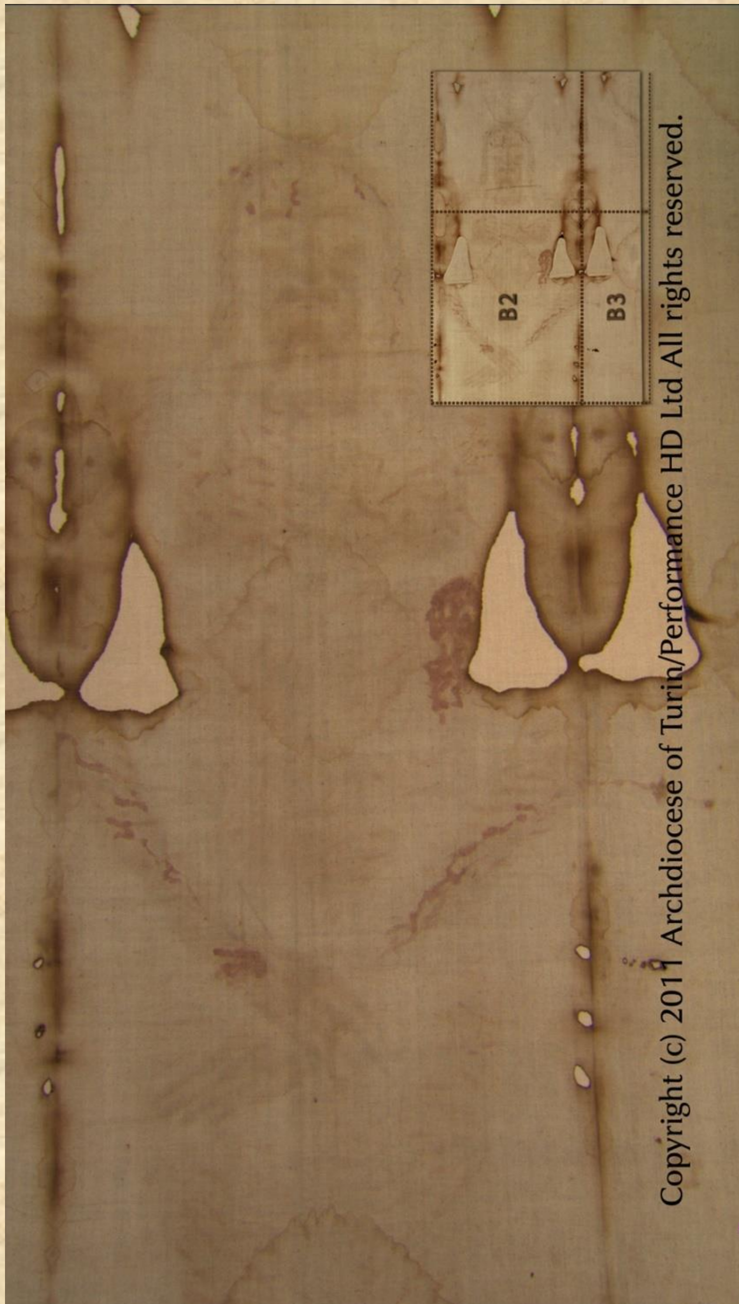
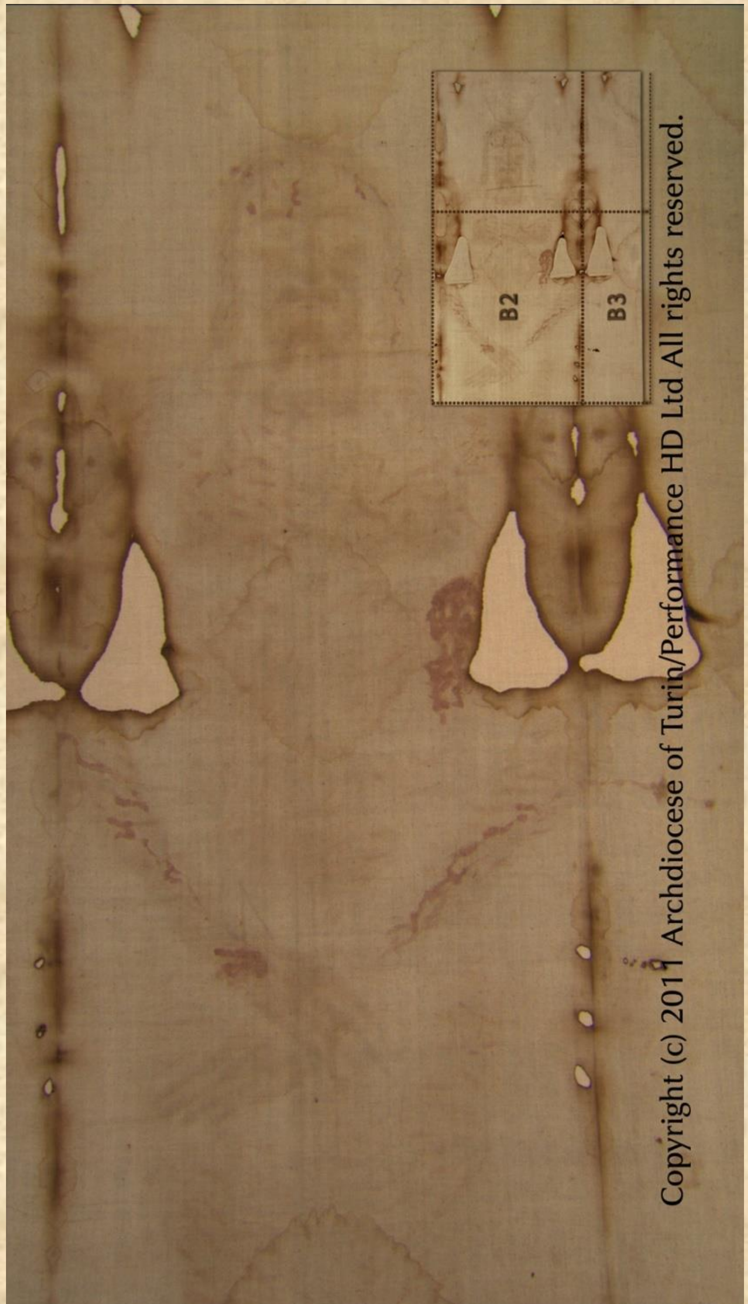
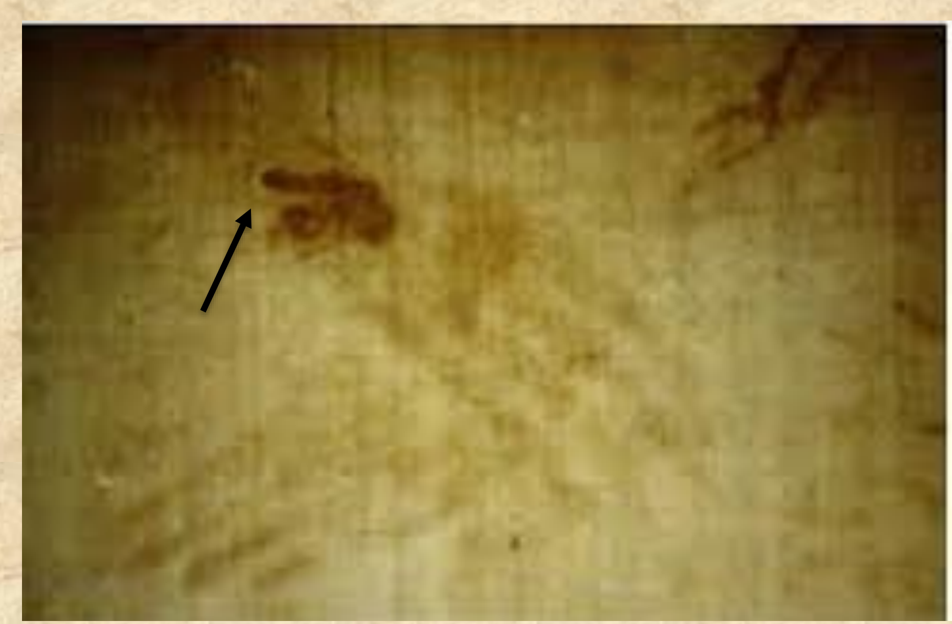
Blood clotting, serum halo rings, and the bloodstains on the Shroud of Turin

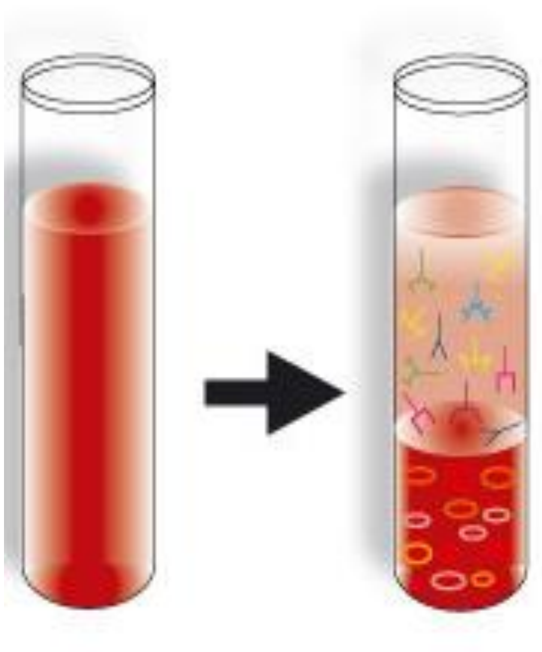


Ultraviolet fluorescence

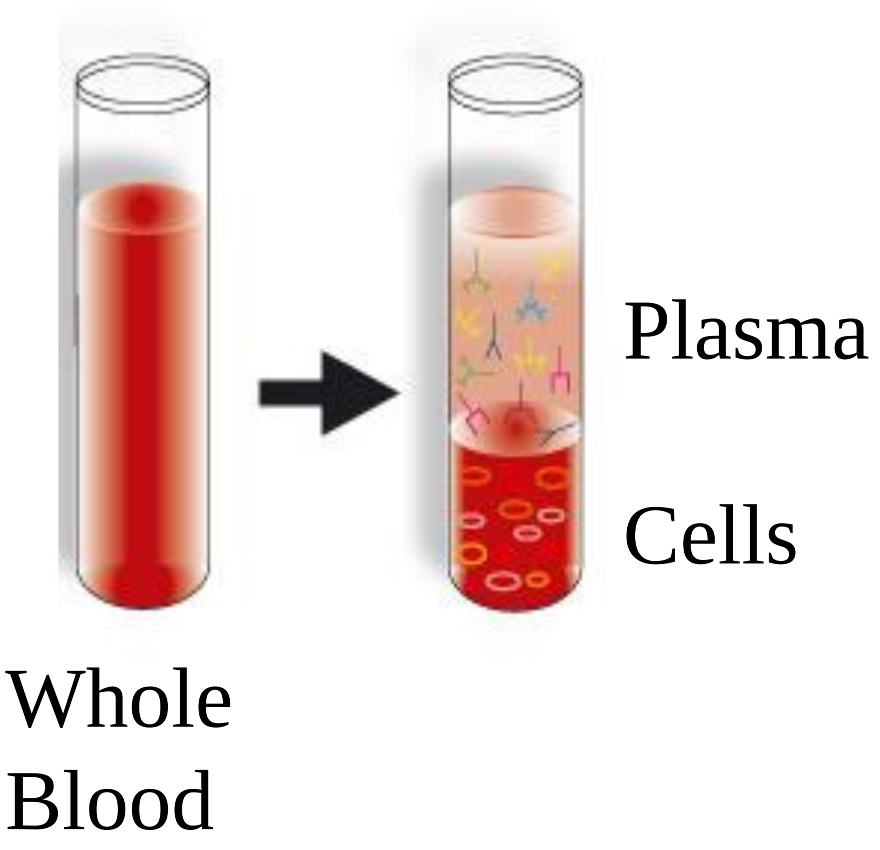




Ultraviolet fluorescence



Whole
Blood


Plasma
Cells
Whole
Blood

Plasma Composition

Water 90%

Proteins 7-9%

Salts 0.9%

Sugar 0.1%

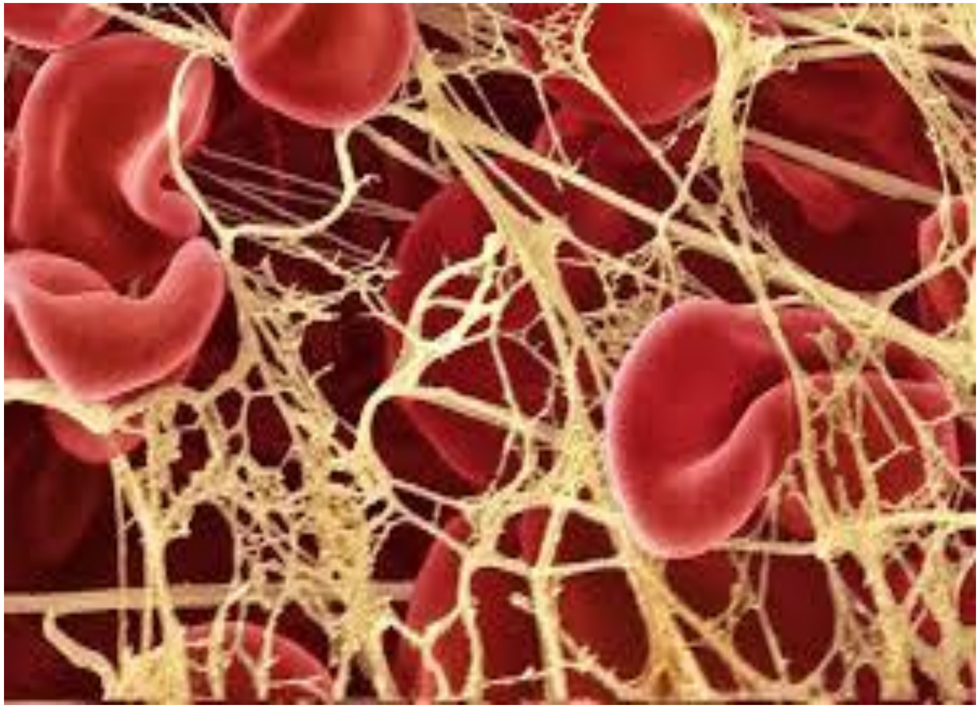
Urea 0.03 %

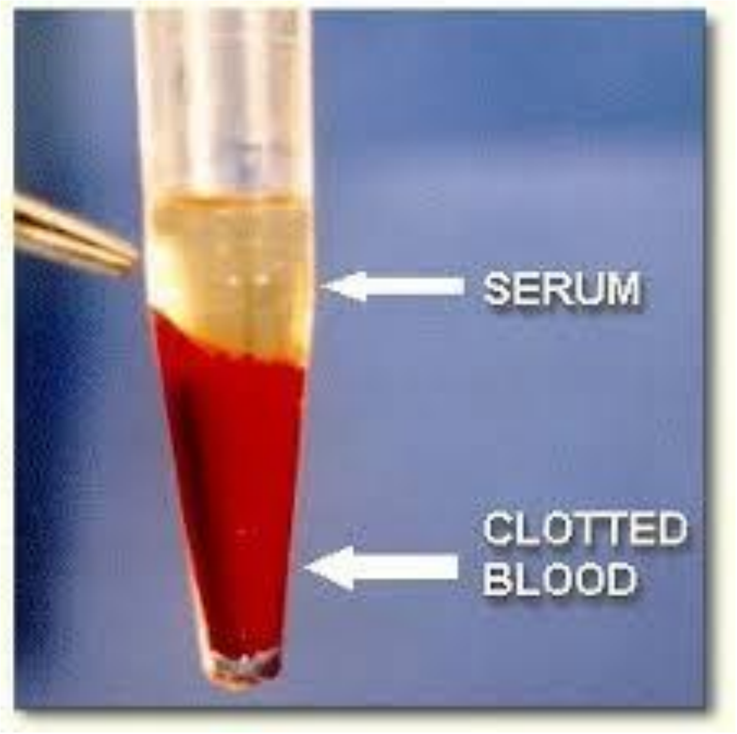
Difference between Plasma and Serum

Clotting

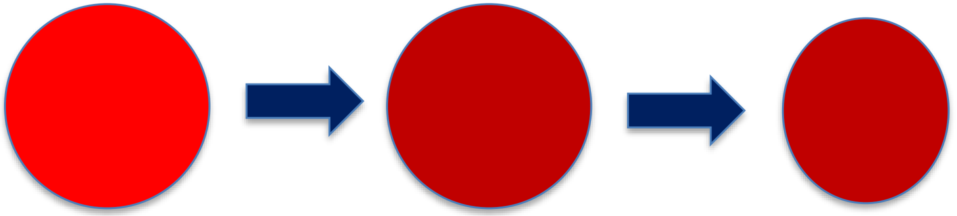
Plasma → Serum

Serum = Plasma – Clotting factors





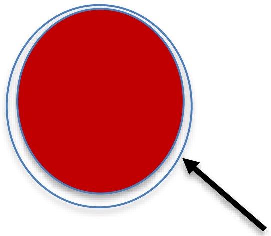
Blood clotting



Clot retraction

Serum exuded at edges of clot

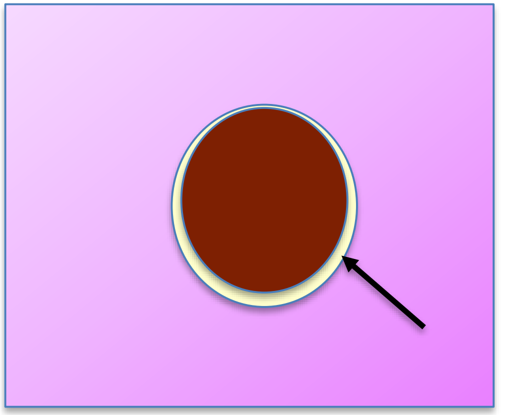
Blood clotting



"Serum halo"

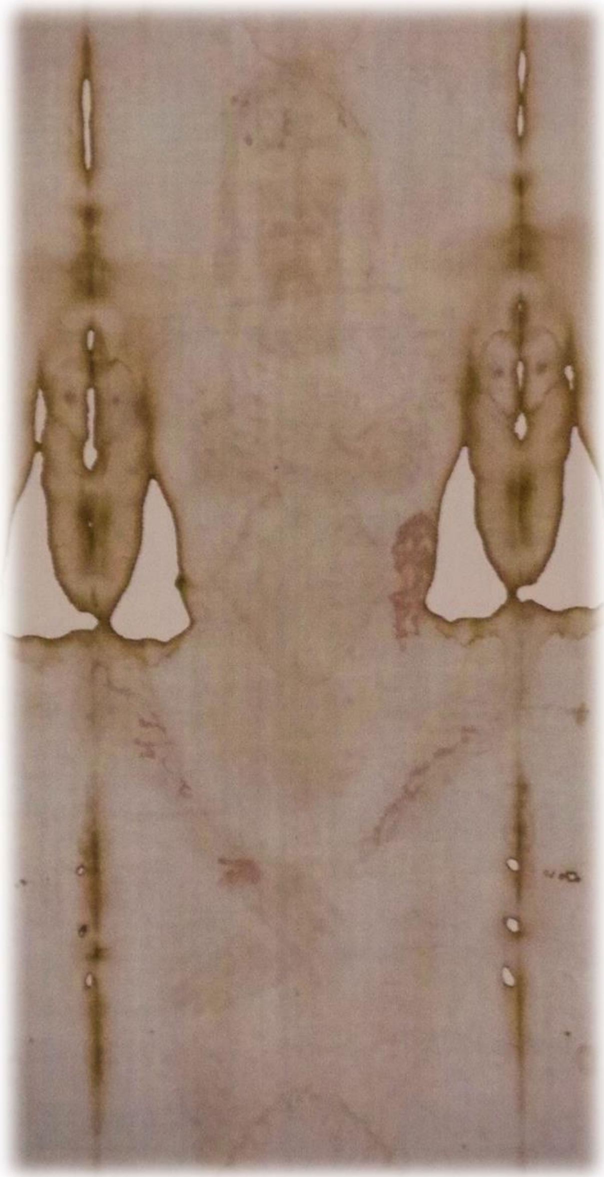
Visible under ultraviolet light

Blood clotting

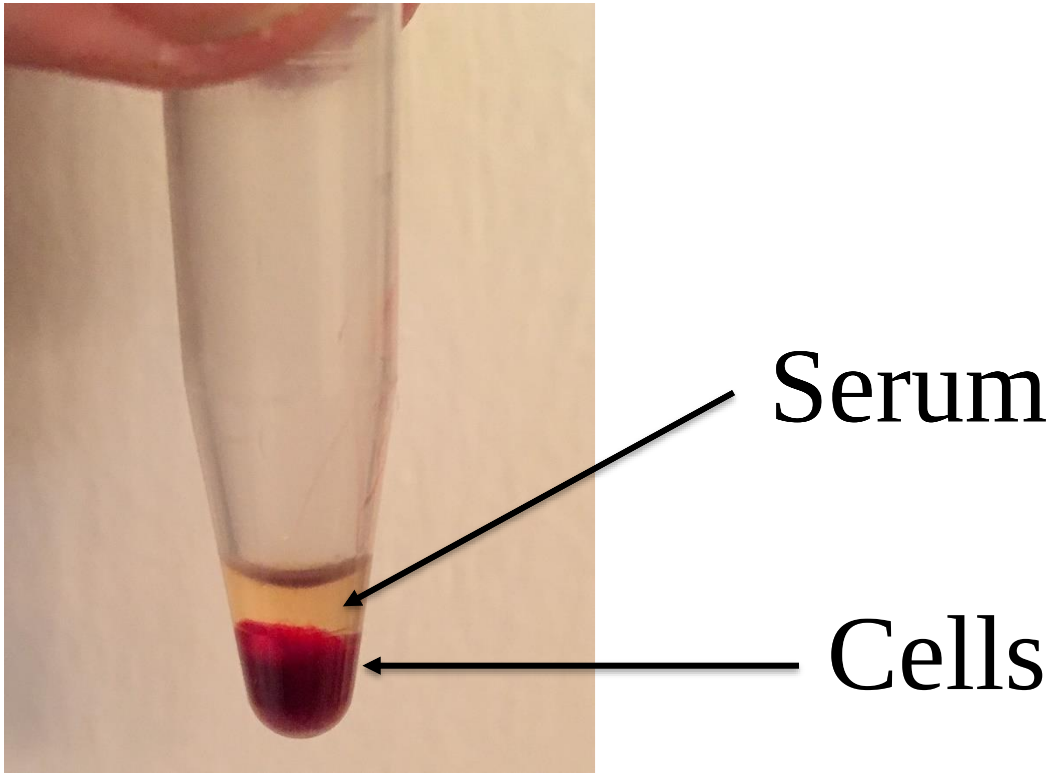


“Serum halo”

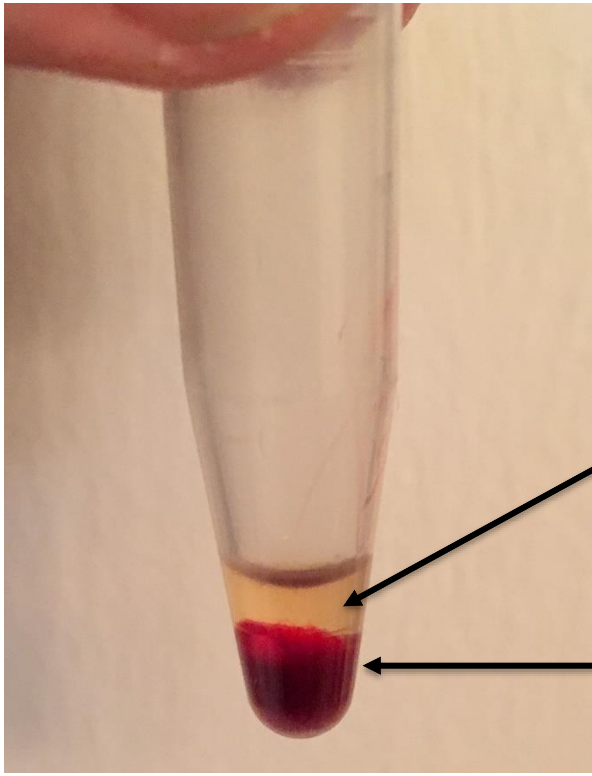
Visible under ultraviolet light



Serum halo rings indicate that clotted blood was transferred to the cloth

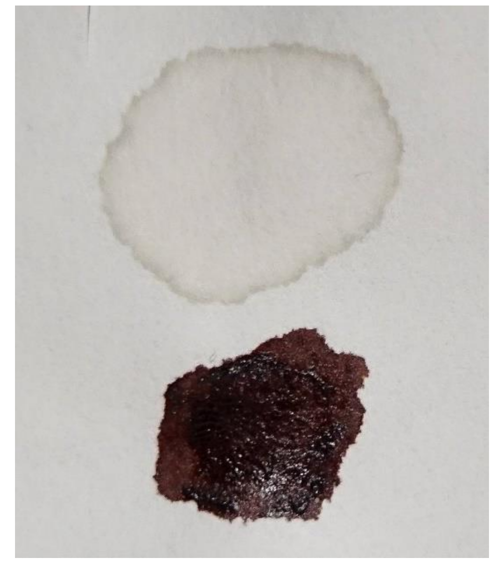

Serum
Cells

Natural (White) Light

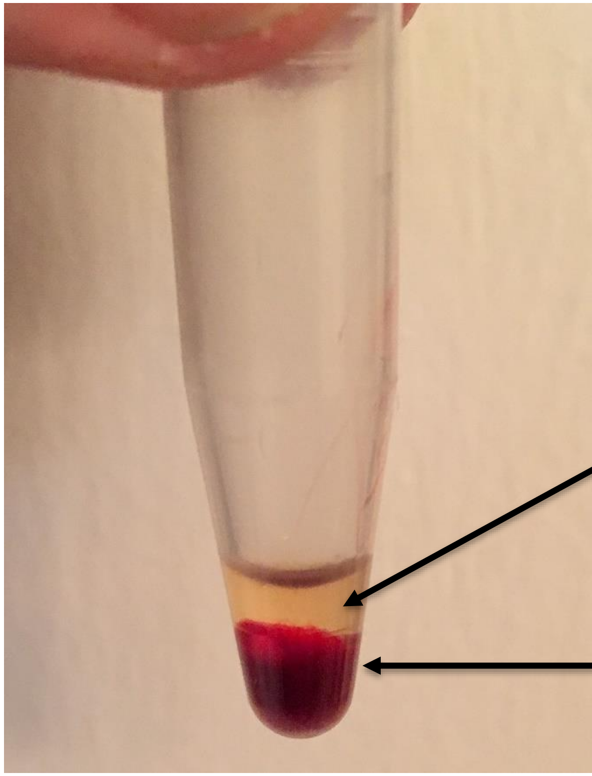


Serum

Cells



Ultraviolet Light



Serum

Cells

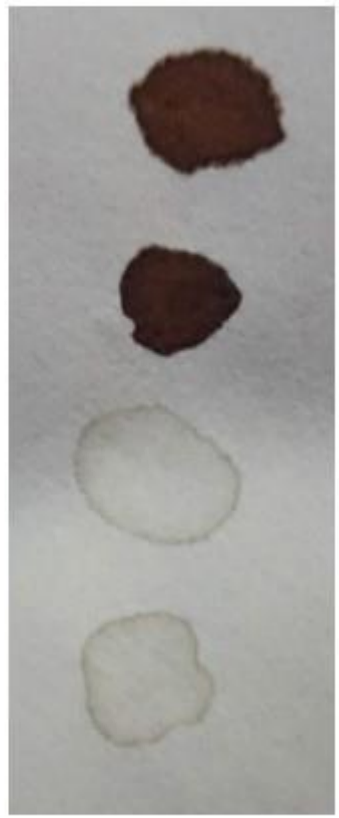
White Light

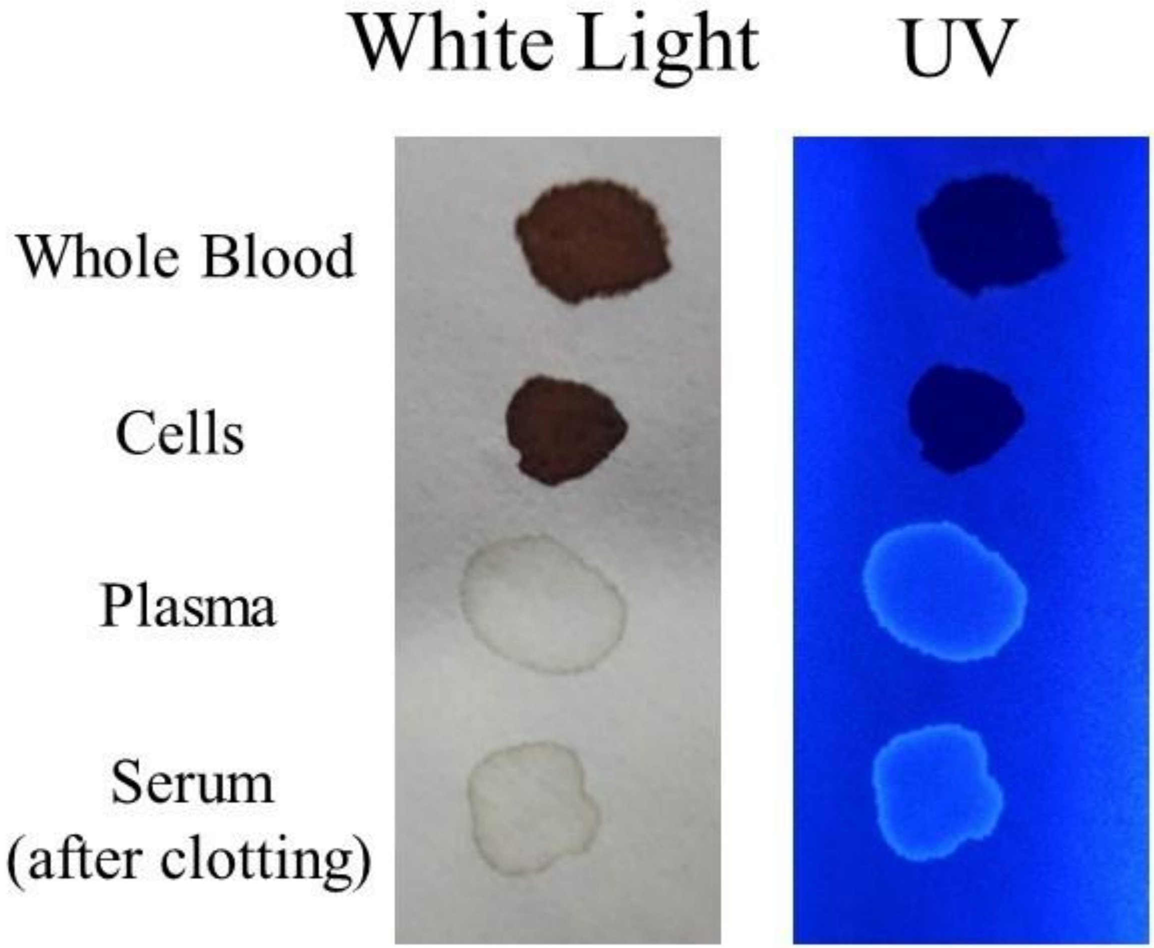
Whole Blood

Cells

Plasma

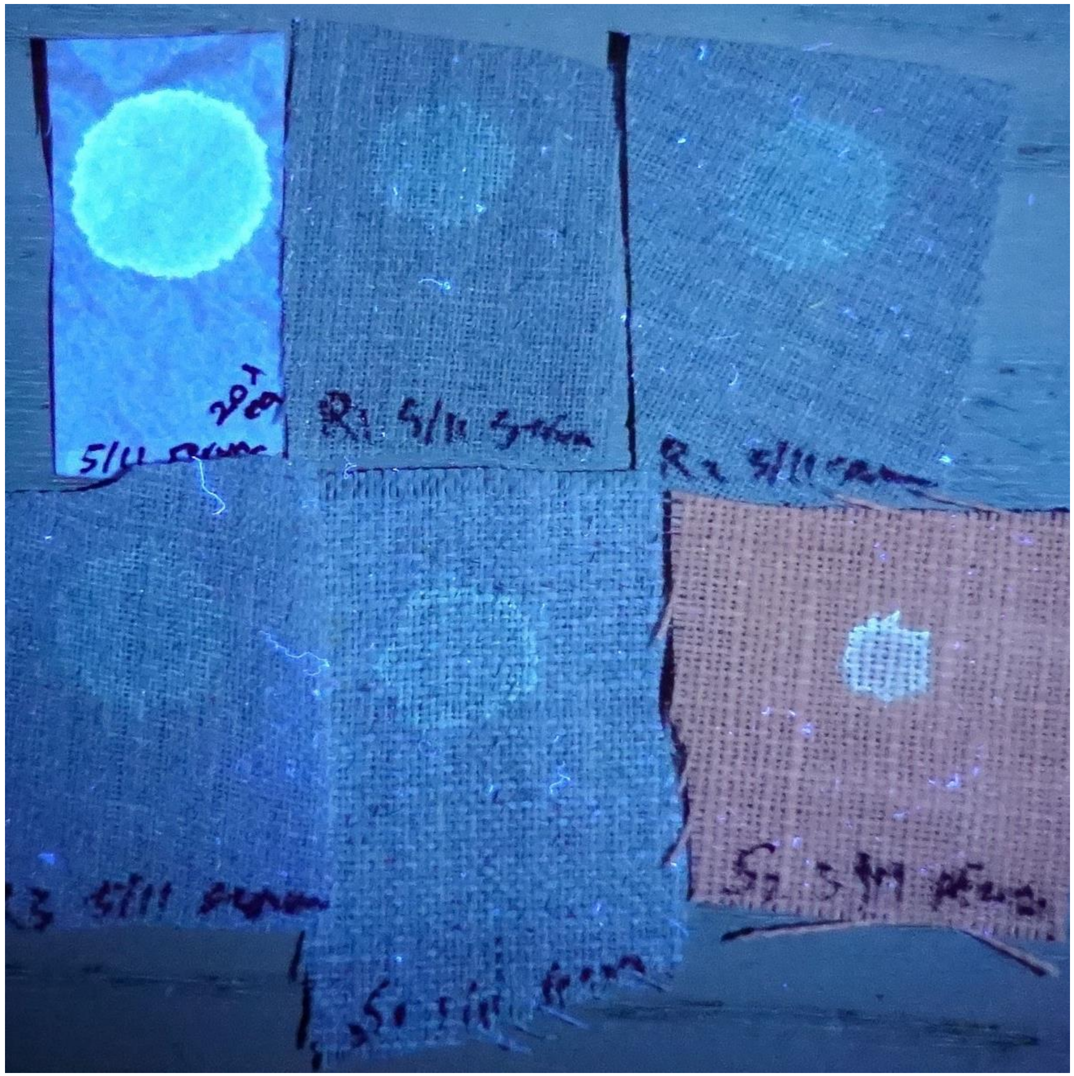
Serum
(after clotting)

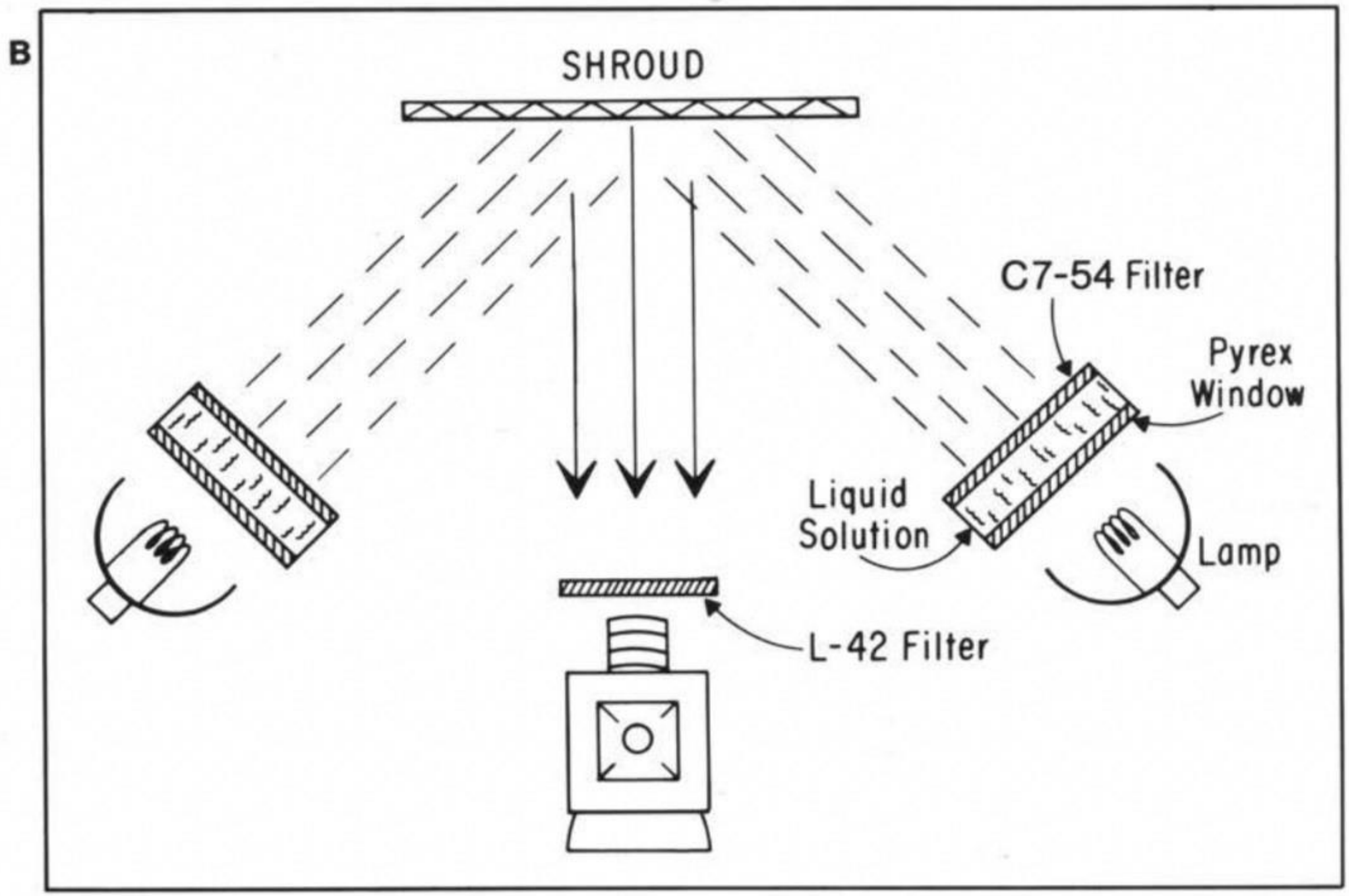



White Light
UV
Whole Blood
Cells
Plasma
Serum
(after clotting)

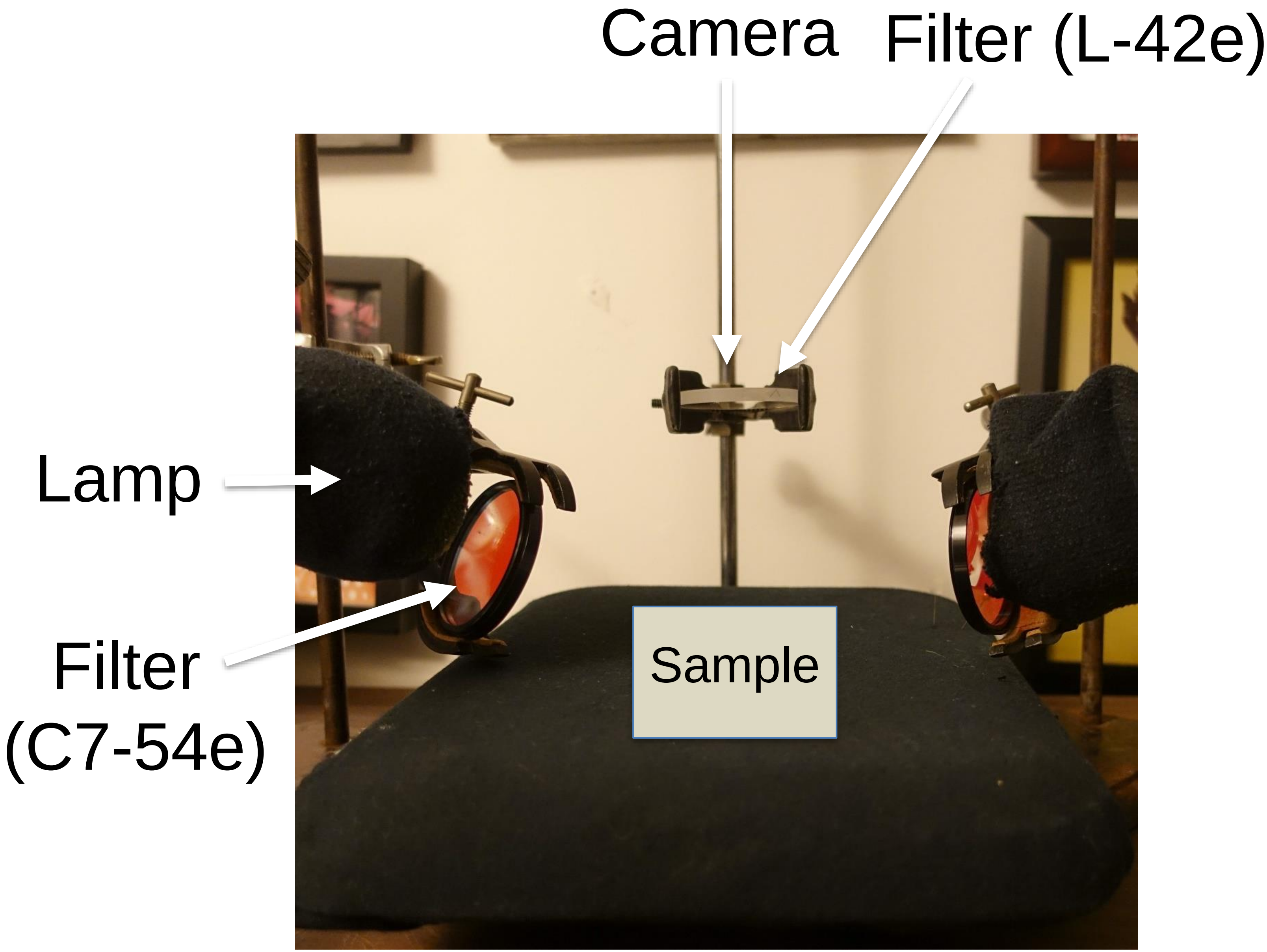
Blood serum

Blood serum

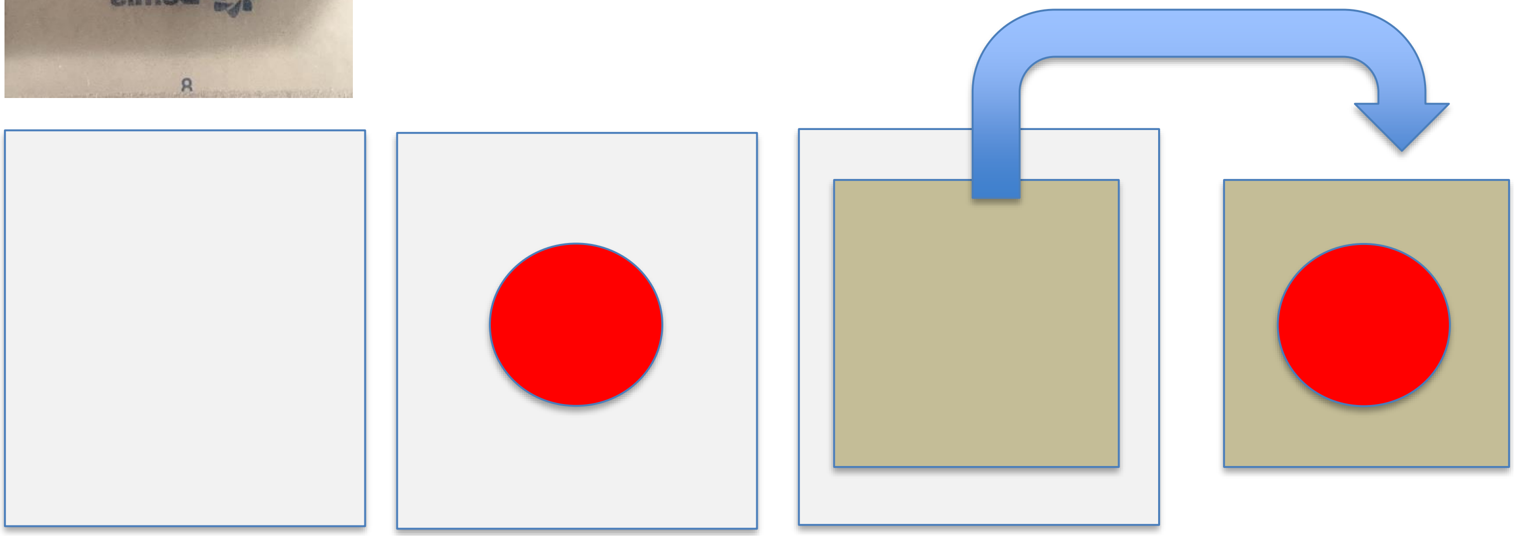




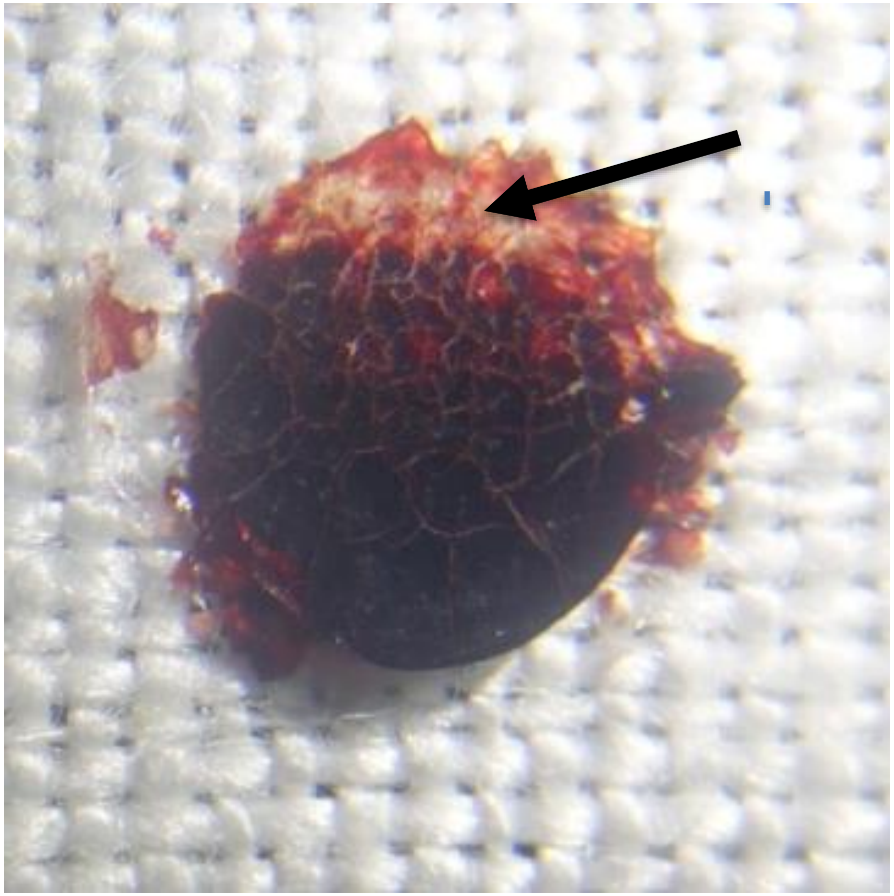
Miller and Pellicori, "Ultraviolet fluorescence Photography of the Shroud of Turin", J. Biological Photography, 49: 3, 1981


Camera
Filter (L-42e)
Lamp
Filter
(C7-54e)
Sample

Blood transfer

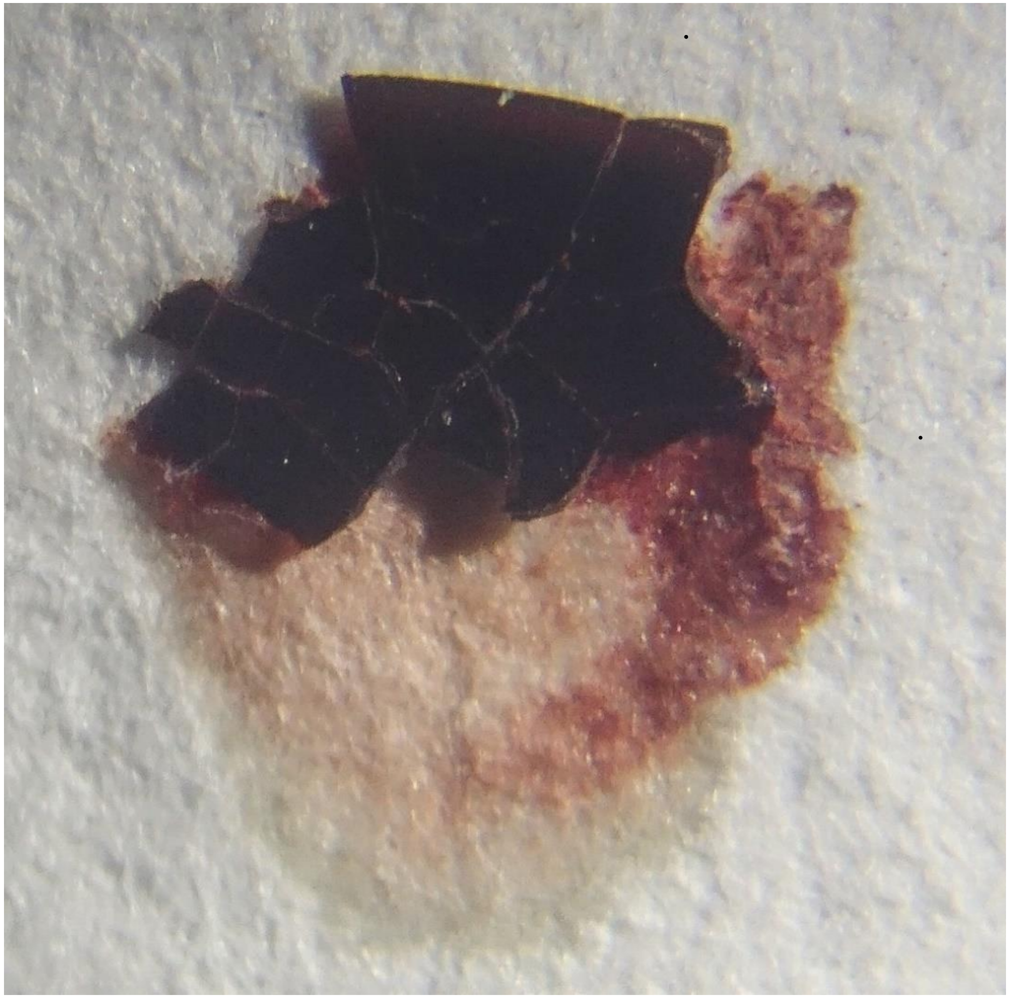


Blood transferred after clotting



Blood transferred after clotting

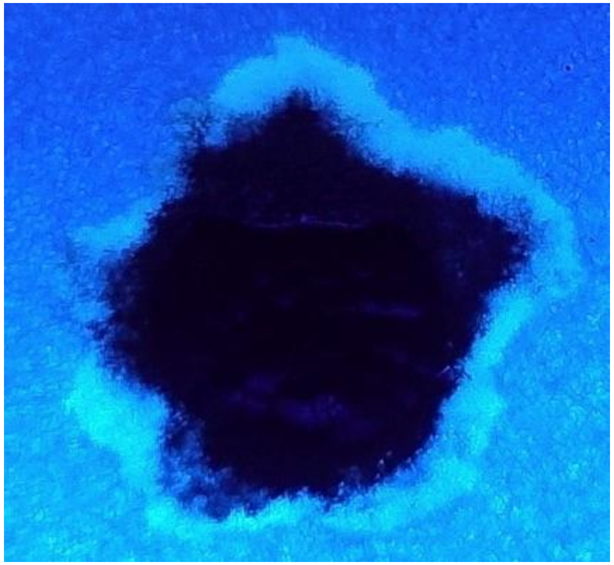
Blood transferred after clotting



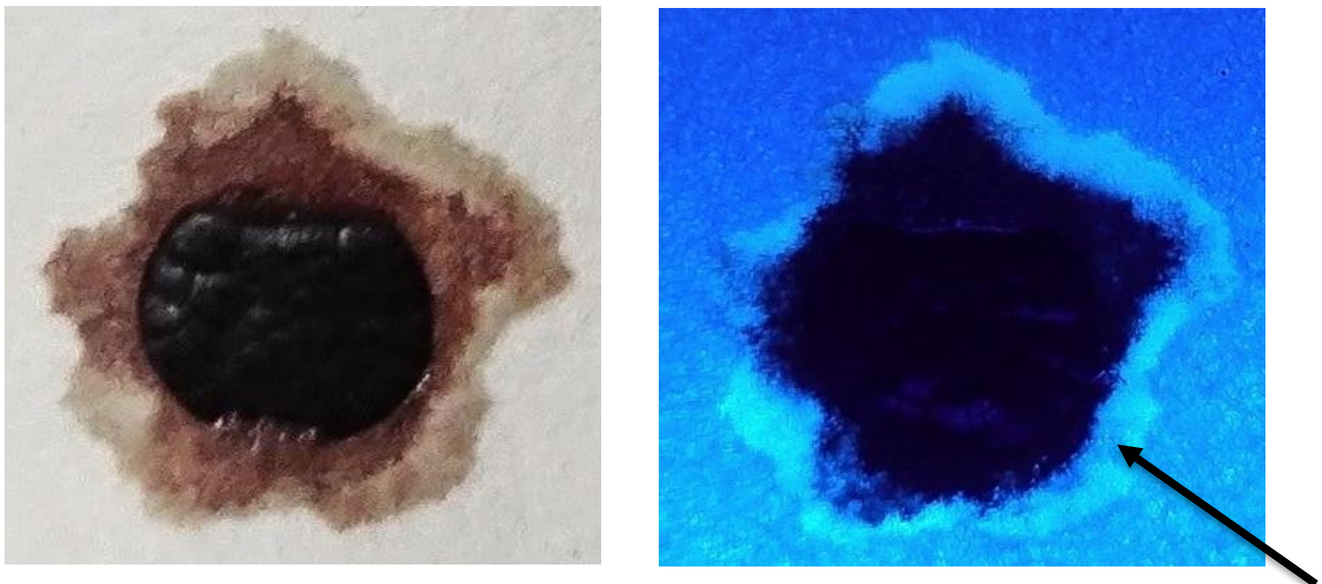
Blood transferred after clotting

White

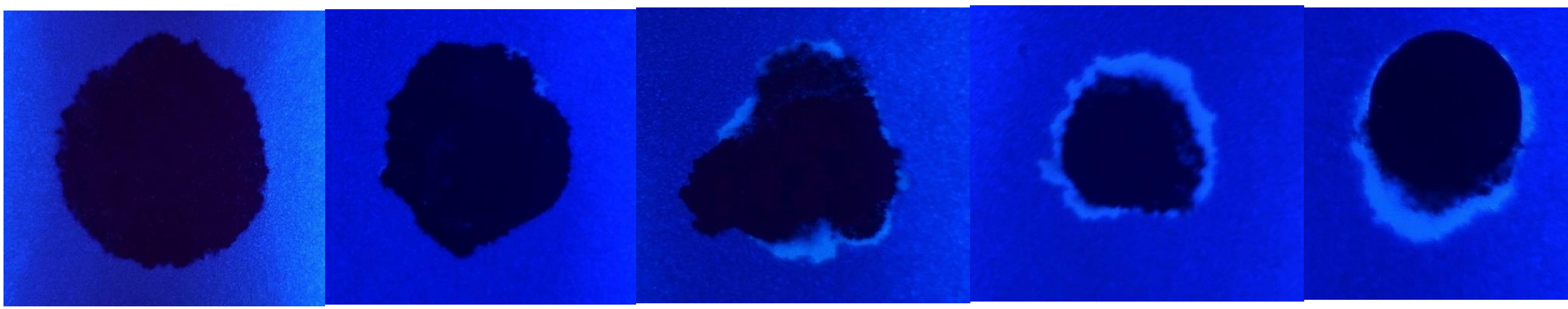
UV



Blood transferred after clotting



Serum halo ring formation

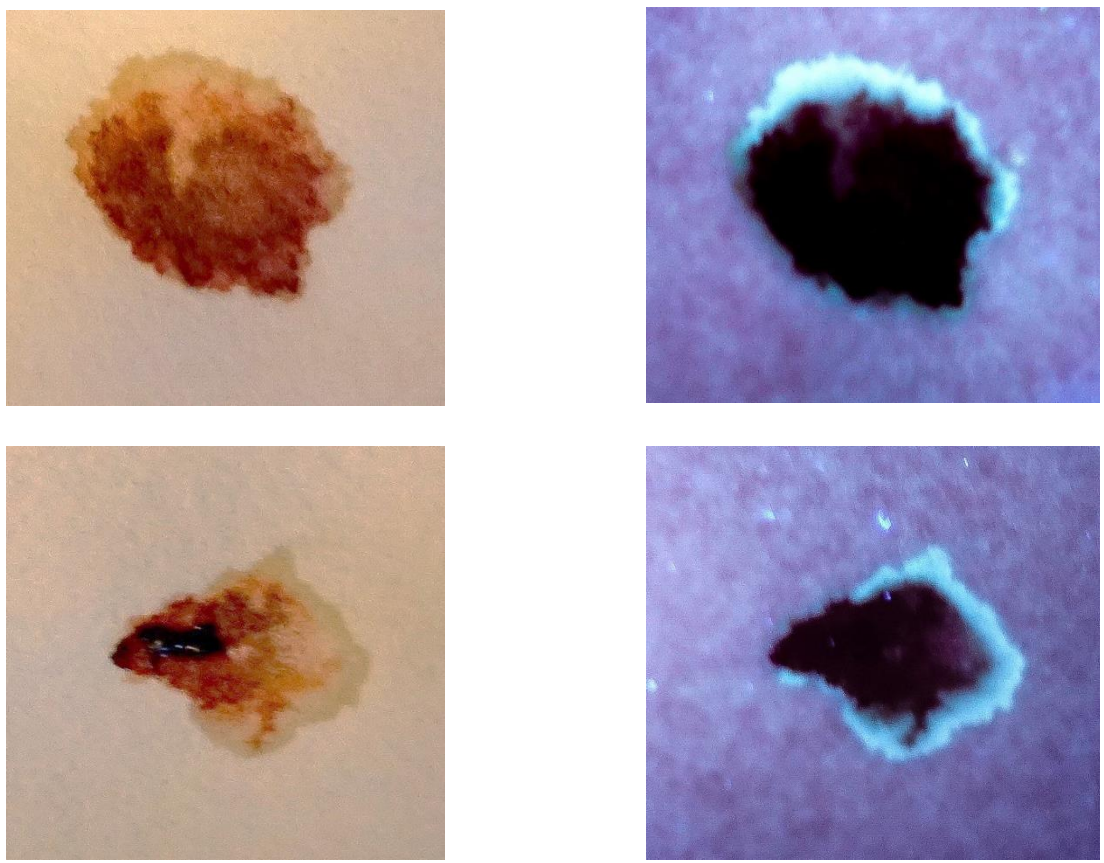


0 min 10 min 20 min 30 min 40 min

Filter paper added to sample @ time indicated

Blood on skin transferred after clotting

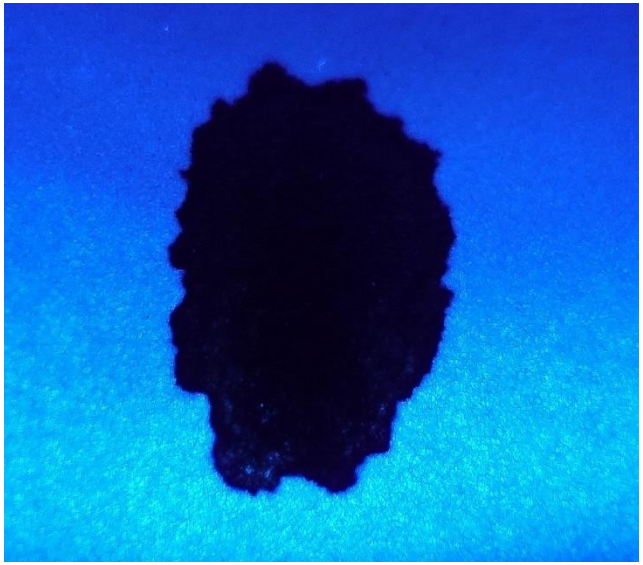
White UV



Blood transferred directly

White

UV



Direct transfer

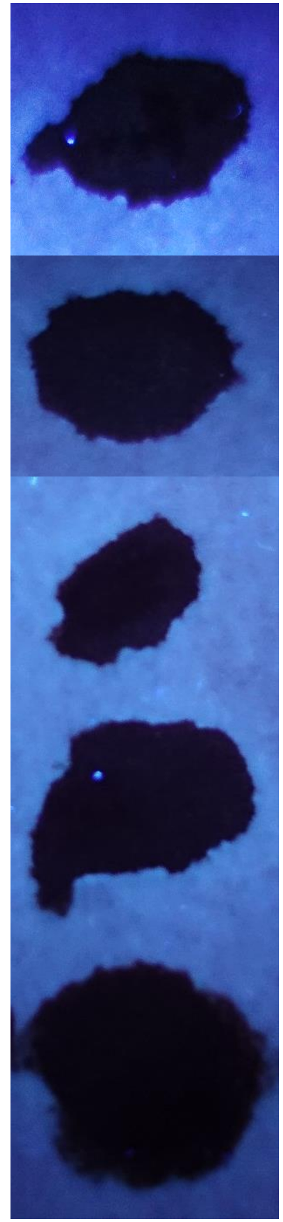
Dropper

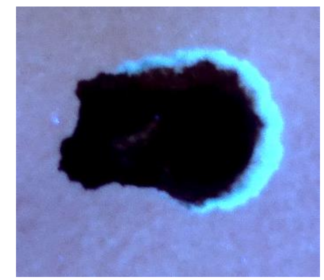
Chopstick

Fork

Cloth

Q-tip



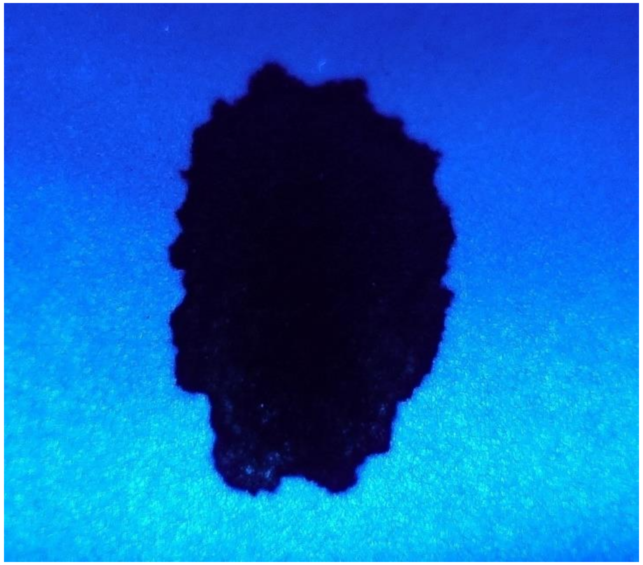


Control
(Clot)

Blood transferred directly

White

UV

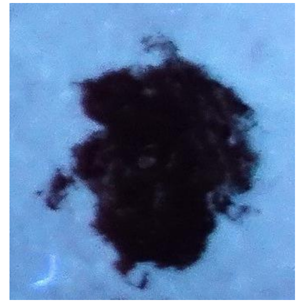


Variation in angles

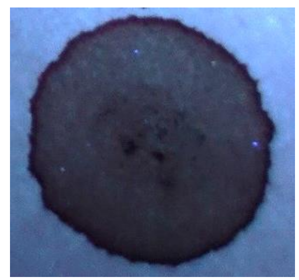
Variation in clotting time

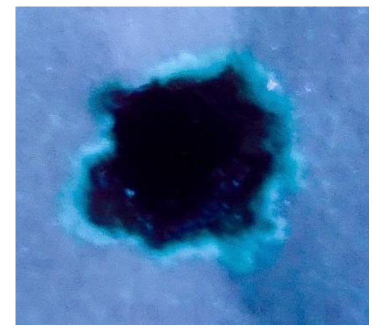
Direct transfer

Post-clot
(vigorous stirring)



Dried blood
(ground, rehydrated)





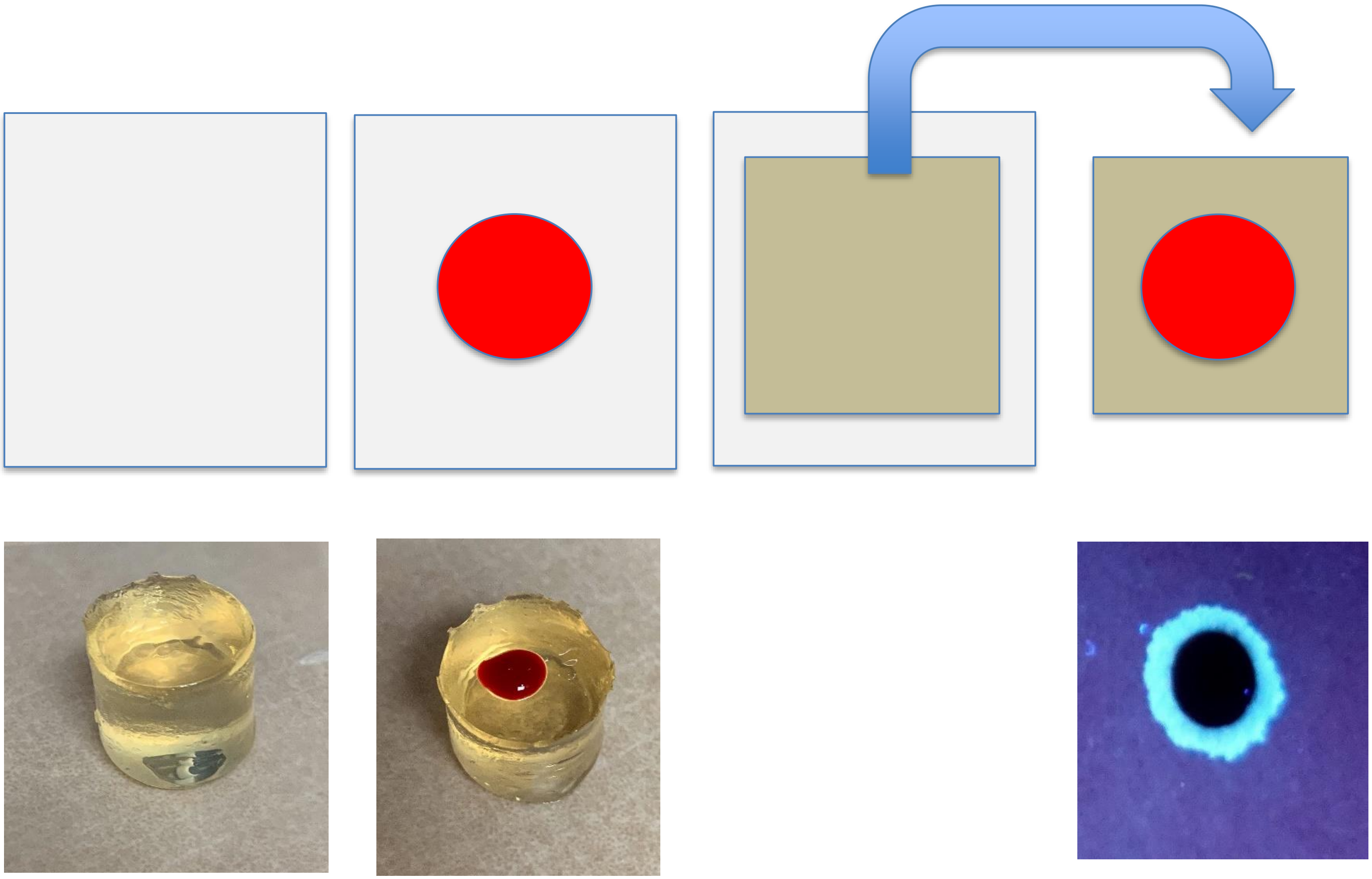
Control
(Clot)

Serum halo rings were only observed when clotted (whole) blood was transferred

Serum halo rings were not observed when blood was directly transferred

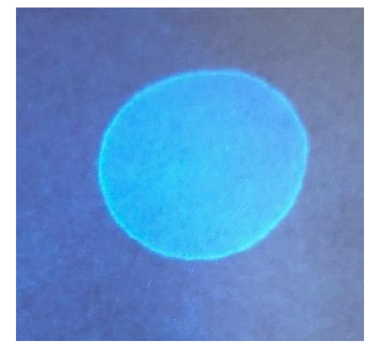
Skin simulant (ballistics gel)

Blood transfer



Gelatin (collagen)

Connective tissue
(ground, hydrated)



Bone
(ground, hydrated)

Blood clotting

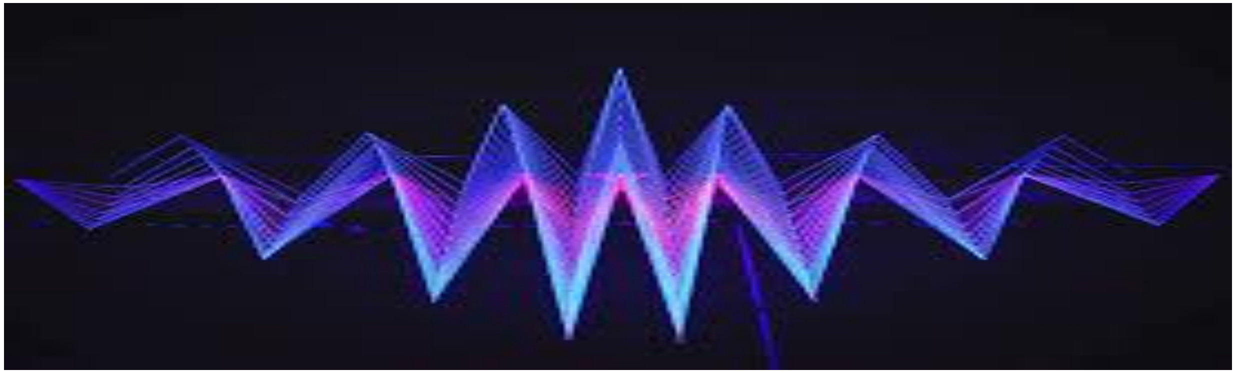
EDTA

Sodium Citrate ($Na_3C_6H_5O_7$)

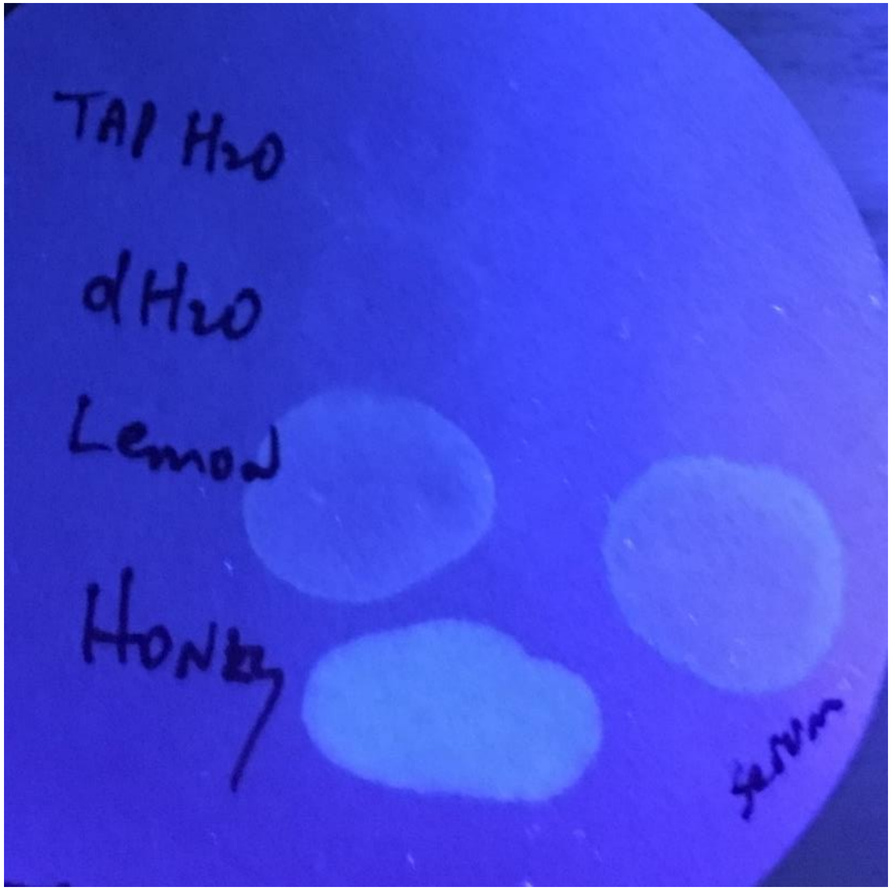
Blood clotting

Many fruits contain
Citric Acid ($C_6H_8O_7$)

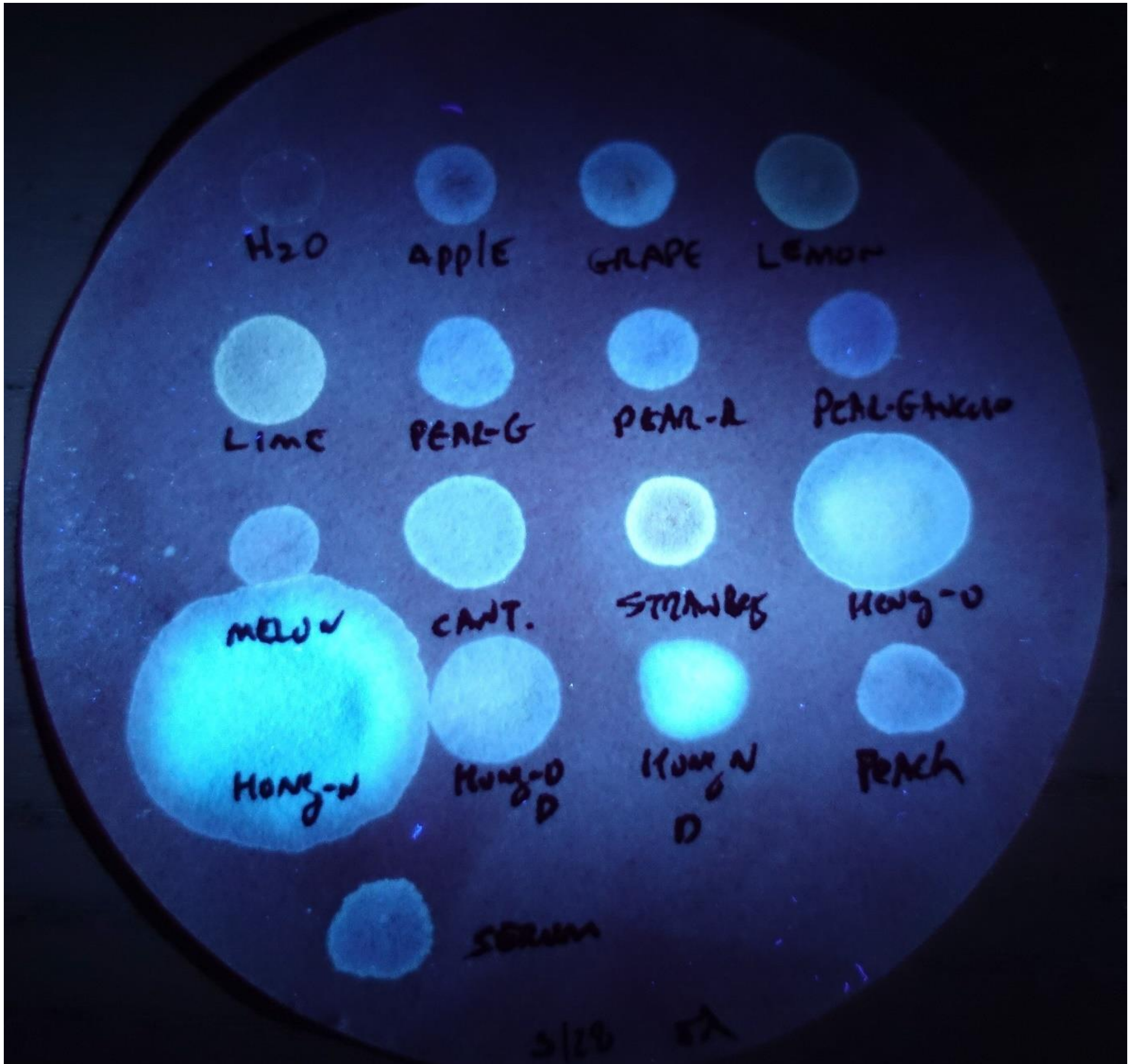
Ultraviolet light



Ultraviolet light

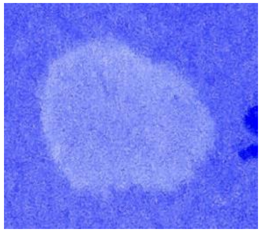
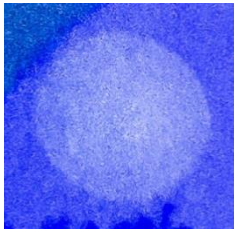
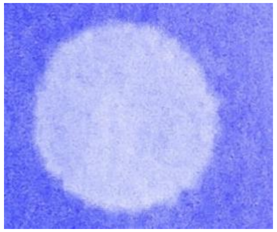
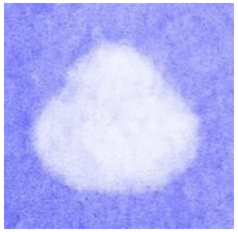


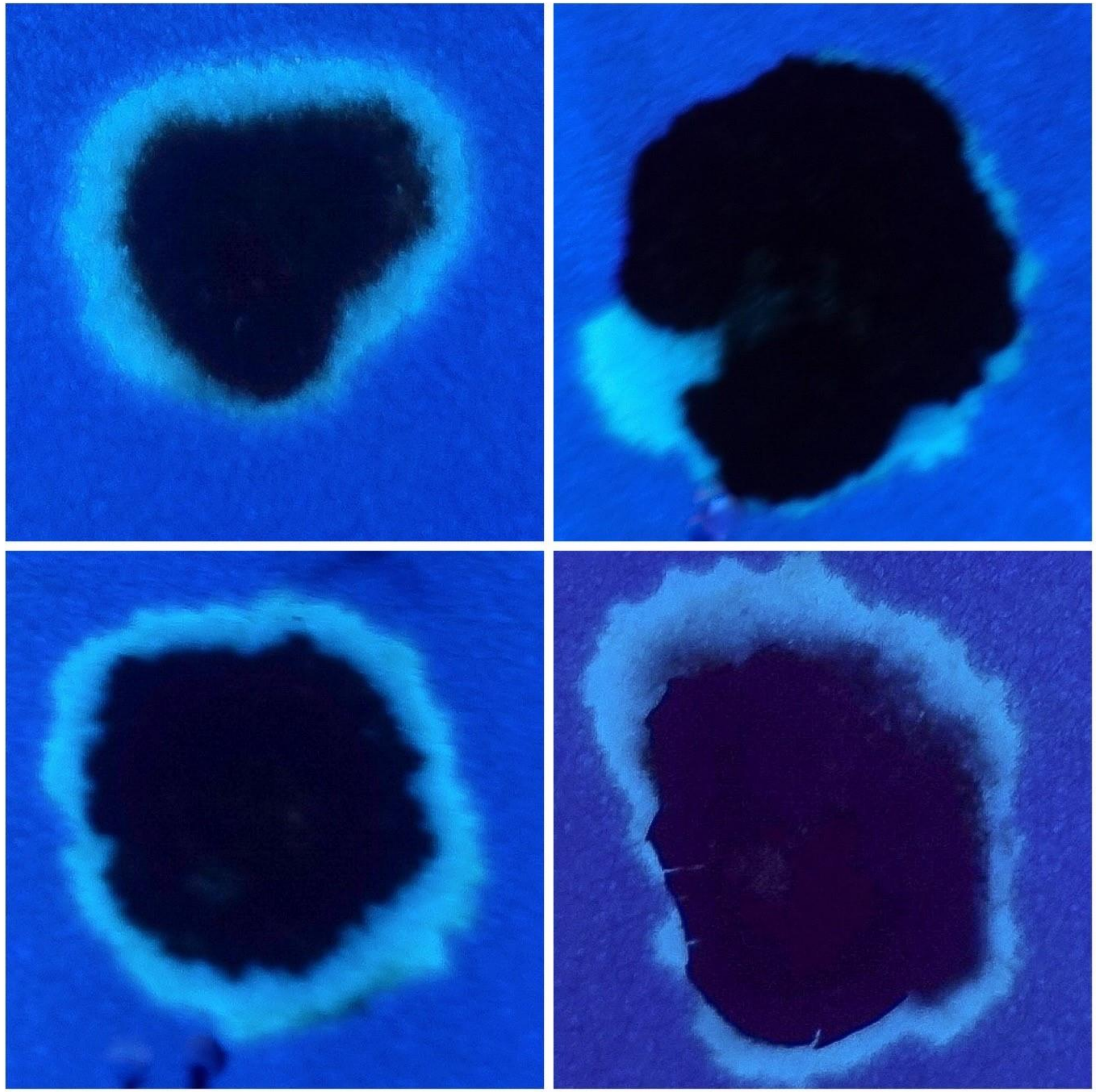
Ultraviolet light



Pineapple

Serum Stem Core Fruit

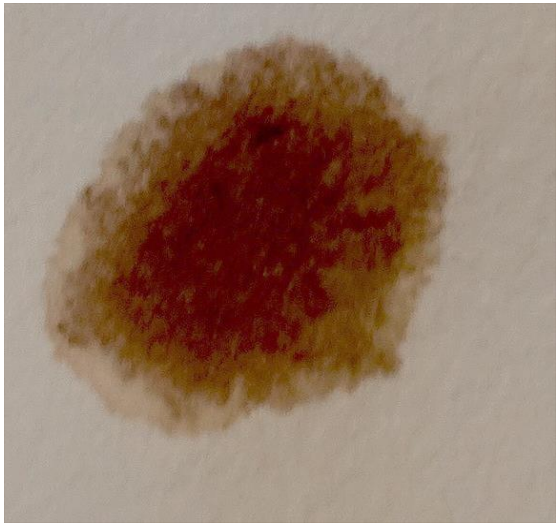


White

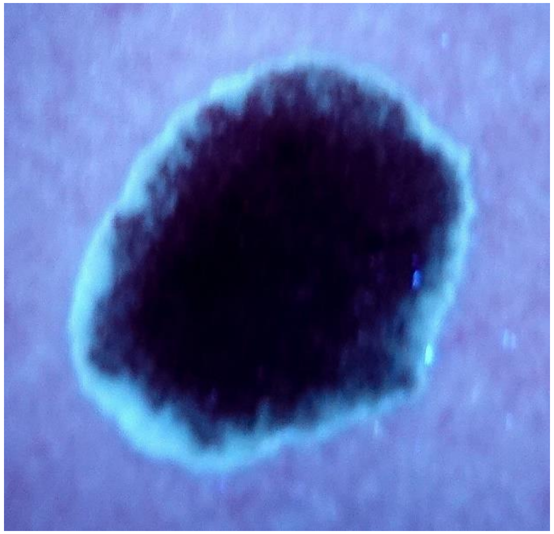
UV

Blood + honey/alcohol mixture

White



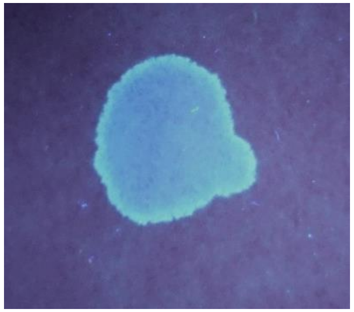
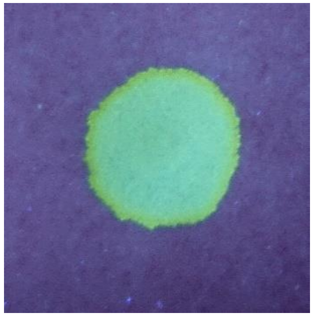
UV



Blood + lemon juice

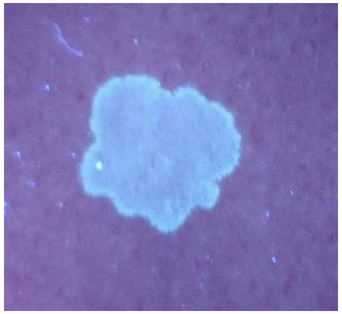
Bilirubin and UV fluorescence

Human Serum plus Bilirubin

-	50x
	

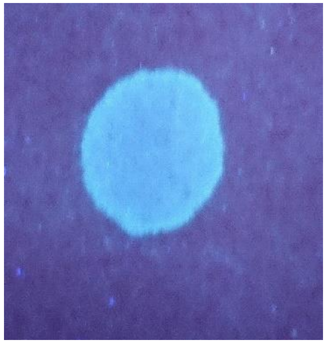
Serum (UV)

WT rat

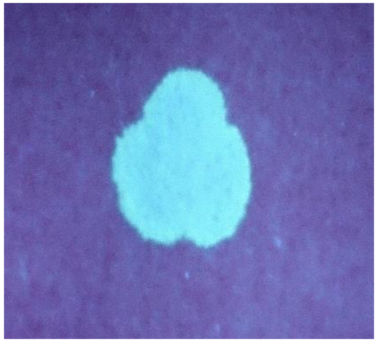


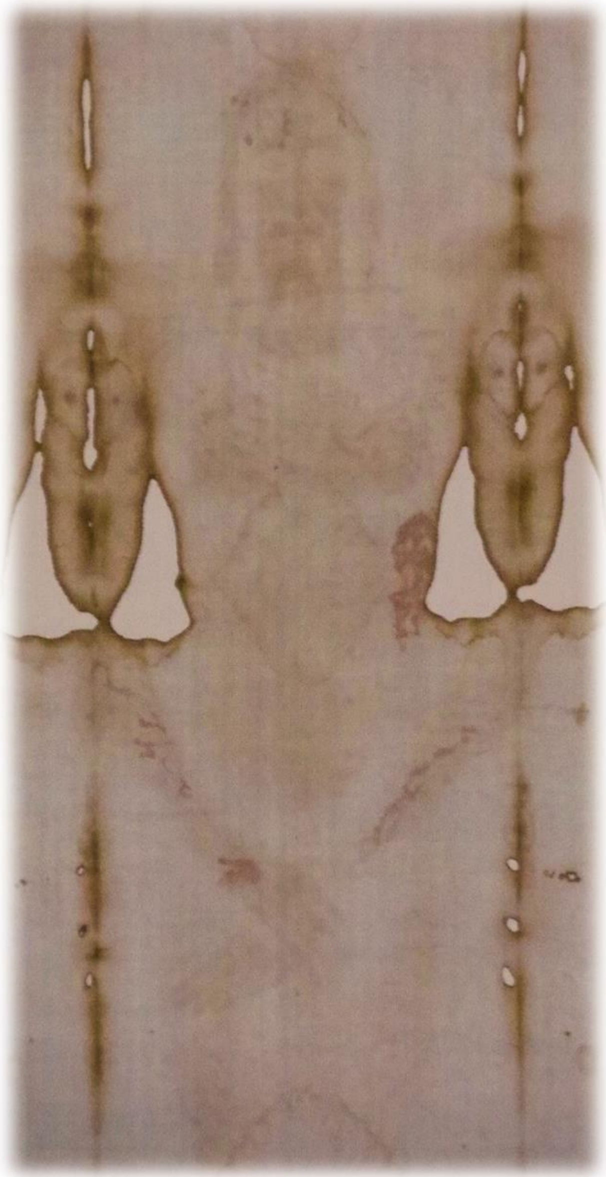
Gunn rat

WT mice



hUGT1 mice





“One cannot simply say that the blood images were painted on afterwards. One would need a constant supply of fresh clot exudates from a traumatically wounded human… and then finally paint a serum contraction ring about every wound. Logic suggests that this is not something a forger or artisan before the present century would not only know how to do, but even know that it was required.”

Alan Adler

Sources of Bilirubin

c&en TOPICS MAGAZINE COLLECTIONS VIDEOS JOBS

Volume 87 Issue 7 | p. 40 | Concentrates
Issue Date: February 16, 2009

Plants Make Bilirubin, Too

Scientists discover that the colorful tetrapyrrole-based pigment derived from heme in animals also occurs in colorful plant seeds

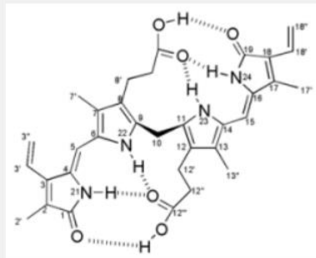
By ***Elizabeth K. Wilson***

SCIENCE & TECHNOLOGY CONCENTRATES

Scientists have discovered that the pigment responsible for the brilliant orange seed arils of the bird-of-paradise tree is bilirubin, a molecule thought to exist only in animals (*J. Am. Chem. Soc.*, DOI: **10.1021/ja809065g**).

How plants produce the

[+]Enlarge



J Am Chem Soc. 2009 Mar 4;131(8):2830. doi: 10.1021/ja809065g.

Animal pigment bilirubin discovered in plants.

Pirone C[1], Quirke JM, Priestap HA, Lee DW.

Author information

Abstract

The bile pigment bilirubin-IXalpha is the degradative product of heme, distributed among mammals and some other vertebrates. It can be recognized as the pigment responsible for the yellow color of jaundice and healing bruises. In this paper we present the first example of the isolation of bilirubin in plants. The compound was isolated from the brilliant orange-colored arils of Strelitzia nicolai, the white bird of paradise tree, and characterized by HPLC-ESMS, UV-visible, (1)H NMR, and (13)C NMR spectroscopy, as well as comparison with an authentic standard. This discovery indicates that plant cyclic tetrapyrroles may undergo degradation by a previously unknown pathway. Preliminary analyses of related plants, including S. reginae, the bird of paradise, also revealed bilirubin in the arils and flowers, indicating that the occurrence of bilirubin is not limited to a single species or tissue type.

Home / Chemistry / Biochemistry

MARCH 11, 2009

First discovery of 'animals-only' pigment bilirubin in plants

In a first-of-its-kind discovery that overturns conventional wisdom, scientists in Florida are reporting that certain plants — including the exotic "White Bird of Paradise Tree" -- make bilirubin. Until now, scientists thought that pigment existed only in animals. The finding may change scientific understanding of how the ability to make bilirubin evolved, they say in a report in the *Journal of the American Chemical Society*.

Bird of paradise

Sources of Bilirubin

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AoB Plants. 2010; 2010: plq020.
Published online 2010 Oct 28. doi: 10.1093/aobpla/plq020

PMCID: PMC3000704
PMID: 22476078

Bilirubin present in diverse angiosperms

Cary Pirone,[1,*] Jodie V. Johnson,[2] J. Martin E. Quirke,[3] Horacio A. Priestap,[1] and David Lee[1]

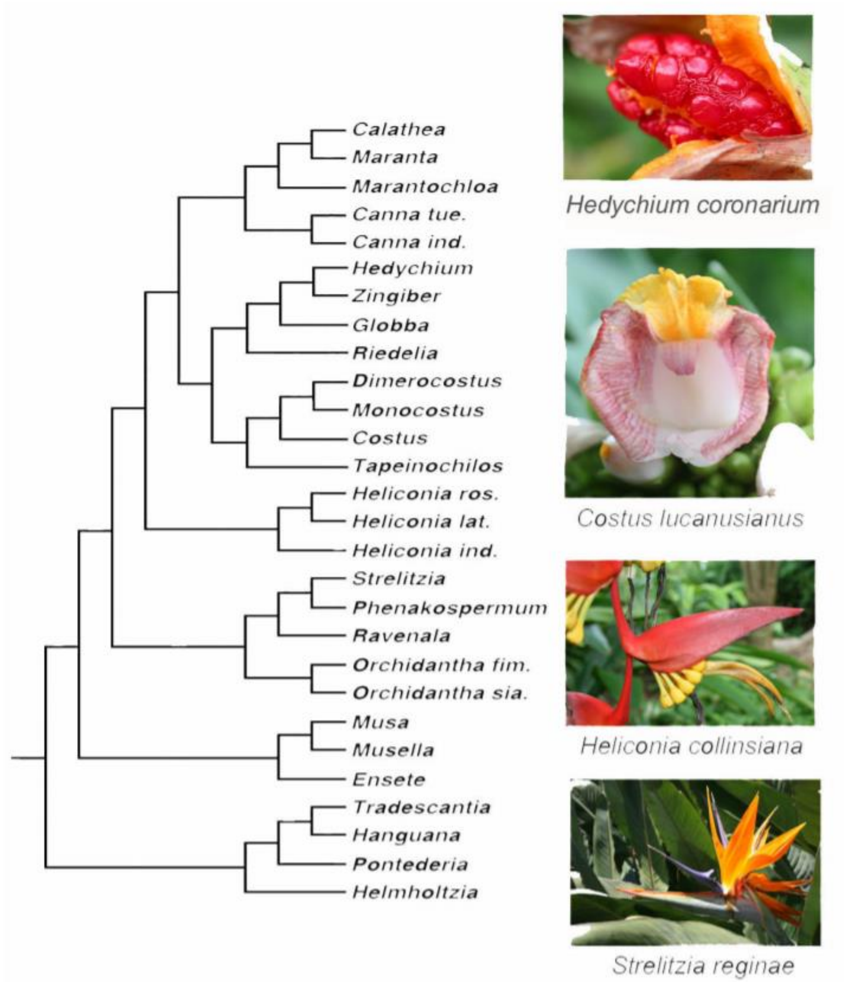
Abstract

Go to:

Background and aims

Bilirubin is an orange-yellow tetrapyrrole produced from the breakdown of heme by mammals and some other vertebrates. Plants, algae and cyanobacteria synthesize molecules similar to bilirubin, including the protein-bound bilins and phytochromobilin which harvest or sense light. Recently, we discovered bilirubin in the arils of *Strelitzia nicolai*, the White Bird of Paradise Tree, which was the first example of this molecule in a higher plant. Subsequently, we identified bilirubin in both the arils and the flowers of *Strelitzia reginae,* the Bird of Paradise Flower. In the arils of both species, bilirubin is present as the primary pigment, and thus functions to produce colour. Previously, no tetrapyrroles were known to generate display colour in plants. We were therefore interested in determining whether bilirubin is broadly distributed in the plant kingdom and whether it contributes to colour in other species.

Sources of Bilirubin



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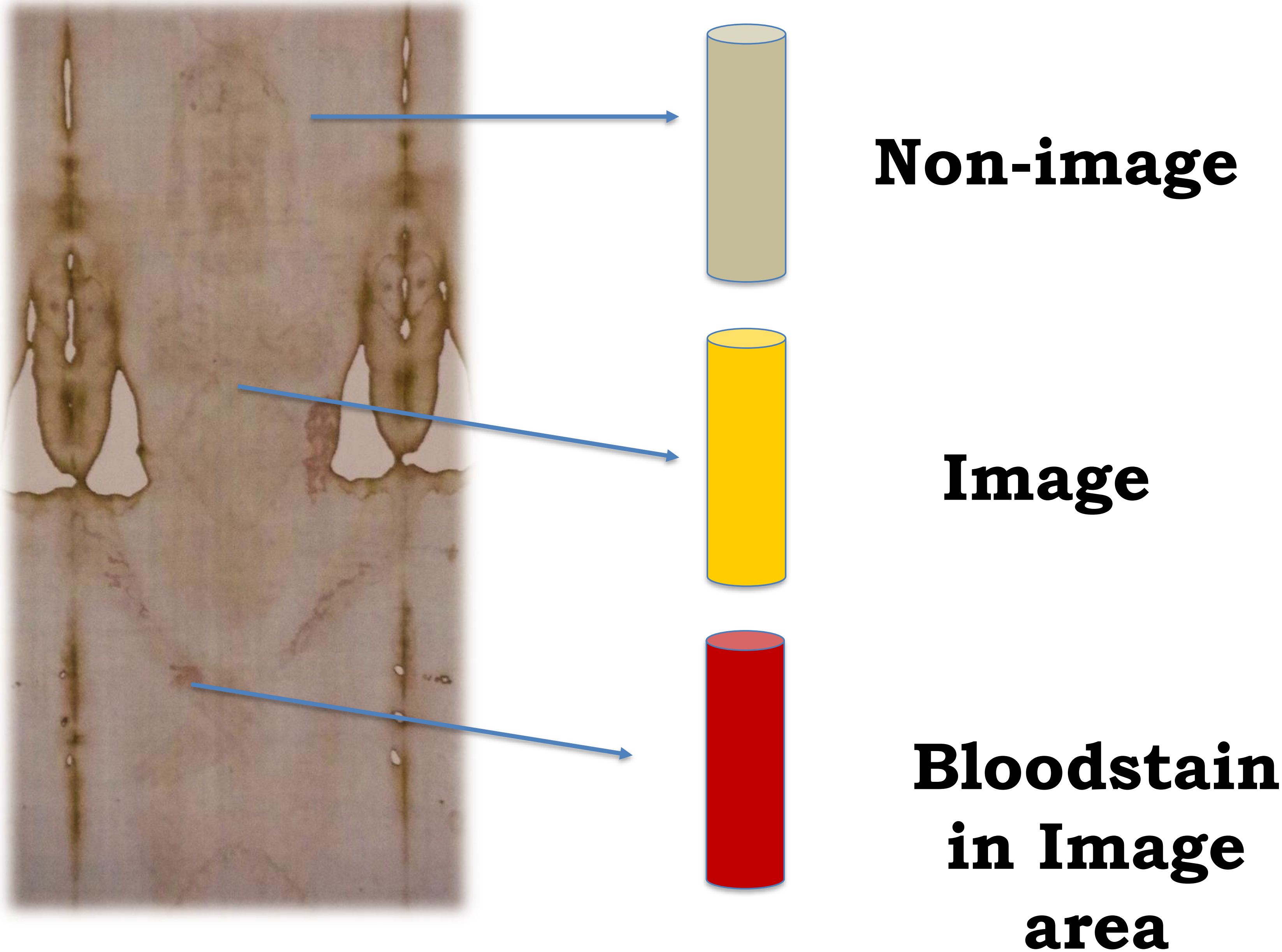
AoB Plants. 2010; 2010: plq020.
Published online 2010 Oct 28. doi: 10.1093/aobpla/plq020
PMCID: PMC3000704
PMID: 22476078

Bilirubin present in diverse angiosperms

Cary Pirone,[1,*] Jodie V. Johnson,[2] J. Martin E. Quirke,[3] Horacio A. Priestap,[1] and David Lee[1]

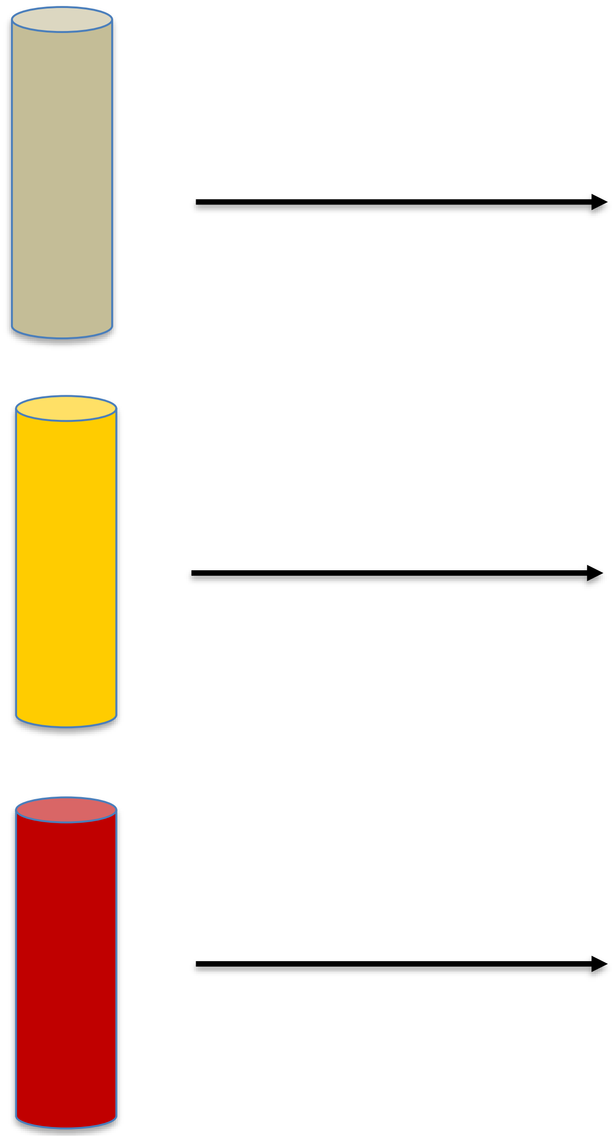

Non-image
Image
Bloodstain in Image area

Protease Treatment

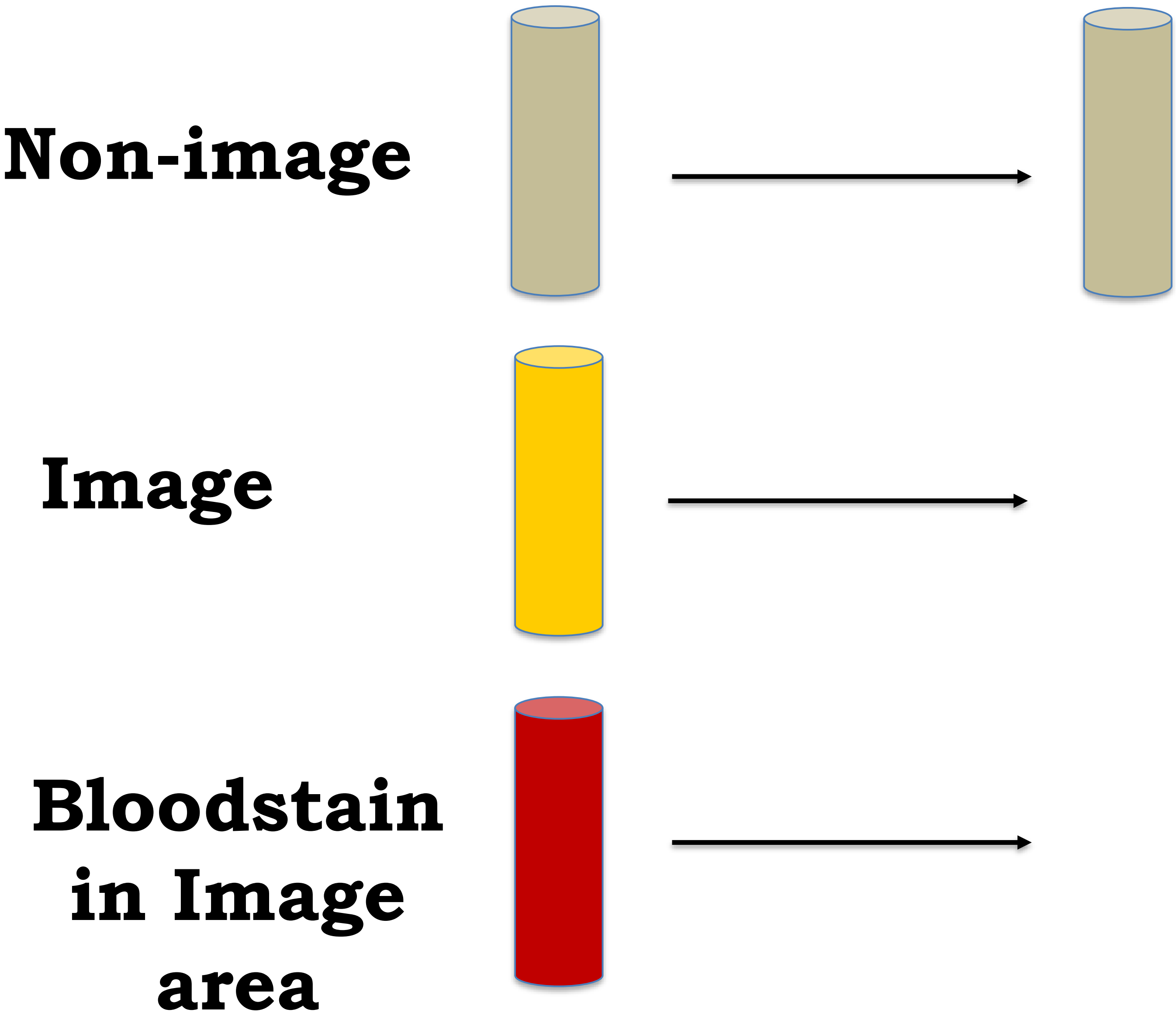
Non-image

Image

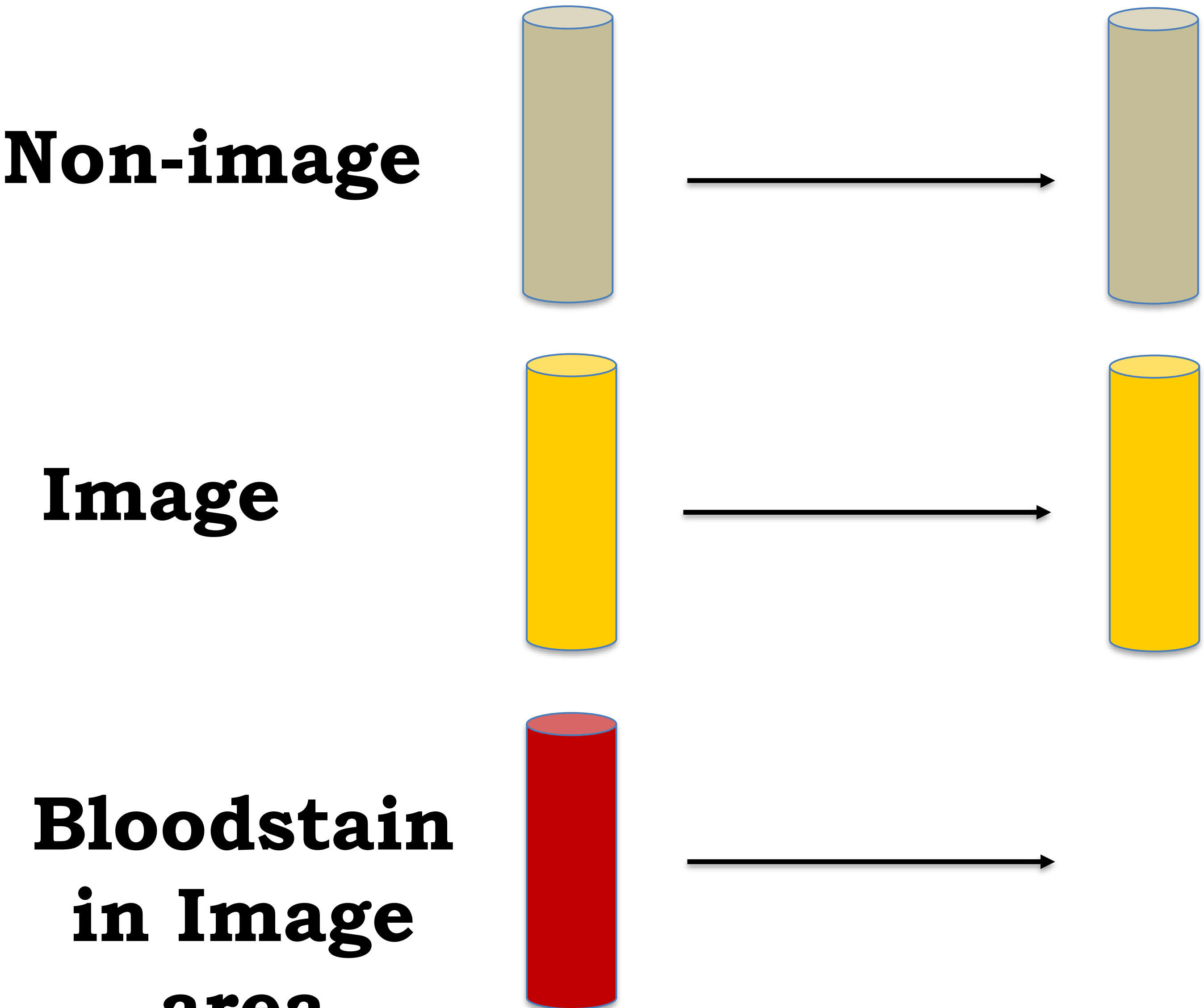
Bloodstain in Image area



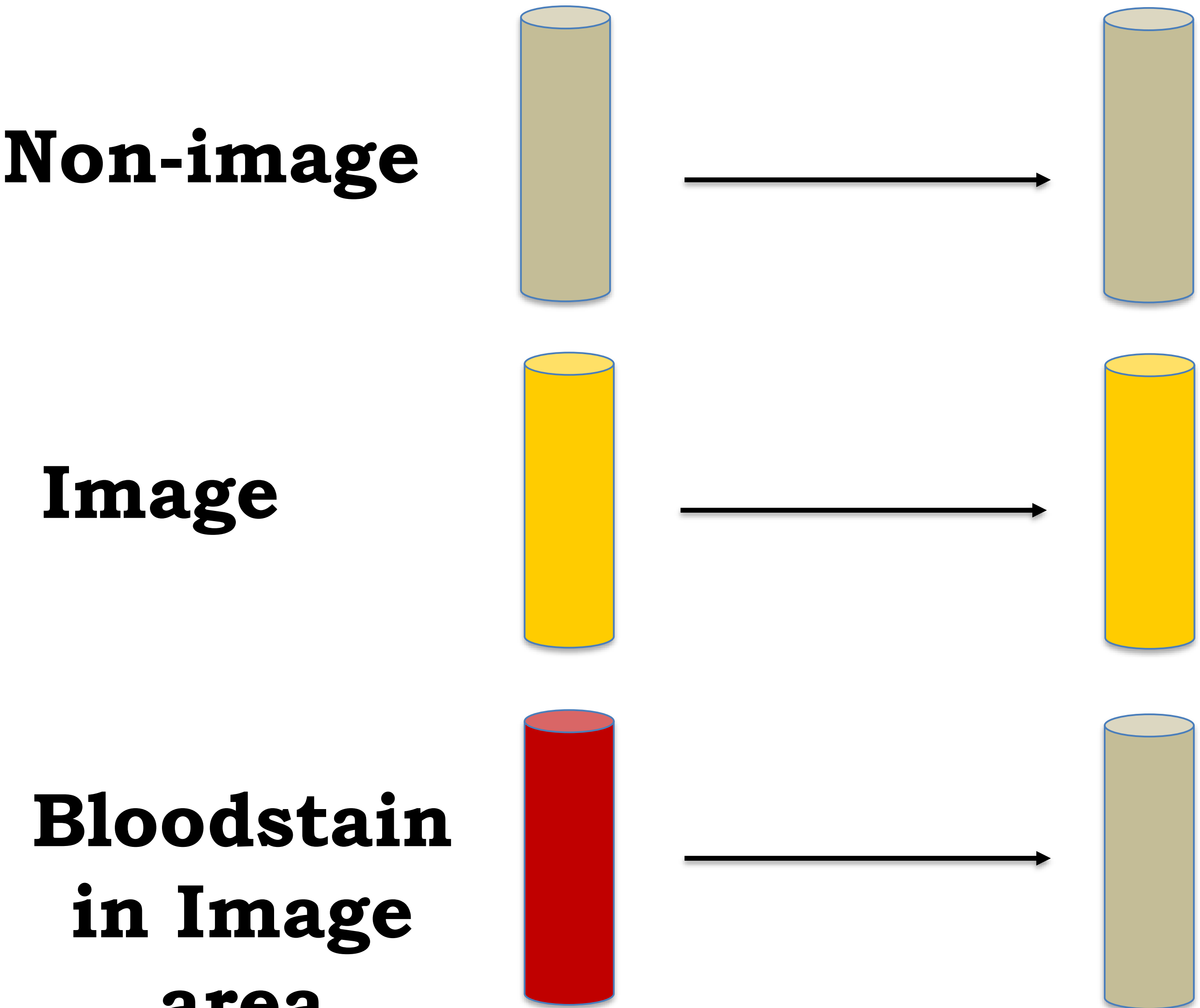
Protease Treatment



Protease Treatment

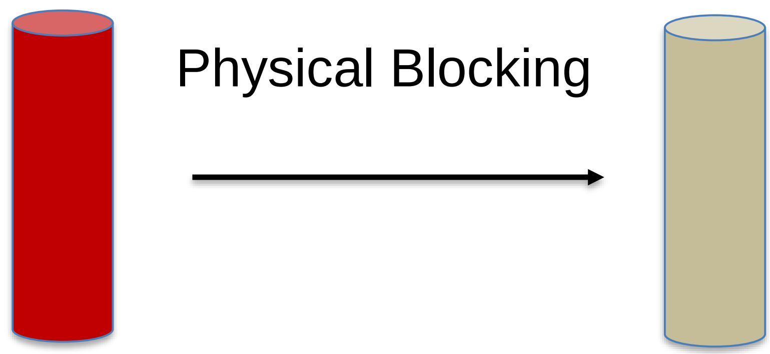


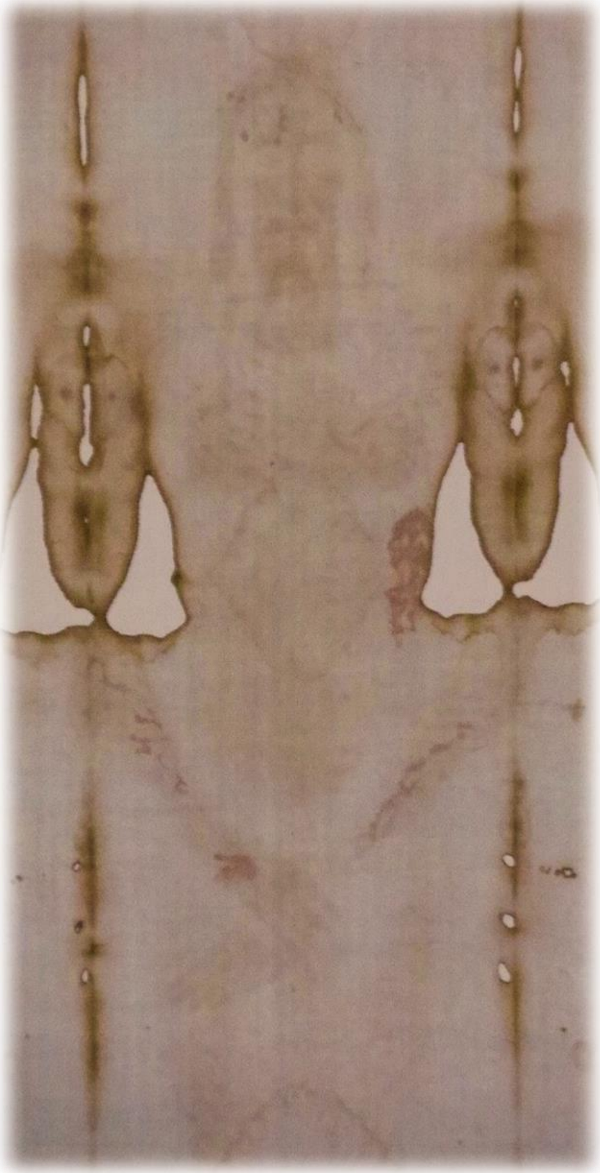
Protease Treatment



Protease Treatment

Blood in Image area





Blood 1st
Image 2nd

Image Formation

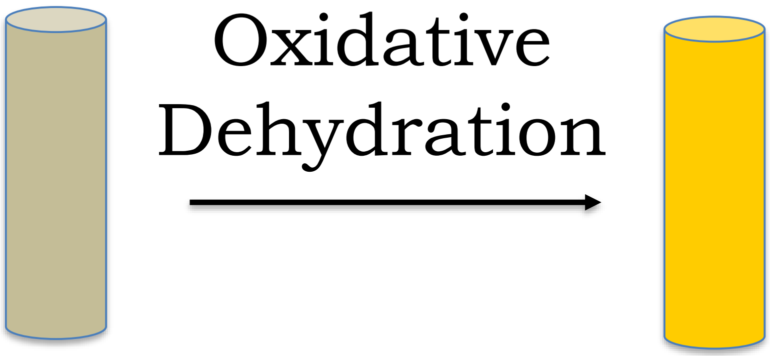
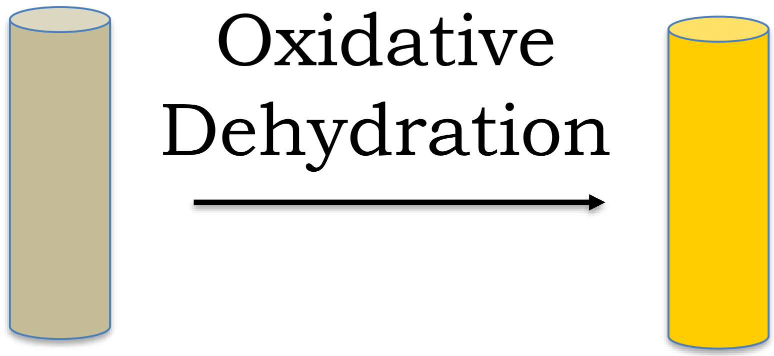
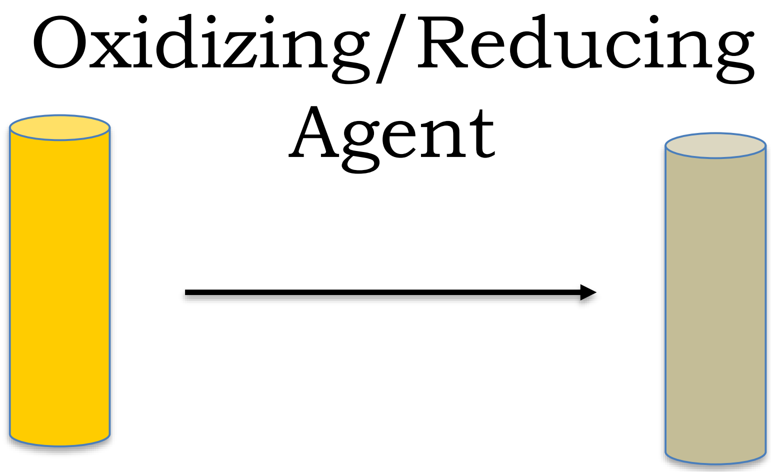
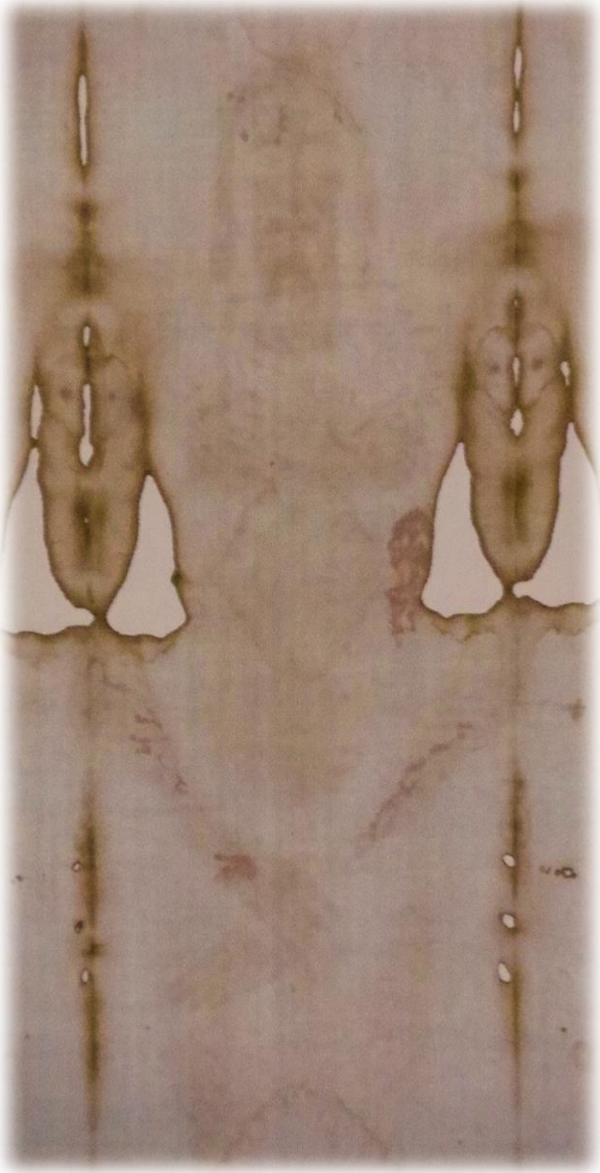


Image Formation



Reversal





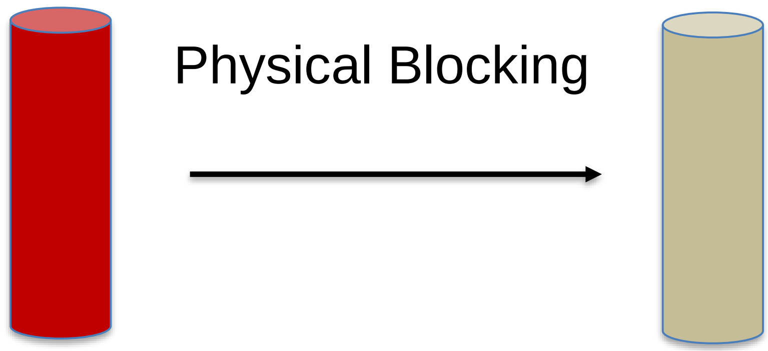
What if?

Blood + x

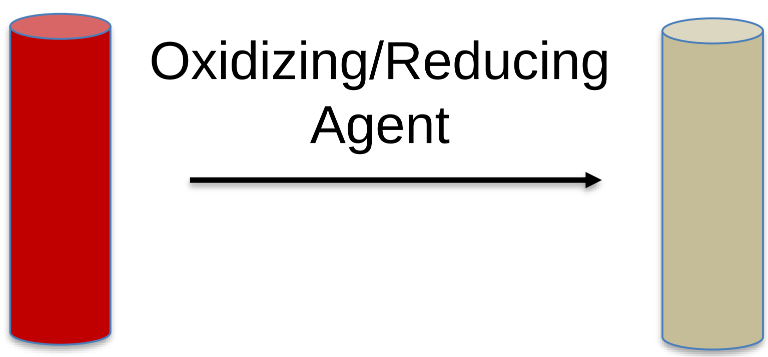
x is an oxidizing/reducing agent

Protease Treatment

Blood in Image area



Blood + x in Image area



Summary

The presence of serum "halos" could be observed without uv light, but visibility was certainly enhanced by it

Serum halos were observed only when clotted blood was transferred

Serum halos were not observed when blood was directly transferred*

*Halos were seen in direct transfer when blood + additives was used

Summary cont.

Increased bilirubin in serum is associated with enhanced uv fluorescence

It was noted that blood is not the only source of bilirubin

The action of an oxidizing/reducing agent in the interpretation of protease treatment experiments was suggested for further thought