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Anna Cooper preparing mock-ups based on Bridget Riley's *Fall* and *Hesitate*

Photo Katey Twitchett-Young. © Tate

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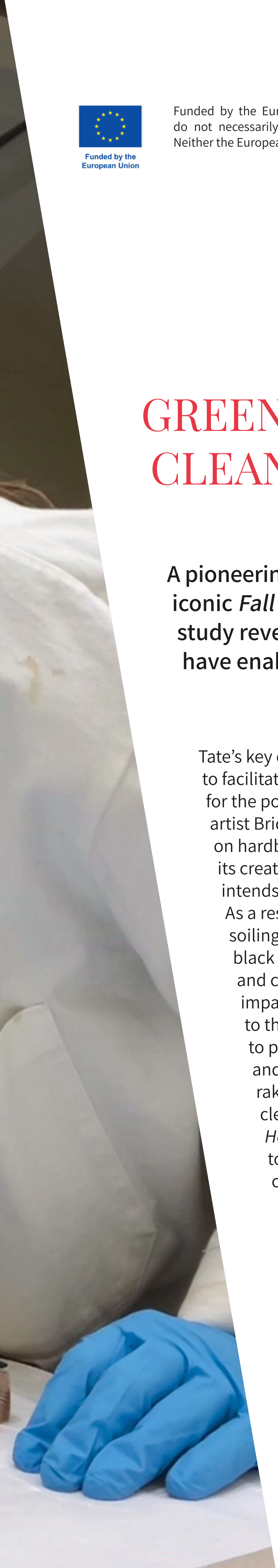


GREENART AT TATE: SURFACE CLEANING BRIDGET RILEY'S *FALL*

A pioneering conservation project at Tate preserves the visual impact of Bridget Riley's iconic *Fall* (1963) using innovative GREENART hydrogel cleaning systems. This case study reveals how scientific research, technical analysis and a rigorous approach have enabled the safe removal of decades of accumulated surface soiling.

Tate's key contribution to the GREENART project has been to facilitate a low-risk, appropriate conservation treatment for the popular mid-20th century painting *Fall* (1963) by British artist Bridget Riley. *Fall* is a polyvinyl acetate (PVAc) painting on hardboard and was purchased in 1963, shortly after its creation, and has been displayed regularly as the artist intends — unframed and unglazed — across the last 60 years. As a result, the painting surface had a light, but persistent soiling layer which dampened the contrast between the black and white painted lines, obscured painterly detail, and created an overall grey-yellow tone which somewhat impaired the powerful, visual effect of this work. In addition to the soiling layer, *Fall* was noted as being sensitive to pressure which manifested (though cumulative scuffs and marks) as gloss changes that were clearly visible in raking light. Thus, *Fall* had been earmarked for surface cleaning (soiling removal) for many years, alongside *Hesitate* (1964), also in Tate's collection, which together were proposed as challenging, important, case studies for the GREENART project.

Tate has been developing and refining a methodology designed to embed case study conservation treatments (where appropriate) into science-lead research. This featured in the NANORESTART project, and was employed once again for GREENART. Tate's project consisted of several investigative research streams which were naturally inter-dependent. These included: identifying case study artwork(s); exploring context through art historical and conservation documentation, as well as artists interviews, painting technical examination and analysis, the creation of mock-ups to understand the making of *Fall*, as well as creating substrates for cleaning treatment assessment and development, informing treatment risk through explorations into the constituents and properties of polyvinyl acetate paints, comparative cleaning system evaluation using GREENART and established cleaning systems, cleaning system optimisation for each case study painting, exploring cleaning system residues, the execution of conservation treatments (wet surface cleaning) and the evaluation of the painting surface pre- and post-treatment.

Several interviews with Bridget Riley are available at Tate (and elsewhere) and a range of art historical and conservation documentation informed the history and wider contexts of these two key works. The team also had the privilege of meeting the artist in early 2024 to discuss *Fall* and *Hesitate* which helped clarify the aims of the conservation treatment, explore their making and to understand which aspects of these paintings Riley views as fundamentally significant.

— Bronwyn Ormsby

Photographic and microscopic examination as well as extensive scientific analysis (of both works) confirmed that the paints are based on a polyvinyl acetate (PVAc)-polymer medium, and that *Fall* has no traditional size or ground layer. Interviews revealed that house paints were deliberately used and that the white paint was by Della Robbia and the black paint was by Ripolin. *Fall*'s hardboard panel was prepared with the white Della Robbia paint in several layers (the initial layers were diluted with water) to achieve opacity, then sanded to a smooth finish. In person, Riley described the consistency of the white paint as being like "single cream".

This combined information enabled the Tate team to prepare mock-ups for *Fall* and *Hesitate* using contemporary materials. Mock-ups serve several functions within conservation treatment research, such as enhancing our understanding of the materials used by the artist and the making processes involved, providing similar surfaces for evaluating and fine-tuning cleaning systems, and facilitating knowledge and skill acquisition around the novel GREENART materials. In this case, contemporary Lefranc Bourgeois paints were used with similar, though not identical compositions and aesthetic qualities, as were similar hardboard supports. The mock-ups were then light aged for the equivalent of about 30 years display in a museum environment (which about equals the cumulative display of *Fall* since its acquisition in 1963), followed by artificial soil application and ageing again for a short period to approximate the level of soiling imbibement noted on the paintings.

In parallel, we carried out a range of activities to identify any risks associated with the conservation of PVAc painted works of art, including a literature review of current knowledge on the analysis and properties of polyvinyl acetate paints, fine-tuning a pyrolysis gas chromatography-mass spectrometry analytical method to optimise the detection of PVAc paint additives, as well as paint extraction and swelling studies using aqueous systems and solvents commonly employed for modern painted surfaces. These studies informed the types of polymer and additives present in the paints, the likely materials at risk from solvent extraction within these paints, formulation changes over the years and new information about the effects of aqueous pH and conductivity on the swelling potential of PVAc paints.

The next stage was to use the carefully constructed mock-ups to evaluate and ultimately design a surface cleaning system for *Fall*, which would; remove the imbibed soiling layer evenly, not disturb the pencil lines and artist adjustments, and would not cause any swelling, blanching or other unwanted changes to the painting surface. Thus, we began an extensive comparative cleaning study after carrying out discreet aqueous and solvent tests on the painting surface, which confirmed that an aqueous system was required for optimal soiling removal. We began by using swabbed free liquids on the aged and soiled mock-ups, exploring the effects of aqueous pH and conductivity on the cleaning and paint response, followed by the gradual introduction of chelating agents and non-ionic surfactants at relatively low concentrations to enhance cleaning power. Empirical observations were made of each test and recorded using Excel spreadsheets and radar charts (also known as star diagrams), augmented using microscopic examination and photography. In this phase, it was quickly established that the action of swabs on the mock-up paint surfaces resulted in unacceptable pigment pickup and gloss changes and that any aqueous system was likely to require additional agents to enhance cleaning power.

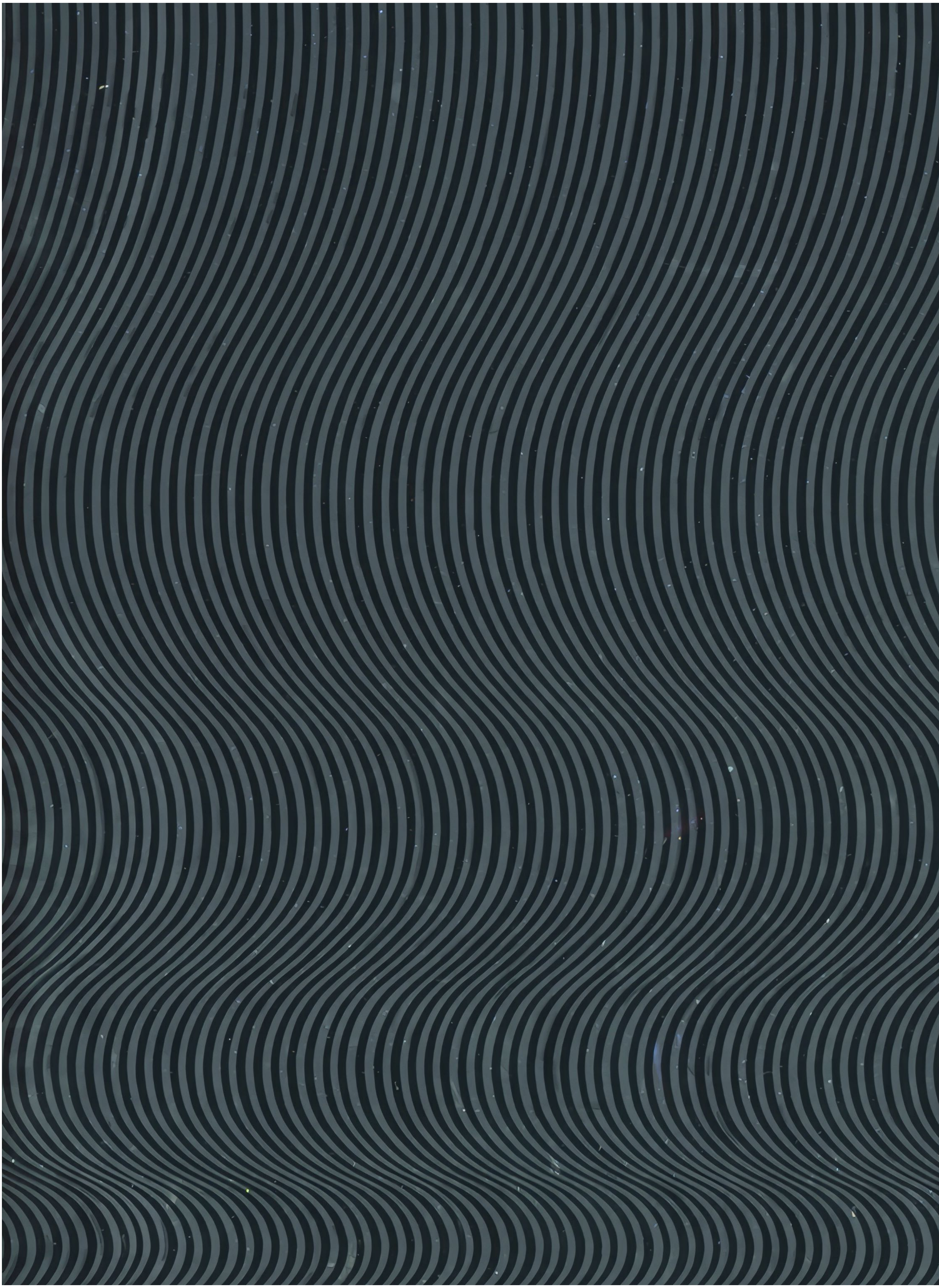
Based on previous experience and knowledge of the painting condition we expected that "gels" would pose less risk to Fall, hence we embraced a range of "contained" systems where the solvent is thickened/held in a polymeric material (thickeners, tissues, hydrogels, emulsifiers) which offer more controlled release of the aqueous liquid onto the paint surface. Many of these (e.g. xanthan gum) required mechanical action during application, removal and clearance, which once again unfortunately caused unacceptable change to the mock-up paint surfaces. Finally, we moved onto more rigid hydrogel systems such as agarose, gellan, as well as the semi-rigid hydrogels Peggy 5 and Peggy 6 from the Nanorestore Gel group, all of which offer the possibility of reduced mechanical action, as well as the new group of GREENART hydrogels: PVA-SA, PVA-SU, PVA-AD, Peggy Plus 3 and a few more!

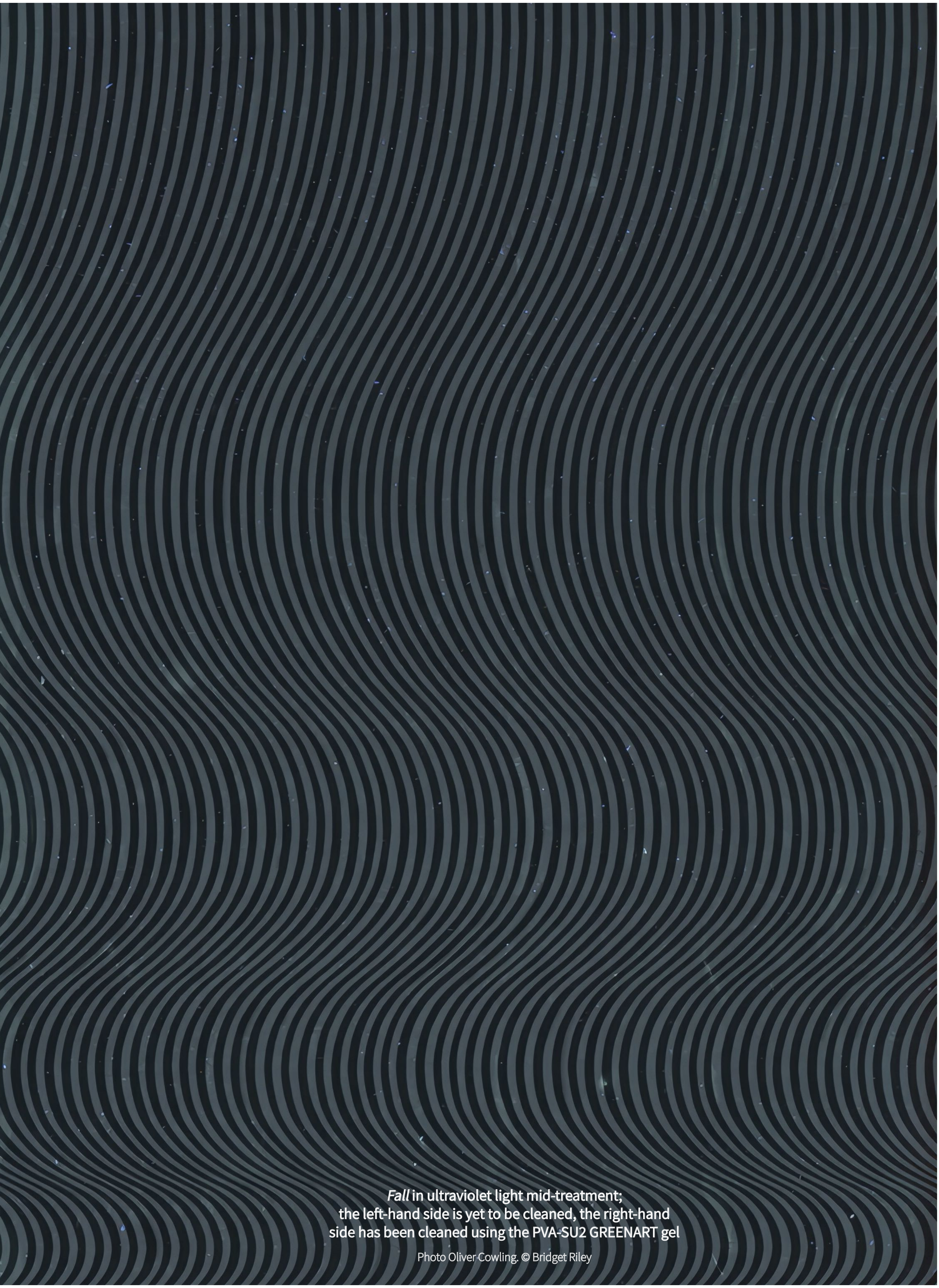
There were several iterative phases during this final comparative stage where the hydrogels were optimised and some were then ruled out due to inefficient soiling removal/uneven cleaning, etc. Towards the end of this phase, the polyvinyl alcohol-based Peggy 6 and the two GREENART gels PVA-SA and PVA-AD (also polyvinyl alcohol based, modified with diacid chains) were proving the most promising of the more rigid hydrogel group (offering an even and efficient cleaning action) with the additions of low concentrations of triammonium citrate chelator and/or non-ionic surfactant ECOSURF-EH6.

The optimal GREENART gel systems were then taken to the painting surface to assess their cleaning action and other effects. These options were augmented with two additional versions of PVA-SU (PVA-SU2) and PVA-SA (PVA-SA2) provided by CSGI which were also put through their paces on the mock-ups and in discreet tests on the painting. The chosen optimised system — PVA-SU2 (polyvinyl alcohol decorated with succinic acid) with

Tate Modern

Photo Kevin Mueller





Fall in ultraviolet light mid-treatment;
the left-hand side is yet to be cleaned, the right-hand
side has been cleaned using the PVA-SU2 GREENART gel

Photo Oliver Cowling. © Bridget Riley

added triammonium citrate and ECOSURF-EH6 — was then evaluated on the painting to determine the final application time of 2 minutes to achieve an even, efficient removal of the soiling layer. The final steps involved exploring how the gels could be optimally applied to avoid over- or under-cleaned areas which, in this case, involved making a cleaning window with Mylar polyester film which was designed sympathetically with the painting composition in mind, then carefully and systematically moved across the painting as the cleaning treatment proceeded.

After many months of examination, analysis, evaluations and treatment design, the treatment of *Fall* was completed in around 12 days. It was important to have the gel preparation and blotting station set up, and to have two people moving the Mylar template and applying the gels across the painting surface according to strict timings. Consistency and planning was key to the success of the treatment, which is evident in the evenness of the cleaning result seen in ultraviolet light. For this treatment, the GREENART gel PVA-SU2 offered the most efficient, even cleaning action, where the gel conformed well to the (in this case relatively flat) painting surface, the soiling layer was efficiently absorbed into the gel and the cleaning and clearance steps did not require problematic mechanical action.

Post-treatment evaluations documented changes such as a reduction in the yellow tone and a slight overall increase in gloss which results from the removal of the light scattering, yellowed soil and thus far, though some studies are ongoing, no residues of the cleaning systems have been detected. This highly successful treatment has resulted in visibly enhanced contrast between the black and white lines, the removal of the overall yellow-grey tone, reduced the risk of the accumulated soiling becoming more permanently imbibed, and has hopefully contributed to the recovery of the intended visual energy of this impactful painting.

A GREENART hydrogel test piece placed on a black painting mock-up

Photo Annette King. © Tate

28.6	29.5	29.6	30.5
28.4	29.3	29.4	30.3
28.2	29.1		