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The First Identification of Spinel

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The octahedral and macle forms of 'Spinel Ruby'.[1]

The credit for the first identification of 'Spinel' is commonly given to Jean-Baptiste Louis de Romé de L'Isle. Within his 1783 work *Crystallography*, De Romé de L'Isle identified 'Spinel Ruby' through its octahedral and macle forms. But is this credit warranted? After all, today's gemmologists would be ill-advised to rely on crystal form alone.

Historically, all red gemstones were considered varieties of ruby. Nevertheless, the 'True Ruby' was commonly separated from other varieties by its hardness.[2] As such, Anselme Boece de Boot gave a practical account of the identification of 'True Ruby' in 1644:

> The RUBY is a transparent gem of a reddish colour, with a small portion of blue, and cannot be touched by a file. The redness is not like that of vermillion[3] but of blood, or rather of cochineal[4], or kermess[5]; but the less blue it has in it the better it is […]. In Pegu [Myanmar] they are found in a river of that name and the inhabitants try their goodness with their teeth and tongue, for they judge those that are coldest and hardest are the best.
>
> (De Boot, 1644, pp.179-181. As summarised by Brookes, 1763, pp.133-134)

De Boot thus described 'True Ruby' as: a transparent gem of purple-red colour; extremely hard; and a good conductor of heat… all useful information in examining a water-worn stone.

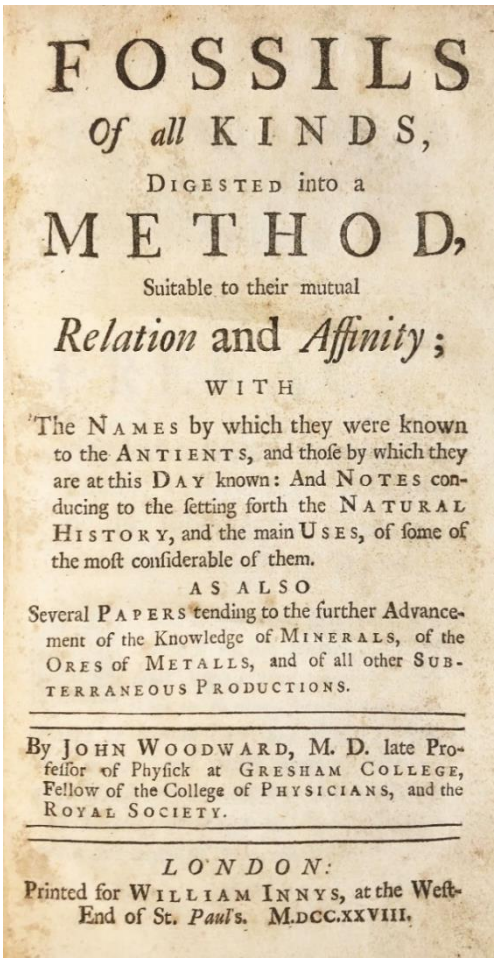
The challenge in identifying 'Spinel Ruby' was therefore to distinguish it from the remaining ruby varieties: the 'Rubasse' ('Quartz'); the 'Hyacinth' ('Zircon'); the 'Granat' ('Garnet'); and indeed, the as-yet-unnoticed 'Tourmaline'.[6] At this time, the ruby varieties were assigned to gemstones according to colour, such that, if 'Spinel Rubies' inclined towards the yellow; 'Lapidary experts […] [would] not put them in the rank of spinels, but in the rank of rubasses […] or hyacinths'. (De Boot, 1644, p.189)

What was required was a method of distinguishing 'Spinel Ruby' from the other ruby varieties in a categorial manner. The person who came closest to this, at least within the Western scientific tradition, was John Woodward. In 1728 Woodward rejected the convention of naming gemstones according to colour. This, he considered, was the cause of the 'Confusion that we find among the writers of Gemms, both Antient and Modern' (Woodward, 1728, p.27). In its place, Woodward outlined a new theory on the formation and composition of crystals:

Portrait of John Woodward.[7]

> The Stones […] [considered in this] Article, are those which the Lapidaries usually call Gemms. The natural Constitution of these having not been hitherto sufficiently explain'd, I presume it will not be thought amiss, that I premise something on this Subject; since 'tis from this only, that their proper Names can be ascertained […]. The […] prime constituent Matter of all of them is, when pure, wholly diaphanous, pellucid [i.e. completely transparent], […] and either Crystal [i.e. 'Quartz'], or an Adamantine Matter [i.e. 'Diamond'] […]. But we find frequently the Diaphaneity [i.e. transparency] of this Matter changed and lessen'd, by Means of a fine metallic Matter, incorporated with the diaphanous, in the original Concretion and Formation of the Stones. By the Access and Mixture of this metallic Matter, I find, by various Experiments and Observations:
>
> 1. That the Weight, or Specific Gravity[8] of the Stone, is somewhat increased.
> 2. The Hardness of the Stone is varied […].
> 3. The Figure into which the pellucid Matter naturally shoots [i.e. the crystal form], is [frequently] changed […].
> 4. A Tincture, or Colour, is imparted to the Stone, paler or deeper in Proportion to the Quantity of the additional Metal.
>
> (Ibid., pp.23-25)

A modern gemmologist would likely agree on Woodward's points 1, 2 and 4: that the incorporation of metallic elements can affect a crystal's specific gravity, hardness, and especially colour. Point 3 is less obvious. On a superficial level, it is indeed the colouring element of 'Ruby' (Chromium) that governs its tabular form (compared to the bipyramid form of 'Sapphire'). But more profoundly, Woodward is suggesting a crystal arising from a mixture of 'Quartz' (SiO_2) and a "metallic Matter" (e.g. Zirconium, Zr) may present a changed form. In this example, the gemmologist might reasonably expect a tetragonal prism of 'Zircon' to be produced ($ZrSiO_4$), rather than a hexagonal prism of 'Quartz'.


FOSSILS
Of all KINDS,
DIGESTED into a
METHOD,
Suitable to their mutual
Relation and *Affinity*;
WITH
The NAMES by which they were known to the ANTIENTS, and those by which they are at this DAY known: And NOTES conducing to the setting forth the NATURAL HISTORY, and the main USES, of some of the most considerable of them.
AS ALSO
Several PAPERS tending to the further Advancement of the Knowledge of MINERALS, of the ORES of METALLS, and of all other SUBTERRANEOUS PRODUCTIONS.
By JOHN WOODWARD, M. D. late Professor of Physick at GRESHAM COLLEGE, Fellow of the College of PHYSICIANS, and the ROYAL SOCIETY.
LONDON:
Printed for WILLIAM INNYS, at the West-End of St. *Paul's*. MDCC.XXVIII.

Woodward's 1928 work, *Fossils of all kinds*.

But how could a gemstone be categorised, if not by its specific gravity, its hardness, its form or its colour – all of which would be affected by the proportion of "metallic Matter" it contained? Woodward's answer was that, whilst the stone's physical attributes *might* be affected by the "metallic Matter", the impact upon its colour was both more certain, and more superficial. The gemmologist must therefore apply judgement in categorising each stone according to its physical attributes. In practice however, it was the hardness of the various stones which drew Woodward's focus:

> There is Crystal [i.e. 'Quartz'], having nearly the same Degree of Hardness with the common, that is notwithstanding of a yellow Hue; as likewise of a Red, of a Blue, or of a Green. To these the Writers of Gemms have given the names of Pseudo-Topasius, Pseudo-Beryllus [i.e. Pseudo-Aquamarine], Pseudo-Sapphirus, and Pseudo-Smaragdus [i.e. Pseudo-Emerald] […]. In the same Manner, the oriental Sapphire, Topaz, Amethyst, Emerald, and Ruby, are all of the same Hardness. […] [Similarly] There are Diamonds tinged with Yellow: Others with Red, Blue, or Green, tho' these be very rare. The Tinctures and Colours of these, as of all other Gemms, and Stones, are owing to […] metallic and mineral Matter, incorporated with the diaphanous, at the first Formation of the Body. (Ibid., p.33-34)

However, as Woodward gathered the gemstones into their mineral groups – according to their hardness – a problem arose: How could the 'White Sapphire' be harder than 'Crystal' ('Quartz')? Given that both stones were colourless, the difference could not be explained by the presence of "metallic Matter". The solution to this problem was simple: The following year, 'White Sapphire' (i.e. 'Corundum') would become a third category of "Crystal Matter" – sitting between the newly named 'Common Crystal' ('Quartz') and 'Adamantine Crystal' ('Diamond'). (Woodward, 1729, p.191)

Had Woodward collected a wider range of colourless crystals, further categories of "Crystal Matter" would surely have been acknowledged. 'Spinel' would have been an obvious candidate. For just as 'Spinel Ruby' was described as being softer than oriental 'Ruby', so too was 'Water Sapphire' (i.e. blue 'Spinel') described as being softer than oriental 'Sapphire'. And, had 'Spinel' been awarded the status of "Crystal Matter", the credit for its first identification would surely have been Woodward's.

So does De Romé de L'Isle deserve the credit for the first identification of 'Spinel'? By focussing on its octahedral form, he had identified a property of 'Spinel' which – though not always useful – was unique among the red gemstones then known.[10] But he was not the first! Unbeknownst to him, Abū al-Rayhān Al-Berūnī had already employed a 'Specific Gravity flask' to obtain an accurate measure of the stone's Specific Gravity. It is therefore Al-Berūnī who should be credited with the first identification of 'Spinel', which he achieved by the year 1035! (Al-Berūnī, prior to 1035, p.66).[11]

[1] Image by Imfoto/Shutterstock.com.

[2] For example, Al-Berūnī noted that: 'The ruby, on account of its hardness, is superior to all stones, and only the diamond exceeds it in hardness'. (Al-Buruni, circa 1040-1048, p.40)

[3] *Vermillion* is a scarlet-red pigment made from powdered cinnabar.

[4] De Boot was describing *carmine* – a purplish-red pigment made from the bodies of cochineal insects.

[5] *Kermess* is another purple-red pigment – made from the bodies of female kermes insects. *Kermess* was replaced in the 16th Century by *carmine*, which is a stronger dye.

[6] Although 'Tourmaline' was as-yet-unnoticed, De Boot did refer to rubies of a mixed colour: partly white and partly 'blush'. These were known to Indians as 'Nilacandi' ('Sapphire-Ruby') but may well have been 'Tourmaline'. (De Boot, 1644, pp.181-182)

[7] Artist unknown.

[8] 'Specific Gravity' is a term used in gemmology that is equivalent to 'density'.

[9] Images of 'Common Crystal' and 'White Sapphire' by Rob Lavinsky. Image of 'Adamantine Crystal' by DmitrySt/Shutterstock.com. All images edited by the author.

[10] Significant deposits of gem-quality cuprite were not discovered until the 1970s (Arum, 1977, p.35).

[11] Al-Berūnī referred to 'Spinel' as 'Ruby of Badakhshân' after the location of its discovery in modern-day Tajikistan / Afghanistan. (Al-Berūnī, prior to 1035, p.61)

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