

IN THE SUPREME COURT OF TENNESSEE

AT NASHVILLE

(HEARD AT JACKSON)

**FILED**

**November 3, 1997**

**Cecil W. Crowson  
Appellate Court Clerk**

STATE OF TENNESSEE

Appellee

V.

BOBBY ED BEGLEY

Appellant

) FOR PUBLICATION  
)  
) FILED: NOVEMBER 3, 1997  
)  
) DAVIDSON COUNTY  
)  
) HON. J. RANDALL WYATT, JR.,  
) JUDGE  
)  
) NO. 01-S-01-9607-CR-00134

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OPINION

AFFIRMED

BIRCH, J.

We granted the defendant's application for permission to appeal in order to determine whether the trial court abused its discretion<sup>1</sup> in admitting testimony concerning the results of a certain method of DNA analysis. While we have previously considered the admission of the results of DNA analysis using the "restriction fragment length polymorphism" (RFLP) method, we address for the first time the admission of testimony regarding DNA analysis using the "polymerase chain reaction" (PCR) method. PCR is to be distinguished from RFLP, the method more statistically precise and firmly established in both the scientific and legal community. After a jury-out hearing, the trial court admitted expert testimony about the results of the PCR analysis performed on the defendant's clothing, and the Court of Criminal Appeals upheld the trial court's determination.

For the reasons stated, we conclude that the PCR method of DNA analysis is a "DNA analysis" within the definition of Tenn. Code Ann. § 24-7-117(a) (Supp. 1991)<sup>2</sup> and is therefore exempt from a

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<sup>1</sup>Abuse of discretion is the standard for review of a trial court's admission of scientific evidence. State v. Ballard, 855 S.W.2d 557, 562 (Tenn. 1993).

<sup>2</sup>Section 24-7-117 provides:

(a) As used in this section, unless the context otherwise requires, "DNA analysis" means the process through which deoxyribonucleic acid (DNA) in a human biological specimen is analyzed and compared with DNA from another biological specimen for identification purposes.

(b)(1) In any civil or criminal trial, hearing or proceeding, the results of DNA analysis, as defined in subsection (a), are admissible in evidence without antecedent expert testimony that DNA analysis provides a trustworthy and reliable method of identifying characteristics in an individual's genetic material upon a showing that the offered testimony meets the standards

judicial determination of reliability and trustworthiness, as would normally be required under Tenn. R. Evid. 703.<sup>3</sup> Furthermore, the expert testimony adduced at trial satisfied the relevancy requirements of Tenn. R. Evid. 401<sup>4</sup> and was of substantial assistance to the trier of fact as required by Tenn. R. Evid. 702.<sup>5</sup>

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of admissibility set forth in the Tennessee Rules of Evidence.

(2) Nothing in this section shall be construed as prohibiting any party in a civil or criminal trial from offering proof that DNA analysis does not provide a trustworthy and reliable method of identifying characteristics in an individual's genetic material, nor shall it prohibit a party from cross-examining the other party's expert as to the lack of trustworthiness and reliability of such analysis.

(c) In any civil or criminal trial, hearing or proceeding, statistical population frequency evidence, based on genetic or blood test results, is admissible in evidence to demonstrate the fraction of the population that would have the same combination of genetic markers as was found in a specific biological specimen. For purposes of this subsection, "genetic marker" means the various blood types or DNA types that an individual may possess.

<sup>3</sup>Rule 703 states:

The facts or data in the particular case upon which an expert bases an opinion or inference may be those perceived by or made known to the expert at or before the hearing. If of a type reasonably relied upon by experts in the particular field in forming opinions or inferences upon the subject, the facts or data need not be admissible in evidence. The court shall disallow testimony in the form of an opinion or inference if the underlying facts or data indicate lack of trustworthiness.

<sup>4</sup>Rule 401 states:

"Relevant evidence" means evidence having any tendency to make the existence of any fact that is of consequence to the determination of the action more probable or less probable than it would be without the evidence.

<sup>5</sup>Rule 702 states:

Therefore, the results of the PCR analysis in this case were properly admitted, and the defendant's convictions and sentences are affirmed.

Because the defendant does not contest the sufficiency of the convicting evidence,<sup>6</sup> a brief summary of the facts is sufficient to place the issue into context.

The record reveals that the defendant, Bobby Ed Begley, lived in the house next to the house of Delma Johnson, age 72. They were acquainted with each other; Begley had been to Johnson's house on several prior occasions to use Johnson's telephone. On February 5, 1993, Begley went to Johnson's house and asked to borrow \$10; Johnson handed the \$10 to him. When Begley offered to return the \$10 later that evening, Johnson admonished him repeatedly that he should not do so.

In spite of the admonishments, Begley returned later that evening. As soon as Johnson opened the door, Begley rushed in past

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If scientific, technical, or other specialized knowledge will substantially assist the trier of fact to understand the evidence or to determine a fact in issue, a witness qualified as an expert by knowledge, skill, experience, training, or education may testify in the form of an opinion or otherwise.

<sup>6</sup>After this application was granted the defendant asked the Court to consider whether counts three through eight of the indictment, under which he was convicted of aggravated rape, were fatally deficient by their failure to allege the requisite mens rea element of aggravated rape. Consistent with our decision in State v. Hill, No. 01-S-01-9701-CC-00005 (Tenn. filed Nov. 3, 1997), we find that the failure of the indictments in this case to allege a specific mens rea does not affect the validity of the defendant's convictions. We decline to address this issue further.

her. He beat and battered her severely. He sexually penetrated her several times. He then stuffed her into the trunk of her car, closed the trunk, and drove off.

He drove a short distance and stopped. He pulled Johnson out of the trunk and dumped her in some bushes. The temperature was below freezing that night, and Johnson was wearing only a nightgown and robe.

Approximately two to three hours passed before Johnson was discovered and rescued. She was in poor condition and weak from loss of blood. However, at the hospital she was able to identify Begley as her assailant, and she identified him again at trial.

Arresting officers observed what appeared to be blood on Begley's trousers. The trousers were seized, and the blood spots were subjected to DNA analysis at a biomedical laboratory in North Carolina.

Following a jury trial, the defendant was convicted of especially aggravated kidnaping, attempted first-degree murder, aggravated robbery, and several counts of aggravated rape.

## I

A brief and simplified explanation of the theory and methods of DNA analysis will be helpful at the outset. The

Washington Supreme Court gave the following general explanation about the nature of DNA:

DNA (deoxyribonucleic acid) is the chemical material contained within an organism's cells which determine[s] that organism's physical composition. Human cells each contain 46 chromosomes, which are arranged in 23 pairs. One chromosome in each pair is inherited from each parent. Approximately 100,000 genes are located on the chromosomes. Genes, which consist of DNA, determine eye, hair, and skin color, the organization of body parts, and virtually everything else about our physical state. Each individual, with the exception of identical twins, has a unique DNA structure which is contained in every nucleated cell. That structure remains constant throughout a human lifetime. It can be found in blood, semen, hair, bone marrow, and other tissues.

State v. Cauthron, 846 P.2d 502, 508 (Wash. 1993) (footnote omitted). The DNA analysis at issue in this case is more specifically known as DNA typing. Ninety-nine percent of the DNA molecule is the same for every individual.<sup>7</sup> Polymorphisms are the DNA segments which exhibit genetic variation within the population. These variations provide the basis for DNA typing. DNA typing is used to determine whether biological material from a known individual can be linked to a sample from an unidentified specimen.

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<sup>7</sup>Only three million of the three billion-odd base pairs of the DNA molecule differ from one individual to the next. National Research Council, The Evaluation of Forensic DNA Evidence 63 (1996).

Forensic applications of DNA typing involve two components: molecular biology and population genetics. Molecular biological techniques, such as the RFLP and PCR methods, permit scientists to extract and examine unidentified DNA from a given piece of evidence. In the PCR method, the sample of DNA is subjected to an enzyme and heating treatment, which causes a specific segment of the DNA to be "amplified" by billions of replications. To determine whether two samples could have come from the same person, the samples are compared to see if they produced the same pattern. Thomas M. Fleming, Annotation, Admissibility of DNA Identification Evidence, 84 A.L.R.4th 313, 323 (1991). In the RFLP method, an enzyme treatment cuts the DNA molecules into fragments. The resulting length and location of these fragments differ among individuals; samples are then compared to see if they match. Id. at 320.

Population genetics is then used to determine the degree to which two samples are similar by greater than a random chance. The Alaska Court of Appeals explained:

Theoretically, each person's DNA is unique; that is, with the exception of "identical twins," no two persons share exactly the same complement of genes. At the same time, however, it is rare for a specific gene to be unique to a single individual. Some genes--for instance, the genes that direct our bodies to form two arms and two legs--are found in virtually every human being. Other genes, such as those that determine skin, hair, and eye color, are shared by substantial numbers of people. Still other genes are so rare that they are shared by

only small percentages of the general population. . . .

That genes<sup>8</sup> are shared by groups of people is of crucial significance when DNA testing is employed to identify the perpetrator of a crime. Even though DNA testing can accurately identify a person's genes, the fact that a person carries a particular gene means little unless scientists can also tell us the likelihood that other people share that same gene. The fact that a defendant carries the same gene as was found in a tissue sample taken at the scene of the crime is not particularly probative if a high percentage of the population also carry that same gene; conversely, if the gene is quite rare, then the DNA match becomes correspondingly more probative.

Harmon v. State, 908 P.2d 434, 440-41 (Alaska Ct. App. 1995)  
(footnote omitted).

Both the RFLP method and the PCR method have advantages and disadvantages. The most significant advantage of the RFLP method is its specificity. Through application of statistical population frequency evidence to the test results, the RFLP method narrows the possible contributors of a given sample to an infinitesimally small portion of the population, and in doing so informs the jury of the likelihood the sample was contributed by someone other than the defendant. On the other hand, the RFLP

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<sup>8</sup>Although the Alaska Court of Appeals used the term "genes" when explaining the DNA testing process, they recognized that it is actually certain alternative forms of a particular gene, known as "alleles," which are copied and compared in this process. Technically, it is the frequency with which these alleles occur in a given population which is examined to exclude or not exclude a certain suspect as the source of the unknown DNA. The court used the term "genes" for the sake of simplicity.



method is time-consuming and requires a large quantity of high-quality genetic material--at least a quarter-sized stain of blood or a dime-sized stain of semen is required to perform the RFLP method of DNA analysis. Also, unless the samples are recovered when relatively fresh, they degrade into fragments too small for the RFLP method.

In contrast, the PCR method can be performed with very small amounts of genetic material, since the process itself allows amplification to produce an amount suitable for testing. The process is relatively simple and can yield results in as little as twenty-four hours. The PCR method, however, is less statistically precise. Further, if the PCR method is not carefully performed, it is more susceptible to contamination than the RFLP method. See id. at 440; George Bundy Smith & Janet A. Gordon, The Admission of DNA Evidence in State & Federal Courts, 65 Fordham L. Rev. 2465, 2471-72 (May 1997); Thomas M. Fleming, Annotation, Admissibility of DNA Identification Evidence, 84 A.L.R.4th 313, 320-25 (1991).

## II

The admission of expert testimony regarding scientific and technical evidence is governed by Tenn. R. Evid. 702 and 703. McDaniel v. CSX Transportation, Inc., No. 01-S-01-9605-CV-00095 (Tenn. Sept. 29, 1997).<sup>9</sup> Questions regarding the admissibility,

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<sup>9</sup>McDaniel held that the pre-Rules of Evidence test of Frye v. United States, 293 F. 1013 (D.C. Cir. 1923), which required that scientific evidence be generally accepted in the particular field to which it belonged in order for it to be admissible, was superseded by the adoption of Tennessee Rules of Evidence 702 and 703.

qualifications, relevancy and competency of expert testimony are left to the discretion of the trial court, whose ruling will not be overturned in the absence of abuse or arbitrary exercise of discretion. Ballard, 855 S.W.2d at 562. In McDaniel, we promulgated the principles for the trial court's guidance in deciding whether to admit scientific or technical evidence.

First, the evidence must be relevant to a fact at issue in the case. Tenn. R. Evid. 401, 402. Second, the expert must be qualified by specialized knowledge, skill, experience, training, or education in the field of expertise, and the testimony in question must substantially assist the trier of fact to understand the evidence or determine a fact in issue. Tenn. R. Evid. 702; McDaniel, slip op. at 14; see also Otis v. Cambridge Mutual Fire Ins. Co., 850 S.W.2d 439, 443 (Tenn. 1992). Finally, when the expert witness offers an opinion or states an inference, the underlying facts or data upon which the expert relied must be trustworthy. Tenn. R. Evid. 703; McDaniel, slip op. at 14.

Simply put, scientific or technical evidence will not be admissible unless it is determined to be reliable. The reliability of scientific evidence is determined by considering the following nonexclusive list of factors:

1. Whether the scientific evidence has been tested and the methodology with which it has been tested;

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McDaniel, slip op. at 16.

2. Whether the evidence has been subjected to peer review or publication;

3. Whether a potential rate of error is known;

4. Whether, as formerly required by Frye, the evidence is generally accepted in the scientific community; and

5. Whether the expert's research in the field has been conducted independent of litigation.

McDaniel, slip op. at 11 (citing Daubert v. Merrell Dow Pharmaceuticals, 509 U.S. 579, 593-94, 113 S.Ct. 2786, 2796-98, 125 L.Ed.2d 469, 482-83 (1993) and Daubert v. Merrell Dow Pharmaceuticals, Inc., 43 F.3d 1311, 1317 (9th Cir.)("Daubert II"), cert. denied, 116 S.Ct. 189 (1995)).

### III

Richard Guerrieri, a forensic scientist with Roche Biomedical Laboratories, testified as a State's witness regarding the results of the PCR analysis. During a jury-out hearing, Guerrieri testified that he had a Master of Science degree in Forensic Chemistry and a Bachelor of Science degree in Biology, with course work equivalent to a similar degree in Chemistry. He had worked in the field of forensic science for fifteen years, with the most recent six years devoted to DNA analysis. During that time, he had worked hundreds of cases with thousands of samples. He had testified as an expert in forensic science between eighty and ninety times and as an expert in DNA analysis approximately thirty of those times. He had only testified on one prior occasion regarding DNA

analysis using the PCR method. The rest of his experience in testifying about DNA was in cases where the RFLP method was used.

Despite his limited experience in testifying on the PCR method of DNA analysis, he testified that it was recognized and accepted in the scientific community and had been admitted into evidence in twenty to thirty states.<sup>10</sup> He was aware of many publications that had discussed the validity of the PCR method. Guerrieri admitted that no DNA analysis can establish identity to an absolute certainty. The available methods are tests of exclusion; they are designed to determine whether a person can be excluded as the source of the unidentified evidence.

The trial court found Guerrieri qualified as an expert and ruled that he could testify regarding the results of the PCR analysis. Guerrieri then testified that the victim's DNA is type "1.2, 1.2," a type shared by 6.5% of the black population. The defendant's DNA is type "4, 4," a type shared by 9.8% of the black population.<sup>11</sup>

Guerrieri further testified that the PCR analysis of spots on the defendant's clothing resulted in the detection of a mixture of type 1.2 and type 4 DNA. Because of the differing intensity of the two types found on the defendant's clothing, Guerrieri opined

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<sup>10</sup>Guerrieri also testified that based on his communications with FBI personnel, he was under the impression that the PCR method had been admitted in Tennessee courts. However, this Court is not aware of any appellate cases in Tennessee addressing this issue.

<sup>11</sup>Apparently both the defendant and the victim are black Americans.

that they most likely originated from two different persons, a "1.2, 1.2" type and a "4, 4" type. Nevertheless, 18% of the black population do have the combination "1.2, 4" type of DNA.

#### IV

The Legislature has determined that DNA analysis is a trustworthy and reliable method of identifying characteristics in an individual's genetic material and will be admissible so long as it otherwise meets the requirements of the Tennessee Rules of Evidence. Tenn. Code Ann. § 24-7-117(b)(1) (Supp. 1991). The Legislature evidently enacted this statute in order to ease the admission of DNA evidence in Tennessee. Neil P. Cohen, et al., Tennessee Law of Evidence § 401.34, at 147 (3d ed. 1995). Even before Tenn. Code Ann. § 24-7-117 was enacted, Tennessee courts recognized the reliability and trustworthiness of DNA evidence. See State v. Harris, 866 S.W.2d 583, 587 (Tenn. Crim. App. 1992) (Harris violation occurred in 1989, before the effective date of the statute).

Tennessee Code Annotated § 24-7-117(a) defines "DNA analysis" as the process of analyzing and comparing DNA for identification purposes. The defendant asserts that the PCR method of DNA analysis is a method of exclusion, not identification, and as such is not governed by Tenn. Code Ann. § 24-7-117. Additionally, the defendant claims the PCR method's reliability has not been adequately established. We find this argument without merit. At the time the statute was passed, the DNA "method of choice" was the

RFLP method, which, like the PCR method, is not definitive in identifying a particular person. Nevertheless, the RFLP method has clearly been considered by the courts to be a method of identification. See, e.g., State v. Edwards, 868 S.W.2d 682, 697 (Tenn. Crim. App. 1993); Harris, 866 S.W.2d at 386; State v. Gregory, 862 S.W.2d 574, 576 (Tenn. Crim. App. 1993). While the PCR and RFLP methods of DNA analysis can be characterized as tests of exclusion, there are nevertheless relevant to the identification of the perpetrator of a crime. Because the results of the PCR method of DNA analysis are relevant to identification, the PCR method falls under the § 24-7-117(a) definition of "DNA analysis."

Under the McDaniel analysis of the admissibility of scientific evidence, the initial question is whether the results of the PCR analysis are relevant under Tenn. R. Evid. 401. We conclude that they are. The discovery of DNA consistent with the victim's DNA, but inconsistent with the defendant's DNA, on the defendant's clothing is relevant because it tends to identify the defendant as the assailant. The results of the PCR method of DNA analysis may not be as probative as that of the RFLP method, because the PCR method results in a large pool of possible DNA contributors, instead of the infinitesimally small number resulting from the RFLP method. Under the results of the PCR analysis here, 6.5% of the entire black population have the victim's DNA type, and 18% of the same population have a combination of the victim's and defendant's DNA type. Yet, the PCR method of DNA analysis, while not as specific as the RFLP method, serves by process of elimination to increase the probability of an identification and thus is relevant.

The next question under the McDaniel analysis is whether the witness was qualified as an expert by knowledge, skill, experience, training, or education and whether the witness' specialized knowledge substantially assisted the trier of fact to understand the evidence or to determine a fact in issue. Tenn. R. Evid. 702. The expert witness, Guerrieri, was extensively qualified, by both education and experience, in the field of DNA testing. Furthermore, Guerrieri substantially assisted the jury to properly understand the complex DNA evidence. He clearly explained the process and results of the PCR analysis, without overstating the conclusiveness of the evidence. We conclude that the requirements of Rule 702 are satisfied.

Next, under McDaniel and Tenn. R. Evid. 703 the facts or data relied upon by an expert in giving his or her opinion must be trustworthy and reliable. Because the DNA evidence at issue here is governed by Tenn. Code Ann. § 24-7-117, the evidence is statutorily regarded as trustworthy and reliable. Tennessee Code Annotated § 24-7-117 exempts DNA evidence from the trial court determination under Rule 703 of whether it provides a trustworthy and reliable method of identifying characteristics in an individual's genetic material. Consequently, a judicial determination of the scientific reliability of the evidence is unnecessary.

Nevertheless, this Court finds the PCR method of DNA analysis an inherently trustworthy and reliable method of identification. In doing so, we join a number of other state and federal jurisdictions that have already recognized the reliability

and admissibility of evidence based on the PCR method.<sup>12</sup> Several factors support our finding. First, the PCR method of DNA analysis has been subjected to extensive peer review. One court has estimated that over four thousand published scientific articles exist addressing the merits of the method. State v. Lyons, 924 P.2d at 813. Second, the PCR method is considered reliable and error-free, as long as protocols and controls are utilized. Id. at 812. With respect to acceptance of the PCR method by the scientific community:

In 1992, the National Research Council noted that "[t]he theory of PCR analysis . . . is scientifically accepted and has been accepted by a number of courts." In 1996, the National Research Council reported

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<sup>12</sup>See United States v. Hicks, 103 F.3d 837 (9th Cir. 1996), cert. denied 117 S.Ct. 1483 (1997); United States v. Beasley, 102 F.3d 1440 (8th Cir. 1996), cert. denied 117 S.Ct. 1856 (1997); United States v. Shea, 957 F.Supp. 331 (D.N.H. 1997); United States v. Lowe, 954 F.Supp. 401 (D. Mass. 1996); Williams v. American Cyanamid, 164 F.R.D. 608 (D.N.J. 1995), aff'd, 164 F.R.D. 615 (D.N.J. 1996); United States v. Yee, 134 F.R.D. 161 (N.D. Ohio 1991), aff'd sub nom. United States v. Bonds, 12 F.3d 540 (6th Cir. 1993); Seritt v. State, 647 So.2d 1 (Ala. Crim. App. 1994), cert. denied (Ala. 1994); Harmon v. State, 908 P.2d 434 (Alaska Ct. App. 1995); People v. Morganti, 43 Cal. App. 4th 643, 50 Cal. Rptr.2d 837 (1996), review denied (Cal. 1996); Redding v. State, 464 S.E.2d 824 (Ga. Ct. App. 1995); People v. Pope, 672 N.E.2d 1321 (Ill. App. Ct. 1996), appeal denied (Ill. 1997); State v. Hill, 895 P.2d 1238 (Kan. 1995); State v. Spencer, 663 So.2d 271 (La. Ct. App. 1995); Commonwealth v. Vao Sok, 425 Mass. 787, \_\_\_ N.E.2d \_\_\_ (1997); State v. Brown, 949 S.W.2d 639 (Mo. Ct. App. 1997); State v. Moore, 885 P.2d 457 (Mont. 1994), overruled on other grounds in State v. Gollehon, 906 P.2d 697 (Mont. 1995); State v. Harvey, 1997 WL 422956, \_\_\_ A.2d \_\_\_ (N.J. 1997); People v. Morales, 227 A.D.2d 648, 643 N.Y.S.2d 217 (1996), appeal denied (N.Y. 1996); State v. Lyons, 924 P.2d 802 (Or. 1996); State v. Moeller, 548 N.W.2d 465 (S.D. 1996); Campbell v. State 910 S.W.2d 475 (Tex. Crim. App. 1995), cert. denied 116 S.Ct. 1430 (1996); Spencer v. Commonwealth, 393 S.E.2d 609 (Va.), cert. denied 498 U.S. 908 (1990); State v. Russell, 882 P.2d 747 (Wash. 1994), cert. denied 514 U.S. 1129 (1995). But see State v. Bible, 858 P.2d 1152 (Ariz. 1993), cert. denied 511 U.S. 1046 (1994); State v. Carter, 524 N.W.2d 763 (Neb. 1994)(holding such evidence inadmissible).



that "[t]he technology for DNA profiling and the methods for estimating frequencies and related statistics have progressed to the point where the reliability and validity of properly collected and analyzed DNA data should not be in doubt."

Id. at 812, n.22 (citations omitted). Thus, the PCR method is generally accepted in the scientific community as a valid means for identifying unknown contributors of body tissue/fluid samples. Finally, Guerrieri testified that he spent extensive time developing and validating DNA testing methods, independent of any litigation.

Hereafter, the PCR method of DNA analysis shall be admissible into evidence without antecedent expert testimony as to its trustworthiness and reliability, pursuant to Tenn. Code Ann. § 24-7-117(b)(1). As provided by that statute, parties are nevertheless allowed to offer proof that DNA analysis is not trustworthy and reliable. Tenn. Code Ann. § 24-7-117(b)(2). For example, a party can challenge the reliability of a particular test in any given case by a showing of sloppy handling of samples, failure to train the personnel performing the testing, failure to follow protocol, and the like.<sup>13</sup> Such a challenge, however, will go to the weight, not the admissibility, of DNA evidence.

We hold that the trial court's admission of the evidence related to the Polymerase Chain Reactive method of DNA analysis was not an abuse of discretion. Accordingly, the judgment of the Court

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<sup>13</sup>The defendant did not raise any issue concerning the manner in which the specimen was handled or the test performed.

of Criminal Appeals is affirmed. Costs of this cause are taxed to Begley for which execution may issue if necessary.

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ADOLPHO A. BIRCH, JR., Justice

CONCUR:

Anderson, C.J.  
Drowota, Reid, Holder, JJ.