Editing historical stereoscopic prints

Contents:

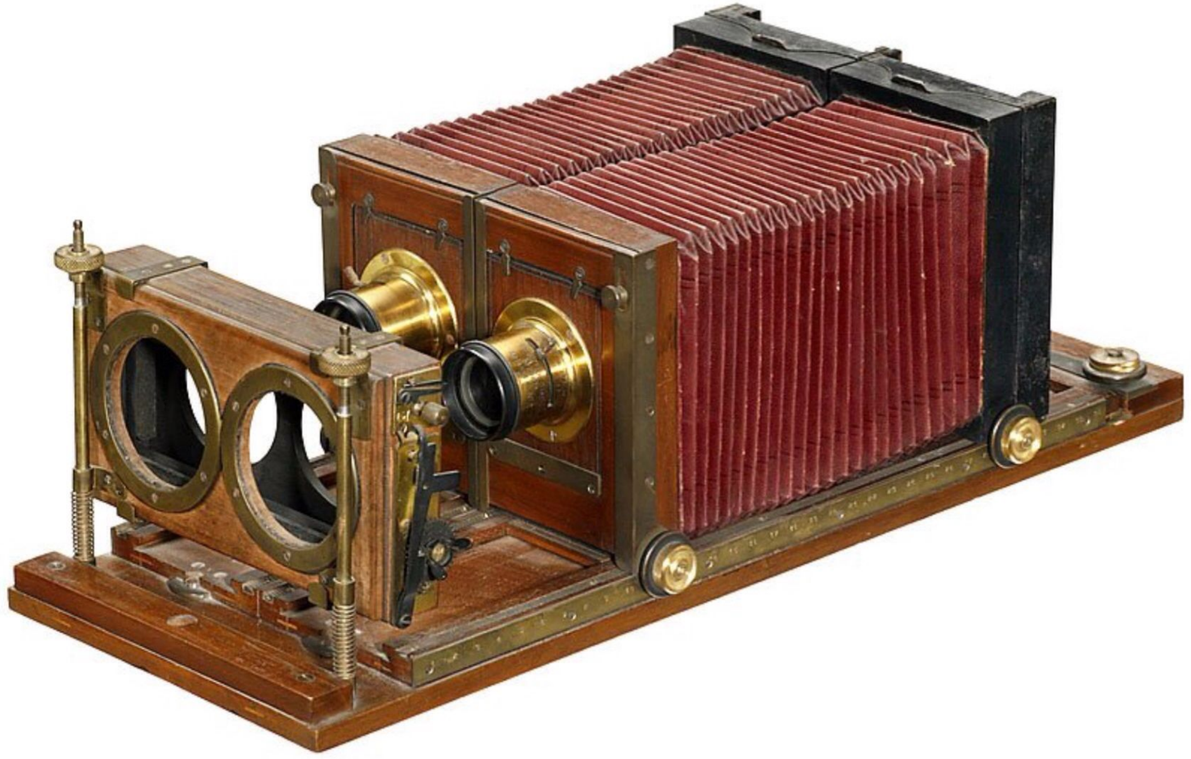
- Hardware
- Stereoscopic displays, asymmetric frustums and zero parallax
- Characteristics of the prints
- Processing pipeline
- Examples…

Paul Bourke, March 2022

Cameras

1864

2022



Viewers

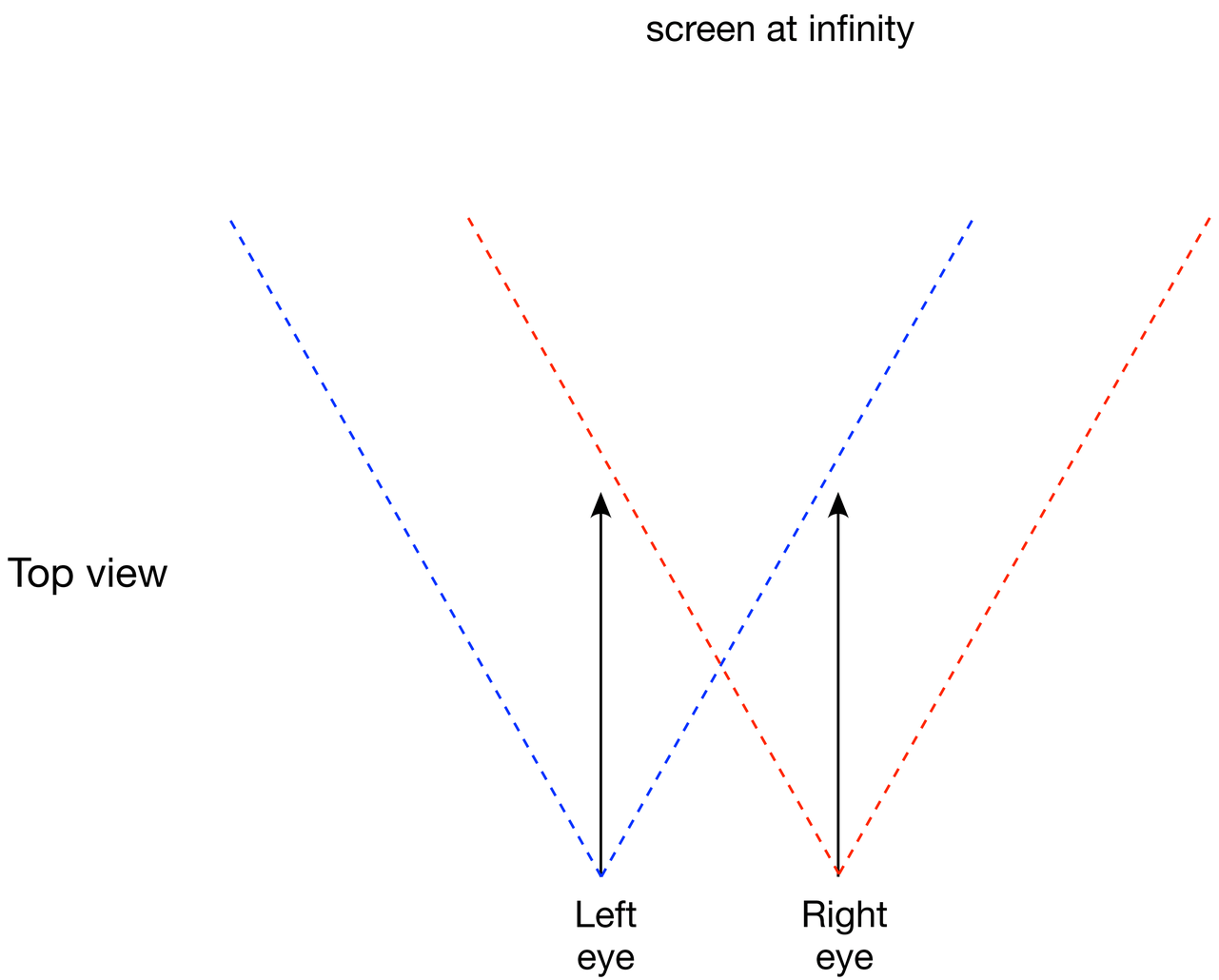
Brewster stereoscope

1870

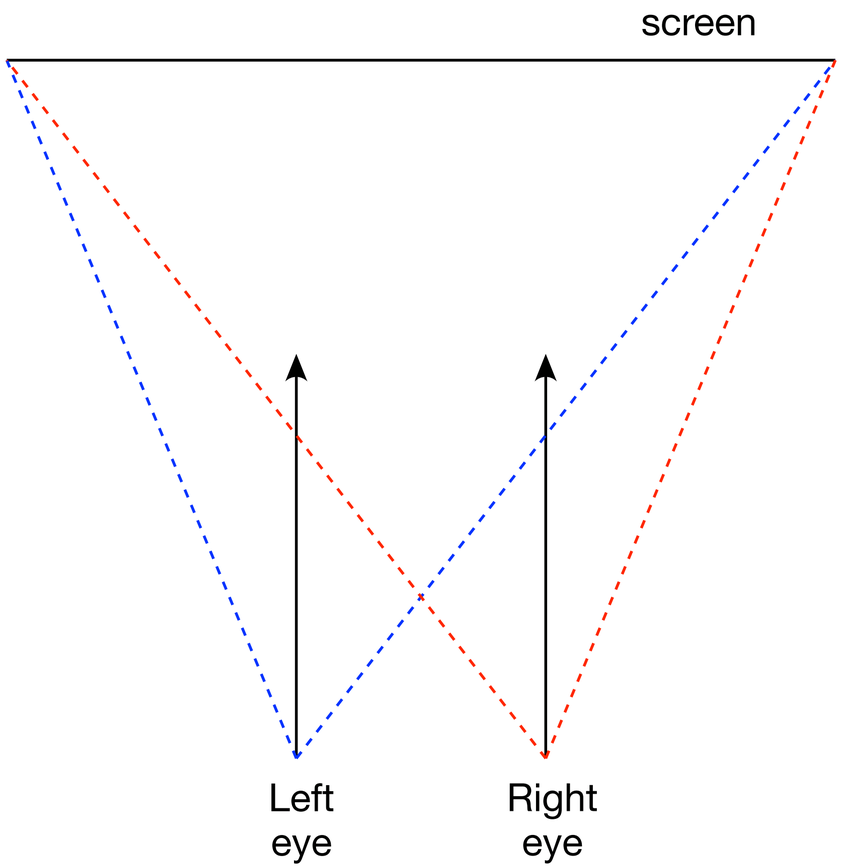
VIVE VR headset

2022

VR displays vs screen based displays



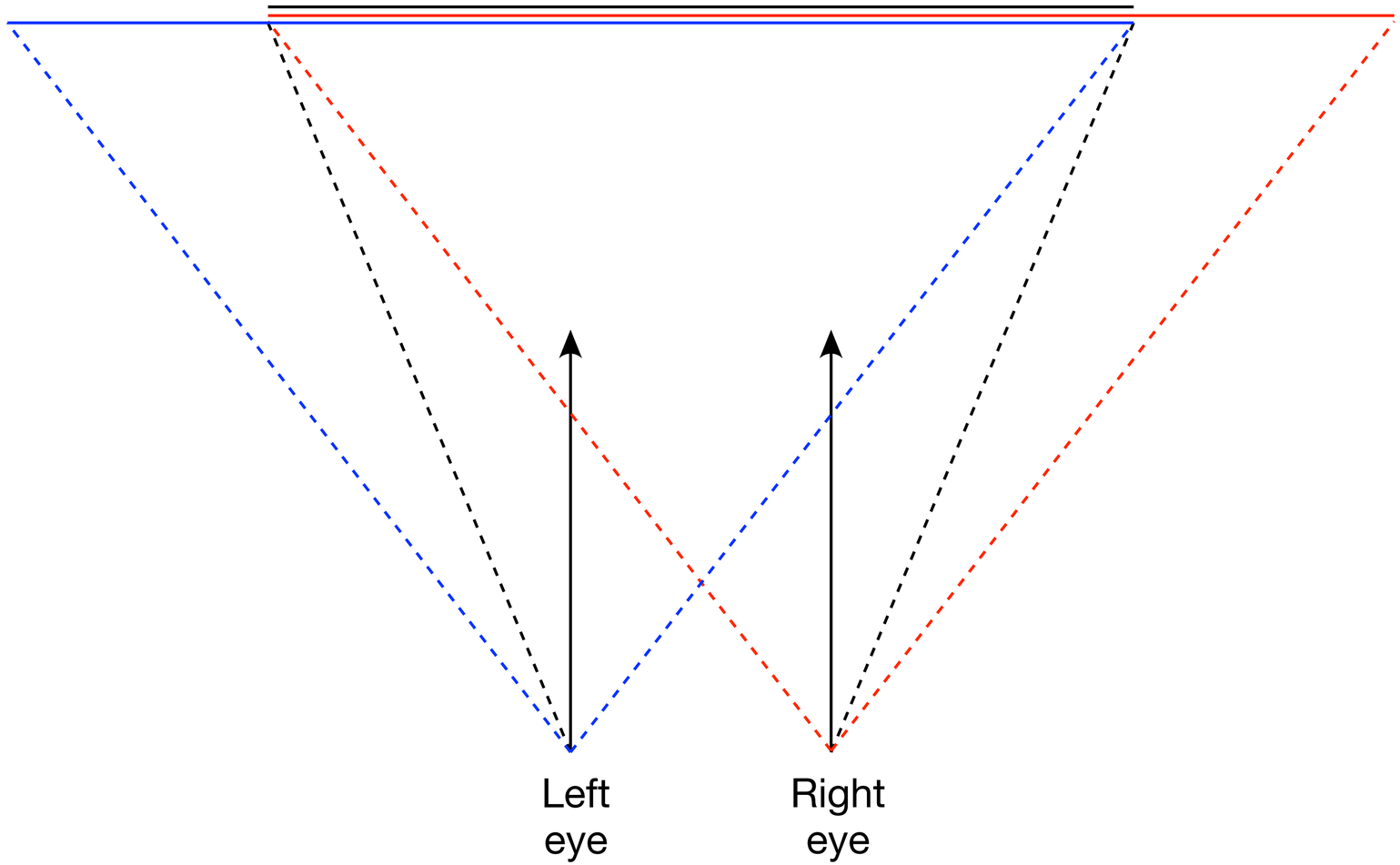
Head mounted display, or stereoscope



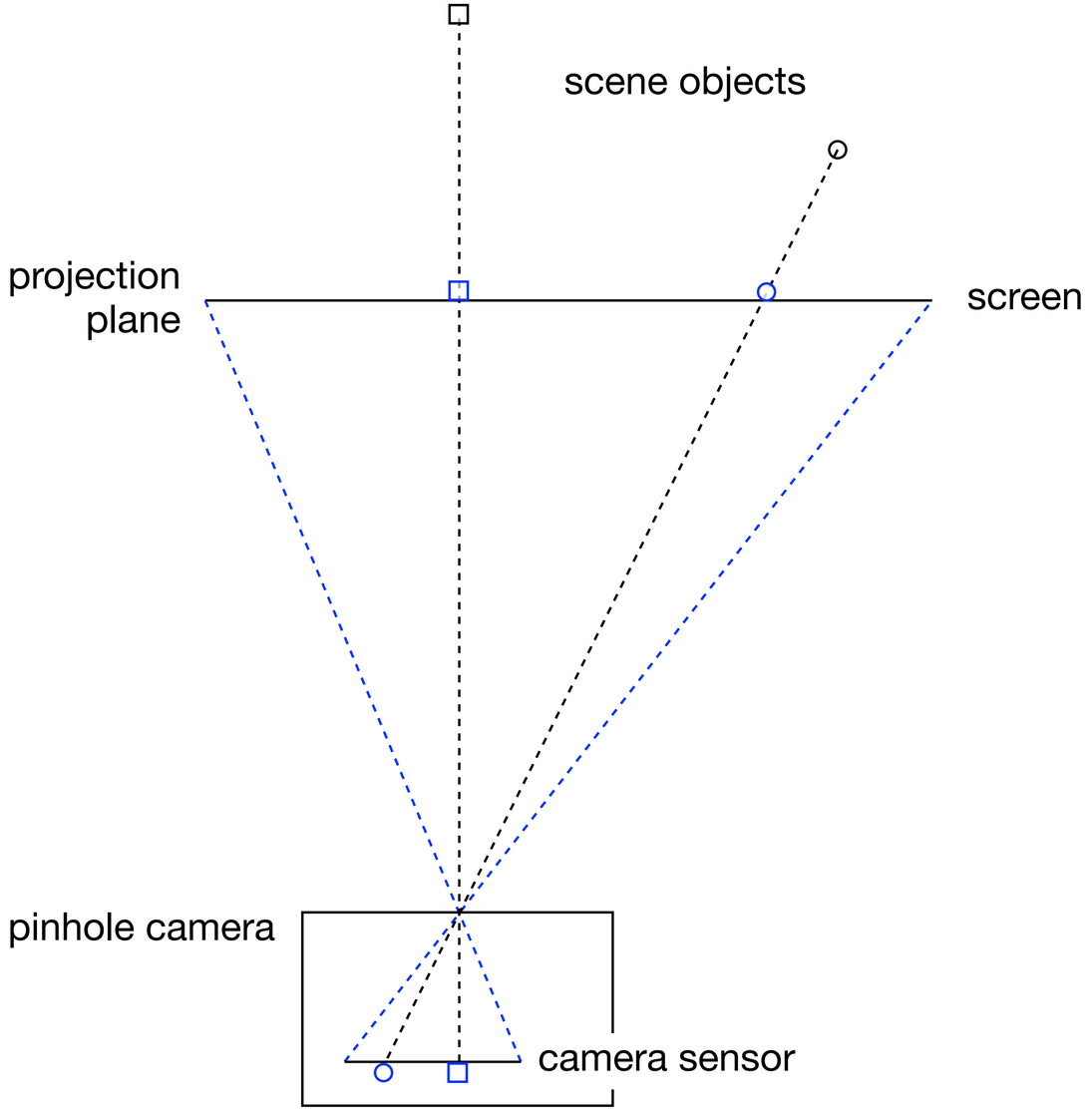
Screen based viewing, asymmetric frustum

Creating asymmetric frustums from parallel cameras

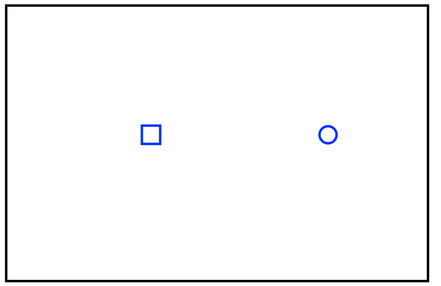
Top view

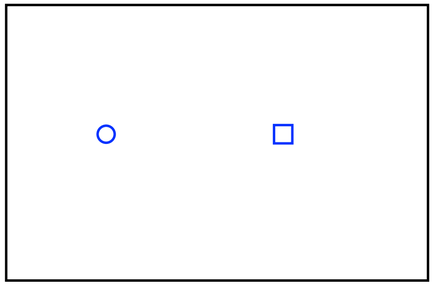


Perspective projection = pinhole camera

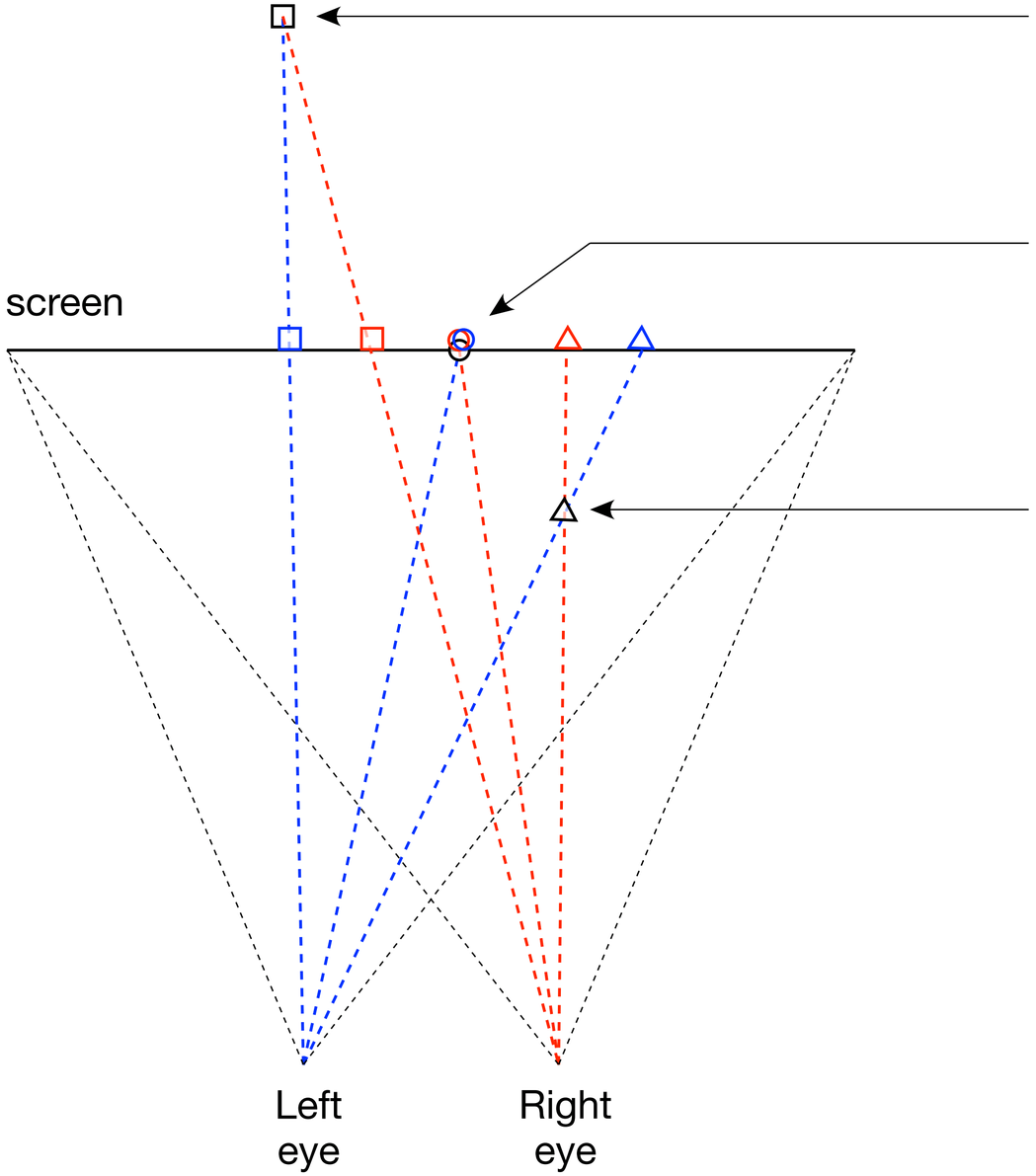


Top view





Stereo separation: parallax



Top view

Positive parallax
- objects appear behind the screen
- as the object moves to infinity, the separation approaches the eye separation

Zero parallax
- objects appear at the screen depth

Negative parallax
- objects appear in front of the screen
- as the scene object approaches the camera the separation can become extreme

Adjusting zero parallax distance

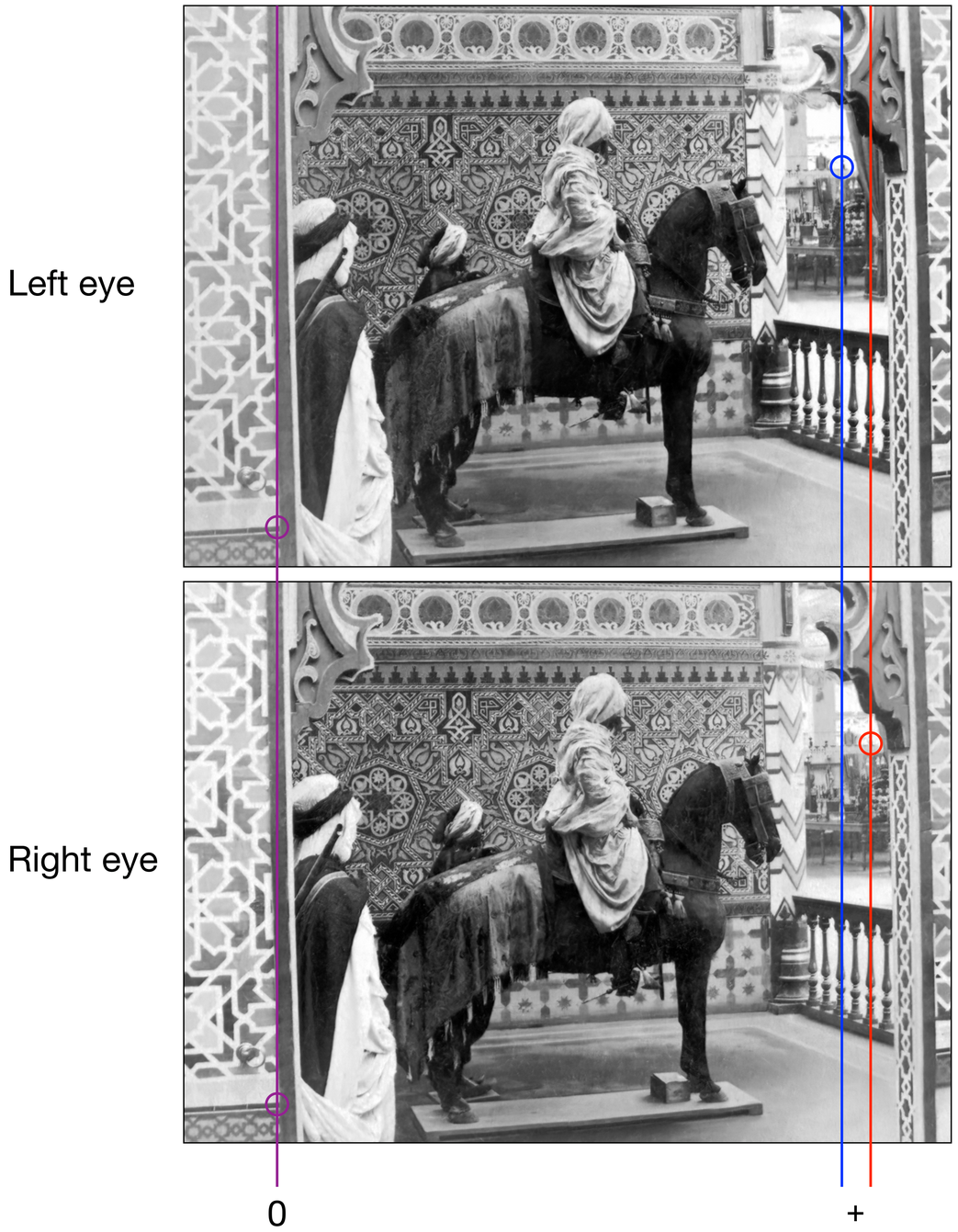
- Slide the two images horizontally until the scene object that is to be at zero parallax overlay exactly.
- Crop the two images as desired.

Guiding principles

- There should be no vertical parallax, our eyes are only horizontally offset.
- Negative parallax (objects appearing in front of the screen) should be modest.
- Negative parallax objects should (ideally) not cut the frame of the display.
- Scene objects at infinity are not separated by more than human eye separation (6.5cm).
  If they do then our eyes need to diverge, which they are not designed to do.

Setting zero parallax example

- The vertical line labelled “0” shows that a point in the scene that should appear at the screen depth has zero parallax,
- The two vertical lines labelled “+”, positive parallax, illustrate that a distant object in the left eye (blue) appears to the left of the corresponding scene object in the right eye.
- In this example there are no scene objects placed closer than the screen distance, exhibiting negative parallax.



Characteristics of the scanned prints

- Monochrome.
  A limit of photography of the day, colour photography (Paget) was another 40 years in the future.

- Low resolution.
  The original glass plates would have been higher resolution, but plates were fragile and often didn't survive.

- Often they have poor focus or low depth of focus.

- High contrast, low dynamic range.

- Likely fading with time.

- Left-right eye exposure differences. This can be stressful on our eyes since it rarely occurs in real life.

- Noisy.

- Damaged, for example, cuts, creased paper, hairs, mold ….

- Some have extreme stereo separation.
  Most likely a pair created from two separate cameras manually offset.

Processing pipeline

- Crop, convert to 16bit greyscale, do a first pass intensity/exposure match.

- Denoise.
  Standard denoise filters were limited, settled on an AI base denoiser (Topaz).

- Cleanup of spots, crinkles, hairs, mold and so on.
  This is a manual process, typically with clone tool in PhotoShop.
  One trick for damaged stereoscopic slides is one can copy from one eye to the other, at least for flat objects at a fixed depth.

- Stereo alignment
  - Sliding images left and right horizontally to optimally align zero parallax.
  - Possibly rotate slides with respect to each other.
  - Vertical shift to remove any vertical parallax.
  - Possibly scaling one image with respect to the other to compensate for optical differences.
  - Apply cropping, in this case to form a consistent 1:1 frame.

- Apply AI colourisation (deoldify).

Original

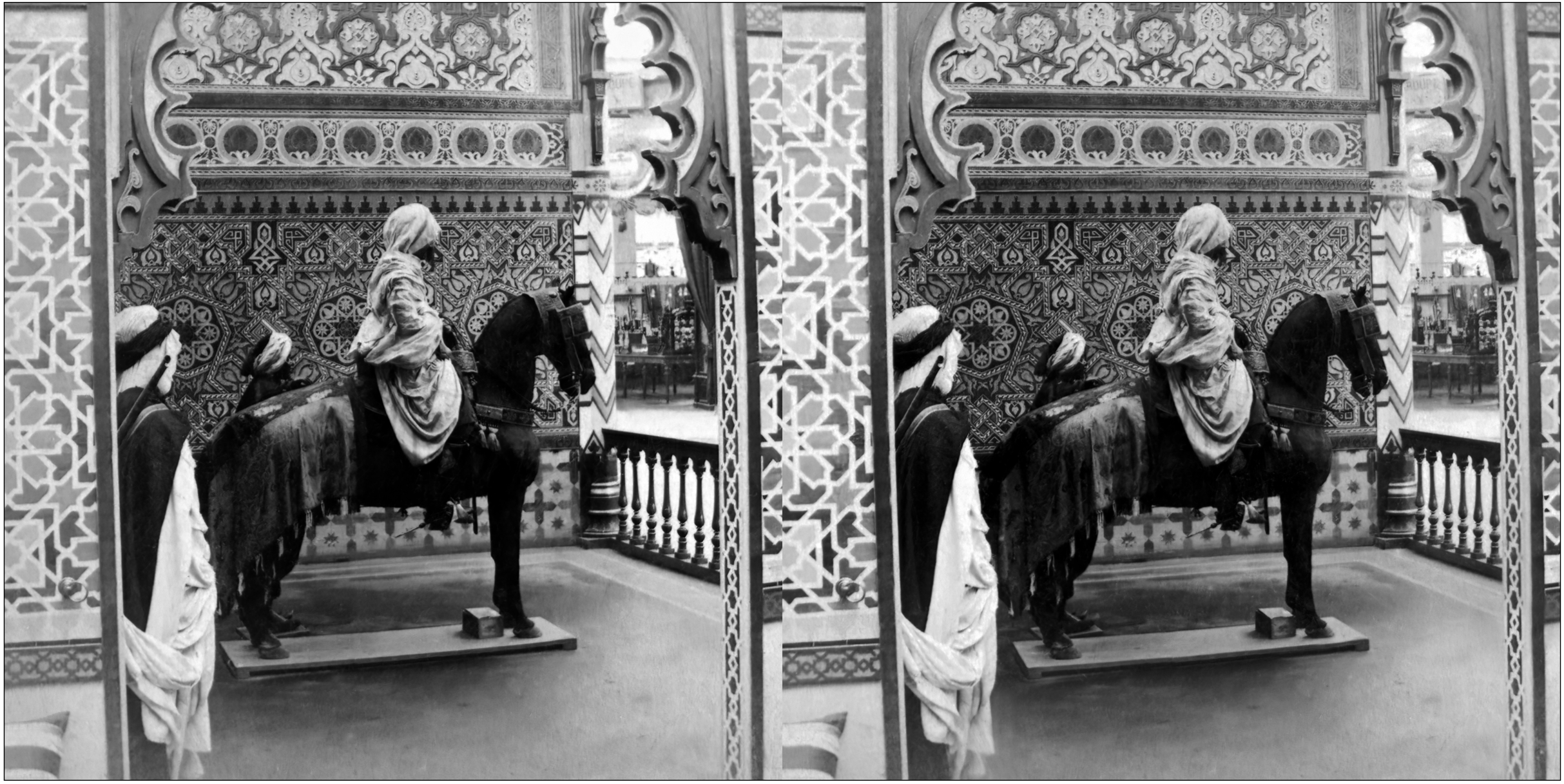

EXPOSITION UNIVERSELLE
De 1867
CONCESSION UNIQUE
PHOTOGRAPHIE
Par M. LEON et J. LEVY
474 — Le Cavalier Marocain.

Cropped, grey scale, intensity matched

Denoise

Manual cleanup

Stereoscopic alignment, cropping to 1:1



Colourisation

Transformation

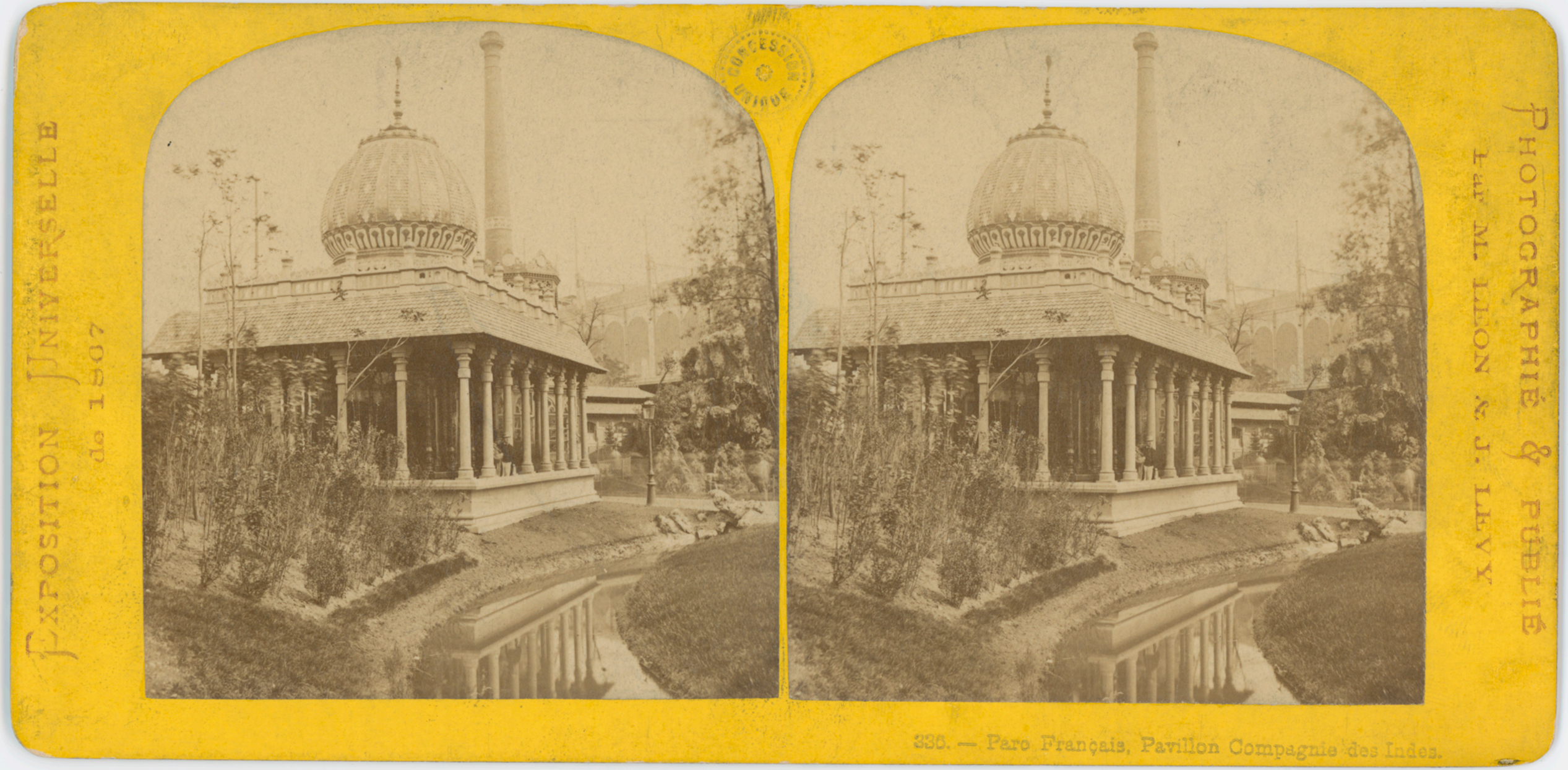
Over exposed white markle


SECTEUR XVI
GRANDE BRETAGNE
ET IRLANDE
SECTEUR I
FRANCE
SECTEUR XVI
GRANDE BRETAGNE
ET IRLANDE
SECTEUR I
FRANCE

Extreme noise

Dirty sky

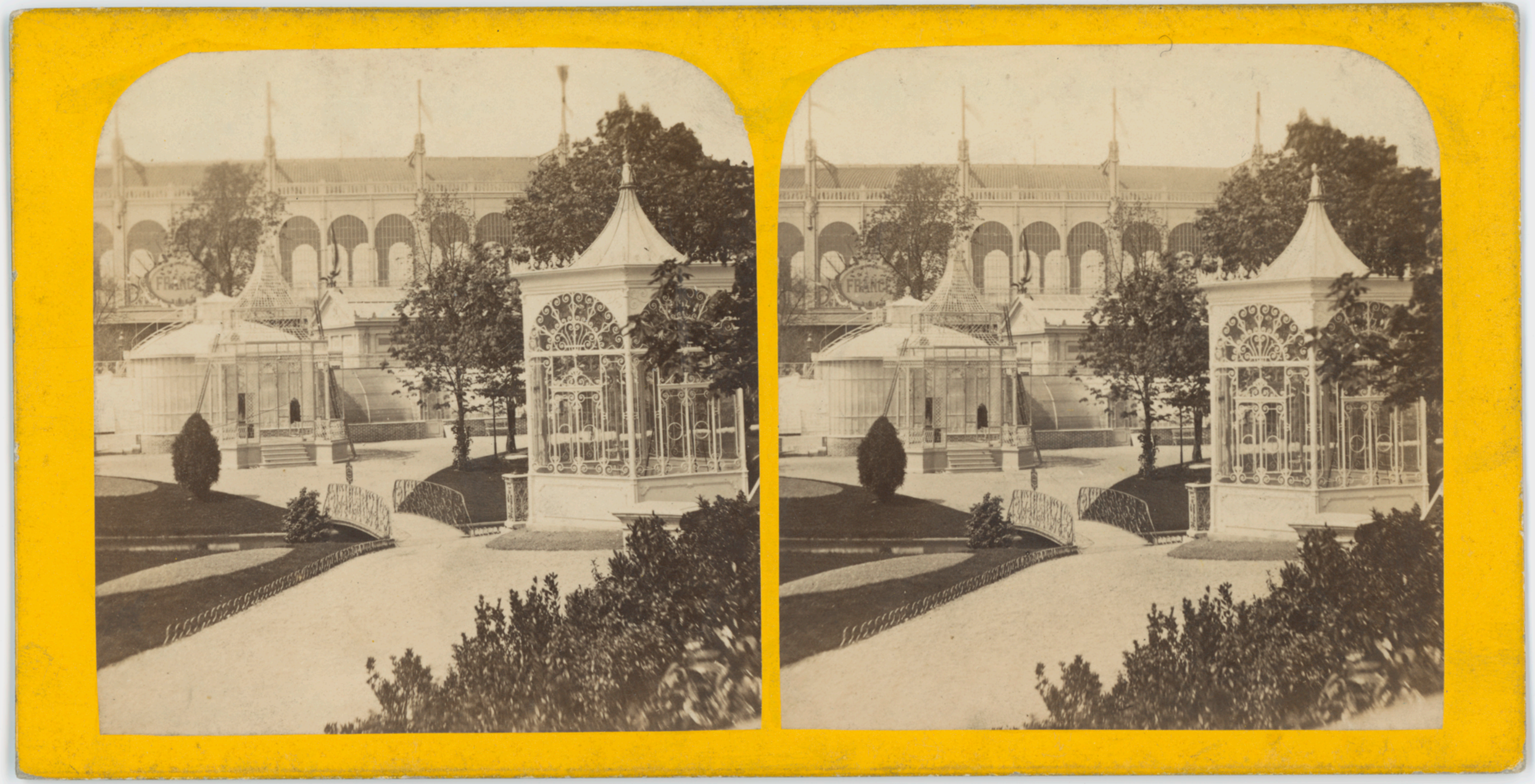
Colourisation often works really well

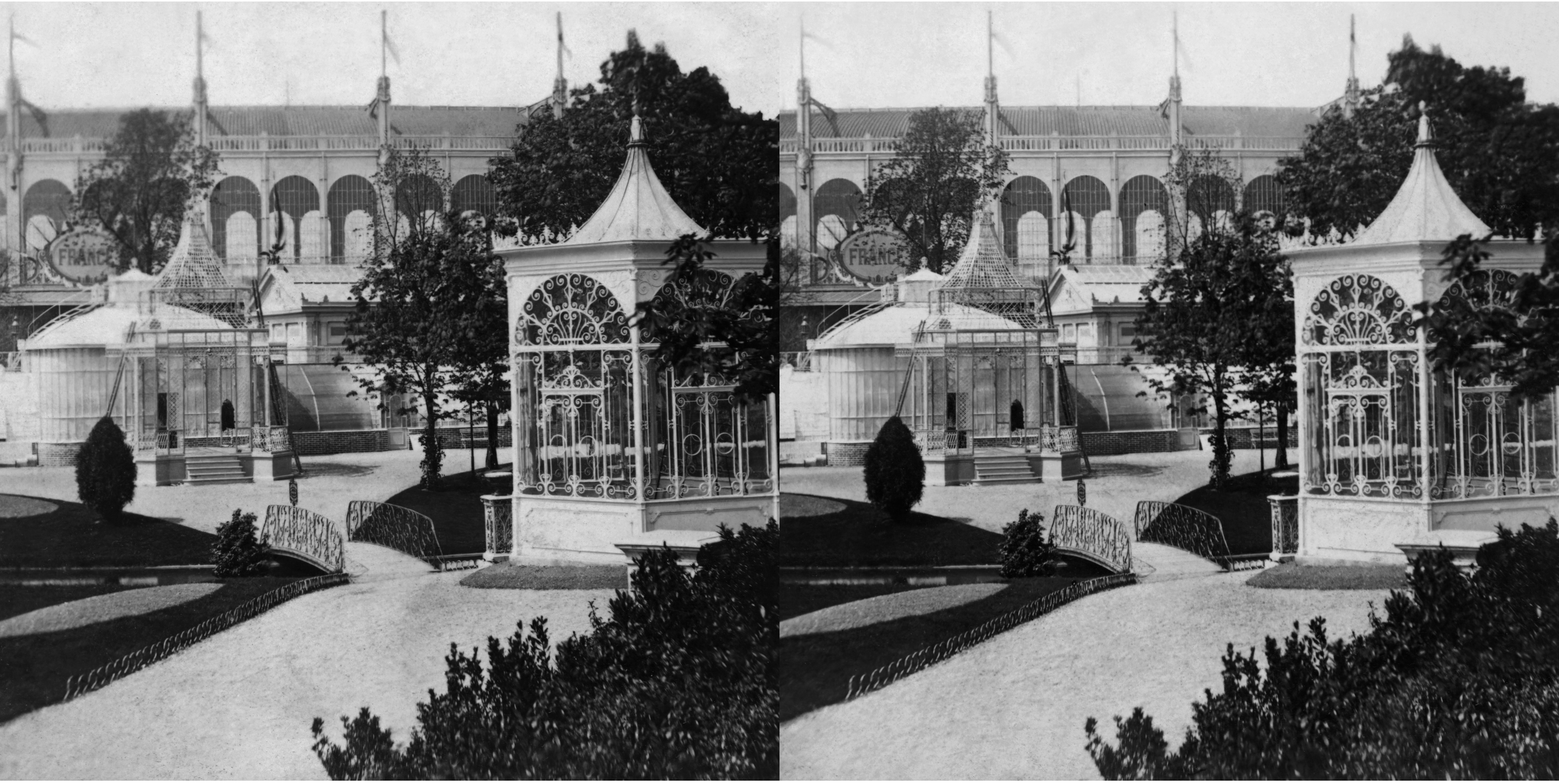


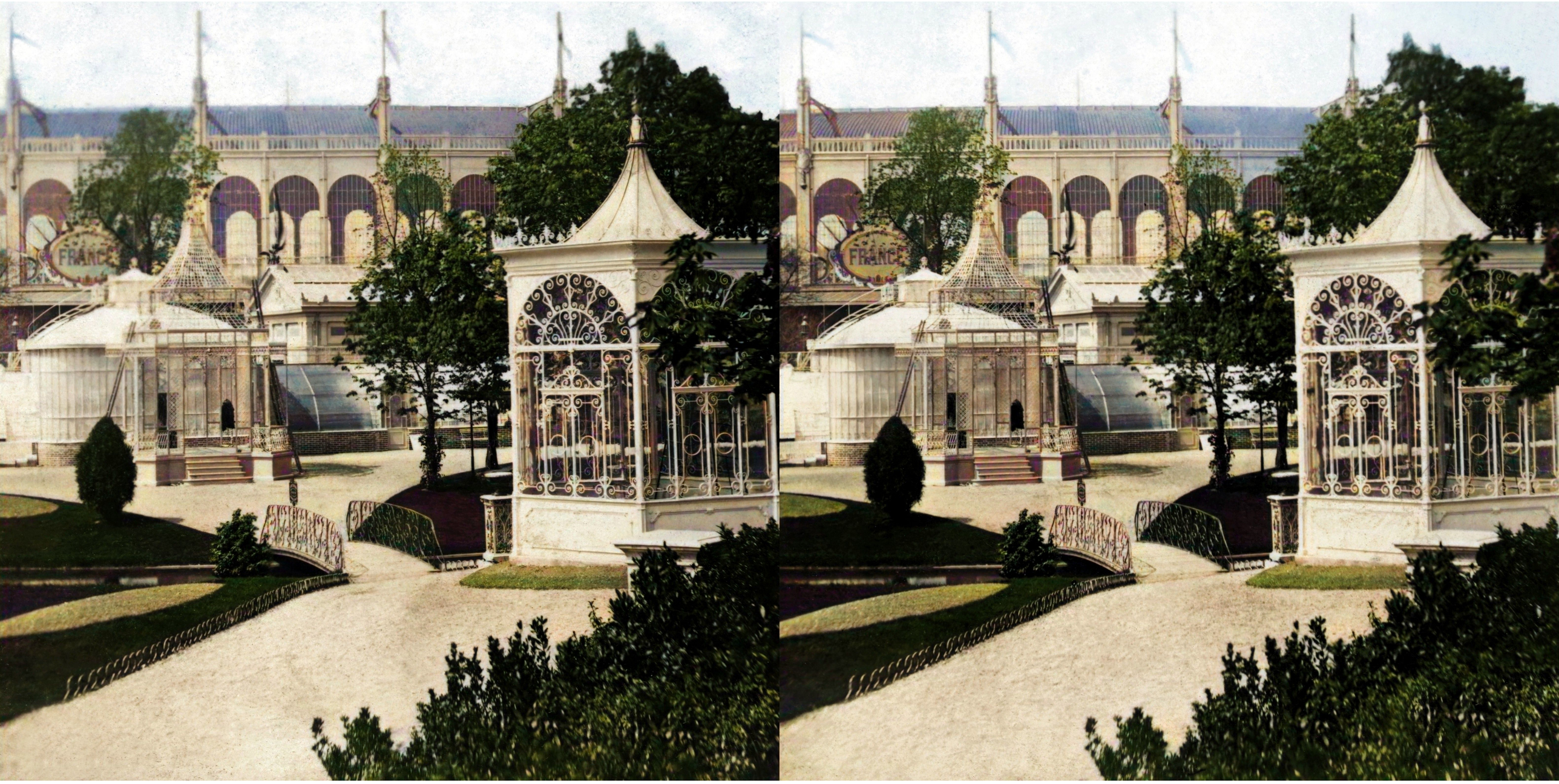

Fake colour


Exposition Universelle
de 1867
Photographié & Publié
par M. Léon & J. Lévy.
698. — La Cigale, par Cambos.

Nice results




FRANCE


FRANCE

435 — Costumes guerriers Japonais.


JAPON
GOUVERNEMENT DU TAICHIOU DE SATSOUMA

Stuffed animals