SEROLOGICAL RESEARCH INSTITUTE

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SERI Case No. R'8630'10
Agency Case No. 821-2021
Victims: [redacted]
Joanne Tate
Suspect: Rodney Lincoln

ANALYTICAL REPORT

On March 16th 2010, thirteen items of evidence were received from Jennifer Schoenholz of the St. Louis Metro Police Department via Federal Express (863573757195). On March 26th 2010, one further item of evidence was received from Ken Blucker of the Midwestern Innocence Project via Federal Express (870888650000). These were analyzed as follows:

ITEM 1 VAGINAL SWAB[redacted](3- 2-4-1)

This consists of one swab with faint yellow staining. The swab gave a negative presumptive test for semen. Half of the swab was sampled, extracted and tested for the presence of amylase (an enzyme found in high concentrations in saliva) and seminal fluid with negative results. Microscopic examination of the cellular material did not reveal any spermatozoa. The swab was further extracted for DNA content and tested for the presence of male DNA. None was detected. No further examination was conducted.

ITEM 2 RECTAL SWAB[redacted](3-2-5-1)

This consists of one swab with light yellow brown staining. Presumptive tests for blood and semen were negative. Half of the swab was sampled and tested for the presence of amylase and seminal fluid with negative results. Microscopic examination of the cellular material failed to reveal any spermatozoa. The swab was further extracted for DNA content and tested for the presence of male DNA. None was detected. No further examination was conducted.

ITEMS 3 HAIR SLIDE[redacted] HAIR FROM PERINEUM (3-2-8-1)

This consists of one human hair with no root and one animal hair. The human hair was removed to a gel lifter and a portion removed and extracted for DNA content. The DNA was amplified using mitochondrial primers and subjected to sequencing. Due to unanticipated DNA found in the extraction blank, a further section of the remaining hair was extracted for DNA content and subjected to mitochondrial DNA analysis. The results are tabulated below.

ITEM 4 HAIR SLIDE[redacted] HAIR FROM PERINEUM (3-2-8-2)

This consists of one long dark brown hair with no apparent root. The hair was removed to a gel lifter and a portion of the hair extracted for DNA content. A further section of the hair was sampled at a later date and amplified using mitochondrial primers. The resulting products were subjected to sequencing, the results of which are tabulated below.

ITEM 5 HAIR SLIDE, BLANKET (11-1)

This consists of one small light brown hair with no apparent root contained within crystallized mounting media. The hair was removed to a gel lifter, sampled and extracted for DNA content. A further section of hair was later removed, extracted for DNA content and amplified using mitochondrial DNA primers. The subsequent products were subjected to sequencing, the results of which are tabulated below.

ITEM 6 VAGINAL SWAB[redacted](12-1-1)

This consists of one intact swab with yellowish staining. A presumptive test for semen was negative. Half of the swab was extracted and tested for the presence of amylase and semen with negative results. Microscopic examination of the cellular material revealed no spermatozoa. The swab was further differentially extracted for DNA content and tested for the presence of male DNA. None was detected. The epithelial fraction was utilized as a reference sample for the mitochondrial DNA sequence of[redacted]

ITEM 7 ORAL SWAB[redacted](12-2-1)

This consists of one intact swab with a small amount of yellow staining near the tip. A presumptive test for semen was negative. Half of the swab was sampled and extracted and tested for the presence of seminal fluid with negative results. The swab was further differentially extracted for the presence of male DNA. None was detected. No further examination was conducted.

ITEM 8 RECTAL SWAB[redacted](12-3-1)

This consists of one intact swab with yellow brown staining. A presumptive test for blood was positive and a presumptive test for semen was negative. Half of the swab was sampled and extracted and tested for the presence of amylase and seminal fluid with negative results. Microscopic examination for the presence of spermatozoa revealed none. The swab was further differentially extracted for the presence of male DNA. None was detected. No further examination was conducted.

ITEM 9 LEFT HAND FINGERNAIL SCRAPINGS JOANNE TATE (13-2)

This consists of a small cardboard box containing brownish debris and blue fibers. The brown debris gave a positive presumptive test for blood. A sterile swab was used to take up the brownish material and extracted for DNA content. A trace amount of male DNA was detected, which was amplified and subjected to YSTR typing. Results are tabulated in Table 1.

ITEM 10 RIGHT HAND FINGERNAIL SCRAPINGS JOANNE TATE (13-1)

This also consists of a small cardboard box with brown crusty material. The material gave a positive presumptive test for blood. A sterile swab was used to remove the brown material and the swab was extracted for DNA content. A small amount of male DNA was detected, which was amplified and subjected to YSTR typing. The results are tabulated below in Table 1.

ITEM 11 RIGHT INNER THIGH SWAB JOANNE TATE (14-1-1)

This consists of one intact swab with yellow brown staining. A presumptive test for semen was negative and a presumptive test for blood gave a weak positive result. Half of the swab was extracted and tested for the presence of amylase and seminal fluid with negative results. Microscopic examination for the presence of spermatozoa was negative. The swab was differentially extracted for DNA content and tested for the presence of male DNA with negative results. No further analysis was done.

ITEM 12 SWAB JOANNE TATE (14-3-1)

This consists of one intact swab with heavy red brown staining. A presumptive test for blood was positive and a presumptive test for semen was negative. Half of the swab was extracted and tested for the presence of seminal fluid with negative results. A test for the presence of amylase gave a positive result. Microscopic examination for the presence of spermatozoa was negative. The swab was differentially extracted for DNA content and tested for the presence of male DNA with negative results. No further testing was conducted.

ITEM 13 PUBIC HAIR SWAB JOANNE TATE (14-6-1)

This consists of one intact swab with faint yellow brown staining which gave a negative presumptive test for semen and a positive presumptive test for blood. Half of the swab was extracted and tested for the presence of amylase and seminal fluid with negative results. Microscopic examination for the presence of spermatozoa was negative. The swab was differentially extracted for the presence of male DNA with negative results. No further testing was conducted.

ITEM 14 REFERENCE RODNEY LINCOLN

This consists of two intact oral swabs a sample of which was extracted for DNA content. The DNA was amplified using mitochondrial primers and sequenced. The results are in Table 2.

YSTR TABLE OF RESULTS (TABLE 1)

ITEM	DESCRIPTION	DYS456	DYS389I	DYS390	DYS389II	DYS458	DYS19	DYS385 a/b	DYS393	DYS391	DYS439	DYS635	DYS392	Y GATA H4	DYS437	DYS438	DYS448
	Left Hand Fingernail Scrapings- Joanne Tate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Right Hand Fingernail Scrapings – Joanne Tate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Extraction Blank	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Key: NA = No activity.

MITOCHONDRIAL TABLE OF RESULTS – HV1 (TABLE 2)

		HVI	16069	16126	16129	16172	16223	16294	16299	16304
Item #	Description	CRS	C	T	G	T	C	C	A	T
6	Vaginal Swab – Melissa Davis			C		C		T		C
14	Reference: Rodney Lincoln								G	
	Extraction Blank		NO ACTIVITY							
3	Hair - Perineum				A		T			
4	Hair - Perineum			1.		C		T		C
5	Hair – Blanket		T	C					R	
	Extraction Blank		NO ACTIVITY							

* Hypervariable Region 1 (HV1) for these samples includes base positions 16018-16374.

Legend
CRS=CAMBRIDGE REFERENCE SEQUENCE PUBLISHED BY ANDERSON ET.AL.
R=BOTH A "G" PEAK AND "A" PEAK ARE PRESENT
BLANK=NUCLEOTIDE IS THE SAME AS CRS AT THIS POSITION
1.=HETEROPLASMY

MITOCHONDRIAL TABLE OF RESULTS – HV2 (TABLE 2 continued)

		HVII	73	114	195	225	226	263	309.1	315.1
Item #	Description	CRS	A	C	T	G	T	A	:	:
6	Vaginal Swab – [redacted]		G	T				G		C
14	Reference: Rodney Lincoln							G	C	C
	Extraction Blank		NO ACTIVITY							
3	Hair – Perineum		G		C	A	C	G		C
	Extraction Blank		NO ACTIVITY							

**Hypervariable Region 2 (HV2) for these samples includes base positions 87-385.

Legend
CRS=CAMBRIDGE REFERENCE SEQUENCE PUBLISHED BY ANDERSON ET.AL.
: =INSERTION (NO NUCLEOTIDE PRESENT IN THIS POSITION IN THE CRS)
BLANK=NUCLEOTIDE IS THE SAME AS CRS AT THIS POSITION

EXPLANATION AND INTERPRETATIONS

The enzyme amylase is found in many body fluids including saliva, urine, breast milk, blood serum, feces, perspiration, semen and vaginal secretion. The highest concentration of amylase is found in saliva followed by feces, breast milk, perspiration, urine, blood serum, semen and vaginal secretion.

Blood of any species can appear as a red to brown stain in the dried form and will react positively with the chemicals ortho-tolidine/peroxide. This two step test is used as a presumptive test for the presence of blood. Other substances are also known to react with ortho-tolidine, therefore, the test is not confirmatory for blood.

Semen is comprised of two fractions: the liquid seminal fluid portion and the cellular spermatozoa portion. Seminal fluid contains high levels of a glycoprotein called p30. P30 is formed in the prostate and secreted into seminal fluid, but is also found at very low levels in other body fluids including female urine and serum. A membrane immunoassay is used to detect p30 in a sample extract. Due to the high sensitivity of the test, a weak positive result for the presence of p30 alone is not a confirmation of seminal fluid. The presence of semen in a sample can be confirmed if a positive p30 result is obtained in conjunction with a positive result for the presumptive test (acid phosphatase) for semen or with the presence of spermatozoa.

Seminal stains encountered in case work are often a mixture of semen and vaginal secretion. Microscopically, semen can be identified by the presence of spermatozoa. Vaginal secretion will normally contain many nucleated epithelial cells. Using a differential extraction technique, the DNA from the epithelial cells can be separated from that of the sperm. If the DNA is not degraded, it should be possible to differentiate the epithelial cell DNA from the sperm DNA. The epithelial cell DNA produces an internal control of the vaginal donor's type.

Once extracted the extracts can be quantified using specific human and male (Y) DNA primers. If human DNA is present but no male DNA is detected this indicates that any DNA present is almost exclusively female in origin. The presence of Y DNA shows that male DNA is present. In this case no male DNA was detected so no further analysis was conducted.

Human DNA consists of a number of genetic marker systems. Nuclear DNA is stored as chromosomes found only in the nucleus of the cell. In the nuclear DNA there are Short Tandem Repeats (STR's) found scattered throughout the human genome in specific locations (loci) and on the pairs of chromosomes. The biological parents contribute one set of chromosomes each to make up a unique genetic profile for the offspring. Included in the set of chromosomes are the sex chromosomes X and Y. The Y-chromosome specific STR loci (Y-STRs) are an inherited consistent group of linked genetic marker types (haplotype). The Y-STR haplotype is located in the non-recombining region of the Y chromosome and the same haplotype is passed on to the male offspring from the male parent. Therefore, a result consistent with an individual for Y-STRs also does not exclude any paternally related male individual. These Y-STR genetic markers can be amplified using the Polymerase Chain Reaction (PCR) process and the PCR products are then analyzed by capillary electrophoresis (CE) to separate the amplified products according to size and by the color emitted from fluorescent dye labeling. The following are Y-STR genetic markers: DYS456, DYS389I, DYS390, DYS389II, DYS458, DYS19, DYS385 a/b, DYS393, DYS391, DYS439, DYS635, DYS392, YGATAH4, DYS437, DYS438, and DYS448.

EXPLANATION AND INTERPRETATIONS (continued)

Nuclear DNA is found in the nucleus of the cell, and is inherited from both the mother and father. Analysis methods utilizing nuclear DNA rely on identifying small specific sections or repetitive sections of DNA wherein there are recognizable differences between people. Alternatively, analysis of mitochondrial DNA relies on determining the specific order or sequence of the thousands of individual nucleotide bases that serve as the building blocks of a person's mitochondrial DNA. Unlike nuclear DNA, mitochondrial DNA is located in the mitochondria of the cell, and is inherited maternally. In other words, both males and females have mitochondrial DNA, but only females can pass it on to their offspring. The mitochondrial genome is passed on in its entirety; therefore every individual in the same maternal lineage should have the identical mitochondrial DNA sequence.

When an organic extraction is performed on a biological sample, all genomic DNA will be extracted, including both nuclear and mitochondrial DNA. Therefore, DNA used for mitochondrial sequencing analysis can be extracted using the same procedures as those intended for nuclear DNA.

Thousands of copies of mitochondrial DNA are present in each cell, making mitochondrial DNA analysis possible from samples which are highly degraded or have very limited quantities of DNA. Samples such as skeletal remains, teeth and hair shafts frequently yield mitochondrial DNA results when nuclear DNA analysis is not possible.

The part of the mitochondrial genome significant to forensic science is known as the Control Region, and is made up of two hypervariable regions (HVI and HV2). The forensic community generally recognizes the HV1 and HV2 regions as consisting of base positions 16024-16365 and 73-340, respectively. An adenine (A), cytosine (C), guanine (G) or thymine (T) nucleotide is designated at every position, and base designations are numbered according to the Cambridge Reference Sequence, also referred to as the Anderson Sequence. Although the entire HV1 and HV2 regions are sequenced, only differences (polymorphisms) from the Anderson Sequence are noted when reporting a sample's mitochondrial DNA type.

Heteroplasmy indicates the presence of two variant populations of mitochondrial DNA in the same person. Point heteroplasmy results in the presence of two different nucleotides at the same base position. Normally, it is expected that the occurrence of heteroplasmy would be present at no more than one position within the same sequence. While heteroplasmy can appear to look like a mixture of DNA from two or more people, it actually results from a mutation in the mitochondrial DNA of one person.

In this case it is assumed that [redacted] and Joanne Tate are all maternally related and therefore will possess the same mitochondrial sequence.

CONCLUSIONS

1. No semen was found on the Vaginal Swab or Rectal Swab of [redacted] (items 1 and 2), the Vaginal Swab, Oral Swab, or Rectal Swab of [redacted] (items 6, 7 and 8) or the Right Inner Thigh Swab, the Swab and Pubic Hair Swab of Joanne Tate (items 11, 12 and 13).

2. The trace amount of male DNA obtained from the Fingernail Scrapings of Joanne Tate (items 9 and 10) revealed no YSTR results.

3. In this case two of the hairs (items 4 and 5) were severely degraded so that only HV1 was sequenced. However, the resulting sequences, even if incomplete, can still be used for comparison purposes. The mitochondrial sequence obtained from the Hair from the Perineum of [redacted] (item 3) could not have originated from [redacted] Joanne Tate or Rodney Lincoln.

4. Only a partial mitochondrial sequence was obtained from the Hair from the Perineum of [redacted] (item 4). This sequence could not have originated from Rodney Lincoln but could have originated from either [redacted] or Joanne Tate.

5. Only a partial mitochondrial sequence was obtained from the Hair from the Blanket (item 5). This sequence could not have originated from [redacted] Joanne Tate or Rodney Lincoln and is different from the sequence found in item 3.

EVIDENCE DISPOSITION

Please advise as to the disposition of the evidence.

SEROLOGICAL RESEARCH INSTITUTE

Brian Wraxall

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