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Author(s): Tarmann, G. M.

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Appendix IV

Flood disaster: a case study

G. M. Tarmann

*Tiroler Landesmuseum Ferdinandeum, Naturwissenschaftliche Sammlungen,
Feldstrasse 11a, A-6020 Innsbruck, Austria*

The day of the disaster

This appendix describes a case study involving the flood disaster at the Tiroler Landeskundliches Museum, Innsbruck, Austria. It happened during the early afternoon of 6 August 1985. After two days of heavy rainfall the rivers in Tyrol (Austria) were no longer able to hold the excess water flooding extensive parts of the country. This had happened several times before but, owing to river regulations, the flooded areas were mainly outside of the towns and villages. This time it was different. Years of devastation to mountain slopes and the restriction of creeks and rivers to a minimum breadth to gain land for cultivation, ski pistes or building activities had changed the country to a 'point of no return' and nature started to fight back. Seven people died on this day. The river Sill, normally a little creek running down from the Brenner Pass to the Tyrolean capital of Innsbruck where it joins the larger Inn, brought enormous amounts of water into the town and flooded parts of the city. The Tiroler Landeskundliches Museum housing the Department of Natural History and all the associated collections of the Tiroler Landesmuseum Ferdinandeum was completely flooded. The building, erected by Kaiser Maximilian I as an arsenal in 1502, had never been flooded before during its 483 year history.

The flood was completely unexpected and without any warning. Rumour has it that the sudden rise of the water level in the river was caused by the opening of the locks of a hydro

electric power station to save the turbines, others claim to have seen a landslide in a gorge south of Innsbruck and that the river was held back for some time and then suddenly pushed through the mud. None of these assumptions has ever been proved. It was at about 1.30 p.m. when the water reached the museum building. It rushed through the open entrance door but also came out of the ground in fountains from the drains and sewers. The volume of water and the power of the flood were so strong that it was impossible to immediately plan any organized rescue activities for the collections. The huge courtyard of the building (40 X 70 m) was completely covered with water within a few seconds. The strong current flowing from west to east made it impossible to close the front door. The ground floor offices with parts of the collections were submerged a few minutes later, accompanied by an earthquake-like shaking and a sound of thunder that came from the mass of water falling against the basement windows, smashing them and filling the basement hall where about 80% of the collections and parts of the library were stored. At this moment the water had reached the central power supply in the basement and the whole electrical system of the museum was cut. The lights went off and the telephone system went quiet. It was almost a miracle, and only because it was lunch-time, that not a single person was in the basement at this moment. An escape from that inferno would have been impossible. However, the exhibition halls on the ground floor and the first

floor were full of visitors. Some of them panicked and tried to reach their flooded cars in the parking area in front of the building but they were pushed back by the power of the water, which had reached a height of 1.15 m at ground floor level. The first reaction of the six staff members that were present was to rescue a handicapped colleague in a wheelchair from the water as he would have been drowned even at ground level. Two staff members were busy calming down the visitors and bringing them up to the first floor. One ran for help but this was difficult as the whole suburb was under water and everyone was clamouring for help. In a neighbouring building more than a hundred cars were flooded in an underground car-park and at ground floor level and in the basements all the houses were filled with water. Consequently, private persons and proprietors of stores, bars and restaurants were attending to their own emergencies and it was very difficult to draw attention to the problems in the museum.

In the meantime the remaining three staff members tried to save parts of the famous Alpine Lepidoptera collection that was situated in a room at ground floor level. The drawers had to be taken as rapidly as possible by hand up to the first floor, carrying them above one's head against the current and against floating furniture, hooks, papers, parts of trees from the forest and pieces of wood. To rescue these drawers of insects it was necessary to travel a

distance of about 40 m against the stream of icy water. In the first hours it was only these staff members, supported by a few courageous museum visitors, who rescued so much of this valuable collection. They managed to carry 1600 drawers up to the upper floor undamaged. At about 4.30 p.m. colleagues from the other museums of Innsbruck, the fire brigade and, slightly later, the first soldiers from the Austrian Army arrived. The visitors were rescued with rubber dinghies. The remaining parts of the collections and library at ground floor level were brought up to the first floor, much of the material already wet and muddy.

It was not until the morning of the next day that the river subsided and the flood-water dropped to ground level. It took three days to pump the water out from the basement. After this the true extent of the catastrophe could be seen.

Extent of the catastrophe

Mineralogy and geology

The collections of approximately 11,500 specimens had been stored in twelve large cupboards with drawers and in about fifty wooden boxes in the southern basement of the building. The pressure of the intruding water and its power were so immense that cupboards, weighing hundreds of kilos, were smashed against the eastern basement wall.



Figure AIV.1 A drawer from the mineral collection.



Figure AIV.2 The mammal and bird collection after being rescued from the basement.

The wood broke into pieces while the minerals and rocks were completely mixed and covered in fine, silvery grey mud (Fig. AIV.1). Many of the salt crystals had dissolved completely. Part of the historical collection was labelled with small oval labels glued to the surface of the rocks but many of these labels had become detached. Moreover, the courtyard of the building had been restored with cobble stones which had washed out of the ground and into the basement where they mixed with the material in the collection. Everything was covered with mud and the collection had lost much of its labelling. Later it was almost impossible to ascertain whether the rescued rocks were part of the collection or just those from the courtyard.

Botany

The famous Tyrolean Herbarium of the Ferdinandeum, containing more than 300,000 specimens mainly from the former Tyrol within the borders of the K. K. Austrian Empire, was stored in the Botany Hall in the north-eastern basement of the building. This area was also completely under water. The collection was arranged in strong cardboard boxes and stored on wooden shelves. The shelves broke into pieces as the wood expanded in the water and the cardboard boxes disintegrated as the glue dissolved (Plate 40). The plants themselves were

covered with the same fine river mud as mentioned above. Fortunately, most of the specimens remained on the papers to which they had been attached and so did the labels. In some of the boxes specimens were pressed together. Parts of this material remained almost clean and only the margins were covered with mud. Fortunately, the precious historical herbaria, including that of Guarinoni from 1620, were stored in the office of the botanist on the ground floor for re-examination and consequently this material was carried to the upper floor before it came into contact with water. The mushroom collection was completely destroyed as the cells of the specimens expanded in water, after which they burst and collapsed. The greater part of the wood collection rose to the surface and drifted away with the current.

Zoology

The mammal and bird collections were stored in historical wooden cupboards with glass doors in the southern basement. All the specimens were under water for two days. Under the enormous pressure the cupboards broke and the glass was smashed. Some of the older and poorly preserved specimens disintegrated into pieces. Most of the collection remained completely covered with mud (Fig. AIV.2). Some of the skeletons drifted away with the current. Others (e.g. a complete skeleton of



Figure AIV.3 A 'floating' cupboard from the Coleoptera collection just rescued by the chief restorer of the Ferdinandeum (left) and the author (right). Note that the water level is up around the waists of the rescuers.

Ursus spelaeus) had been restored earlier using water-soluble substances. Naturally these restored skeletons fell to pieces. The egg and nest collection was partly destroyed by the pressure and partly by drifting away with the current.

The mollusc collection was stored in small polyethylene boxes in cupboards by the wall of the basement. Some specimens were smashed but most remained in their boxes, rather muddy but with the labels still intact.

Except for the greater part of the Lepidoptera, most insects came into contact with water for a limited time even when stored at ground floor level. As some of the shelves broke, many drawers fell into the water. Some older cupboards, especially those containing the Coleoptera collections, started to float and drifted away (Fig. AIV.3), but most of them were held back. Some material was stored in older wooden or cardboard boxes which disintegrated in the water and the material was lost. The newer wooden drawers of fine quality, and each containing sixteen polyethylene system boxes in which the insects were arranged, turned out to be almost waterproof. Some of them kept the water out in spite of the fact that they had been immersed for more than 18 hours, so that the specimens survived without any damage. However, the drawers had to be abandoned as they had lost their exact shape and could not be closed

properly once they had been opened. If these drawers had come into contact with the water for only a short time they could have remained unaffected. More than 200,000 Coleoptera, about 100,000 Lepidoptera and some 10,000 other insects fell into the water. The muddy Coleoptera could be rescued. If the Coleoptera had been glued to small pieces of card with water-soluble glue, they became detached and it was not possible to associate them with the pins and labels any more. Those Coleoptera that were pinned and labelled could be saved and restored (Plate 42). The Lepidoptera were lost for exhibition purposes owing to the collapse of the wings but valuable scientific material (e.g. type material) did not lose its value completely as each specimen and its pin and label were still a unit; if the abdomen was present at least genitalia slide preparations could be made. Although some of the labels washed off, the genitalia slide collection survived because the slide numbers were etched into the glass with a diamond pencil.

Alcohol material

The alcohol material was also stored in the southern basement close to the collection of minerals and rocks. Most of the tubes were smashed by the heavy pieces of wood and rocks. Only a very small part of this collection could be saved.



Figure AIV.4 An office on the ground floor of the museum during the flood. In the background the 'river' flooding through the museum's courtyard can be observed.

Library

Unfortunately large parts of the Natural History Library of the Ferdinandeum were stored in the basement (e.g. books on mineralogy, geology, botany, mammals and birds and almost all scientific journals). Parts of this library were taken away by the current. Many bindings of books and journals disintegrated and the books fell to pieces. It was absolutely impossible to save the thousands of floating sheets of paper during the flood.

Catalogues

The large catalogues of the collections and the library, which dated back to the foundation of the museum in 1823 and which comprised thousands of index cards, were completely washed away. The cupboards in which they

had been stored floated front-down and the drawers slipped into the water.

Material on loan

The greatest possible care is always taken with borrowed material. As the author was then working on a major revision of the American and Asian Zygaenidae, valuable material from London, Paris, Berlin, Washington, Leiden, Bonn, Budapest and other museums was stored in his office in a special locked cupboard. Except for the material from the museums of Leiden, Bonn and Budapest, that remaining on loan was saved by climbing up against the wall in the office which was completely under water, with floating tables, chairs and cupboards, and depositing it just under the ceiling on top of a book-shelf fixed to the wall (Fig. AIV.4).

Chemicals

Some chemicals are especially dangerous if they come into contact with water. In the present case several killing jars filled with potassium cyanide and more than 1 kg of pure potassium cyanide crystals were stored in a special 'poison room' in the southern basement of the museum. No one could prevent the water entering this room but, as the killing jars and the cyanide crystals were stored in waterproof boxes, no water penetrated them and no poison escaped.

Personal losses and psychological effects

Many colleagues lost major parts of their scientific work and all or parts of their collections. It was a very hard decision what should be saved first: museum property or years of personal scientific work. The botanist and ornithologist of the museum, Mr W. Neuner, and the author, both present when the water invaded the museum, finally decided to save the most valuable collections of the museum first. These collections were entrusted to them not only by the authorities of the Ferdinandeum but also by generations of idealists and collectors who had donated this material to the museum, thoroughly convinced that it would receive the best care and attention possible. It was an obligation to fight for these collections with all possible power. It should also be mentioned that the psychological effect on the staff was traumatic after the initial drama of the incidents of this day had calmed down and the loss of years of personal scientific work was fully realized. All persons involved were close to nervous breakdowns and it took days and, for some, months to recover.

'First aid' — the most important factor for saving valuable material

Now, 12 years after the flood, it is realized that the action taken during the first hours and the day after the catastrophe was decisive. It was a hot August in 1985 and late summer. The high temperatures combined with the humidity were the most important factors affecting

the material. The muddy sand of the river was full of organic substances and it was only a few hours before a smell of decay was noticed. The chief restorer of the Ferdinandeum, Mr M. Klingler, already had experience with flood disasters as he had worked with a restoration team after the big flood of Florence in 1966. He decided that all material that had been rescued had to be deep-frozen immediately. This was the only way to conserve the status quo, to gain time and to enable the careful organization and implementation of further moves that were necessary for restoration. Thanks to his expertise (which was not readily accepted by all responsible authorities), and thanks to the help of a private company free of bureaucracy, 80 tons of material was taken to a deep-freezing facility in Salzburg on 8 August 1985. Part of the material was to remain there for almost ten years!

National and international help

One of the main problems of many institutions is that their value is often not sufficiently realized in their own country. This also happened to the natural history collections of the Ferdinandeum. They had often been regarded as just an unavoidable appendix to the collections of history and the art galleries of the museum. Therefore, action from outside the country was essential. Professor C. M. Naumann (Bonn, Germany) immediately initiated an international fund under the title 'Entomologists help Tyrol' to raise money for the devastated collections and solicited moral support by writing petitions to authorities and distributing information on the value of the collections to the press. The response to that action was breathtaking. More than a hundred institutions and private persons supported the museum with donations of collections, scientific literature and money. The constant reports in the news of those international actions, which also stressed the importance of the collections, finally convinced the responsible politicians to make a definite promise to raise the money for the complete restoration of the collections and the supply of new collection rooms. This is one of the finest examples in the history of natural history museums where

international solidarity between friends saved invaluable treasures. The Natural History Museum in London supported the Ferdinandeum by providing, on permanent loan, a number of important books and scientific journals from its duplicate collections. This was initiated by staff members of the Lepidoptera Section, the then editor of the *Entomology Bulletin*, Mr W. G. Tremewan, and by Miss P. Gilbert, then Head Librarian of the entomological library. This stock is now an important part of the library of the Ferdinandeum and is enthusiastically used by scientists, students and visitors. After this preliminary response similar attempts were initiated for the collections of Mineralogy, initiated by Dr R. Exel (Vienna, Austria). The museum received valuable mineral collections and financial support. A great number of volunteers, some of them for many years, provided important help during the difficult period of restoration.

Restoration

The restoration started immediately after the collections were safely deep-frozen and is still going on. It took nearly ten years before a new building was found to house the collections and until sufficient new collection and working facilities of an international standard could be installed. Four moves with the whole staff and all the rescued and restored material into three different temporary buildings were necessary. Since October 1994 the collections have been stored in air-conditioned and safe rooms in a new permanent building.

Mineralogy and geology

This part of the collection was not deep-frozen. The material was washed in clear tap water and carefully brushed. The cleaned specimens were pre-sorted and stored in boxes. The materials whose labels had come loose were stored separately. The registration numbers were repainted on the specimens with waterproof ink and the labels rewritten. Historical labels were restored and were cleaned by careful brushing and the use of an eraser. More than two-thirds of the collection was saved. The restoration and resorting of the surviving 7500 specimens took

ten years. The collection is now stored in a special collection room for Mineralogy using wooden drawers housed in a metal compactor system in the new collection building.

Botany

The largest part of the collections affected by the flood was the herbarium. More than 300,000 plant specimens had been rescued in a completely wet and muddy condition. The deep-frozen fascicles were first transported to Vienna and disinfected in the Volkerkundemuseum Wien. Restoration experts feared that the rotting mud could contain poisonous bacteria or fungi that might attack the lungs of the restorers, similar to those that had killed scientists in the tombs of the Pharaohs in Egypt. After the material was disinfected it was dried. Specimen by specimen the plants were cleaned and remounted after removing the mud with fine brushes and air. The muddy historical labels were restored as far as possible and mounted on the herbarium paper beside the new labels. Now, after twelve years, only 30% of the collection has been restored. This restored material is now stored in a new air-conditioned collection room using flexible cardboard boxes housed in a metal compactor system.

Zoology

The mammal and bird collection was also the first to be deep-frozen, then disinfected and finally restored by a Danish team of specialists by washing the skins in a special liquid (not disclosed), after which they were dried, fanned and remounted. Most of the rescued material could be saved and the task was completed after one year's work.

The Coleoptera collection was restored after deep-freezing and disinfection in Tickopur R 27* at 5–10% concentration using ultrasonic sound waves. This very elegant and effective method had been tested by Professor

*Tickopur R 27 is a liquid bactericide, fungicide and algicide. It is an acid used to dissolve grease and remove chalk, concrete and rust. It can be used to clean iron, steel, copper, silver, gold, chrome, glass, plastic materials and rubber. It is distributed by Bandelin Electronic, Heinrichstrasse 3-u, D-10317 Berlin 45, Germany.

Naumann's team and the equipment was bought with money from 'Entomologists help Tyrol'. However, the collection could only be partly restored as thousands of specimens had come unstuck from the cards on which they had been glued and were lost. The restoration has just finished and took twelve years.

The Lepidoptera collection has been rearranged in new drawers of the same good quality that had resisted the water during the flood. Now they will at least survive exposure to water from the fire brigade in the event of a local fire. The most valuable Lepidoptera material that could not be restored satisfactorily has been dissected. Several thousands of genitalia slides have been prepared, a task that took ten years.

The Zoology collections are now stored in air-conditioned rooms on metal shelves (insects) or in compactor systems (mammals and birds). Of the molluscs, only the Conchylia were saved and these were carefully washed and cleaned, relabelled and resorted. Most of the material was still in the boxes together with the labels and was only dirty. The remainder of the mollusc collection was lost together with the alcohol material.

Library

Only the most valuable books that were rescued could be restored by special paper restorers owing to the high cost of this work.

Precautions for the future and recommendations in the event of a catastrophe

After such an event one has to think what went wrong and what can be done in future to prevent similar catastrophes. The possible sources of catastrophes are many and complex and it is almost impossible to take precautions against everything that might happen. Seen from the point of view of possible flooding or damage by water (and only from this point of view!), I would recommend the following:

1. Avoid the storage of collections in basements.
2. Store the collections so that at least the water from the hoses of a fire brigade

cannot do any harm to the material should there be a local fire.

3. Put scientific information on to a computer and save several copies on discs in different places.
4. Establish an effective pre-warning system on the floor to detect water that may come in unobserved from broken pipes (e.g. at weekends or during the night).

In the event of a catastrophe it is important:

1. To try to keep as calm as possible.
2. To look for and think carefully where there might be danger (e.g. electricity, gas, chemicals, smoke, falling walls, crashing shelves, falling cupboards etc.).
3. To make sure not to endanger one's own life.
4. To save the lives of endangered persons.
5. To assess what can be done immediately without external help to save valuable material.
6. To try to get help, if possible.

The problems are not over after a catastrophe has taken place. When the event is no longer in the headlines many promises made by responsible authorities in their first enthusiastic statements may be quickly forgotten. A continuous and carefully planned programme to keep things going and a strong personal commitment are essential. The fact of having been personally involved in the disaster provides a useful psychological 'bonus' when dealing with those who try to hold back money and other support. A firm belief in the importance of one's own activities provides a great antidote to frustration, and a strong will to fight for the entrusted material, whatever may happen, can work wonders. The most important thing is to never give up.

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