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Title: Introduced Pollutants: The Risks of Treating Mineral Specimens with Ammonia

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Introduction.

The eighth in our series of *The Ten Agents of Deterioration* is **Pollution.** A subject for which the literature is sparse and the science within the natural history collection environment is still in its infancy. The traditional concept of pollution as being merely a particulate deposit or some problem of air quality has been extended to include the affects of storage material off-gassing and residual traces of pollutants from previous treatments.

The effect of pollution on natural history collections is now widely acknowledged as a serious threat and conservators are beginning to give this the research it deserves For example the first prize for Research and Innovation at the Jerwood Foundation and MGC1998 awards was won by Stuart Adams with the re-developed gloss meter that can indicate the levels of particulates settling within a store, thus determining whether the collections are at risk.

The use of new materials in collections should be done with caution, one should always try to use conservation quality materials or those listed in an 'acceptable materials' list. If a new material (i.e. its conservation quality unknown) is to be used, it should be tested by standard practices. For information on these see Lee, L.R. & Thickett, D. 1996 *Selection of Materials for the storage or Display of Museum Objects*, British Museum Occasional Paper 111: 60pp.

The contents of this issue have enlightened me about the problems of pollution, I hope that the same will be true for you.

Darren

Next Issue

The next in our series of *The Ten Agents Deterioration* is: **Physical Forces**. A subject for which I'm sure there are plenty of potential authors, especially with all the collection moves that are happening around the country at present. So, get your pens and keyboards going, and send me some articles.

Introduced Pollutants -
The Risks of Treating Mineral Specimens with Ammonia

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Most pollutants are not deliberately introduced into collections, however, I feel that I ought to write of an unhappy experience I had last year whilst treating mineral specimens with gaseous ammonia (based on Waller, 1987), as part of an ongoing pyrite treatment programme.

There is a lack of published information on the consequences of treating pyrite decay in mineralogical specimens, especially where more than one species of mineral is present on one specimen. As a result, I have been cautious in treating only one of each type of specimen at any one time, especially if the localities from which they were obtained are no longer producing specimens.

My caution turned out to be fully justified when I discovered to my horror that what had been a rather nice green crystalline pharmacosiderite $[KFe_4^{3+}(AsO_4)_3(OH)_4\ 6\text{-}7H_2O]$ on a pyritic matrix had, upon treatment in gaseous ammonia, become a red crystalline specimen. Whilst this was rather attractive, it was obviously no longer pharmacosiderite.

After one week in a dry environment (to allow the ammonia to dissipate) the colour changed from red to pinkish brown, which is how it has remained. I suspected that the potassium (K) in the formula had been replaced by NH_4, as potassium is an exchangeable base. According to Hey's Mineral Index (1993), pharmacosiderite containing NH_4, as an artificial compound is known, and I had just produced it. I was interested to know if this was only a surface phenomenon , so I looked at a small piece under the microscope, unfortunately it was a uniform red all the way through.

The next step was to check for the presence of the ammonium group using a Fourier Transform Infrared (FT-IR) Spectrometer, making a comparison with an untreated pharmacosiderite from the same locality. In the treated specimen, the peaks in the spectrum signature did appear to correspond

with those expected if the ammonium group was present, and these were absent in the untreated specimen, thus confirming my suspicion of a complete replacement. I thought that I should bring this to other people's attention, although I suspect that others may have had a similar experience but not published.

The questions that now arise from this are: Has anyone else had similar problems with ammonia when treating mineralogical specimens that contain other important minerals in addition to pyrite or marcasite? Is this reaction reversible? Does anyone know of any research in this area, and if so, where it is published?

Acknowledgements
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References

Waller, R. 1987. An experimental ammonia gas treatment method for oxidized pyrite mineral specimens. Preprints (Working Group 13), 623-630. ICOM Committee for Conservation. 8th. Triennial Meeting, Sydney, Australia, 6-11 September, 1987. Getty Conservation Institute, Los Angeles.

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Pollutants in Museums

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Pollutants take two forms, gaseous and particulate - or simple terms: smells and dirt.

Prevention of contamination by particulate pollution and the removal of such contamination is perhaps the most common concern amongst conservators. Strangely, gaseous pollutants have tended to receive less attention

and were, at least until the last twenty years or so, perhaps perceived as less of a concern.

The Oddy tests were developed at the British Museum (see Lee & Thickett, 1996 *Selection of Materials for the storage or Display of Museum Objects*, British Museum Occasional Paper 111: 60pp.) as an accelerated test to determine if materials to be used in the construction of displays would give off copper, silver or lead tarnishing compounds, principally hydrogen sulphide, other sulphides and carboxylic acids. Modifications and assessments of these tests indicated that they are a valuable testing method, provided the test is carried out correctly.

The Oddy test combined with a range of other test strips provided the basis for my own research project done in 1991 in Canada on pollutants in mineral collections. The findings of this research project, carried out in conjunction with Rob Waller of the Canadian Museum of Nature and Jean Tetreault of the Canadian Conservation Institute will appear in the next edition of Collections Forum, spring 2000. A summary of the method employed was published by SSCR in Vol 4, no 1 Feb 1993, one of three papers concerned with gaseous pollutants in the museum environment. The project detected a range of pollutants within systematic mineral collections and set out to compare the effects of cabinet furniture on internal pollutants. Some of the pollutants were generated by the specimens themselves: mercury and sulphur vapour due to the low vapour pressure; reduced sulphide gasses by decaying sulphide minerals and carboxylic acids emitted from the wood of cabinet furniture.

For biological specimens, Brimblecoome, who spoke at the very first Natural Science Conservation meeting in Ipswich, gave a paper on biological materials as sources of air pollution in museums, which was written up in Life after Death. The very first recorded natural science conservation problem was Byne's disease; the papers describing the efflorescence on modern mollusc collections were published in the 1880s. It was not until 1985, when Norman Tennant, working initially with Baird, started to analyse the efflorescence's that the were cause of the problem - thus, carboxylic acid emission from wood cabinets was identified.