Fingerprints Forever

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L6?9 DOP

Fingerprints forever

Visualizing fingerprints in the corrosion that sweat causes to metals

Fingerprints forever

How do fingerprints solve crime?

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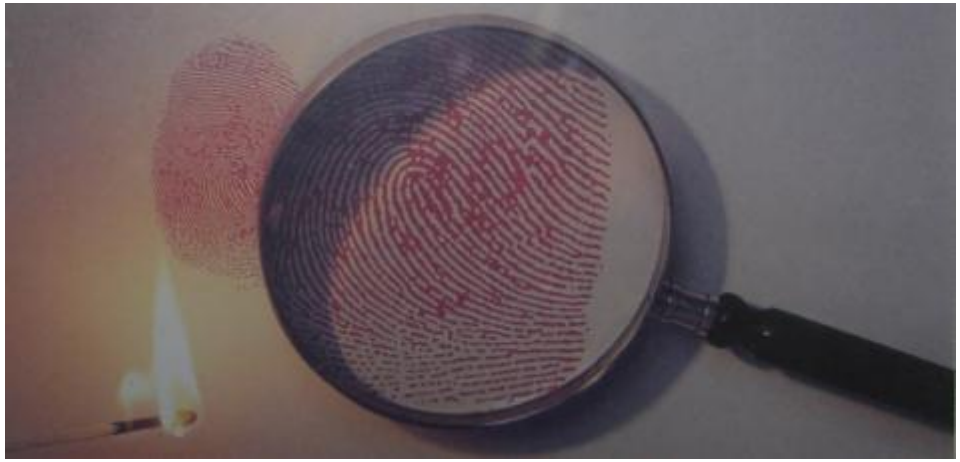
"As he held the match nearer I saw it was the well marked print of a thumb"



"You are aware that no two thumb marks are alike"

What are fingerprints

Arch

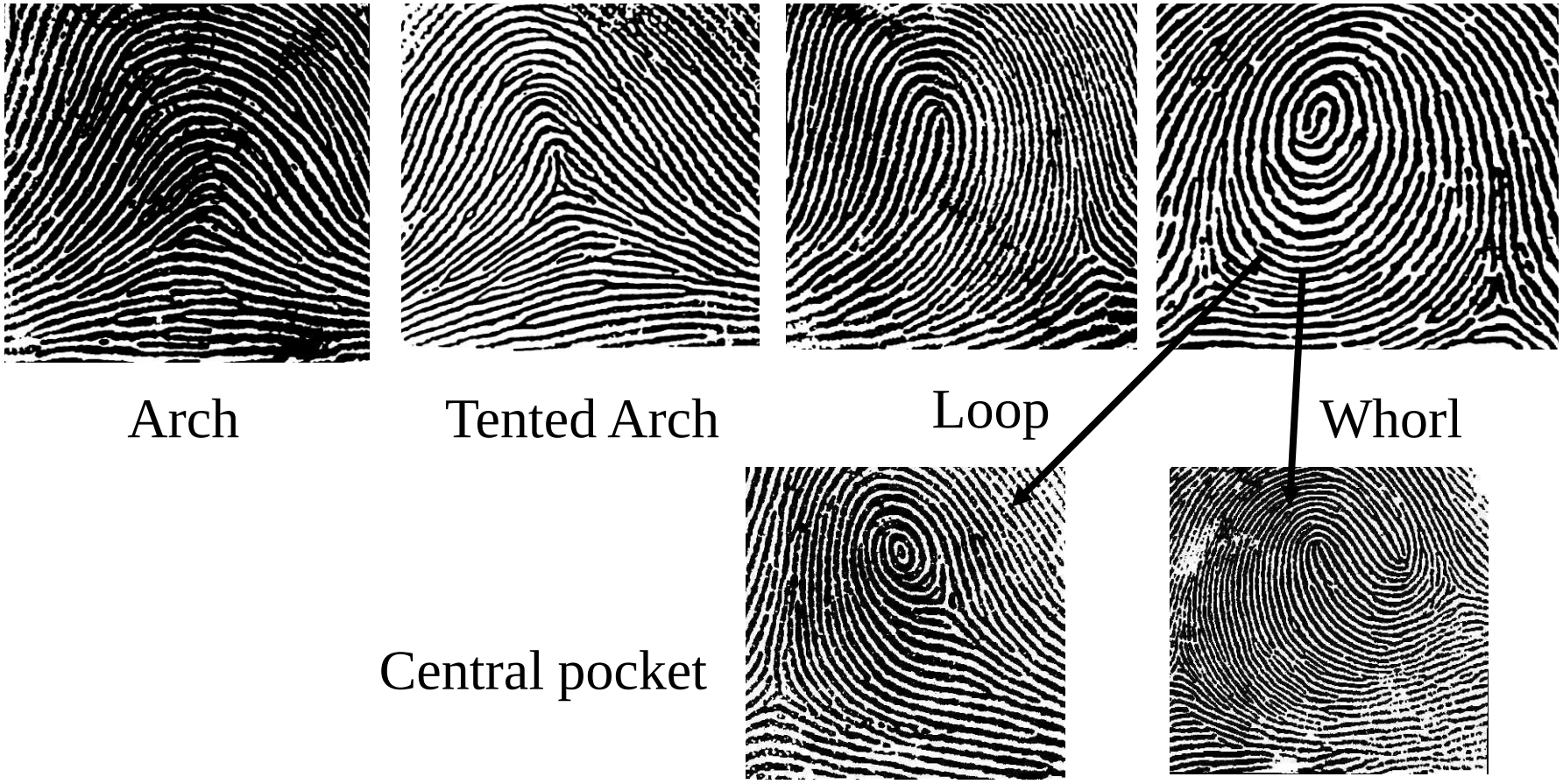
Tented Arch

Loop

Whorl

Fingerprint patterns

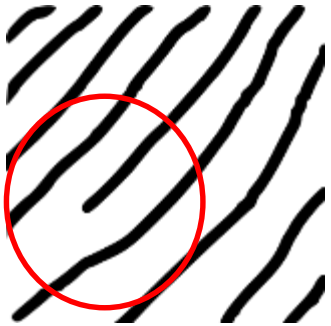
What are fingerprints



Fingerprint patterns

Ridge Features

- *Ridge ending* – the abrupt end of a ridge



- *Ridge bifurcation* – a single ridge that divides into two ridges

- *Short ridge*, or *independent ridge* – a ridge that commences, travels a short distance and then ends

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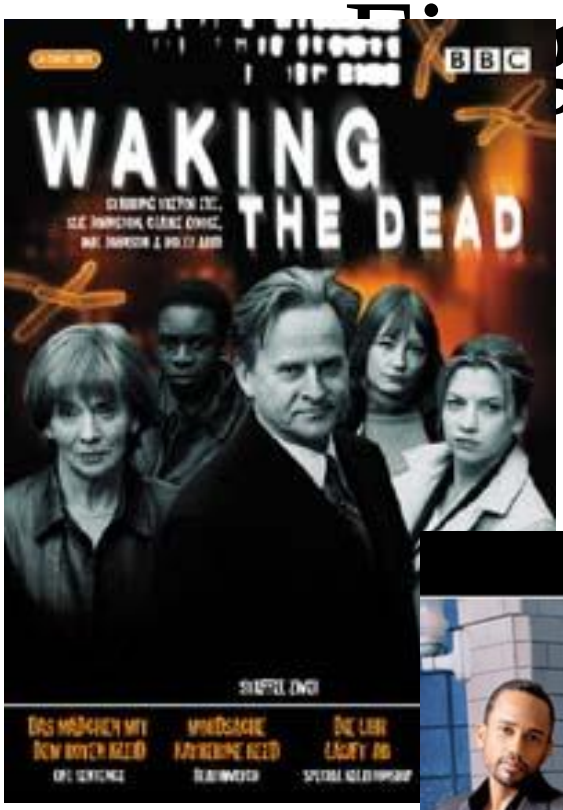

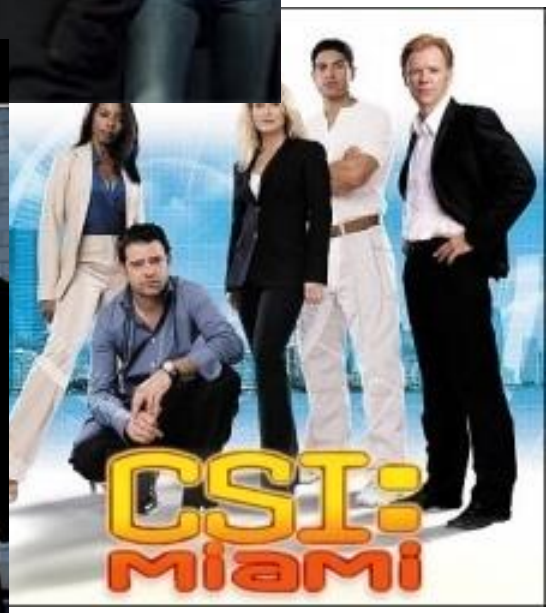

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What is metal corrosion?

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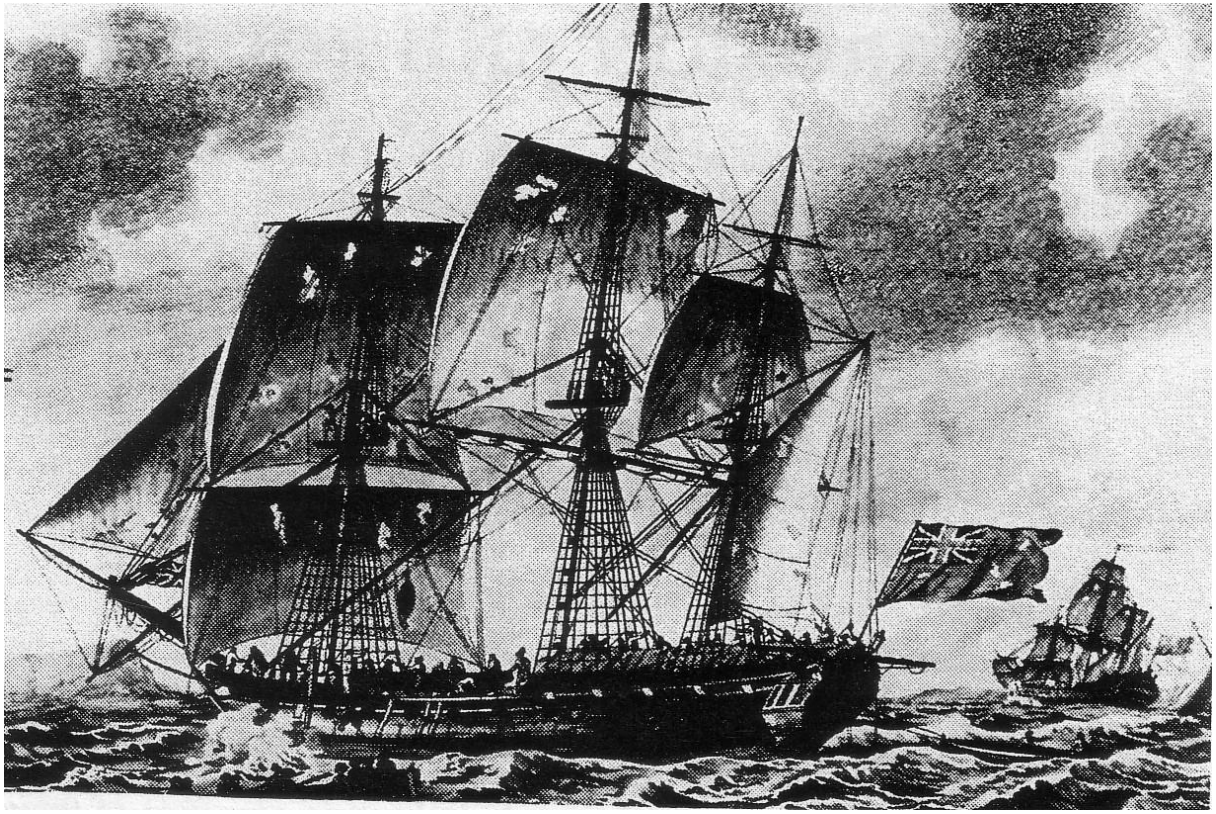

HMS Alarm, subject of the first recorded study of bimetallic corrosion, 1763

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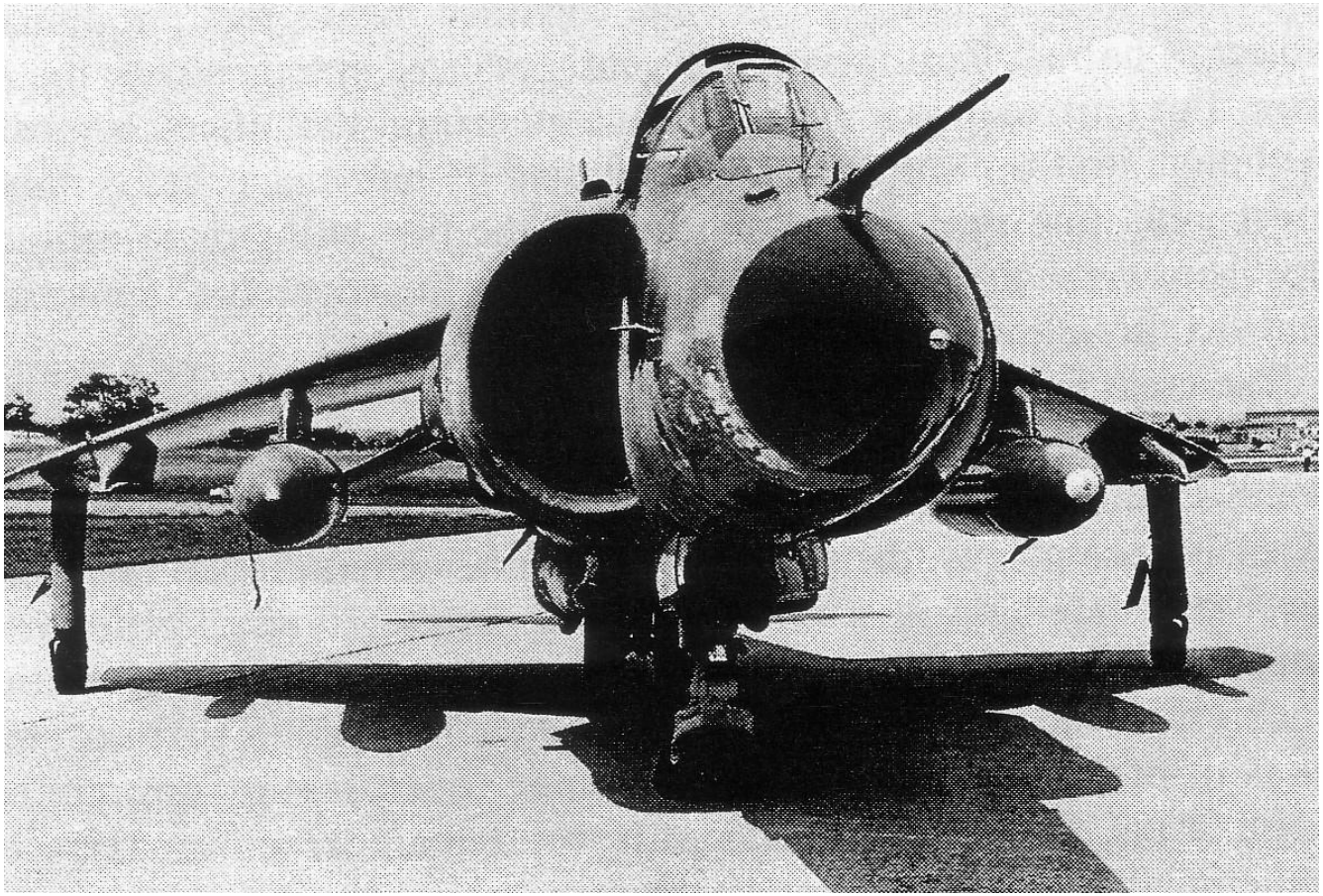

Royal Navy Sea Harrier

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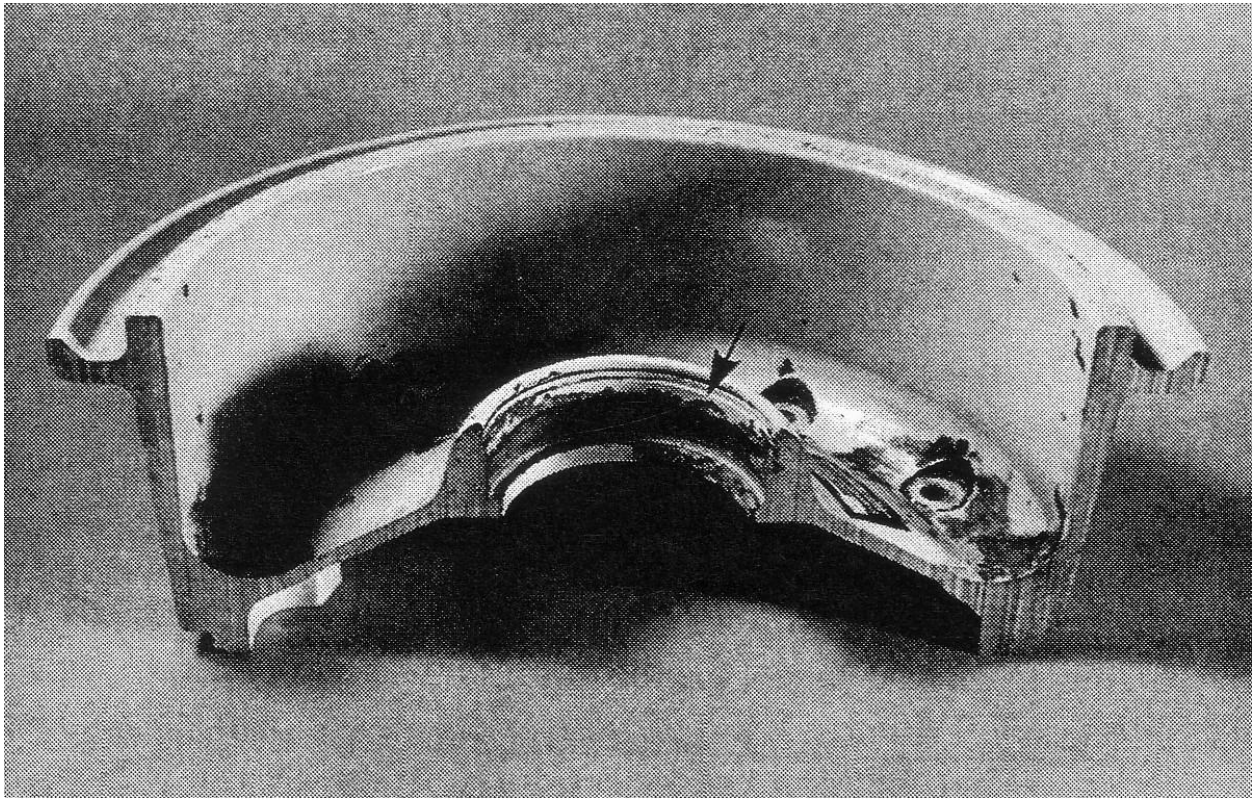

Cross section of failed wheel of Sea Harrier caused by bimetallic corrosion of magnesium alloy and steel, 1982.

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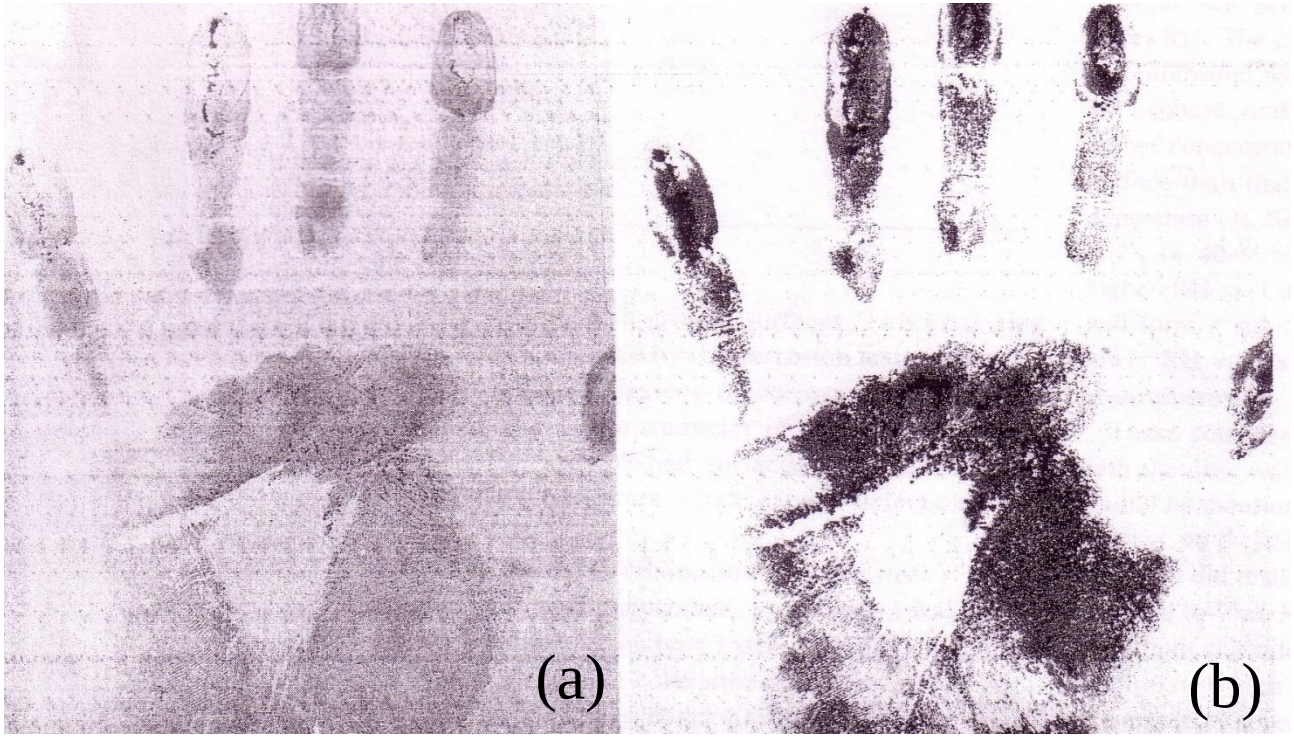

Hand print on mild steel (a) 2 weeks, (b) 2 months after deposition.

High salt = high corrosion in ‘rusters’ (hyperhidrosis)

Jensen *Acta Dermatovener* 1979

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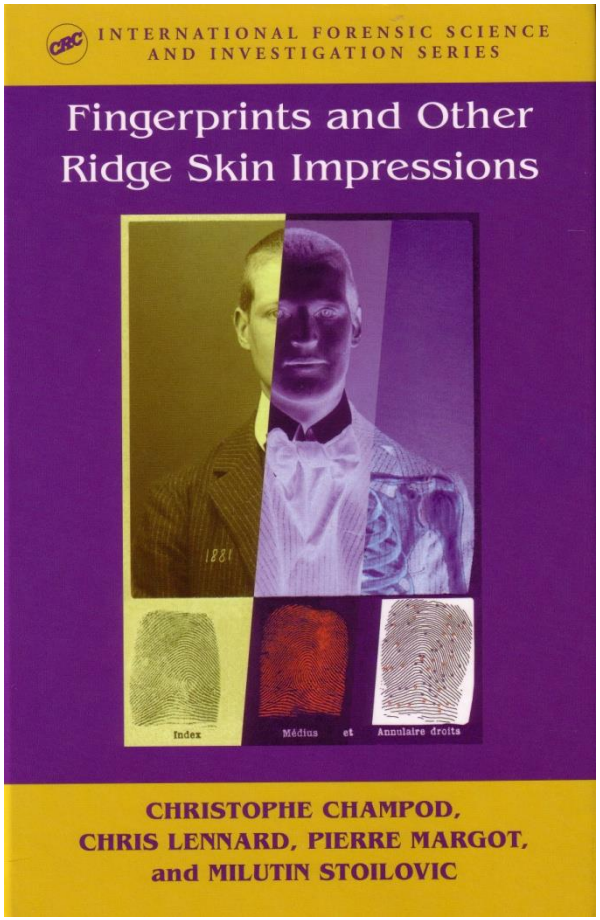

"…latent finger marks on brass cartridge cases may sometimes spontaneously develop over time……."

Champod et al. *Fingerprints and other ridge skin impressions* 2004

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Why does salt water
(or fingerprint sweat with salt in it)
corrode metal?

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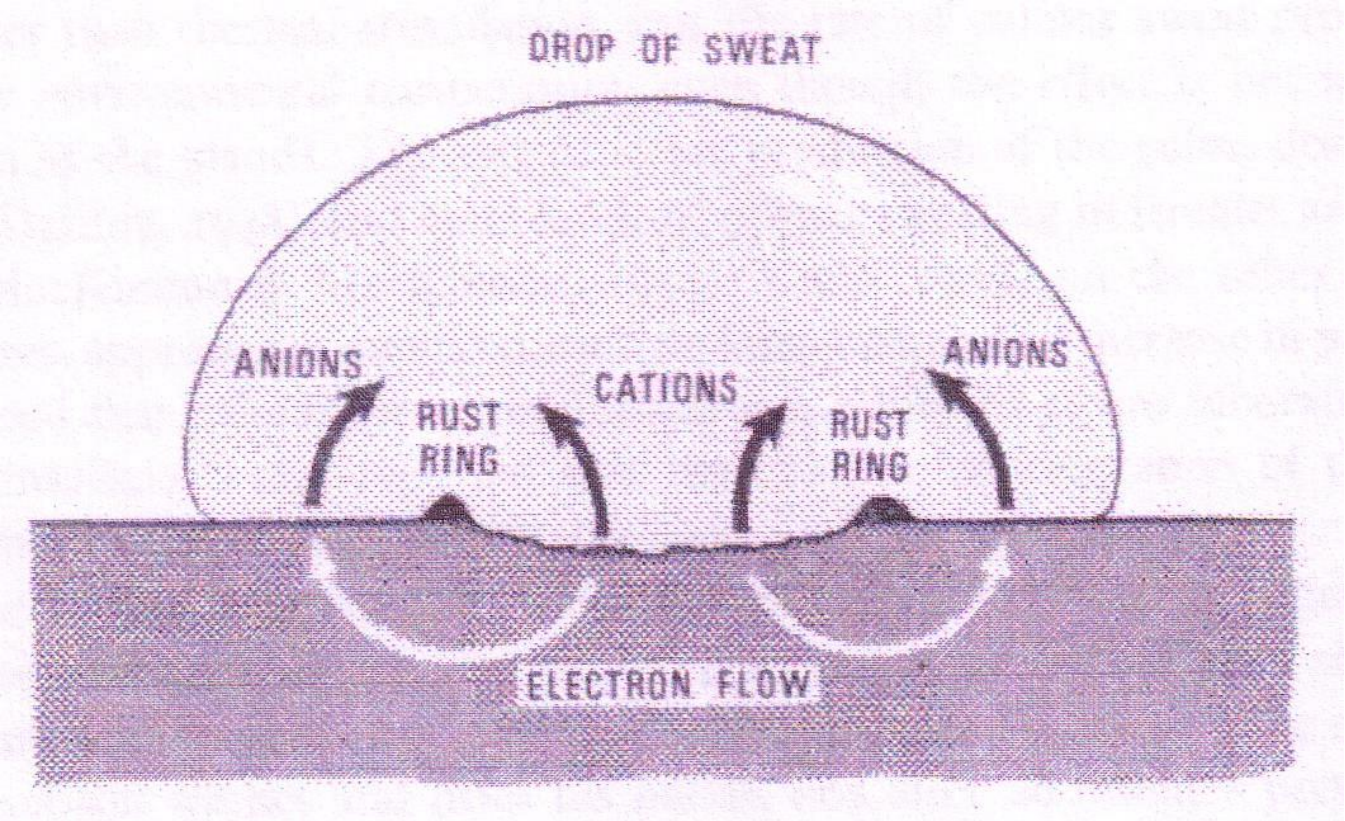

Corrosion of iron by a drop of sweat

Burton et al. *Br J Dermatol* 1976 (after Evans *An introduction to metal corrosion* 1963)

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Where does this electrical current come from?

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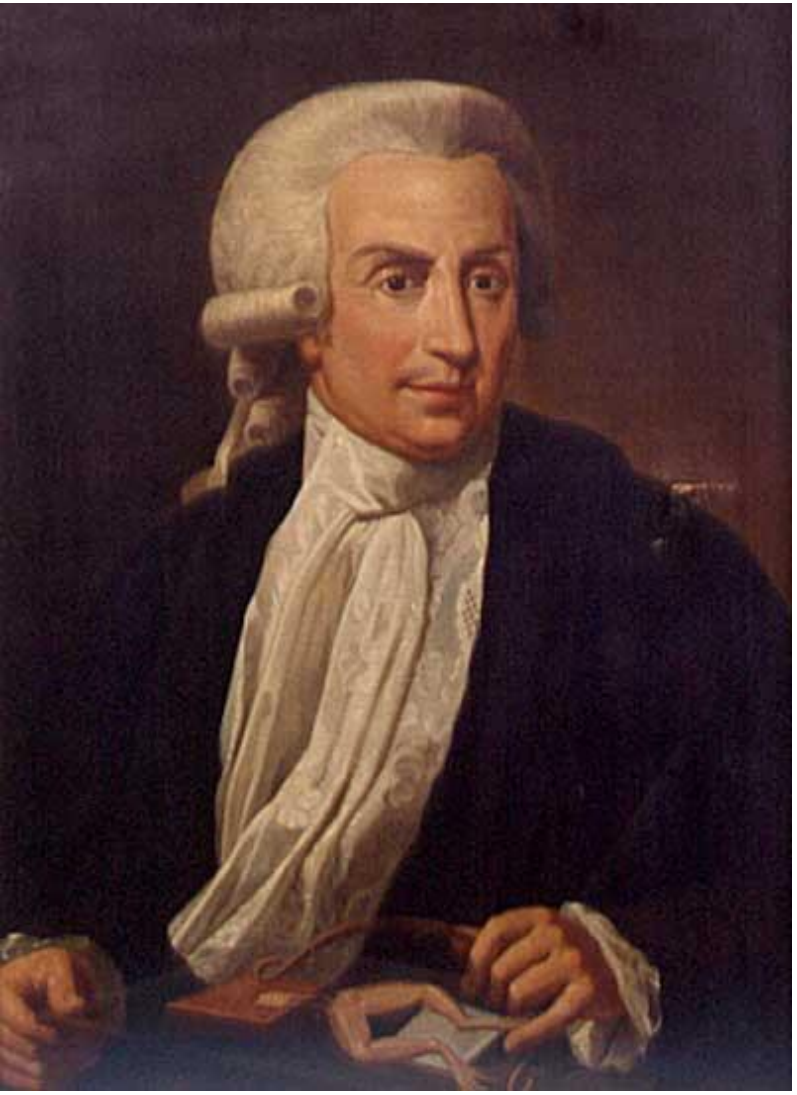

Luigi Galvani, 1737 – 1798

In 1786, whilst dissecting a frog, Galvani's assistant touched an exposed sciatic nerve of the frog with a metal scalpel, which had picked up an electrical charge. They saw sparks and the dead frog's leg kicked as if it were alive.

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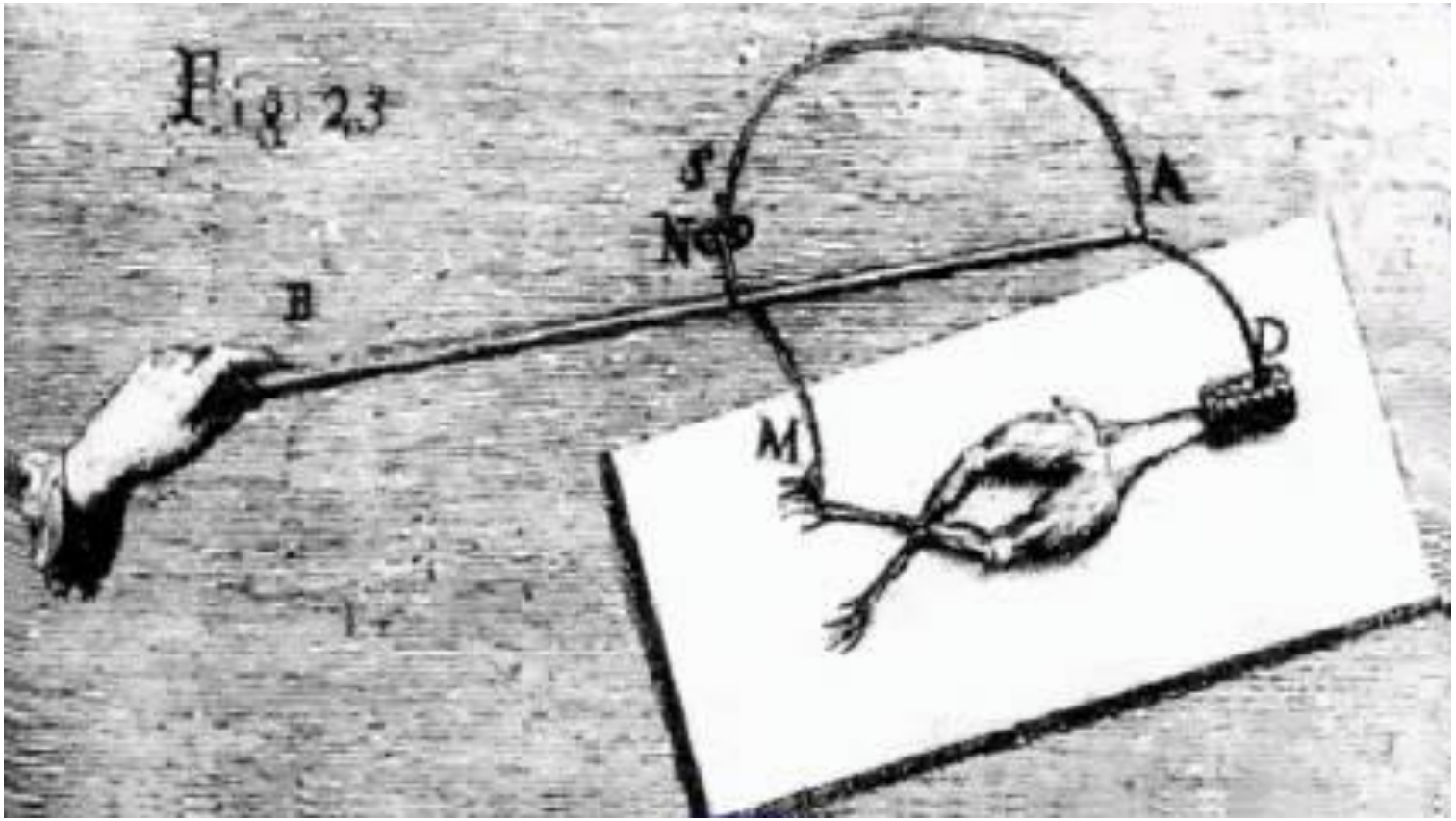

Galvani called this *animal electricity.*

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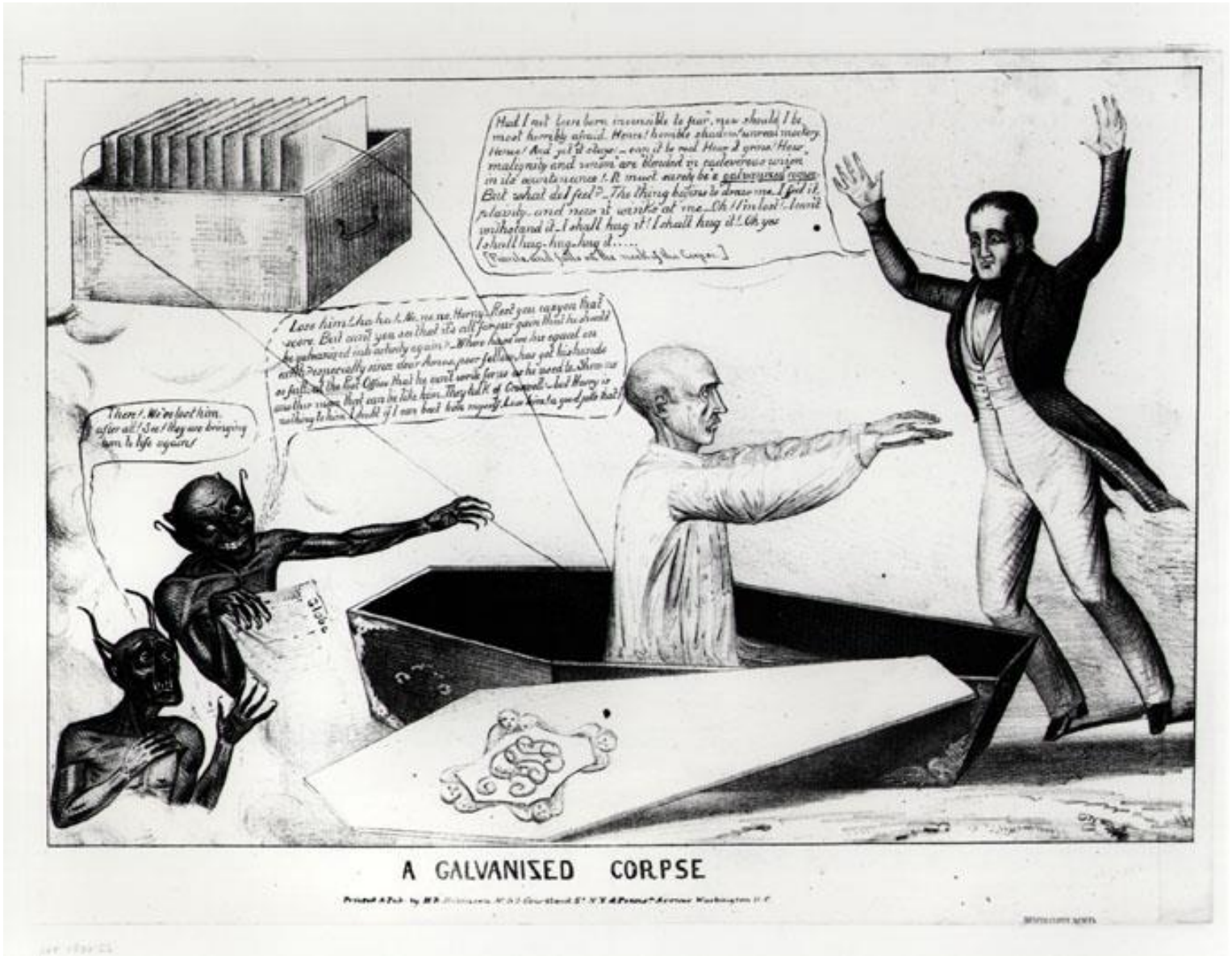

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1084. The most striking effects of Galvanism on the human frame, after death, were exhibited at Glasgow, a few years ago. The subject on which the experiments were made was the body of the murderer Clydesdale, who was hanged at that city. He had been suspended an hour, and the first experiment was made in about ten minutes after he was cut down. The galvanic battery employed consisted of 270 pairs of four-inch plates. On the application of the battery to different parts of the body, every muscle was thrown into violent agitation; the leg was thrown out with great violence, breathing commenced, the face exhibited extraordinary grimaces, and the finger seemed to point out the spectators. Many persons were obliged to leave the room from terror or sickness; one gentleman fainted, and some thought that the body had really come to life.

Natural and Experimental Philosophy, 1854

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“I saw the hideous phantasm of a man stretched out, and then, on the working of some powerful engine, show signs of life, and stir with an uneasy, half vital motion“.

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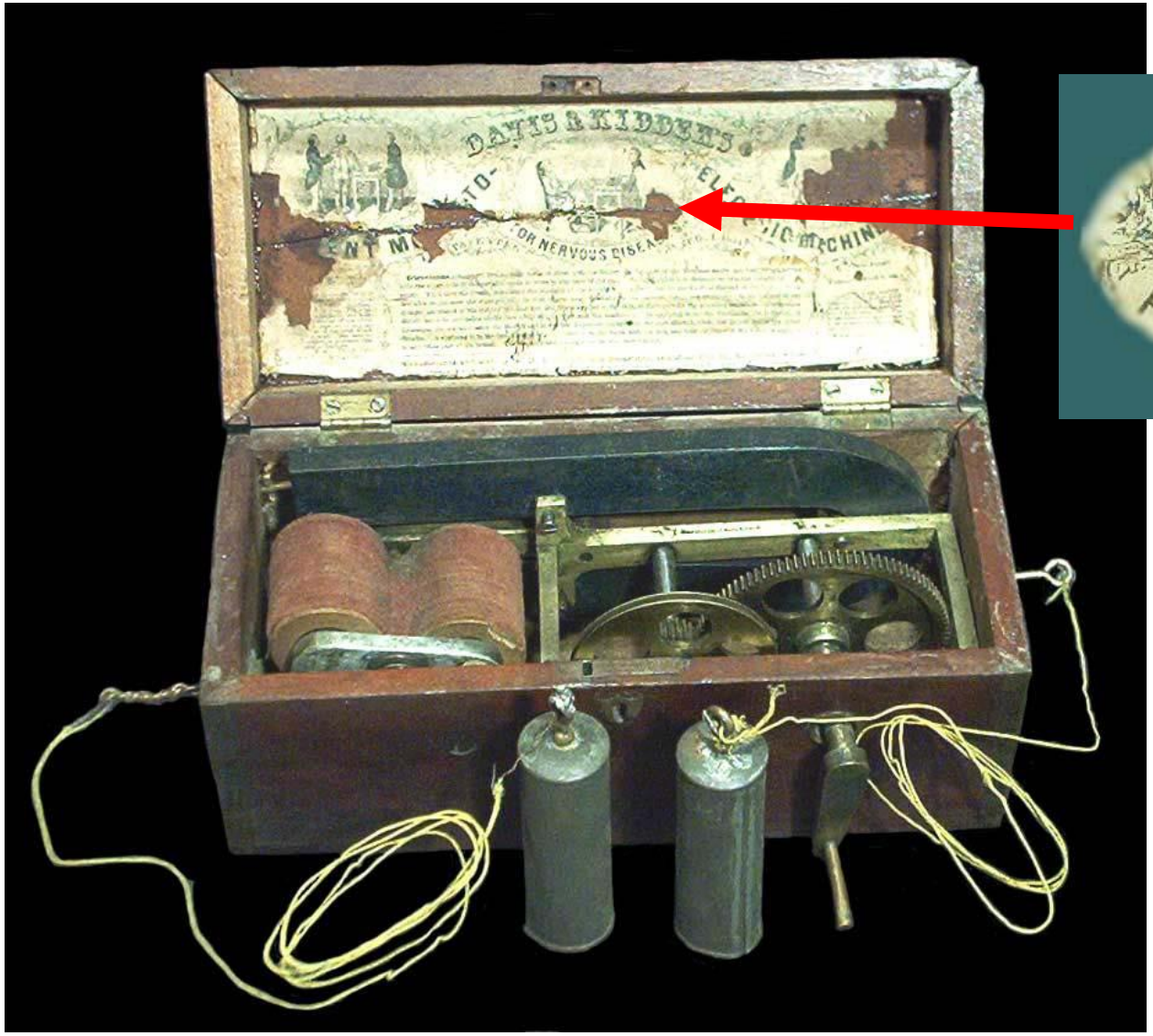

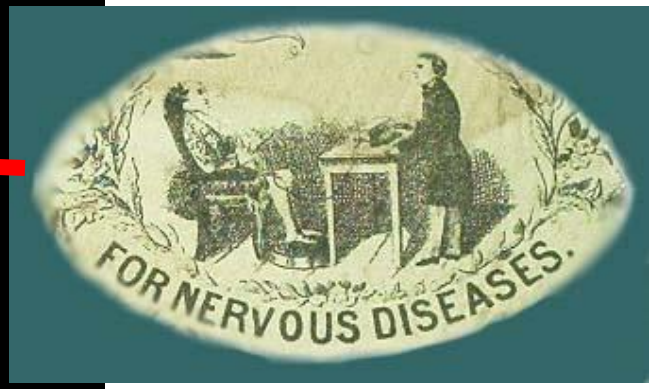

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Rejuvenate your complexion, revitalize your scalp, and refine your body.

- Introducing Nu Skin Galvanic Spa™ II system:
- Programmable device with patented self-adjusting Galvanic currents and interchangeable heads for the face, scalp and body.
- Works synergistically with specially formulated products to facilitate transport of key ingredients delivering revitalizing, restorative and rejuvenating benefits.

Galvanic Spa™ II

NU SKIN

Fingerprints Forever

Fingerprints Forever

A contemporary of Galvani, Alessandro Volta, reasoned that animal electricity was a physical phenomenon.

Volta coined the term *galvanism* when an electrical current is produced by chemical action.

Volta built the first battery or “Voltaic Cell”

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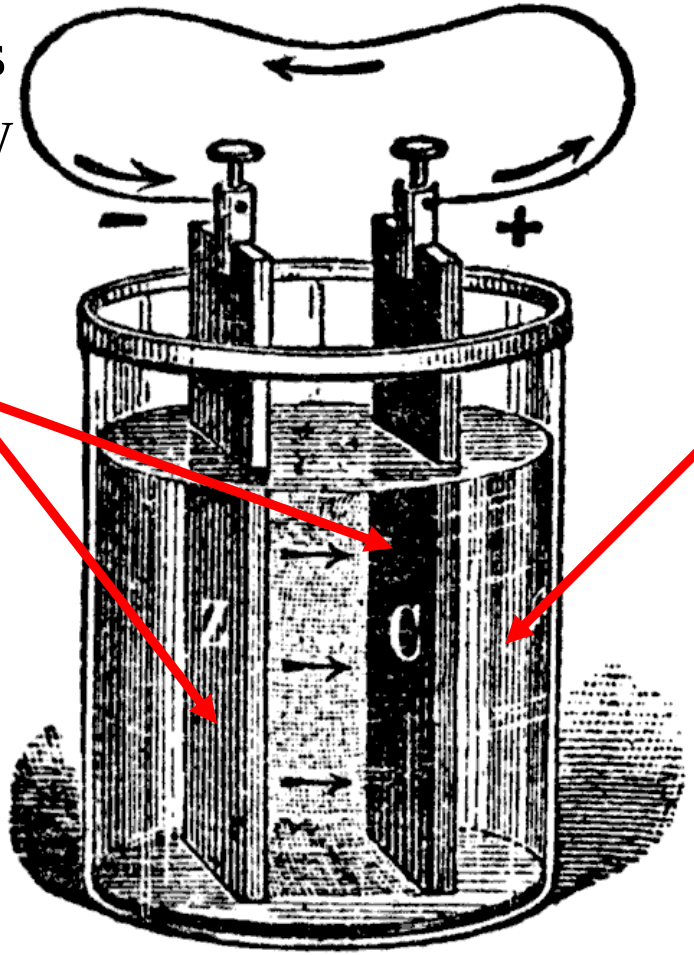
Connecting electrodes
Causes current to flow

Dissimilar metals
(e.g. copper and zinc
= electrodes)



Conducting liquid
(e.g. salt solution
= electrolyte)

An early voltaic cell

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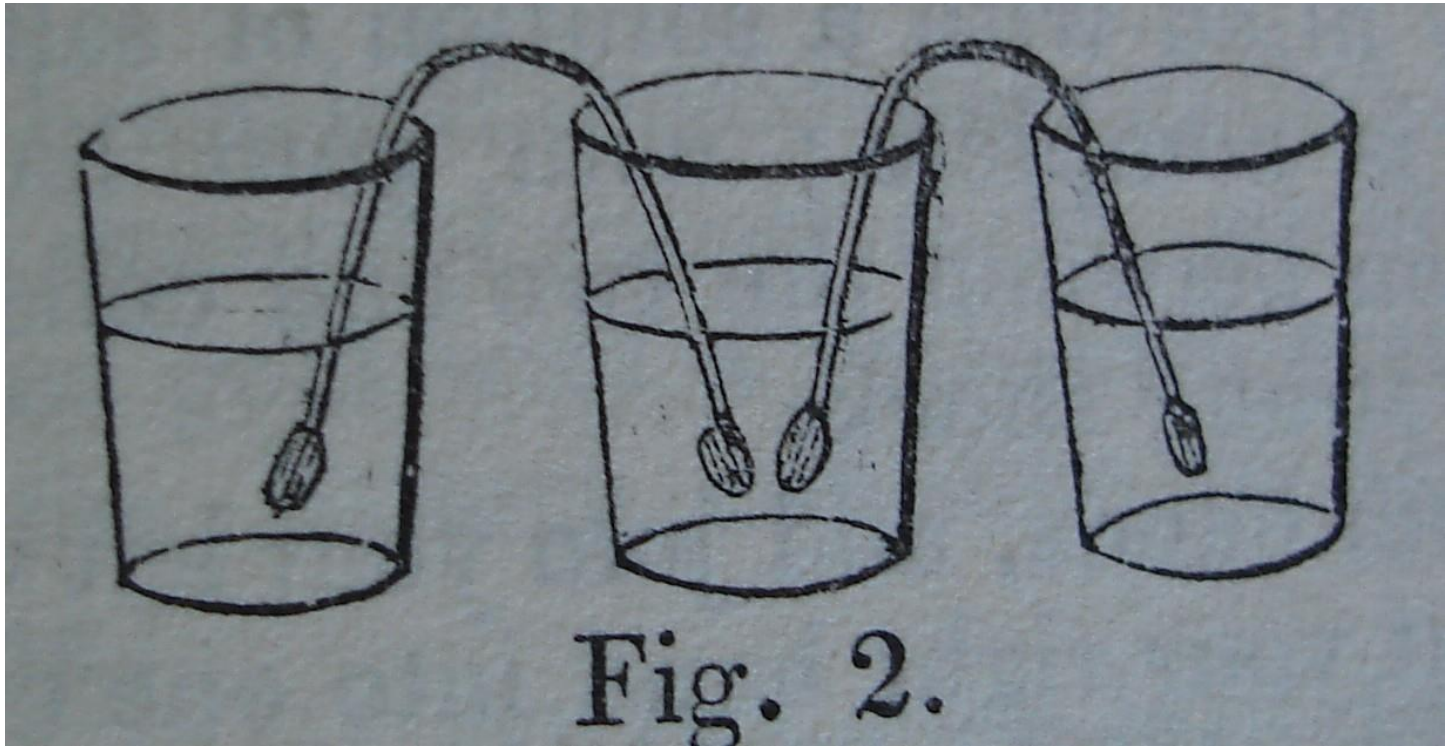

A home made voltaic cell, silver and zinc in solutions of salt water
Scientific Dialogues, 1836

"Dip one hand into the first glass, and the other into the last"

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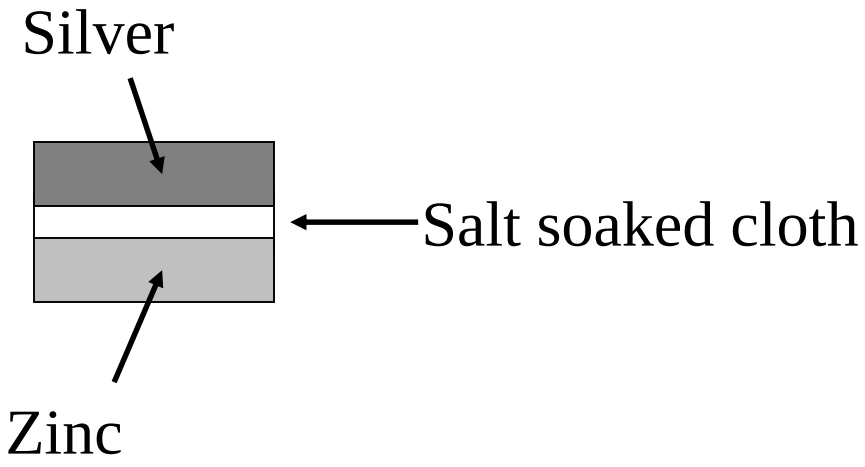
A voltaic pile



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How does this work with fingerprint sweat?

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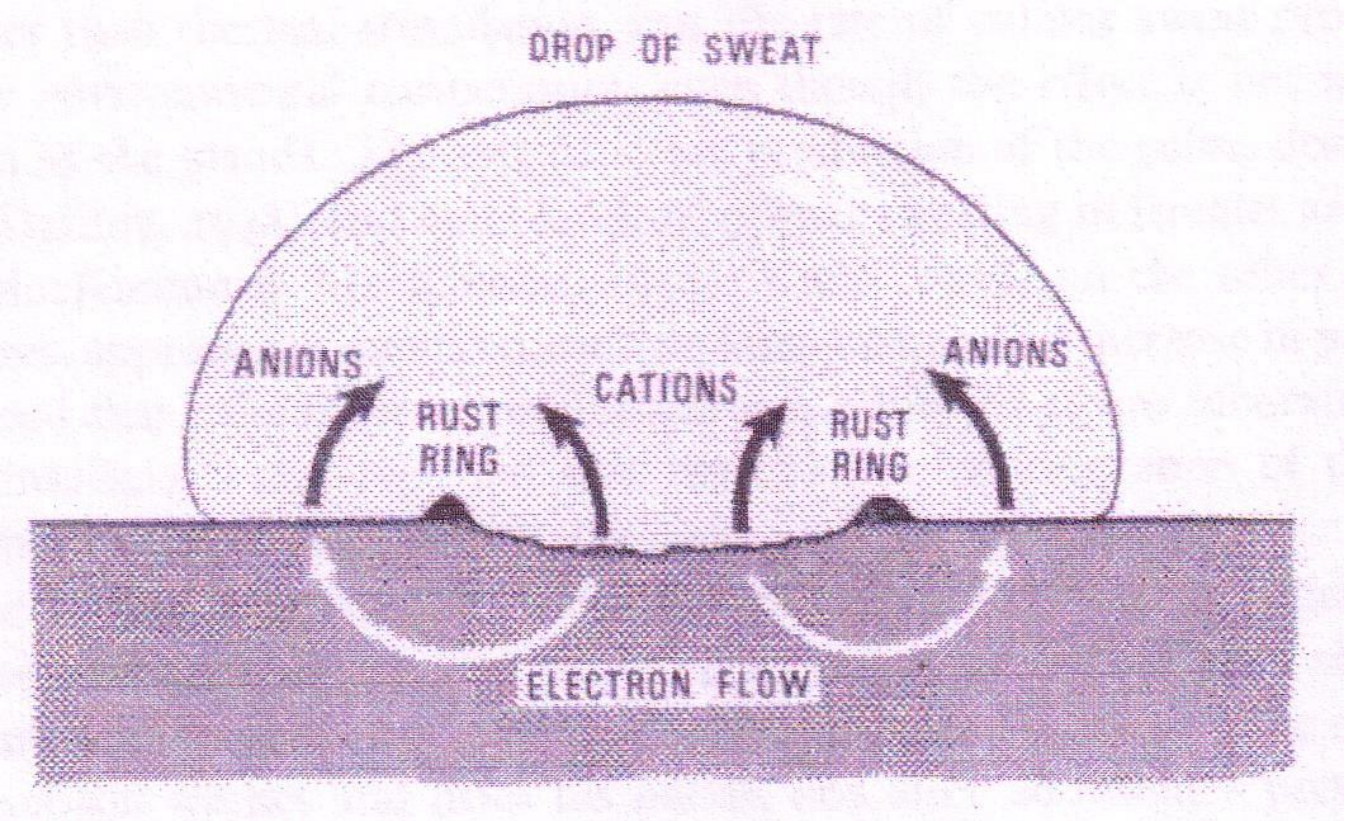

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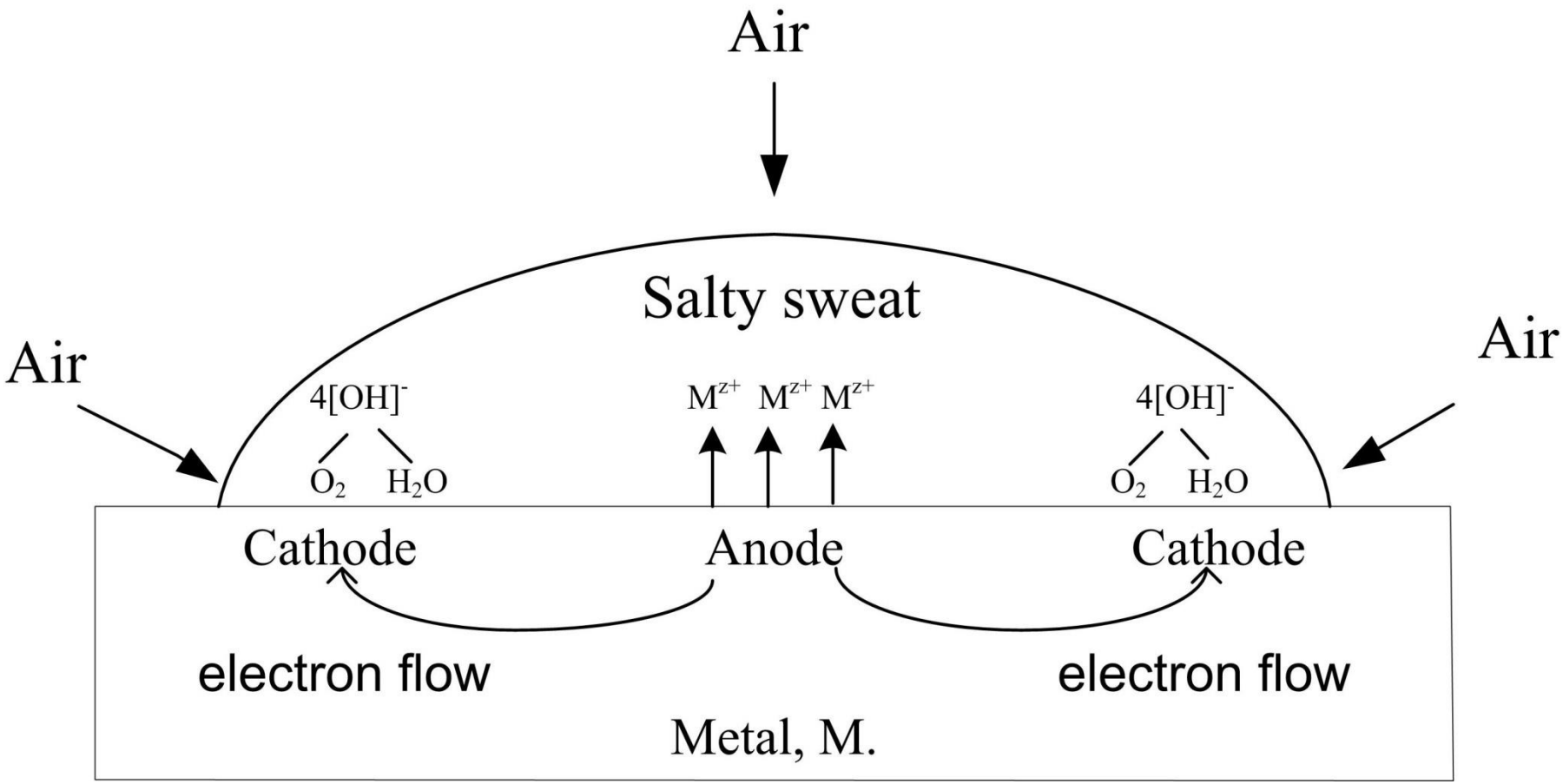
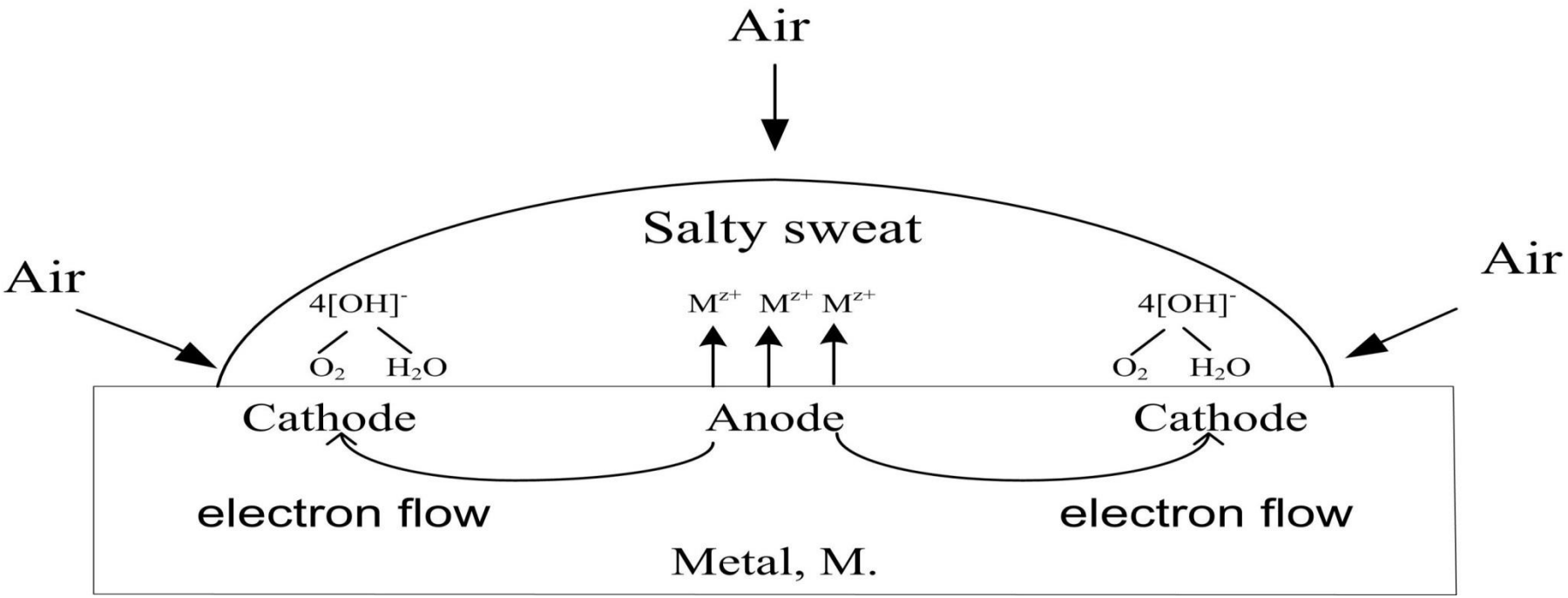


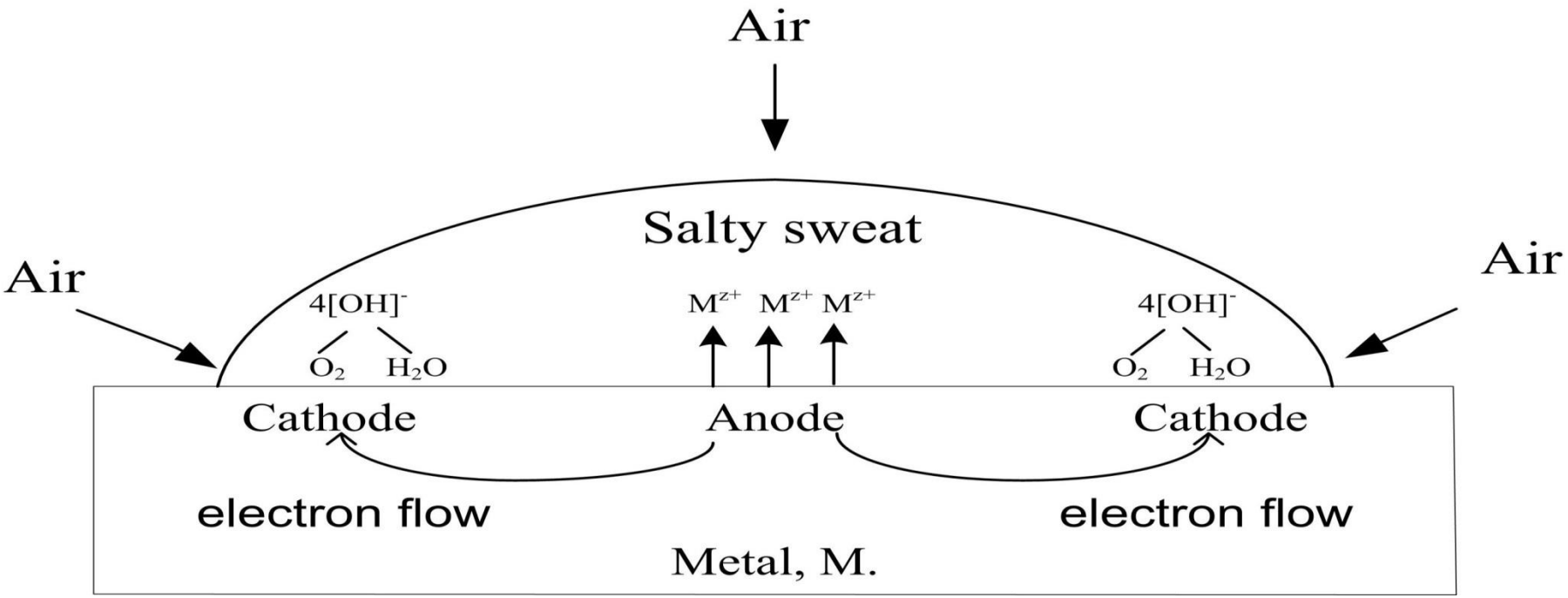


$$Cu + Cl^- \rightarrow CuCl_{ads} + e^- \qquad CuCl_{ads} + Cl^- \rightarrow CuCl_2^-$$

$$2CuCl_2^- + H_2O \rightarrow Cu_2O + 2H^+ + 4Cl^-$$

$$Zn + 4Cl^- \rightarrow ZnCl_4^{2-} + 2e^- \qquad Zn + 2CuCl_2^- \rightarrow 2Cu + ZnCl_4^{2-}$$

$$ZnCl_4^{2-} + H_2O \rightarrow ZnO + 2H^+ + 4Cl^-$$



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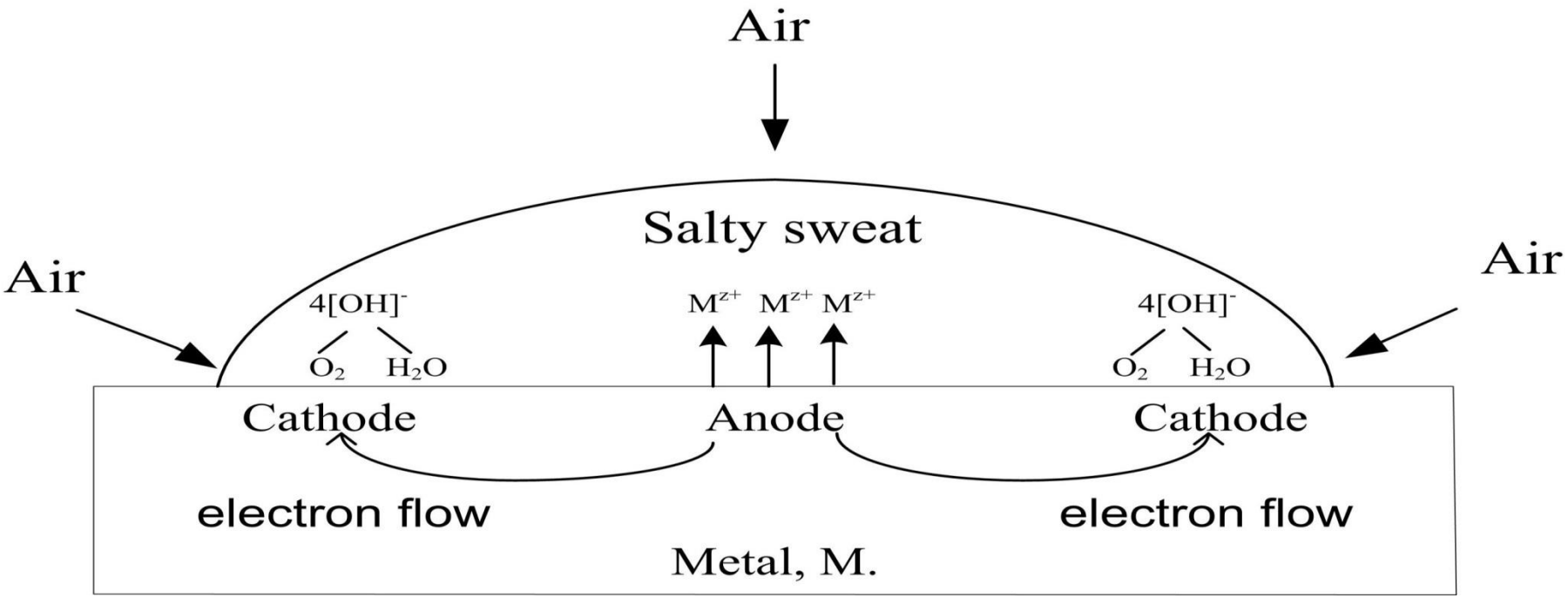

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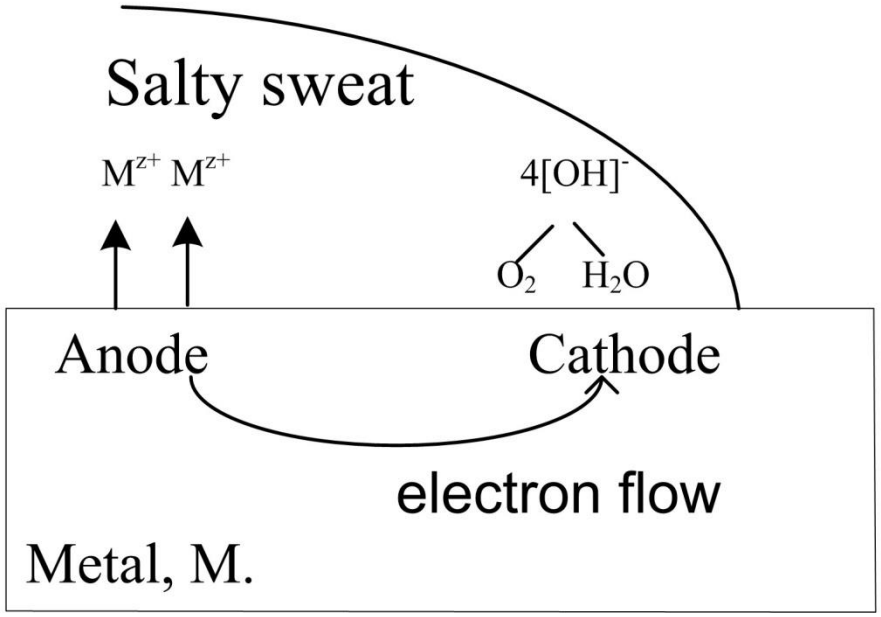
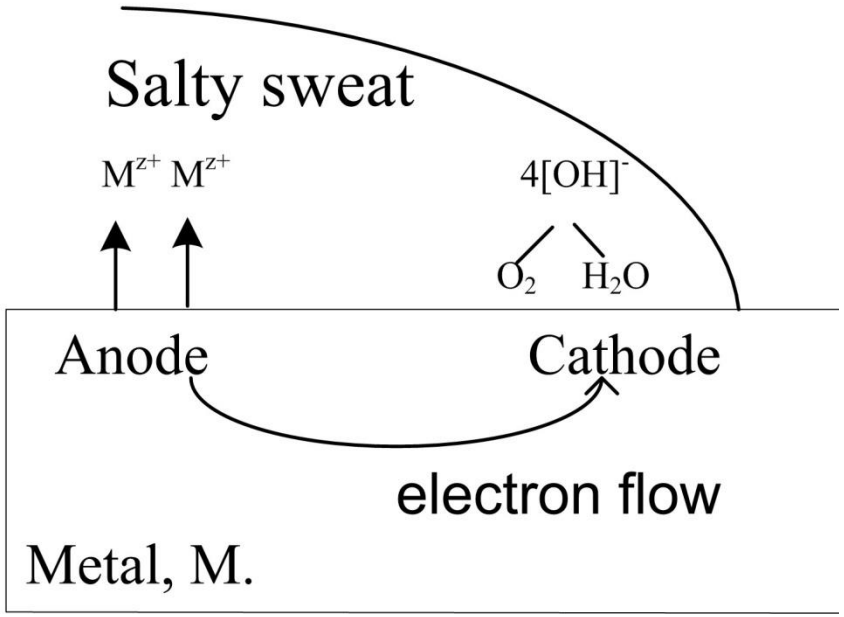
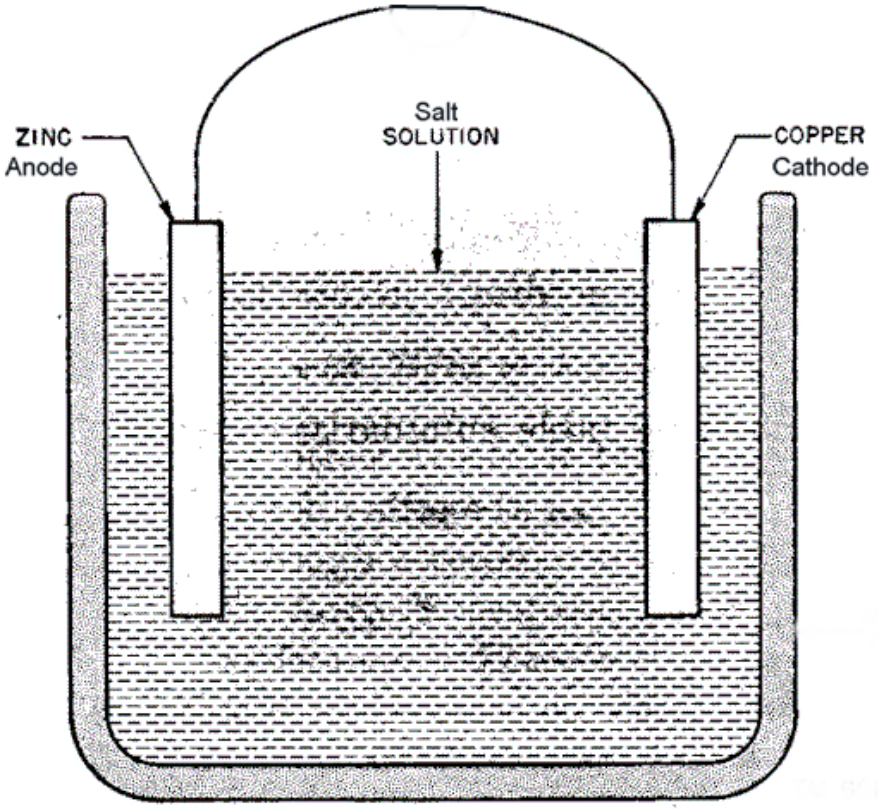
Fingerprints Forever



Fingerprints Forever





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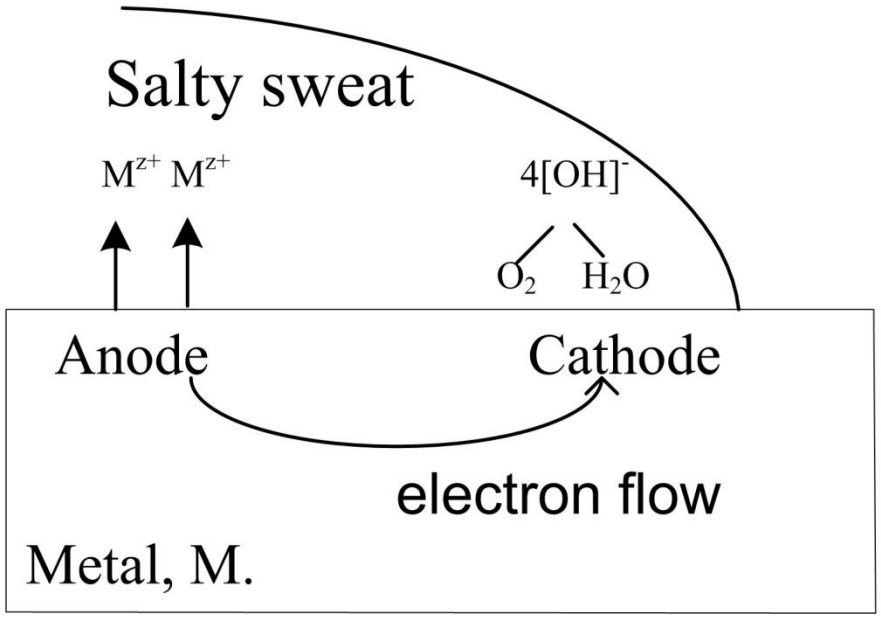

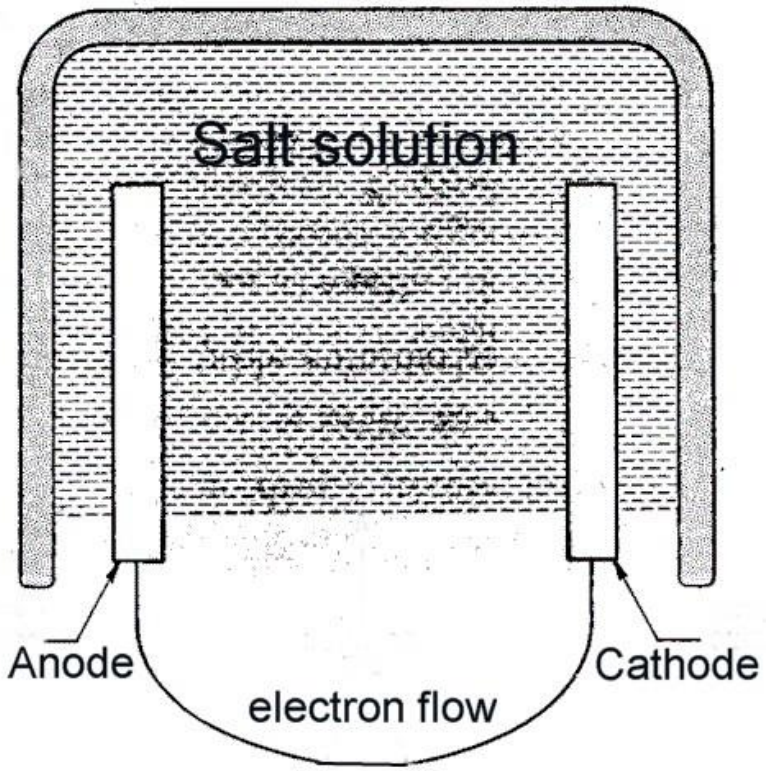

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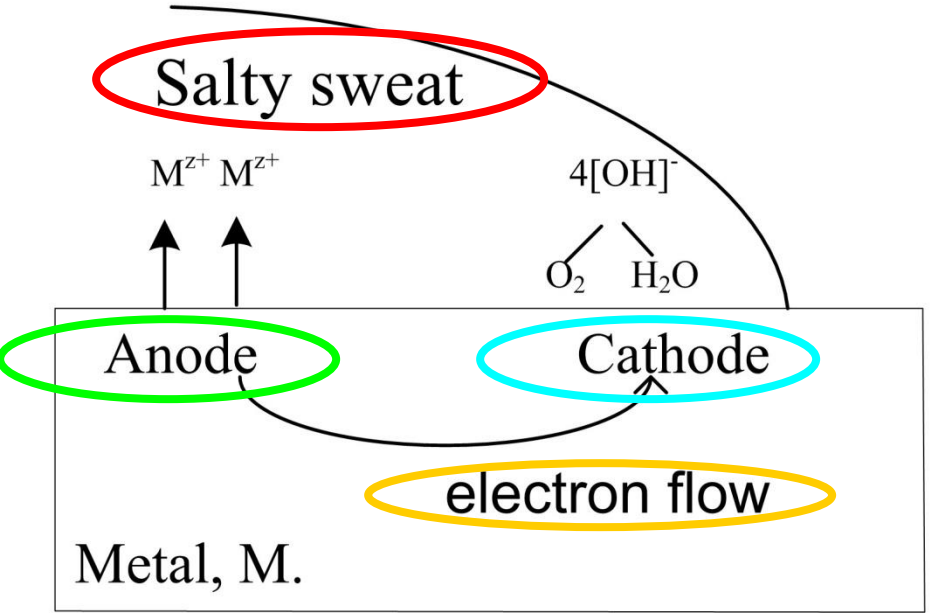

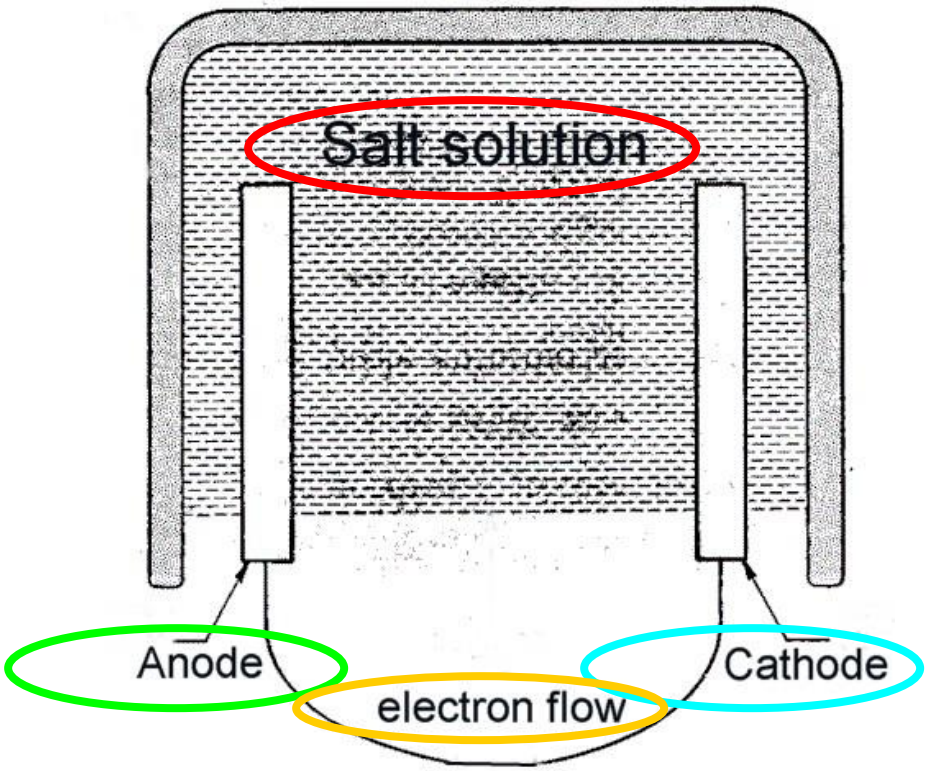

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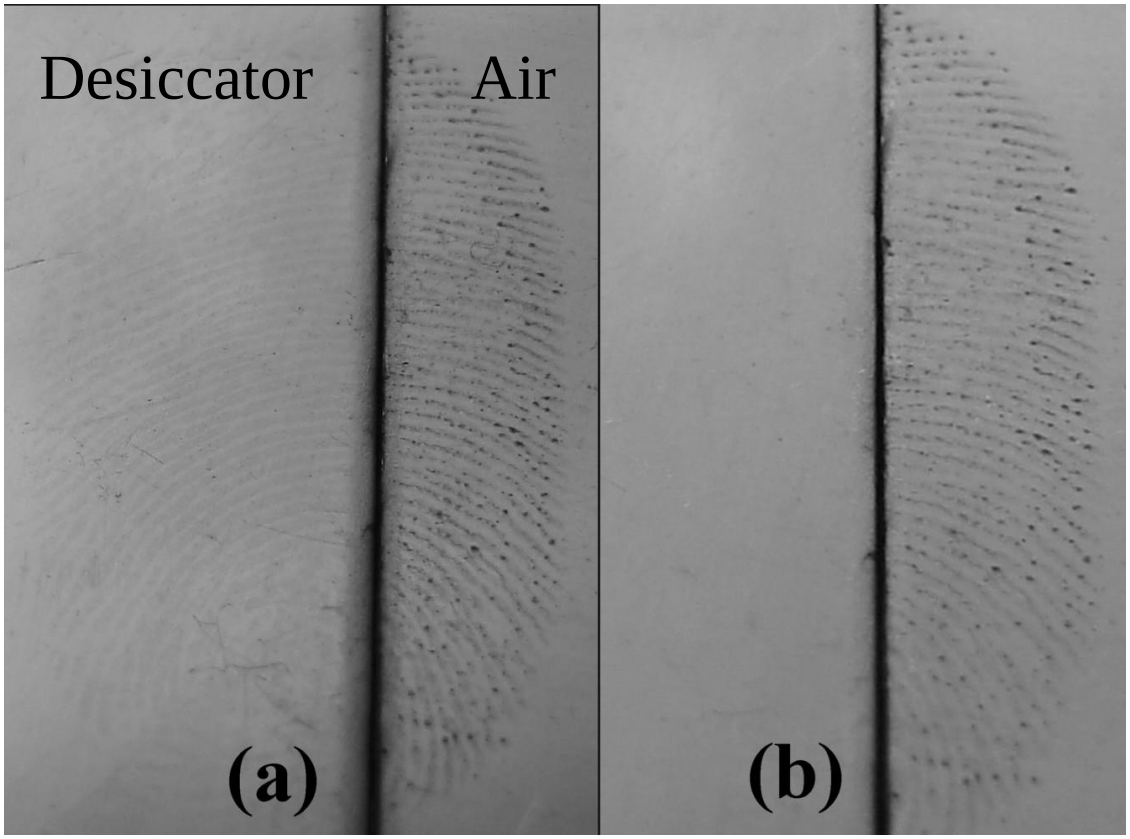

Brass 10 days after deposition. (b) = (a) after washing

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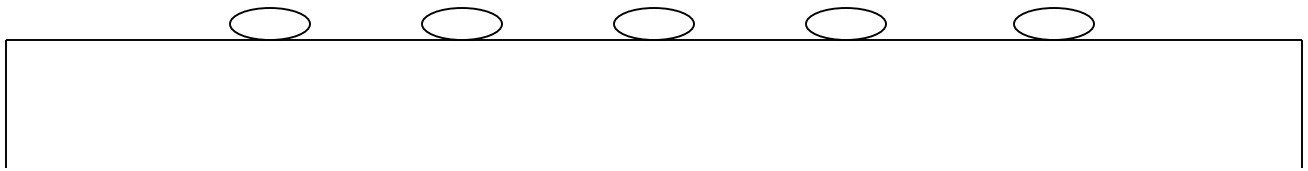
How do we see this corrosion?
and
Can this be used on real crimes?

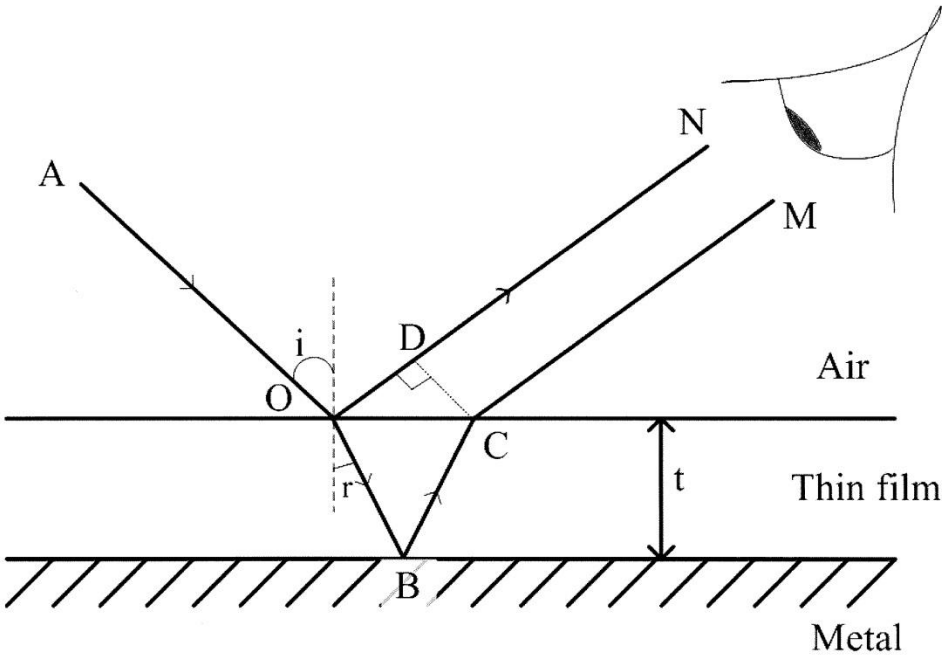
Fingerprints Forever



Fingerprints Forever

Fingerprints Forever

Method 1 : Look at it (optical interference)



Constructive interference when

$2ntcosr = m\lambda$

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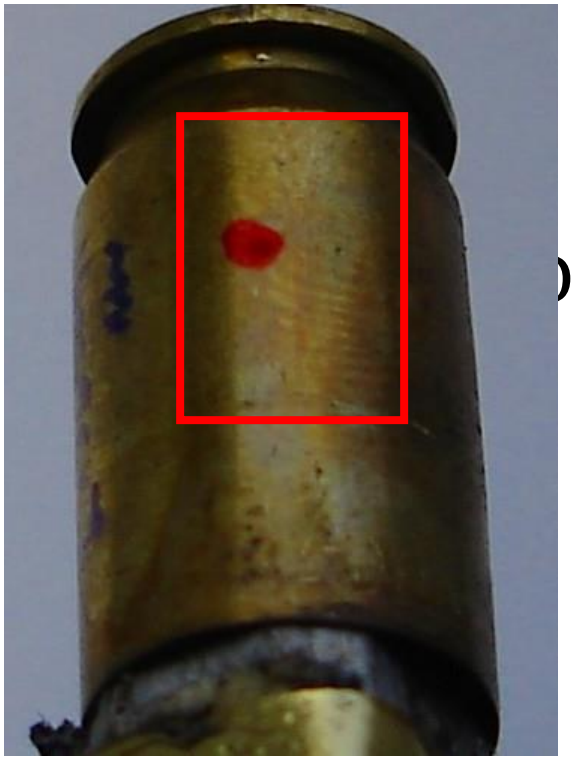
Fingerprints forever

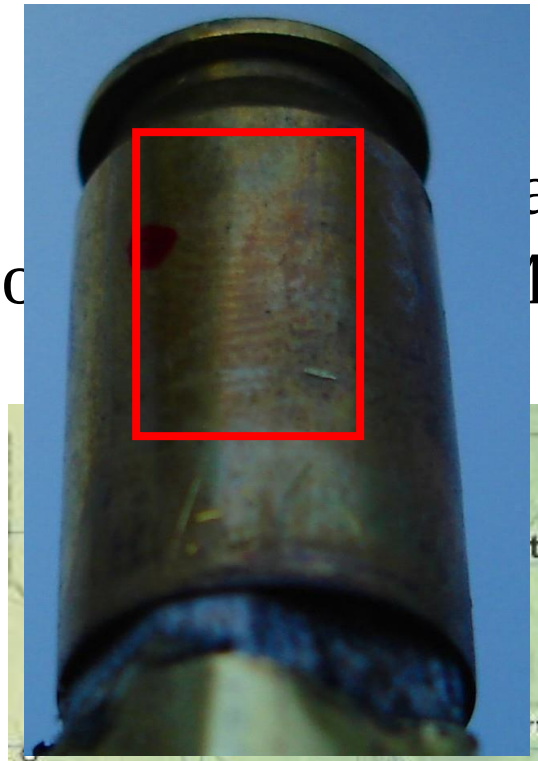
Killeen, Texas
Double homicide May 2007

Fingerprints forever

Killeen, Texas
Double homicide May 2007

Fingerprints forever





All same casing

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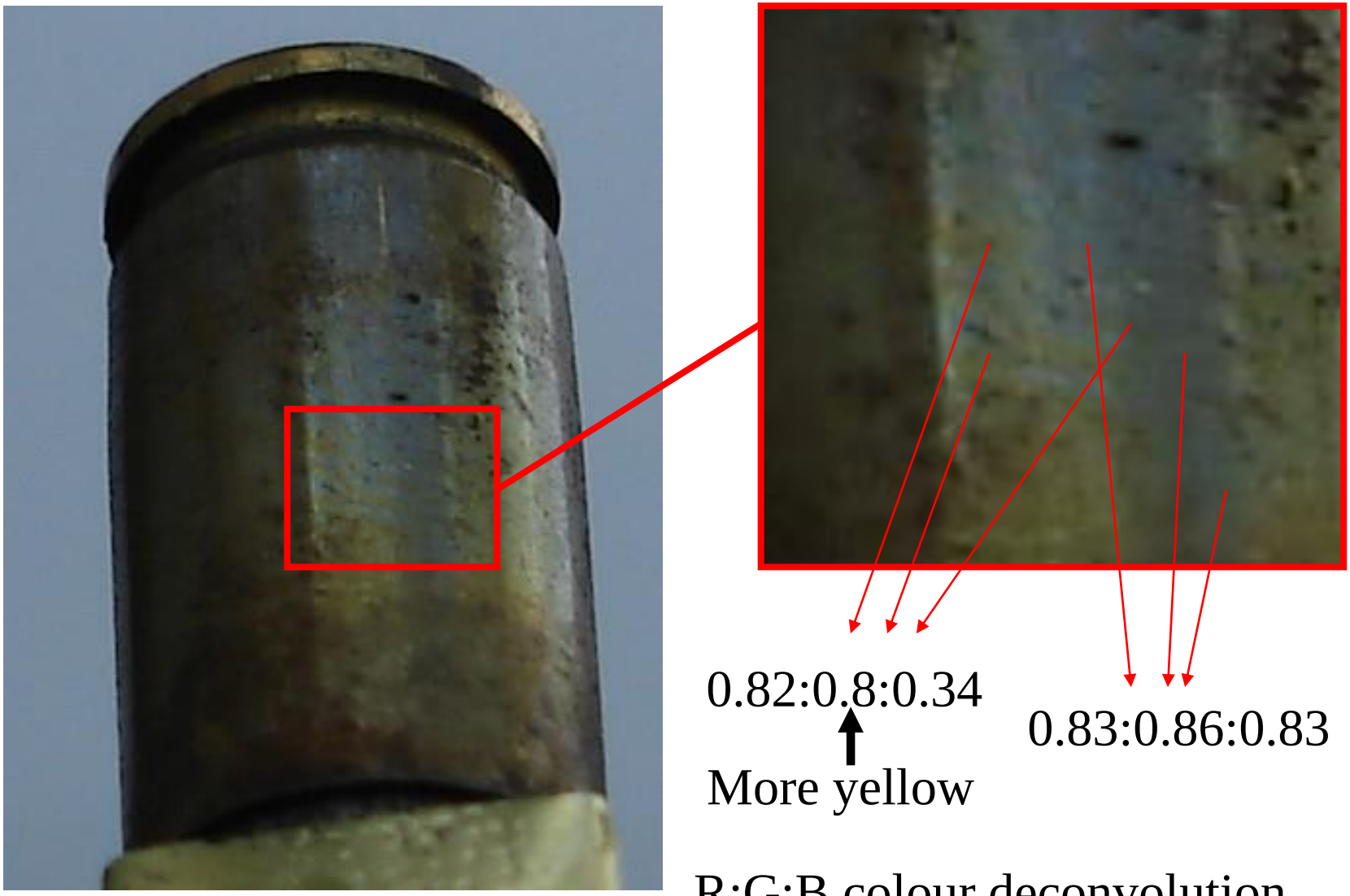
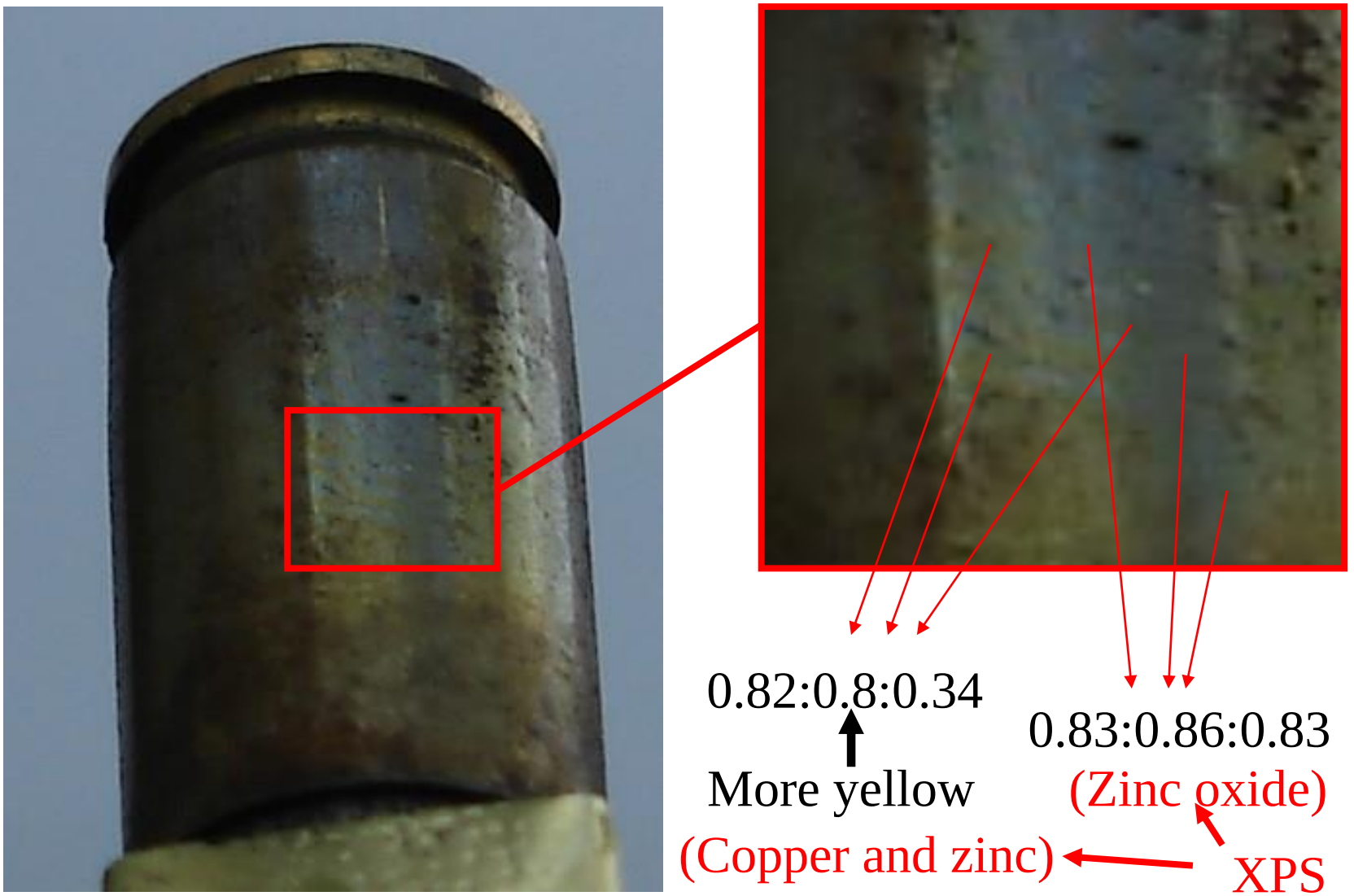
Method 2 : optical interference
+ digital colour mapping

Fingerprints forever



R:G:B colour deconvolution

Fingerprints forever



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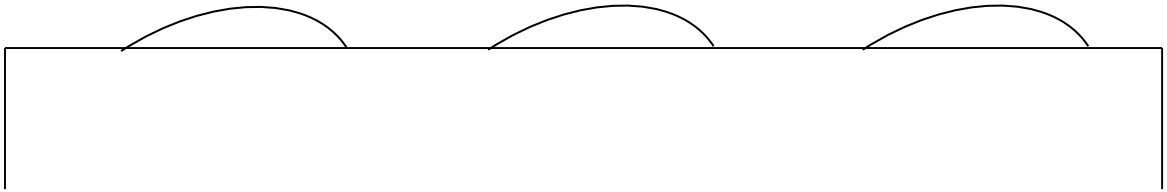

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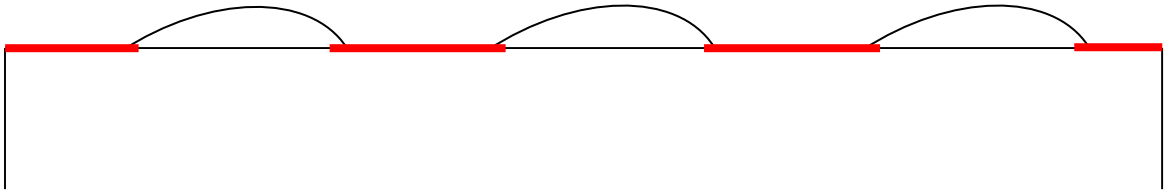

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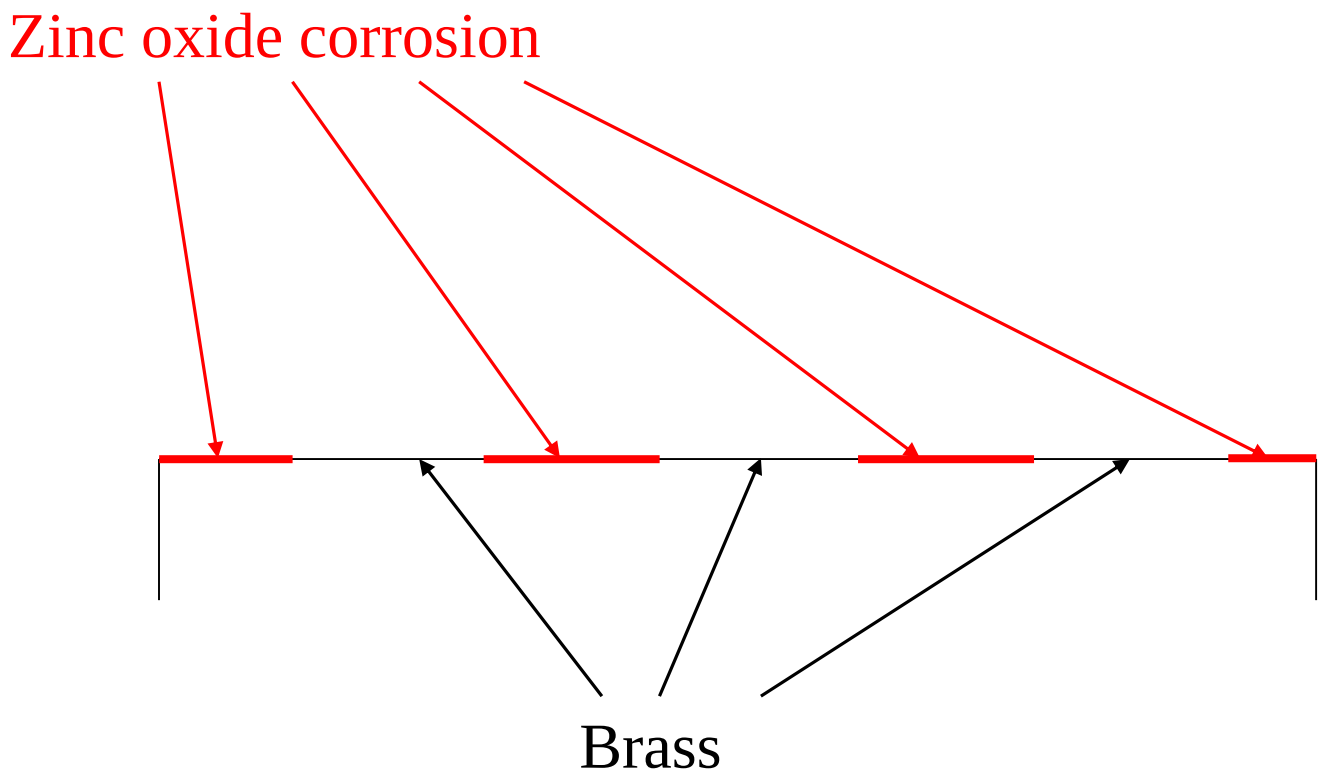

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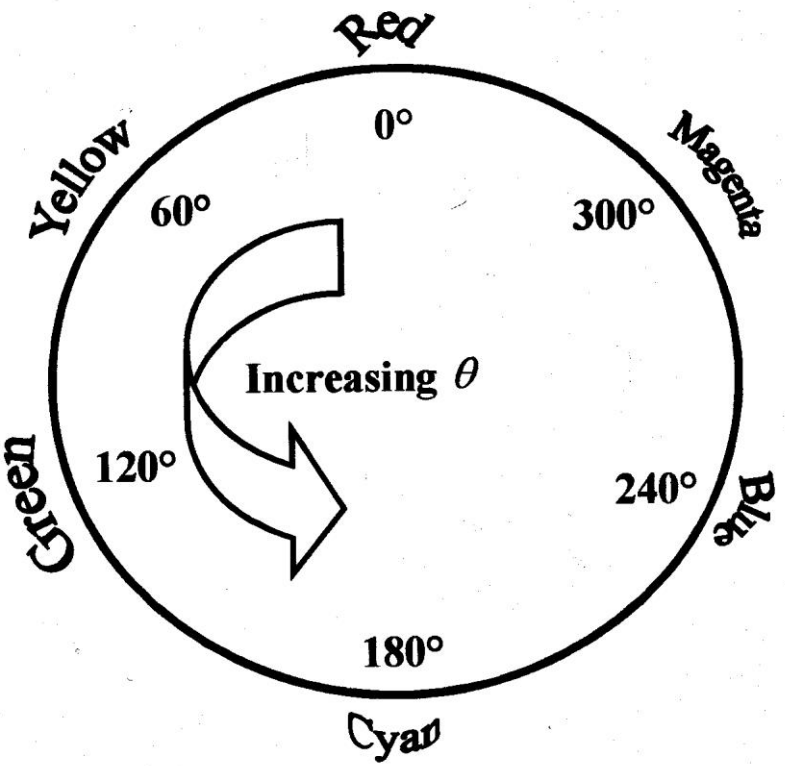

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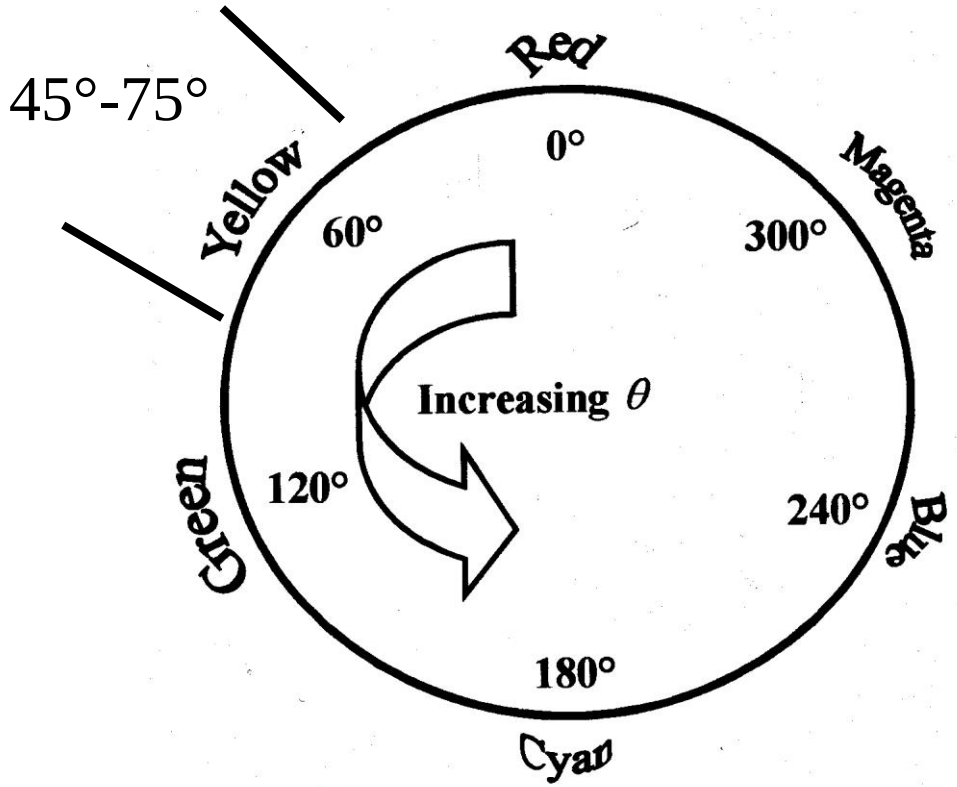

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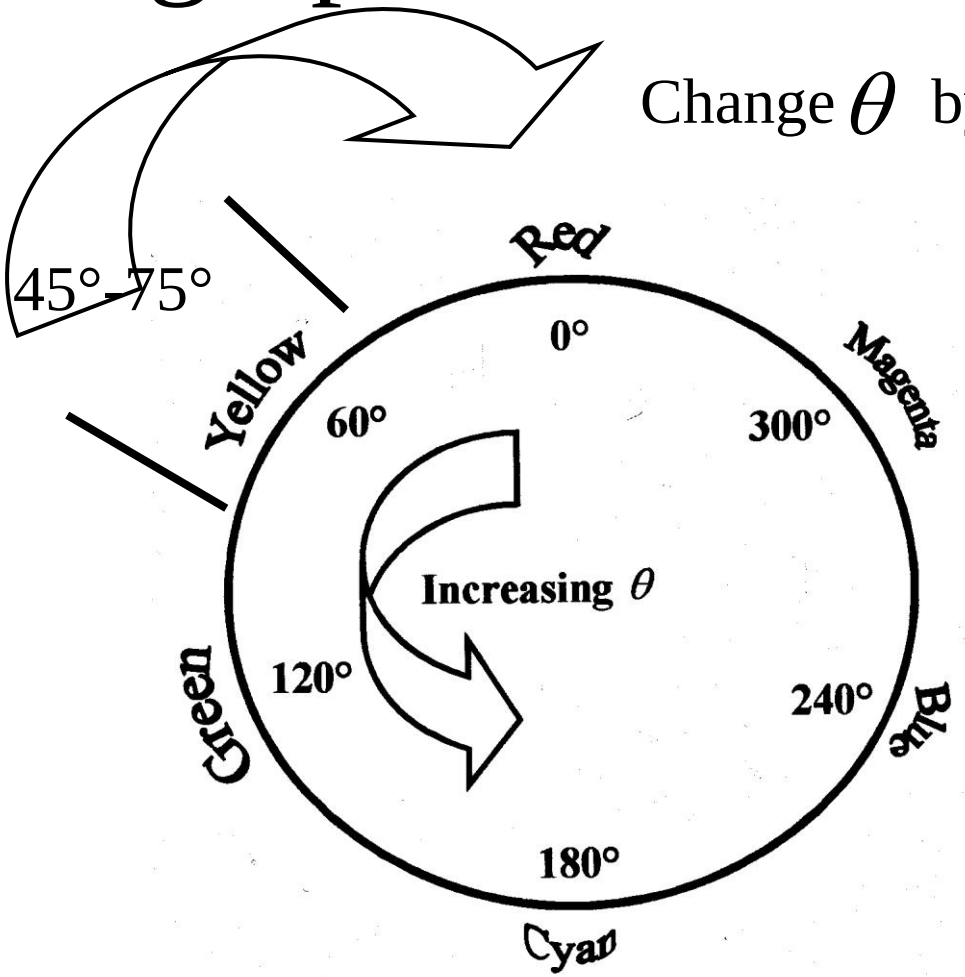

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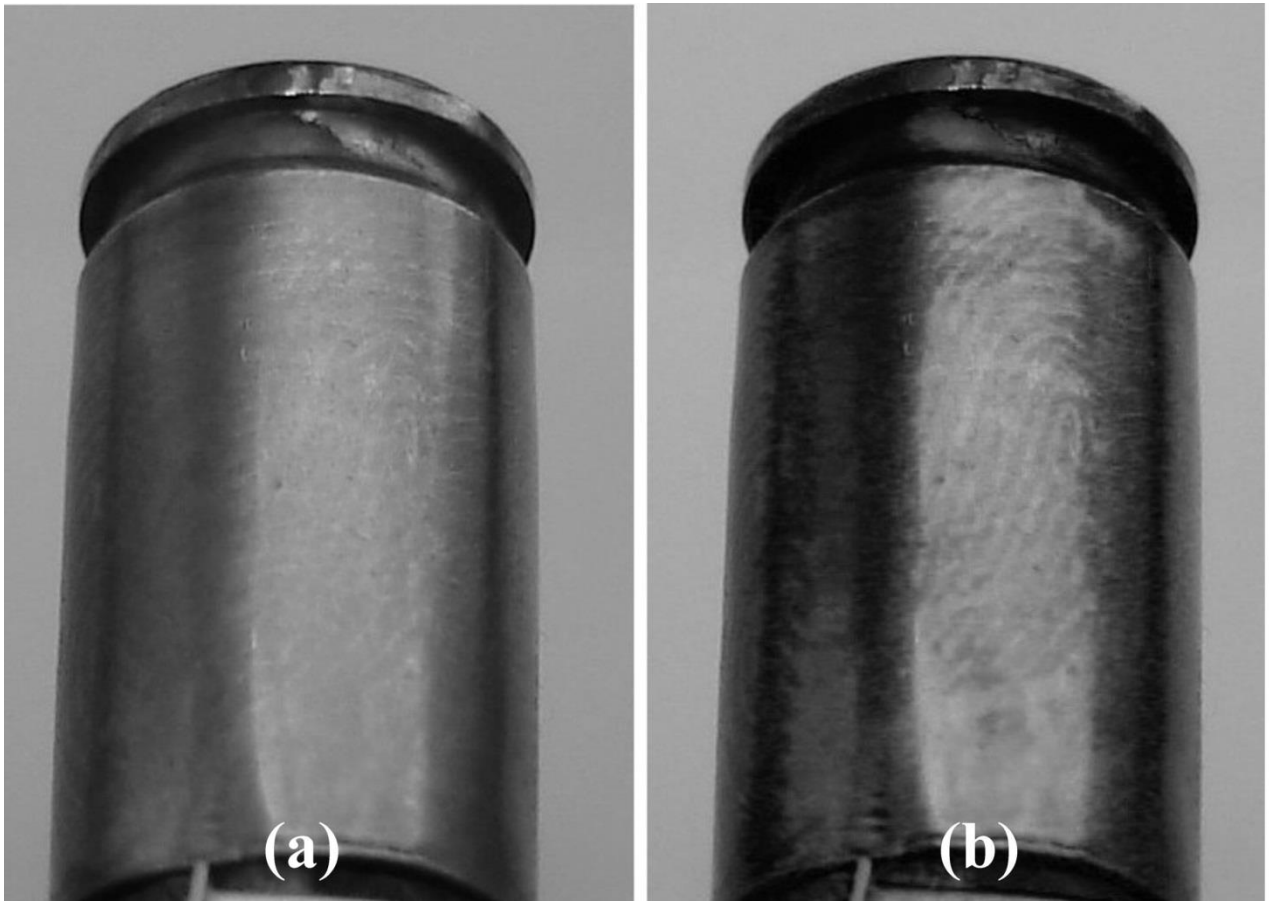


Fingerprints forever

Tinley park, Illinois
Five homicides February 2008

Fingerprints forever

llinois

bruary 2008

Fingerprints forever

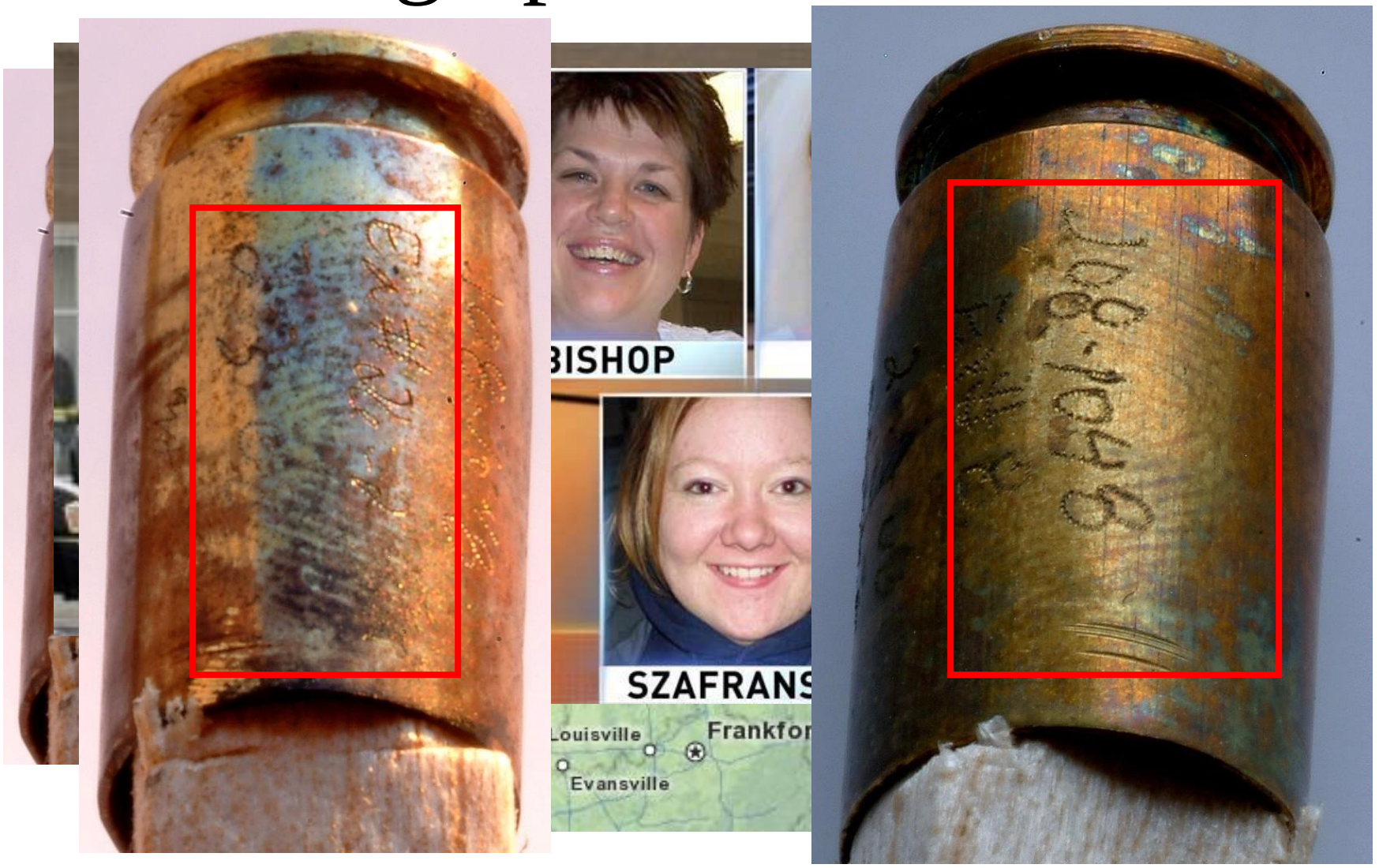
Fingerprints forever

Created by the Tinley Park Police Department in cooperation with the surviving victim.

Fingerprints forever

NASA helped investigators enhance stills to try to identify a possible getaway car.

Fingerprints forever



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Method 3 : electrostatic enhancement

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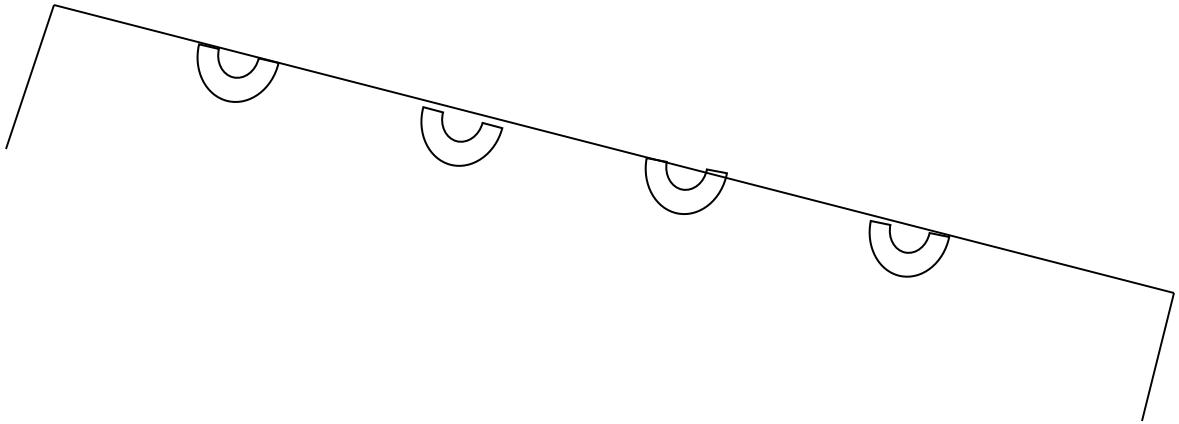
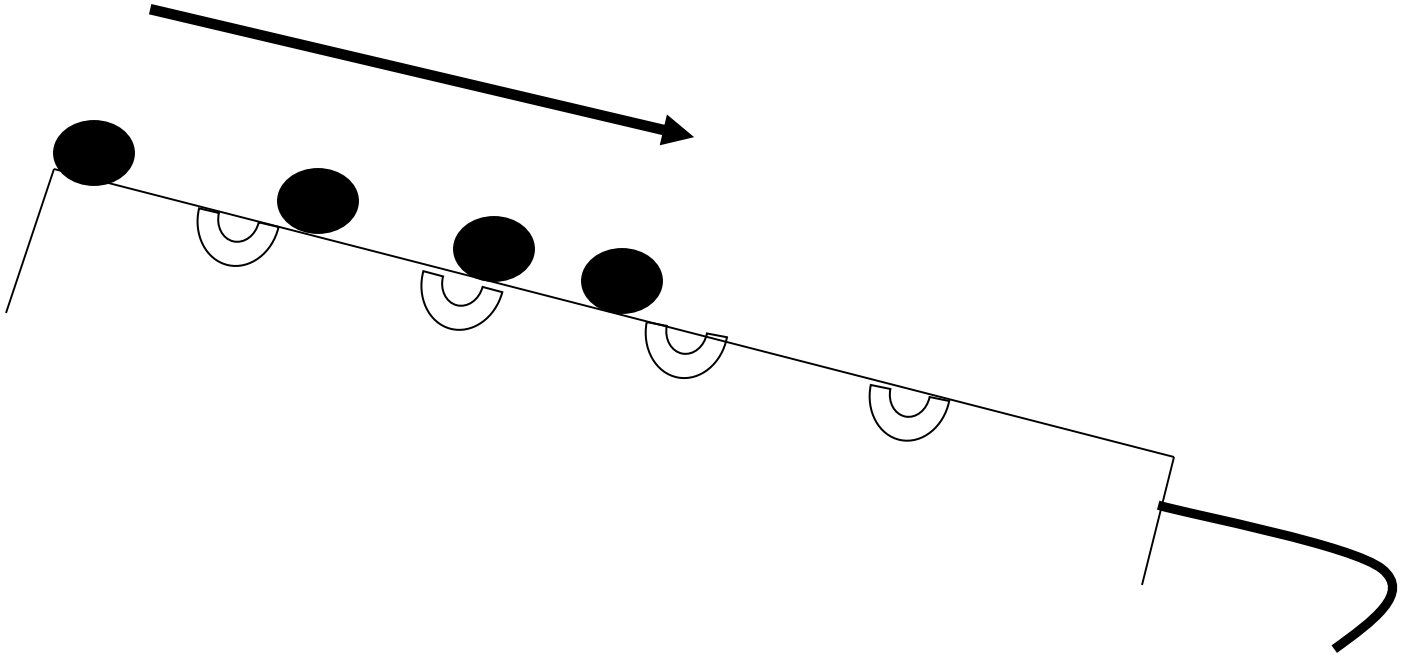
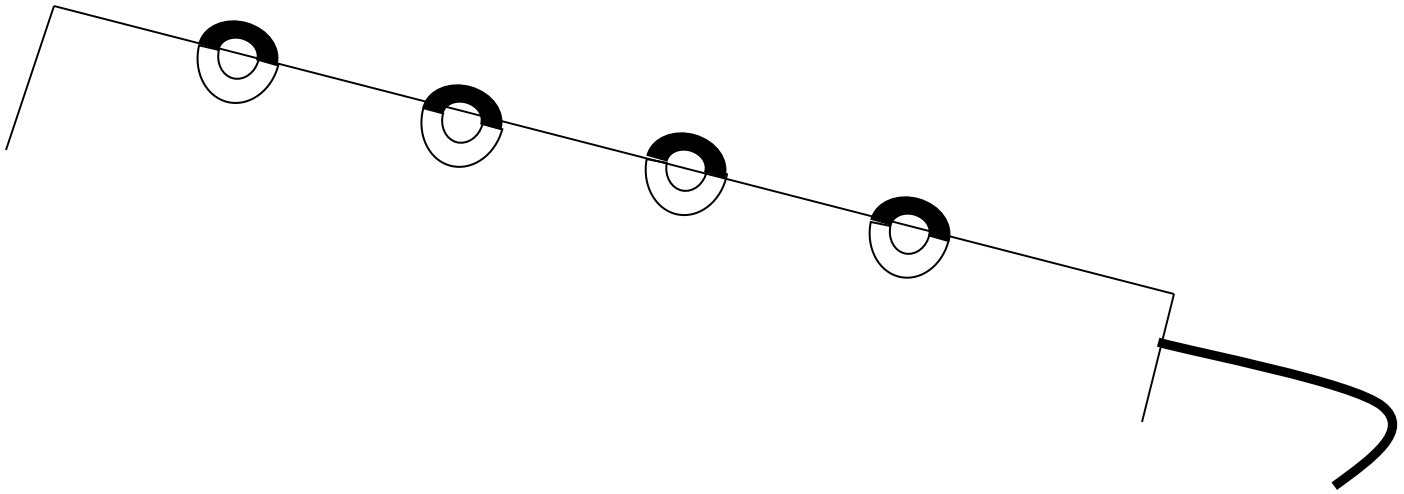


Fingerprints Forever

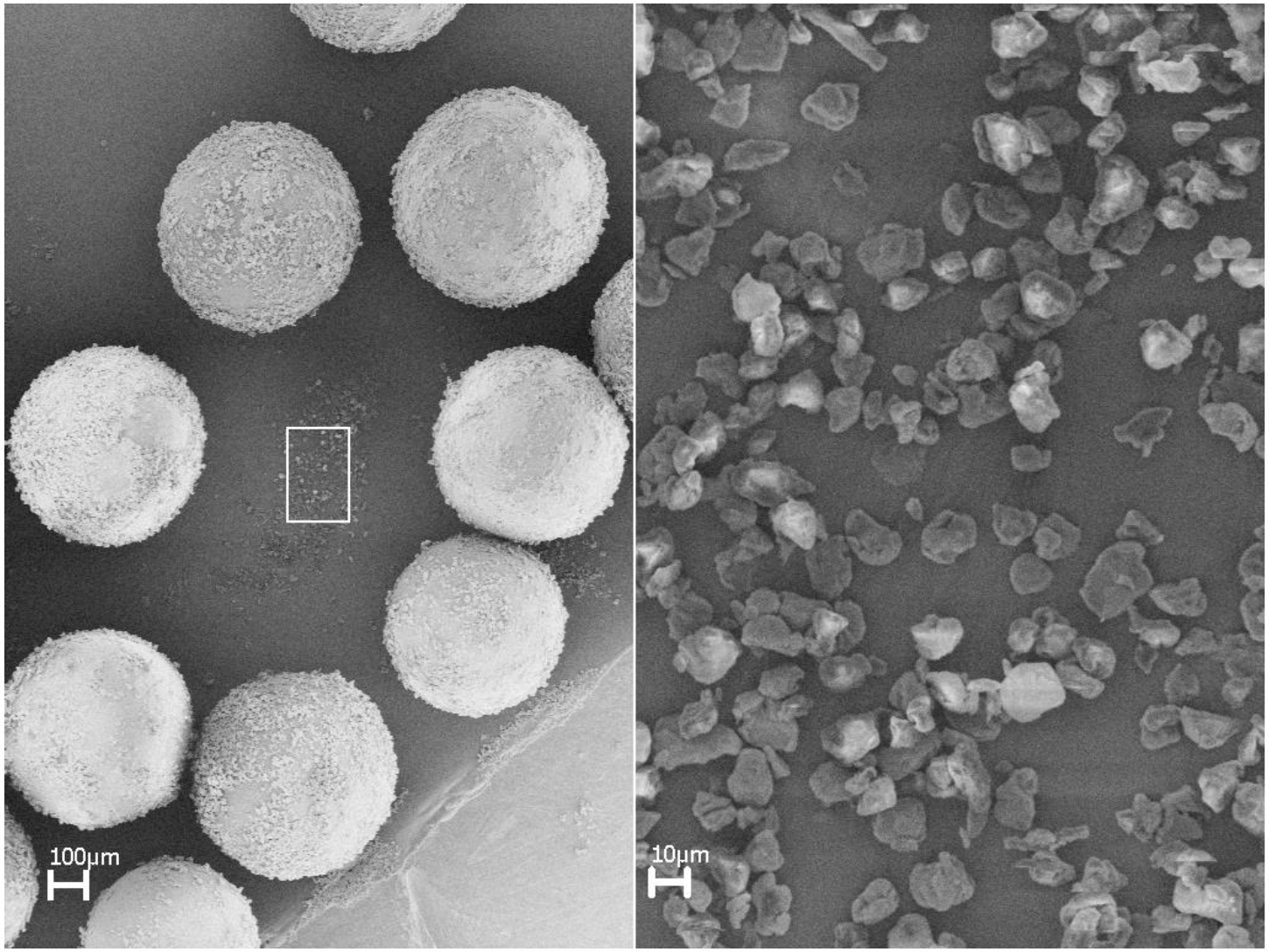


Fingerprints Forever



Fingerprints Forever

Fingerprints Forever



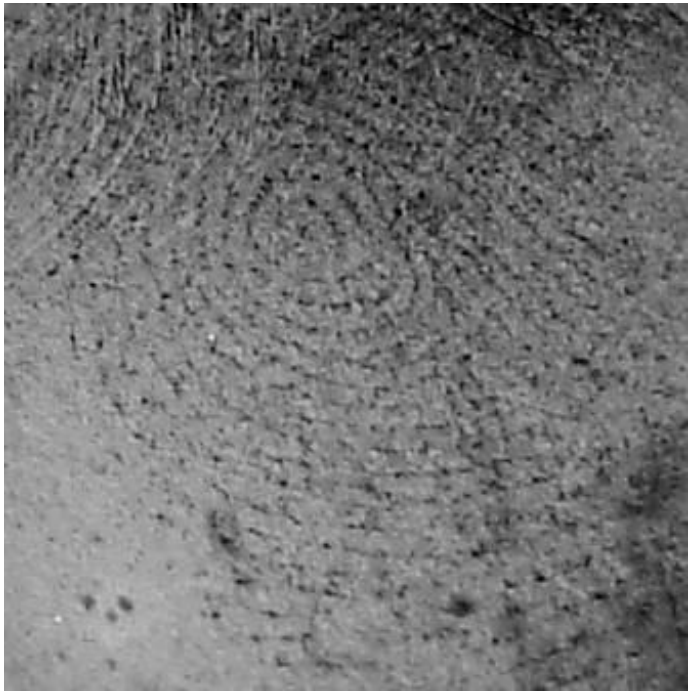
Fingerprints Forever

Fingerprint sweat removed by washing in soapy water

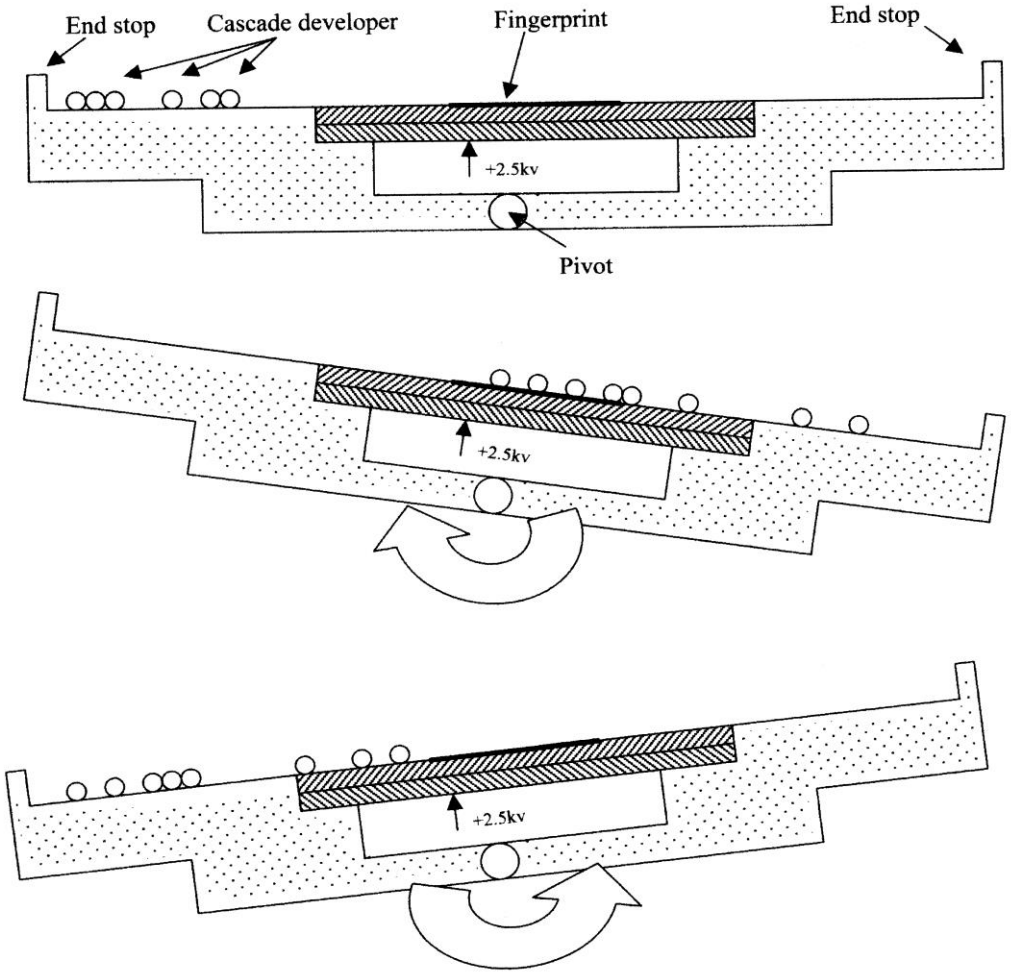
Fingerprints Forever

Washed

Enhanced

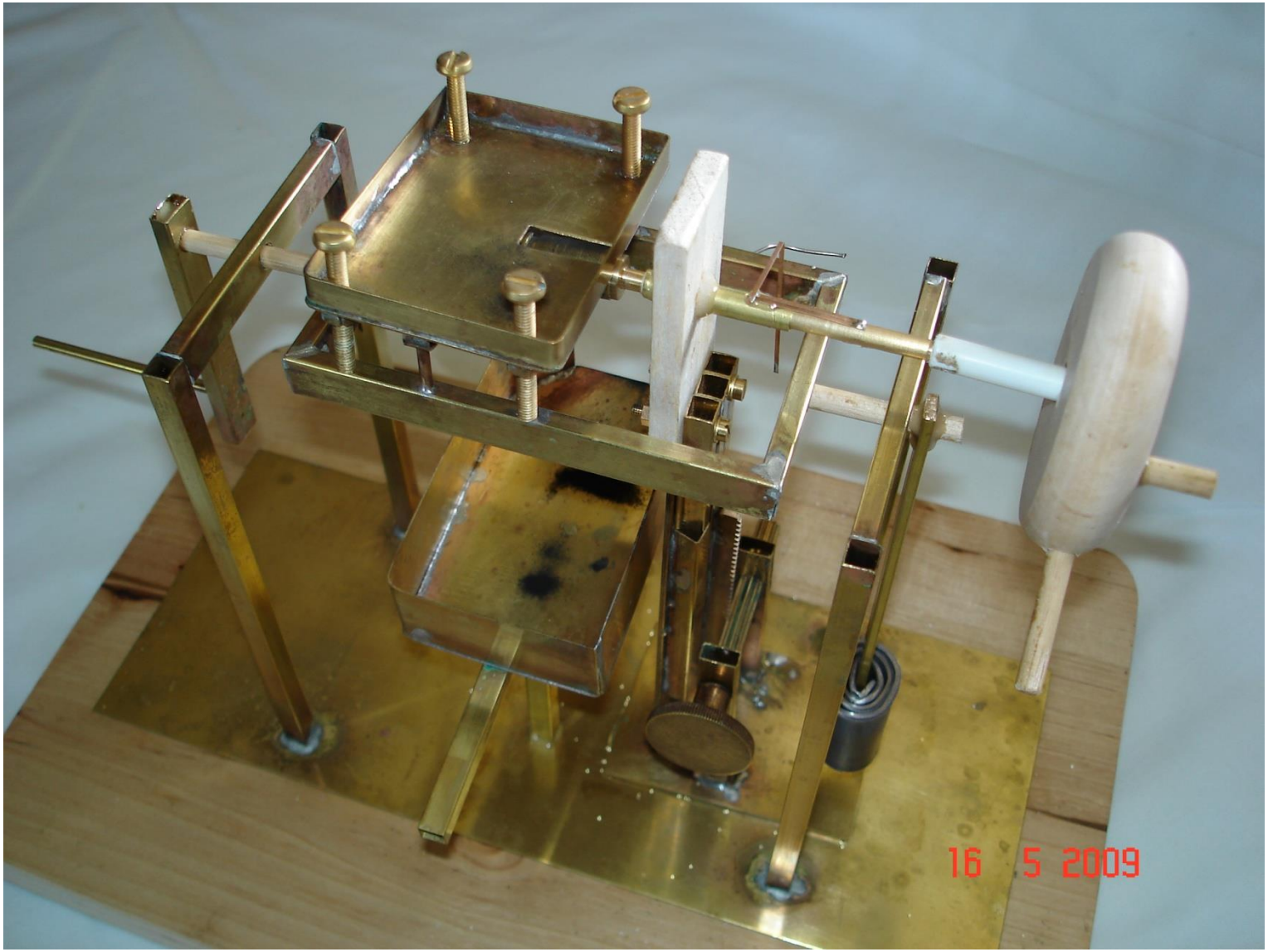


Re-washed and re-enhanced

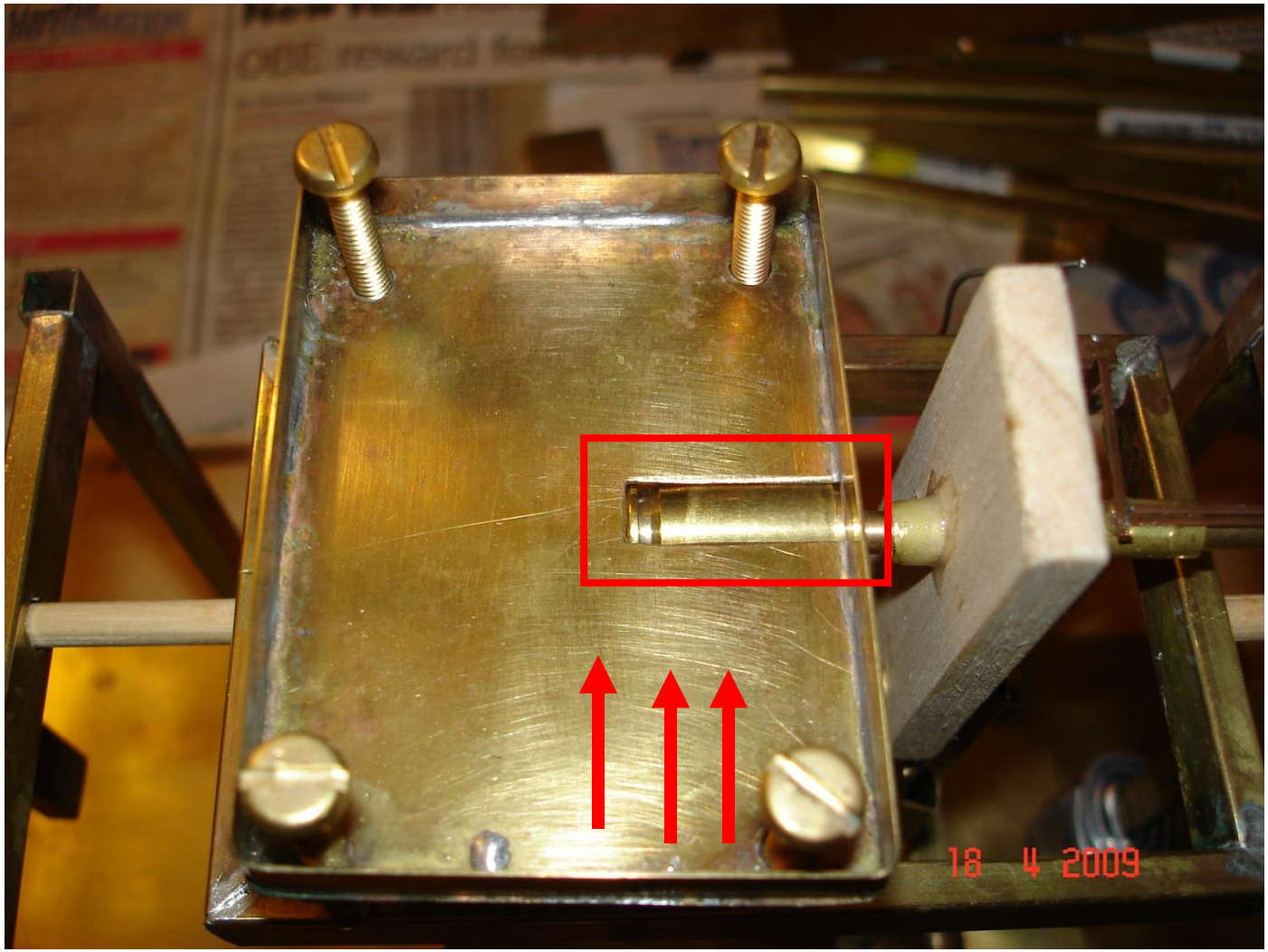

End stop
Cascade developer
Fingerprint
End stop
+2.5kv
Pivot
+2.5kv
+2.5kv
Key
Charged metal disc
Test metal disc with fingerprint
Plastic frame

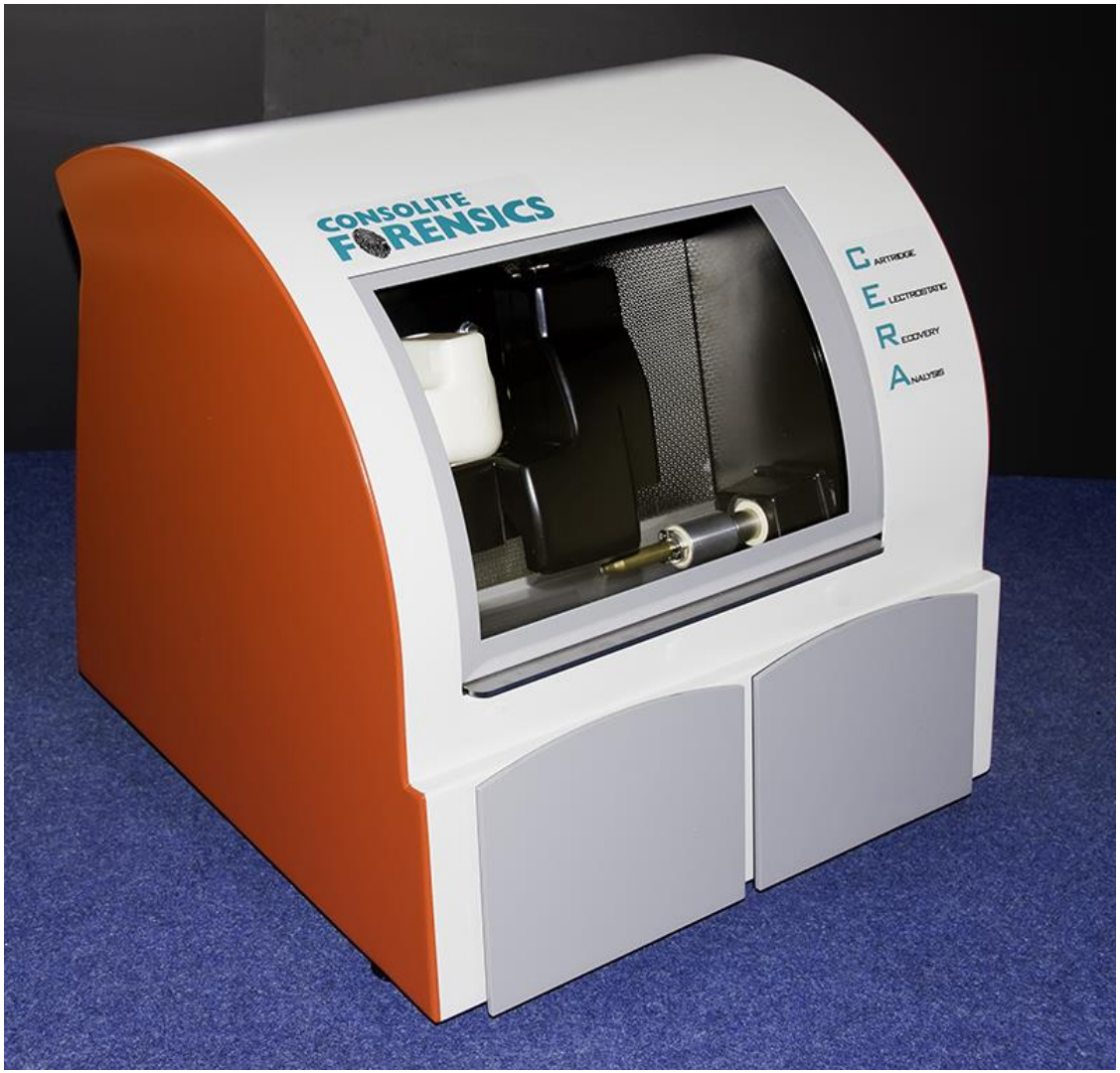
Fingerprints Forever

Fingerprints forever



Fingerprints forever





CONSOLITE FORENSICS

CERA

Fingerprints forever

Kingsland, Georgia
Double homicide 1999

Fingerprints forever

Georgia
ide 1999

Same casing

Fingerprints Forever

Method 4 : Try washing it!

Fingerprints forever

North Richland Hills, Texas
Homicide December 2007

Fingerprints forever

h Richland Hills, Texas

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Fingerprints forever

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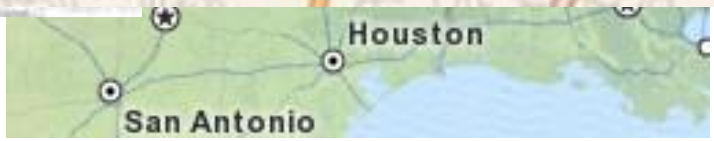
Fingerprints forever



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Fingerprints forever

Fingerprints forever

Fingerprints forever

What’s new?

Fingerprints forever

Copper pipe bombs

Fingerprints forever

Dynasafe explosion containment vessel

Fingerprints forever

Fingerprints forever

Fingerprints forever

Frederick Dash and Bruce Judah, Bomb Technicians with the Jacksonville Sheriff's Office Bomb Squad

Samples from one pipe bomb, post –washing.

1. Folding of pipe

2. Work hardening

- Five fragments (chosen at random) from each of the three pipe bombs were measured for Vickers Hardness (HV) either side of the pipe wall.

- Compared with measurements from either side of the pipe wall of an unexploded piece of copper pipe.

Mean of 10 HV measurements across the surface calculated.

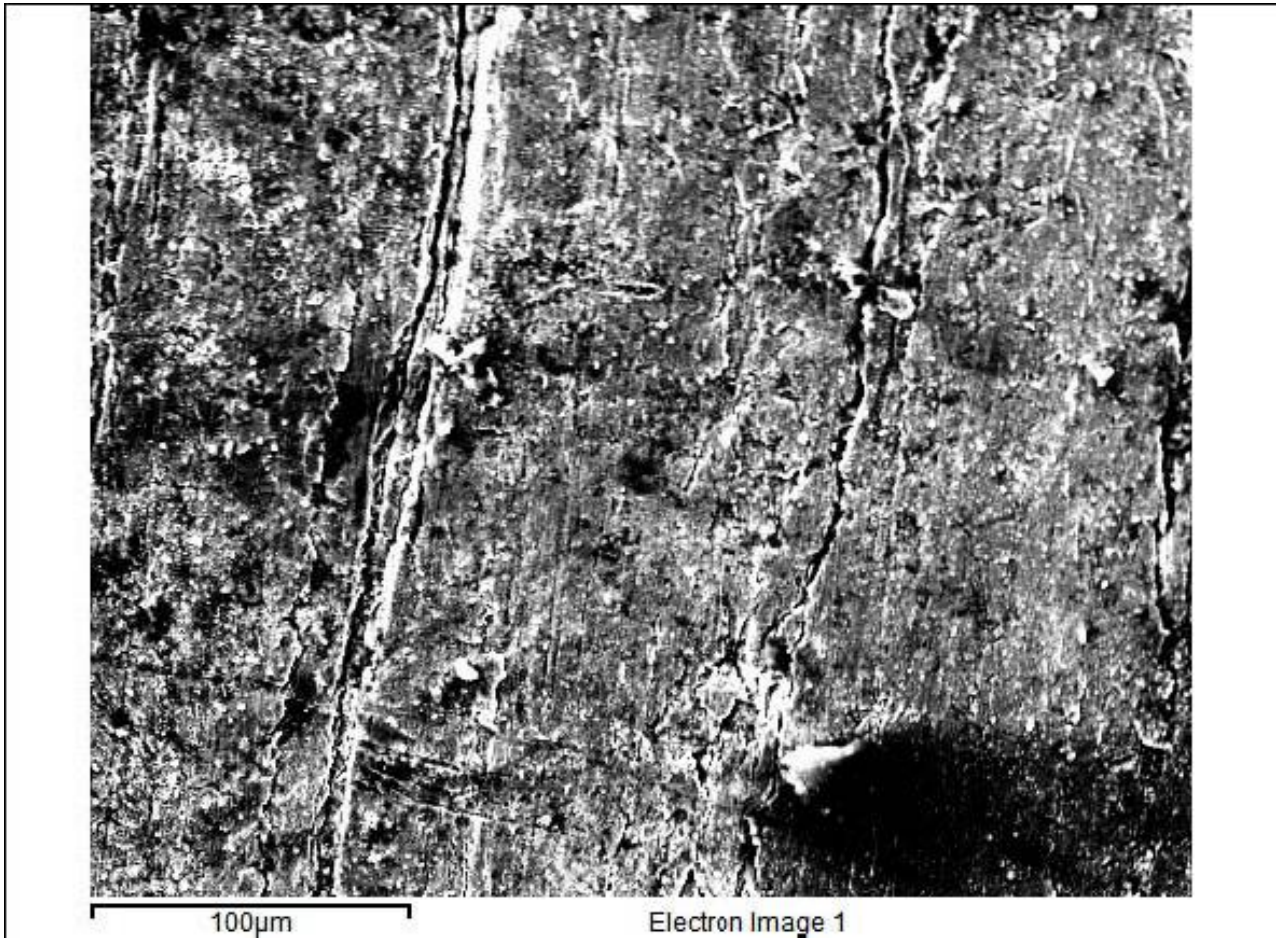
Values of HV were consistent either side of the pipe wall and between fragments.

Mean HV = 107 (107HV1), SD = 9.1.

Mean HV for unexploded copper pipe = 80 (80HV1), SD = 3.

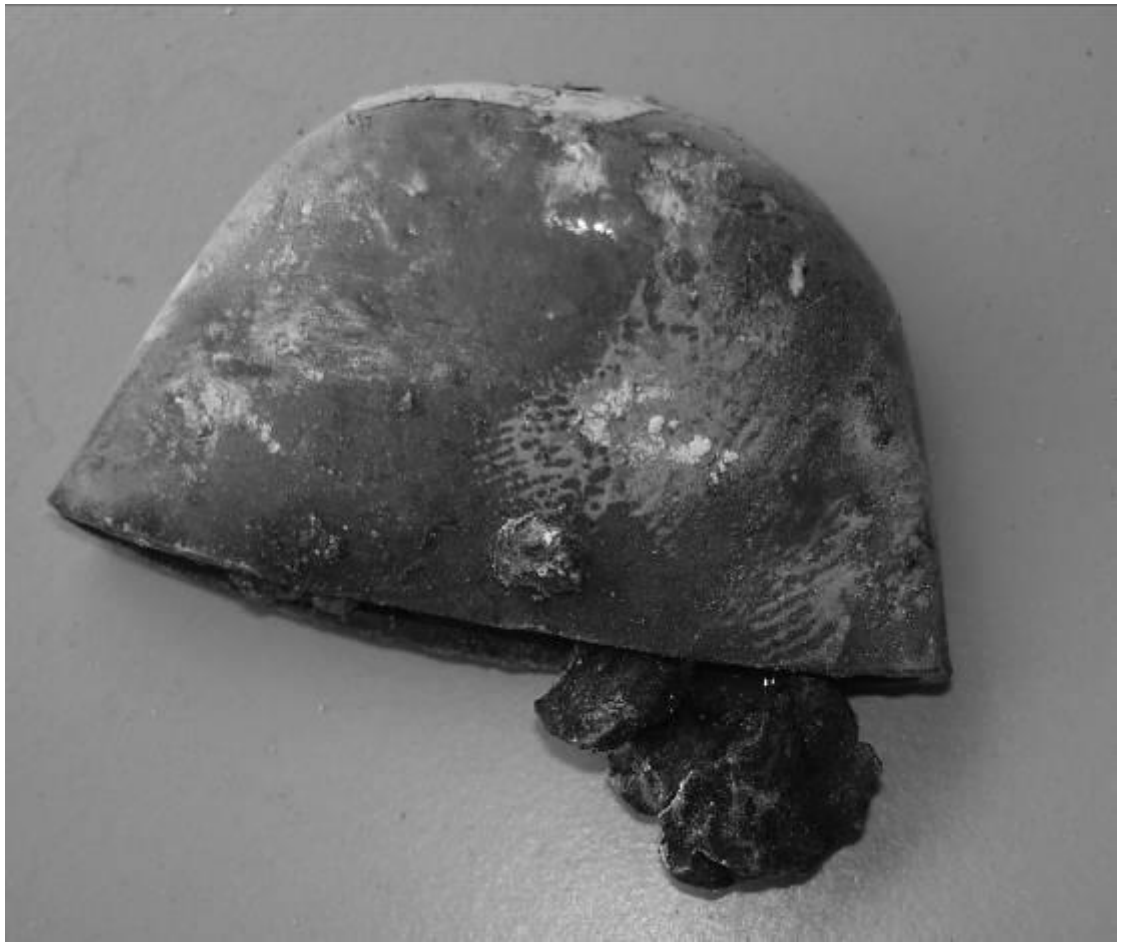
(HV = 50 for annealed and 100 for work hardened copper).

3. Microfractures



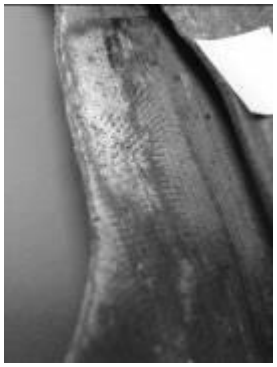
Parallel to the length of the pipe. ~100µm intervals, ~ 1-2µm in width.

4. Fingerprints

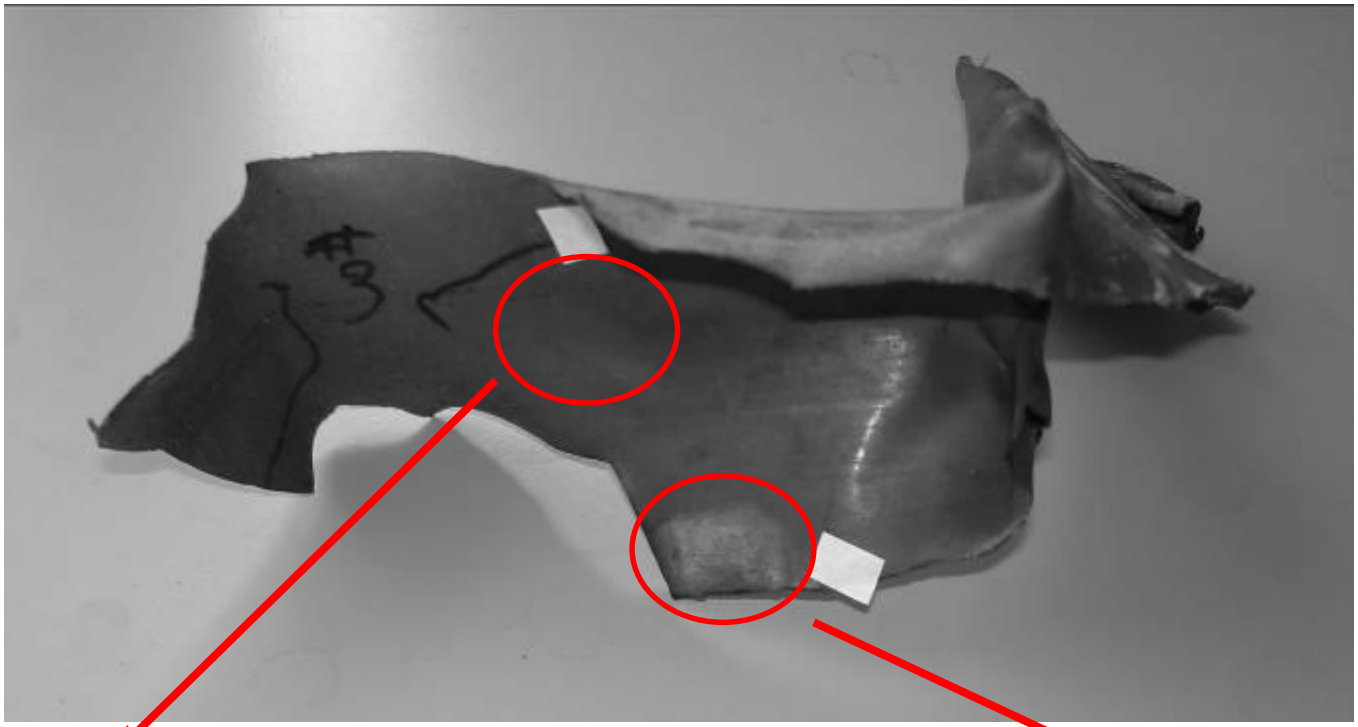


Fingerprints forever

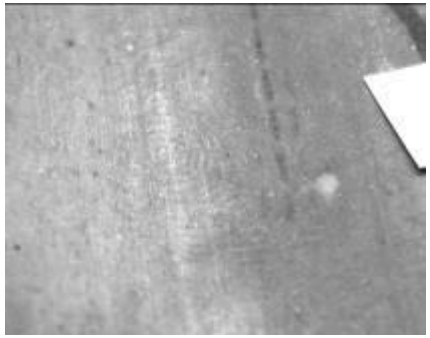
Enhanced

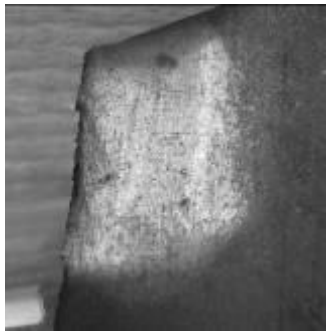


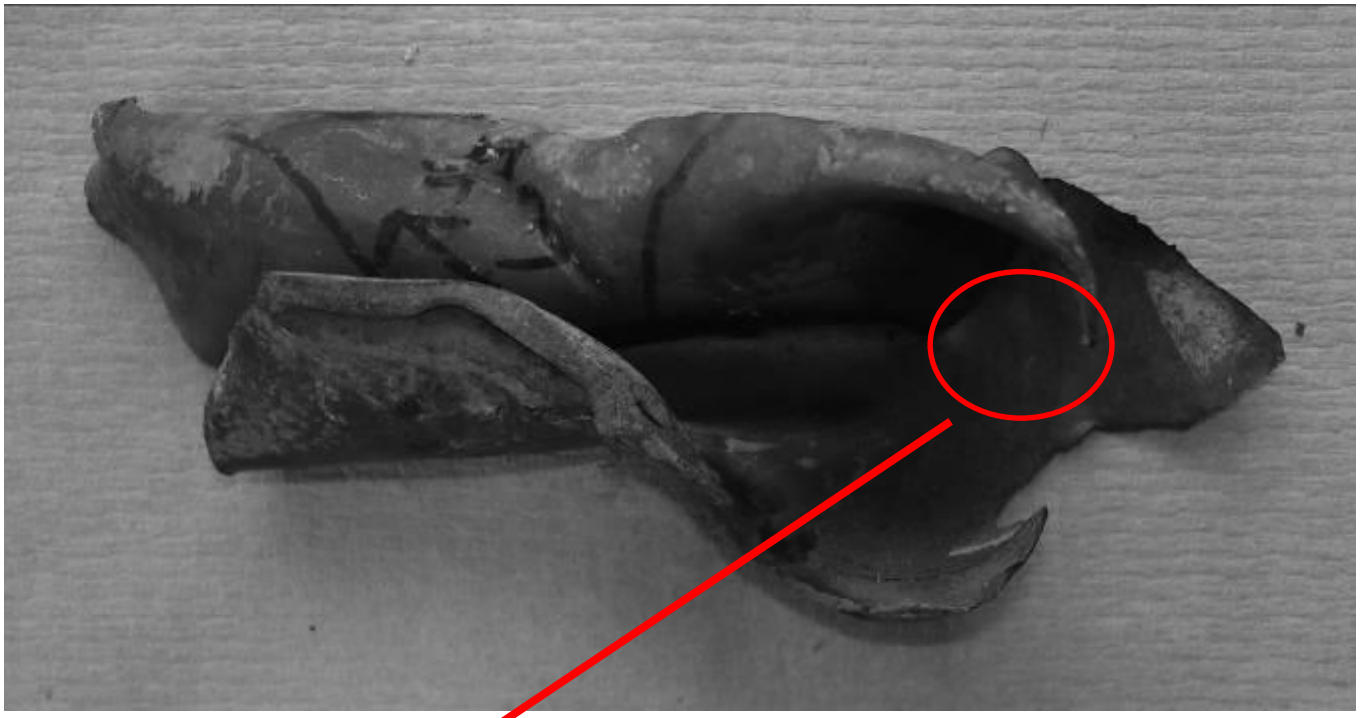
Fingerprints forever

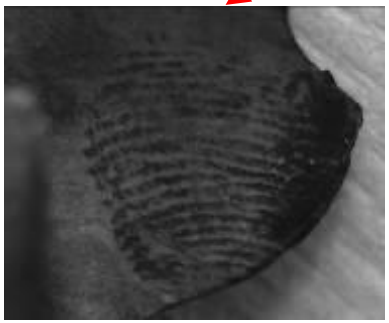


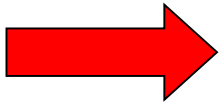
Enhanced











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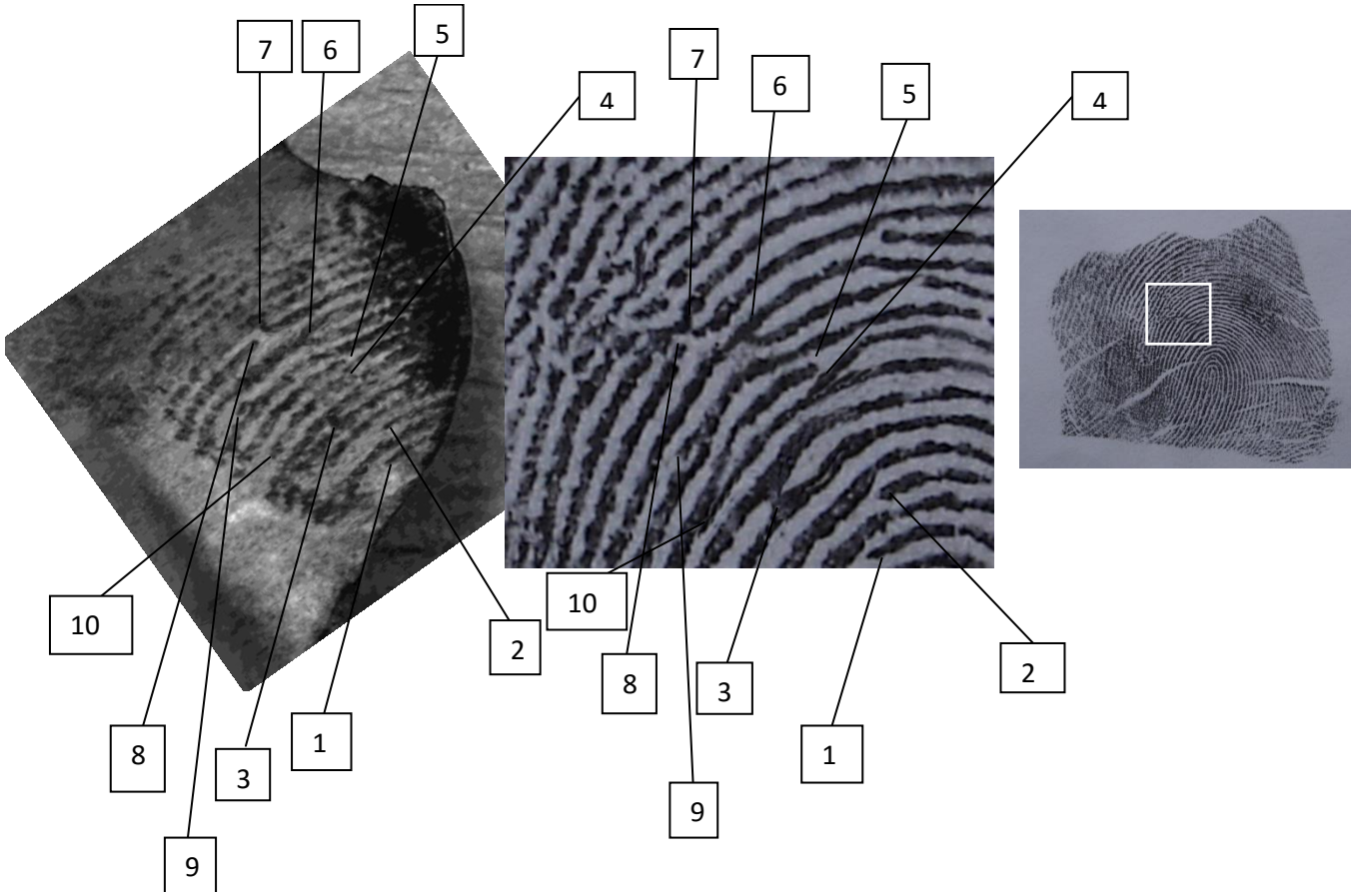
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Fingerprints Fo

39

Enhanced Fingerprints.

English physicist John Bond has developed a technique for analyzing fingerprints on a gun's ammo even if it's been wiped clean. Sweat corrodes metal, so Bond applied an electrical charge and a fine carbon powder to a shell case's corroded part, revealing a fingerprint. Police are already using the four-month-old technology to reopen some cases.

40

The Seven New Deadly Sins.

In March the Vatican updated the traditional seven deadly sins with seven new social sins, to bring the list into line with the temptations of the modern world. The additions: bioethical sins, morally dubious experiments that harm human embryos, drug abuse, polluting, social injustice, accumulating excessive wealth and creating poverty.

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The Large Hadron Collider.

5

If someone invented a practical 200-m.p.g. (1.18 L/100 km) automobile and that automobile got a flat tire, nobody would claim that the car itself was a failure. The same applies to the Large Hadron Collider, the world's biggest particle accelerator, which went online in September, ran for 10 days and then had to shut down at least until next spring because of an overheated wire. The mammoth machine will send protons wheeling in opposite directions at nearly the speed of light, then smash them together at 6,000 times a second to try to answer such deep questions as why mass exists and whether the universe has extra dimensions. If it takes a few extra months to find out, so what?

Fingerprints forever

The judges

SIR JAMES DYSON

LESLEY GARVIN

RICHARD NOBLE

JIM STANSFIELD

ON THE PODCAST

BBC FOCUS AWARDS 2009

SCIENCE • TECHNOLOGY • FUTURE

Britain really has got talent. And here, according to our team of expert judges, are the British innovations that you should be looking out for over the next few years...

The robot with greater reach

OC Robotics, Bristol, founded by Dr Rob Buckingham and Andrew Graham

OC Robotics' snake-arm can get to all those hard-to-reach places

MINI MARVELS

BIO BURNERS

AIR BATTERY

Indelible prints

Dr John Bond, University of Leicester

Criminals who touch a metallic surface will no longer be able to wipe that surface clean, thanks to Dr John Bond, a Fellow of the University of Leicester and scientific support manager for Northamptonshire police. Dr Bond has come up with a way to detect the corrosion on metal surfaces caused by tiny traces of salty sweat on human fingers. What's more, he built his device at home using wire and gaffer tape.

Dr Bond's technique makes prints indelible

A fingerprint on a piece of brass

Fingerprints forever