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## THE LAST ITALIAN PETRIFIER, FRANCESCO SPIRITO (1885–1962), AND HIS METHOD OF PRESERVATION OF ANATOMICAL SPECIMENS

**ABSTRACT:** *This paper offers to the international community of students of the anatomical sciences a brief biographical and historical sketch of the Italian embalmer Francesco Spirito (1885–1962) and his preservative petrification technique. After describing the formula and method he used, the paper examines the educational role played by his preparations and the research potential they offer.*

**KEY WORDS:** *Anthropology - Embalming - Human anatomy - Preservation - Teaching - History of medicine - History of anthropology*

### BIOGRAPHICAL INTRODUCTION

Among the Italian scholars who have worked on the petrification of bodies the name of Francesco Spirito (1885–1962) stands out. Born in Naples in 1885, Spirito graduated in Medicine in 1909. While still at university, he attended the *Istituto di Anatomia Chirurgica ed Operazioni* ('Institute of Surgical Anatomy and Operations') at the Neapolitan University, directed by Professor Fabrizio Padula, where he received a good training as a 'preparator'. From 1911 to 1923 he was an intern, and later an assistant at the *Clinica Ostetrica e Ginecologica* ('Obstetrics and Gynaecology Clinic') in

Naples. He arrived at the University of Siena in 1928 as director of the Obstetric Clinic, and over the years he held prestigious positions, including those of Dean of the Medical Faculty and Rector. He authored over 200 publications of a purely experimental nature, including studies on the thyroid and other endocrine organs in pregnancy, placental transplants, fibromyomas, prophylaxis of cervical cancer, ovarian transplants, and the coagulability of placental blood.

He died in Naples on 4<sup>th</sup> December 1962.

Despite his prestigious academic career, he is remembered today by medical historians mainly for his technique of petrifying organic tissue. This brief note

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aims to discuss this method by presenting it to the broader anatomical community, with a special reference to anatomical education (Galassi *et al.* 2015, Papa *et al.* 2019, 2021) and the very materials it relies on.

# SPIRITO'S MANNER OF PETRIFYING BODIES: EXPLANATION OF HIS TECHNIQUE

It may seem odd that a clinical doctor should deal with a subject apparently so distant from his field of work, but it is Spirito himself who explains and clarifies that, in truth, petrification is a research field which is familiar and useful to him, as it offers him the 'possibility of presenting young people with anatomo-clinical material which is much more valuable for teaching purposes than pieces preserved in liquid or artificial preparations' (Brugi 1939). Only two years later, in 1941, did Spirito add: 'With this method I am preparing an anatomical-pathological museum for this specialty,

which I find very useful in clinical demonstrations' (Spirito 1941). These words unequivocally demonstrate the importance of such preparations as essential tools for the teaching, popularisation and practice of anatomy and pathology.

In this sense, in 1951, the Florentine physician Andrea Corsini – then President of the *Società Italiana di Storia Critica e delle Scienze Mediche e Naturali* ('Italian Society of Critical History of Medical and Natural Sciences'), nowadays the *Società Italiana di Storia della Medicina* ('Italian Society of the History of Medicine') – recognised the teaching value of the petrified specimens by Spirito, 'because the old anatomical waxes, which require skilled artists to form and special care to maintain, made even more necessary by the friability of the wax itself, and the papier-mâché models, can be replaced not by other models but by unalterable natural pieces' (Corsini 1951).

To achieve this goal, Francesco Spirito worked hard (*Figures 1, 2*) to perfect his preservative technique,



FIGURE 1: Francesco Spirito in his office. Reproduction of all images is kindly granted by the Archivio Storico Museo Galileo – Istituto e Museo di Storia della Scienza, Florence, Italy.



FIGURE 2: Francesco Spirito holding one of his preparations.

starting in the early 1930s. Preserving anatomical specimens had always fascinated Spirito, so much as to make him begin rich and constant experimentation that would lead him – as the author himself states – to petrify by chance. During his scientific communication on the use of paraffin for the conservation of samples given at the *Accademia dei Fisiocritici* in Siena on March 20, 1939, Spirito presented what he called 'solidified pieces'.

The method with which he managed to produce them, he said, 'has nothing original about it because it is nothing more than the broadest application of the common method of paraffin embedding used in histological technique. It is important only because it allows the use of a substance which is very different from the common substances used for inclusions for histological studies, which, as is well known, are very expensive, and as such would make the method uncommon because it is very expensive' (Spirito 1939).

As a matter of fact, this partly understated communication of his was just a way of making the scientific community aware of a new petrification method he had developed, which surpassed the one based on the paraffin inclusions (Spirito 1939). The basis of his new petrification method was a solution of potassium silicate which had to penetrate all the cells and the spaces between the cells of the anatomical specimens so that they would take on a stone-like appearance and consistency.

In his work Spirito explained step by step the six 'fundamental moments of the petrification of the anatomical specimens' (Spirito 1951). The first step involved 'fixing the anatomical piece for as long as possible in a 10% formalin solution or a 3% corrosive sublimate solution' (Spirito 1951). Indeed, he went so far as to state that 'those who wish to prepare a collection of petrified anatomical pieces would do better to use those belonging to old collections, preserved in formalin' (Spirito 1951). The second stage consisted of bleaching, a decolourisation to give the specimen a whitish colour before immersing the piece in the silicate solution. The piece was then immersed in the potassium silicate solution (*Kalium Silicium Solutum*), but the use of sodium silicate was also useful: 'The permanence of the piece should vary according to its size and original consistency.' After a few days in the solution with the container covered, the lid was removed, and then, as water evaporated, the solution became gradually denser outside and inside the piece, which thus remained almost unaltered (Spirito 1951). Spirito recommended diluting the solution in the proportion of 2/3 to 1/3 of distilled water, leaving it to

evaporate spontaneously with the container uncovered, and adding new silicate from time to time. Once removed from the liquid, the piece had to be fixed on supports so that, hardening by 'free air drying in the shade', it could retain its shape. 'By passing with the needle, just below its outer surface, various resistant threads suitably arranged, it is possible to stretch the piece on wooden or metal supports, so that the individual parts remain in the desired position as long as necessary for evaporation' and until it turned into a 'hard stone mass' (Spirito 1951).

While for the majority of specimens, immersion in the potassium silicate solution for a longer or shorter time could be sufficient, for larger specimens it was also necessary to inject the same liquid into the tissues of the sample. The consistency of the liquid, which was not suitable for injection, and the resistance it encountered in penetrating the tissues, made the petrification of large anatomical specimens particularly complex and difficult.

Spirito also dwelled at some length on certain methods which attempted to solve problems met with during petrification, in particular with the petrification of the fatty parts and the possibility of maintaining a colour of the preparations which was relatively similar to the natural one.

He proposed two methods for petrifying the fatty part. The first method involved that 'the fixed piece, before or after bleaching, must remain in chloroform for an average of 24 hours' (Spirito 1951). The second method required that 'for an equal time the piece must remain in caustic potash, which must be used at a concentration of 2%' (Spirito 1951). Between these two methods, Spirito recommended the use of chloroform, which did not alter the tissues in any way. On the other hand, the problem with the colour of the preparations is due to the fact that, once treated with silicate, they took on a 'blackish colour'. To avoid this problem, he proposed fixing pieces to be petrified in Jores' liquid, which he modified as he explained in his paper. In this way 'the preparations obtained have a uniform and diffused pinkish colour' (Spirito 1951).

## CONSIDERATIONS ON SPIRITO'S PRESERVED SPECIMENS

A further issue to which Spirito paid particular attention is the preservation of the anatomical samples, also in view of their musealisation (*Figure 3*). Knowledge of the materials and methods used in the petrification process – which Spirito explained in some of his scientific



writings – is particularly useful because it allowed to identify the best conservation technique and the most appropriate restoration methods when necessary.

Spirito noted that, after some time, efflorescence formed on the preparations, which could alter their appearance, therefore their educational value. In order to avoid this, he recommended paying the utmost attention to the sixth and final stage of the petrification process, namely the protection of the petrified piece. This could be done using two methods: 'a more or less prolonged and repeated bath in vaseline oil, followed by careful cleaning to remove the superfluous', or by 'varnishing with aluminium sulfate varnish or linseed oil or copal' (Spirito 1951).

Following these tricks, Francesco Spirito managed to obtain that the petrified pieces maintain their shape over time and their volume is almost unaltered, with a 'perfectly' stony consistency. Even today, 70 preparations from his collection can be seen in the Natural History Museum of the *Accademia dei Fisiocritici* in Siena (Vannozzi 2003).

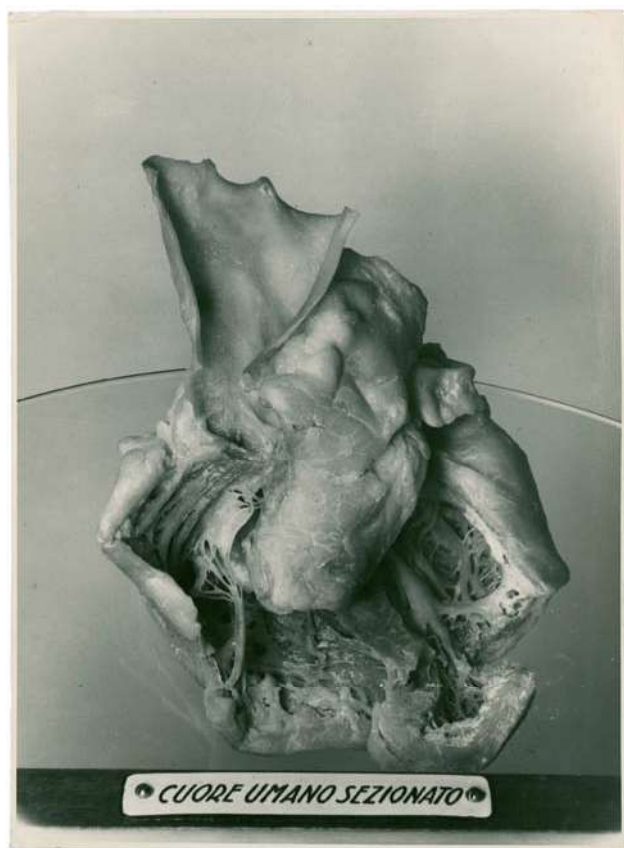


FIGURE 3: Petrified human hearth made by Francesco Spirito.

These preparations were part of a larger collection in the *Clinica Ostetrica* ('Obstetrical Clinic') of the *Santa Maria della Scala* Hospital in Siena, directed by Spirito himself. In all likelihood, in view of his retirement Spirito decided to transfer his collection partly to the aforesaid Sienese Academy, and partly to the *Istituto e Museo di Storia delle Scienze* ('Institute and Museum of the History of Sciences') in Florence, to which he donated – as reported by the newspaper *La Nazione* on February 14, 1951 – 'a foot, a hand, a heart, a brain, a severed human head and that of a hydrocephalus; all rigorously petrified, as if it were not the work of a doctor but that of a scrupulously realistic sculptor' (Vannozzi 2003).

Spirito's gift was placed in the part of the museum that had already housed Girolamo Segato's rich legacy for some time.

#### A FINAL NOTE: THE PROPERTY OF REVERSIBILITY

Concluding this examination of the method of petrification developed by Francesco Spirito, it is important to remark an especially interesting characteristic of the preparations created using his methods: reversibility.

'From what has been said about the method of petrification', Spirito wrote, 'it is easy to deduce that reversibility, which has always aroused such amazement in everyone, is one of the simplest phenomena, since, since it is a substance soluble in water, it is enough to put the petrified piece back into the water and keep it there for a longer or shorter time, so that the saline substance dissolves and it returns to its natural state' (Spirito 1951).

As evidence of his words, during a scientific meeting in 1939 Spirito showed 'histological preparations made from pieces of organs that had been petrified for some months, and brought back to their natural state by means of the opposite artifices to those used to obtain petrification. [...] They come from organs that have been kept in a solid condition for more than two years and show that even at this distance of time the elements retain their structural characteristics and present a very high quality of life'.

#### CONCLUSIONS

In conclusion, the work carried out by Francesco Spirito in the field of that particular and unique conservation technique known as 'petrification' of

anatomical preparations appears relevant. Equally important is the fact that Spirito published his method in scientific journals and dwelt at length on some of the more problematic passages his art involved. As in any scientific experiment, it is necessary to make procedures and information available to the scientific community in order to allow other scientists reproduce the aforesaid experiments possibly obtaining comparable results.

At the beginning of the 2000s, some of the procedures indicated by Spirito for the solidification and conservation of anatomical finds were repeated, with appreciable results.

In addition, in view of a possible restoration, a careful analysis was carried out on a deteriorated preparation from Francesco Spirito's collection, which showed visible whitish efflorescence on the surface due to deposits of carbonates and sodium bicarbonates (Soiartze Zabaleta 2005–2006).

The fact that Spirito published fairly detailed descriptions of his petrification methods in scientific journals facilitates the process of restoring his preparations. In this way, this man of medicine and science showed his great attention to the museum value, as well as the didactic value, of the preparations he made. They document his training as a clinician and his passion for didactics at a time when the direct and real representation of pathological lesions was still the method of choice for explaining diseases, their evolution and the changes they brought about in the human organism. Above all, they bear witness to his great work in attempting to set up a museum of pathological anatomy at the University of Siena: while this project unfortunately did not come true during his life time, the rediscovery and systematic analysis of his scientific output can yield novel insights into the art of preserving human tissue, also allowing further comparisons with other international schools of thoughts and approaches.

## REFERENCES

- BRUGI G., 1939: Mostra ed illustrazione di pezzi anatomici pietrificati. *Atti dell'Accademia dei Fisiocritici* 11, 7: 47.
- CORSINI A., 1951: Un problema risolto: la pietrificazione degli animali. *Castalia* 3: 123–126.
- GALASSI F.M., RUGGERI A., PETTI K., ASHRAFIAN H., 2015: Marvels of the Bologna Anatomical Wax Museum: their theoretical and clinical importance in the training of 21st century medical students. *HAPS Educator* 19, 2: 4–9.
- PAPA V., VAROTTO E., VACCAREZZA M., BALLESTRIERO R., TAFURI D., GALASSI F. M., 2019: The teaching of anatomy throughout the centuries: from Herophilus to plastination and beyond. *Medicina Historica* 3, 2: 69–77.
- PAPA V., VAROTTO E., VACCAREZZA M., GALASSI F. M. 2021: Teaching anatomy through images: the power of anatomical drawings. *Anthropologie (Brno)* 59, 2: 145–153. <https://doi.org/10.26720/anthro.21.03.29.2>
- SOIARTZE ZABALETA, A., 2005–2006: *Tecnologie di conservazione e restauro di tessuti animali per scopi museali*. Thesis (supervisor: Prof. Luigi Garlaschelli), University of Pavia, Italy.
- SPIRITO F., 1939: La impregnazione con paraffina per la solidificazione e la conservazione dei pezzi anatomici. *Atti dell'Accademia dei Fisiocritici* 11, 7: 36.
- SPIRITO F., 1941: Su alcuni preparati istologici eseguiti da pezzi già precedentemente pietrificati da circa due anni e riportati allo stato naturale. *Atti dell'Accademia dei Fisiocritici* 11, 9: 233–234.
- SPIRITO F., 1951: Dettagli di tecnica di un metodo personale di pietrificazione reversibile dei pezzi anatomici. *Atti dell'Accademia dei Fisiocritici* 12, 19: 3–13.
- VANNOZZI F., 2003: I preparati pietrificati di Francesco Spirito: storia di una collezione. *Museologia scientifica* 20, 2: 335–344.

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