A RESTORATION
AUREL STEIN was above all concerned that his Central Asian finds should be examined by the best linguistic specialists to discover the content, and his somewhat careless attitude to conservation was characteristic of his time. In his day, the postal services were frequent and reliable and he often posted unique manuscripts to scholars all over Europe so that they could study them at their leisure. Rudolf Hoernle in Oxford received a packet of paper fragments in 1907 which had been sent by George Macartney, British Consul in Kashgar, to J.P. Vogel of the Office of the Director General of Archaeology in Simla, who then posted them to Hoernle, and Stein authorised the dispatch of some 200 Dunhuang manuscripts to Paul Pelliot in Paris in 1911 in unlined cases, courtesy of Thomas Cook and Sons.

Posting unique manuscripts would be unthinkable today, and their condition and conservation are of prime importance to museums and libraries. The history of the conservation of the Diamond Sutra illustrates the changing attitudes to the care of manuscripts in the British Museum and British Library during the 100 years since the Diamond Sutra arrived in London in 1909. Looking at early photographs, it is clear that the sutra had already been damaged over a thousand years ago and repaired with patches on the back before it was deposited in Cave 17. The earliest surviving photograph is that included in Stein’s Rains of Desert Cathay in 1912 (fig. 1). Plate 191 shows the frontispiece with a severe water stain running along the entire sheet, and the rolled-up portion of the sutra shown on the left clearly reveals two major patches. In the photograph Stein included in Serindia (1921), which was prepared over a decade (with interruptions to its production partly due to the First World War), both the water stain and the patches are less prominent. There are, unfortunately, no records of the treatment of the Diamond Sutra from 1909 to the 1960s, so following the process is only possible by looking at old photographs, examining the sutra itself and considering events.

It is likely that some conservation work was undertaken to prepare the Diamond Sutra for its first display in the exhibition of Stein’s finds held in the British Museum in 1914. Removal of the patches on the back would have been carried out with the intention of protecting the sutra from further damage and, perhaps, making it lie flatter. Such early patches were applied to areas of damage, most characteristically along the centre of the scroll. Chinese scrolls were rolled up and closed for storage by having a narrow silk tie (attached to the thin stove at the right-hand end of the scroll) wrapped tightly around them. It is very common to find damage along the centre of a scroll caused by rubbing or excessive tightening of the tie. Patches applied to manuscripts and documents during the Tang period were often not very suitable: the paper was often of a different type to that of the original, often heavier and coarser, and the liberal application of paste, or worse, glue, could cause further damage to the fragile scroll. Today, we try to maintain the

Fig. 1. The photograph of 1912 shows items as they were when they first arrived in England, probably selected by Paul Pelliot who, as a Sinologist, was better equipped to judge the collection than Stein. At the bottom is the Diamond Sutra, showing a scribe running across the frontispiece, close evidence of early patches on the left-hand side, as well as the original wooden roller to place on the left. Above is one of the many printed prayer sheets found at Dunhuang, all later than the Diamond Sutra, probably locally produced in the tenth century but attractive to Siste’s European audience because of their illustrations. At the top, less glorious in black and white, is the wonderful yellow-dyed, blue-still tinted copy of the Gem Hoop-sutra.
appearance of a scroll as we find it and, as far as possible, retain old patches as part of the history of the scroll, but in the past it is probable that 'inappropriate' early repairs were removed because they were seen as damaging.

The photograph of the scroll reproduced in Sermiä shows a less prominent water stain. It is likely that some effort was made to remove it, probably by washing, immersing the scroll in hot water or, more seriously, by bleaching. Both treatments would have had a bad effect on the yellow dye that was so commonly found in the paper used for Buddhist texts, whether manuscript or printed, in China. The dye, made from the bark of the Amur cork tree, imparts a yellow tinge to the paper, a colour associated with Buddhism and seen in the saffron robes of many monks, but it is also a powerful insecticide which protected precious documents from becoming worm-eaten. Though the colour can be quite strong, the dye is easily soluble in water and it is likely that washing or bleaching the frontispiece of the Diamond Sutra may have removed much of the original colour.

We do not know when the photographs reproduced in Sermiä was taken, certainly before 1921, perhaps as early as 1914, but, though it shows traces of the old patches, it also shows that the Diamond Sutra was still united. The question of lining has been a difficult one to resolve. All the manuscripts and printed documents found in Cave 17 were unlined, for they were 'books' and documents, not traditionally lined. However, once such ancient documents were removed from their context, regarded as precious ancient relics rather than working texts, it was common, particularly in Japan, to mount them, backing them and enclosing them in a frame of fine silk, as if they were paintings. Paintings in the Far East were always mounted and framed in silk and the same treatment was applied, by extension, to significant texts, as can be seen in the sets of the empress Shôtoku's charms acquired in Japan. Even as late as the mid-1970s, when curators and conservators in the British Library had reached the conclusion that wherever possible, non-intervention was the best method of conserving the Dunhuang documents, Japanese delegations in particular criticised their conservation condition, feeling that they should be respectfully mounted. The conclusions of the British Library's conservators and curators today remain the same: the Dunhuang collection should be treated as a collection of documents, not paintings, and preserved, as far as possible, in their original form and format.

It appears, however, that in the early decades of the twentieth century a decision was made at the British Museum to back the Diamond Sutra. This may have been because of the apparent fragility of the scroll, a fragility that probably seemed more serious when the early repairs were removed, for removal seems to have trimmed the back of the paper, making it even thinner. The treatment of the water stain may also have affected the paper.

Most of the conservation of the Dunhuang documents, which consisted of backing fragile scrolls with sturdy manila paper or pasting fragments onto dark brown sugar paper, was carried out in the British Museum bindery where the conservators were much more familiar with European papers and European book formats. It seems likely, however, that the Diamond Sutra, singled out for its fine frontispiece and therefore associated with 'art' rather than pure text, may have been treated slightly differently. It seems that sometime after the Sermiä photograph was taken, the scroll was given its first backing of fine Japanese paper.

The backing appears to have been quite sensitively applied and the paper chosen with some care. It is likely that this backing may have been applied by a Japanese scroll mounter who worked in the British Museum under Laurence Binyon, Binyon (1869–1943), the poet best known for his First World War lines 'They shall grow not old as we that are left grow old. / Age shall not weary them nor the years condemn, / At the going down of the sun and in the morning,/ We shall remember them', worked as an Assistant Keeper in the British Museum's Department of Prints and Drawings, where the Sub-Department of Oriental Prints and Drawings was created in 1909, the year that Stein's finds from his second expedition arrived in London. Though he wrote on Chinese art as well, much of Binyon's training in the subject was through Japan, through Japanese friends and advisors, through the Japanese art magazine Kokka and through the collections of Far Eastern paintings, mostly amassed in Japan, that were beginning to be acquired by the British Museum. Thus it was logical that he should have employed a Japanese scroll mounter and probable that he, Binyon, was responsible for overseeing the first backing.¹

The Diamond Sutra, together with all the other Dunhuang documents from Stein's second (and the third expedition of 1913–16) was handed over to the British Museum in 1919. Lionel Giles (1875–1958) was placed in charge of the collection and he 'was able to begin sorting, examining and cataloguing them one by one. It was no light task, even in a physical sense, for the total length of the sheets which had to be constantly unrolled and rolled up again must have amounted to something between ten and twenty miles.'² Giles's description of constant rolling and unrolling illustrates one of the great problems of conservation for any backing, however skilfully applied, is liable to create unevenness and sometimes cracking, particularly in a scroll that must be unrolled and rolled for inspection and storage. Though Giles himself admits to constant rolling and unrolling, he does not seem to have welcomed visitors, and two distinguished specialists from the National Library of China, Wang Chongmin and Xiang Da, who spent 1936–7 in London, were particularly bitter about Giles's treatment. In a whole year, he only allowed Xiang Da to see 496 scrolls (out of a possible 6800), thus avoiding considerable rolling and unrolling.³
During the Second World War, the Diamond Sutra was moved to the National Library of Wales at Aberystwyth for safe-keeping (fig. 2). It is difficult to tell exactly when it was moved there. The first evacuation of 171 cases (containing 6000 books and manuscripts) from the British Museum's Department of Oriental Printed Books and Manuscripts was on 24 August 1939, and another mass evacuation of 'all remaining Oriental manuscripts', numbering 20,000, took place after dozens of incendiary bombs fell on the British Museum in May 1941. The Diamond Sutra was almost certainly in the first load, for when Lionel Giles spoke to the China Society in London in October 1941, giving 'a short history of the Stein collection of Chinese manuscripts in the British Museum', he mentioned that his catalogue, although not yet printed, 'had been completed some years ago, just before the manuscripts were removed from the Museum for safety'.

Though the war made it impossible for conservation work to be carried out on the manuscripts packed away for storage in Wales, it is clear that, wartime excepted, over the decades between 1920 and 1960, more and more bookings were applied to the Diamond Sutra, always with the intention of smoothing out creases and cracks but, almost inevitably, worsening its condition. The story of the restoration of the Diamond Sutra is told by the conservator.

FOLLOWING THE FOUNDATION of the British Library (from the British Museum Library) in 1972, and the creation of the Oriental Manuscripts and Printed Books department (OMPB), a new conservation studio was established with the aim of developing specialisms and expertise in core Asian collections. One area that was singled out for conservation work was the Stein collection.

As mentioned earlier, many Chinese scrolls within the collection had, in the previous 60 years, been subject to Western methods of, and materials for, repair, stemming from the long-established bookbinding tradition of the British Museum bindery. Whilst Western-style books were successfully conserved in this way, 'books' in other formats fared less well as there were inevitable compromises. This was now the time to reappraise the approach to the conservation of Asian objects, learning traditional techniques from the East and acquiring, if possible, more compatible repair materials from eastern sources.

In 1974, 1975 and 1979 three study tours to China were undertaken: the first by Peter Lawson, head of the new conservation studio, who went together with other representatives from the British Museum and the V&A as part of a cultural visit; the second by Howard Nelson, Assistant Keeper of the Chinese collections, who was specifically concerned to observe
Chinese scroll conservation methods and storage options; and the final tour was again made by Peter Lawson who also purchased materials for the studio in London.

It was fortunate that extra funds for two additional conservators were soon found, thus enabling the studio to expand and allowing the newly enlarged team to put into practice what had been learnt in China. Initially, these new techniques and materials were applied to the Stein paper fragments, groups of ten fragments being mounted on paper so as to form a continuous scroll (fig. 3, previous page). The focus was then on the Diamond Sutra, whose existing lining was now showing characteristic vertical creasing, forming ridges with a likelihood of imminent splitting (fig. 4). The team had a solution: to undertake strip repairs on the verso of the creases and adding a lining, using Chinese paper (fig. 6, overleaf).

It is easy to understand the logic of this approach to the Diamond Sutra, which followed the long-established and highly skilled East Asian scroll mounting tradition that used a variety of hand-made paper and other materials developed specifically for scroll conservation. Tempting though this method might have seemed, Stein hand scrolls, now accepted in the West as ‘documents’ to be read and studied rather than as objects to be displayed, needed to function differently from traditionally mounted scrolls which may be hung and viewed. It soon became apparent that the new lining to the Diamond Sutra, rather than providing stability, caused more problems especially during the rolling and unrolling operation, creating new fractures. Clearly, this was not the answer to the long-term preservation of the sutra or indeed other Dunhuang scrolls (fig. 5).

Through the 1980s, conservators, with the full support of curatorial colleagues, developed a method of minimum intervention similar to restoration principles used in the (western) Prints and Drawings department, adding only what was required to a missing or fragile area, not necessarily filling all gaps if they were stable or aesthetically acceptable, and using the very best Japanese and Chinese papers, equipment and techniques.

Whilst this hybrid approach of western principles and eastern materials and techniques is well suited to scrolls in their original condition, it was not necessarily appropriate for the hundreds of scrolls that had been lined from the 1920s onwards, the Diamond Sutra being the prime example.

In 1987, a decision was made to set up a long-term project with two broad aims. The first was to understand the nature and the reason for the fading of the horizontal stain across the frontispiece and the background dye; this would include looking into the pH (to check the acidity of the paper – level of acidity being one of the key indicators of paper degradation), the fibre composition of the scroll and other tests using made-up samples. The second was to restore the...
Fig. 4a. In the photograph of the Diamond Sutra in Sertidra (1523) the stain on the frontispiece is less prominent than in Rains of Desert Cathy (1522) Fig. The wooden roller seems to have been removed and the patches on the verso of the scroll are nearer, suggesting that some conservation work had been carried out although the scroll, at this time, was still not lined.

Fig. 4b. This image was taken in 1976. It shows the new white Chinese paper lining, but also the 1950s manuscripts. The seemingly flat and stable appearance of the sutra masked the inherent tension within the scroll.
Diamond Sutra to as close as possible to its 'original' condition. The conservation would consist of 'peeling away' up to five paper linings, the removal of the glue and paste residues that had built up over the course of the relineings — this was the most problematic task — and, most importantly, the realignment of the frontispiece.

In 199, links were established with Kenneth Seddon, Professor of Inorganic Chemistry at Sussex University, latterly at Queen's, Belfast, to explore the chemical constituents of berberine, the yellow dye used on Dunhuang scrolls and possibly to develop a solvent that would allow the removal of the adhesive without dissolving the dye.

In parallel with this research, a trial was undertaken in-house to find a way to remove the linings and adhesives using various methods, from ultrasonic moisture to super-heated steam. Lessons learnt from this joint research enabled the team carefully to remove the linings and the adhesive residues from two similar printed scrolls (fig.7), thus paving the way to commence work on the Diamond Sutra in 2003.

The first phase was to remove the old edge repairs that had been carried out around 1950: overly strong, unattractively coloured manila paper on the top and bottom margins, and light, thinner Chinese paper on the side edges (fig.8). Removal of these was difficult as sutra paper was dyed with berberine which was very light-sensitive and water-soluble. Using a controlled application of water and alcohol mix directly on to the border, it was possible to release the margins slowly (fig.9). A total of 11 metres worth of border paper was removed in this manner. During this time — a period of six months — exploratory tests were carried out on the linings: when the single lining of one of the panels was removed a multitude of previously hidden vertical creases were exposed (fig.10).

Additionally, a number of non-destructive analytical tests were undertaken such as measurements of paper thickness, surface pH spot-testing of panels, observation of fibre distribution within panel sheets and examination of adhesives under a polarising microscope. One of the test results revealed that the frontispiece had, surprisingly, five linings, explaining the reason for its rigidity (fig.11).

Fig.7 The combination of two contrasting paper types with different texture and tones was aesthetically unsatisfactory and disturbed the visual presentation of the sutra. In addition, the differing expansion and contraction rate of the manila border exacerbated the distortion of the scroll.

Fig.8 The creasing of the scroll, as shown here in a photograph taken under raking light, originally occurred when the sutra was repaired in antiquity (pre-twelfth century). The application of thick glue and heavy paper patches caused the paper to contract.

Fig.9 The paper was first carefully thinned to allow the moisture to penetrate the outer layer and then the adhesive so the paper could be released and then the adhesive residue removed.

Fig.10 A 3cm² area of the sutra was carefully restraightened and layered were lifted and repaired. This opening up enabled the testing of adhesives, paper types and paper quality. It was also the first opportunity to investigate the paper of the frontispiece.
The success of the first phase enabled a structured repair programme to be formulated between the Head of the Chinese Section and the Head of Paper Conservation at the Library. A decision was made to fully remove all linings from the scroll and separate the scroll into its component panels. The latter operation was necessary primarily because the scroll was found to have been separated previously and rejoined inaccurately.

In June 2006, the second phase began with the removal of the linings using controlled ultrasonic vapour via a tube to create a microclimate of 85 per cent humidity which released the adhesive bond from the lining paper (figs 12 and 13). A fibre-optic light, a cold light source, was placed underneath the object to highlight areas of damage (fig. 14). The removal of adhesive residues and linings was vital to the conservation of the sutra because they, together with repair

Fig. 12 The most complex and challenging area of lining removal was the separation of the multiple sheets on the verso of the frontispiece. This image shows the painstaking removal of the outermost lining (1870s Chinese paper). Enough moisture had to be applied to soften the adhesive but not to saturate the sutra paper.

Fig. 15 (above) Following the removal of all the linings, numerous patches of paper of varying quality were exposed. Applied over areas of damage, these crude repairs contributed to the uneven thickness and distortion of the scroll. Removal followed the same approach as that developed for the lining removal, but with the added difficulty of the weak and damaged scroll paper clinging to the old repairs.

Fig. 16 Scroll panel backlit within its controlled environment.