

CONSERVATION AND RECONSTRUCTION

In the excavation, the papyri found near each other were lifted together as whole batches which were each given a field number (Figs. 1–2).¹ The batches were wrapped in aluminum foil to consolidate them as found and to protect the papyri during transportation. The batches were packed into cardboard boxes and transported slowly by car from Petra to Amman. In Amman, the papyri were stored in the conservation laboratory of the American Center of Oriental Research (ACOR) to await study.

In December 1993, Ludwig Koenen conducted a preliminary evaluation of the papyri and their contents. In February and March 1994, Jaakko Frösén further evaluated the state of preservation of the papyri. For this purpose, he conserved a handful of papyri. His primary concern was, however, to remove the batches from the aluminum foil in order to prevent any harmful chemical reactions caused by the foil. The batches were then wrapped in acid-free tissue paper. The conservation team began large-scale conservation in August 1994; this was completed in May 1995. The papyri are currently stored at ACOR where they are available for study. Eventually they will be transferred to a local museum.



Figure 1. Field conservators preparing to lift a batch of rolls



Figure 2. A batch of roll pieces placed into a box

Physical Description of the Papyri (Figs. 1–7). Each batch consisted of a more or less chaotic pile of a varying number of severely fragmented papyrus rolls covered with a detritus of sand, mortar, charcoal, ashes and minuscule floating papyrus fragments; there were even minor artifacts other than papyrus (see pp. 5–8). The fire which had caused the carbonization had particularly damaged the outer faces of the rolls. In addition, further damage was caused by the crushing weight of the collapsed structures. Practically all the papyri were fractured irregularly into pieces, and most of the papyri had sections chopped into piles of tiny bits. The inevitable minor dislocation of the pieces from their original position created difficulties, particularly for the later reconstruction. The dislocation must have taken place on site, possibly in antiquity after the fire as well as in modern times, particularly during the transportation of the papyri.

Due to the overlying rubble, many of the rolls had lost their original round shape, especially if they had been loosely rolled in antiquity and possibly packed tightly with others into a container. Such roll pieces were flattened into stacks of layers as the original continuous folds had been broken along the sides of the roll. Especially the outer folds of the rolls were sometimes

1. For the field numbers, see p. 6, *supra*, Figs. 2 and 4.



Figure 3. A batch of roll pieces before conservation

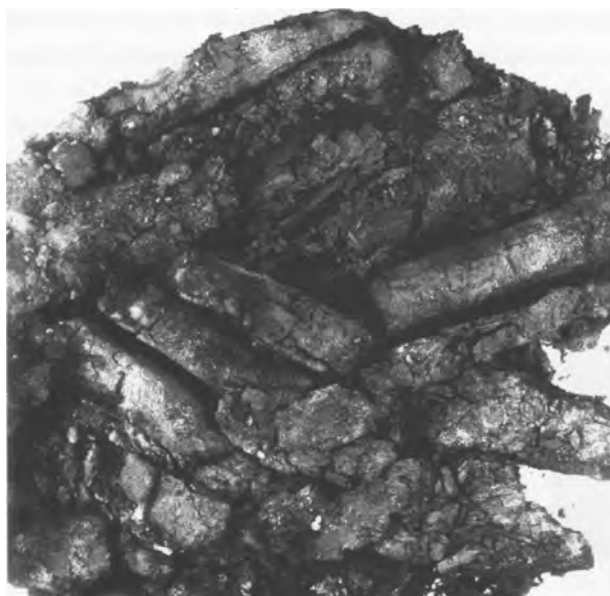


Figure 4. Roll pieces before conservation

pressed into various wrinkled forms.

The rolls that had been tightly rolled in antiquity had sometimes preserved their original round shape but due to the fire had become extremely compact and thus resembled cigars. The damage varied in these rolls, depending on the intensity of the burning process. In some cases, the core was well preserved even if the surface was beyond rescue whereas sometimes the core of the roll was thoroughly burnt underneath a well preserved surface.

Some of these cores were left unopened to await improved future conservation methods.

Damage was also caused by the vegetation that grew at the site throughout the centuries. Quite a number of the papyrus pieces contained remnants of tree roots² that had made their way through the papyrus layers; these further fractured the pieces. Humidity and decomposition also had an impact, particularly on the lower parts of those pieces that had lain against the floor. These parts had often been transformed into a brownish powdery pulp on which traces of ink were no longer visible.

*Conservation.*³ (Fig. 8) The purpose of the conservation was twofold: to prevent further decomposition of the papyri and to retrieve the documents for study. The latter meant that the originally three-dimensional object had to be converted into a two-dimensional text.

Actual unrolling was impossible due to the brittle and fractured state of the papyri, hence each roll piece had to be unfolded layer by layer and fragment by fragment.

The conservation of each batch (i.e., field number) began by drawing a superficial sketch to display the position and stratigraphy of the roll pieces within the batch. Then detritus was removed from the surface. After an examination of each roll piece within the batch, the conservator chose the working order for opening the pieces. Stratigraphical order was preferred whenever possible to avoid unnecessary further dislocation of the adjacent and underlying roll pieces. In an ideal case, the conservator could start the opening of each piece from its top layers proceeding towards the bottom layers. However, this approach was rarely possible and would have resulted in further damage to the surface. In most cases, the piece was halved horizontally along the existing fractures in order to work with its better preserved inner layers. The conservator would open each half working

2. According to the analysis by Harri Nyberg, the trees were a species of *Populus*.

3. The conservation methods were the same as described in Kampichler, *Konservierung*. A short description of the conservation of the Petra papyri can be found in Lehtinen, *Conservation*. The method uses no chemicals or enzymes.



Figure 5. Section of a loosely rolled papyrus



Figure 6. Tightly rolled papyrus



Figure 7. Section of a tightly rolled papyrus

from the inner layers towards the top layers. In this way the text was visible to the conservator and helped in distinguishing the extremely thin layer levels. The halving process was repeated whenever the layer stacks were too tightly stuck together.

It was rarely possible to retrieve complete layers, but instead the conservator would detach a layer fragment by fragment. These were then rejoined as kinds of assemblies. Inevitably, some fragments were lost in the process. Sometimes two or more layers remained undetached when they were too tightly pasted together and the danger of losing them altogether was considered too risky.

The detached fragments were fixed with adhesive⁴ to acid-free Japanese paper on their blank sides. When the fragments had dried under light pressure, codes were written on the Japanese paper for each layer or fragment. The coding was not unified, but each conservator chose a coding system that best suited the purpose. Some conservators preferred simply to label a piece with a letter and number the layer levels. Thus, consequent letters display the working order rather than the location of the piece in the batch. In some cases the conservator used a grid. The grid divided a roll (or a piece) into areas and the conservator labeled the fragments according to the area of the grid they came from. The areas were indicated by letters and the layer levels by numbers. Thus, ideally, each layer would consist of fragments covering the whole grid. In addition, each batch (field number) had a large proportion of so-called loose fragments. This label was given to dislocated small pieces or fragments found floating in the batch at various stages of the conservation process. If the hand was recognizable,

the conservator would indicate it on the label, e.g., loose fragments from roll (piece) A. If the piece had several layers, the layers were also numbered. If the original roll could not be identified at the time, the fragment was labeled, e.g., as a loose fragment from area A /Field No. I, etc.

Usually a preliminary reconstruction of the papyrus (i.e., a rough arranging of the fragments) was prepared by the conservator based on the fragment codes and the handwriting. After this preliminary reconstruction, the fragments were placed between the glass plates and photographed. However, the final reconstruction often considerably differed from this first sketch. The plates at the end of this volume in most cases reflect the latest rearrangement of the fragments.

The papyri were given inventory numbers after conservation. Theoretically, an inventory number would contain fragments belonging to one single roll, but in practice many of them have fragments belonging to several rolls.

4. The adhesive was neutral PlanatolB (or equivalent) diluted in water in the proportion 1:8.



Figure 8. Conservator collecting loose fragments from the remnants of a batch of roll pieces



Figure 9. Strings of layers fixed to Japanese paper awaiting preliminary reconstruction



Fig. 10. Excess Japanese paper being cut off before the fragments were joined

Immediately after conservation, the number of individual papyri was estimated to be 152, but since then the reconstruction efforts have decreased the number of the papyri as a number of roll pieces have been joined together, e.g., **8** consists of two roll pieces initially considered to be two different papyri. Thus, the true number of papyri is probably ca. 140.

The sizes of the papyri vary considerably. The majority of the papyri are rolls, some several meters long, consisting of hundreds, if not thousands, of fragments (e.g., **2** was ca. 8.5 meters). Some papyri are small sheets cut from a roll in antiquity (e.g., **6**). The texts were written either *transversa charta* or in wide columns across the length of the roll. Some of the papyri had been taken into secondary use, and had a text written on the reverse side (i.e., verso) of the papyrus as well. In this case, the fixing of the fragments with adhesive was naturally out of the question, and the fragments were placed between the glass plates immediately after they had been separated. Thus, the number of texts is somewhat higher than the number of rolls (see above), but no estimate can as yet be given.

Reconstruction. (Figs. 9–11) The goal of the reconstruction was to display the papyrus as it would have looked when unrolled in antiquity. This was a complicated task because a carbonized papyrus is physically quite unlike a normal, even damaged, papyrus roll. For example, as no single papyrus had been preserved unbroken, an individual line always had to be reconstructed from several adjoining fragments. As the layers were extremely thin, it was rarely clear from the start which of the apparently adjoining fragments belonged to the same layer. For example, a fragment, A1, containing, say, the beginnings of two lines, lines 1–2, almost never could be directly linked with the next two lines; fragment A2 immediately below A1 would contain lines 5–6 and the next fragment, A3, lines 9–10. The missing lines 3–4 and 7–8 would be found on the other side of the roll—if, indeed, they could be found at all. Very often they were simply missing.

The two halves of a roll thus formed two physically separate sequences of fragments. In an ideal case, the editor would have only these two sequences to work with, the “upper” and “lower” half of the roll. The only task was to determine their relative position, that is, to place fragment A25 containing lines 7–8 between fragments A2 (lines 5–6) and A3 (lines 9–10) from the other half of the roll. If the fragments were reasonably well preserved, this would pose few difficulties as the contents of the text would reveal the correct order, and one secure match would suffice to fix the whole sequence. Unfortunately, ideal cases were rare. More often the two halves consisted of several more or less adjoining sequences, depending on how fractured the roll was initially and how large the fragments the conservator was able to de-



Figure 11. An assembled plate; **10** at left; **7** and **9** right

result is that the final transcript does not always have the fragments in a logical numerical order. In the worst cases, these human mistakes have not been detected, or the correct order can no longer be reestablished.

The reconstruction, or jigsaw puzzle, began from the layers coming from the core of the roll. First it was necessary to determine which way the document had been rolled in antiquity. This required a superficial study of the text. If the core of the roll had signatures, it meant that the core contained the end of the document. However, a number of the papyri had the beginning of the document rolled inside (e.g., **1** and **2**). In that case, the core layers would contain the date written in the main hand. In case of texts written horizontally in a column, the conservator would look for either the left or the right margin of the text in the core of the roll.

Several factors added to the difficulty of the final reconstruction. In some cases, the papyri had been folded before rolling. These folds were already detected during the conservation when the surface with the text would alternate in an abnormal way. The folds could comprise various lengths of the papyrus. They naturally influenced the reconstruction of correct layer sequences, requiring complicated calculations and visualization of the original roll.

Due to the thinness of the layers, different fragment layers were sometimes impossible to separate from one another without considerable damage or even total destruction of the layers in question. Thus, some layers of the roll pieces were left unseparated (see, e.g., **2** comm. *passim*). In some cases, such layers were separated after the fragments had been fixed to the Japanese paper and after the text on the top layer had been carefully recorded and studied, since it usually meant the ultimate destruction of the top layer. Unseparated layers also affected the reconstruction of the layer sequence. It was often difficult, if not impossible, to estimate how many layers remained attached, and this uncertainty was reflected in the location of every fragment further down the same sequence. Conversely, if a layer had been altogether destroyed and this was unrecorded, the sequence would be correct but the numbering of the following fragments would be off by one. Speculation on this effect can be found in the commentaries of most documents, but the alternative solutions cannot be displayed in the transcripts.

tach from it. Then the editor not only had to couple the corresponding layers from the opposite sides of the roll (“layers” and “counterlayers”) but also had to decide which fragments from the one side of the roll belonged to the same layer. The fragments might be so small or otherwise so poorly preserved that it was difficult to connect them on the strength of contents alone. At this stage of the work, the sequences, of course, no longer existed as physical entities, but only as conservation codes attached to individual fragments. The code numbers themselves were not always reliable. A stack of indistinguishable layers might have been given a single layer number as the conservator had no way of establishing the exact number of layers. Sometimes the codes may have been written mistakenly, with a sequence of three layers numbered in the reverse order, for example, particularly if the conservator had halved the piece several times and been forced to work with multiple smaller stacks of the halved piece. The

So-called loose fragments were included in the later stages of the final reconstruction after the main fragments had been placed and the gaps in the papyrus were visible. Occasionally even the loose fragments could form sequences, if they came from a tiny stack of layers. In addition to the fragments belonging to the Inventory Number in question, all editors have also taken a look around at the roll fragments coming from adjacent Field Numbers. At least in one case (Inv. 10), fragments belonging to one single document have been found in three different original Field Numbers representing four different Inventory Numbers.

The final transcripts are based on reconstructions completed by each editor with the collaboration of the conservators. The long and painstaking process has required an understanding of both the physical structure of the roll, particularly the damage and losses affecting each roll piece, and of the text itself, its contents and wording. The text could not be established by one criterion only. Individual fragments were joined by comparing their contours and fibers, and by checking that the ink traces reaching out to adjacent fragments would indeed match. Ultimately, the reconstruction had to result in a sensible text. The large number of remaining unplaced fragments testifies to the rigor with which the editors have applied these criteria.

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