Witt's Plate
Otto Niklaus Witt (1853-1915)

Monty Python and the Holy Grail is often ranked among the funniest films of all time. A parody of the Arthurian legends it brilliantly combines every conceivable misconception about the middle ages with ludicrously anachronistic gags and visual puns. But in one respect, the film is absolutely correct: aside from a few nobles, most of the characters wear distinctly drab colours. This is in stark contrast to the riot of colour that one sees today when one enters almost any clothing shop. If in Britain we often remember and celebrate William Perkin Sr., in fact the dye industry is a good example of how an industry that began in Britain, lost its way, and came to be dominated by another country entirely: Germany. And among the key players was a man who helped solve the problems of how to isolate a precipitate.

Otto Witt was born in St Petersburg in Russia. His father, a pharmacist from the German province of Holstein, had moved to Russia where he became professor at the Pharmaceutical College. He was still in school when his parents moved to Switzerland. After graduating from high school and completing his military service he studied chemical technology at the Zurich Polytechnic (ETH) where he worked with Émile Kopp a technical chemist who had interests in both dyeing and steel-making. Taking his degree in 1873, Witt found a job in a steelworks in Duisburg in the Rhinelands. But he was restless, and within months was back in Zurich making colours for cotton printers.

Dyeing had never been more exciting. Although the discovery of mauveine by Perkin twenty years before had been met with scepticism by Perkin's supervisor August Hofmann (CK29 Jan 2010), it was soon followed by the discovery of other brightly coloured compounds obtained by the oxidation of mixtures of anilines. The new colours began to revolutionise the textile industry stoking demand for more colourful and exciting fabrics. In 1858, the flamboyant graduate student Peter Griess, working in Hermann Kolbe's lab, discovered the diazotization reaction when he warmed anilines with nitrous acid. Griess's discovery was incredibly significant because it opened up the possibility of coupling together the burgeoning range of aromatic molecules that were being discovered by chemists across Europe. Griess joined Hofmann's group in London where he continued to study his coupling reaction. In Manchester, Heinrich Caro and Carl Martius (a student of Hofmann's), working with their employer John Dale, developed the first two azo dyes, named Manchester Yellow and Bismarck Brown.
Developments in the dyeing industry were therefore so interesting that Witt went back to university, this time working at least in part in Viktor Meyer's lab (CK54 Feb 2012), where he began to unpick the nature of a series of coloured mercapto dyes that were being used in France. His thesis in 1875 reported on the reactions of aromatic nitrosamines and their reactions with dichlorobenzene. It is not surprising that with this unusual combination of the fundamental chemistry and the applied technology that he quickly found a job. But it was not in Germany. Instead, on Caro's recommendation, he joined Williams, Thomas & Dower in West London, as their first development chemist. He was given a free rein to experiment and immediately focused on the azo dye technology rather than the anilines. Witt had been thinking deeply about these coloured compounds and puzzling over what determined their colour. In a crucial paper published in 1876, Witt speculated that coloured compounds were the result of a consistent grouping of atoms – he called it a *chromophore* – whose properties were modulated by changing the structure of the aromatic groups around it – the *chromogens*. By adding a charged unit, the *auxochrome*, the dye could be made to stick to a fabric. It was a huge conceptual leap. By deliberately changing the number of amino groups on an aromatic framework he obtained an orange compound that sat neatly between the previous known reds and yellows. He named it chrysoidine and, by making further substitutions obtained a class of yellows – tropaeolins – that provided a vast range of tonality.

In spite of this success, Witt tired of working in Britain. Like many of his German contemporaries he felt that British industrialists were reluctant to take up innovations. Caro and Martius had already returned to Germany to join firms that would eventually become giants in the field, BASF and Agfa. Peter Griess, who had moved from Hofmann's lab to work as a chemist with a brewer in Midlands, would patent his continuing dye research with Caro's BASF rather than with his own employer who just wasn't interested. The result was that German firms like BASF, Agfa, Hoechst and Baeyer steadily undercut British industry in both price and quality leading to its decline.

Witt returned to Germany and worked for a series of different dye companies in Mülhaus (today Mulhouse) and Mannheim before he finally came to the conclusion that he was more interested in the science than in the day-to-day problems of the factory. He moved to the Technical University Berlin where he gained his habilitation in 1886 and started lecturing and taking research students. The basement lab he inherited was a mess. He set to work, with the help of the previous occupant's lab technician clearing the lab, and equipping it with apparatus. Like so many of his time he was an exceptional glassblower while his lab technician, an excellent mechanic, built the rest.

The real sense that Witt was particularly at home in the lab is captured in a short paper he submitted in 1886 describing an improved method for vacuum filtration. Vacuum filtration in a normal conical filter funnel could not be done with conventional paper and Bunsen (link should be to Sprengel's pump CK5 – March 2008) had proposed the use of little sieves made of platinum or pumice that would sit in the funnel and catch the precipitate. Instead Witt proposed placing a disc made of glass, porcelain or the purest nickel (platinum was too expensive), riddled with holes, into the funnel. Onto this would be laid two sheets of long-fibre filter paper, moistened to provide a good seal, and the product could then be filtered, washed, and recovered with ease. It worked, but it required real care as the plates leaked round the sides and could slip sideways dumping the precipitate into the filtrate. The instrument maker Martini and Kaehler quickly began marketing plates equipped a rubber O-ring and a long "tail" to locate the place in the funnel.
But almost immediately Robert Hirsch at a dye-works in the Midlands (CK19 – March 2009) and Ernst Büchner (CK27 – Nov 2009), a German ultramarine manufacturer developed their now eponymous filters in which the plate is integrated into the funnel itself. Witt is largely forgotten. And yet he had the last laugh. If our world today appears to be almost beyond parody, Witt's idea of the chromophore has given us the myriad colours, tones and hues that brighten every moment of our lives.

Reference: O. N Witt, Über eine Filtriervorrichtung. *Ber. d. Deutschen Chem. Ges*. **1886**, *16,* 918.

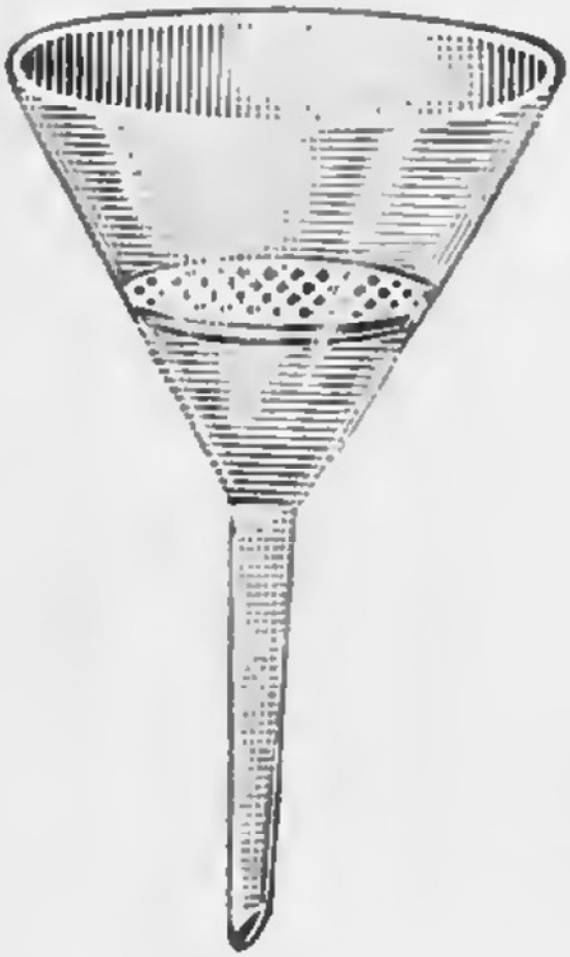

Fig. 203.