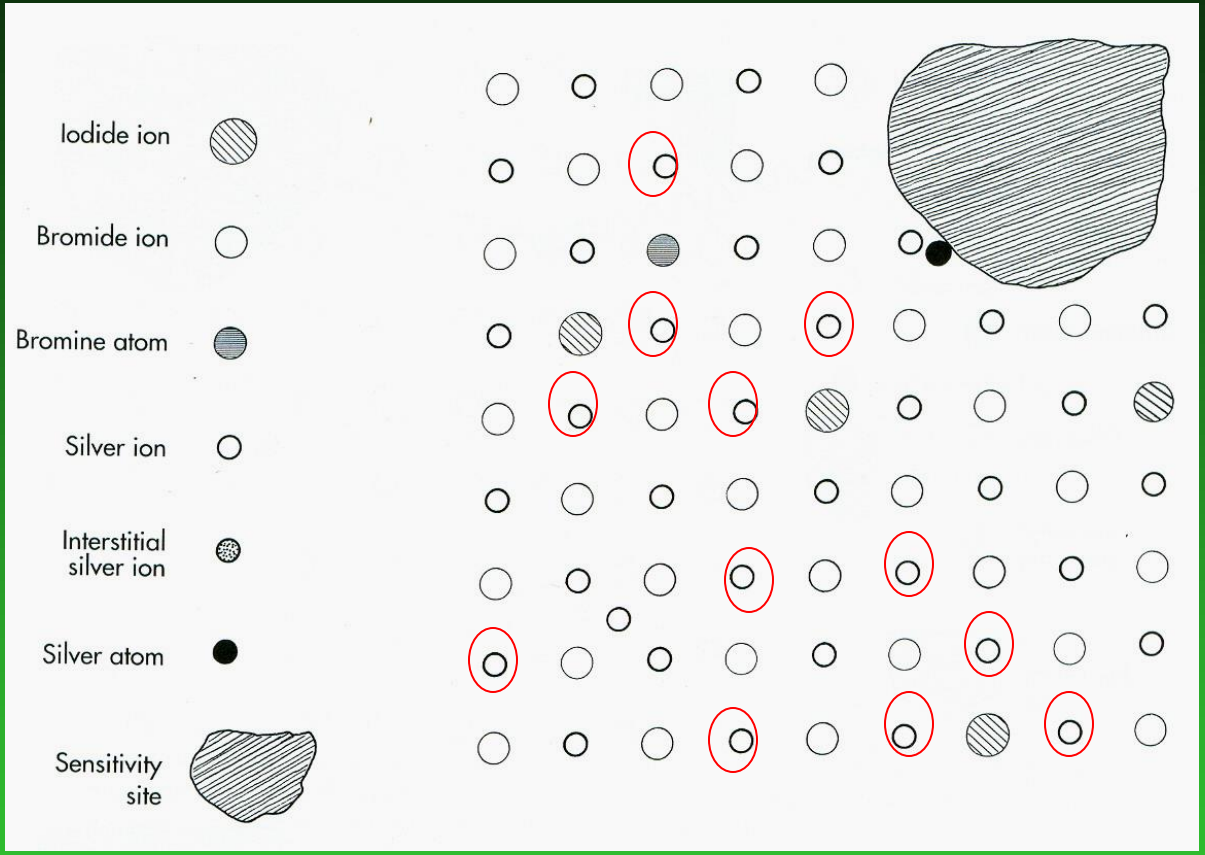




But this is not enough !!







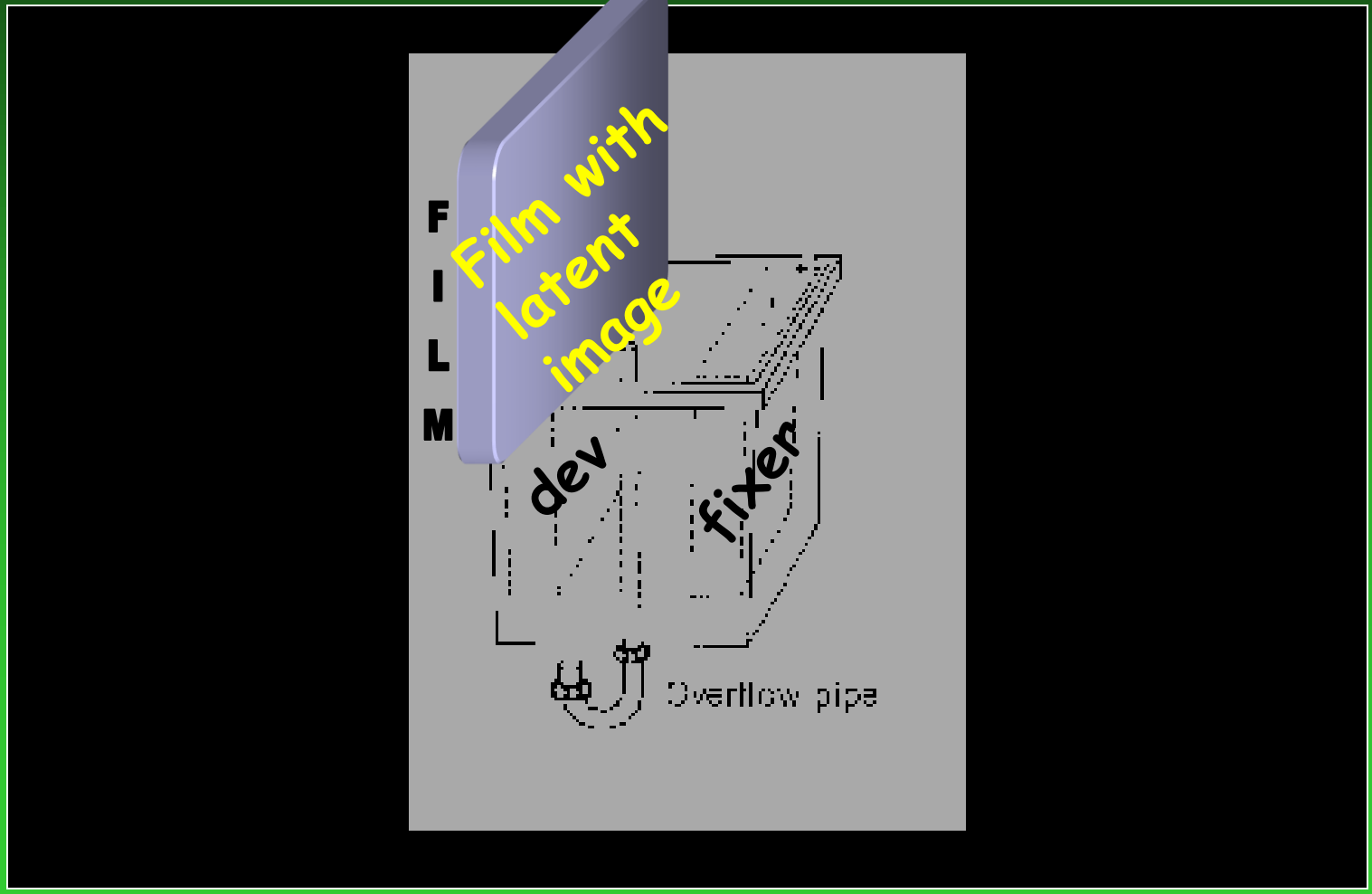
$Ag^+ \longrightarrow$ Ag atom

How ??

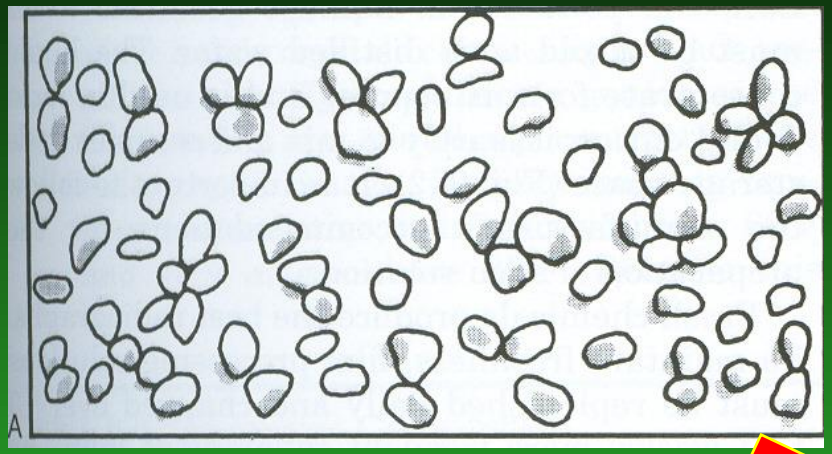
$Ag^+ + e^- \longrightarrow$ Ag atom

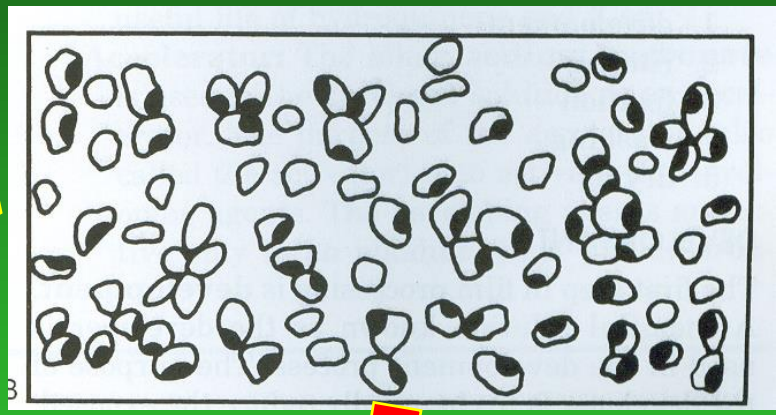
Where will the electrons come from ??

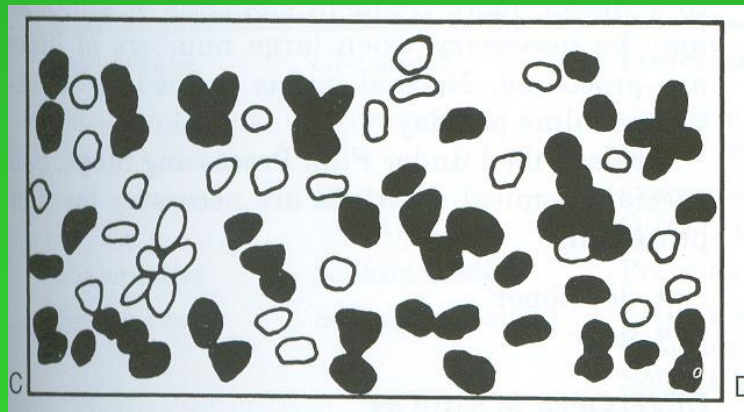
DARK ROOM



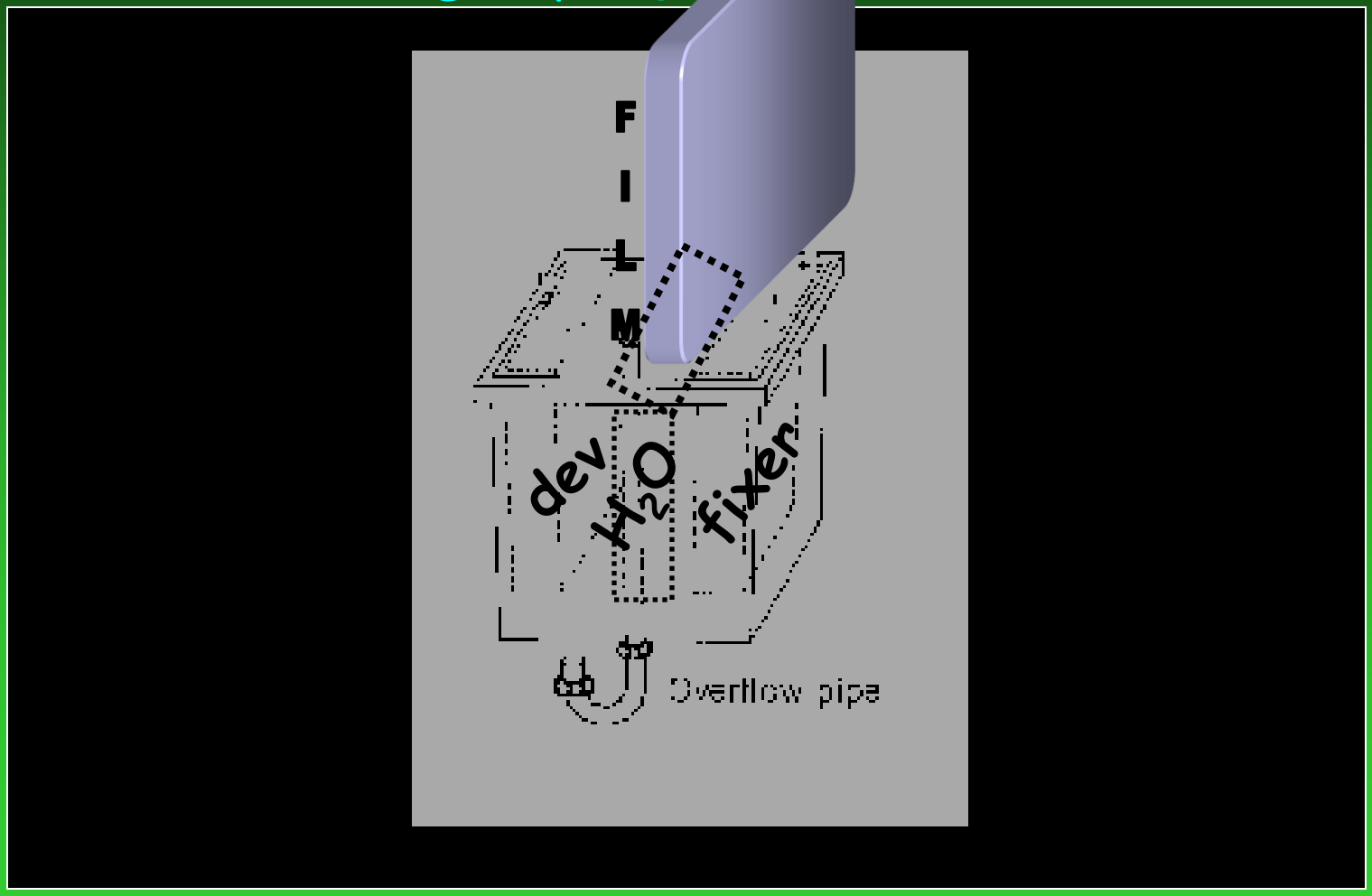
Exposed film is immersed in developer solution



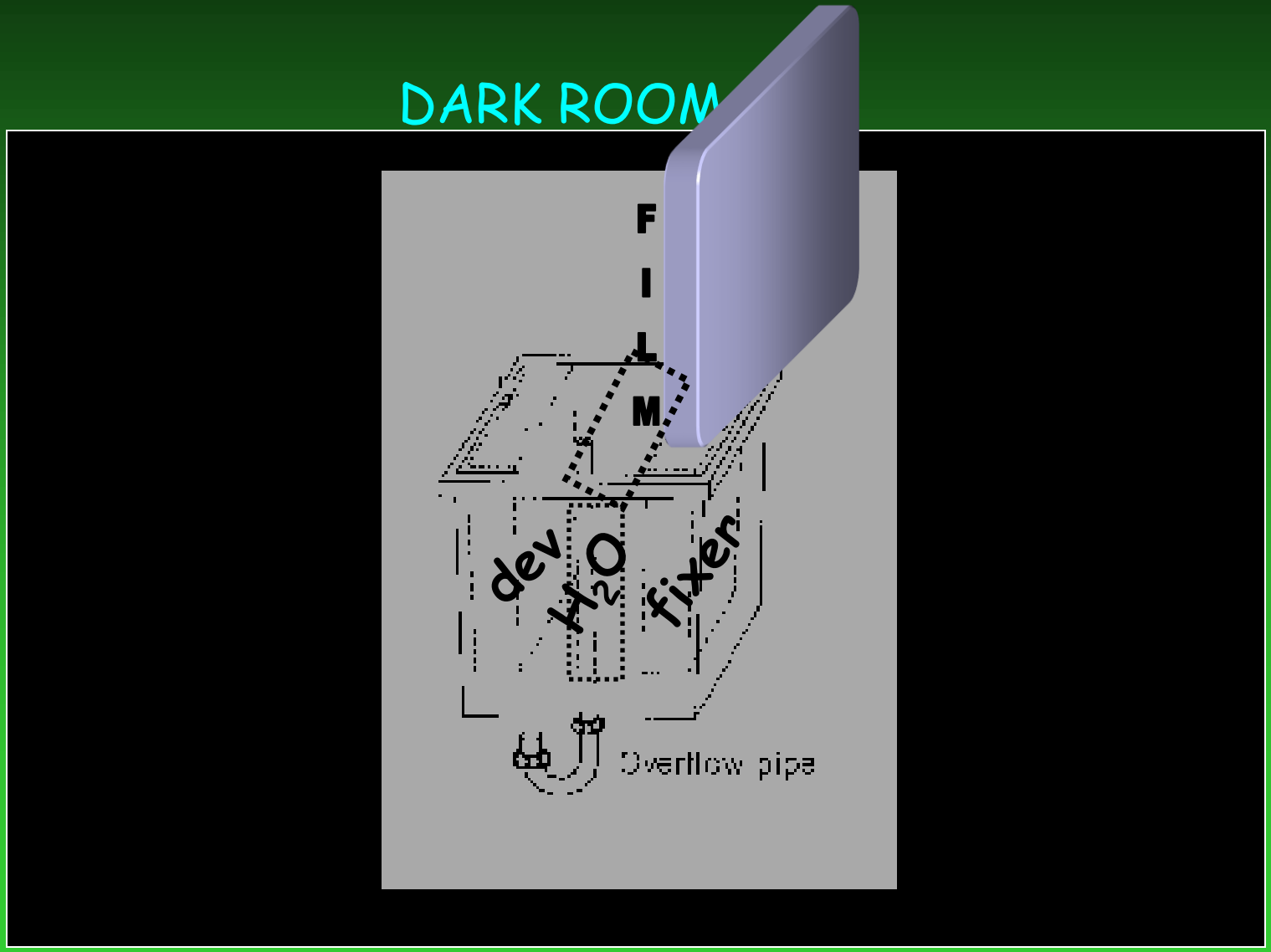




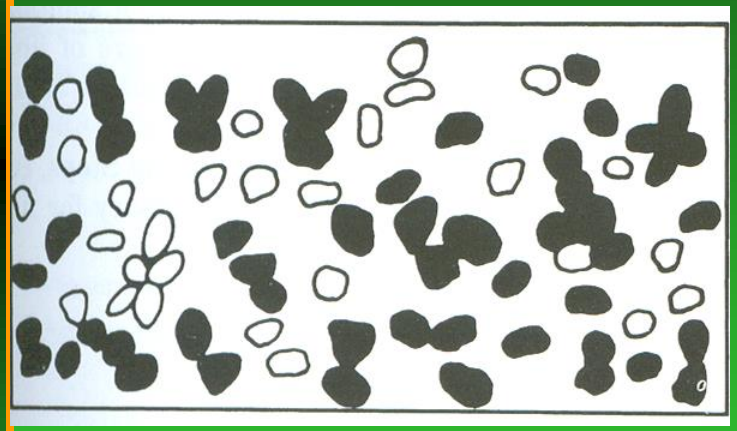
Film is rinsed in a running water bath

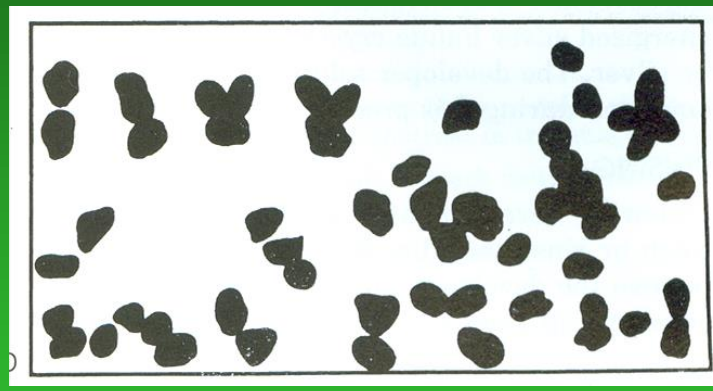


Film is immersed in a fixing solution



What happens ??

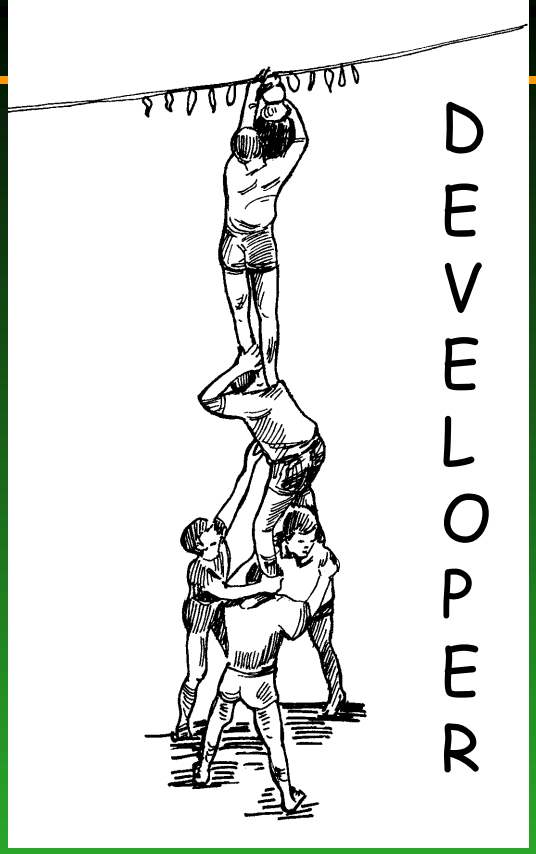




Fixer removes the unexposed silver halide crystals & creates white or clear areas on RG.

Film is washed in running water bath

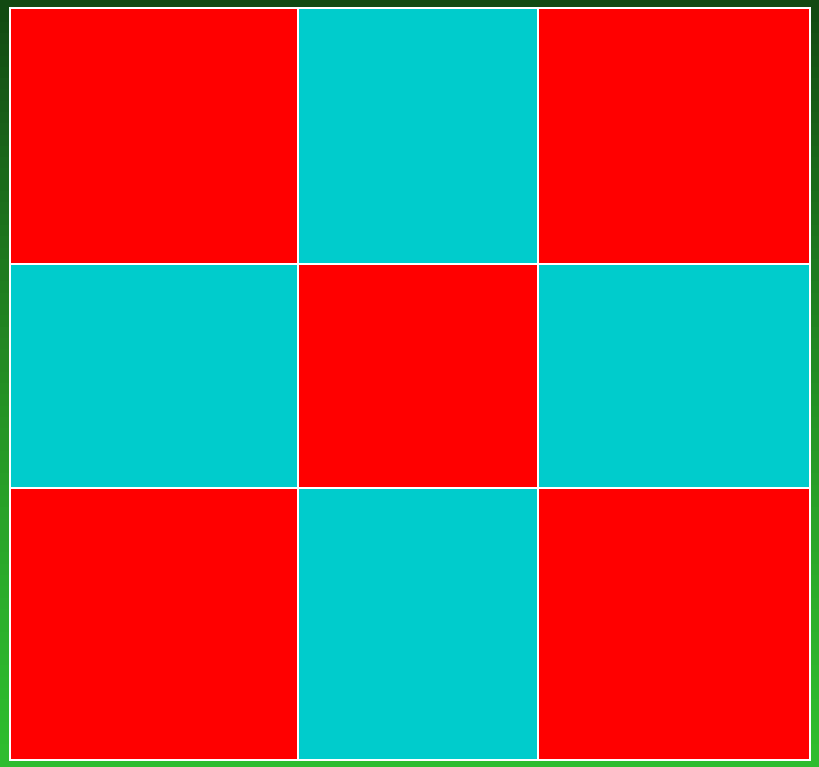
Film is dried and mounted for viewing



PROCESSING

FIXER

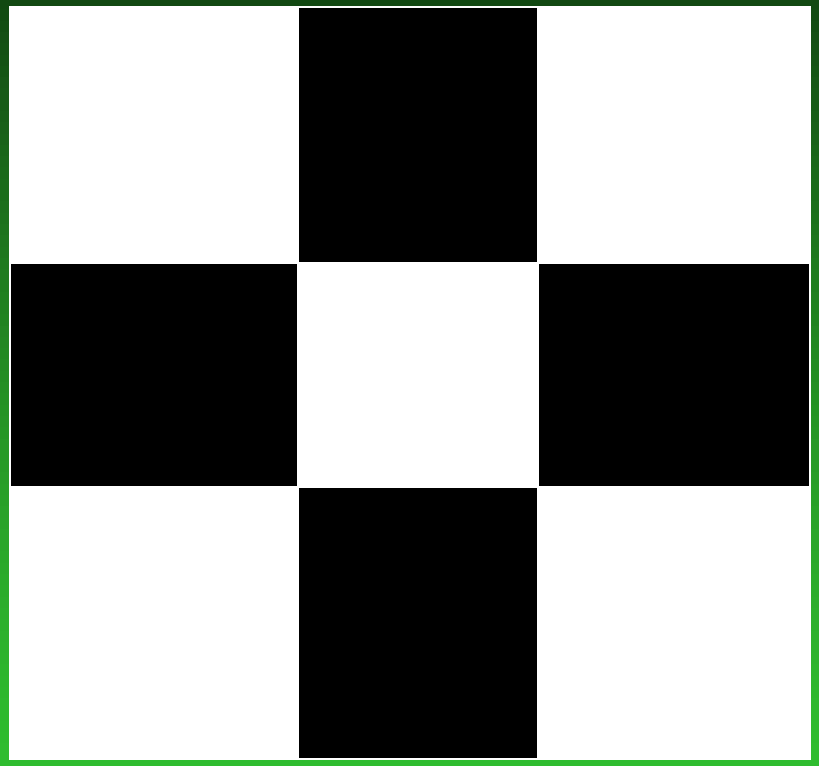
THE VISIBLE IMAGE



Hard tissue

Soft tissue

THE VISIBLE IMAGE



Hard tissue

Soft tissue

Black areas on RG created by deposits of metallic silver

'White' or clear areas- no metallic silver

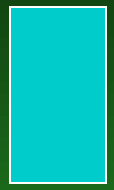
THE VISIBLE IMAGE

RADIOLUCENT: A structure that readily permits the passage of the x-ray beam & allows more x-rays to reach the film

> x-rays reaching film, greater no. of Ag halide becoming exposed & energized* (*latent image) greater the deposits of black metallic silver*(*P)

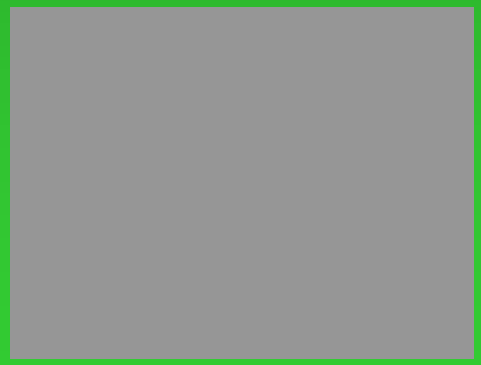
RADIOPAQUE : A structure that resists the passage & restricts or limits the amount of x-rays that reach the film. If no x-rays reach film, no silver halide crystals in the film emulsion are exposed, hence no deposits of black metallic silver*(*P)

THE VISIBLE IMAGE

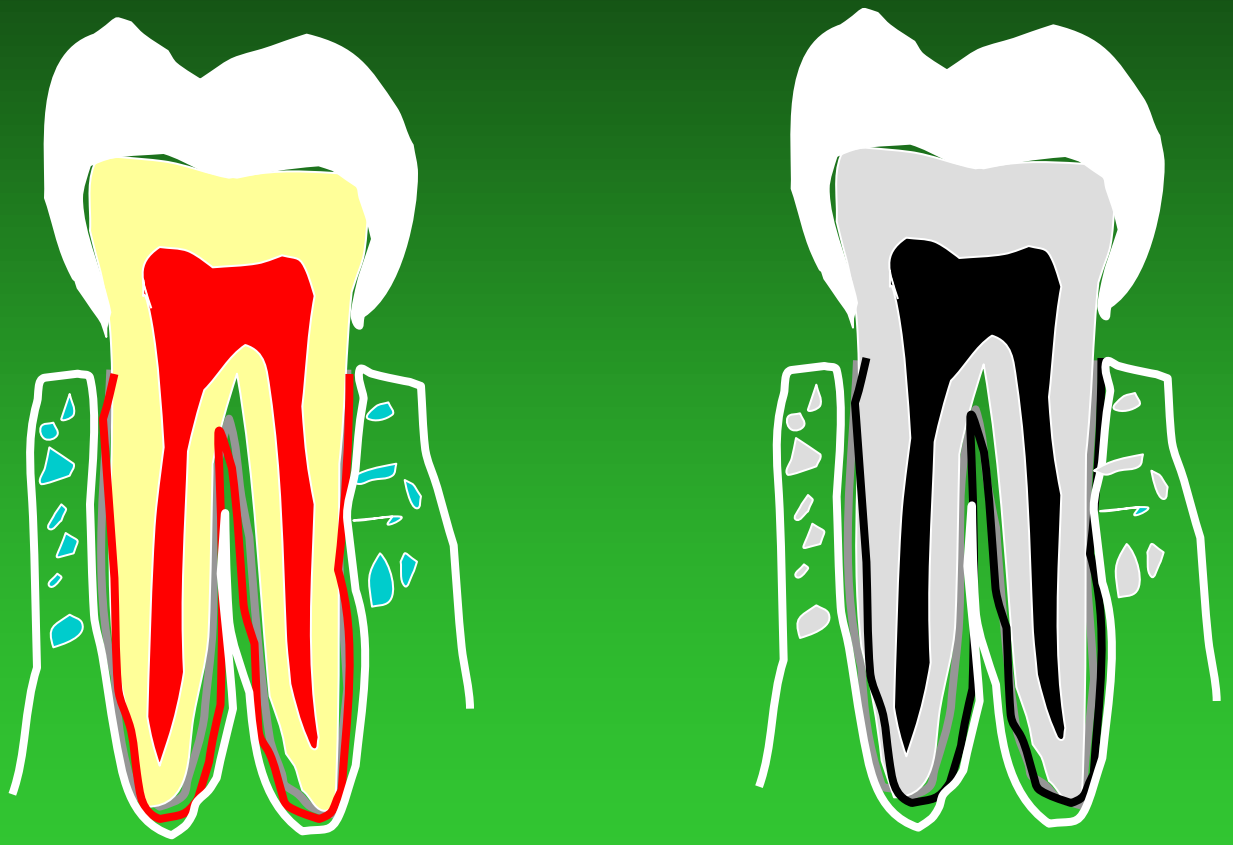



MORE MINERALIZED

LESS MINERALIZED



THE VISIBLE IMAGE



Methods of film Processing

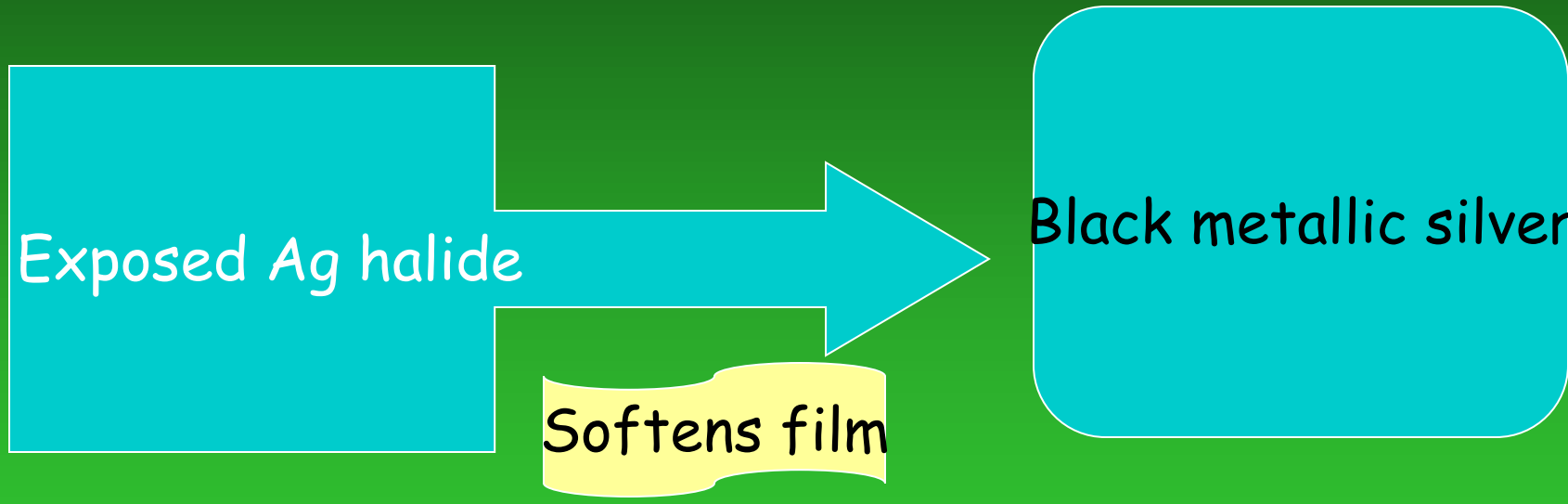
- Manual
  - Time-temperature method
  - Visual
- Automatic

Steps in film processing

I. Development
II. Rinsing in water
III. Fixation
IV. Washing
V. Drying

Steps in film processing

I. Development



Steps in film processing

I. Development

II. Rinsing in water

To remove developer from film

Stop The development process

Steps in film processing

I. Development

II. Rinsing in water

III. Fixation

Removes Unexposed, unenergized Ag halide

Hardens the Film emulsion

Steps in film processing

I. Development

II. Rinsing in water

III. Fixation

IV. Washing

To remove all excess chemicals From film emulsion

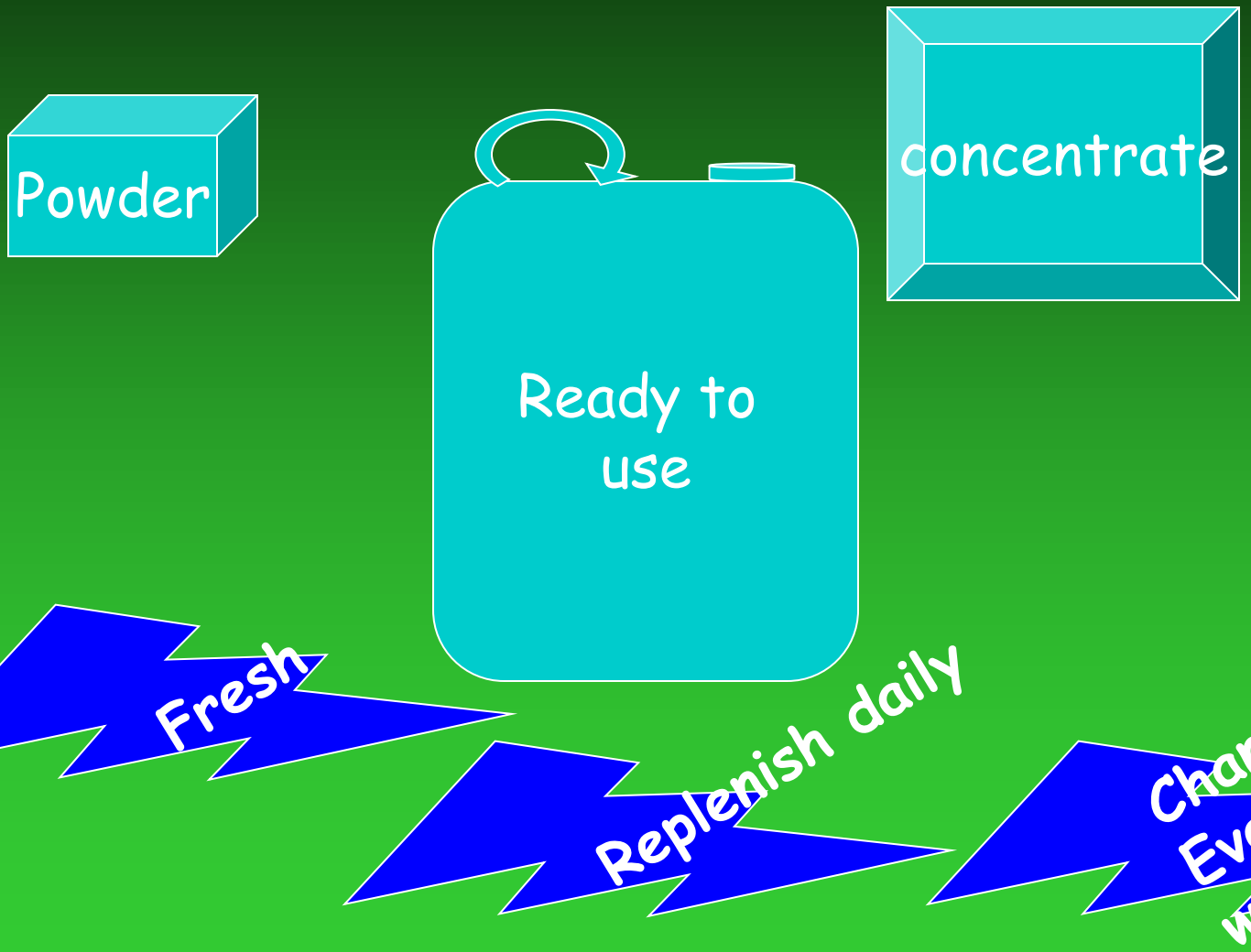
Steps in film processing

I. Development
II. Rinsing in water
III. Fixation
IV. Washing
V. Drying:

Air dried at room temp

Heated drying cabinet

Film processing solutions



DEVELOPER SOLUTION

I. Developing agent

Reduce the exposed Ag halide crystals chemically to black metallic silver

Hydroquinone

Elon (metol)

Slowly

Combination

Quickly

DEVELOPER SOLUTION

I. Developing agent

Reduce the exposed Ag halide crystals chemically to black metallic silver

Hydroquinone

- Generates black tones
- Sharp contrast
- Temp. sensitive
- 60-80^{0}F (68^{0}F)

Elon (metol)

- Acts quickly
- Generates GRAY shades

DEVELOPER SOLUTION

I. Developing agent

Two types

Elon hydroquinone combination

Phenidine hydroquinone combination

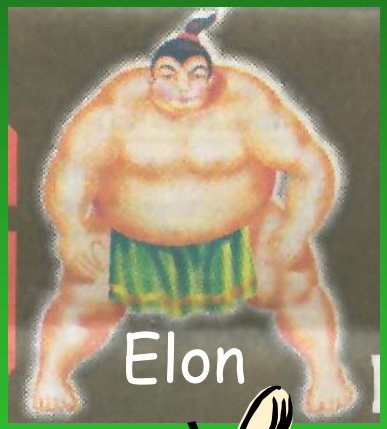
- 10-15 times more effective
- Does not exhaust as quickly
- Less susceptible to restrainer

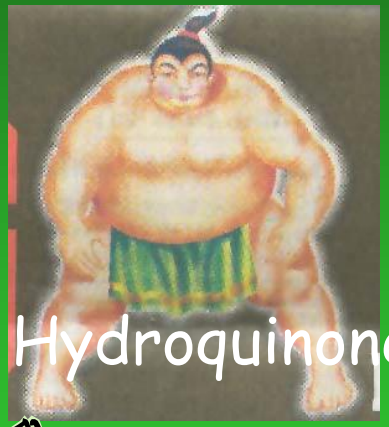
DEVELOPER SOLUTION

II. Preservative

Prevent the developer solution from oxidizing in the presence of air

O_2





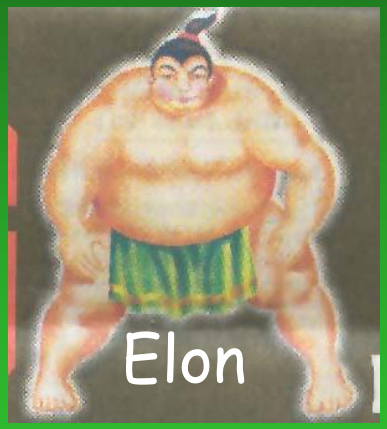
DEVELOPER SOLUTION

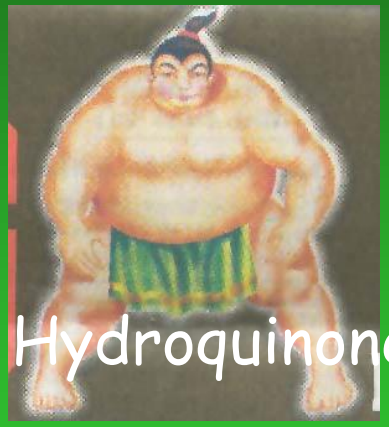
II. Preservative

Prevent the developer solution from oxidizing in the presence of air

O_2

PRESERVATIVE





O_2 +Preservative (Na sulphite) → Na sulfate

DEVELOPER SOLUTION

II. Preservative

Prevent the developer solution from oxidizing in the presence of air

- Prevents oxidation of Developer
- Combine with brown oxidized developer

  to form colorless solution
- Prevent staining of film

DEVELOPER SOLUTION

III. Activator

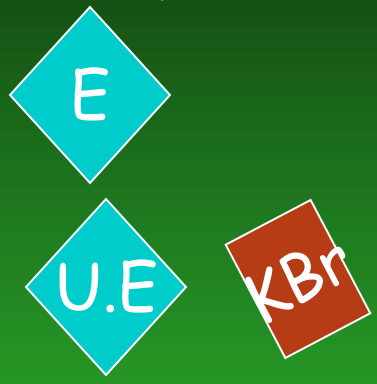
- Also called accelerator
- Alkali sodium carbonate, Na hydroxide, Na metaborate or Na tetraborate

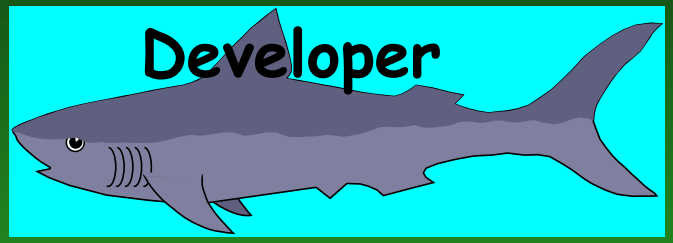
1. Activates the developing agents, active only in alkaline PH
2. Causes emulsion to swell
3. Softening of emulsion

4. Developer can diffuse more rapidly into emulsion

DEVELOPER SOLUTION

IV. Restrainer- Potassium bromide





1. Control the developer
2. Most effective in stopping development of unexposed crystals
3. Prevents **Fogging**

DEVELOPER SOLUTION

V. Solvent - Water

1. Common constituent of D & F
2. Distilled water preferable
3. Hard water may cause precipitates on film

Developing Time

Period required for the image to develop optimum density and contrast

I. Constitution of solution

- High contrast
- High speed
- Minimum fog

Developing Time

Period required for the image to develop optimum density and contrast

II. Temperature of solution

- Hydroquinone most temperature sensitive
- Lower temp. - longer time
- Higher temp. – shorter time

Developing Time

Period required for the image to develop optimum density and contrast

III. Degree of exhaustion of solution

Developing Time

Period required for the image to develop optimum density and contrast

III. Degree of exhaustion of solution

1.Developer when in use

Developing agents + AgBr – Ag + Bromide ions + hydrogen ions + oxidized developing agent

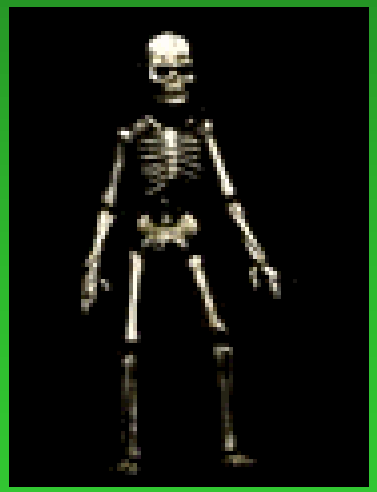
2. Developer when not in use

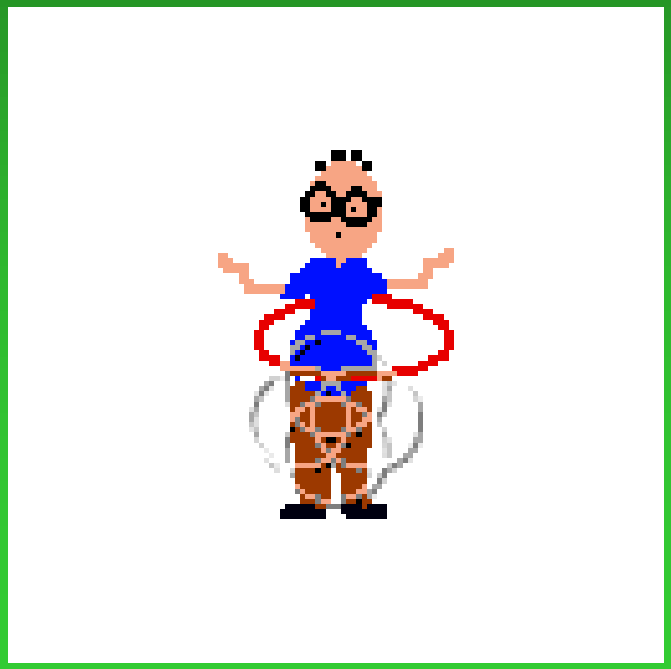
Developing agents + O^2 – Oxidized developing agents + hydroxyl ions

Developing Time

Period required for the image to develop optimum density and contrast

IV. Agitation given to the solution and films



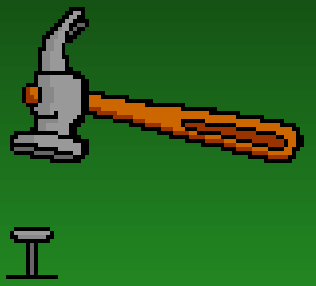


Agitation to solution and films

- Shorter development time
- Uniform development

FIXING

- Remove unexposed Ag-halide
- stop further action of developer
- harden film



FIXER SOLUTION

1. Fixing agent/ Clearing agent
2. Acidifier
3. Preservative
4. Hardener
5. Solvent
6. Other additives

FIXER SOLUTION

Fixing/Clearing agent

- Sodium thiosulfate (hypo)
- Ammonium thiosulfate

1.Silver Br + Na Th sulfate = Na Br + Na salt of mono argento-di thio-sulfuric acid

2.Silver Br + Am Th sulfate = Am Br + Am salt of mono argento-di thio-sulfuric acid

FIXER SOLUTION

Acidifier

- Acetic acid

Halts action of developer

FIXER SOLUTION

Preservative

- Acetic acid

- Prevents oxidation of thiosulfate
- Binds with oxidised developer

WASHING

Benefits of washing

- Removal of thiosulfate ions
- Removal of Ag thiosulfate complex

If film not washed thoroughly

- Yellow, yellowish brown stain
- Silvery stain

Drying

- Removal H_2O from gelatin surface
- Do not over dry

FIXER SOLUTION

Other additives

Anti-sludge agent

- Boric acid

Processing - AVS

Processing - AVS

Processing - AVS

Processing - AVS

Processing - AVS

Processing - AVS

Processing - AVS

Processing - AVS