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THE ROLE OF DNA IN THE INVESTIGATION OF CRIME: A CASE FOR ITS USE BY SOUTH AFRICAN INVESTIGATORS

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"Probably the most exciting, as I view it, of the new techniques emerging for the criminal investigator is the DNA identification technology. Through a genetic pattern-matching process, criminals can now be identified positively by comparing evidence from a crime scene – that is blood, body fluids, or sometimes a single hair – with that of a suspect." (William Sessions, Director of the Federal Bureau of Investigation, in a speech before the National Press Club on September 1, 1988)

INTRODUCTION

Crime amongst human beings occurs at all levels of society and exerts influence over all people. This means that each individual and police official involved in combating crime must continually adjust their methods and search for new, more effective ones. But the police cannot be present in all places at all times in order to prevent a crime. Therefore it is to be expected that those people involved in tertiary prevention should enhance their investigative skills. Tertiary prevention deals with the actual offenders and involves interaction in such a fashion that they will not commit further offences (Lab 1992:12). The investigation of a crime becomes important when all other actions have failed to prevent, deter and stop criminals from committing a crime or have not lead to immediate arrest after the commission of a crime. (Folley 1980:186). Accordingly, deterrence performs an important role in the prevention of crime (Lab 1992:101). Failure to address tertiary prevention, however, is shortsighted and ignores many efforts aimed at preventing further criminal activities (Lab 1992:13). Tertiary prevention refers to deterrence and deterrence with a conviction can be one of the best prevention activities. The effect of deterrence in any community rests upon the interaction of a number of factors. One of these is the performance of the police, which is referred to as the reaction time between the reporting of a crime and the arrest being accomplished. The quality and quantity of manpower, equipment and training also influence these factors. The apprehension and punishment of a single individual serves as an example and a lesson to other offenders and potential law violators (Lab 1992:102). Deterrence seeks to discourage criminality in the offender and in the population as a whole (Kalmanoff 1976:318). Therefore, effective investigation is the last expedient the police and the community have in order to solve crime.

The purpose of this article is not about the scientific analysis of a DNA sample, but to determine the use of DNA as an investigative method, to establish the general knowledge about the method amongst investigators, to ascertain the success rate of DNA and to examine the reasons why DNA is not used more often as an investigative tool by investigators in South Africa.

CRIMINAL INVESTIGATION

Criminal investigation can be defined as the discovery of relevant facts, the making of inferences from these facts, the reconstruction of the crime scene, the identification and apprehension of the offender and the preparation of the case for the prosecution and trial of the suspect(s) (Van der Westhuizen 1996:354).

According to Caldwell (1965:317) criminal investigation refers to the police activity directed to the identification and apprehension of alleged criminals and the accumulation and preservation of evidence regarding the alleged crimes. Criminal investigation therefore means the process of tracing people and objects through which the real circumstances of an illegal action can be reconstructed, i.e.the gathering of admissible evidence.

Crime can only be positively solved with the help of objective and subjective clues. Objective clues can be described as the factual proof and the objective explanation of these. Subjective clues are defined as the evidence from people, who are directly or indirectly involved in the crime (Van Heerden 1986:188). Collecting evidence or facts is, according to this definition, the fundamental character of criminal investigation.

To solve crime effectively, it is very important that each criminal investigator enhances his/her investigation skills and uses the best and most effective investigative methods and techniques. Investigation of crime has different objectives. The objectives are the identification of the crime, gathering of evidence, individualisation of the crime, arresting of the criminal, recovery of the property and the involvement in the prosecution process. Individualisation refers to the involvement of the perpetrator or alleged criminal in the act committed (Van der Westhuizen 1996:4). Individualisation involves comparison, usually of the disputed object found at the scene of crime with one of known origin obtained from the suspected criminal. DNA (deoxyribose nucleic acid) is such a method of individualisation.

DNA

DNA is the genetic material found in all human cells and carries the coded messages of heredity unique to each individual. DNA governs the inheritance of eye colour, hair, stature, bone density and many other human and animal traits (Riley 1998:1). One can state that it is the fundamental building block for an individual's entire genetic makeup. In investigation terms DNA is our genetic fingerprint. Each of the approximately 100 trillion cells in a human body contains 23 pairs of chromosomes – one of each pair coming from one's father, the other from the mother- which contain DNA molecules. The human body's cells each contain a complete sample of our DNA (Riley 1998:2). A person's DNA is the same in every cell. For example, the DNA in a man's blood is the same as the DNA in his skin cells, semen and saliva (What Every Law Enforcement Officer Should Know about DNA: 1. http://www.ncjrs.org/nij/DNAbro/what.html. 10/17/01. 9:54).

THE LEGALITY OF THE USE OF DNA IN CRIMINAL CASES

According to Marais (1992:118), DNA- prints satisfy all the requirements that fingerprints, as an individualising medium, have to comply with. These are uniqueness, individuality, invariability, classifiablity, universality and ability to be reproduced. In the USA the criteria of admissibility that has been established by the courts is the so-called Frye test (Cassim & Prinsloo 1997:20). During 1923 a Colombian District Court in the case of *Frye v United States* 293 1013 9DC CIR 1923, formulated the following test that scientific evidence has to comply with: "..in admitting expert testimony deduced from a well-recognised scientific principle or discovery, the thing from which the deduction is made must be sufficiently established to have gained general acceptance in the particular field in which it belongs" (Cassim & Prinsloo 1997:20). In general, the USA courts have interpreted the "general acceptance" principle of the Frye case most liberally and have thus allowed expert testimony on a wide

range of scientific topics, leaving it to the jury to weigh the conclusions that the expert testimony derives from the data. If the court is confronted with a new or novel scientific technique, such as DNA profiling, and if the admissibility is under challenge, it is the duty of the presiding judge to decide the issue and not the jury.

Other examples in the American Case Law, according to Cassim and Prinsloo (1997:20), are:

- In *State v Andrews* 533 So. 2d 841 (Fla. Dist Ct. App 1988) the jury convicted Tommy Lee Andrews of rape almost exclusively on the basis of DNA profiling. In this case the complainant could not identify the accused, but a DNA print from semen found in the victim matched that of the accused. The appellate court upheld the conviction and the use of DNA to successfully convict an accused in a criminal case. This was the first criminal case in the United States in which DNA was used. The court accepted that the scientific method which was used complied with the famous test in *Frye v United States* 293 F 1013 9DC CIR 1923.
- In the case of *People v Westley* 533 NYS 2d. 643 (1988) the defendant was charged with murder based on DNA recovered from bloodstains found on the clothing of the defendant and compared to those of the deceased. Although the defendant questioned the reliability of the methodology used in establishing the respective DNA fingerprints, the testimony of the experts convinced the court of the reliability and accuracy of the particular testing method and a conviction was accordingly achieved.
- In *People v Castro* (1989 545 NYS) case a twenty-year old pregnant woman and her two- year old daughter were found stabbed to death in an apartment. Dried bloodstains were found in the grooves of the accused's wristwatch. The prosecution showed through DNA testing that the blood was that of the murdered woman. The court found that although DNA fingerprinting and the methodology used were generally reliable and admissible in evidence, in this particular case the testing laboratory had failed in several major respects to use generally accepted techniques and experiments for obtaining reliable results.
- *Spencer v Murray* 18F. 3d. 229 (4th Cir. 1994) was the first case in which a defendant, convicted on DNA evidence, was executed. DNA had linked Spencer to semen found on the clothing of four women who had been raped and murdered.

In South Africa the taking of blood samples is administrated in terms of section 37 of the Criminal Procedure Act 51 of 1977. Section 37 reads as follows:

"(1) Any police official may –

(e) take the finger-prints, palm-prints or foot-prints or may cause any such prints to be taken-

(i) of any person arrested upon any charge;

(ii) of any such person released on bail or warning under section 72

(iii) of any such person arrested in respect of any matter referred to in paragraph (n), (o) or (p) of section 40(1);

(iv) of any person upon whom a summons has been served in respect of any offence referred to in Schedule 1 or any offence with reference to which the suspension, cancellation or endorsement of any licence or permit or the disqualification in respect of any licence or permit is permissible or prescribed; or

(v) of any person convicted by a court or deemed under section 57(6) to have been

convicted in respect of any offence which the Minister has by notice in the Gazette declared to be an offence for the purpose of this subparagraph;...

(c) take such steps as he may deem necessary in order to ascertain whether the body of any person referred to in paragraph (a)(i) or (ii) has any mark, characteristic or distinguishing feature or shows any condition or appearance; ….".

In the case *S v Maqhina* 2001 (1) SACR 241 (T) it was decided that where the state's proof of the accused's guilt depended on the results of scientific analyses, the testing process, including the control measures applied, had to be executed and recorded with such care that at any time later it could be verified by any objective scientist. In *S v R and Others* 2000 (1) SACR 33 (W) it was held that the fundamental test for the admissibility of evidence was its relevance and that the evidence must be obtained constitutionally. Only a trained medical official is entitle to gather DNA samples from a crime scene (Smith, DNA unit commander, November: 2001) and only a registered medical practitioner or registered nurse from a person (section 37 (2) (a) Criminal Procedure Act 51 of 1977).

DNA AS AN INVESTIGATIVE TOOL

DNA is a powerful investigative tool because, with the exception of identical twins, no two people have the same DNA (What Every Law Enforcement Officer Should Know about DNA:1. http://www.ncjrs.org/nij/DNAbro/what.html. 10/17/01. 9:54). DNA was developed by Prof Alex Jeffreys of the University of Leicester in England during September 1984. He states that, with the exception only of identical twins, no person that has ever lived, or who will ever live, will share the same DNA-print. John Huss of Cellmark Diagnostics sets the probability of two persons sharing the same DNA-print at one in four to five trillion (Marais 1992:119). DNA "fingerprinting" can be used for the elimination or association of suspects with a crime victim or a crime scene (Weston et al 2000:85). DNA evidence can be collected from virtually anywhere at a crime scene (What Every Law Enforcement Officer Should Know about DNA:1. http://www.ncjrs.org/nij/DNAbro/what.html. 10/17/01. 9:54).

The first application of DNA took place in an immigration case in Britain. A boy from Ghana sought to emigrate to Britain, claiming that his mother was already a resident. Conventional blood tests were not conclusive enough to confirm that the two could be related, but DNA analysis showed beyond reasonable doubt that the relationship was as claimed, and the Home Office put its stamp of approval on the new technology (What Every Law Enforcement Officer Should Know about DNA:2. http://www ncjrs.org/nij/DNAbro/what.html. 10/17/01. 9:54).

A detective in the East Midlands read about the abovementioned case and sought Jeffreys' help in solving the vicious murder and rape of two British girls. The prime suspect in the case was a kitchen porter who had confessed to one of the murders. They provided Jeffreys with semen samples from the murder scene and blood samples from the suspect. Jeffreys confirmed that the same person had committed both crimes but that it was not the suspect the police held. On November 1986 the kitchen porter became the first person in the world to have his innocence proven by DNA. The investigation continued. All male residents of the area between the ages of 17 and 34 were requested to voluntarily submit a blood sample. The police then received an unexpected tip. A bakery manager chatting in a pub with some of his employees learned that one of his colleagues had convinced another baker to be blooded in his stead. The new suspect was arrested and confessed. He became the 4 583rd and last man to be

tested in the hunt for the Midlands killer. His sample provided a perfect match to the sperm that was found in the two young victims. Thus in September 1987 DNA was on its way as investigative tool.

The following are a few examples of how DNA can be used as an investigative tool: A murder was solved when the suspect's DNA, taken from saliva in a dental impression mould, matched the DNA swabbed from a bite mark on the victim. A masked rapist was convicted of forced oral copulation when his victim's DNA matched DNA swabbed from the suspect's penis six hours after the offence. Cases have been solved by DNA analysis of saliva on cigarette butts, postage stamps and the area around the mouth opening on ski masks. DNA analysis of a single hair without the root found deep in the victim's throat provided a critical piece of evidence used in a murder case (What Every Law Enforcement Officer Should Know about DNA:1. http://www.ncjrs.org/nij/DNAbro/what.html. 10/17/01. 9:54) An American DNA-research institution, Lifecodes Corporation, developed the DNA-Print Identification Test. Lifecodes was able to extract DNA from a dry bloodstain on a crime scene and to divide it into fragments by means of a chemical process. The fragments formed a unique pattern. After a blood sample was drawn from the victim during the autopsy, the same process was repeated with it. It was found that the pattern was identical with that of the dry bloodstains found on the crime scene. By means of this positive comparison, adequate evidence was adduced to prove that the deceased had been on the crime scene (Marais 1992:119).

Only a few cells can be sufficient to obtain useful DNA information to help solve a case. The mere fact that you cannot see the stain does not mean there are not enough cells for DNA typing. DNA does more than just identify the source of the sample; it can place a known individual at a crime scene, in a home, or in a room where the suspect claimed not to have been. It can refute a claim of self-defence and put a weapon in the suspect's hand. It can change a story from an alibi to one of involvement or guilt.

DNA can be used to determine paternity and maternity, as well as for criminal identification. Because a person inherits his or her VNTRs (variable number of tandem repeats) from his or her parents, VNTR patterns can be used to establish paternity and maternity. The patterns are so specific that a parental VNTR pattern can be reconstructed even if only the children's patterns are known. Parent-child VNTR pattern analysis has been used to solve standard father-identification cases, more complicated cases of confirming legal nationality as well as in instances of adoption. DNA isolated from blood, hair, skin cells or other genetic evidence left at the crime scene can be compared with the DNA of a suspect to determine guilt or innocence. DNA can also be used to establish the identity of a homicide body (What Every Law Enforcement Officer Should Know about DNA:1. http://www.ncjrs.org/nij/DNAbro/what.html. 10/17/01. 9:54).

IDENTIFYING DNA EVIDENCE

Since only a few cells are needed for a useful DNA sample, the list below (What Every Law Enforcement Officer Should Know about DNA:1. http://www.ncjrs.org/nij/DNAbro/what.html. 10/17/01. 9:54) identifies some areas at the crime scene or on a victim that may contain valuable DNA evidence. Possible crimes have been added to the list in Annexure A. The analysis of DNA can associate victim(s) and/or suspect(s) with each other or with a crime scene. Blood examinations can determine whether blood is human or non-human and can determine the animal species, although it cannot determine the age or race of a person.

DNA AS AN INVESTIGATIVE TOOL IN SOUTH AFRICA

To determine the general use of DNA as an investigative tool in South Africa, 34 detectives attending an in-service training course at the Detective Academy, Silverton, in November 2001 and an investigator and commander from the detective services at Krugersdorp and Carltonville, as well as the public prosecutor at Carltonville were interviewed. The group on course at the Detective Academy was nationally representative: three from the Western Cape; five from the Eastern Cape; six from KwaZulu-Natal; four from Gauteng; three from the Free State; three from Mpumalanga; four from the Northern Cape; three from Northern Province; and three from the Northwest Province. This group consisted of 28 investigators, five unit commanders while one did not mention his position. Of the ten officers (nine captains and one superintendent), six indicated that they were commanders/investigators and four that they were commanders; one was from the Western Cape, three from the Eastern Cape, one from the Northern Cape, two from Northwest Province, two from the Northern Province and one from Gauteng. There was no officer from Northern Cape, Free State and Mpumalanga. All 24 non-commissioned officers (constables, sergeants and inspectors) indicated that they were investigators. The Western Cape had two representatives, the Eastern Cape two, Kwazulu-Natal five, the Free State three, the Northern Cape three, Northwest Province two, Northern Province one, Mpumalanga three and Gauteng three.

Out of the group of 34 undergoing training, 26 (six officers and 20 non-officers) indicated that they used DNA as an investigative tool. From the data gathered through the interviews DNA was used in murder, rape, cash-in-transit robberies and housebreaking cases. Aspeling (investigator, November 2001) is of the opinion that DNA as an investigative tool can be used in all cases where blood is involved and in cases where the identity of an unidentified body has to be established. Combrink (prosecutor, November :2001) is of the opinion that DNA as a tool can be used in all cases where the perpetrator has to do something on the scene. The result of the action can be sweating, the loss of hair and blood on the scene caused by an injury, leaving behind important evidence through which the perpetrator can be connected to the crime.

Most of the respondents, namely 31 of the 38, indicated that they have used DNA as an investigative tool in cases of murder, rape and cash-in-transit robberies and that the results were positive. Only one of the respondents indicated that he had no success with DNA. From the 38 respondents 28 were of the opinion that DNA is frequently used as a method in the investigation of a crime, while nine said that it is not (three did not answer this question). To the question "Why is DNA not generally used as a method?" respondents answered that it is expensive. From the responses to this question the following opinions were expressed: "DNA testing is very expensive and is only done when the court requests it" (Du Plessis, investigator, 2001). One said that there were times when investigators from his station requested DNA-testing to be done. They were informed that it is not cost effective and that the forensic science laboratory first needs to receive a motivation from the prosecutor before any DNA analysis can be done. Another problem identified by respondents was that members at station level do not know much about the method (Mbathha, investigator, November: 2001; Laubscher, investigator, November 2001), while the length of time it takes to get the report is also regarded as a problem (Combrink, prosecutor, November 2001).

In following up on the problems identified by the investigators, Senior Superintendent Smith, the DNA unit commander of the Forensic Laboratory in Silverton, Pretoria, was interviewed on 20 November

2001. His unit examined 7 400 DNA cases per year, which according to him represents approximately 20 percent of all the cases that are received by the unit which have crime samples that may be examined for DNA evidence reported to the police. This is believed to be approximately 6 percent of the total cases that are reported to the police where DNA evidence may be of use in the investigation process. The unit does not have the ability to examine all the reported cases at this stage, but they are working on a three-year plan to increase the capacity of the unit to the stage where it can examine all cases reported. At this stage the DNA unit focuses on sexual offences, serial cases, cash-in-transit heists, armed robberies, murder cases, cases where police officials are involved and cases where the prosecutor requested the analysis. But, if an investigator requests DNA analysis and motivates the request, the unit will make exceptions.

According to Smith (DNA unit commander, November 2001), DNA analysis is indeed expensive. A single DNA analysis costs R1200.00 per sample (includes the duplication of the result). This amount excludes overhead costs. There are normally three samples that have to be tested. These samples are from the victim, the suspect and the crime sample (e.g. blood stain from the scene of vaginal swab from a sexual assault victim). The analysing process takes between 10-12 weeks to complete. It is therefore important that the investigator notify the prosecutor that DNA results are being awaited and that it will take up to 12 weeks to obtain the report. The main reason for the delay is the quality assurance programme that has been implemented. The Forensic Science Laboratory has to make sure that the analysis will stand the admissibility test in court. Smith agrees that much must be done by his unit to improve the service to investigators. He admits that at this stage his unit cannot analyse all cases referred to them, but that they are in the process of improving their service. Already an additional 73 members have been employed and another 50 will be employed in the new financial year. Additional equipment has been purchased and certain parts of the DNA analysis process are being automated. The establishment of a fully automated system for the DNA analysis of blood samples is in a very advanced stage of implementation. The laboratory Information System (LIMS) has been procured and will be implemented next year to assist with better casework management. The crime evidence collection kits (sexual assault kits, blood crime scene collection kits etc.) have been re-engineered so that a quality sample is collected for DNA. The DNA analysis process will be optimised in the next months by the introduction of new technology (new equipment and automated instrumentation) and improved examination protocols. This will also have the spin-off that the DNA testing in the laboratory will become cheaper per sample, turn-around times of the samples will improve, and the number of samples analysed by the laboratory will drastically increase.

Although DNA profiling cost per sample will be significantly reduced through the introduction of the new innovative protocols and technology, the need for DNA profiling on crime samples will increase dramatically as the impact of DNA evidence becomes more evident. It is expected that the use of DNA profiling in crime investigation locally will follow the same path as in other parts of the world. The present budget for profiling is R16 million (reagents only) and this is expected to increase to at least R64 million in the next three years.

Smith, however, cautioned that in the interim period, the unit cannot provide the envisaged service. It takes at least 18 months to train a university graduate and to authorise the person as a reporter in DNA profiling. He is confident that the problem will be solved over the next three years. Smith is also of the opinion that when the upgrading of the laboratory's facilities and improvement of its capacity is completed, the unit will

not only provide a better service, but will also be able to provide the investigator with a DNA Intelligence Data Bank.

FINDINGS

From this research, based on the available literature and the interviews, it is clear that:

- DNA is an effective tool in the investigation of crime.
- DNA is also frequently used as an investigative tool (28 of the 38 respondents).
- The use of DNA in South Africa can be improved.
- DNA testing is expensive.
- It takes up to three months to obtain the results.
- Not all members at station level know about DNA as an investigative method

RECOMMENDATIONS

Although DNA is still in its infancy in South Africa, a great deal can be done to inform investigators about DNA as an investigative tool. It is recommended that the DNA unit:

- Uses every training opportunity to advise and educate investigators on the use of DNA as investigative tool.
- Makes training videos on the use of DNA available to police stations and other training units.
- Publishes the results achieved by the use of DNA as widely as possible for investigators to read.
- Use the opportunity to lecture investigators while going around the country to testify in court.
- This will shorten the distance between the unit and the investigator and improve communication and contact.
- Seeks opportunity to lecture prosecutors on the use of DNA and the advantages of it to prove guilt.
- Arranges practical workshops in the use of DNA at police stations countrywide.

CONCLUSION

The more officers know about DNA and how to use it, the more powerful a tool DNA will become. If investigators really want to play their part in preventing crime and raise their effectiveness, they have to improve their knowledge of investigative methods and techniques such as DNA. Investigators in South Africa do not have a history of writing about their experiences, with the result that very few of the investigation successes are documented. This shortcoming will hopefully be addressed in future by research through a new coursework degree offered by Technikon Southern Africa (TSA) as from 2002. The B Tech: Forensic Investigation, M Tech: Forensic Investigation and D Tech: Forensic Investigation degrees will provide learners with the opportunity to do research in the study field of forensic investigation. The degree will provide learners with the opportunity to research investigative methods and techniques, such as DNA, and to publish their findings in accredited magazines and journals, as well as to obtain a professional degree in this specialist field of policing.

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Annexure A

Evidence	**Possible location of DNA evidence**	**Source of DNA**	**Crime**
baseball bat or similar weapon	handle, end	sweat, skin, blood, tissue	violent crimes like assault, murder, house-breaking, malicious injury to property
hat, bandanna, mask or balaclava	inside	sweat, hair, dandruff	any crime
eyeglasses	nose or ear pieces, lens	sweat, skin, hair	any crime
facial tissue, cotton swab	surface area	mucus, blood, sweat, semen, ear wax	any crime
dirty laundry	surface area	blood, sweat, semen	violent crimes: murder and rape
toothpick	tips	saliva	any crime where the suspect helps him/herself from the kitchen: murder, rape, housebreaking
used cigarette	cigarette butt	saliva	any crime
stamp or envelope	licked area	saliva	extortion, fraud, intimidation
tape or ligature	inside/outside surface	skin, sweat	theft, housebreaking
bottle, can, or glass	sides, mouthpiece	saliva, sweat	crimes where the suspect help him/herself from the kitchen or fridge or where alcohol is involved
used condom	inside/outside surface	semen, vaginal or rectal cells	rape, murder
blanket, pillow, sheet	surface area	sweat, hair, semen, urine, saliva	murder, rape
"through and through" bullet	outside surface	blood, tissue	murder, attempted murder
bite mark	person's skin or clothing	saliva	rape
fingernail, partial fingernail	scrapings	blood, sweat, tissue	murder, rape, assault