

TOWARDS A DIAGRAMMATIC REPRESENTATION OF NON ORIGINAL LAYERS ON PAINTED SURFACES

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Taller de pintura mural

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ABSTRACT: *Stratigraphic diagrams are very useful resources in documenting the cleaning process, as they allow the different strata removed and their relationships to be integrated into a single document. Although the drawing up of these diagrams is quite a complicated task, it can be simplified to a certain degree through the use of a computer application specifically designed for this purpose. One interesting possibility is Stratify, an application designed by Irmela Herzog that combines the use of professional tools with facility of use.*

KEYWORDS: stratigraphic diagram, stratigraphy, Stratify, cleaning, painting, strata, recording, documentation

1. INTRODUCTION

In recent years, an interesting line of research has been developing, the aim of which is to use, in the conservation of cultural assets, tools borrowed from archaeological stratigraphy (Vidale and Proenca de Almeida, 2001; Barros García, 2006b). More specifically, this methodology is being applied to the study and documentation of pictorial works, both in mural paintings (Prisco *et al.*, 2004; Barros García *et al.*, 2006) and in easel paintings (Watts *et al.*, 2002; Barros García, 2007). The ultimate aim is to gather information on the different strata that make up the work in a more precise and complete way. One of the tools that is being employed is the stratigraphic diagram, also called the *Matrix* or *Harris Matrix*, in honour of its creator, the archaeologist Edward C. Harris (1979).

The use of the stratigraphic diagram opens up new perspectives in the documentation of non-original strata superimposed on the original pictorial structure, and also in the documentation of the cleaning process (Barros García, 2004), although this is still not a widely used methodology. The reasons for this are as follows. Firstly, many conservators are still not familiar with this work method, as not many research papers have published on this issue, which is understandable if we bear in mind that it is still in the initial stages of development. Secondly, it is a form of documentation that requires an extra effort to be made by the conservator. Indeed, in some cases, the first reaction of many professionals on finding out about this documentation system is a mixture of interest and fear: Interest and curiosity about a way of working that involves tackling cleaning in a different way and, no doubt, fear about a new source of problems, challenges and obligations. If cleaning in itself is already difficult, documenting the strata removed using a stratigraphic diagram does not exactly facilitate the work, but quite the contrary. This type of reaction is not exclusive to conservators. Similar reactions were produced in the field of archaeology when *Matrix* was introduced in 1979 and, even today, many archaeologists regard the use of the stratified diagram more as a problem than a solution.

What has the conservator to gain by using a stratigraphic diagram aimed at documenting the cleaning process? This is the basic question. One has to be sincere: it is not a tool that makes the task any easier or that makes it more comfortable or quicker. If cleaning is regarded

from an exclusively aesthetic point of view, i.e. as the undertaking of a procedure aimed at recovering a subjective visual effect at any price, it is clear that any other consideration concerning conservation or the historic-documentary values that the non-original material deposited over the surface of the painting may have fades into insignificance. If cleaning is thought of as a simple face wash or surface embellishment, the aims of the intervention are distorted and any methodological development becomes impossible. Taking this approach a conservator is going to show little or no interest in documentation systems that would only delay the achievement of the previously set aim.

Employing a stratigraphic diagram obliges the conservator to undertake cleaning in a more methodical and thoughtful way, to pay more attention to details in the relationship between the different strata. It is inevitable that more detailed documentation will mean a slower work process. Precision and scientific rigour have their costs. All of this, therefore, will be regarded as something positive or negative, depending on one's point of view.

The importance of documentation in the cleaning process must not be overlooked. An undeniable fact is that this operation is a process of controlled destruction of one part (non-original) of the work. The act of destruction is an irreversible event, a lack of documentation on which meaning the loss of very valuable data on the history of the piece and on the cleaning process itself undertaken by the conservator. To paraphrase the title of one of Harris' texts (2006), we could be speaking about "cleaning and the ethics of scientific destruction".

A post-cleaning analysis of the data gathered enables us to reconstruct the material history of the work. Often, an object undergoes modifications according to changes experienced by people's religious beliefs or moral values, political changes or events which alter society. The deposits we find on many objects can tell us a lot about the ways of thinking and the assessments of people through history. As Watson (1994: 11) points out, the overpaints "testify to the irrepressible human urge to modify paintings and sculptures to suit current fashions or to suppress undesirable subject matter".

The different treatments undergone by works always leave marks on the surface, such as, for example, varnishes, overpaints, new

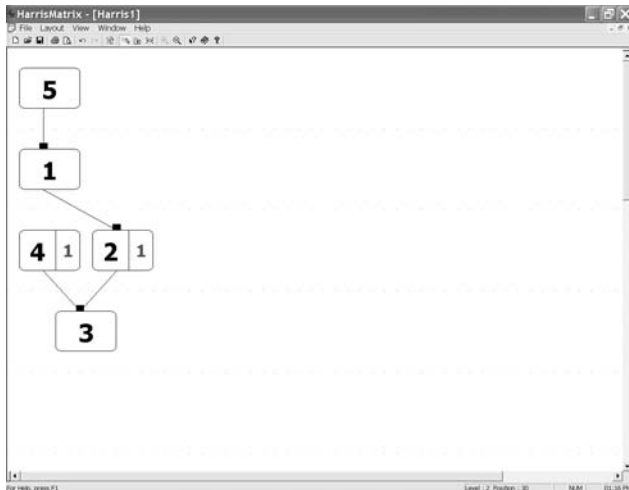


Figure 1. Building a basic matrix with ArchEd

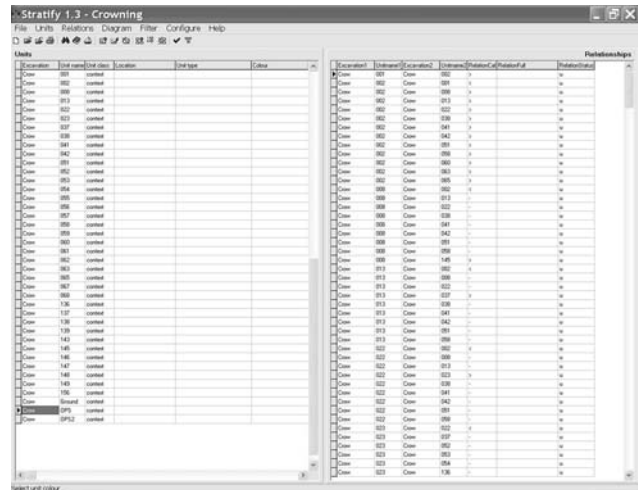


Figure 2. Stratify 1.3

polychromy and layers or remains of adhesives or consolidants. This is very valuable evidence indeed in order to reconstruct the history of conservation as a discipline and also to better understand an object's own material history. Thereby we can learn about what techniques and materials were used in the past and how they may have influenced a work's actual state of conservation.

In any case, it could be said that the main dividends will only be received by the restorer in an indirect way. His or her work will be compiled in a way that allows better and greater inspection of the decisions taken and the results obtained. It hence provides a somewhat more objective evaluation of the form of cleaning. This can have important advantages for the restorer, even though being *a posteriori*.

Doubts about how correct a cleaning intervention is are intolerable. And even more so when those doubts are based not on the difficulty of analysing the existing information, but due to the absence of such information. Restoration, if it wishes to become a scientific discipline has to offer certainties or, at least criteria based on rational decisions. These certainties, these rational criteria, this scientific rigour, can only be achieved using an appropriate methodology and with documentation that explains the methodological path followed in a process such as that of cleaning. The huge amount of information that can be gathered by applying the archaeological stratigraphy method is a resource from which great benefits can be reaped.

The aim of this article is to show the use that the computer application, *Stratify*, can be put to for constructing stratigraphic diagrams. There are numerous applications both free and commercial ones that share this goal and which, although they have been designed for use in archaeological findings, can be used just as well in documenting the strata removed during the cleaning process. The advantages of *Stratify* are the fact that it is free, available on the Internet and combines a certain facility of usage with a highly professional finish in the diagram finish.

2. BUILDING A STRATIGRAPHIC DIAGRAM

The stratigraphic diagram or *Harris Matrix* "is a simple way in which the relationships between stratigraphic units can be seen in a single diagram" (Brown III and Harris, 1993: 7). This so simple definition can be misleading. A stratigraphic diagram is a powerful instrument for converting complex three-dimensional stratigraphs into two dimensional form. This capacity to bring together all the stratigraphic units that can only be viewed through a large number of sections into a single document (a single diagram), and the possibility of processing that information by computerised means, makes this type of diagram an enormously valuable resource.

Undertaking a stratigraphic diagram is a task that may seem disheartening if adequate means are not employed. As Roskams (2001: 170) points out, "As for how descriptive data are held, those old-fashioned media, pen and paper, are still effective for many purposes, though soft copy stored within a computer is now taking their place". A stratigraphic diagram can be drawn up by hand using paper and pencil and, perhaps this may seem the simplest way of doing it. However, this way of working is extremely complex and is beset by difficulties. Throughout the process we see how many problems arise putting the nerve of the coolest head to the test, especially as the diagram grows in the number of its units and relationships. This complexity makes it increasingly difficult to evaluate the correctness of the process and errors can easily multiply as a result. Two of the most frequent errors are the repetition of a number for different stratigraphic units and the appearance of cycles in the stratigraphic relationships of type *1 later than 2* and *2 later than 1*. These errors are very difficult to detect in diagrams drawn up by hand. Another problem is the finish of the diagram. Making the final copy is also a long and complex process, unless it is undertaken with the aid of a computer.

One possibility is to use a computer application for flow charts. There are numerous applications for this purpose. For example, Zorn (1996: pág) has suggested the use of *ABC Flowcharter*. However, this type of tool may help to draw up a diagram with a better finish, but nothing else. It provides simpler elaboration from the aesthetic point of view, but does not provide any specific help in the internal construction of the diagram, nor does it offer any advantage compared to the manual system in terms of detecting errors.

The best way of undertaking a stratigraphic diagram is to use a specifically designed computer application, given that the advantages are many, especially in automating and detecting stratigraphic errors. Besides providing the advantages of a flow chart program, they have the necessary and specific tools for drawing up stratigraphic diagrams. Various programs can be found on the Internet. Some of them are free of charge such as *ArchEd* or *Stratify* or are trial versions of commercial programs such as *Proleg StratiGraf* or *SiteWorks*.

Programmes for visualising, editing and manipulating the stratigraphic sequence have a comparatively long history (Harris, 1975: pág; Herzog, 1993: pág). In what now seems like an earlier age of archaeological computing, the application of computers to the manipulation and analysis of stratigraphic sequences probably began in 1975 with *STRATA* program (Ryan, 2001: pág). Nowadays there are several programmes although here I shall refer to two which can be obtained free of charge through Internet: *ArchEd* and *Stratify*, which although designed for use with archaeological sites, can also be used to carry out the stratigraphic sequences for any kind of object. These or other similar programmes can be of great help to the conservator who

Excavation	Unit name	Unit class	Location
► Crow	001	context	
Crow	002	context	
Crow	008	context	
Crow	013	context	
Crow	022	context	
Crow	023	context	
Crow	037	context	
Crow	038	context	
Crow	041	context	
Crow	042	context	
Crow	051	context	
Crow	052	context	
Crow	053	context	
Crow	054	context	
Crow	055	context	
Crow	056	context	
Crow	057	context	

Figure 3. Stratigraphic units in the database of Stratify



Figure 5. 'The Flagellation' (Universitat de València).

approaches the use of stratigraphic sequences for the first time as they facilitate the work enormously. Commercial programs are much more comprehensive, with a greater variety of tools than the free programs. However, the latter are widely available to any conservator and have sufficient tools for effectively undertaking a documentation process.

The *ArchEd*¹, developed in the Max Planck Institut fuer Informatik, is probably the most adequate to start off with as it has a much simpler user interface, based on a graph editor, and it is easy to use for those unfamiliar with these kinds of tools (Hundack *et al*, 2005). *ArchEd*



Figure 4. Stratigraphic diagram of 'The Flagellation' (OPS: original pictorial structure; OVP: overpaint)

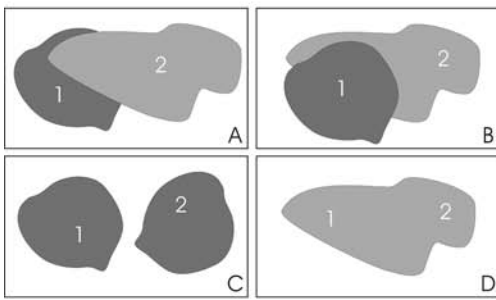
is a very simple and intuitive application. The relationships between stratigraphic units can be introduced with ease. However, it is limited by the tools that it has available, especially if we compare it with another application, *Stratify*², which combines a database to record all relevant data for each stratigraphic unit with powerful checking and exploration tools. *Stratify* 1.3 is a computer application created by Irmela Herzog, who has been working for more than a decade on this type of program for drawing up stratigraphic diagrams (Herzog and Scollar, 1991; Herzog, 1993).

3. STRATIGRAPHIC UNITS AND THEIR RELATIONS

The surface is the boundary between object and environment. Here is where all the traces, all the signs of an object's life are gathered so it is, in fact, a constantly mutating interface. We can find these signs in deposit form, that is, in accumulated layers, or gaps formed through the partial destruction of original or non-original pre-existent stratification. Deposits and losses make up the archive of successive contexts which have marked an object's evolution.

This stratification process is a cycle of both accumulation and erosion or removal of materials and this process causes the stratified structure to be divided into positive or negative stratigraphic units. These are the basic elements that shape the stratigraphic construction. The positive units are the layers of deposited materials. A layer or stratum is, from the standpoint of stratigraphy, a portion of relatively homogeneous and indivisible material. Negative units are formed through the partial destruction of the pre-existent stratification. These units are erosions or gaps, loss of materials and they have their own stratigraphic relations with other units and their own limits and outlines (Barros Garcia, 2004).

Basically, the stratigraphic diagram describes the relationships among the stratigraphic units. In a Matrix the units are represented as numbered rectangles. Each one of those numbers is the name of a unit. When a unit is recognized, its number is registered and then it is situated on the diagram, according to its stratigraphic position. The numbers allocated to stratigraphic units are only labels. It is only a means of giving the unit a name. The units can also be labelled with letters or even with texts that indicate the composition or typology, as, for example, in figure 4 that shows the stratigraphic diagram of the painting *The Flagellation*⁴.



SYMBOL	EXPLANATION
>	later than
<	earlier than
=	equal to
-	contemporary with

Figure 6. Relationships between two units: '1 earlier than 2', '1 later than 2', '1 contemporary with 2' and '1 and 2 are equal'.

Excavation1	Unitname1	Excavation2	Unitname2	RelationCat	RelationFull	RelationStatus
Crow	001	Crow	002	>		u
Crow	002	Crow	001	<		u
Crow	002	Crow	008	>		u
Crow	002	Crow	013	>		u
Crow	002	Crow	022	>		u
Crow	002	Crow	038	>		u
Crow	002	Crow	041	>		u
Crow	002	Crow	042	>		u
Crow	002	Crow	051	>		u
Crow	002	Crow	058	>		u
Crow	002	Crow	060	>		u
Crow	002	Crow	063	>		u
Crow	002	Crow	065	>		u
Crow	008	Crow	002	<		u
Crow	008	Crow	013	-		u
Crow	008	Crow	022	-		u
Crow	008	Crow	038	-		u
Crow	008	Crow	041	-		u
Crow	008	Crow	042	-		u
Crow	008	Crow	051	-		u
Crow	008	Crow	058	-		u
Crow	008	Crow	145	>		u
Crow	013	Crow	002	<		u

Figures 7 and 8. In *Stratify* each relationship category is designated by a symbol (Herzog, 2007).

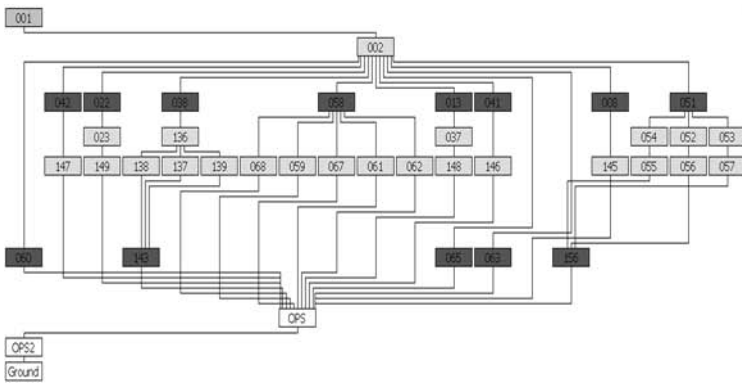


Figure 9. Partial diagram of 'The Crowning with Thorns'

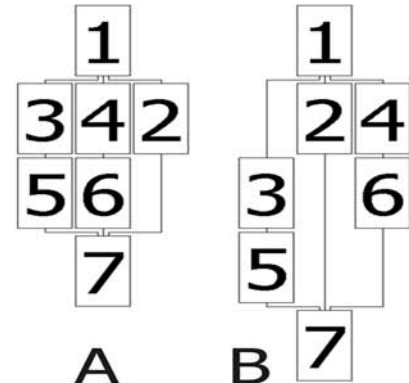


Figure 10. From diagram A we introduce a change ('3 contemporary with 6') generating diagram B

Stratify supports the following relationships: *earlier than*, *later than*, *contemporary* and *equal*. Each relationship category is designated by a symbol. It is also possible that no direct relationship exists between two units. The only two relationships that are purely stratigraphic, i.e. that are based on relationships of physical contact are *1 is later than 2* and *1 is earlier than 2*. The first includes relationships such as *1 over 2* and *1 cuts 2*. The second includes the relationships *1 under 2* and *1 cut by 2*. Succession in time can be checked by a direct physical relationship between both units. In these cases there is no interpretive action, although at times the superimposed relationship may be difficult to verify, especially in very fine strata that may have penetrated each other.

Two units are regarded as being contemporary when they have been created at approximately the same time and are situated at the same stratigraphic level. In a stratigraphic diagram they are represented as units situated on the same horizontal level. In the *Stratify* application the relationship *1 and 2 are equal* refers to a single unit that has originally been recorded by mistake as different units during the study process of the stratigraphic structure. These two units (although only being one in reality) appear connected by two horizontal lines.

4. AUTOMATIC DATA CHECKING

As stated above, stratigraphic diagrams can be hand-drawn although the easiest way is to use computer programmes which facilitate the work as they carry out some of the operations automatically and verify possible errors in the stratigraphic sequence. Some of the most obvious advantages are that the programme checks the information for internal consistency, and may even remove the loops in the sequence ('1 is later than 2 and 2 is later than 1'), it avoids duplicated numbers and can print out the resulting diagram in various colours.

In the article published in *Studies in Conservation* the stratigraphic diagram of the painting 'The Crowning with Thorns'³ (Barros García, 2004: 252)

had been done by hand, without the support of a computer application. Later, on employing *Stratify* the advantages of the application as opposed to the manual method were clearly demonstrated. To illustrate this, a part of that same diagram using *Stratify* is shown (figure 9). When the diagram of *The Crowning with Thorns* using *Stratify* was being drawn up, an error was observed: the duplication of a stratigraphic unit. This kind of mistake is very common when undertaking the *Matrix* manually. Nevertheless, although the work is undertaken more quickly and safely, it is essential that the relationships have to be correctly documented. The computer application can detect certain kinds of clear errors, such as repeated cycles or units, but not undocumented or badly documented units and relationships.

The diagram is automatically generated by the application, but only when the data has been introduced into the computer and checked. If essential data are missing or if there is some error, the diagram is not generated and a warning message appears. One of the main problems that may arise is the cycles: "Mathematically speaking they are contradictions of the principle of irreflexivity of the later relation, i.e. there exists a path of later relations which starts and ends at the same layer" (Herzog, 1993: 207). A basic example would be *1 later than 2* and *2 later than 1*.

The problems generated by conflicting relations can vary widely; for example, those generated by erroneous contemporary relations. This type of relation is not based on exclusively stratigraphic information so they are of a less objective nature: "Later or earlier relations have a higher priority than contemporary relations, because the former are based on physical observations, whereas the latter can be based on more subjective conclusions and are therefore more open to error" (Herzog, 1993: 208). If the following relations have been established: *1 later than 2* and *2 later than 3*, the relation *1 contemporary with 3* must be considered wrong and unacceptable.

A further example can be observed in figure 10. In this case, from diagram A onwards, we can introduce a change - *3 contemporary with 6*-

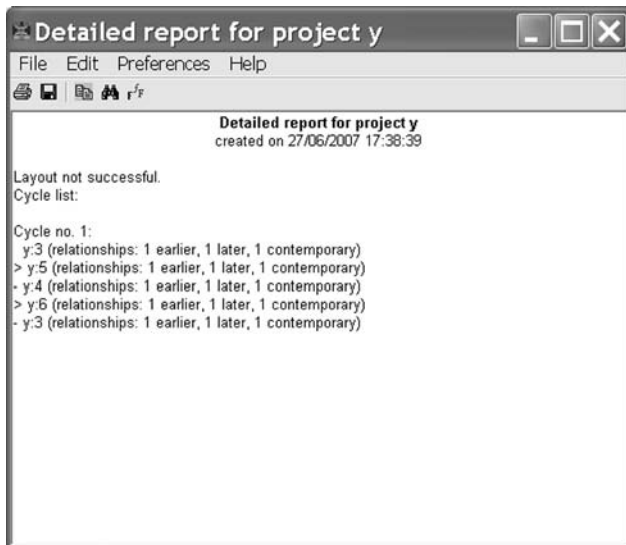


Figure 11. Warning Message

so generating diagram B. Nevertheless, we can also add the relation 4 *contemporary with* 5, as a cycle is then generated and a warning message appears (Figure 11).

Another problem, although very different, is that of *redundant relationships*. According to Harris, only significant stratigraphic relationships, from the chronological point of view, should be shown in the stratigraphic diagram. Other relationships are considered redundant and do not appear in the diagram. However, in the *conservation of paintings* it may be convenient to document physical relationships between strata, even though these relationships do not provide new data on the relative chronology of the deposits. However, to show all the physical relationships in a diagram may complicate their elaboration and create chaotic diagrams with a huge quantity of interweaved links. *Stratify* offers the possibility of showing redundant *relationships* or of eliminating them. If they are maintained, these relationships appear marked with the letter R (Herzog, 2007).

5. AREAS FOR FUTURE RESEARCH

Despite the fact that *ArchEd* and *Stratify* are programmes designed for use exclusively with archaeological sites, they are extraordinarily useful when we are working with paintings as the stratigraphic principles are always the same. One of the main problems is that the description sheets are structured for sites and not for the kind of layers we may find on objects. However, this is not really a hindrance. The important thing is to facilitate the storage of the units and their relations and to make the drawing of stratigraphic diagrams easier, and these aims are perfectly achieved. The description sheets in *Stratify* can be used to a certain extent to document non-original strata removed during a cleaning process, as a file can be configured and some of the fields that are useful in archaeology but which serve no purpose in a painting can be eliminated (figure 12).

There is, therefore, an evident need for a file specifically for use in pictorial works. Although several important advances have been made in this direction (Barros García, 2006a), a definitive model is still not available. It would be useful to integrate a file model into a computer application. Files, such as those used by *Stratify*, can be used by conservators, but a more specific model would be preferable.

Stratify offers huge advantages but also some important limitations compared with commercial programs. One of the main ones is the

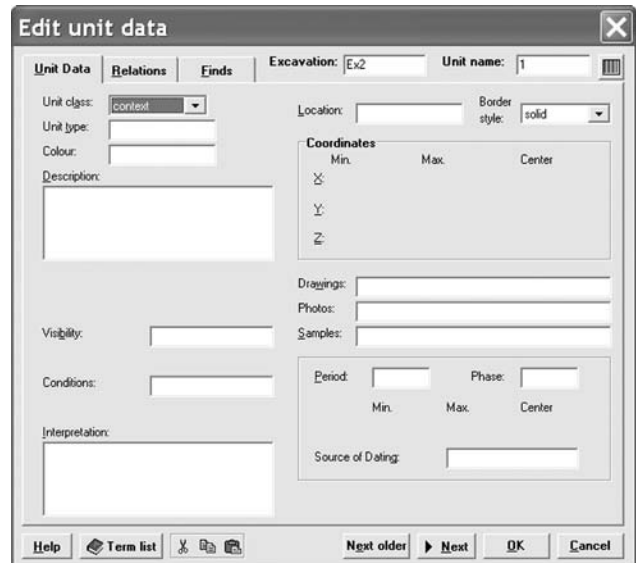


Figure 12. Recording sheet for unit data in Stratify

lack of integration with graphic documentation: *Stratify* does not allow one to include in the SU file the graphic documentation on that unit. It would be very useful to be able to view photographs and maps in the same file where all the information on the stratigraphic unit is, as, in this way, the information would not be scattered throughout different documents and formats.

The ultimate aim of these lines of work is to achieve an adequate exchange of information between different conservators on the issue of cleaning. Naturally, standard procedures have to be created for the design of cleaning systems, something that is already being worked on in the Modular Cleaning Program (Stavroudis, 2007). This application, although still in the trial stage, already constitutes an important advance in the systemising of an intervention that not long ago was too closely linked to a very subjective point of view. However, the systemisation of data gathering procedures for strata removed during cleaning - strata which, let us not forget, may be destroyed - also needs to be worked on.

6. CONCLUSION

As we have seen, *Stratify* possesses interesting advantages for a conservator when it comes to documenting the strata removed during a cleaning process. Without doubt, archaeological stratigraphy offers the best instruments for this. Its use is essential in any field working with stratigraphic structures.

Although *Stratify* cannot be considered a definitive application for use in painting, it can be used for making stratigraphic diagrams, as it has sufficient tools for this purpose. Applications like this one can be a good way for conservators to introduce themselves to a new methodology, which is what archaeological stratigraphy is.

NOTES

¹ ArchEd is available at www.ads.tuwien.ac.at/arched/index.html.

² Stratify can be downloaded from <http://www.stratify.privat.t-online.de/Download/Download.htm>.

³ Painted by an anonymous artist during the first half of the eighteenth century (2.36 x 1.89m), Universitat de València [UV0030].

⁴ Painted by an anonymous artist during the first half of the eighteenth century (2.35 x 1.92m), Universitat de València [UV0008].

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José Manuel Barros García received a PhD in Fine Art from the Universidad Politécnica de Valencia (UPV). He has published various papers and books, and has lectured extensively on the conservation of paintings and, in particular, on the theories, techniques and methodologies of cleaning, these subjects being his main field of research. Currently he teaches in the Department of Conservation and Restoration of Cultural Heritage (UPV).

Versión española

TÍTULO: *Hacia una representación digramática de las capas no originales en superficies pintadas*

RESUMEN: *Los diagramas estratigráficos son un recurso muy útil en la documentación del proceso de limpieza, al permitir integrar en un solo documento los diferentes estratos eliminados y sus relaciones. Sin embargo la elaboración de estos diagramas es una tarea bastante compleja que sólo puede simplificarse en cierta medida mediante el uso de una aplicación informática específica para esta tarea. Una interesante posibilidad es Stratify, una aplicación diseñada por Irmela Herzog, que combina la utilización de herramientas profesionales con la facilidad en su uso.*

PALABRAS CLAVES: *Stratigraphic diagram, stratigraphy, Stratify, cleaning, painting, strata, recording, documentation*