ANNETTE OTTERSTEDT

Investigating Green Marquetry on Bowed-String Instruments

The Leaves Be Greene

Whilst researching the bowed-string instruments of the Alemannic School,[1] which have fronts and backs richly ornamented with marquetry, we were keenly aware that some of these marquetries are distinctively coloured. Flower petals appear a reddish brown, whereas the leaves and other small areas of the ornamentation still show a green colour that has lost none of its brightness. This colour is not smooth and even, as in 'through–stained' wood, but streaky and of varying intensity, which seems to increase the luminescence of the surfaces. We had already given some thought to what colouring agent might be involved and had pursued this within the limitations of our scientific competence: 'Whilst there are numerous mineral and vegetable substances available for staining black, red, and yellow, green was always a problem, as the colorants obtained from plants tend to bleach when exposed to the light. . . The marquetries of the treble violin *Ad 1*[2] made [by Olga Adelmann] in 1983 in the style of the Alemannic masters had been stained with simple textile dye. In the summer of 1996 it became evident that, compared to the treble violin ascribed to Joseph Meyer *(Me 8),*[3] these colours had faded quite considerably. . . The conclusion was inevitable that the Alemannic fiddle makers used other substances capable of retaining their original colour after three hundred years'.[4] We then adopted the working hypothesis that the green colour must be based on verdigris, the only substance recognised as non-fading in contemporary compendia,[5] although as quite poisonous at the same time. Unfortunately we did not succeed in resolving the problem before the book about the Alemannic School was published, which is why an attempt is to be made here to remedy this shortcoming.

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[1] Olga Adelmann & Annette Otterstedt, *Die Alemannische Schule. Geigenbau des 17. Jahrhunderts im südlichen Schwarzwald und in der Schweiz*, Berlin 1997; *GSJ* LII (1999), pp. 219-242.

[2] Musikinstrumenten-Museum Berlin Kat.- Nr. 5508.

[3] Musikinstrumenten-Museum Berlin Kat.-Nr. 4519, 3rd quarter seventeenth century.

[4] *Die Alemannische Schule,* p.150.

What triggered the research which led to the conclusions we now believe to be the answer was the inquisitiveness of the violin maker, Tommy Schmitt, of Hamburg, who had resolved to use original techniques and materials to make his 'masterpiece' (which would qualify him to become a member of the Guild). He was no less impressed by the iridescent green pieces, and while he was experimenting with the recipes we had communicated to him, an expert dendrologist and student of Prof. Dr. Olaf Schmidt of Hamburg-Bergedorf, ambled into his workshop seeking information about acoustic properties of wood. He suggested that the green colour might be due to a fungus, *chlorociboria ærugitiosa* (green cup-fungus, or verdant fairy-cup).[6] Schmitt's enquiries completed the full circle and returned the ball into my own court, i.e. the administrative body known as the 'Stiftung Preussischer Kulturbesitz', of which the Museum of Musical Instruments, Berlin, is a sub-entity. To be more accurate, it landed in the court of the Museum of Arts and Crafts - our next-door neighbours, whose scholars I meet at lunch on occasion - and the 'Rathgen-Forschungslabor' (research laboratory), who have meanwhile acquired an international reputation as a historical materials research institution. The reason why I describe this bewildering situation at such length is that it illustrates the suffocating potential of obliging institutes such as museums to become totally absorbed in administration, leaving no scope for the resident scholars to pursue fruitful scholarship. Thus they have to rely on outside assistance if, and when, it may be forthcoming. (ICOM and CIMCIM take notice!)

Schmitt went in search of pieces of green wood in North and South German woods and forests, and built up his own collection, from which he could carve the marquetry for his masterpiece. Fortunately, the fungus is omnipresent even today, and it is quite likely that you may have inadvertently seen it yourself. The fact that such naturally green wood was used in furniture and wainscot marquetry has been known for some time.[7]

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[5] Works consulted: Johann Zieger: *Der Neu-aufgerichteten und Vergrösserten In Sechs Bücher oder Theilen velrfasten curieusen Kunst- und Werckschul... Anderer Theil...*, Nürnberg 1707; Johann Melchior Cröker: *Der wohl anführende Mahler, welcher curiöse Liebhaber lehret, wie man sich zur Mahlerey zubereiten ... solle*, Jena 1743; Johann Martin Teuber: *Vollständiger Unterricht von der gemeinen und höheren Dreh-Kunst...*, Regensburg & Wien 1756. In addition: Eszter Fontana, Friedemann Hellwig & Klaus Martius: *Historische Lacke und Beizen auf Musikinstrumenten in deutschsprachigen Quellen bis 1900*, Nürnberg: 1992.

[6] *chlorociboria æruginosa*, or *chlorociboria æruginascens*, sometimes *chlorosplenium æruginascens*, containing the colouring agent 'xylindeine'; cf. Olaf Schmidt, *Holz- und Baumpilze. Biologie, Schiden, Schutz, Nutzen*, Berlin/Heidelberg 1994, p. 92-93.

[7] Robert A. Blanchette, Antoine M. Wilmering, Mechthild Baumeister, 'The Use of Green-Stained Wood Caused by the Fungus *Chlorociboria* in Intarsia Masterpieces from the 15th Century', in: *Holzforschung* 46 (1992), No. 3, pp. 225-232. Hans Michaelsen, Achim Unger, Christian-Herbert Fischer: 'Blaugrüne Färbung an Intarsienhölzern des 16. bis 18. Jahrhunderts', in: *Restauro* 98 (1992), pp. 17-25.

There is reliable evidence for *chlorociboria*-infested wood in fifteenth-century Italian marquety. A list of furniture in the Historischen Museum Basel[8] includes chests, tables, and cabinets from various Swiss regions very probably containing *chlorociboria*-wood, too. They are dated from the second half of the sixteenth century; the material used is invariably poplar, with one exception (common beech). This list confirms that the use of wood coloured by *chlorociboria* was known in the region of the Alemannic School. A German book dated 1773[9] shows a hand-coloured illustration with such wood, and the woodworkers of Tunbridge Wells can be shown to have used green *chlorociboria*-wood from at least the late eighteenth century.[10] However, attempts at breeding the fungus in a controlled environment have not been successful so far.[11] It requires a long period of growth and moderate temperatures to turn the colour of the wood its characteristic green. This is often preceded by an attack of other fungi, but it seems that wood affected by *chlorociboria* retains a sufficient degree of firmness for a long time to be made into marquetry. The green surfaces produced in this manner are usually small, in conformity with the availability of the wood in the wild (e.g. as individual leaves or blades of grass). Of course, these little chips of wood can only be inserted where there is no constructional tension on them.

This is even more so where musical instruments are concerned. Fronts and backs of fiddles are subjected to a great deal of tension, and a loss of strength of these parts has to be avoided at all costs. The use of *chlorociboria*-wood on these parts demands a very thorough knowledge of wood and precise work. As a matter of fact, the region from which the Alemannic instruments originated had a long tradition of trading and working in wood, so that we may take this knowledge for granted for the instrument makers whose work is exceptionally precise in any case. The only known instruments decorated with coloured marquetry are those by Joseph Meyer (*c.*1610-1682) and Hans Krouchdaler (before 1650-after 1699). Meyer worked at Geroldshofstetten in the Black Forest/South-Western Germany, and Krouchdaler, in all likelihood his apprentice, at Oberbalm near Bern/Switzerland. What we had to establish was whether they also used *chlorociboria*-wood.

The Rathgen Research Laboratories in Berlin specialize in cooperating with museums and are familiar with their specific problems: exhibits that are unique and precious, can hardly be moved or not at all, and curators in

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[8] Ralph Stoian, *Grün gefärbte Intarsien an Objekten des Historischen Museum Basel 1550-1700*, communicated by Thommy Schmitt.

[9] Blanchette, p. 227 (illustration), 228, 231; the quotation does not give the title of this book, which is now in the Smithsonian Institution Libraries, Cooper-Hewitt Branch, New York.

[10] Blanchette, p. 231; however, there is nothing to suggest that this was an old-established tradition; Michaelsen, p. 25.

[11] Experiments carried out at Oldenburg University, Germany; courtesy of H. Piening.

charge, are not always open-minded towards scientific testing methods. Under pressure of such conditions, a method has been developed called high performance liquid chromatography (abbreviated to HPLC), which offers a high degree of accuracy while consuming a minimal amount of material: to demonstrate the presence of a substance, only a few micrograms are necessary. These are dissolved in concentrated sulphuric or hydrochloric acid, diluted with methanol, and injected into the machine by means of a syringe. As the sample is passed through the separating-tube it is broken down into its component parts. The time of retention (i.e. the amount of time spent in the separating-tube) and the absorption spectrum of each component are measured. By comparing the results with a vast reference library of spectra the individual substances can then be determined.

Figures 1(a) and (b): *HPLC analysis: Comparative diagrams of agents for colouring wood blueish green*

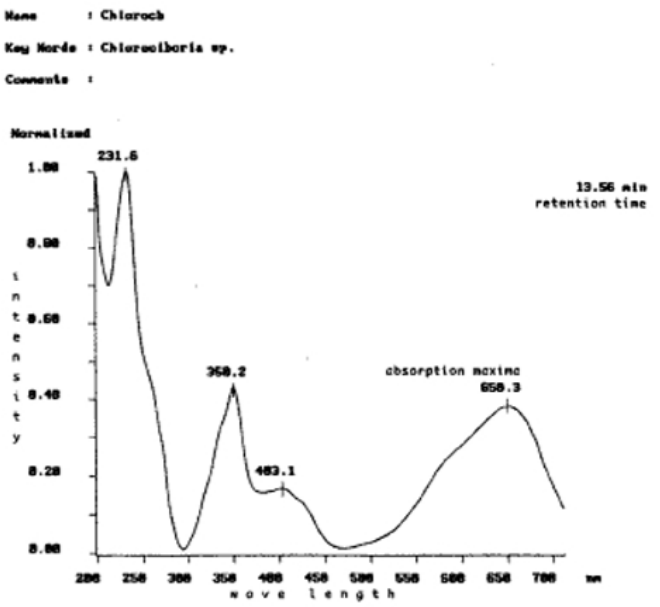

Figure 1(a): *chlorociboria* (xylindeine)

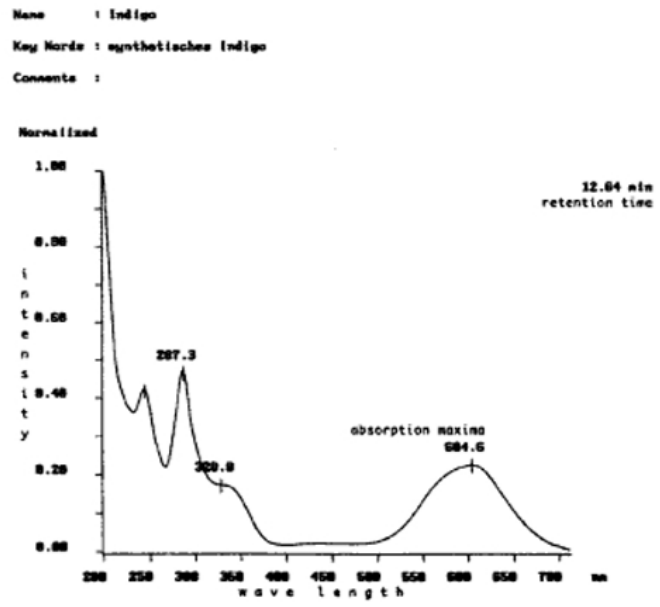

Figure 1(b): synthetic indigo (made available by A. Unger)

The advantage of this method is its high accuracy; the disadvantage is that the test sample is destroyed. Where it may be excusable to sacrifice a minute quantity of a tapestry or a piece of furniture, this avenue is closed where a musical instrument is concerned, particularly if it is still intact, although the method might still be valuable for other evaluations.

The Rathgen Laboratories suggested and organized another method based on measuring spectral-analytical refraction, which does not require the destruction of the sample, known as VIS (= visible) spectroscopy.[12] This had been used before, mainly for prints and book illustrations; using it to identify colouring agents in furniture is a very novel idea, and there is only one scientist at present studying its practicability thoroughly - Heinrich Piening of the Bayerische Schlösserverwaltung München. It works like this: 'The surface under investigation is lit with a fibre-optic source, and the reflected rays are detected in a diode array spectrometer according to their wave lengths.[13] The spectrum is displayed on a screen and can be compared for identification to pre-recorded spectra of known reference samples. A range of different-sized probes can be used to investigate more inaccessible or very small points, lighting the object from an angle of about 45°. The spectral range reaches into the ultraviolet, although not quite as far as the HPLC method.

In November 1998, the Rathgen Research Laboratories and Heinrich Piening, together with Messrs. J & M, Aalen/Germany and the Berlin Museum of Musical Instruments carried out a test series on three stringed instruments: a treble and a tenor violin by Joseph Meyer and a violin ascribed to J.B. Vuillaume.[14] There is practically no varnish at all on the treble violin (and perhaps never was), but the tenor violin, presumably one of the earliest instruments by Joseph Meyer, was apparently revarnished an opaque brown at a later date, and this had to be considered in the measurements. The third instrument was one of those copies after 'Gaspard duffo prucard/in Milano. Anno. 1521', probably made for a collector and containing fragments of old marquetry as well as newly-inlaid ones. The sections made in the nineteenth century, which are of a clearly different quality from the old fragments, have some green elements.[15]

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[12] Heinrich Piening, 'VIS-Spectroskopie. Eine neue, zerstörungsfreie Untersuchung eingefärbter Intarsien-und Marketereie-Hölzer an zwei Roentgenmöbeln der Münchner Residenz', in: *Bayerischer Schlösser Erforschen und bewahren*, (ed. G. Hojer), München 1997, pp. 299-308.

[13] Heinrich Piening, VIS spectral analysis of coloured marquetries on various bowed instruments from the workshops of J. Meyer and Tieffenbrucker, report dated 23/3/1999.

[14] Kat.-Nr. 4519, Adelmann/Otterstedt: *Me 8* and Kat.-Nr. 5675, Adelmann/Otterstedt *Me 6;* Kat.-Nr. 5261.

[15] Another instrument attributed to Vuillaume (Kat.-Nr. 4090) also has a fragment of old marquetry on the back containing two pieces of a green colour. This instrument was not included in the project, but judging from appearances, these could certainly be *chlorociboria* too.

This was the first time these methods had ever been applied to musical instruments anywhere. Because of the novelty of the method any experiment is welcome which might be suitable to add to the reference data, as there is no data base readily available for the apparatus employed. To allow the resulting spectra to be compared and evaluated, the samples had to be related to a neutral reference spectrum, such as that of barium sulphate, which unlike, for example paper, is a white substance containing no optical whiteners. Then the spectrum of a sample of wood turned green from *clilorociboria* was introduced as a reference. Similarly, the reference spectra of other historically relevant pigments or colorants were introduced, viz. verdigris and indigo.

Figures 2.1 – 2.4. *VIS spectroscopy*:

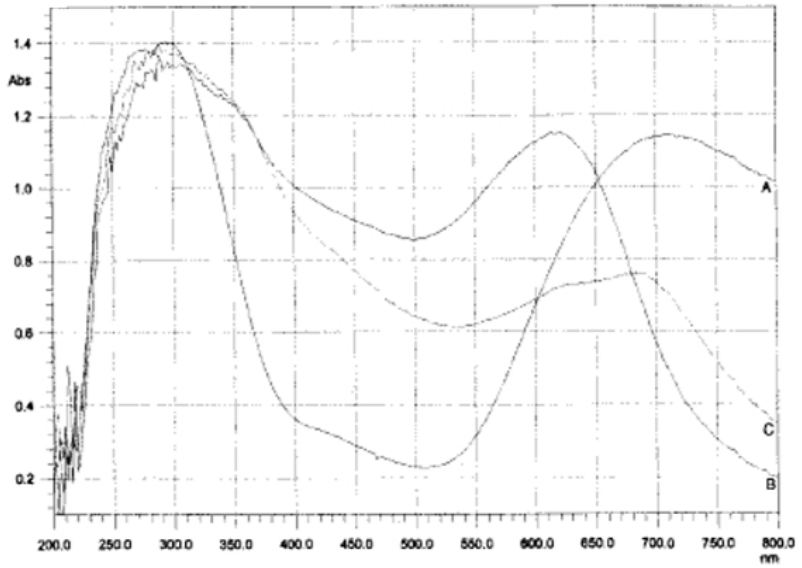

Figure 2.1: (A) *verdigris on bone,* (B) *indigo on wood,* (C) *poplar wood with chlorociboria.*

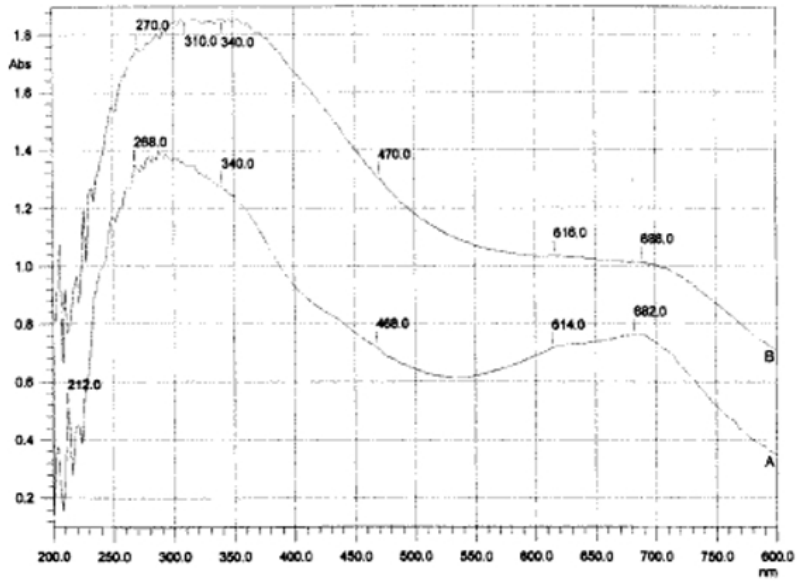

Figure 2.2: (A) *poplar wood with chlorociboria,* (B) *violin Joseph Meyer Me 8.*

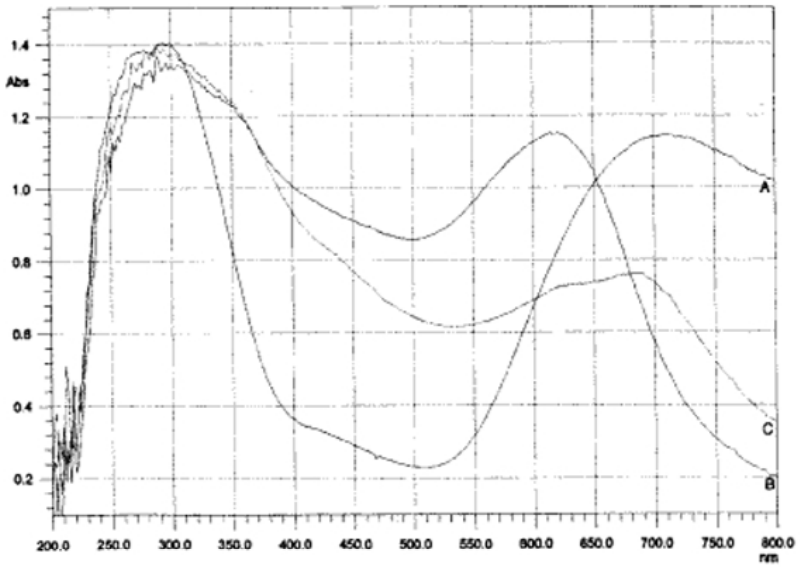

Figure 2.3: (A) *violin J. Meyer Me 8,* (B) *Tieffenbrucker copy with unidentified substance.*

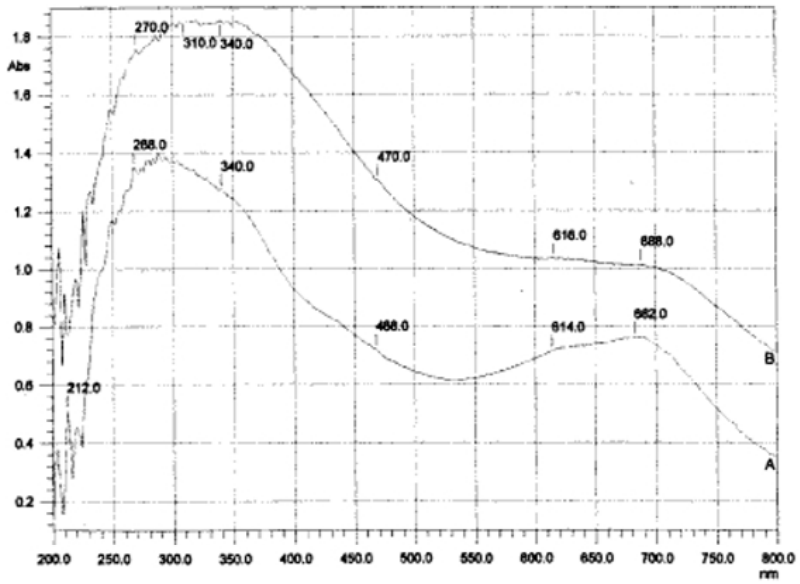

Figure 2.4: (A) *viola J. Meyer Me 6,* (B) *'Tieffenbrucker' copy with traces of red wood.*

The spectrum of the green inlays on the treble violin *Me 8* was a significantly better match with the *chlorociboria*-wood reference than with the verdigris and indigo reference graphs. The same is true for the tenor violin *Me 6,* which shows additional traces of red wood. This could be due to a varnish containing extracts of red wood.[16] The spectral result of the Vuillaume instrument was of a different nature, however, suggesting a synthetic blue colorant which, in the absence of a reference, could not yet be identified.

[16] applied during revarnishing at a later date.

Conclusions

These investigations have consequences in two different fields of equal importance.

1. Apparently it can be taken for a fact that Joseph Meyer - and most probably his apprentice Hans Krouchdaler - used wood coloured by *chlorociboria* for their green marquetry, a likelihood underlined by the presence of the technique in the region in question. It seems that the Alemannic masters totally dispensed with chemical stains and dyes and even preferred a naturally red wood for pieces of that colour. These included flower petals, which may very well be plum-wood, since this was widely used by the Alemannics for fingerboards, tailpieces, and for the pegs; with time this wood assumes just that shade of rich brown which can be observed both in the marquetry and the fittings. The inlay-techniques of the Alemannic violin makers show a close affinity with those of the regional furniture makers. Perhaps one might go so far as to hypothesize that the abstention from using chemicals even included the surface finishes, and that the same kinds of varnishes and grounds may be assumed for violins as for the contemporary articles of joinery of the region.

2. The two methods, HPLC and VIS spectral analysis, offer a great many possibilities for the future of establishing the colorants used on musical instruments. At present, HPLC is still superior in accuracy to VIS spectral analysis, for which a reliable data base of spectra has yet to be collected. But removing a sample, be it ever so tiny, from a musical instrument will remain a problematic issue, and it has to be decided on the merits of each particular case if a spectral analysis is the most one can obtain, or if a few micrograms of material should be sacrificed to get a clear picture of its composition.

Similar considerations must apply to questions of the varnish, among the most contentious and controversial in violin research. Although it is usually impossible to draw any conclusions about the age of an instrument from its varnish, ways of analyzing or deducing the composition of varnish would be most welcome, so enabling us to write a history of the development of varnishes on stringed instruments exceeding those attempts which have been made so far. HPLC is less useful for analyzing colourless varnishes. But other methods which are essentially similar offer themselves: the Fourier transformation infrared spectroscopy (FTIR), which actually necessitates taking a sample, so that the characteristic passage of infrared light through this can be measured, or gas chromatography (GC), which works in a manner comparable to HPLC. Instead of being dissolved in sulphuric or hydrochloric acid, the sample is vapourised and transported by gas. These methods are thus quite as efficient as dendrochronology: this can date the year after which a tree was felled from which the soundboard was made. It does not say when the work was carried out, but it gives us the eminently conclusive *terminus post quem*. Likewise with material and varnish analyses: we shall not be able to say whether the work is old or 'original', but knowing what materials were used may at least give us a fundamental clue.

A Renaissance instrument displaying marquetry coloured with aniline dye ought to make us as suspicious as a Neanderthaler wearing a Rolex watch.

Finally I wish to thank all those who participated and assisted in this project: to begin with, Herrn Tommy Schmitt/Hamburg, without whom we could not have made the experiments, the Rathgen Research Laboratories/Berlin, especially Dr Achim Unger, who gave the explanations comprehensively and intelligibly with infinite patience, Herrn Dipl.-Ing. Jens Dietrich who represented the firm of J&M Analytische Mess und Regeltechnik GmbH Aalen/Germany, Herrn Heinrich Piening of the Bayerische Schlösserverwaltung/München, who supplied both the measured graphs and permission to ransack his own working report, and Hans Reiners for translating this article.

Editor's Note

When this article was first submitted, the title was followed by the words 'The Leaves Be Greene'. I edited this out, saying to the author that I would only include it if a relevant reference could be found. I remarked that I could well expect correspondence from readers querying what other colour they might have been! The author replied – I quote 'yesterday I received your letter, and I hurry to reply. But dear Charles, how far has your splendid country gone that a Hun must give you lessons in good old English folk song? Let us sing 'Browning Madame'.

This was followed by a line of music to which the words 'The leaves be greene, the nuts be browne, they hang soe high thay will not come down.' had been set. The author went on to say that there is an alternative version on a tile *c.*1600 in Kensington Palace: 'The rose is red the leaves are grene / God save Elizabeth ovr Qvene' (cf. *The Byrd Edition,* Vol. 17: Consort Music, London, 1971, p. 155). Dr Otterstedt continued by quoting an even more apt version supplied by Hans Reiners, the translator of her article: 'The leaves be Green, the Flowers Red / on Back & Front, but not the Head'.