Challenge or Bother? Writing a Conservation Science Paper*

Writing is a creative occupation, regardless of whether it is creating a novel, writing a letter or a scientific paper. Everyone who has ever published in a journal will remember how demanding it was to write their first paper (Fig 1). Publishing confronts the author with the questions, how much of the gained information should be included and how should the information be organized? How can it be presented so that the target group understands the relevance and meaning of the message? Are the conclusions sound and the results relevant for other colleagues?

Publishing is not yet generally required as part of conservators’ professional development and so employers do not usually support it. It is therefore logical that the amount of publications by conservators remains quite low. Publication is currently mainly limited to the work of dedicated individual conservators. In addition, the conservation training programs do not usually provide information on how to publish a paper and hence master students intending to publish their results have difficulties in getting papers accepted.

This situation can be described as a major drawback for the development of the conservation profession. The longer that only a few conservators are able to prove the relevance of their work by publishing papers that meet scientific standards, the longer the profession will keep its low profile status in comparison to other professions such as curators or conservation scientists. The question arises of how the quality of contributions can be improved and how conservators can be stimulated to share their knowledge by increasing the number of papers published. This contribution attempts to fill one gap by providing the basic knowledge necessary for writing a scientific paper for the conservation profession. It aims to support conservators that rarely publish by presenting a procedure that directs the author step by step in writing a paper containing all the necessary information in the correct order.

General information regarding the structure of scientific papers is provided by other web sites, usually university web sites (e.g. try Google for ‘How to write a scientific paper’). In this article special attention is given to the particular requirements for publishing in the journal ‘Papier-Restaurierung’. This journal reports regularly on new research outcomes and innovative developments in the conservation of cultural heritage objects of paper and related materials. The target groups of the journal are paper conservators, art historians, archivists, librarians and conservation scientists.

Will it be a Scientific Paper or an Article?

The purpose of writing scientific papers is to communicate an idea (or set of ideas) to people who have the ability to either carry the idea even further or make other good use of it. It is believed that the communication of good ideas is the medium through which science progresses.’ (Goldreich 2004: 1)

In the world of natural science ideas are usually expressed as a solution to a research question regarding a specific problem.

Publishing a paper is reasonable if the author addresses a problem that is relevant for the target group of a journal and if scientific methodology was applied to solve the research question. To ensure a relevant contribution, the author should first consider whether the idea is novel, innovative and whether it advances the current state of knowledge.

It is quite easy to decide whether the information can be published as a scientific paper: besides presenting a new idea, a scientific paper must contain research. If not, although the information to be shared may well be relevant, a scientific paper is not the right form. Other approaches are more appropriate like publishing an article or placing an article on a web site. Before submitting a paper the author must know which kind of contribution it will be: a scientific paper or another form of publication. Some journals only publish scientific papers. The ‘Papier-Restaurierung’ encourages two types of contributions:

The subjects of scientific papers cover the creation, preservation and conservation of cultural heritage on paper and related materials. They can vary from new information about the material-technical aspects of the creation of objects (art technology), new insights into how objects change through the centuries (decay processes and decay prognosis), new preservation strategies (risk management) as well as evaluation, improvement or development of new techniques for conservation treatments. Scientific papers are peer reviewed.

The subjects of articles or notes also cover the creation, preservation and conservation of cultural heritage on paper and related materials but do not include research. Such works come under the headings of ‘A Conservation Project’, ‘Conservation Techniques’, ‘New materials’, ‘Literature review’, etc. These publications are not peer-reviewed and have a more current or news value.

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*Writing a Conservation Science Paper by J. R. C. van de Wetering. This contribution is part of ‘How to write a scientific paper’) (Fig 1). Publishing a paper is reason-
**Publishing a paper more than once**

(1) Papers written in the style of instruction material and that address a general subject, for instance: ‘Adhesives applied in the field of paper conservation’, ‘Consolidation techniques for powdery paint’, often discuss the relevant literature but lack any original research. Such contributions are relevant for the conservation field due to the continuing lack of instruction material. However, they are not considered to be research papers because instead of presenting a new idea the previously published ideas of others are merely summarized. In the field of the conservation of cultural heritage ‘Reviews in Conservation’, published annually by the International Institute for Conservation of Historic and Artistic Works (IIC), is the only journal specialized in publishing such articles. The editors of ‘PapierRestaurierung’ will either refer such submissions to IIC or publish it as an article, not as a research paper.

(2) Contributions that contain the text of a presentation or lecture usually do not meet the criteria of research papers. These texts often need revision before publishing and also often lack a theoretical background with relevant references.

(3) Articles that describe a specific conservation project can be relevant for the target group; for instance, conservators facing a comparable question (same artist, same technique or similar problems). However, if such contributions do not include research, they will not meet the criteria prescribed for scientific papers. The ‘PapierRestaurierung’ publishes such submissions under the heading of ‘A conservation project’. This approach enables the spreading of information amongst the conservation community without putting authors in the difficult position of having to force information into a research form when it is not.

(4) Publishing a paper more than once is risky. For the author it might be a way to spread information to different target groups, however readers are often confused when an paper is published elsewhere because it is unclear where the content of publication 1 differs from the content of publication 2. Choosing a second language (German/English) might be a logical reason to reach a larger public. However, the reader should be informed if an paper has been previously published elsewhere. Consequently the ‘PapierRestaurierung’ asks authors to provide this information. The editorial board decides if it is worthwhile for the readers to publish an paper a second time.

**Where to Publish a Paper?**

Only a few journals exist in the field of conservation of cultural heritage, some of national and some of international relevance (Fig 2). Firstly an author should consider whether the information is for the national public or whether it has international relevance. The next thing to consider is the target group. Each journal is aimed at a certain target group. If this target group coincides with that which the author aims to inform then this journal is a good choice.

A journal that offers a peer review has a higher quality than a journal that does not. However, in the field of conservation, hardly any journals are in fact peer reviewed. It is interesting to know that in the ‘real’ scientific world, paper citation rates and the impact factor (IF) of a journal determine the scientific value of a journal.

Conservation related papers often use visual information to enhance explanation. The quality of published figures is therefore important. Does the journal publish photos in colour? Is the size of the figures large enough? The author should also ask if and how published papers are accessible and searchable by using the internet. For instance, papers published in the ‘PapierRestaurierung’ can be found on ‘Conservation online’ (CoOL).

Directly after publication, titles and summaries of each paper are accessible online through the IADA Website found at http://palimpsest.stanford.edu/iada. After a period of 5 years the full papers (PDF) are put online and are accessible without charge.

**How do the Editors Evaluate the Quality of a Paper?**

Journals are either peer reviewed or not. Offering a peer review is always a sign of quality. Since they are required to evaluate and thereby improve a paper’s quality, peer reviews aim to support the author and the publisher as well as the reader. When the editor receives a manuscript, it is sent to two or three specialized experts for a critical peer review. The evaluation criteria differ from journal to journal. For the ‘PapierRestaurierung’, the following key criteria are applied: 

- **Novelty:** is this study innovative and does it advance the current state of knowledge? Will the results lead to an improvement in the preservation of cultural heritage? Will the results lead to an improvement in the intellectual or material access to cultural heritage?

- **Applicability:** will the implementation of the results significantly improve understanding of and enhance the conservation of cultural heritage? This factor determines the relevance for the target group.

- **Scientific quality:** is the applied methodology or experimental work scientifically and technically sound?

- **Presentation:** is the information well organized?

The referees judge if a paper makes a new and important contribution to the understanding of any area of paper conservation or related subjects. Based on the evaluation crite-
ria, they recommend the acceptance, revision or rejection of a paper. It is the final responsibility of the editor to determine the suitability of a manuscript for publication.

Several people read each contribution during the review process. For the ‘PapierRestaurierung’ at least five people (the publisher, the editor, two or three reviewers and, if required, a translator) will examine a paper. Both the editor and the publisher will read an article at least three times and the author at least twice during the editing process.

Points to consider:
(1) Even with experienced writers every paper or article requires some modifications to the content, style, or language.
(2) The reviewer, the editors and the authors spend their valuable time providing the target group with relevant information. The comments of reviewers are never personal but aimed at improving the quality of the submitted paper. Taking comments personally is a sign of inexperience and lack of professionalism.
(3) E-mails are a tricky medium for communicating about problems especially if a foreign language is involved. While e-mails provide structured information they can sometimes seem too abrupt: a personal communication usually helps to prevent misunderstandings. A telephone call or personal conversation are more effective in reaching the final goal—creating a win-win situation for the author and the reader.

How to Layout a Submission?
Receiving all papers in a similar layout makes the work of the publisher and editors much easier. Therefore each journal has particular requirements for the outline of submissions. They are described in detail in the ‘Guidelines for authors’ which are usually available on a journal’s website. For ‘PapierRestaurierung’ the guidelines can be found at http://palimpsest.edu/ida/PR_guidelines_en.pdf. It is necessary to meticulously read and follow these guidelines since a paper will most probably be returned to the author or may even be rejected when the guidelines are not followed. Consulting former journal issues can give an idea of how to apply the guidelines correctly.

Points to consider:
(1) There is just one rule: follow the guidelines strictly even if you personally dislike the layout or if it differs from that with which you are familiar. You can write the paper in your own layout but always edit it as prescribed before submitting.
(2) Special attention must be given to the references: all journals have different requirements for citing and listing references.

How to Organise the Information?
The content of a paper must be presented in a structured and logical way. Papers always follow a prescribed order in the natural sciences field. This order has proven to be so useful that it is generally applied regardless of whether the paper presents medical, chemical, or biological research. An increasing number of humanities papers also apply a similar organisation. Papers organized this way always start with an introduction to the subject, then discuss the theoretical background, describe applied materials and equipment, present the results, discuss them and finally end with a conclusion (Fig 3). This order allows the readers to easily find the required information. Submissions for the ‘PapierRestaurierung’ also should follow this order. The next sections will discuss all necessary parts of an article in detail, starting with the title and ending with the acknowledgements.

Points to consider:
(1) Often it is felt to be quite difficult to organize a paper according to this prescription. Understanding, accepting and applying the prescribed order will lead to improvement. Just as for life in general, the following slogan also applies to publishing: ‘Practice makes perfect’.
(2) Inexperienced authors tend to describe an experiment in chronological order. It is essential to bear in mind that the structure of a scientific paper does not usually reflect the chronological sequence of the research but instead follows a logical order. Following the prescribed order will help the author to maintain a logical organization of the information.
(3) Never organize a text by beginning with describing the materials, methods, results of the first experiment, then continuing with the second experiment etc. This is very confusing and time consuming for the reader as they are forced to search for the required information.

Who are the Authors?
The authors of a paper are all those colleagues that made essential contributions to the study, either by writing it, carrying out analyses or by supporting the author with general advice during the study. As publishing is part of the professional evaluation within any scientific environment it is crucial to include all con-
tributing colleagues. The first author is the person who did the relevant work or most of it. The names of the other contributors are sorted either in alphabetical order or according to the significance of their contribution. For the ‘PapierRestaurierung’, the full name(s) of author(s) should be stated correctly using one of these two orders. The author for correspondence should be indicated with an asterisk (*) (for example: Lucia Schneider, Annabell Rusting* and George Blue).

Points to consider:
(1) Papers submitted to conservation journals are often written by a single author. In a scientific environment this is an unusual exception as several people usually contribute to a study. Indeed, it is not uncommon to have more than five authors.
(2) Colleagues that significantly contributed to a study should be asked beforehand if they want to be included as author. When publishing a diploma thesis, all supervisors should also be asked.
(3) Everybody who is named as author should receive the paper well in advance before submission. This will allow time for agreement on the content of the paper and the opportunity to add more information when necessary.
(4) Colleagues that are not included as author but did contribute to a certain extent should always be included in the acknowledgement section.
(5) Failure to include or acknowledge contributors is highly unprofessional and implies that the author is more motivated by self-advancement than contributing to the body of knowledge.

How to Formulate a Catchy Title?
A proper title is the key to ensuring that an paper will reach its intended audience. The title will be read by many more people than the entire paper (e.g., when it is cited in an other paper and included in references). It should consist of the fewest possible words that accurately describe the content of a paper. A title should also stand out. To help the reader, the ‘PapierRestaurierung’ requests a two-part title where the general subject should first be briefly stated, followed by a brief description of the topic (e.g. ‘Pastel painting: Fixatives applied in the 18th century’). To raise interest, titles often refer to common proverbs, ideoms, phrases, poems etc. like ‘Dust in the wind: 18th century fixatives on pastel paintings’.

Points to consider:
(1) It is very difficult to condense the content of an entire paper into a single line: the title. Eliminating all superfluous words such as ‘A study of ...’, ‘Investigations of ...’, ‘Observations on ...’, already helps to shorten a title to the ideal length of less than 15 words. Defining a limited number of descriptive keywords beforehand helps.
(2) When the author uses only the common subtitles of Introduction, Theory, Results etc., while being correct, it is boring to read. Skilled writers instead use more appealing subtitles that refer to their content while still adhering to the structure.

How to Write a High-quality Summary?
Reading a summary enables the reader to decide whether it is worthwhile reading the entire paper or not. Consequently a summary should sum up the key information of the paper in very few words (150-250). A summary should contain a brief background to the topic including the research question, a description of the applied materials and methods, the major results of the study and finally the conclusions are given taking care to answering the initial research question.

Points to consider:
(1) If there is no problem, no research needs to be done. Therefore a clear explanation of the problem is essential. Often authors imply that the reader is already familiar with the problem and so fail to describe it adequately. In this case a reader might not fully understand the importance and urgency of a problem and the necessity of the research. But if there is no clear problem, why

The Introduction
The introduction should introduce the reader to the general subject of the research. This is usually a problem that requires an investigation. The problem must be understandable even if the reader has not done any work in the field. The aim of an introduction is to establish the significance of the current work. If the problem is not stated in a logical, understandable way, the reader may not develop an interest in the solution. Including a photo that illustrates the problem aids understanding and so supports the relevance of the study (Fig 4). The introduction ends with a description of the research question to be addressed. Formulating a concise, clear and understandable research question needs some practice but is indispensable. The application of the final results should always be the focus when formulating the research question. A properly formulated research question will leave the target group eagerly looking forward to learning the solution to the problem in order to apply the newly gained knowledge in their own practice.

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would one spent money and time in carrying out the research?

(2) When formulating research questions for conservation research, authors often overlook the fact that the results should be applicable for the target group. Such papers are unconvincing and will score low in a review.

For example: Charcoals, pastels, and other artifacts with powdery media are susceptible to surface damage. This is a recognizable problem for conservators and collection keepers. Such a general problem usually encompasses many topics. Therefore it is necessary to reduce the scope to a single research question which addresses only one topic. In this case, a research question could focus on one of the following topics: is it possible to optimize present transport strategies for such vulnerable objects? Which fixing agents for powdery paint have been applied on pastels in the past? How does the size of pigment particles influence the powdery character of media? These questions differ in one major point: the final application of the results. The first question will lead to an optimized transport strategy for this type of object. Answering the second question will help conservators and collection managers to better understand the process of pastel making and to optimize preservation or conservation strategies. The third question does not lead to an applicable result either for conservators or for collection managers. A paper addressing this last question would score low and might fail to be accepted.

The Theoretical Background

The theory presents the background knowledge necessary for the reader to understand why the research question can not be answered with the already existing knowledge. To this end the published literature is critically reviewed. The author should point out which information is available and commonly accepted and which aspects are doubtful or un-known and therefore require further research. The theoretical background ends with the definition of the research aim. A properly defined research aim is only successful and relevant if the target group will be able to apply the results of the study. The aim of the study should be referred to once more in the conclusion. Some research papers combine introduction and theory. The ‘PapierRestaurierung’, prefers to keep them separate.

Points to consider:

(1) Some authors attempt to exhaustively express all they know and all that has been published on a subject. Such authors forget that there is a reader. It might be appealing for the author(s) to demonstrate their superiority, however a reader may be rather bored.

(2) Limiting the theoretical part to a critical review of the current state of knowledge on the specified problem will keep the reader interested in the problem. Everything unrelated to the research question is redundant.

(3) A typical mistake is to list literature in the bibliography that is not referred to in the text. Also, introducing authors and their areas of study in general terms without indicating their major findings is pointless.

(4) Plagiarism (copying the work of others without proper acknowledgement) is unprofessional. Usually it will be discovered as the reviewers are familiar with the published literature and always check for plagiarism.

(5) If the research aim is not linked to the general problem and the research question then confusion may arise and cause misinterpretation of results and reluctance to accept the conclusions.

(6) Ending the theory section without specifying the aim of the study leaves the reader without a direction: they should know where the study is going.

For example: For a paper that addresses the problem of exhibiting mould infected pastels, listing all existing literature on mould on paper can be quite boring to read and even misleading. Instead, a critical review of publications on pastel technology in relation to the potential development of mould may lead to the conclusion that the present knowledge is sufficient to understand the fungal decay of pastels on paper. However, pastels on parchment are not yet addressed in the literature nor are appropriate exhibition policies. The suggestion to limit the present study on this subject would be a logical conclusion for the reader to accept. However, the research will be not relevant if the results were not applicable for a conservator. So the study could, for instance, aim at developing an exhibition policy that mitigates mould formation on pastels on parchment. Such a concrete research aim would form a worthy end to the theoretical background.

The Experiment (Materials and Methods)

The purpose of the experiment section is to describe the methods and materials used. In principle, this description should be detailed enough to allow other researchers to replicate the work. The scientific methodology applied must be explained even if no experiment was carried out. The procedures vary from one field to the other. In conservation research, quantitative as well as qualitative research methods are applied.

Points to consider:

(1) A scientific paper is not the right place to report on a subject if you have not carried out any research or experiments. Instead, a more suitable approach of disseminating relevant information is to publish an article under the title of ‘A conservation project’ or ‘New conservation techniques’.

(2) A common mistake is to describe the experiment chronologically, combining materials and methods with the results and even adding conclusions.

(3) The names of the research techniques used should always be presented in full length before adding the abbre-
viation: e.g., Scanning Electron Microscopy (SEM).

(4) Equipment should be described accurately within the text including the supplier: e.g., Climate chamber (VC0020: Vötsch). The same applies to materials: e.g., Ethanol (96 %: Sigma-Aldrich Corporation).

(5) Colloquial names or jargon should be strictly avoided. Nobody will remember what ‘Magic rub’ was in twenty years time. Some jargon may be specific to certain countries: e.g., the term ‘Amylum Tritici’ is widely used for a wheat starch adhesive in the Netherlands while in other countries other names may prevail. To prevent misunderstanding, materials need to be specified: e.g., Hollytex® (white, non-woven polyester fibres: Conservation Resources International).

(6) Modifications to equipment or equipment constructed specifically for the study should be described in detail.

The Results

The results of a study are presented under this heading without attempting to interpret their meaning. The trick to writing a good results section is knowing what information to include and what to leave out. The results section must be clear and logically organized. To achieve this, instead of including all the raw data, only relevant data are presented as text and illustrated with tables and figures. The text is used to state the results in such a way as to indicate to the reader the most relevant outcomes. Tables present lists of numbers or text in columns. Figures are everything that is not a table. They are used to visualize results and include photos, drawings, graphs, diagrams, charts, etc. (Fig 5). Graphs usually demonstrate trends or identify patterns of a relationship. Graphs should include the standard deviation, as only when the margin of error is provided can the reader judge the consistency of the findings (Fig 6). Charts show structures (Fig 3). Each figure or table requires a label (e.g., Fig 1 or Tab 1) and a descriptive explanation so that the reader knows what to look for (Fig 7). It is very valuable also to include negative results not only for a complete report but also so that other colleagues can avoid repeating the work.

Points to consider:

(1) In this section, only results are included. The author should neither attempt to explain anything nor discuss or interpret the results.

(2) Data are mentioned just once; repetition should be strictly avoided.

(3) Text should complement any figures or tables and not repeat the same information. Not all results require a figure; simple results are best stated in a single sentence.

(4) All figures and tables must be so complete that they can stand alone separate from the text. They should be published with a caption that explains the information that is being presented.

(5) Graphs should contain a standard deviation.

(6) Tables should not be used to show a trend or a pattern of relationship between sets of values; these are better presented in a Figure.

The Discussion

The discussion explains what the results mean and how they compare with any findings of other colleagues. It is crucial that the discussion rests firmly on the evidence presented in the result section. Note that the results can be referred too but should not be repeated. It is not enough to state that the results are consistent with the expectations. Instead it should be suggested why results came out as they did by explaining the theory and mechanisms behind them. Relevant literature can be cited in the discussion if it supports the reasoning. The discussion serves to support the final conclusions. Some authors combine the results and discussion, others discussion and conclusion.

Points to consider:

(1) For the inexperienced writer to learn how to separate the task of recording data from interpretation, it is useful to treat the results and the discussion separately.

(2) Results should not be repeated here, only discussed.

For example:

Say that the result of an EDX analysis proved that a drawing ink contained the elements Fe and Ca as well as traces of K and S. Then the discussion section is the right place to argue that inks containing Fe and S are likely to be iron gall inks due to iron sulfate being a major ingredient. This statement should be supported with a reference. However other inks as, for instance, Bistre, could also contain
similar elements. This should also be supported by referring to other studies.

**Conclusions**

Each paper must end with a conclusion. Here the research question as set out in the beginning should be answered, the aim of the study addressed and the significance of the results discussed. The significance of the results is primarily dependent on their ultimate applicability. The conclusion should state in which context the results are applicable in order to avoid the reader thinking ‘So what?’ The conclusion should be as concise as possible.

**Points to consider:**

1. A conclusion is not a summary. Never repeat what the reader has already read elsewhere in the paper. In particular, results should not be repeated here.
2. Do not discuss decision making in the conclusion.
3. Studies that neglect their ultimate application have low relevance.
4. Suggestions for further study can be made here.

**For example:**

Within the introduction the author stated that a serious problem was determined in typewritten documents of a specific archival collection, all dated between 1970 to 1980. Most of the documents show a dark blue halo around the ink lines that impede photocopying. The research question was to determine how much of the collection currently presented this decay and to predict the long-term risk to the collection. The aim of the study was to formulate a preservation and, if necessary, a conservation treatment strategy for the affected collection. In such a case, the conclusions would be the place to inform the reader that a prediction model for typewritten documents was developed and made accessible for general use. This in turn facilitated the formulation of adequate preservation strategies.

**The Acknowledgements**

Acknowledging the help of institutes, colleagues or funding organs is always worthwhile: it is simply good manners. Personal reflections can be included here. Colleagues that contributed to a study should always be identified together with their institutes, cities and countries.

**Also Important**

Personalization should be avoided (e.g., ‘I did’, ‘we decided’) with exception of acknowledgements. It has proven useful to ask colleagues to read a manuscript before submission as they can judge if the problem is relevant, the message clear and if the paper is written logically and comprehensively. However colleagues should be aware that the author is more interested in critical comments than in compliments.

**Final Remarks**

Editors of journals all over the world that focus on the conservation of cultural heritage have one major problem: the difficulty conservators have in publishing. Many conservators either have a limited experience in writing papers or the scientific methodology leaves a lot to be desired (Horie 2007: 60). For the editors this is a problematic situation as their aim is to maintain a certain quality level without simultaneously discouraging potential authors. Interdisciplinary studies turn out to be most promising combining the experience of colleagues of different disciplines. The editors and publishers of the ‘Papier-Restaurierung’ emphatically invite paper conservators to publish! It is hoped that this contribution is a first step in making publishing a challenge instead of a bother for author and editor.

**Acknowledgements**

In the first place, I would like to thank all the conservators and other colleagues that have made the effort to publish papers in the ‘Papier-Restaurierung’. Without their work, the journal would not be able to provide useful information four times a year for the readers. Also, my thanks go to the editors and publishers of the journal for the fruitful co-operation during the past years. I would like to particularly thank Frank Ligterink (Instituut Collectie Nederland, Amsterdam) for the valuable discussions we have had on the requirements for papers on conservation science. I am also grateful to Anna Bilow (National Archives, London), Jennifer Barnett (Bully, France), Birgit Vinther Hansen (Royal Library, Copenhagen) and Claire Phan Tan Luu (Université Paris 1, Sorbonne, Paris) for their critical reading and comments. For language proof reading I would like to especially acknowledge the work of Jennifer Barnett.

**Endnote**

* This article will be available online at http://palimpsest.stanford.edu/iada/PR_writing.pdf. See also the ‘Guidelines for authors’ at http://palimpsest.stanford.edu/iada/PR_guidelines_en.pdf [In German: http://palimpsest.stanford.edu/iada/PR_guidelines_de.pdf]

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