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Dr. Owen Lovejoy report to Coroner Balraj re: forensic weapon testing

Cuyahoga County Prosecutor's Office

Cuyahoga County Coroner's Office

December 21, 1999

Dr. Elizabeth K. Balraj, M.D.
Coroner
Cuyahoga County Coroner's Office
11001 Cedar Avenue
Cleveland OH 44106

Dear Dr. Balraj:

The following is my summary report with respect to my activities in the analysis of Case No. 76629. Essentially these activities to date have been two-fold:

1. At your request I attended the disentombment of the remains of Marilyn Reese Sheppard on 5 October 1999, and assisted in the removal of those remains from the casket (by which they were transported to the Coroner's Office on Cedar Avenue) and in their examination. I understood my role, during these activities, to be primarily one of support to all those in attendance. To that end I assisted wherever possible. Following examination of the body and removal of clothing a preliminary examination of the skull was made while it was still in the casket. That examination revealed that it was no longer connected by any soft tissue to the remainder of the skeleton, and it was therefore agreed to by those in attendance that the skull could be removed and examined separately. Prior to any removal of (completely dehydrated) soft tissue, X-rays were made of the skull. What at first appeared as an obstructing "brain mass" was quickly determined to be too radiopaque to be any form of soft tissue and examination revealed that the cranial cavity had been reconstructed, presumably for funerary purposes, with a now very hard, plaster like material, which may indeed have been plaster, although it was exceptionally hard and difficult to incise. This "plaster mass" prevented examination of most of the cranium by simple X-ray, although after numerous attempts, satisfactory images of the anterior face and maxilla were obtained. These revealed extensive fractures in and around the maxilla, the zygomatics, the nasal bones, and the lateral orbital rims. Because time was short, it was agreed that Dr. Thomas Holland, with whom I was examining the skull, would chart and note the various fractures, while both he and I continued to dissect both the plaster like material and the dehydrated soft tissue in an effort to further expose the number and extent of the facial fractures. Because my role had been to this point primarily a support one, I had not, at the time of exhumation, examined the postmortem photographs from the original autopsy.

The pattern of fractures observed in the skull was one of very extensive trauma. Both the left and right sides of the vault bore numerous fractures and were depressed inward (they were now stabilized and immobilized by the plaster material). On the left side, this depression of the vault appeared to be restricted to the frontal bone, and anterior to the coronal suture. On the right side, however, the damage was more widespread, extending almost to the lambdoidal suture The superoposterior portion of the frontal bone was not present and observable, though it is probable that its fragments were embedded within the plaster material and therefore obscured from view. Repeated attempts to remove this material proved fruitless. However, the anterior part of the frontal was observable and bore a substantial series of fractures which also involved and communicated with both orbits. The maxilla was separated and depressed posteriorly and numerous isolated fragments could be identified. Both zygomatics were fractured. There were no apparent fractures of the mandible. After it was agreed by all in attendance that no further examination within the permitted time period would be fruitful, further examination was terminated and the cranium was then thoroughly photographed by Mr. James T. Wentzel.

2. At your request I prepared an experiment designed to provide relevant information about the type of weapon that might have been used in the murder of Ms. Sheppard. To this end I directed the construction of a test skull, fabricated in the following way. A young adult anatomical specimen human skull in good condition with no obvious injury or pre/post mortem defects was first filled with commercially purchased fat ("suet") to simulate the brain as its cranial contents. I directed Ms. Linda Spurlock, who conducts facial reconstructions for me as part of my examination of unidentified cases sent to your office, to prepare the skull with a facial and surface reconstruction using standard tissue depth markers. A synthetic clay, consistently used in these kinds of reconstructions was used, and its surface, upon completion, was covered with a thin layer of yellow acrylic enamel. A large (1" diameter) dowel was inserted into the foramen magnum as a simulation of stabilization of the cranium by the vertebral column (for the purposes of the experiment) and this model was transported to the Coroner's Office. I also obtained a 50th Percentile Hybrid II dummy head and neck from the U.S. Air Force for possible further testing. On December 15th I conducted a series of tests using this "test skull" as the object of blows delivered by a series of potential weapon-types made available by your office. A large sand bag weighing approximately 75 pounds was used to simulate a human trunk. It was placed on a mattress supplied by your office directly on the floor in order to simulate the approximate absorptive capacity of a mattress and box springs (the latter being assumed to be only minimally deformable). The dowel was inserted into this bag such that the head was positioned in appropriate approximate anatomical juxtaposition, and a series of blows was delivered using several of the above mentioned "weapons". After each blow the skull was transported to the sixth floor for AP and ML X-ray in order to observed any damage. While the clay surfacing material was somewhat radiopaque, it was nevertheless possible to determine presence/absence of damage to the cranium after each blow, although details will require the future disarticulation of this test skull and removal of its contents and clay surfacing (this procedure has not yet been conducted as of the date of this report). Notes on this series of tests were transcribed by Dr. Sandra A. Caramela-Miller. A summary of the results of the tests is as follows:

Blow 1. Flashlight; handle end (light/lens end being held in the hand). I attempted to strike a blow to the cranium with as much force as possible. For the first blow I was wearing a rubber glove to

prevent possible injury to my hand. Not being practiced in this endeavor I missed my primary target (the frontal bone) and delivered only a glancing blow to the clay covering the left parietal. No damage to the cranium.

Blow 2. I removed the rubber glove for a better grip and concentrated more on my "target". Again I attempted to strike the skull with as much force as I could possibly muster. I again used the "lens/light" end of the flashlight as my "handle" and delivered the blow with the "battery/handle" end. I succeeded in directly striking the skull just posterior to the left orbit. A large ovoid depression was produced in the flashlight, but it was apparent from the reaction of the light and the skull that I had not succeeded in fracturing the skull. This was confirmed by X-ray.

Blow 3. This blow was delivered with the lens/light end of the flashlight as its striking portion. Again I struck the skull with maximum possible force (this and all previous blows were overhand with complete circumduction of the arm). I struck the skull again on its frontal slightly left of midline. It is of note that the original ovoid contour of the flashlight was so depressed as a consequence of this blow that the depression in the aluminum was almost perfectly circular, as was the depression in the clay material overlying the skull. A 1 to 2" diameter "laceration" was produced, with exfoliation of the clay material as it clearly elastically rebounded from the blow, exposing the cranium beneath. X-ray revealed no damage to the cranium.

Blow 4. The skull was struck once again as above at full force with the lens/light end of the flashlight. It was again struck just above the left orbit. A circular depression was again induced and the flashlight was further deformed in the following two ways: 1) the aluminum was depressed just up to and including slight deformation of the "ring" portion that holds the glass of the lens, and 2) the lens/light end of the flashlight was partially separated and bent away from the handle. X-ray reveled no damage to the cranium.

Blow 5. At this point I concluded that I could not succeed in breaking the ~~occiput~~ frontal with the flashlight and that further use of the light might cause it such damage that we could not use it again. I then chose the "channel lock" (TM) plier as a weapon and struck the skull as above. Upon contact with the skull I was immediately conscious of having succeeded in penetrating it with the course of the weapon. Upon inspection a fragment of cranial cortex could be seen though the "laceration" and this was confirmed by X-ray.

Blow 6. This blow was conducted using a fireplace poker as above. I struck the skull with a glancing blow to the cranium succeeding only in partial contact with the face. Even so, the blow cracked the left zygomatic arch and opened a clear crack of approximately 2 mm. in it. Confirmed by X-ray.

Blow 7. This blow was delivered with a very heavy adjustable wrench of considerable length, and with the skull in a semi-reclined position. The skull was struck with the wrench "on edge" . First contact was made just above the right orbit and extended posteriorly almost to the lambdoidal suture. The blow penetrated the cranium and continued into the fat material with which the cranial cavity had been filled. It caused a number of isolated fragments of varying size. It should be noted that were this a real skull with intact internal membranes, the dura matter and internal

subperiosteal fibrous membranes would have almost certainly prevented this depth of entry of the tool into the brain case, and would probably have caused substantial elastic rebound.

Blow 8. This blow was struck with the flat end of the adjustable wrench as above (blow 7). X-ray revealed extensive damage to the cranium with additional fragments being produced.

My conclusions from these experiments, coupled with my observations of the skull of Ms. Sheppard are that the blows which caused her injuries were classifiable as blunt trauma and delivered with great force, and by means of a weapon which was probably greater in mass than the flashlight used in the above experiment but less in mass than the adjustable wrench used in the experiment. It should be noted that once a cranium is fractured and one or more pieces displaced, its integrity is then compromised and more extensive injury will then ensue with the same or substantially less force. The "weapon" used, in my judgement was more likely to have been of a mass similar to that of the channel lock pliers, based on the latter's effect upon the cranium. It should also be noted that no attempt was made in these experiments to simulate the fracture pattern seen in the lower face (except in the one unintended case where the poker contacted the zygomatic arch [blow 6]). Those fractures may well have been produced in some other fashion (with or without a weapon) and were not part of the experiment described above. It should also be noted that in my review of the photographs taken of Ms. Sheppard's cranium during the original autopsy, special note should be made of two areas of damage sustained to the left parietal approximately 2-4" posterior of the coronal suture. These two "areas" show flaking of the external cortex to expose the diplőe. In my opinion these are unlikely to have been generated by simple percussive contact of the planar surface of a prospective weapon, but are much more likely to have been generated by contact to the cranium of a weapon bearing a sharp or ridged surface. It is difficult to otherwise account for the exfoliation of surface cortex from the underlying bone when the latter is "protected" by the energy absorbing effects of overlying soft tissue, i.e., some substantial surface irregularity(ies) must have been present in the weapon in order to induce this kind of fracture pattern. It should be also noted that judging from the photographs of the soft tissue injuries which are likely to correspond to these areas of bone damage, the two areas of flaking are most likely to have been exfoliated during the same blow and that the weapon therefore is likely to have had multiple "complex" surfaces.

As always, if I can be of further service in the analysis of this or other cases, please let me know.

Sincerely,

C. Owen Lovejoy, Ph.D.
University Professor; Department of Anthropology; Division of Biomedical Sciences
Technical Advisor; Cuyahoga Co. Coroner's Office