

# Maxwell's creation of colour science at Aberdeen

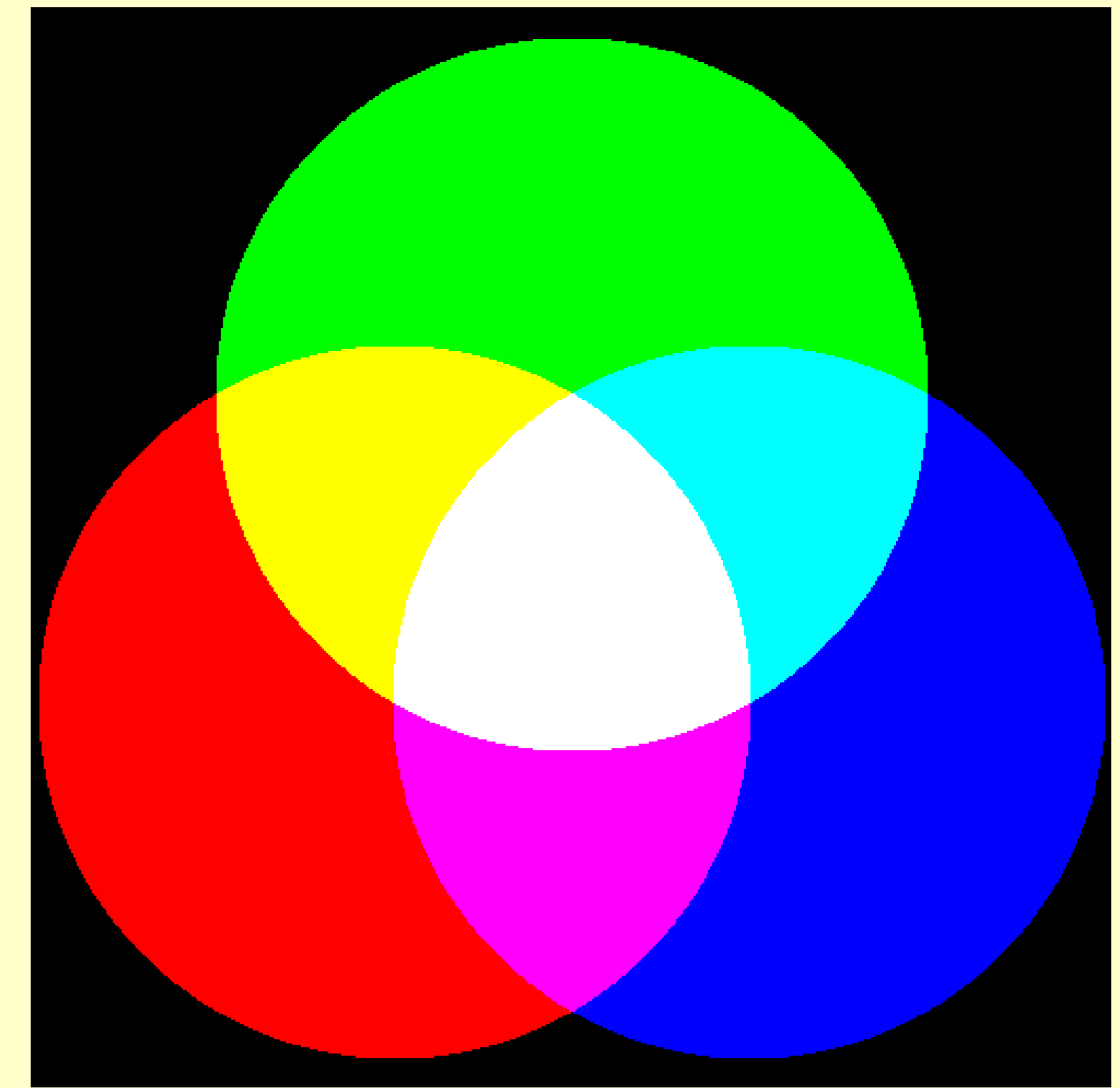
❖ Maxwell made 3 fundamental discoveries in colour science while at Aberdeen

- ❖ he showed how to measure colour
- ❖ he showed how to measure 'colour blindness'
- ❖ he showed how a colour photograph could be made from 3 black and white images and 3 colour filters



- ❖ Colour vision is a product of Physics, Physiology and Psychology, making it difficult to study
- ❖ Maxwell explored how colours are not unique but can be matched by a combination of 3 primary colours
- ❖ He investigated this while still a youngster, with his *colour tops* and *colour wheels*

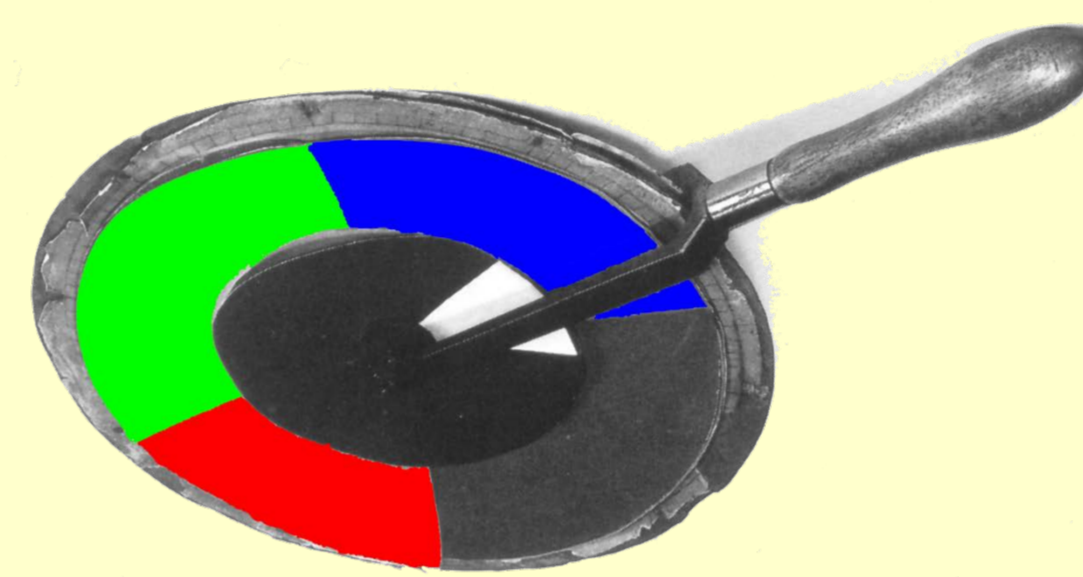
Thomas Young, pictured here, earlier in the century had suggested that the range of colours we experience could be explained if we possess just 3 different types of colour receptors in our eyes



Using primary lights of red, green and blue, a wide range of other colours can be made by mixing these primaries. This is how colour TVs and monitors work



- ❖ Not quite Maxwell's spinning top but a similar idea from [blog.mprintables.com](http://blog.mprintables.com)
- ❖ Variable colour sectors can be put on top and when the top is spun the colours mix
- ❖ Maxwell turned this into a quantitative tool for measuring colour mixing



Maxwell also used a spinning wheel of the kind he is holding in the picture on the previous board

- ❖ The top circle is printed with just the green and red colours shown to the left of it
- ❖ Move away until the detail blurs and as a result the colours mix
- ❖ For most people the top circle will appear the same colour as the lower circle
- ❖ This is additive colour mixing

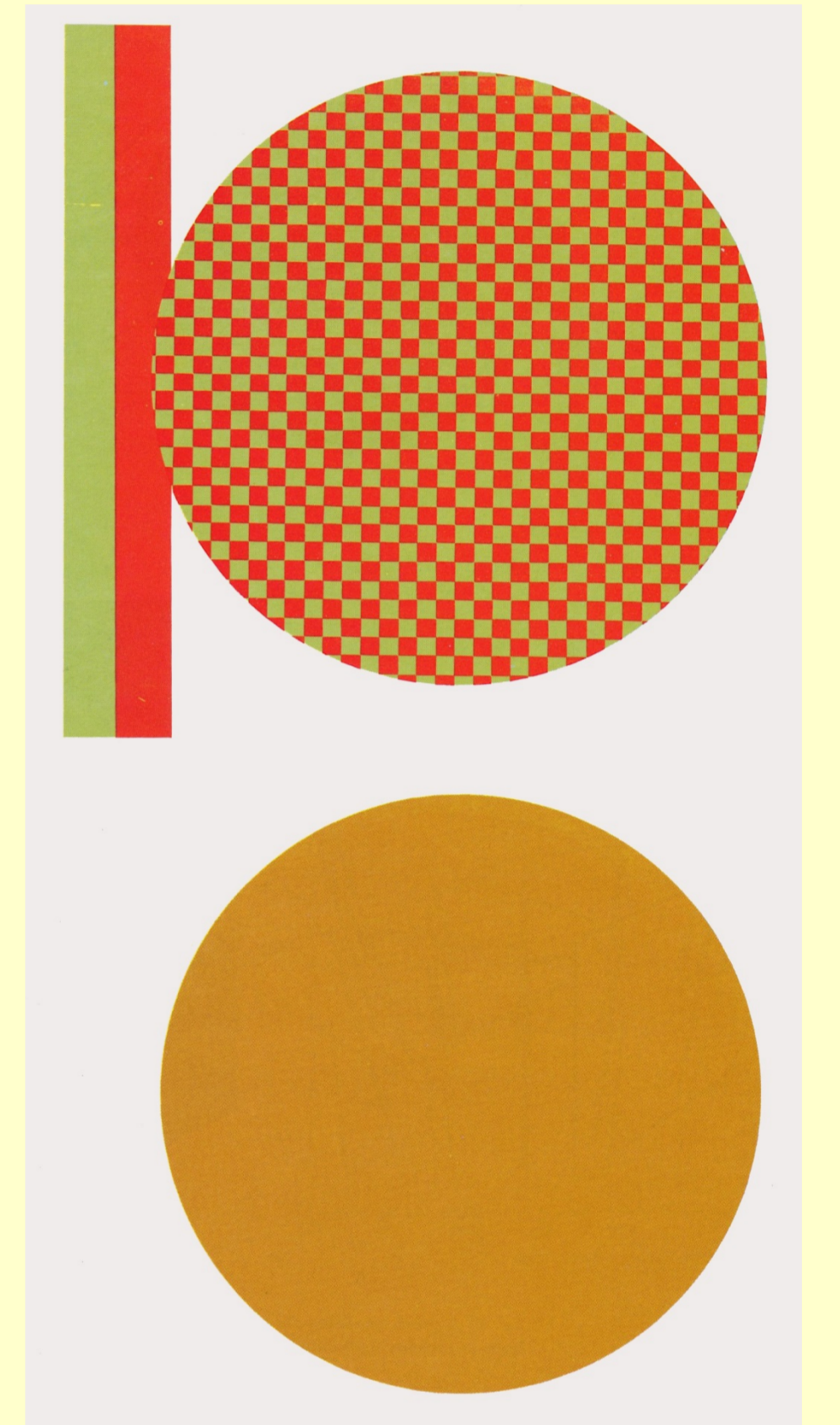
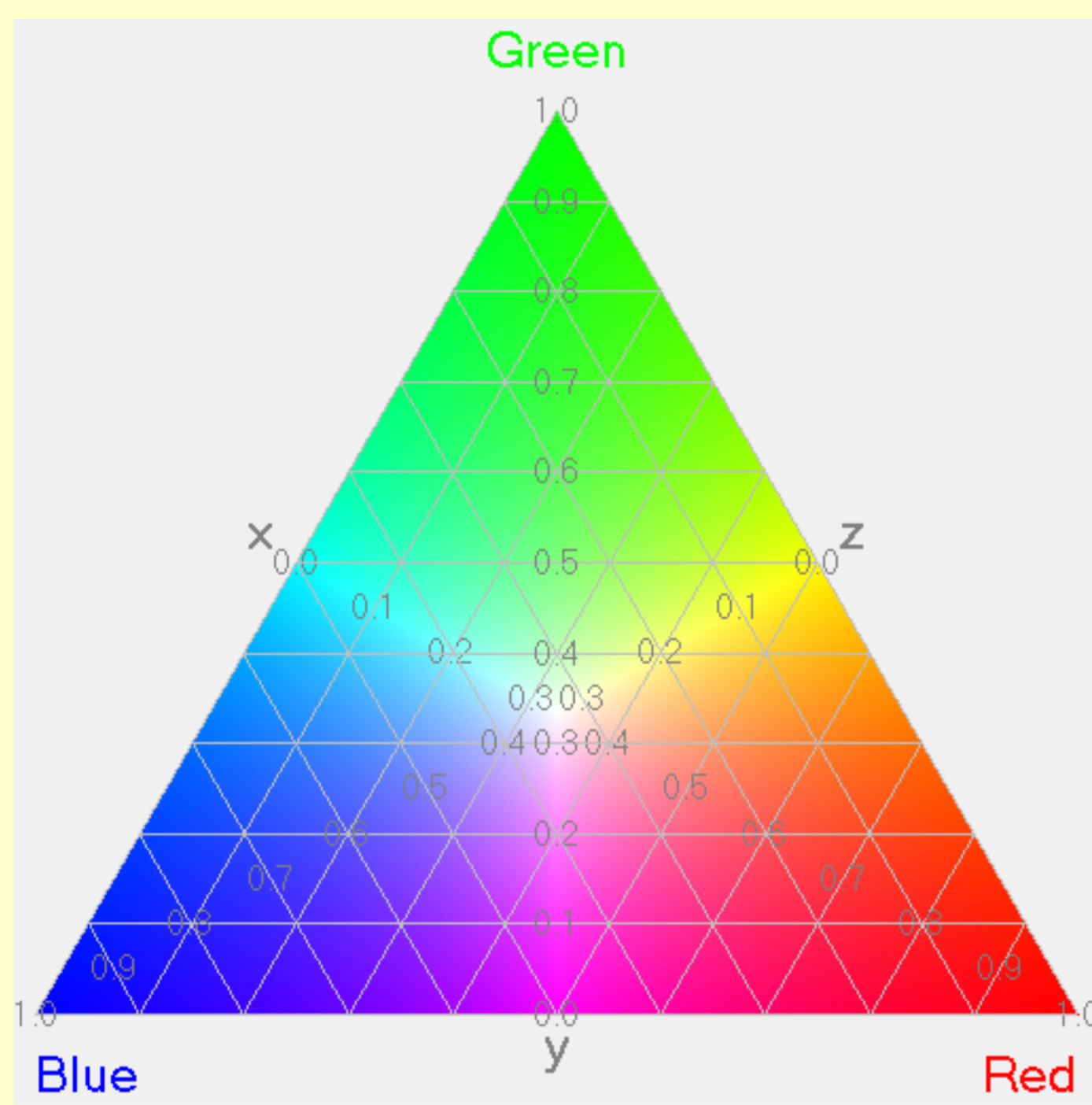


Diagram courtesy Cornsweet

- ❖ Maxwell devised the concept of a 3-dimensional mathematical colour space. Each colour had a coordinate in this space
- ❖ He showed how all colours of a constant brightness could be represented on a triangle, now called **Maxwell's colour triangle**
- ❖ His main paper 'on the theory of compound colours' won him the Rumford medal of the Royal Society of London

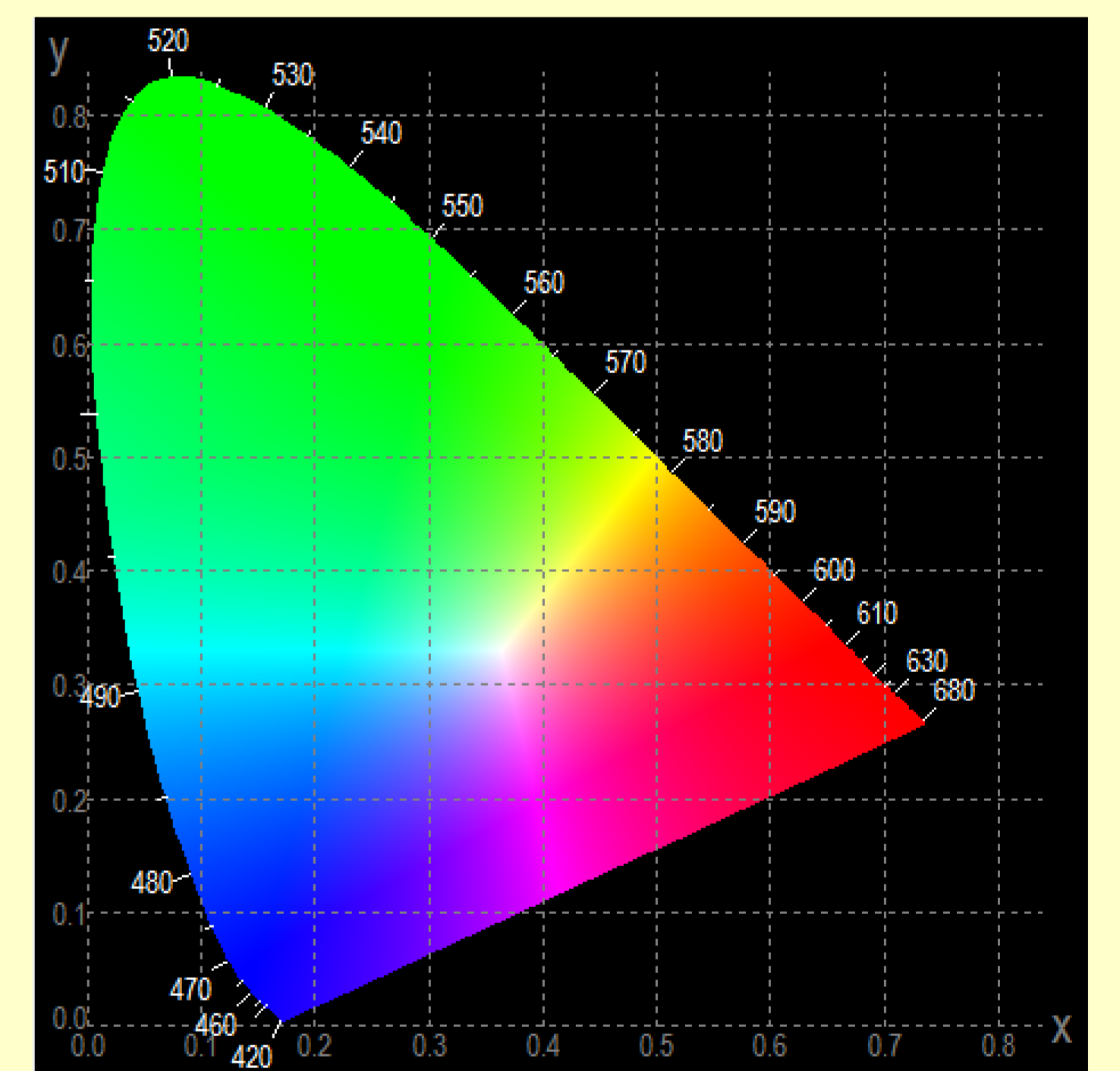


Maxwell's colour triangle. The corners are the primary colours red, green and blue.

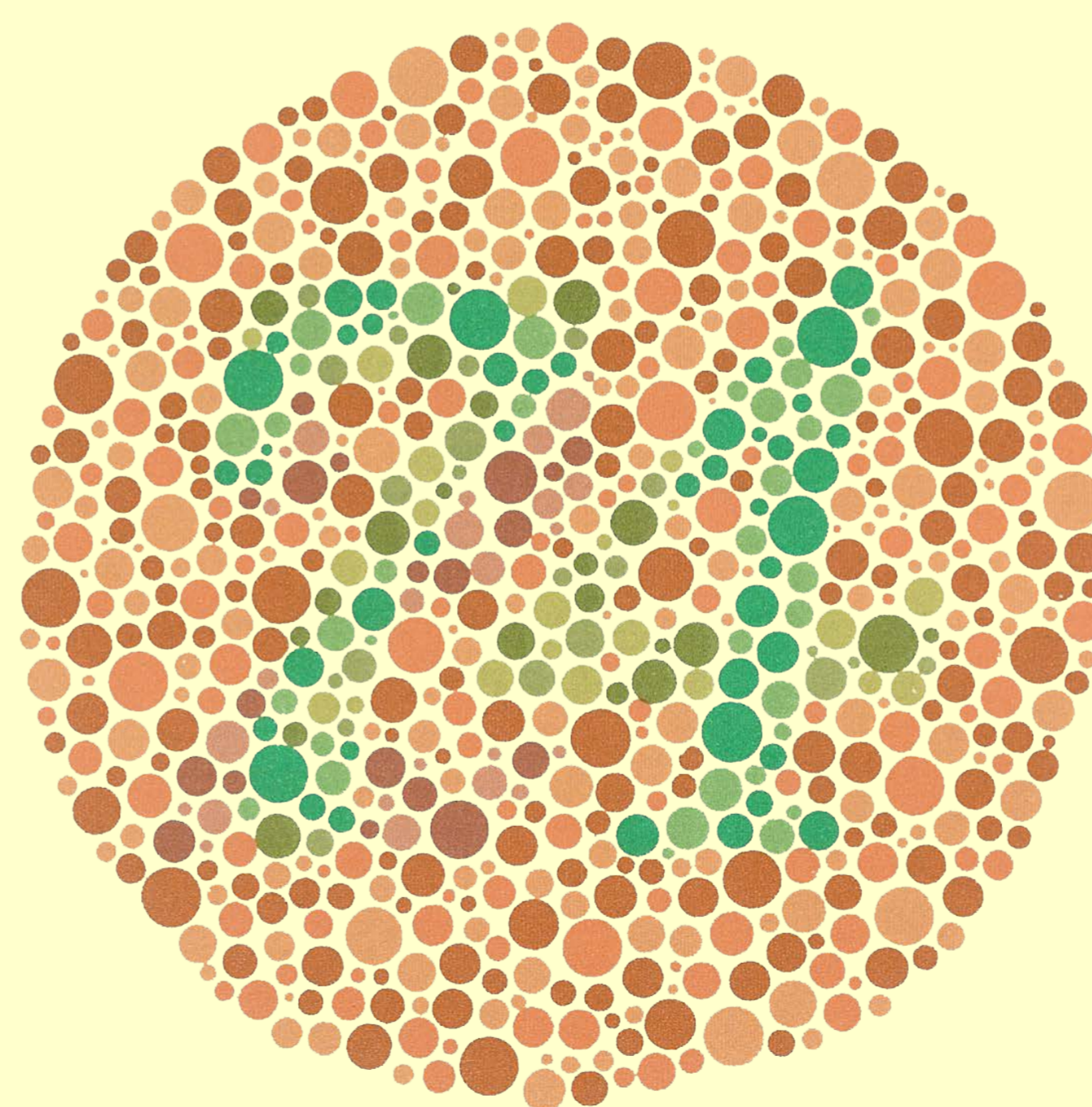
Maxwell's *colour box*, made by Smith & Ramage of Aberdeen, that he used to determine how spectral colours could be matched by 3 primaries. Courtesy Cavendish Laboratory, Cambridge



Right: the 1931 style CIE chromaticity diagram developed from Maxwell's triangle



Reconstruction of the first colour photographic picture made by Maxwell and projected at the Royal Institution in 1861 during his lecture. Presented to the University of Aberdeen in 1961. Maxwell's concept was correct but the technology of his day wasn't up to it. It took over 4 decades before Autochrome and Dufay colour made Maxwell's idea work commercially



- ❖ Maxwell realised that 'colour blindness' could be measured by the results of his colour mixing experiments with his colour box
- ❖ He measured the details of a Marischal College student in 1859
- ❖ The Ishihara colour test uses abnormal colour perception to classify colour blindness, though not to measure it precisely
- ❖ In controlled lighting, people with 'normal' colour vision can see the number 74 in the above image



James Clerk Maxwell coloured panel in the Great Tapestry of Scotland on display in Aberdeen in 2014