Restoration of astronomical photographs on glass plates

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Abstract:

This paper consists of several parts: At the beginning we add, for the information of the readers, a brief description of the History and Characteristics of Astronomical Images on Glass Plates. Next, we add a brief description of the techniques used for their restoration according to the different physical and chemical damages that the plates may have and some recommendations on their storage and keeping. Finally, we present the "Case Studies". They are the most important part of the work and they describe the activities that we are developing and the projects that we have in progress.

Glass plates were used since 1816 to fix images using different types of light-reactive chemical emulsions. These plates fixed positive and negative images until the use of the Daguerre method became popular at the end of the 19th century. Successors of this process and through emulsions in variants of Silver Bromide, towards the beginning of the 20th century they were already used to capture astronomical images and study them as part of the observational process.

In the present work we will focus on solar pictures taken at the San Miguel Cosmic Physics Observatory between the years 1940 and 1970. These plates were abandoned for 23 years and stored, if it can be considered this way, in conditions that were not always satisfactory, for which deteriorated in various ways. This work explains the techniques and processes to which parts of the plates were subjected, how they were cleaned and the images that were obtained from them for their subsequent catalogue, use and study.

Keywords: Astronomical Photographs – Restoration – Glass plates – Solar Pictures – Museum material

Previous presentations related this work

Merlo, David y Balbi, J. Nicolás, RAAA 65 (2023) San Juan, Argentina. Reunión de la Asociación Argentina de Astronomía. Fotografías solares en Placas de Vidrio / Boletín de la Asociación Argentina de Astronomía, Volumen 65, Buenos Aires, 2023.

Balbi, J. Nicolás et al, SEAC 30th (2023) Warsaw, Poland. La Red MoAA y sus propuestas.

Balbi, J. Nicolás et al, SEAC 31th (2024) Sicilia. Glass Plates astronomical photographs restoration.

Merlo, David y Balbi, J. Nicolás, RAAA 66 (2024) La Plata, Argentina. Reunión de la Asociación Argentina de Astronomía. Eclipse de 1958. Fotografías inéditas.

Balbi, J. Nicolás et al, FDEACYT (2024) San Miguel, Argentina. Trabajos de Restauración en el Observatorio de San Miguel.

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[2] Colchester Archaeological Group (UK), IAU, EAA, SEAC, SIAC, SACEM, SEAC-EAA Community, etc.

"Images in glass plaques: Restoration and recovery Of Solar Astronomical photographs at the San Miguel Cosmic Physics Observatory (Argentina)"

1 Presentation of the Topic:

Glass plates were used since 1816 to fix images using different types of light-reactive chemical emulsions. These plates fixed positive and negative images until the use of the Daguerre method became popular at the end of the 19th century. Successors of this process and through emulsions, basically in variants of Silver Bromide, towards the beginning of the 20th century were already used to capture astronomical images and study them as part of the observational process. In the present work we will focus on solar panels taken at the San Miguel Cosmic Physics Observatory between the years 1940 and 1970. These plates were abandoned for 23 years and stored, if it can be considered this way, in conditions that were not always satisfactory, for which deteriorated. This work explains the techniques and processes to which part of the plates was subjected, how they were cleaned and the images that were obtained from them for their subsequent catalog and use.

02 Origins of glass supports:

In both negatives and positives the origin is very ancient and with an interesting development: In 1814 Joseph Nicéphore Niépce devised "heliography" and made his first positive supports on glass in 1817. Associated with Louis Jacques Daguerre improved the quality, although Daguerre, in 1829, published a treatise on the subject and appropriated the invention, from which it became known as Daguerreotypes[3]. However, at the time it was about reflecting in the negatives what was called the "Stereoscopic Vision", which was two separate negatives with a different variation of angles of the same image, since it was supposed to be the way the human eye could be emulated. Sir Charles Weatstone carried out a large number of studies and published his discoveries in 1838, in which he used a glass support treated with a Collodion emulsion. David Brewster, in 1849, modernized this process using the negative (Glass/Collodion), and the positive was printed on cardboard paper treated with albumen. This combination would be used until approximately 1880, when positive plates with gelatin bromides would begin to be used directly, thanks to the work of Charles Harper Bennett. To give a brief explanation of the chemistry of these discoveries, we can say that a daguerreotype will use a silver-covered copper plate sensitized with iodine vapors, which will be exposed and developed with mercury vapors. This copper plate would have a mirror finish and would be protected by glass. Collodion is a nitrocellulose solution in a mixture of ether and alcohol to

[3] According to the partnership contract signed between Niépce and Daguerre, on December 14, 1829, for the development and commercialization of the invention, the method was composed of the following steps: «on a stone, a paper or a metal plate — silvered copper, for example—a varnish made with Judean bitumen dissolved in lavender essential oil was spread, then the plate was exposed to light in the dark chamber, and then bathed in a solvent composed of lavender oil. Lavender and white petroleum oil and, subsequently, wash it with warm water, being able to then appreciate the image obtained.

which a light-sensitive product was placed; the practical complication was that the plate had to be prepared immediately before exposure. We can also define the ambrotype, in which the image is formed in a binder (Collodion) placed on a glass plate and sensitized with silver salts. This emulsified glass is exposed in the camera and the negative is obtained, producing a positive image that came with a black back cover that highlighted the whites of the silver salts. On the other hand, the tintype is an ambrotype in which the Collodion was applied on a black varnished tin plate where the positive is obtained directly from the camera. Already at the end of the 19th century, more stable emulsions were used, such as those of different types of bromides, which were actually a solution of cadmium bromide, water and gelatin sensitized with silver nitrate. These plates allowed several days of storage, although the machine chassis had to be loaded in a dark room, as they were ready for the reaction. Finally, silver halide gelatins sensitized with sulfur, reducing agents or precious metals would be used. During the course of this exhibition, we will exhibit glass negatives treated with this last method.

03 Description: Examples of glass plaques on images. There are different images to illustrate every chapter.

04 Glass Plates and Slides:

We are carrying out the restoration of some of the glass plates and slides found at the San Miguel Cosmic Physics Observatory, with the Bella Vista al Cosmos team. The old slides may contain very important information about the work that was done at the Observatory in the mid to late 20th century. These slides and glass plates, in most cases, are attacked by humidity, stuck dust and in most cases impossible to appreciate, as we can see in the first copy. The stabilization process of the materials is very slow, since they were subjected to extreme temperature/humidity conditions and we must proceed slowly to try to make the most of the information stored in the supports. In the case of slides, the work consists of disassembling the plastic frame and subjecting the film to a cleaning that is carried out with diluted “Stop Bath”, which turns out to be the last chemical (understood in order) that is applied to photographs in the so-called “analog development”; this procedure is also used for glass plates. In my case I was able to get the Kodak SB-5a brand product, which must be diluted with demineralized water, then the film must be immersed at a temperature that is not lower than 21°C (which is ideal in Buenos Aires in January) and Clean mold and dirt with a swab as much as possible, since it is best for the water itself to clean the surface[4]. After washing with distilled water, it should be left to dry in an environment with as little humidity as possible (I use a cigar humidifier box, complete with silica gel crystals), and after a few hours you can see the restored and dry material. An important point is the use of distilled water, since the gelatin layer is reactive to oxidants and if it were immersed, say, in bleach directly, it would take seconds to dilute. A previous procedure that is sometimes sufficient consists of cleaning with a brush with sable hair, or the so-called Japanese ones, normally used in Art or Cosmetics, since the dry

[4] Some authors prefer to use demineralized water and a surfactant (alcohol, ether, Kodak Photoflo) and clean with trichloroethane (to emulsion), although the product is toxic and harmful to the environment.

support tends to attract dust. The use of a rubber bulb or a vacuum cleaner is also useful. In our particular case, almost all of the plates suffered deterioration that required the use of a stop bath, although dry cleaning was attempted, which is also useful after chemical treatment, since freshly dried plates tend to attract dust on the surface, making it difficult to document its contents. In the case of the slide, it is placed in a homemade tube, which I made in a workshop many years ago with a 50mm lens, a slide holder box and a mount (in my case Nikon). All you need to do is find an afternoon with a clear sky, point the camera and take the digital photo, focusing manually with the aluminum tubes.

05 Glass Plates at the San Miguel Observatory:

We have many devices to restore to recover more information about the research carried out in San Miguel by the Observatory scientists. This knowledge and the success of the restorations allow me to carry out a similar process with some glass plates with the emulsion intact, except that the drying must be done in the open air and without the need for drying with silica stones, since gelatin, in In this case, it has lost its humidity and that is why they have darkened a little more than normal. To document the content I use a Negatoscope that I have made based on a polycarbonate film, tracing papers and its support on a notebook with a white luminous background. To scan, simply place the plate on the scanner with the computer on top of it and adjust the light intensity. I have seen many negatoscopes, medicine or dentistry ones can also be used, with the same results.

06 Deterioration and Recovery of Glass Plates:

It is possible to find plates correctly stored, but it may be the case that they are deteriorated due to physical breaks caused by incorrect handling or storage. The glass used in the plates usually has different thicknesses, but the material is brittle and is very easy to break. These plaques can also be attacked by chemical agents, which include all oxidants, coming from both cleaning products and the deterioration of buildings, paints, etc.[5] we must bear in mind that Bromide salts are completely diluted in Chlorine concentrates or its hypochlorite variants. Likewise, it is also natural to have the idea of the organic constitution of gelatins treated with Bromide salts and that this will be the behavior of said gelatin. However, gelatin is originally attacked by all types of bacteria given its composition, although Bromide salts They act quickly like antibiotics. That is why in some plates you can see the edges of gelatin attacked by bacteria but not its center, where the images are usually found. Likewise, increased humidity can cause a loss of transparency and fungal attack will permanently deteriorate the image. The hygroscopic nature of the salts added to gelatin (Sodium, calcium, potassium, etc.) leads to the absorption of

[5] The EEC (European Economic Community) classifies bleaches based on the concentration of sodium hypochlorite they contain, as follows: less than 5% sodium hypochlorite: non-irritant, between 5 and 10% sodium hypochlorite: irritating. Greater than 10% sodium hypochlorite: caustic. Currently, the current regulations for bleaches for domestic use establish that the concentrations of sodium hypochlorite be 3.15 to 6.3% (20 and 60 g active Cl/L of product), so that they do not cause caustic reactions. When concentrations exceed 10%, we speak of bleaches for non-domestic use. In Sánchez, M., Sancho, N., & Andrés, M. (2020) NURSING ATTENTION AND CARE IN POISONING BY DOMESTIC PRODUCTS. Retrieved 12 November 2020, from https://revistas.um.es/eglobal/article/view/677

moisture and the loss of transparency of the image. This reaction will generate an autocatalytic process that will produce an increase in the alkalinity of the plate, which will become more opaque.

07 Deterioration of the glass support due to the action of salts[6]:

We have mentioned the action of different salts in the process of deterioration of the plate and as a consequence of this, the surface of the glass can reach a pH of 10, which is a value much higher than that necessary to dissolve silica, which is the main component of glass. At first, no traces of the action of the salts are seen in the material, only a whitish appearance, which under the microscope (at 100 x) will not appear gelatinous but rather like small sheets of crystals. With a humidity of less than 40%, a kind of dust can form and when the humidity decreases and if it is greater than 55%, tiny droplets can form in the material that can be seen under a microscope and that is why it is usually not detected in time. The material of the plate (glass) becomes fragile, unstable and sensitive, given the gaps it presents in its structure. In a more advanced state, the surface of the object may become slippery, as if soaped[7]. Chemically damaged glass has immediate consequences. On the one hand, it suffers an aesthetic alteration by losing transparency, something especially relevant, for example, in negatives and photographic processes seen by projection (lantern plates, auto chrome). On the other hand, its physical stability is affected by becoming more fragile and transmitting this excess moisture to the emulsion that houses the final image and that is in direct contact with the glass. In cases where the glass is another piece of the photographic object, in the form of protective glass, for example, the loss of transparency will be a problem to take into account. In these cases, the conservator - restorer will have to consider whether or not to replace that original piece that has been part of the set for decades but that no longer fulfills the protective function and impairs the correct viewing of the object. In my experience, and since a quantity of humidity has acted on the gelatin of the plate, it is already deteriorated and has stuck to the protective plate; It would be advisable to cover the plate again with the materials indicated for the broken plates.

08 Broken negatives on glass plate:

We found many broken negatives either because the support has been handled incorrectly or due to blows received during storage. The break may have split the negative along with its image, or may have been held together by the gelatin on the plate; In this last case I have tried using a cling film on the part of the plate without emulsion and proceeding to photograph the piece. The cling film can resist the cleaning process and if it is carried out in a hot environment, its tips may rise. It is possible to change this film prior to storage. In all cases of breaks, the first thing to do is stabilize them, trying not to continue the damage. Some restorers believe that the best way is to join them without glue since it is the most common practice in archives and libraries, in collections in which the priority is to preserve documentary information and provide the plates with sufficient stability to be able to be manipulated,

[6] Herrera Garrido (2014)
[7] Herrera Garrido (2014)

observed. and scanned. This stabilization assembly is carried out by placing the parts of the damaged plate between two new transparent glasses of the same size as the original, reinforced with plastic material on the edges and with the addition of a small thickness that will form some windows for air circulation through the inside of the original plate. Various types of tape can be used, although Filmoplast® P-90 adhesive tape is recommended. This form of fastening has the function of preventing the emulsion from sticking to the added glass and, in addition to deteriorating the emulsion, forming distortions known as Newton rings[8] when illuminated, which are so disturbing when viewing or scanning the plates. Once closed, the spacers are hidden and invisible under the adhesive tape. In those cases in which we are missing an original piece, it must be reproduced with conservation cardboard. Its function is to prevent the broken pieces from oscillating inside the "box" made up of glass and tape.

09 Broken plate splinting (or sandwich):

This solution, based on merely stabilizing a broken plate with the addition of new layers of glass, is very practical and widely used, due to its evident reversibility. However, it has an unaesthetic finish and involves multiplying the original thickness and weight of our object by three. Therefore, it is not recommended for all cases. The adhesion of the pieces with this system turned out to be very clean and strong. The epoxy resin used, in my case I usually use Devcon or similar two-component preparations, whose characteristics, compared to other epoxy resins, must be a medium viscosity, which allows the mixture to work with small tools but whose viscosity is not so low that it migrates. alone along the fracture. In this case, there would be no gaps or bubbles, but the adhesive would move out of the crack. Some techniques, which I personally do not use, indicate leaving remains of the adhesive on the outside of the crack, being glued on the emulsion side, so that the remains descend by gravity and close the gaps, then these remains must be removed with acetone. before the resin polymerizes, which, depending on the product, can take several hours. To facilitate the elimination of said residues, as I had clarified, it is about working on the smooth part of the glass, leaving the frosted part, which is more difficult to clean, on the opposite side. However, this technique usually has the peculiarity that the emulsified side is the smoothest and the procedure becomes more risky.

10 Preventive Conservation of photography on glass:

Glass is a material of great hardness and dimensional preservation, which ensures the stability of the emulsion content without the plate being affected by the storage conditions. The problem lies in the emulsion and its content. That is why the application of temperature and humidity regulators in plate tanks is so particular, depending on the continuity of this regulation. That is, if the place where the deposit is located does not have the security that the equipment will be attended to and will be calibrated to the stipulated values, the possibility of leaving the material in the natural climate should be studied, of course, depending on the location of the site. Although this clarification is not ideal, in practice it happens that many sites

[8] This phenomenon was first described by Robert Hooke in his book Micrographia, although its name derives from the physicist Isaac Newton, who was the first to analyze it in 1717.

lack correct monitoring of values and sudden variations in temperature and humidity are much more harmful, which could cause the detachment, deterioration or delamination of the emulsion. I have not seen this opinion of many restorers in practice, after restoring plates subjected to extreme conditions and that have not delaminated. In any case, and currently a temperature of about 18ºC and a relative humidity of between 30 and 40% are desirable conditions, which, according to experience, would be effective both in preventing the emulsions from drying out and in preventing the emulsions from drying out appearance of microorganisms. Although I have already discussed the results of the action of chemical elements, the presence of reactive agents such as peroxides, nitrogen oxides, sulfur dioxide, hydrogen sulfide, ozone, etc. should be avoided. Inside the plate deposit Glass does not suffer particularly from exposure to light.

However, to protect the photographic image, it will be stored in the dark in envelopes and boxes according to its format. Furthermore, an additional characteristic must be taken into account: The weight, volume and fragility of the elements and therefore, providing them with appropriate, safe and economical storage continues to be a serious problem in archives. Many of the plates are still housed in the original boxes where they were purchased, which contain very useful information regarding the brand, processing, expiration date, etc., but they are made of poor quality cardboard. Furthermore, the plates preserved in this way are not usually protected by an individual envelope, although they generally have the tracing paper inserted with which they were normally acquired. In the case of medium plates, for example, the boxes were sold containing 12 plates each, a number that does not match the number of exposures in each archival box and results in boxes with few plates or a quantity close to 20. , in these cases, the emulsions can then suffer scratches and all kinds of mechanical damage.

According to ISO:18960 standards, it is advisable to house the plates in individual envelopes, preferably with four flaps, made from recommended papers and plastics such as surgical support paper[9], which is very economical. sold in rolls and used in operating rooms to support sterilized items, which is preferred because it is not supposed to have acidity; Specific restoration products such as Tyvek® IX and Filmoplast P90 tape can also be used; I use Medical Kraft with a special 3M tape. All these standards can be found in an international standard catalog known as PAT, for its acronym in English Photographic Activity Test"; developed under the international standard norms already mentioned (ISO:18916) and that deal in a specific way with the storage and exhibition materials of photographic heritage, developed by the Image Permanence Institute in order to assess the interactions between supports and their conservation. The PAT is used, today, to analyze a wide variety of materials: papers, adhesives, inks, plastics, glass, decorative elements, presentation, assembly and framing of works, as well as materials used for envelopes, folders, labels and albums, and there are sites that specifically market the products included in these standards[10], some of which are very expensive although they were the subject of studies carried out for better preservation of the elements. In practice,

[9] Known in Argentina as "Medical Degree Paper or Medical Kraft".

[10] Conservation Materials, available in July 2023 at https://materialesdeconservacion.com/category/materiales/productos-p-a-t/

and precisely because of their cost, I have seen many of these products replaced by some with less specific use.

It is important to take into account some details such as the material of the envelopes. While in Europe and the United Stated the paper is acidic and is mostly produced from cellulose (And the bibliographic references mentioned this), in Central and South America it is produced almost exclusively from sugar cane pulp, which makes it suitable for direct use, since we have verified at Lab its PH at 7. In Argentina, almost all the paper used is of this type.

11 The PAT and materials.

Some practical substitutions: - Conservation papers and cardboard must be made from rag pulp or purified wood and have high alpha-cellulose content (minimum 87%). Be free of sulfur, lignin, bleaches, dyes, peroxides, waxes, metallic particles, chemical impurities, and acidic sizes. Have a neutral or slightly alkaline pH (7-8). In other words, paper and cardboard made from vegetable cellulose are perfectly viable and, on the other hand, are the most common on the market. If the chemical treatment indicates a PH greater than 10, we were able to see previously how plaque can attack, although these PH values are not common.

Conservation covers and plastics must: Be free of plasticizers and without surface treatments. Preferably made of polyethylene (PE), which is one of the most common plastics, polyester (PET) or polypropylene (PP); which are obtained through different polymerization reactions of Polyethylene. Also some obtained by polymerization by free radicals, anionic, by coordination of ions or cationic polymerization. In the case of searching for a neutral plastic, the most suitable would be polypropylene. Polyvinyl chloride (PVC) plastics should never be used. I understand that this indication from the Institute is due to the fact that its polymerization leaves chlorine atoms in the components, which are corrosive as we have seen[11].

12 Envelopes and Boxes:

Providing each photographic object with individual direct protection prevents abrasion and prevents the transfer of damage. The envelope also allows the labeling of the object and the possibility of separating it individually for study, avoiding unnecessary manipulation of the rest of the specimens. The broken plates must be stabilized among other plates or their pieces mounted on cardboard so that they do not rub together, and loose pieces should never be stored inside an envelope, to avoid scratches and deterioration. Once protected with an envelope, the plates can be stored in conservation boxes, drawers or shelves. The boxes must meet a series of characteristics to be suitable for housing photographic collections. As we had seen in the PAT recommendations, the boxes must be made from acid-free cardboard, with high alpha-cellulose content. Secondly, they will be built without adhesives or staples (based on metal edges, stainless steel, or notches that fit into the sides) and will have reinforced corners. They must also close perfectly so that dust does not enter inside and be of dimensions adjusted to the format of the type of photography they are going to house. On the

[11] However, this component is used in elements that require extreme hygiene measures such as catheters, bags for blood and blood products, as well as many drinking water pipes. Its useful life is estimated at about 60 years.

outside of the boxes, the following information “fragile”, “heavy”, “glass” must be included, thus warning the person who is preparing to handle it and prevent possible accidents. Photography collections should be organized by type and format, and it is not advisable to mix prints with negatives, or glass with film. Mixing formats in the same box can cause mechanical damage as the edges of smaller objects will rub against larger plates. We must also establish a maximum number of artifacts per box, folder or drawer and place them vertically or horizontally depending on their format. Edge storage, vertically, is recommended for small formats. On the one hand, this avoids the accumulation of weight on the bottom plate, which is what inevitably happens when they are stacked in horizontal position. And on the other hand, better ventilation is allowed between the pieces. When storing vertically, it is highly recommended to insert a rigid divider every 10-20 cm. These dividers, which can be made from corrugated cardboard or thick conservation cardboard (2mm), offer greater structural support and prevent the plates from tilting.

13 Recommendations for storage:

Regarding the quantity and location of plates and their boxes, I will base my notes according to the work of a restorer who follows the principles of the Restoration Institute[12], although practice may suggest differences: The storage position, given the fragility of glass, it seeks to avoid excess weight. In formats: ≤13x18cm they will be installed vertically and in a quantity of +/-20 to 25 negatives per box. The IPI advises twice as much. For ≥18x24cm horizontal. +/-10 negatives per box. In large formats the IPI recommends +/-5 per box horizontally, I store them in individual boxes, vertically. I must say that I have only seen problems with horizontal storage; I suggest doing it vertically in a maximum of 20 plates per box with dividers and false plates to complete the size of the box, with the intention of making the box more solid and compact. The reason is simple: Originally, most of the studies carried out at my workplace were done for days at a rate of one plate every hour, the taking takes time and the astronomers found hourly regularity to be something acceptable for the study. With an addition of some additional plate, the plates were stored by boxes and a number of 20 plates is easy to handle. In reality, there is usually an average of 17/18 plates per day. For special events, my experience is that they are registered with less than 20 plates each[13].

Comment: Photography conservation is a recent discipline when compared to other arts, which means that it is somewhat lagging behind and there is not enough historical perspective when evaluating ancient treatments. On the other hand, it is based on a type of support and technology that is constantly changing, which means that we specialists in the subject have to constantly update ourselves. There are, therefore, many gaps to be filled, of which the conservation of photographic glass is, without a doubt, one of them. For years, photography has been valued solely for its iconic image, ignoring the beauty and information provided by protective glass, mounting boards and other pieces. However, today, there is a tendency to study these photographic objects as a whole, three-dimensional, whose pieces were selected

[12] Herrera Garrido (2014)

[13] Examples: Solar eclipse 1952 (13 plates) Solar eclipse 1958 (17 plates) Solar eclipse 1959 (11 plates). There are some check pictures on the boxes. For Example in 1958 eclipse only 6 images documents the eclipse itself.

and assembled by the same person who took the image and, therefore, are part of the photograph itself. On the other hand, most photographic processes on glass are negatives, which do not have the artistic halo of copies, which are normally exhibited, appreciated and published. The negatives are dark, difficult to read and interpret. Unfortunately, they have been undervalued for a long time and cases are well known in which entire collections of glass plates were thrown away after their digitization, so in vogue, by the way. Glass negatives are heavy, break and annoying, but they are the photographic original taken in camera and can never be replaced by a scanned image, regardless of its resolution. Therefore, it would be advisable to raise greater awareness about the importance of these objects, and to educate the general public, who deserves to be able to understand and enjoy these pieces in a museum room. Finally, more research is pending in the field of broken glass, since we still do not have ideal solutions or adhesives to restore a fracture in a durable, stable and reversible manner.

14 Intervention methodologies:

Before undertaking any recovery and conservation project of a photographic collection, it is necessary to consider the problems linked to the nature of the materials that make up the fund or collection to evaluate the state of conservation in which it is made. found and the treatment to apply for identification and subsequent intervention. It is necessary to distinguish the materials, know their characteristics and the types of possible deterioration. Differentiating the type of photographic emulsion is very important. The plate emulsions, collodion or gelatin-silver bromide, will pose different problems and deteriorations for which we must seek and use alternative solutions; but not only emulsions are sensitive to deterioration, although it is more complex, the glass support is also susceptible to physical/chemical damage, being a fragile material prone to breaking if not handled carefully and sensitive to variations in temperature. Temperature and humidity if not stored under acceptable environmental conditions. In general, a possible protocol of action for the preservation and intervention in photographic collections must be carried out following an order[14]:

a) Record of the file, institution or place from which they come.
b) Historical-artistic study of the material.
c) Preparation and treatment proposal.
d) Planning the transportation of the material to the laboratory or place where they will be treated, ensuring or at least trying that said place is in optimal environmental and hygiene conditions.
e) Pre-restoration photographed of each object as well as the entire background.
f) Preparation of a collection report (Condition report) and restoration technical sheets to document each object that is going to be intervened.
g) If necessary, perform microbiological extractions and other tests before or during the intervention.
h) Conservation and/or restoration intervention process.
I) Photograph the entire process.

[14] Herrera Garrido (2014)

j) Prepare adequate storage.
k) Final report and conclusions of the work carried out in conservation – restoration.
l) Transportation and storage of the restored materials to the place where they will finally be stored or archived.

15. Intervention and treatments:

Once the procedures to be performed have been decided, it is suggested to follow a methodology that includes the following steps:
1. Analysis and visual examination
1.1. Collection order.
1.2. Number the lots and order the original supports.
2. Choice of the work to be carried out (most representative plates, same type of deterioration, etc.) I have made thematic selections that can be expanded.
2.1. Isolation of plates with deterioration such as emulsion release, biological attack, etc.
2.2. Broken and fragmented plates.
3. Cleaning
3.1. Dry surface cleaning
3.2. Aqueous cleaning (stop baths)
3.3. Consolidation of emulsions.
3.4. Treatment for fungus.
3.4 Treatment for insects.
4. Complete an intervention sheet.
4.1. General and superficial description (inventory number, measurements, technique, signatures, inscriptions, etc.)
4.2. Deteriorations.
4.3. Applied treatment (cleaning, reintegration, consolidation, etc.).
5. Storage.
5.1. Individual: Paper envelopes.
5.2. Collections: In boxes

16. Conservation of collections:

It is common to find already assembled collections from old observatories, whose policy has been to stabilize the collection and take logical and possible conservation measures. These ways do not suggest long-term conservation of the collection, so I will add some references to storage conditions:

Attention to the Collection: We must take into account the place or institution where the storage is carried out. It is common for a collection of photographic plates to be found next to libraries, and in some cases with temperature and humidity controls. Regarding these controls, in some places where the equipment cannot be attended to permanently, conservation may fail due to applying sudden temperature changes to elements that should not receive them. The difference between a collection that only wants to be preserved and one for permanent use

must also be taken into account. Finally we must keep in mind that many of the variables are applied according to common sense.

Environmental conditions: Temperature, humidity, pollution and light sources must be taken into account mainly. Humidity values should not exceed 55%, as this will favor biological deterioration, nor should they be below 18%, so as not to cause drying and dehydration of the emulsions or deterioration of the support. The temperature should never exceed 25º and changes in environment should be gradual and progressive, not abrupt, so that they affect the materials as little as possible. Sudden changes in temperature that could affect the emulsion, contact with chemical products (usually cleaning products) and storage in a humid environment that can cause attack by microorganisms must be avoided since gelatin emulsions are susceptible to attack. In humid environments due to its hygroscopic nature. Bacterial attacks on the gelatin produce an effect on the edges of the emulsion and in most cases it is stopped by the antibiotic action of the Bromides, which are, paradoxically, what maintain the emulsion.

The fungi will produce a whitish powder and since they will reproduce on the same image, they will permanently deteriorate it. Light control is important, as it causes irreversible and cumulative damage to photographic materials, which are highly sensitive to UV rays, accelerating reactions and photo-oxidation processes. In a conservation storage environment, the amount of light should be controlled, and brighter, windowed environments should be avoided. The ideal, for any storage, is to do it in total darkness. This is not to disregard the effects of pollution produced by the atmosphere, which contains all the chemical and biological elements that we have discussed in this work.

17 Use and handling:

As I had mentioned, it is important to know what type of collection is being restored, that is, what use it will be given in the future. Handling and carelessness cause a large part of the deterioration and there must be periodic maintenance of the collection. We must take into account the effect of changes in the environment on the material and try to minimize any effect that manipulation may have on the piece.

It is also important to take into account the importance of subjecting the piece to sudden changes in temperature due to exposure to enlargers, photocopiers (which additionally produce chemical vapors), etc. In my case I take the photographs with a normal camera with a natural or LED light source. It is advisable to create a protocol for the use of the collection and assign degrees of work when it comes to the possibility of deterioration of a piece, that is, who will be in charge of documenting, carrying out the intervention, etc. Personal protection: In general rules, the rules of those who handle objects with corrosive and chemical danger must be applied; latex-free nitrile gloves, eye protection and respirators when working with chemicals.

18 Case studies:

Case N°1 Conservation models at the Cordoba Observatory Museum:

Laboratory at the Córdoba Observatory: Text and images about the processes carried out in Córdoba in June 2023.

Case N°2: The Horizon in Solar Photographic Plates:

The San Miguel Observatory was very active in the study of everything concerning the Sun, carried out with the Lyott solar telescope system and with the Celostat, equipped with a 12-meter-high vacuum chamber. I am presenting one of the plates obtained so that you can see it, already restored. It is a photo of the sun, with a middle line, although all the records of different formats have this characteristic. After several consultations about the plates, and although in the group we have true specialists on the sun, currently the images are received by computer, clean and do not use these supports. The problem was that meridian line that divided the image of the sun in two. Speaking with Stanislaw Iwaniszewski, who is an Archaeoastronomer and whose mother was an astronomer at the Polish Observatory of Piwnice, before its destruction in the First World War, I use this story to pay a brief tribute to her. At the beginning of the 20th century, star photographs were taken on glass plates and had "that" middle line. That line indicated a terrestrial meridian corresponding to the place where the photograph was taken; it was a question of the location of the content of the image. Around 1935, solar images changed this characteristic to a solar meridian by a convention of European astronomers and that is the middle line that we see in our images. We saw images of this type in the museum of the Felix Aguilar High Altitude Observatory, and in others. But the most interesting thing happened when I consulted the specialists of the OAFA and we went to see images of the sun with the HASTA solar telescope, which can be seen in one of the photos. In the image in which I am in front of the monitor, the sun can be seen live, with "that" meridian drawn obliquely and which I reproduce in a screenshot. Then, when saving it, the software erases the line and places the North of the Sun at the top, to better locate the spots and phenomena of a sun that had been quite active in those days; thus the images can be found on the website, if you wish to consult them. In addition, we find other references: At the CASLEO Observatory, on the giant telescope 215, photographs were taken with glass plates until 1996, preserved under conditions of humidity and temperature in the camera that I show in the last photo; very far from the difficult conditions that ours endured, which darkened quite a bit. CASLEO still has its own development laboratory on hand and we received from them many tips and references to special products.

Case N°3; The Eclipse of 1958: We were looking for new plates for restoration, and particularly plates documenting eclipses to present at the Annual Meeting of the Argentine Astronomy Association, which had proposed the theme "Eclipses". We had restored a series of plates from 1957 and 1958 given the extraordinary solar activity recorded in those years and I looked for the eclipse of 1958 that was visible in the southern cone, and because of the date I found a box with those plates. They were actually numbered from 1 to 11 and there were only 6, but they were undoubtedly plates of a total eclipse. From our research, the eclipse of 1958 could not be seen in its entirety in our location in San Miguel. We conducted several interviews, and diverse people (That worked in the Observatory, an astronomer priest in the Maximum College that is near the Observatory) indicated that at that time, if there was such an event, one of the Jena telescopes was dismantled, placed on a truck with the cameras, and then an expedition was carried out. We even found a photograph of the expedition, although we do not

know which astronomers went on it. The Eclipse is documented in NASA's extensive library on the subject, where there is a great deal of data, although there are no references to photographs of it[15]. We contacted NASA and prepare to donate the photographs and publication rights of the 1958 eclipse, seen from an intermediate zone between the provinces of San Luis and Mendoza, in the Andes Zone, Argentina. You can currently consult this page on the Internet.

Case N°4; Sunspots: As mentioned in other cases, we were interested in the information that we can obtain from the plates. Basically we are making a list of the observed sunspots and our objective is to number and scan all the solar images and make a file containing the date of taking, the number of the observed sunspots, information on the restoration and other data that may be of interest. When we began this task, and from our first investigations, we were able to observe that the current numbers for the sunspots are assigned by the NOAA, and this has been the case since shortly after its foundation in 1970. However, previously, these numbers were assigned to each sunspot by astronomers from different observatories. That is, the same sunspot observed by an astronomer in San Miguel could have a different number than the same sunspot observed by another scientist in another part of the world. One of the tasks we are proposing is to compile this list of sunspots observed in San Miguel and correlate them with other archives of this same type in other observatories.

Case N°5; Heritage preservation group: In Argentina, a few years ago, the Directors of the Museums of the Historical Observatories (in Argentina there are 5) formed a Network that we call the MoAA Network. The Directors and later several invited scientists and institutions hold a virtual meeting (and during the events, in person) every two weeks to share various projects that the Network carries out. These include the creation of a catalogue of assets of the Museums, etc. One of the activities carried out is to share experiences and published material regarding the restoration of different elements, including glass plates, for which we have shared a lot of information and held an exhibition during 2024 for the Annual Meeting of the Argentine Astronomy Association. This model of cooperation between Institutions led the author to present the idea at the Annual Meeting of the European Society for Cultural Astronomy, which was held in Warsaw, Poland, in 2023. By 2024, the idea of forming a network to share information was more developed and was presented and peer-reviewed at the 2024 Meeting held in Sicily, Italy. At the time of writing this (January 2025), we are awaiting the formation of a larger group to share information obtained from restored elements in the Museums of Astronomical Observatories; in a first step, we expect the formation of a group in which European, Central American and Argentine Observatories would participate. It is noteworthy that at the European Meeting there were American members of the IAU, who supported the idea. In this sense, the author (IAU Member in Commission 3 – Archaeoastronomy) is expanding his membership to Commission 6 – Historical – and will present a new proposal; the idea is to create an International Network of cooperation to rescue and preserve as much of this Cultural Heritage as possible.

[15] NASA Eclipses webpage; http://science.nasa.gov/eclipses

Case N°6; Shared data: It is a priority for the Museum of the Cosmic Physics Observatory of San Miguel, to organize all the information obtained and begin to share both the data and the techniques developed for the restoration of all heritage related to Cultural Astronomy.

19. Conclusions:

Restoration work requires technique, methods, patience and common sense. In addition to the restoration techniques described, the plates must be kept at a temperature of about 18º with a variation of +/- 4º and 30 - 40% relative humidity, in an environment that is as clean and dark as possible, and these values must be maintained. constantly to avoid drying out of the emulsions and the proliferation of microorganisms.

Restoration of the glass plates is more than a recovery, which it is, of photographic heritage. It is also a work of cultural preservation and a didactic activity. The restoration is carried out based on the idea that the original support, in this case the astronomical photographs have in themselves an irreplaceable value, and whose recovery is an important job, to which we must apply total dedication and research into new methods in order to improve our work with them.

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Previous presentations related this work

Merlo, David y Balbi, J. Nicolás, RAAA 65 (2023) San Juan, Argentina. Reunión de la Asociación Argentina de Astronomía. Fotografías solares en Placas de Vidrio / Boletín de la Asociación Argentina de Astronomía, Volumen 65, Buenos Aires, 2023.

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