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# Mountain Vaults: a thousand years perspective

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*"Protect*
*our dead*
*and our living*
*Against the persistent*
*Sunshine*
*and rain called time"*

*From "The heart of the mountain" by Asbjørn I. Straumfors*

This poem was written to the opening ceremony of the mountain storage vault – a vault built for preservation purposes. Working with preservation is a struggle against time and the climate that surrounds us in our daily life.

The National Library of Norway has four major storage facilities. In Oslo is the newest stacks, finished in 2004, the underground stack with about 40 000 metres of shelves The collections in this stack is often in use and the climate in this stack is close, but of course stable, up to the climate in the rest of the building. In Mo i Rana, a thousand kilometres north of Oslo, but in the middle of Norway, the National Library has a huge automatic storage with an automatic retrieval system for the Repository Library. This automated storage and retrieval system, which was built in 2003, has a capacity of 1,5 million books and can handle 200 book reservations per hour. The oldest storage vaults, but not very old, the mountain storage vault

and the vault for nitrate film, opened in Mo i Rana in 1993. These storage vaults play a different role from the underground stack in Oslo and the automatic storage, which are for the users today. I will now tell you about the history and thoughts of these two vaults. But first a few words about Mo i Rana and the National Library.

## History

In 1988, the Norwegian parliament decided to establish a division of the National Library (NB Rana) in Northern Norway, in the industrial town of *Mo i Rana*. Mo i Rana had a long tradition in iron industry and had a state owned Iron Company with thousands of employees. But the iron market was going down and the community was forced to build up other activities. The National Library was one of them. By building up a library in an industrial town, the industrial way of thinking was brought into the National Library and one result is the automated storage.

One of the main tasks for the "new" National Library in 1990 was to administer the Norwegian legal deposit act (1989) and to preserve one copy of each document collected through this act. The legal deposit act states that seven copies of every printed publication are to be sent to the National Library. Radio and television programmes, movies, music, photographic material and electronic documents are also to be delivered to the National Library, but in lesser numbers.

## Storage for the users of tomorrow

One copy of all documents delivered through this act shall be preserved for future generations. Soon after the establishing in 1990, there started a discussion about how to both store and preserve the collections. Most of the collections and documents in libraries are not made for the next generations. They are made for today use. We are working against the time and the environment which deteriorate our collections.

The main task was to create an environment that would preserve the collections for a thousand years. A quite ambitious goal, I would say. We started discussions about preserving books and paper and we learned that other large libraries and archives had projects on deacidifying books and other documents on paper. After considerations about technology and economy, we concluded not to deacidify our collections.

Years later, we understood that other large institutions have come to the same conclusions. In 2001 the Council on Library and Information Resources wrote in "Preservation Science Survey" that: *"There is a clear shift in preservation research toward large scale passive conservation."*

What does passive conservation means?
I define passive conservation as the total amount of efforts for prolonging the lifetime of each document or the content of the document.

- Climate
- Security
- Shelving
- Boxing
- Disaster Planning and Control

## Climate and environmental control

Research from different parts of the world has showed that stable climate and low temperature combined with low relative humidity slow down the deterioration processes that all groups of material are victims of. Cold and dry storage will contribute to prolonging the lifetime of the different materials and collections. Research done at the Image Permanence Institute in Rochester (in the United States) shows that you double the lifetime of a motion picture film by reducing the temperature from 20ºC to 14ºC! (At 45% Relative Humidity)

The vault in the mountain of Mo

As there are a lot of mountains in Norway the idea of building a storage vault inside a mountain came naturally. Inside the mountains in the northern part of Norway there is a constant temperature of 8ºC all through the year. The mountain storage vault is a building built into one out of two mountain halls blasted out for this purpose. Before building a next vault, another mountain hall will be blasted out, so shaking will not disturb collections in the existing storage vault.

We used the mountain temperature to create a cold and stable climate inside the vault, by having the same temperature inside the building as outside. The relative humidity (RH) is set to 35%. New fresh air from outside the mountain is dehydrated and filtered before it goes into the storage rooms. The filtering system contains first two particle filters, then a filter with activated charcoal and at last one particle filter. 80% of the air coming out from the different rooms is cleaned again and then recycled, thus saving energy. The air exchange is once per hour.

In the year 2000, the digital storage vault was built inside the mountain vault. The challenge was then to counteract the heating from the equipment. The solution was to isolate this room from the rest of the building and put some extra ventilation into it.

We've also discovered that humidity from the mountain penetrates into the building, so today we also dehydrate the air in the mountain hall.

Climate measurements made through the year prove a high degree of stability.

Acclimatizing

To counteract a climatic shock, all material going in and out of the storage vault is acclimatized in a room with a temperature of 14ºC and 35% RH.
The length of the acclimatization depends on the volume of the material. The material shall at least stay in the acclimatizing room for 24 hours.

Vault for nitrate film

One part of the storage vault is actually placed outside the mountain. Nitrate film is very inflammable and therefore kept apart from the other collections. Originally the nitrate vault was built to house the collection of 11 tons of nitrate film that was formerly kept by the Norwegian Film Institute in Oslo. The vault has 37 cells, each of which was designed to hold 1500 kg of film. Non-flammable materials have been used wherever possible in the construction. Every cell has an inward opening steel fire door, blast relief via a «chimney» in the roof, and a modern fire alarm system coupled to a sprinkler system. Today the vault holds 45 tons of nitrate film.

## Security

Since the planning of a storage vault began during the Cold War, security was considered very important and used as an argument for mountain storage too. The access to the storage vault is therefore also limited. You only get access to the storage vault if you have work to do inside the vault and we also make controls from time to time.

For security reasons no documents from this storage vault are to be loaned to the public. The public only has access to the documents and the information trough copies, either analogue or digital. In this way the collections are protected against wear and tear caused by use.

## Shelving

When the mountain storage vault opened in 1993, there were 42 000 metres of empty shelves waiting to be filled up. The documents stored are both traditional library material like books, magazines, pamphlets, maps and posters, and other media like microforms, photographs, and motion picture films and sound recordings. A tendency over the last years is that we receive more modern media like sound recordings in various formats and digital documents. This gives us new challenges regarding preservation.

The various groups of materials are stored in separate rooms so that breakdown products from one material will not affect other materials. As a consequence the housekeeping can be less dynamic than desired; some rooms are filled faster than others.

We have rooms for printed material on paper, newspapers, photographic materials, magnetic tapes, acetate film and so on. It means that collections may be divided and moved into different rooms. This organizing also makes it easier to follow up the different kinds of material.

## Cleaning

The storage vaults have to maintain a high level of cleanness. This means that before a collection is placed in the vault, it must be cleaned and records must be made. It sounds simple, but it has been – and still is - a great challenge. Outside the mountain we've built an area for reception and cleaning of collections of different sizes. In this area there is also a room for handling collections infected with mould or insects, which we fortunately don't receive very often here in the north. In connection with this area, we also have intermediate storage for large collections.

## Boxing

Most materials are placed in acid free, lignin free, buffered (2,5% $CaCO_3$) cardboard boxes or envelopes to create a good microclimate. Boxes and envelopes used for photographic material or film are tested by the "Photographic Activity Test", so we are sure that the box or envelope won't harm its content.

Acetate film is packed in polypropylene (PP) boxes. To ensure some ventilation, the boxes have holes in the edges. After storing the boxes in a dusty environment for a short period, we experienced that the air exchange through the ventilation holes works quite well. It is therefore very important to maintain dust free environment using this kind of containers, unless you want to clean lot of film, which is no good for the film either.

## Disaster Planning and Control

Preventive measures against external conditions which may damage collections in the vaults.
Luckily, Northern Norway is not among the areas most likely to have an earthquake, but we still have done some thinking on the subject of protection against natural disasters. The vault will withstand a small earthquake and is situated so high above sea level that there is no risk of flooding. Electric power is essential to the operation of the ventilation system, and during Northern Norwegian winters it is important to safeguard this. A diesel driven backup power generator has therefore been installed in connection with the vaults.

During the planning of the building we also discussed protection against acts of war. The vaults are reinforced against conventional weapons, but not against nuclear weapons. In case of war it is important to ensure an uninterrupted supply of electricity. The building has also been secured against magnetic radiation, which is of the utmost importance for the protection of the Digital Long Term Repository.

Preventive measures against internal factors that may damage the collections.
What is of most concern is that the collections may be damaged or destroyed by fire or water. So we have tried to reduce the possibility of accidents which may lead to this. A minimum of electricity is used in the vaults, for lights and the Digital Long Term Repository only. The electrical system is constantly supervised and serviced so that malfunctions are caught and corrected as early as possible. All ventilation piping is located on the exterior of the building. Water for putting out fires is not under constant pressure, the pressure is turned on with a main faucet in the technical room by the entrance to the facility.

We also keep close contact with the local fire department. They have the superior authority in case of a catastrophe, but it is vital that they know what valuables we have in our vaults, and be able to take this into account when putting out a fire etc.

The human factor, manifested through for instance theft and vandalism, is hard to govern, but our entrance control system aims at reducing these risks.

These are measures that will reduce the risk of loss of material in catastrophes, but they do happen, and so it is essential to have a plan for the salvage of material on site and of damaged collections, but I will not go into it here.

## Preservation Policy

A good climate and a good environment form the basis of our effort to prolong lifetime of our collections. It is a simple and effective strategy when dealing with traditional archive and library materials printed on paper. Modern media with shorter expected lifetime forces us to make a more complete preservation plan or policy.

Testing
Although the collections are placed safely in the storage vault, it's important to follow up the condition of each group of the material. Up till today we have tested the collection of 45 tons of nitrate film (alizarin test) and we are testing the collection of 15 000 rolls of acetate film. A result of these tests is that several films go to the laboratory to be restored.
Another way of follow up condition to a group of material is building up test collections; for instance on paper. It gives us the opportunity to follow up the condition of the paper-based

collections and examine the effect of cold storage after several years without harming the originals.

Copying

There are two reasons for making copies of a document content; to give the public access to the collection and by this protect the originals, or when the physical carrier of a document is in a bad state or the expected lifetime is short. At NB all newspapers both the historic ones and the ones delivered in accordance with the legal deposit act, are microfilmed and we store both the original and the master microfilm in the storage vault. Collections of old photographs voluntarily delivered to NB are also digitised and are today available to the public on the Internet. The originals and the master copy are placed on different floors in the storage vault.

## Modern media – a great challenge

The greatest challenge in preservation today is the various modern media, like magnetic tape, optical discs and digital documents. These kinds of information storage introduce a set of new preservation problems, which make them extremely vulnerable:

- They usually have a shorter lifetime than traditional media
- They are harder to restore than traditional media. If a paper document gets a scratch it is usually no problem to restore, but if a CD gets a scratch all of the stored information may be lost.
- Dependence on machines and software to make use of the stored information. You can read a book without any equipment at all, but you need a computer and software to read information from a floppy disc.

Most modern "high-tech" media has a shorter life than traditional library media. Even though the physical object may seem intact, the stored information may be damaged; Magnetic tapes will demagnetise in time, regardless of the storage environment. Optical discs may become worthless due to scratches or microscopic cracks letting in air that oxidizes the reflecting layer. When problems like these occur you can't just send the document to the conservation studio, as you would do with a traditional paper document. If it is possible to retrieve any information at all it will happen in the hands of sound, video and IT engineers, making their magic in rooms where conservators fear to tread …

If the physical document is well preserved we are still dependent on machines to make use of the stored information. Considering the rapid technological development, what is state of the art today may be antique next week. Sooner or later it will be impossible to get new machines, not to mention spare parts for the ones we have. In our vaults today we have a large number of videotapes for which we have no player. There is a minor chance that we'll find one some day, but until we do, the tapes are dead – do we have to preserve them?

As a rule of thumb you can say that the keeping quality of the information is inversely proportional to the amount of technology involved in storing and retrieving it.

For the traditional conservator it has been and still is important to preserve the document itself in its original format, not only the stored information. The original document contains not only the original information, but also a lot of information as a culture historical item. When dealing with machine dependent documents the problems are different. Therefore it may be practical to regard the document as two separate parts: the physical carrier (the culture historical item) and the original expression (the intellectual object).

This dualism introduces another problem: Authenticity. Which is most original? The magnetic tape (and the original player) with a degrading carrier and constantly decreasing signal to noise ratio, or the digitised and digitally "cleaned" sound recording kept alive on a computer or on an optical disc?

We copy all of our nitrate films on to polyester based safety film. Do we have to preserve the original inflammable, self-destructive films if the original expression can be preserved on new film? And photographic glass negatives: Do we have to use time and effort to preserve them when they are copied onto safety film and digitised? Not to mention old, faded colour photographs: Do we have to spend money on them when the digital copies with "corrected" colours are a lot better?

Original documents contain information, which is not possible to save in a copy, either analogue or digital. Footprints from production and direction of motion picture films are for example of great importance to a film archivist. The originals are also documentation of the technological development and history. Can we allow those footprints to be erased?

Preservation today takes a lot of work, a lot of money and the courage to make difficult strategic choices. Good storage conditions and follow-up programs are essential, considering the huge collections that libraries manage, but it is not a solution to all preservation problems. We have to meet these challenges willing to use new technology, but our choices must be based on the goal to give every document the longest possible lifetime.

*"We*
*who stole*
*the heart of the mountain*
*Let us put*
*our own hearts there."*