

A MICROSCOPIC STUDY OF PERUVIAN FUNEREAL MATERIAL

by

George Robert Talbott

with a summary by Frederic Jueneman, FAIC

Summary

In 1987 the San Diego Museum of Man received a pair of mummified right hands and forearms from two young children which had been excavated at La Capilla, Chillon Valley, Peru. Whether or not these children were related to one another will have to wait on further DNA analysis.

What was most intellectually enticing about these dour specimens was that each child held a hollow funerary cane in their respective mummified hands, and the canes themselves were stoppered with raw cotton, not unlike what has been found with ancient Egyptian funerary practices. And, what was found inside these tubes was a white powdery substance that at first was suspected of being an hallucinogenic drug, but forensic electron microscopy and x-ray diffraction at Scripps Institution of Oceanography later identified the white substance as gypsum, an inorganic which in its dehydrated state - plaster of Paris - acts as a desiccant.

There the matter might have stood, leaving the mystery as to both why these canes were filled with gypsum and why the children held them in their right hands. A sample of the powder from one of the canes was sent in mid-1993 to medical technologist George R. Talbott, a research associate at the Museum, for his specialized analysis. He didn't know at the time, but there were uncharacterized dark specs in the gypsum.

Talbott has a Zeiss universal light microscope at his disposal, supporting the brightfield, darkfield, phase contrast and polarization applications with trinocular optics for preparing photographs of any specimen of particular interest, and making his expertise invaluable for such an investigation. This level of sophistication in microscopy was desirable since, if the unidentified darker material was organic in origin, any mummified fragments would not be amenable to the usual histological techniques of fixing, blocking, sectioning, staining and mounting, as could be used with fresh samples of cellular matter. So the more advanced

technique of "light-staining" was applied, supported by phase contrast, darkfield, and polarization.

Indeed, when Talbott first observed a small sample of gypsum under the Zeiss instrument at 400 power amplification, he recognized one of the dark spots as a fragment of what appeared to be triturated heart tissue. Other samples were then found to contain myocardial cells with pseudomorphs of mitochondria, muscle fiber, intercalated discs, both epicardial and pericardial wall material, all specifically indicative of heart tissue.

Being cognizant of similar Egyptian funerary practices, but not content with this array of inferences, Talbott sent several photomicrographs to an associate, Allen Steinmetz, a microbiologist at UC Berkeley, who confirmed Talbott's findings. The formal report was then filed with the Museum in early 1994. Yet, such a curious finding required additional confirmation, which the Museum apparently secured from pathologist Art Aufderheide, of the University of Minnesota. And, Talbott's report was subsequently featured in a paper presented by Rose Tyson, the Museum's curator in physical anthropology, at the annual meeting of Paleopathology Association in Denver in the Spring of 1994.

Why was this finding of mummified heart tissue fragments in Peruvian funerary paraphernalia so curious?

Such practice in ancient Egyptian funerary ritual is not unknown. Sir Wallis Budge, the noted Egyptologist and Assyriologist, regarded that the Egyptians mummified the heart separately from other organs of the body in their rituals, but others more recently have dissented. Still others claim that such practice was performed in the late dynasties of Egypt.

Nonetheless, however late such practices were performed in ancient Egypt doesn't detract in the least from the fact of a parallel practice in Peruvian antiquity. The question naturally arises as to what, if any, influence Egypt might have had on the Chillon Valley in Peru.

Standard archaeological persuasion says that there was little or no contact between The Old World and the New World prior to the time of Columbus, and in any case it would have been by accident - storm-blown shipwreck - rather than by design. Succinctly put, anything before Columbus automatically becomes apocryphal. But anyone with a critical eye can wonder.

(Frederic Jueneman. 1996)

Preface

THIS PAPER describes the microscopic study of material submitted to me on June 23, 1993, by Rose Tyson, Physical Anthropologist for the San Diego Museum of Man. The material is a white powder which was found in a tube held in the hand of a child who had been buried in Peru. The age

of the child is not certain, but is thought to be much less than the assumed twelve years of age.* The assessed time of the funeral, its site and the location and ethnography of the situation can be determined by communication with the Museum. Discussion in this paper is limited to physical and medical commentary concerning the powder itself, except for a closing personal statement.

Instrumental methods used in this investigation

THE PRINCIPAL instrument used was the Carl Zeiss Universal Light Microscope. The term "universal" is a technical one, designating the fact that our microscope supports brightfield, darkfield, phase contrast and polarization microscopy, with optics for both superstage and substage illumination. The instrument has a polyfunctional condenser permitting darkfield and phase contrast work, and a stage combining rotational and vertical/horizontal movement, all graduated. Polarization equipment includes a retardation plate for precision shifting of the polarization opacity point to a red band. The scope is trinocular, so that a MINOLTA XK camera is permanently mounted, and the image can be deflected from the binocular viewing device to the camera at any time, for making photographs.

Figure I shows the camera, and the oculars. Figure II shows the side illuminator and the objective head assembly for superstage viewing of opaque objects, and Figure III shows the polyfunctional condenser and objective head for normal viewing with substage illumination.

IT MIGHT reasonably be asked why such an advanced microscope is used in the current investigation. The answer is that that we are not examining a fresh tissue which we can treat with well known histopathologic technique, fixing, infiltration with paraffin, blocking, microtome sectioning, staining and mounting. Rather, we are required to characterize a material which, to all appearances, is a desiccated specimen resembling mummified tissue. This characterization is far more difficult than one required in routine biological practice. We are not allowed microtome control of the thickness of a section. Diagnostic resolution and contrast, which are facilitated by stain technology, are absent. Herein lies the requirement for what may be called "staining

by means of light", an advanced technique supported by phase contrast, darkfield and polarization optics. Thus we are pleased to have the Carl Zeiss Universal System at our disposal.

Some additional instrumental methods to be applied at a later time include electron microscope scanning, and DNA matching of the powder with any material which can be extracted from the body, as separate from the funereal tube and powder. This would confirm or deny that the powder is a portion of the body of the deceased youngster. Finally, it is strongly recommended that the San Diego Museum of Man obtain a piece, however small, of a KNOWN mummified heart from any culture. It is the conviction of the author that a powder made from this KNOWN heart material will match the specimen presented to me by Rose Tyson. However, there is considerable disagreement regarding whether or not the ancient Egyptians mummified the heart SEPARATELY from the whole body. Budge says "yes", and Lucas and Harris say "no". Other authors say that separate mummification of the heart was done only in later dynasties.

Discussion of the photomicrographs

Figure IV shows the powder at 1000X, using darkfield illumination. Strong optical activity is apparent. This is not the sort of photomicrograph one would obtain with simple inorganic materials. Probably inorganic, non-cellular organic, and tissue materials will be found here.

Figure V shows the powder at 400X. The blue structure at the centre of the photomicrograph appears to be a myocardial cell, with the typically large nucleus just above the lower cell wall. The centre blue structure of Figure VI shows an intense border between the upper and lower cell-like figures. Figure VI is taken at 400X.



Fig.I: XK MINOLTA camera and Zeiss Ocular.



Fig.II: Objective Head Assembly for viewing opaque objects.

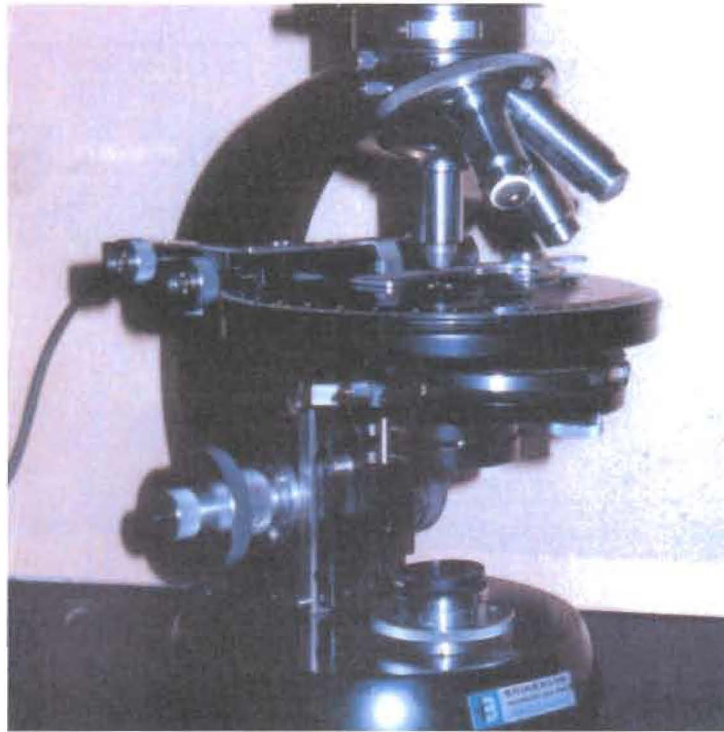


Fig.III: Multifunctional Condenser and Objective Head Assembly for viewing transparent objects.

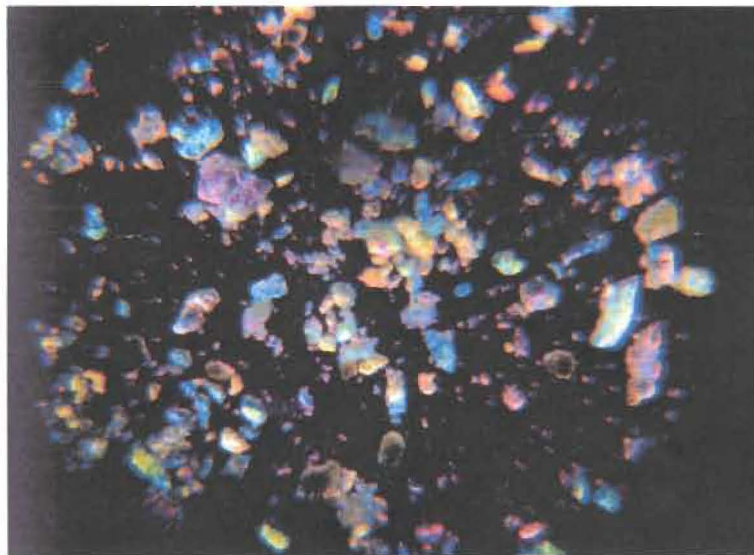


Fig.IV: Funeral Powder at 100X under darkfield illumination.

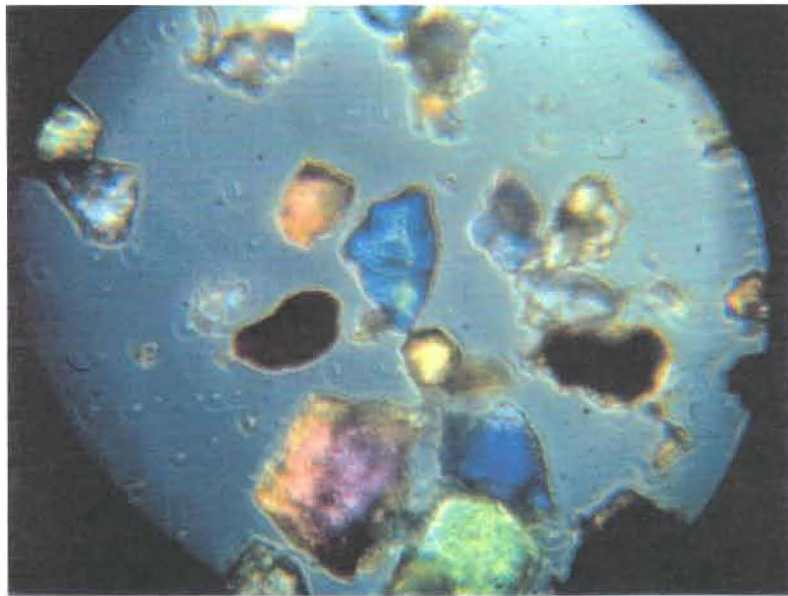


Fig.V: Funereal Powder at 400X using polarization.
Notice cell and nucleus at center.

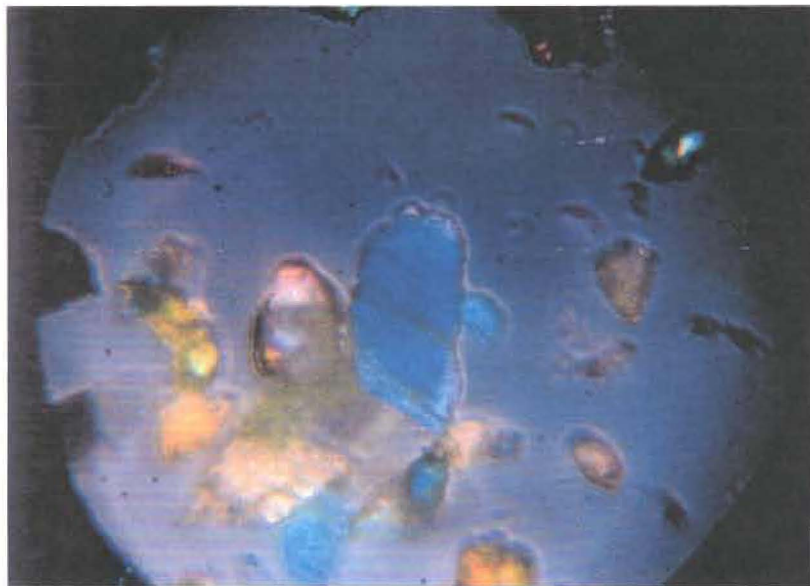


Fig.VI: Funereal Powder at 400X using polarization.
Notice cell and nucleus at center.

Figure VII. is a photomicrograph taken at 400X, using brightfield illumination, and the material strongly resembles a muscular fibre.

Figure VIII., a photomicrograph taken at 400X, and using a polarization in the presence of a retardation plate, shows a structure resembling muscle layers from the heart. What appears to be an intercalated disc is to be seen on the right hand side.

Figure IX. is taken at 400X, again using polarization and the retardation plate, and this shows a definite cell configuration, this time one resembling epicardial or pericardial wall material.

Figure X., also taken at 400X, exhibits geometry almost definitive of myocardial fibers, and Figure X. should be compared with Figure XII., which was taken from a text on microanatomy. This pattern of fibre bundles occurs only in the heart.

Figure XI. is perhaps the most dramatic photomicrograph, since it shows what can only be vascular apparatus, an open capillary at the center, of exactly the type which nourish the heart by carrying blood from the coronary into the myocardium itself.

Figures XII., XIII., XIV., and XV. show textbook illustrations of heart muscle, and our photomicrographics can be compared to the text illustrations to show similarities and differences.

Conclusions and informal discussion

Since reference based upon ancient remains is difficult, I asked my associate, Allen Steinmetz, to study the photomicrographics and give us the benefit of his judgement. Mr. Steinmetz has had extensive medical laboratory experience, some of it specialized in the area of cardiology. On 9th March, 1994, Mr. Steinmetz replied as follows:

Dear Dr. Talbott:

Intense study of the photographs received last week has led this researcher to conclude that the cells shown in photographs V and VIII are of cardiac origin.

In particular, the nucleus of the cell in photograph V is highly characteristic of a cardiac cell nucleus, with its central placement, large size, and circular shape. What appears to be a profusion of mitochondria or their breakdown shells distributed throughout the cytoplasm and not limited to the area adjacent to the nuclear membrane, is characteristic of a cardiac cell.

The junctional features of the cell pairing in photograph VIII, are typical of the intercalated discs seen in cardiac fibers. The precursors of fibrils occasionally seen at the cell termini are not readily discernible in photographs V and VIII, probably due in no small part to the advanced age and dessicated state of the specimen. However, the nuclei, mitochondria, and intercalated disc seen in these two photographs would point strongly toward the tentative identification of these cells as cardiac cells.

Sincerely,

Allan D. Steinmetz, Microbiologist.

IT WAS NOT difficult to be influenced by two factors in my own background, first my lifelong study of ancient Egyptian civilization, and secondly, my confirmed belief that different cultures can make parallel discoveries, and arrive at parallel conclusions, without having any sort of contact with one another. The pivotal importance attached to the heart by various ancient civilizations may be ascribed to "coincidence", or to primitive superstitions evolving from crude psychological "self-observation" of the heart in matters of love and battle, but one can leave his mind open to more interesting possibilities.

I did NOT begin my microscopic analysis with any expectation of finding heart material, but when I did observe structures

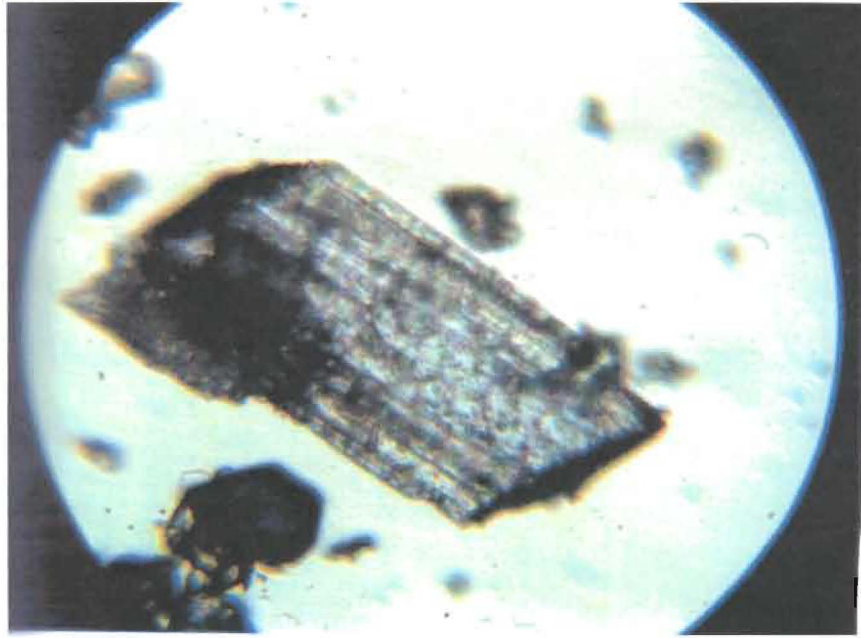


**Fig.VII: Apparent muscle fiber or bundle in Funereal Powder.
Brightfield illumination.**

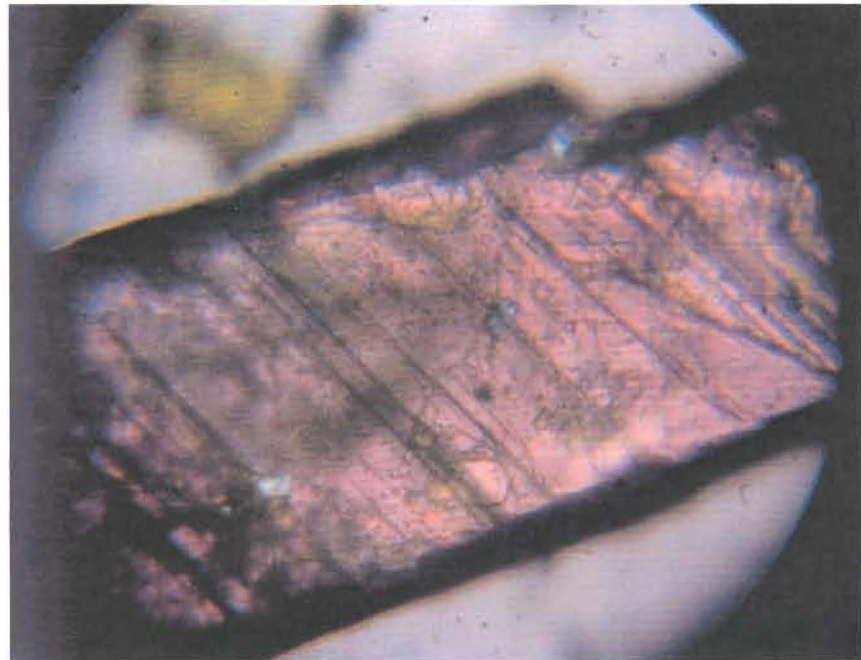


**Fig.VIII: Apparent cardiac muscle in Funereal Powder, showing intercalated disc.
Polarization with retardation plate, 400X.**

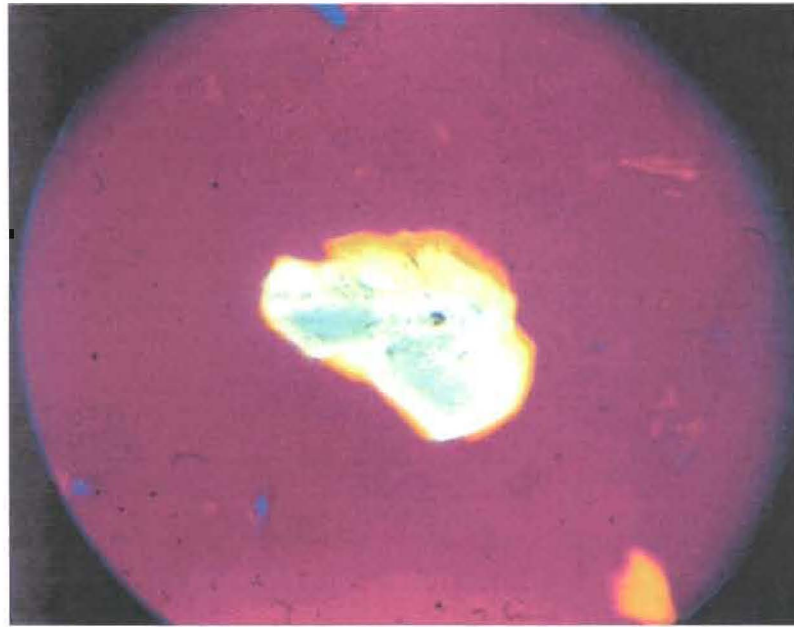


**Fig.IX: Apparent epicardial or pericardial cell in Funereal Powder.
Polarization with retardation plate, 400X.**

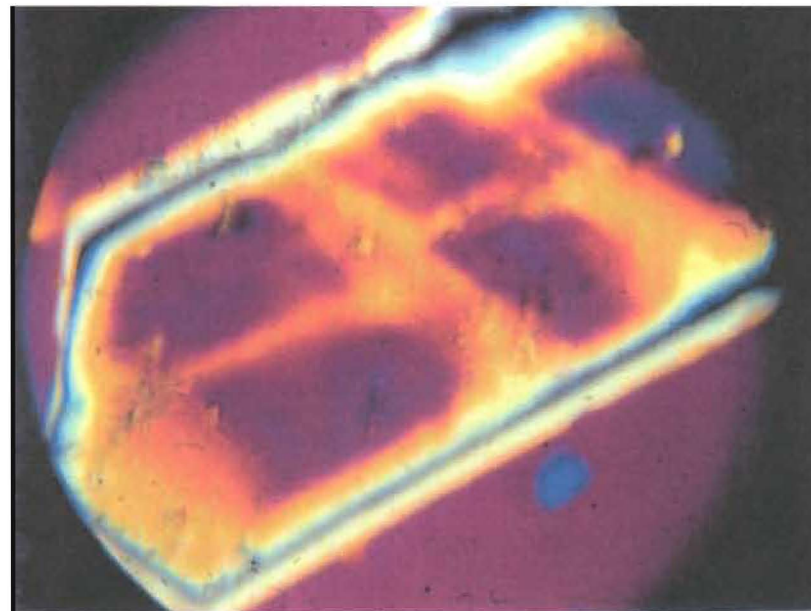


**Fig.X: Apparent bundle of myocardial fibers. (Compare to Fig.XII).
Polarization at 400X.**

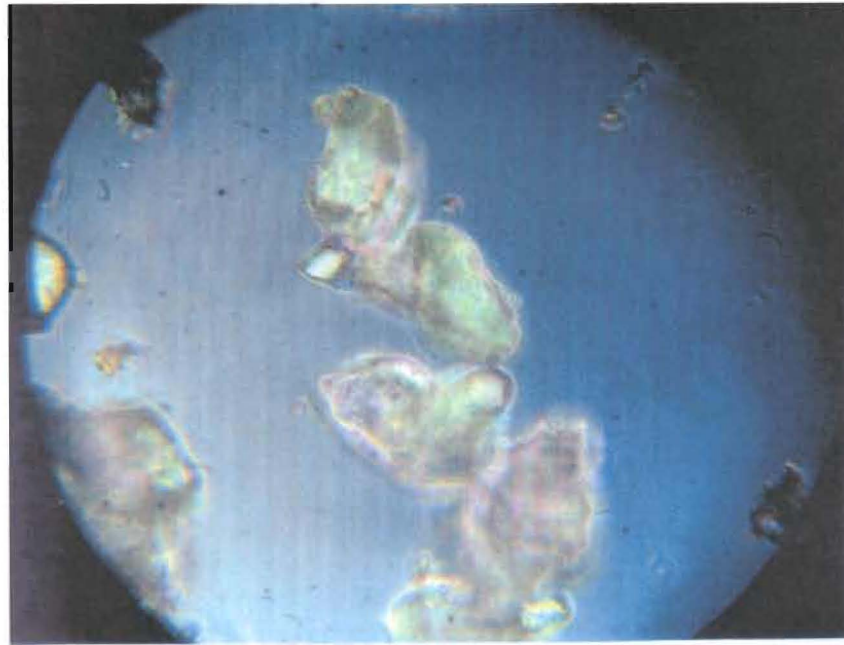


Fig.XI: Apparent vascular capillary. Use of phase contrast optics, 400X.

resembling cardiac tissue, I was deeply moved. I was moved by a reasonable image of the youngster, cut off from his games and family and times so early, walking across the sky to his gods, holding his credentials in his hand, credentials housed in a thin stoppered tube. Did his credentials somehow come to me? But all of this is assuredly beyond the promised scope of this tearless paper.

Addendum

Since this paper was written in early 1994, electron microscope scanning showed the presence of gypsum (calcium sulfate) in the sample, and it was thereafter assumed that

the specimen amounted simply to gypsum. Gypsum is a good dehydrating agent, which can function in tissue preservation exactly as sodium carbonate or natron. It is not necessary to argue the point. Simply examine gypsum under the microscope at the same powers I used in studying the subject sample. As I stated in the paper, some of the material is indeed simple inorganic material, but other material in the sample cannot be gypsum.

George Robert Talbott
Physical Scientist and Research Associate for
The San Diego Museum of Man.
February 28, 1994.

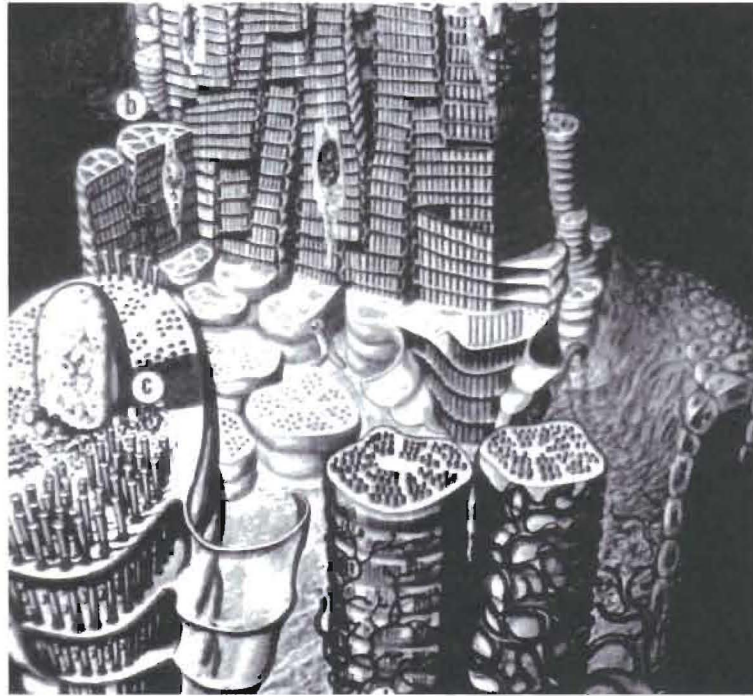


Fig.XII: Textbook illustration of bundles of myocardial fibers, showing geometry peculiar to heart.

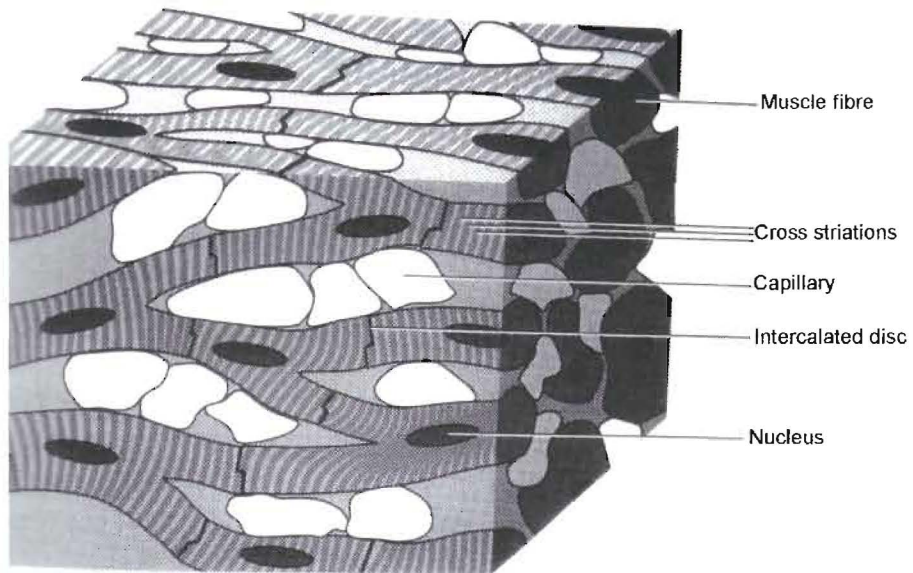


Fig.XIII: Textbook schematic drawing of cardiac muscle, showing intercalated discs.

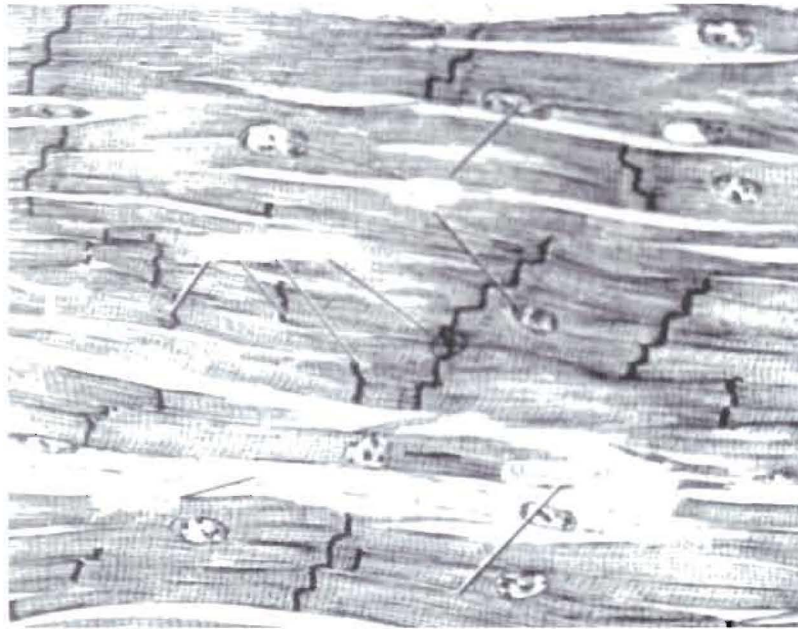


Fig.XIV: Textbook photomicrograph of cardiac muscle.

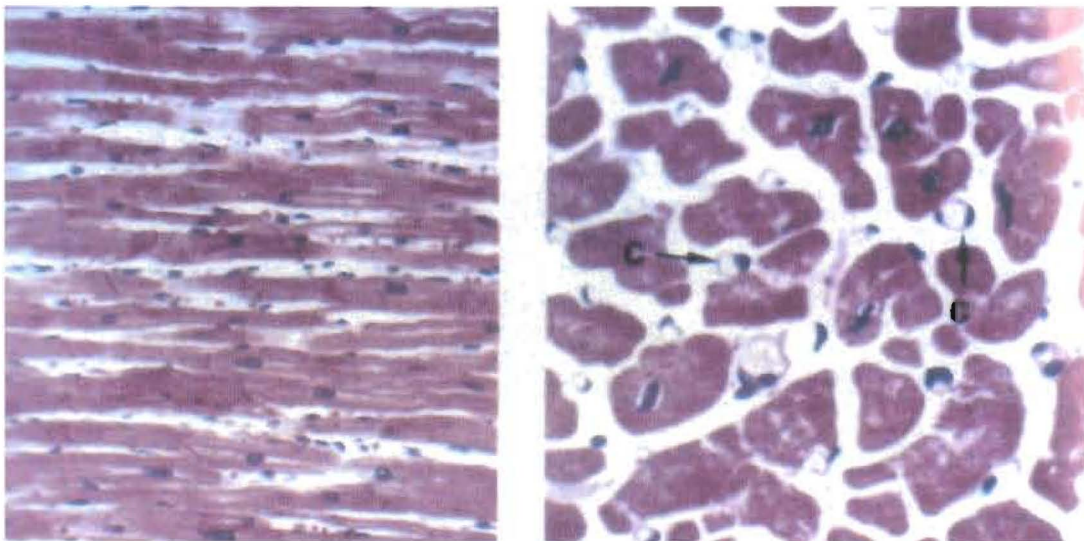


Fig.XV: Textbook photomicrographs of cardiac muscle fibers and cells.

***Note on the burial**

The burial contained two children. One child was approximately two years old, and the other was an infant of about six months.

This paper was originally published by The San Diego Museum of Man in Balboa Park in March 1994.

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AUTHOR'S MAIN PUBLICATIONS

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