If you go to a fireworks display today, the colour of the pyrotechnics will be as essential for raising all those oohs and aahs as the shapes of the patterns, the noise and the smells. Today we’re used to seeing a wide range of bright colours in fireworks. But when did this start? How did fireworks become colourful?

The standard answer in the few books that have been written on the history of fireworks is that the arrival of coloured pyrotechnics came in the first decades of the 19th century, when a French pyrotechnist named Claude-Fortuné Ruggieri described using a ‘green fire’. Ruggieri took four parts of verdigris (copper carbonate) and two parts blue vitriol (copper sulphate) and one part sal-ammoniac (ammonium chloride). He mixed them together and added alcohol, then dipped cotton threads into the wet paste and hung them on the figure of a palm tree to make the leaves appear to burn green. The sal-ammoniac volatized the metal salts to increase the intensity of the colour, and soon after potassium chlorate, a highly volatile substance discovered by Claude-Louis Berthollet in 1786, was used to the same end. Potassium chlorate is a high-energy oxidizer and allows the salts to burn with a bright, coloured flame. It quickly became a standard ingredient of coloured fires and by the 1840s, fireworks recipe books were filled with recipes for coloured fireworks using different metal salts. Strontium nitrate produced red, copper nitrate made blue, barium nitrate made green, and so on. Later on, the addition of magnesium and aluminium allowed fireworks to burn with even brighter colours.

According to this account, fireworks before Ruggieri were not coloured, or rather had only the colour of ‘white fire’, that is the natural red-yellow colour of elemental fire. But this sharp division between pre-modern and modern pyrotechny based on the use of potassium chlorate has its problems. First of all, Ruggieri was not the first to use green fire. As I showed in my book *Fireworks: Pyrotechnic Arts and Sciences in European History* (Chicago, 2010), the origin of Ruggieri’s green fire lay in Russia. In the middle decades of the 18th century enterprising Russian artillerists invented the recipe in an effort to compete with an interloping pyrotechnist from Bologna whose ingenious fireworks impressed the Russian court. Mikhail Vasil’evich Danilov and Matvei Martynov received very little credit for their invention, but green fire continued to be used in Russian fireworks for the remainder of the 18th century. Then, in 1804, the French aeronaut and inventor of the parachute André-Jaques Garnerin reported on the green fire to his friend Claude-Fortuné Ruggieri after witnessing it on a visit to St. Petersburg and Moscow. It was at that point that Ruggieri set out to imitate the Russian green fire, ‘whose colour’ said Ruggieri, ‘rivalled that of nature.’

Another problem with the standard account is that references to coloured fireworks are quite common before 1800. In fact many people tried to make green fire in the 18th century, including the Italian natural philosopher Raimondo de Sangro, the Russian chemist Mikhail Vasil’evich Lomonosov, and even Antoine Lavoisier, who failed in his efforts in 1766. Records of performances indicate the use of coloured fires. In 1710, fireworks for Tsar Peter the Great in St. Petersburg included ‘beautiful light blue and green fires, invented by the tsar himself’. Many treatises and manuals on pyrotechny from the 16th to the 18th century included colour recipes. A manuscript book on the ‘Secret of Gunmen’ from the early 17th century proposed, ‘To make fire of diverse colours [use] Spanish green Camphire, Sulphire, Turpintine, oyle of Linseed, oyle benedict, oleum benedictum, oil of bricks, these give in the night many colours, & feareful to see.’ Other 17th-century books proposed using aqua vitae (brandy), oil of spike (lavender oil), camphor, rosin, linseed oil, verdigris and other substances to make coloured fires.
The standard account does occasionally acknowledge these recipes but dismisses them on the grounds that when mixed with gunpowder, none of these substances could give anything more than a slight tint to a pyrotechnic flame, of no comparison with the bright, clear colours of modern fireworks. This may be true (experiments with the old recipes would be the best way to explore the matter). But it assumes something of a view from nowhere - that what counts as colour and colour difference are self-evident and comparable across history. It also assumes that pyrotechnic flames are always the most important element of a display to involve colour. But none of these things can be taken for granted.

The fact that colours could be ‘fearful to see’ indicates that early modern experiences of fireworks were quite different to our own. Early modern pyrotechnists perhaps had a different sensitivity to colours compared to later practitioners. John Bate, author of The Mysteries of Nature and Art in 1635, proposed making fireworks in which a change of colours would be generated by alternating gunpowder mixtures whose ingredients do not appear to have differed except in their proportions. Perhaps the recipe was a fabrication, but it may be that Bate and his contemporaries saw a greater difference in tints or shades of colour than we might today. A slight change in the redness or yellowness of a flame could count as a different colour. So early modern pyrotechnists did not see their fireworks as lacking colour, but identified colour in a different way.

The idea that the colour of fire is important in pyrotechny also seems to have originated in the early 19th century when brightly coloured fires became possible. Throughout its history pyrotechny has been allied with a great variety of sciences and different forms of expert knowledge, ranging from architecture and mathematics to chemistry and computer science. The alliance with chemistry seems obvious to us today, but was really only forged in the wake of the Chemical Revolution in the early 19th century, in particular by Claude-Fortuné Ruggieri, the creator of green fire. Prior to Ruggieri, pyrotechnists were certainly interested in colour and the chemistry of their compositions, but these were not singled out as being of special importance. Fireworks involved sounds, smells, scenery and decorations, costumes, music, and story-telling, and pyrotechnists paid attention to all of these elements. Prior to the 1830s, all fireworks were set off around artificial scenery depicting temples, statues, mountains, arches and columns. These were always brightly painted and were the real focus of colour in displays. The standard account claims that colourful scenery was used to make up for the lack of colour available in pyrotechnics, but this would only make sense if pyrotechnists could compare their colours to much later ones. Rather, making architecture the most colourful aspect of displays just reflected different priorities in pyrotechny.

Identifying the origin of colour in fireworks, then, is not a simple matter, because it depends what counted as colour and how important colour was for the different elements of a display. If we stick to the colour of the pyrotechnics, the question might be decided by looking at images of fireworks from prior to 1800 to see if they showed coloured fireworks. The few paintings that exist do not appear to show colour, but, as indicated above, the fires that they do show might have been considered to have different colours by people at the time! Furthermore, many paintings produced after coloured fireworks became commonplace still only show the fireworks as having a single, ‘natural’ fiery colour. The colour of fire in paintings appears to be more of a convention than a reflection of real displays.

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The fires in colour images of early modern fireworks are always ‘natural’ coloured, but this may only have been an artistic convention.

Antoine Caron, The Elephant Carousel, second half of the 16th century. Image in public domain.