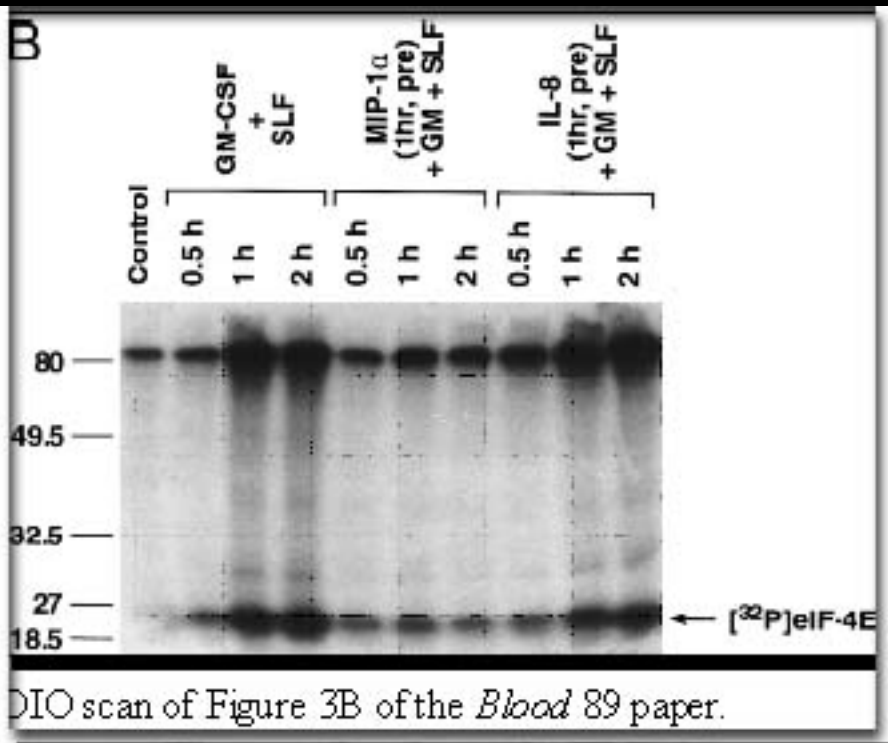
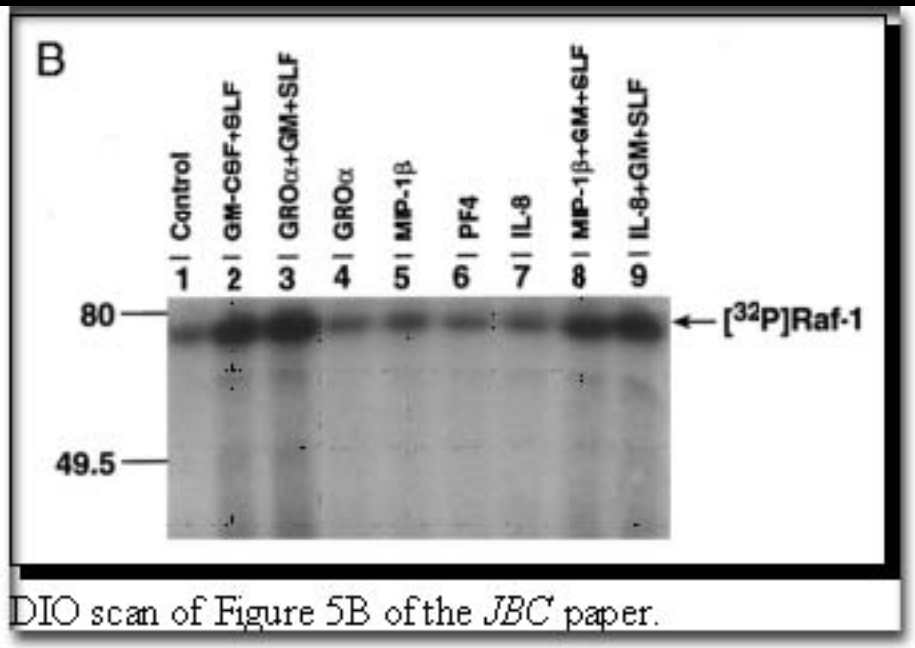
Examination of questioned images

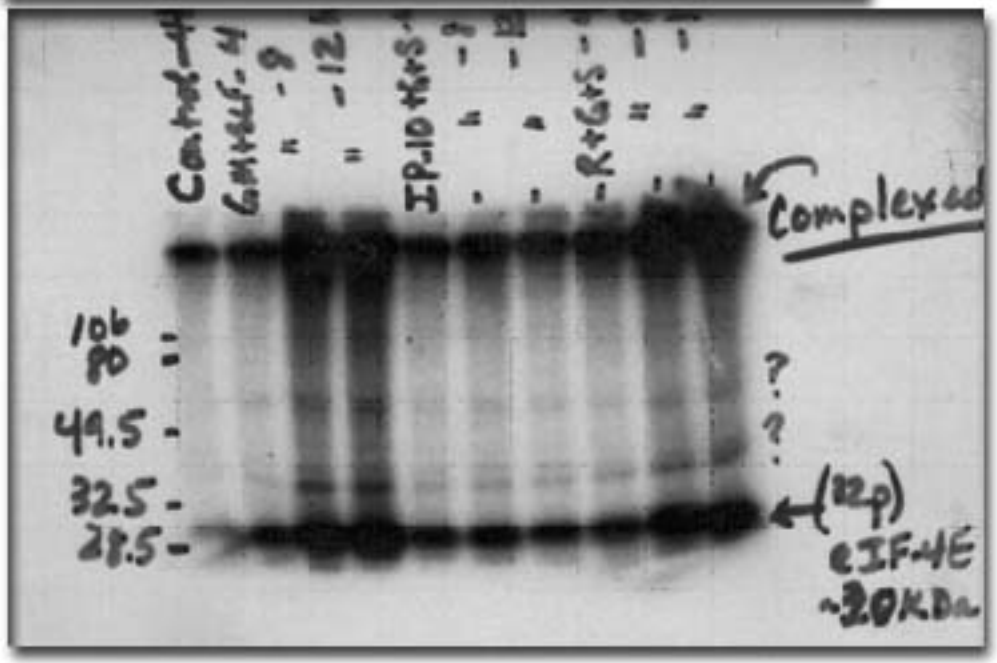
- There has been a lot of attention recently to “photoshopping,” that is, use of PhotoShop to alter images. Many such alterations can then be detected with PhotoShop, as will be shown in a minute.
- However, PhotoShop does not detect most cases of falsified images – the human eye does.

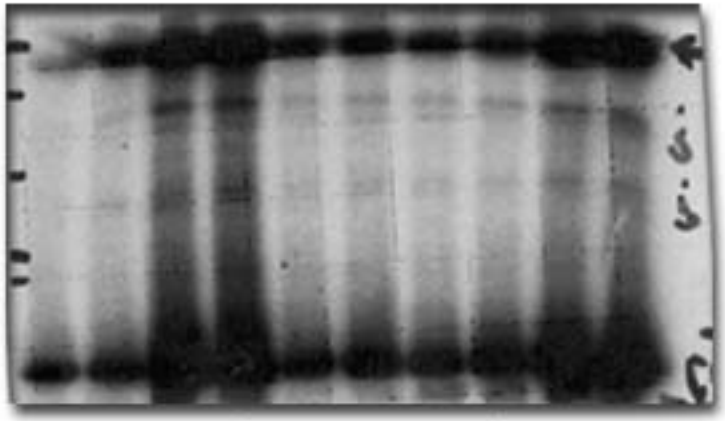


DIO scan of Figure 3B of the *Blood* 89 paper.



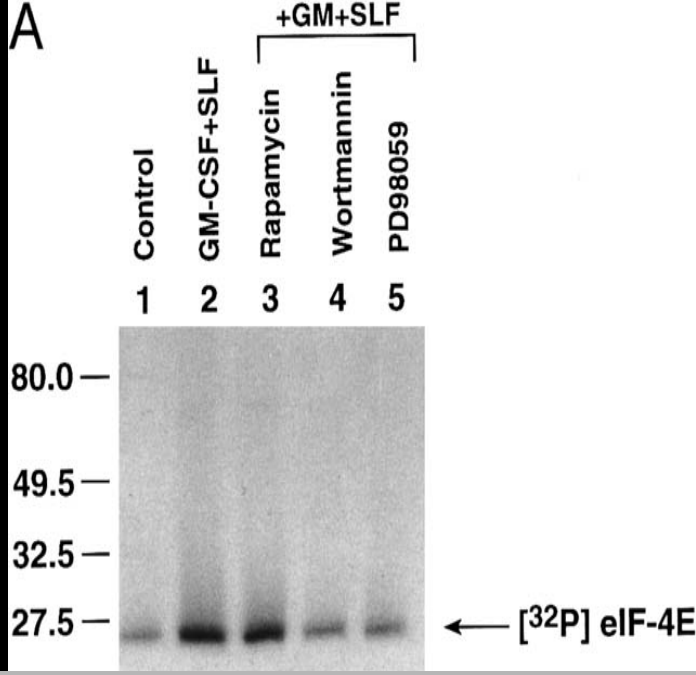
DIO scan of Figure 5B of the *JBC* paper.

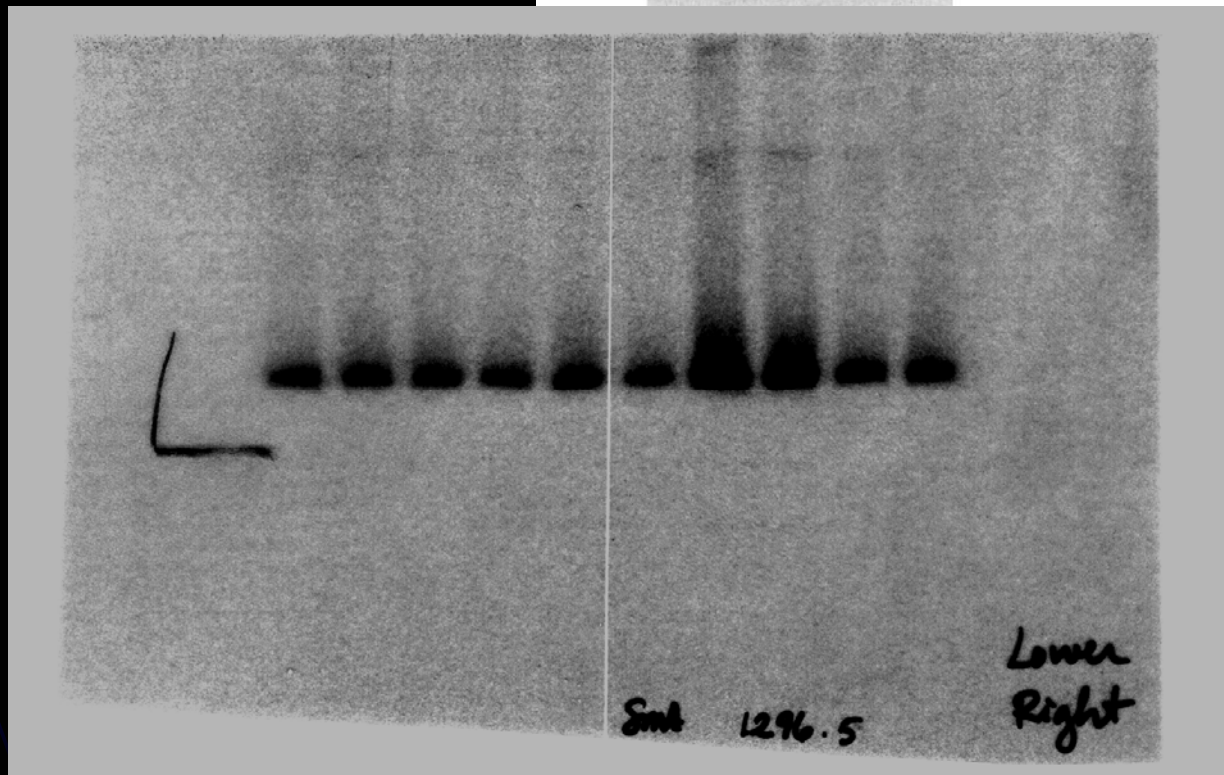




The original film to the left has been flipped vertically.

In this example, the respondent published a figure (shown to the right) and claimed that the blot had been stripped and re-probed to provide a loading control (not shown). ORI's review of the notebook showed that she had cut a film into two fragments and claimed that one-half was the loading control. However, forensic examination clearly established that the two films were cut from a single exposure of a blot.





Films scanned in Reflection Mode

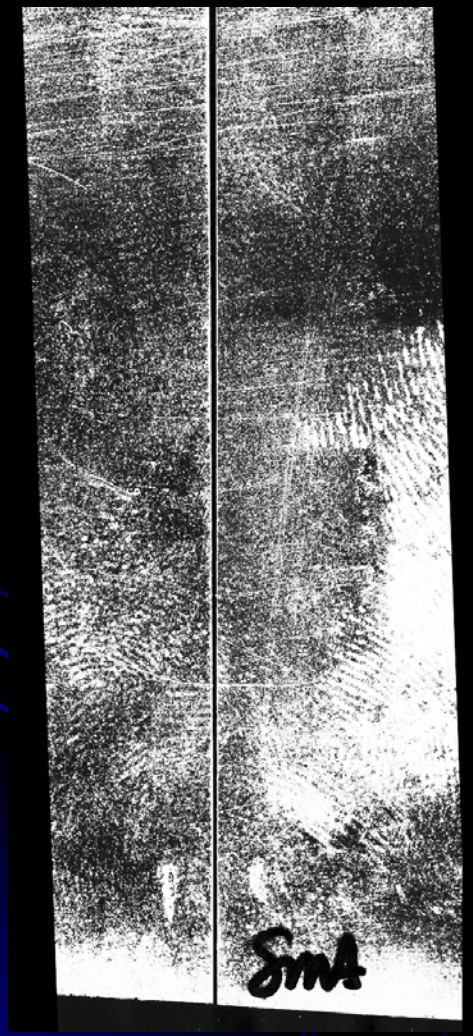
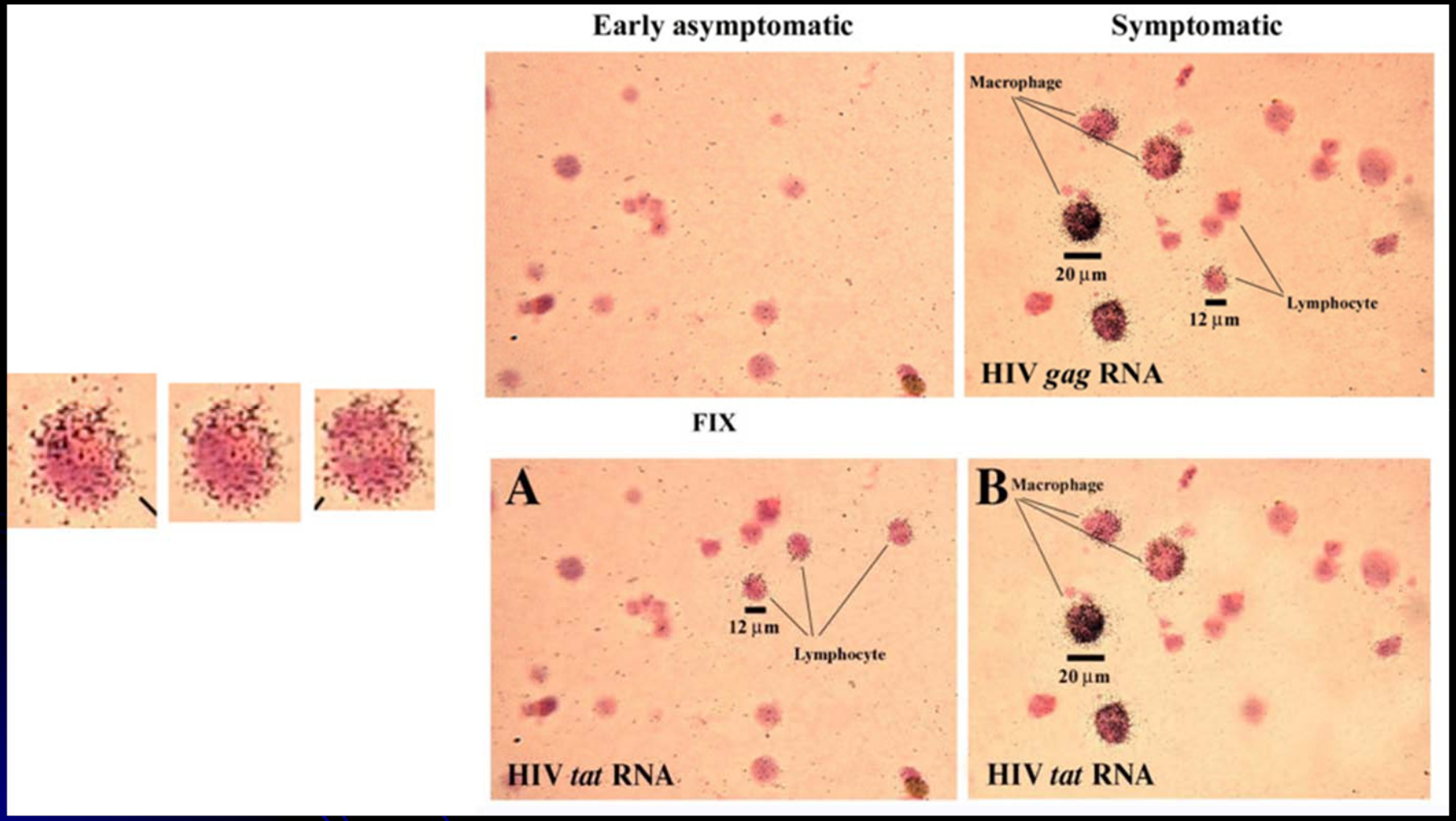


Image processing tools bring out hidden features:

- common edge
- scratches and prints crossing edge

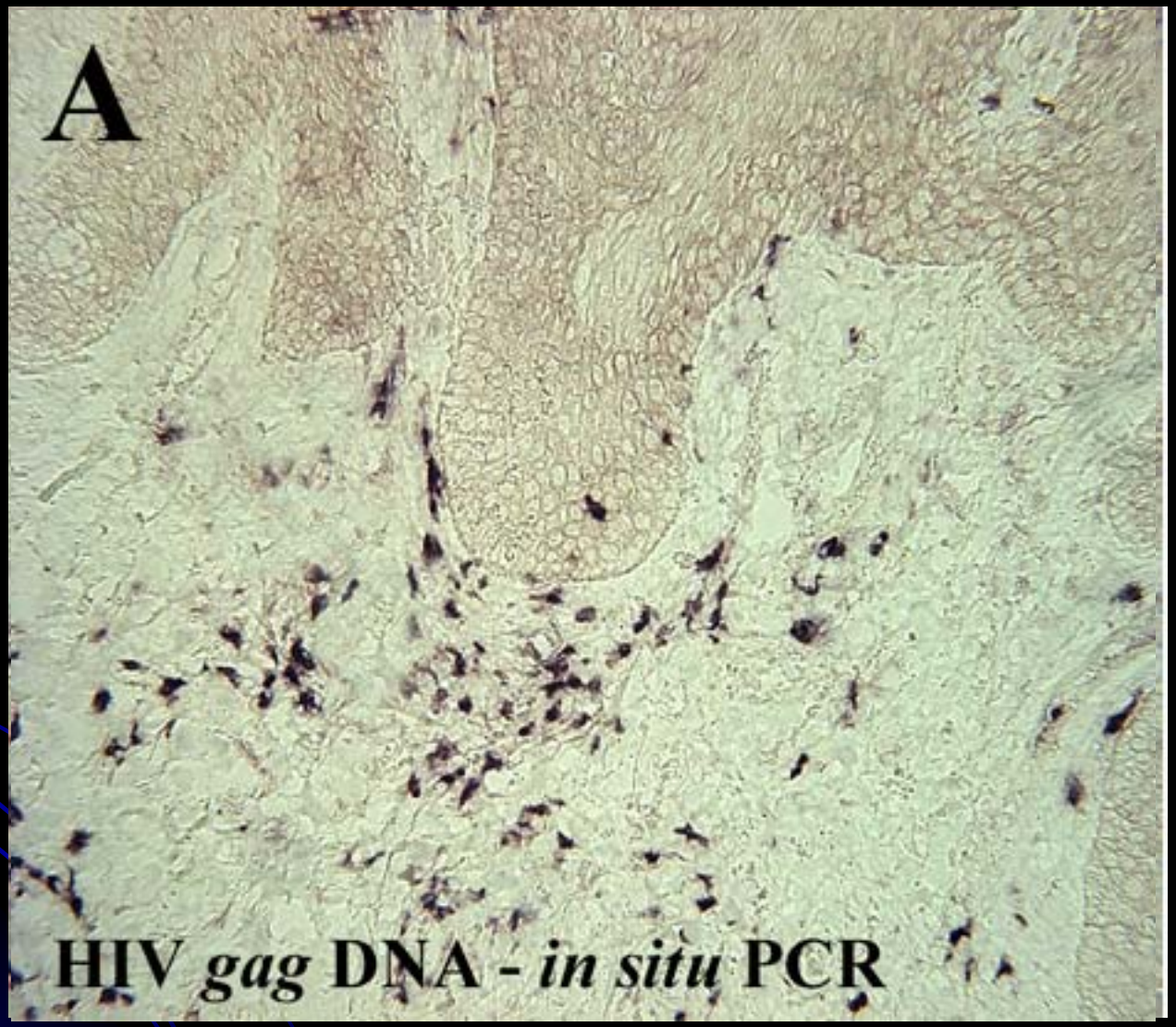
Reviewing image files

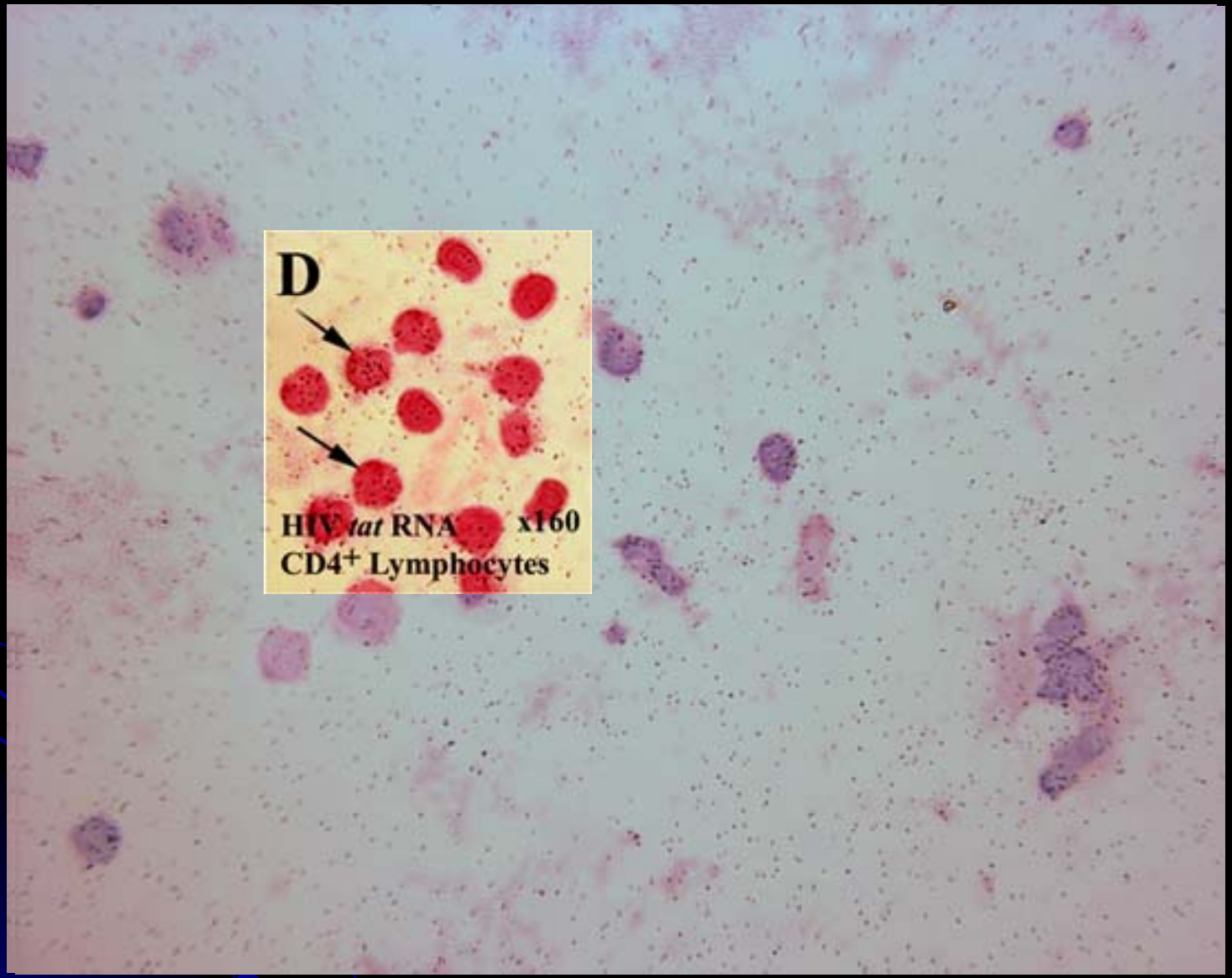
- Important evidence for misconduct can come from careful review of sequestered computer files.
- We pay particular attention to time-date stamps and expect institutions to both promptly sequester computers and portable storage media and to make forensic copies.
- A few examples of how this can pay off are shown next.

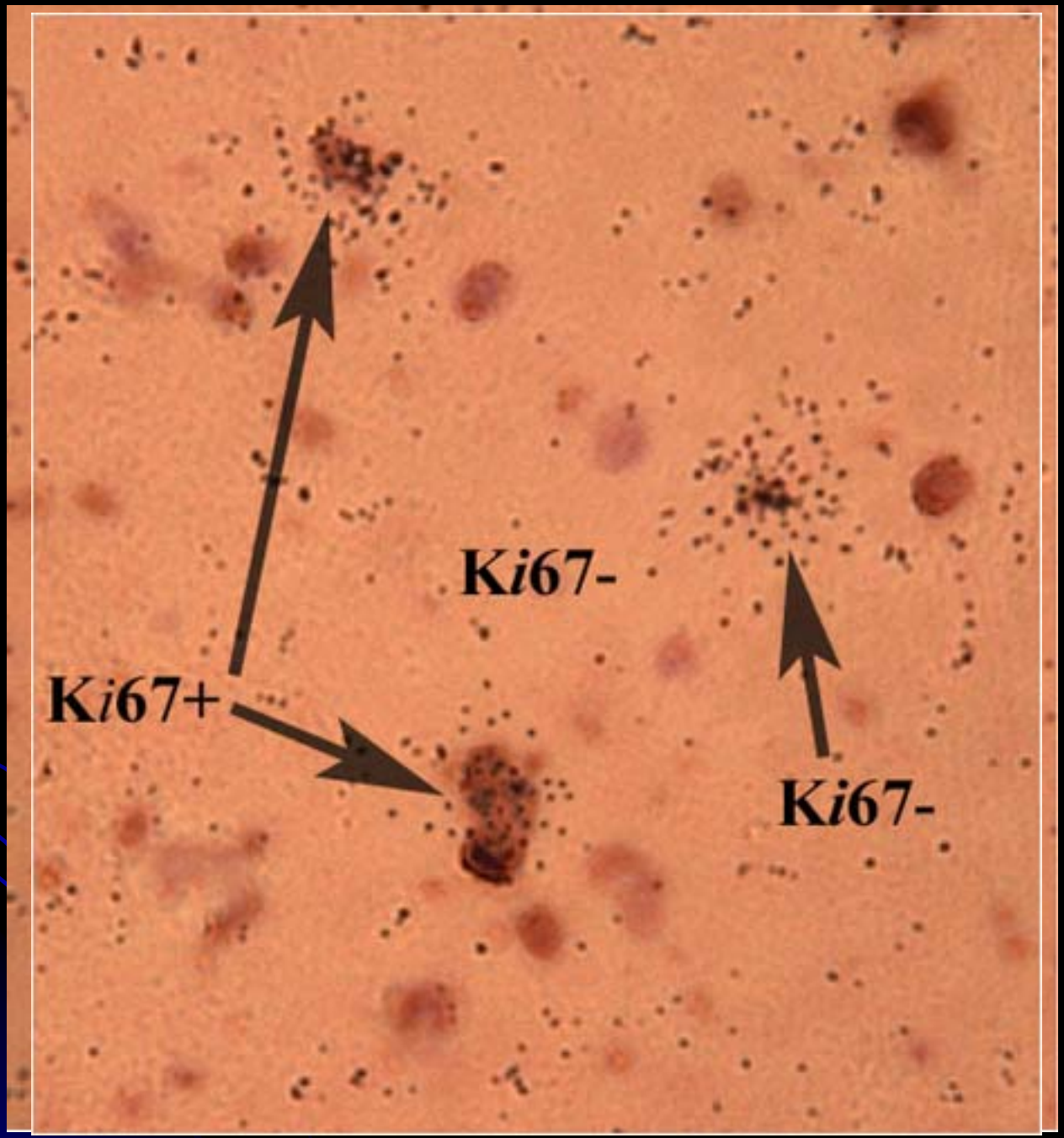

Early asymptomatic
Symptomatic
Macrophage
20 µm
12 µm
Lymphocyte
HIV gag RNA
FIX
A
12 µm
Lymphocyte
HIV tat RNA
B
Macrophage
20 µm
HIV tat RNA

Assessing the significance of falsification of figures

- It is important to determine who was responsible for the data.
- The time/date stamps on computer files may be very important in showing on which computer an image was manipulated.
- It is also important to evaluate how significant the manipulations are
- The following three slides illustrate an increasing degree of concern about the manipulations.


A
HIV *gag* DNA - *in situ* PCR


D
HIV *tat* RNA x160
CD4+ Lymphocytes


Ki67-
Ki67+
Ki67-

Using PhotoShop

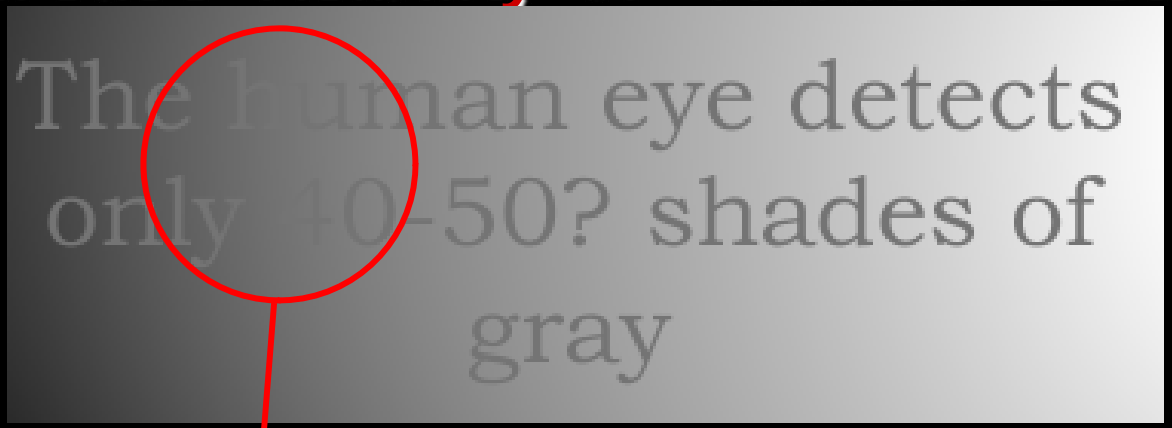
- In addition to reusing their own or other people's images, often relabeling them, respondents often make internal alterations to figures.
- When images are altered globally (ie, equal changes to each pixel), the changes are generally considered acceptable.
- Adding or removing or moving data, however, can be a different matter.

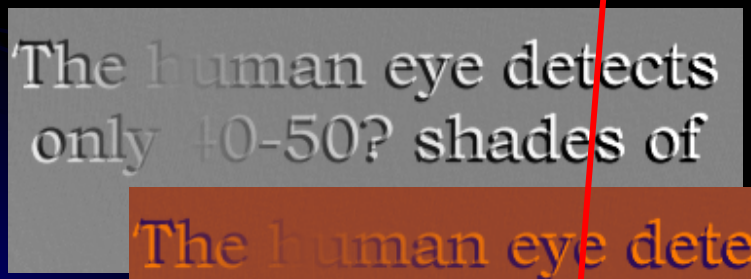
How to detect non-obvious changes

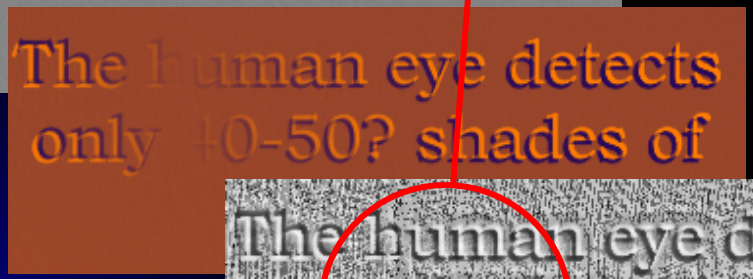
- Some of the following slides will illustrate how Photoshop can be used to help our eyes visualize alterations to images, and verify suspected duplications, through the use of specific tools such as the gradient map, contours, and various enhancements such as contrast and intensity.

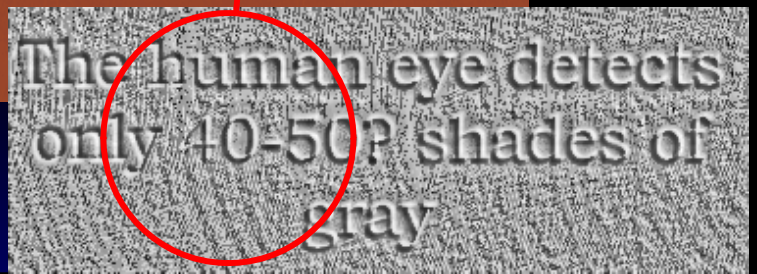
DETECTION

Increase Visibility of "Hidden" Details





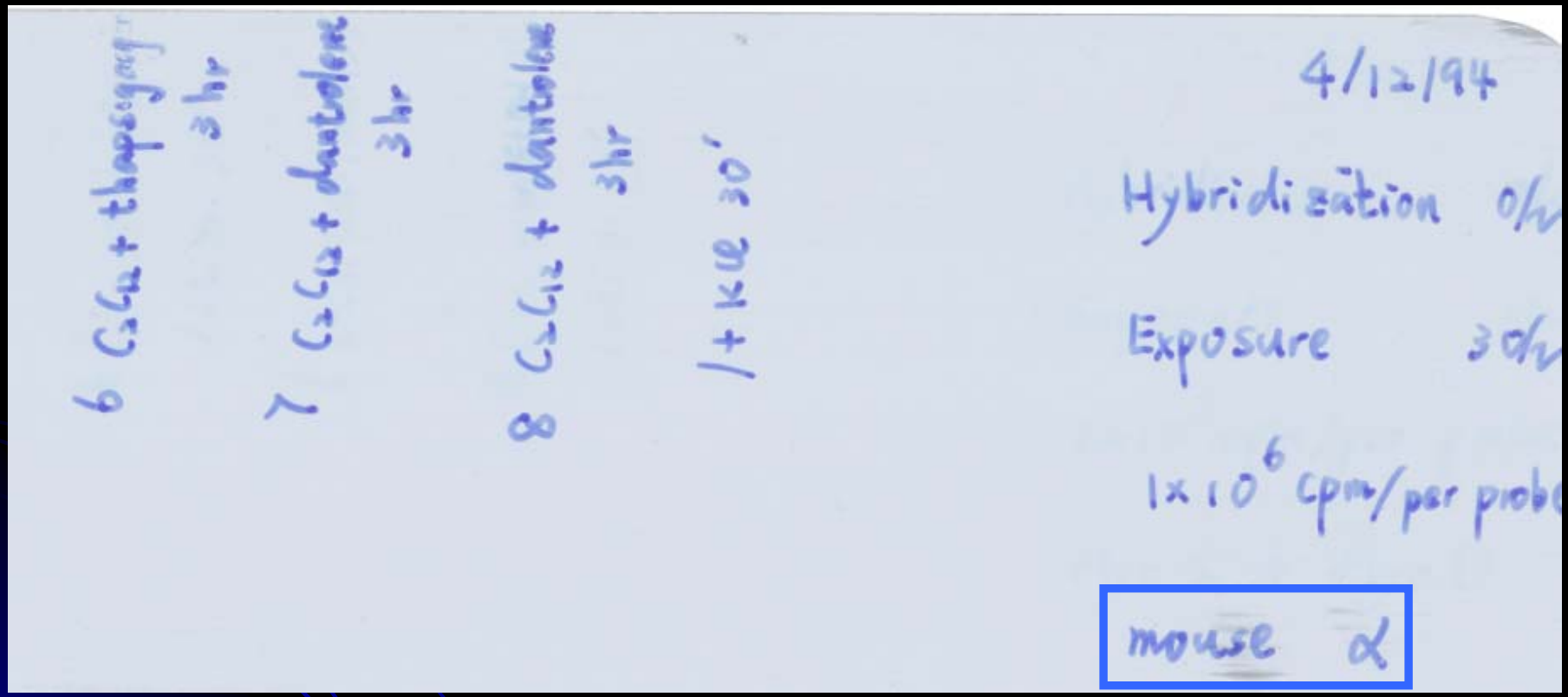




Forensic Examination of Scientific Images

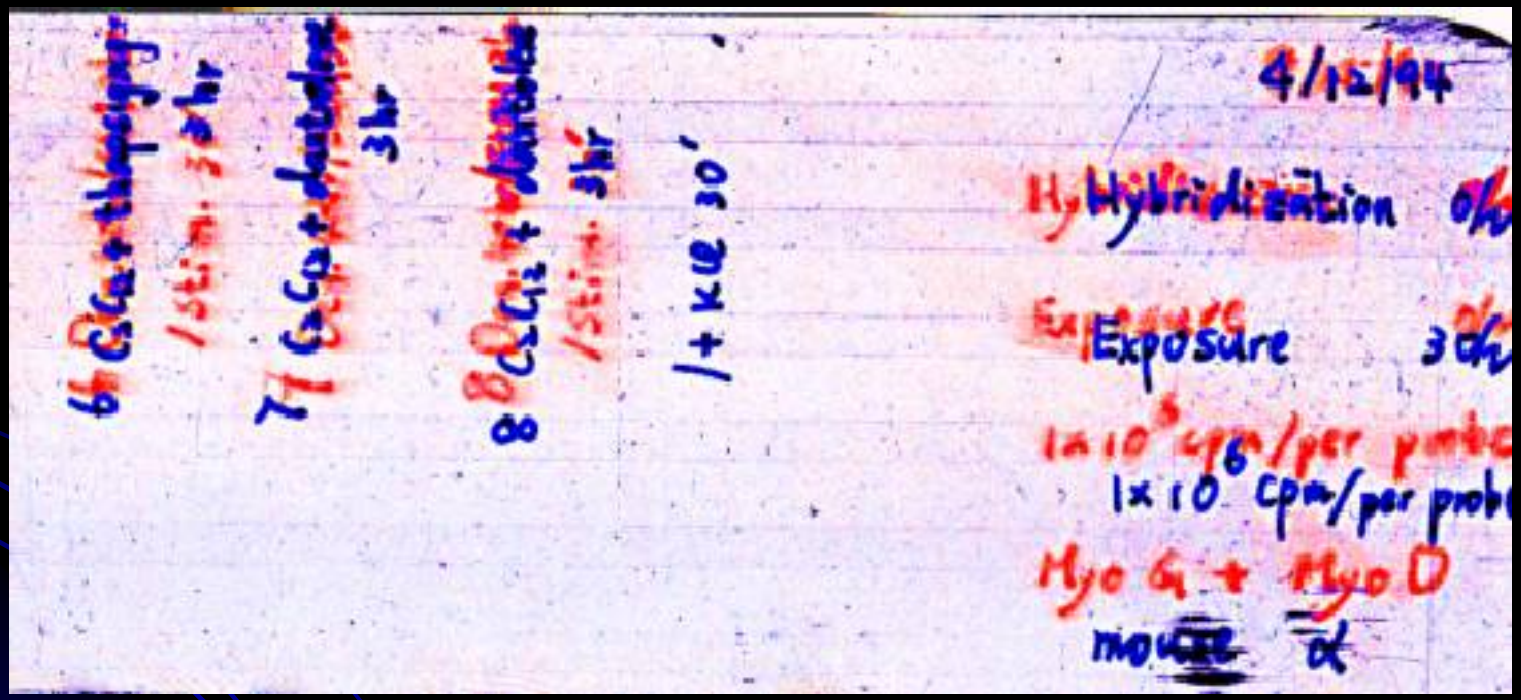
1. Contrast Enhancement ("Curves") - human eye is not very good at detecting small differences in gray scale
2. Texture, Variance – examination for erasures
3. Histogram Equalization – quick look for background inconsistencies
4. Gradient Map – powerful tool to reveal many similarities in background and band morphologies
5. Embossing – shadowing makes the image slightly dimensional to reveal borders in background or edges
6. Overlay of Images – shows similarities of images

Use of Photoshop detect different inks



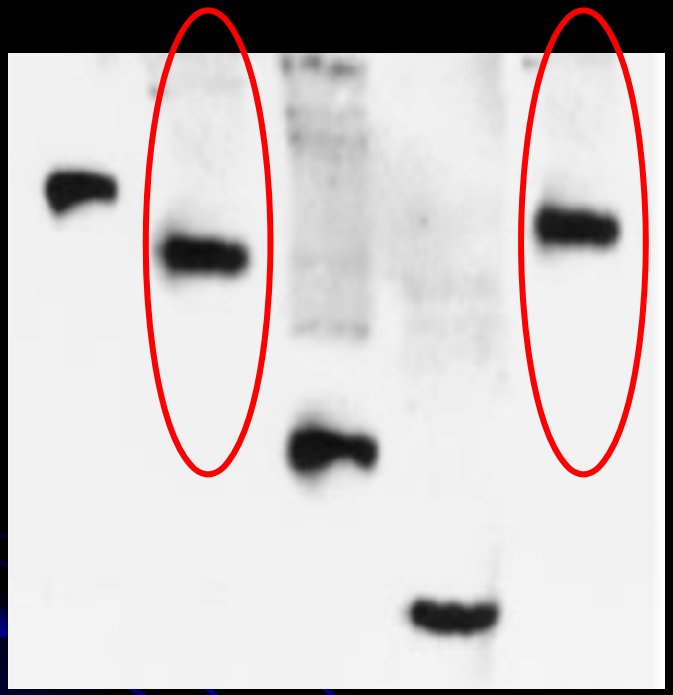
Labeling on a Corner of Film claims to detect mouse α

The same film examined in Photoshop: the original ink erased with alcohol was enhanced by “hue separation.”

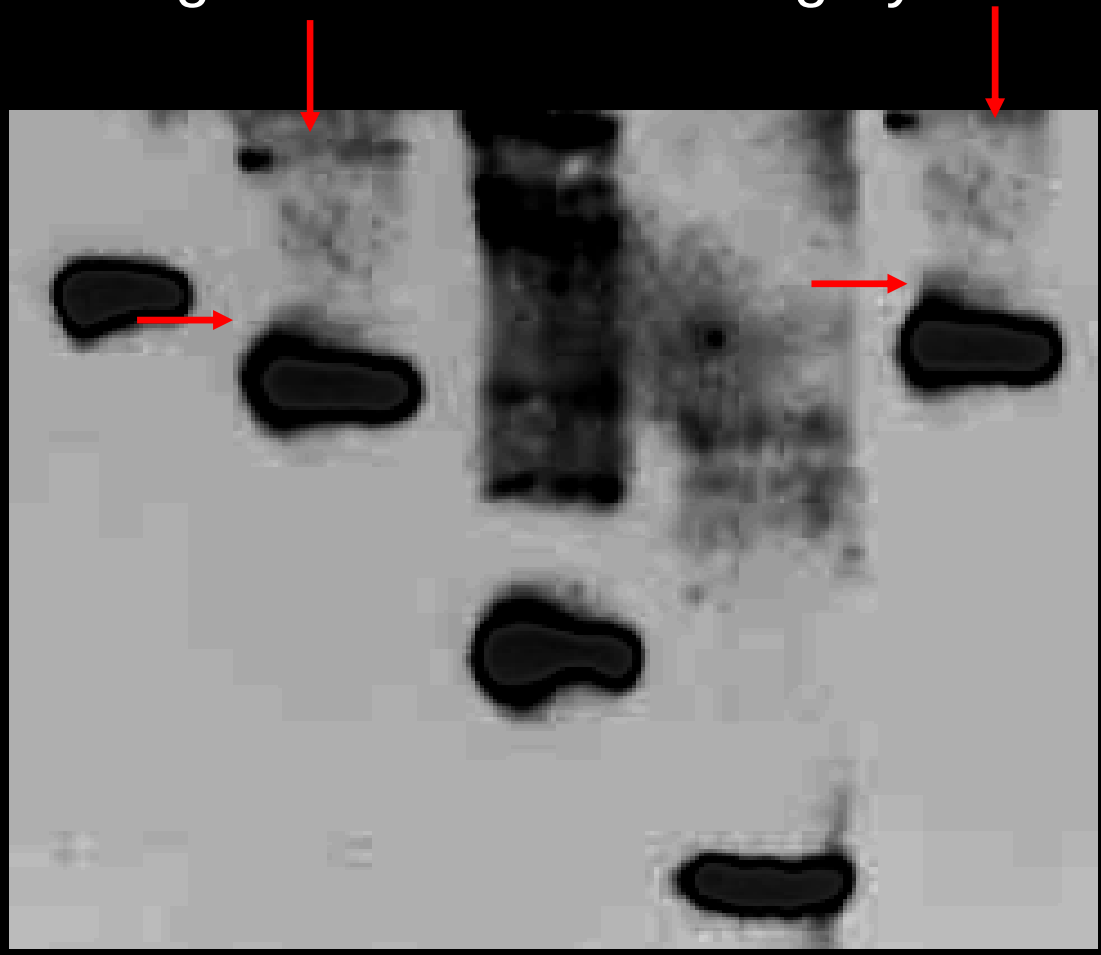


The original experiment on chicken muscle was altered to represent an experiment with mouse muscle.

Contrast Enhancement – detecting small differences in gray scale



Original Data



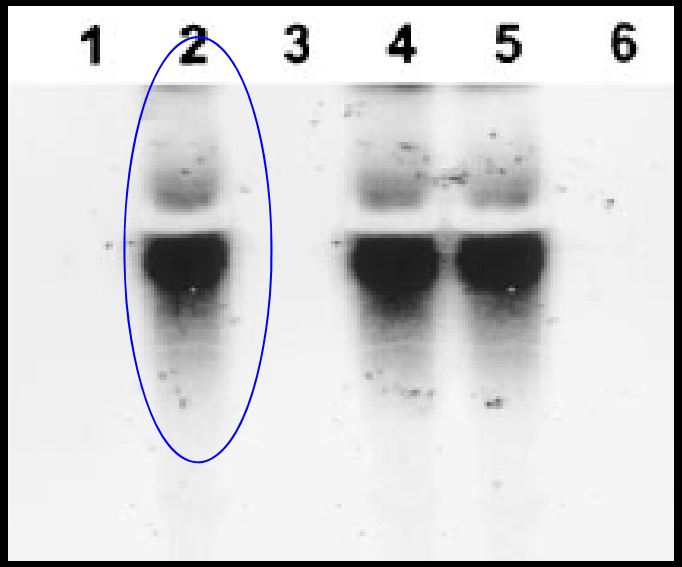
Contrast Enhanced

Forensic Value of Background:

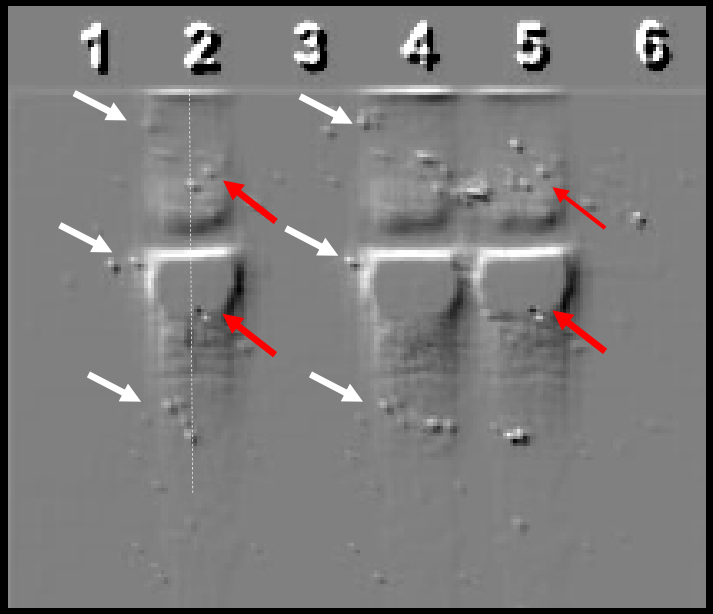
- Harder to see since it has the least contrast
- Overlooked since not of primary interest, i.e., below the perceptual “radar screen”

Embossing – reveals borders in background or edges

Original Data

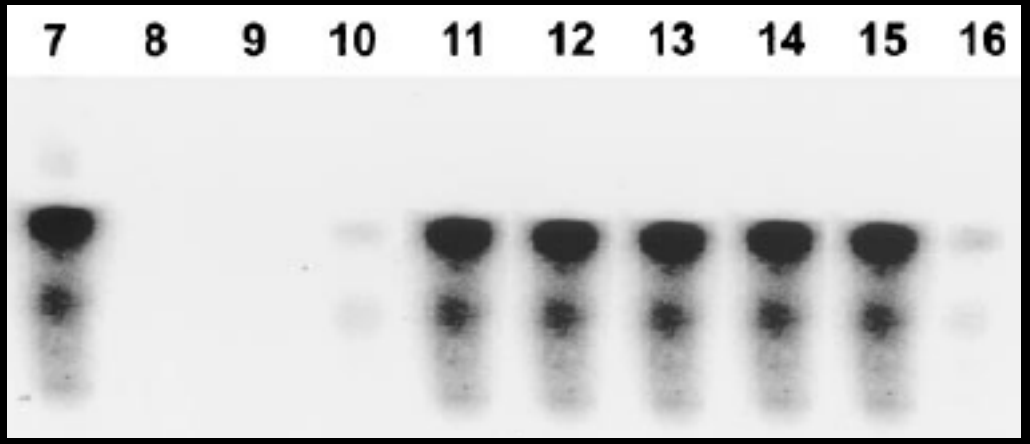


Published Data

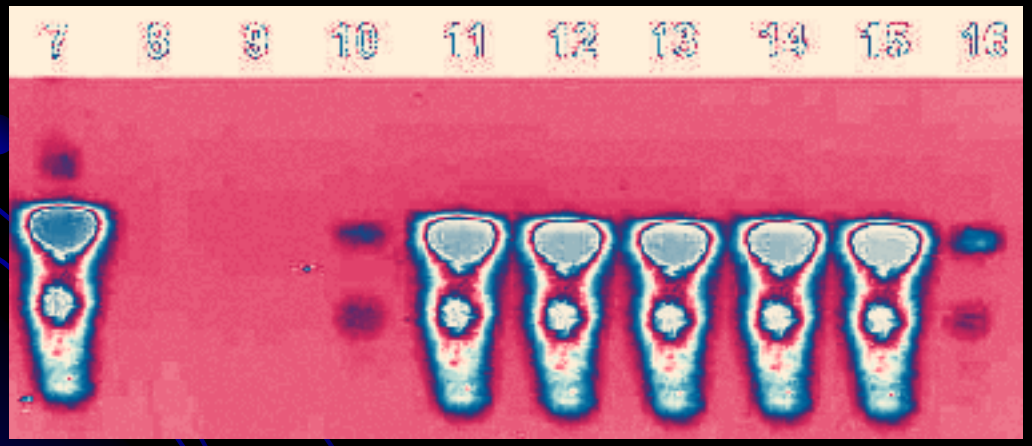


Embossed

Gradient Map – reveals similarities in background and bands

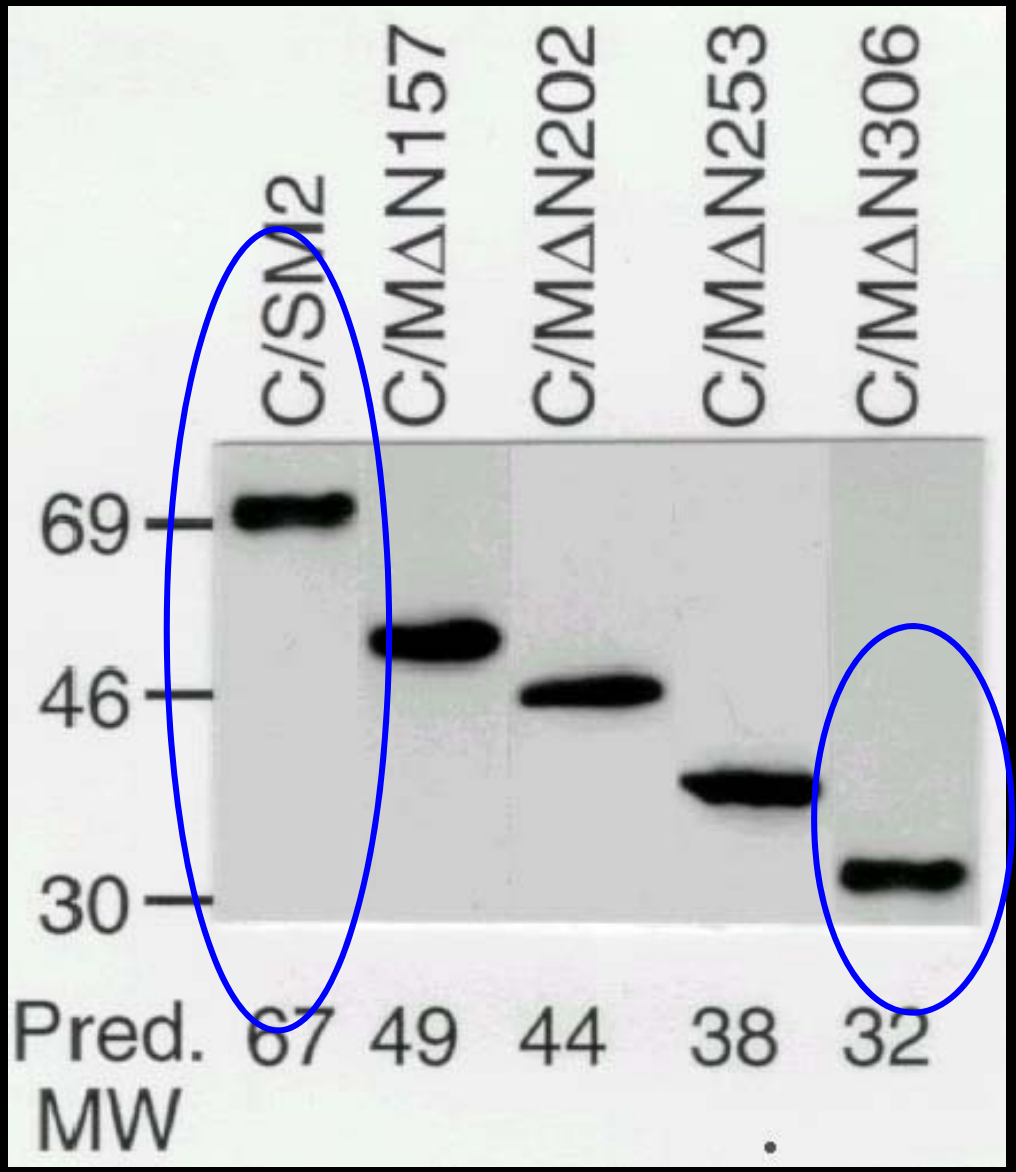


Original Data

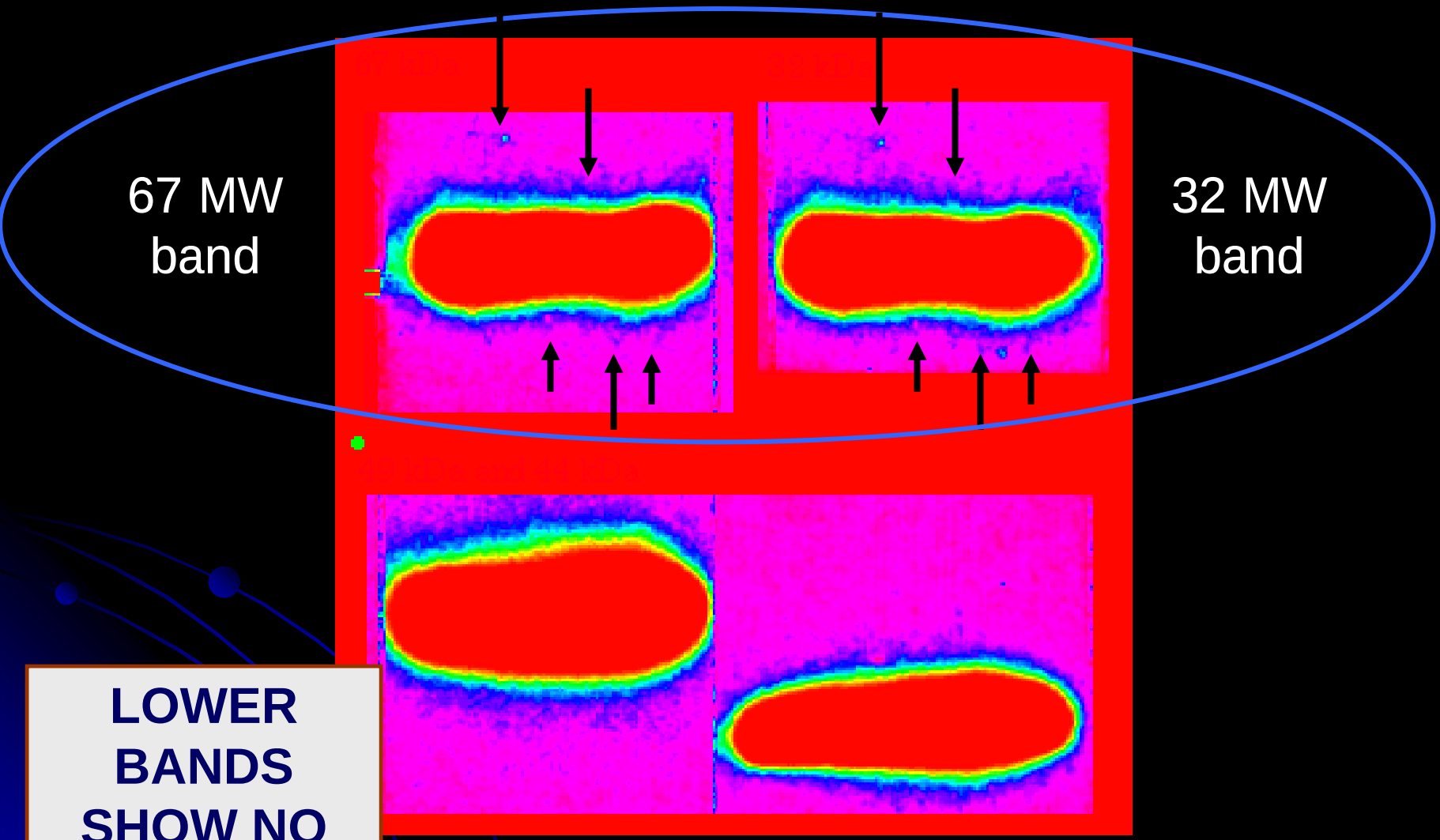


Colorized Data

MORPHOLOGICAL FEATURES OF BANDS



False Colorization “Gradient Map” Reveals Mini-features



LOWER BANDS SHOW NO SIMILARITY

Use of the Image Overlay procedure

Immunity, Figure 1

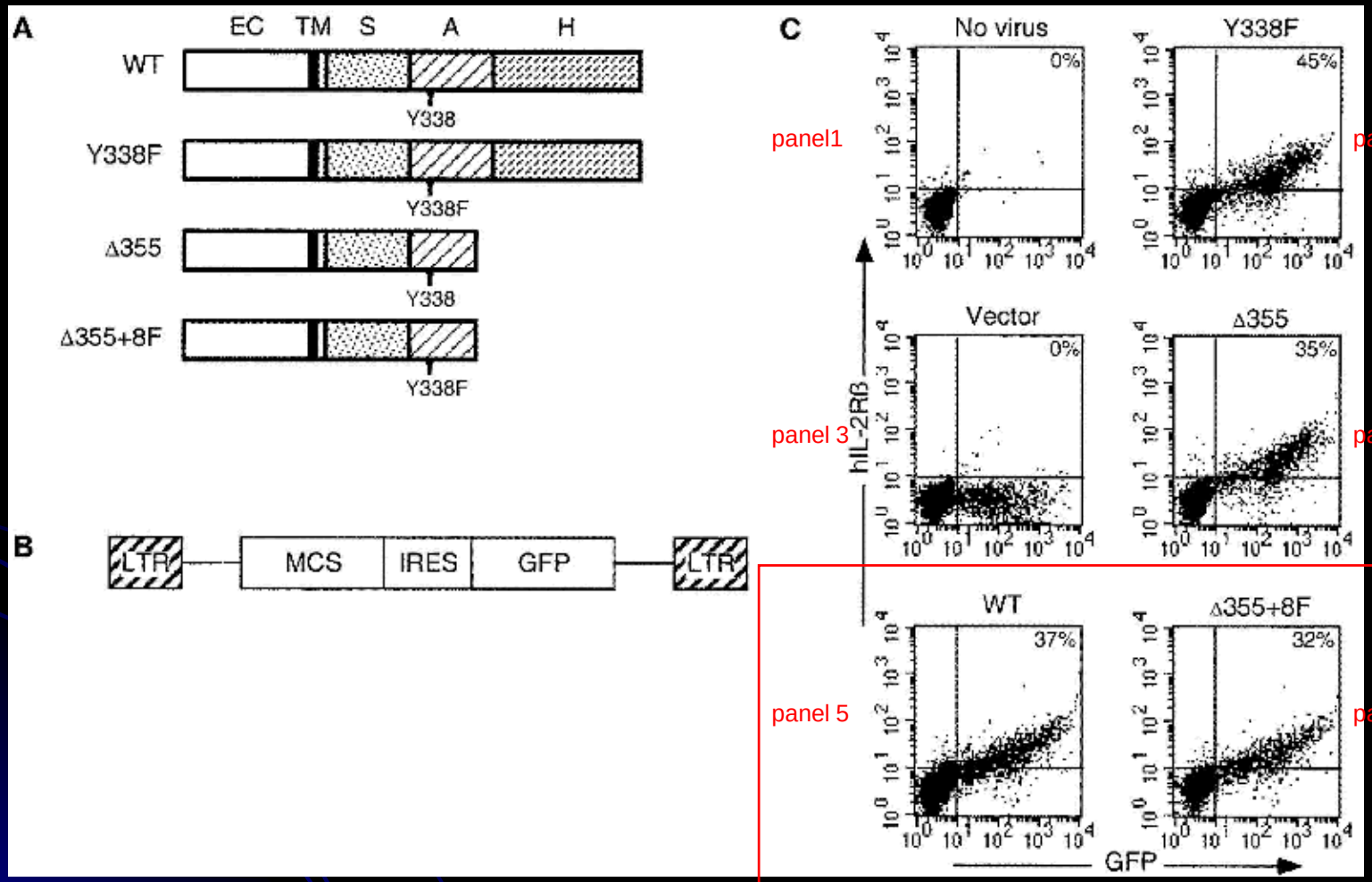
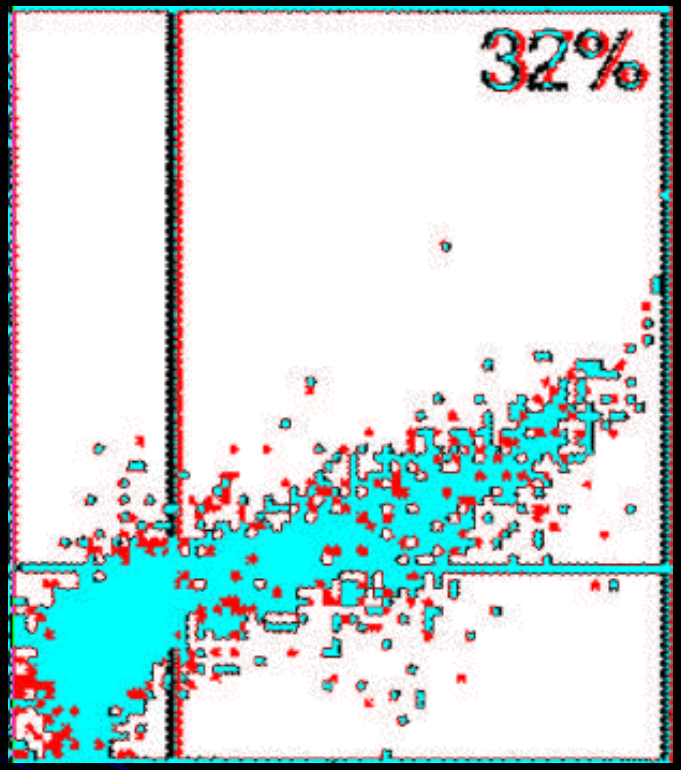
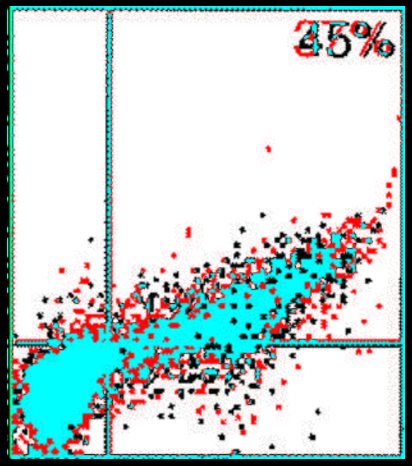


Figure 1 (panel 5 vs 6)



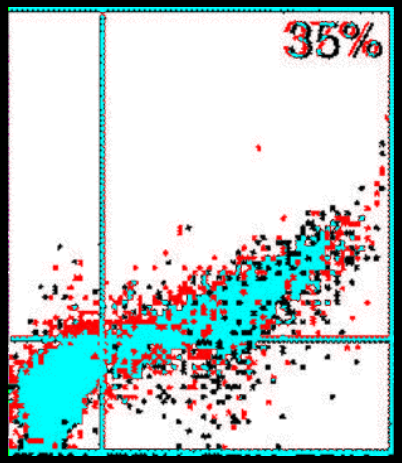
panel 6 (black) is a subset of panel 5 (red)

red and black = unique
blue = overlap



panel 5 vs 2

no overlap



panel 5 vs 4