Genetics and Forensics: Making the National DNA Database

Paul Johnson, Paul Martin and Robin Williams

This paper is based on a current study of the growing police use of the epistemic authority of molecular biology for the identification of criminal suspects in support of crime investigation. It discusses the development of DNA profiling and the establishment and development of the UK National DNA Database (NDNAD) as an instance of the 'scientification of police work' (Ericson and Shearing 1986) in which the police uses of science and technology have a recursive effect on their future development. The NDNAD, owned by the Association of Chief Police Officers of England and Wales, is the first of its kind in the world and currently contains the genetic profiles of more than 2 million people. The paper provides a framework for the examination of this socio-technical innovation, begins to tease out the dense and compact history of the database and accounts for the way in which changes and developments across disparate scientific, governmental and policing contexts, have all contributed to the range of uses to which it is put.

Keywords: DNA, databases, forensic sciences.

The establishment of the biochemical basis for the 'new' genetics after World War II through a developing theoretical understanding of the structure of deoxyribonucleic acid (DNA) vastly increased the epistemic authority of molecular biology as one of the natural sciences, and also made possible the development and application of biotechnologies to a widening range of scientific and social projects. These projects have included for example the design and targeting of pharmaceutical products, the manufacture of genetically modified food, improved medical diagnostics and a range of genetic therapeutics. This paper examines an additional application: human identification based on the analysis of highly polymorphic and largely 'non-coding' areas of the human genome. This application has been deployed in a number of socially significant ways and contexts, including: determining parentage; establishing and verifying claims to identity in various legal and commercial contexts; and inferring the

identity of individuals who are the victims, or possible perpetrators, of crime. All such uses of genetic profiling seek to establish identity as individuality *and* relatedness in order to implicate or exonerate persons from participation in particular social relations or activities.

The incorporation of forensic DNA identification technology into the criminal justice process of a widening number of states has been fast and far-reaching. From the introduction of 'genetic fingerprinting' in high profile cases of serious crime in the mid 1980s, to the now routine use of 'genetic profiling' in volume crime investigation, DNA identification makes an important contribution to the detection of crime and to the construction of prosecution cases for courtroom hearings. Such identifications typically involve the collection of biological material discovered at crime scenes, the profiling of DNA extracted from this material, and the comparison of the profile obtained with existing DNA profiles of offenders held on a 'forensic' database.

Two main kinds of academic studies have contributed to current understandings of the course and consequences of these uses of molecular biology and bio-technology in the criminal justice system. The first kind of study, largely informed by an interest in the institutional correlates of large-scale socio-historical changes, has represented the developing uses of DNA profiling and the construction of DNA databases as the instantiation of more generic changes in the modes of control and control policies characteristic of recent and contemporary Western European and North American societies. From this standpoint, DNA profiling is seen to play a significant (but largely unanalysed) part in the 'new culture of crime control' which has both been informed by the political and cultural values of late modern society and has in turn come to shape the ways in which this society has installed '…more intensive regimes of regulation, inspection and control…[whilst]…our civic culture becomes increasingly less tolerant and inclusive, increasingly less capable of trust.' (Garland, 2001: 194-5)

Accordingly, DNA databases containing an increasing number of the genetic profiles of criminal suspects constitute 'centres of calculation' (Latour) whose installation marks the growing extensiveness and intensity of bureaucratic surveillance in contemporary society – as one amongst the multiplicity of ways in which modern forms of government seek and use knowledge about their citizens in general and 'suspect citizens' in particular (see for example Lyon, 1991; 2001; Lyon and Zuriek, 1996; Marx, 2002; Norris and Armstrong, 1999; Norris *et al.*, 1996). Here DNA profiles, databased as seemingly robust and resilient knowledge about such citizens, are characterised as part of a bio-surveillance apparatus to which can be submitted the material residue of the past, present and potentially future criminal conduct of the person profiled. Stenson (1993: 379 *et seq.*) has written about the ways in which a variety of forms of surveillance both embody and enhance such 'specialized knowledge about crime and criminals'. And like others (e.g. Miller & Rose, 1988; O'Malley, 1992; Rose, 1999) he uses Foucault's (1979) original idea of 'governmentality' to assert that knowledge of such surveillance has effects on the self management of those whose ac-

tions and identities are captured by its gaze. The incorporation of genetic knowledge into such techniques of surveillance is then simply '…only one element within a complex of programmes which address the issue of crime control…' (Rose, 2000: 20), and the contemporary crime control complex is seen to deploy DNA databasing as part of a technologically facilitated infrastructure of intelligence gathering aimed at effective detection, crime reduction and risk management.

Whilst most of these studies show little interest in the specific understandings that attach to genetics as such, Rose (2000) has discussed the relationship between the growth of genetic knowledge and a renewed interest in the relationship between biological factors and criminal conduct, and Duster (2003) has described the ways in which the various methods for the inference of ethnicity based on the analysis of large numbers of forensic DNA profiles easily contribute to highly contested understandings of the relationship between crime, policing and 'race' in the United States. Even if the conjectures that fuel such an interest in the 'identification, calculation and management of biological risk factors' (Duster, 2003: 24) associated with crime and crime control play no part in the current design of the DNA profiling technologies that are described in this paper, it is clear to these writers that the genetic information captured by these – or closely related – technologies can be used for these other purposes.

Ericson and Shearing (1986) argued that the embrace of science by policing arises from the recognition that any process organised around an historical inquiry will be helped by enlisting the assistance of scientific expertise in its attempt to reconstruct the past. The image of the police as technical agents of scientific rationality rather than representatives of particular social interests is assisted by such a rhetoric of scientification in which they acquire whatever are the latest scientific and technological aids and deploy them in – to use a currently popular expression – the war against crime. The seeming objectivity of DNA profiling then becomes recruited as another 'means by which the police effect closure and express authoritative certainty about what they know and the decisions they have taken.' (Ericson and Haggerty, 1997: 358) The authors suggest that these rhetorical uses of science and technology are used to support claims for the legitimacy of police actions. "Science, technology and law become bound up in the constant ideological struggle of trying to make sectional interests appear general and universal, part of the 'public interest'" (Ericson and Shearing, 1986: 134). Informed by Geertz's observations of the technological restless of many modern institutions, they also describe a process of 'scientific inflation' through which police expectations about the potential utility of scientific and technological innovation are used to provide 'more and improved resources for gathering, processing and analysing' (137) a widening repertoire of data relevant to crime prevention and detection.

In summary, these kinds of studies provide interesting – but contestable – generic characterisations of the significance of science and technology for contemporary forms of social control in 'late-modern societies'. However they rarely offer any insights into the specific ways in which the epistemic authority of

molecular biology not only provides a warrant for the construction of forensic DNA profiles and DNA databasing, but is itself an accomplishment of these 'downstream' activities (Gieryn, 1999). Instead the materiality of DNA and DNA profiles tends to be subsumed by wider assertions about the ideological uses of science and technology, even when – as in the work of Ericson and Shearing – it is acknowledged that the police not only make use of existing scientific knowledge and technology but also stimulate innovations in their further development.

In contrast, a second kind of study has focused in much more detail on the uses of DNA identification evidence within considerations of the role of the scientific expert and the presentation of forensic evidence in judicial proceedings (Callen, 1997; Edmond, 2000; Freeman and Reece, 1998; Jones, 1994; Redmayne, 2001; Roberts and Willmore, 1993). Some work has been concerned with issues of rhetoric, logic and advocacy surrounding forensic DNA profiling (e.g. Coleman and Swenson, 1994; Evett and Weir, 1998; Lynch, 1998) and others have also focused attention on the recent 'Bayesian Turn' as a general approach to assessing the probative significance of forensic science evidence in general and DNA evidence in particular (Allen and Redmayne, 1997; Foreman *et al.*, 1997; Robertson and Vignaux, 1997).

One group of scholars, more directly informed by several research traditions within science and technology studies, have produced especially perspicuous accounts of the ways in which the abstract knowledge system of molecular biology and its technological correlates have become implicated in the criminal justice process. A group of such studies by Fujimura and Fortun (1996), Jasanoff (1998), Jordan and Lynch (1998) and Lynch (1998) have proved particularly useful for thinking about the range of influences on and uses of DNA profiles and DNA databasing in the UK. All of these studies stress the ways in which the standardised procedures that make up established scientific technologies are the outcome of negotiation amongst a variety of innovators and users, and that the trajectory of such innovations are marked by contestation, contingency and adaptation. A special issue of Social Studies of Science published in 1998 contained a number of papers (especially Jordan & Lynch, Lynch, and Jasanoff) which dealt explicitly with the technology underlying the construction of DNA profiles and considered in detail the history of the forensic uses of these artefacts within the US judicial system. It is in the spirit of these latter investigations into the relationship between molecular biology, DNA technologies and forensic scientific practice in particular institutional settings that we hope to produce a detailed analysis of the trajectory of DNA profiling and databasing. Our aim is to reveal the practical – rather than theoretically stipulated – course and consequences of its routine integration into criminal detection in a particular legal jurisdiction. Unlike Jordan, Lynch and Jasanoff, however, we are less interested in the contingencies surrounding the use of DNA evidence in criminal prosecutions and more interested in the use of DNA 'intelligence' by the police in investigations. In the following sections of this paper we try to show the ways in which the scientific and technological character of DNA pro-

filing and databasing in the United Kingdom was both shaped by and has also shaped the legislative and policing contexts within which it has been located over the last decade or so.

Approaching the NDNAD

Any effort to understand the trajectory of the technical application and operational implementation of the set of scientific innovations that constitute DNA profiling and databasing in the UK requires a dense – and sociologically sensitive – account. This account needs to attend to the interwoven series of technical, legislative and organisational changes which have underpinned this development. This is a intricate history which is also supported by advances in computerization and automation which support, and are indeed engendered by, the need to incorporate the routine collection, analysis, databasing and matching of DNA profile across the whole range of crimes investigated by the police. In the remainder of this paper we try to capture this complexity by outlining some of the heterogeneous material, disciplinary and rhetorical resources that are brought together in the forms of coordinated action that make up this socio-technical assemblage.

The most important of these resources and actions are: specific bodies of disciplinary knowledge, most obviously the scientific knowledge of the form and range of genetic variation within human populations, which provides the NDNAD with its scientific base; the assortment of material artifacts that provide the source material for scientific analysis, including crime scene stains and tissue samples taken from criminal suspects, along with the paperwork within which the narrative of their production and subsequent preservation within a specific chain of custody is located; a repertoire of laboratory and computing technologies that make possible the storage and genetic analysis of bodily samples, along with methods for the representation of measured genetic variation in the form of standardized individual profiles which can be compared with one another; a set of very dense organizational imperatives, routines and practical actions that constitute a crime investigation process within which the material artifacts are produced, and the results of scientific analysis are deployed and audited; a body of regulatory frameworks which sanctions the construction of artifacts and their use within the criminal justice system, including specific statutes, home office circulars, chief constables orders and judicial decisions.

This imbricated set of different knowledges, practices, and routines which together constitute the NDNAD have arisen and been developed within several distinct organizational contexts, but they are each given new inflections through their combination and operational redeployment in the investigation of crime. In other words, separate 'specialist areas' – such as genomic sequencing, forensic science practice, information technology, police investigatory procedures, and governmental expertise – are combined in the form of the NDNAD to effect its construction and deployment in certain ways and with specific aims. Therefore, of particular interest to us are the relations that have come to exist between certain sets of actors within this complex of elements. The interests and resources of these ac-

tors are not just passively combined, but rather rely upon and mutually reinforce each other in the course of the construction and continued development of the database and its deployment.

From our point of view, and in contrast to the first group of studies mentioned above, it is neither desirable nor practical to see the development of this complex assemblage in terms of either the linear implementation of some overarching ideological set of ambitions or as the outcome of a stochastic series of events. Rather, we would propose that the development of the NDNAD has been generated somewhere between these two poles: as a scientific potential which has been developed in accordance with specific state interests but which, because of its inculcation with such interests, has itself prospered and grown in other contexts. Whilst we agree with Bereano (1992) that technologies are not value-free or neutral, and are themselves human interventions into social and political environments, it would be misleading to overstress the notion of a 'governmental drive' which simply steers the development and implementation of such innovations. But nor would we wish to expunge completely the political ambitions of the state from the development of this scientific technology; it is not simply that genetic profiling 'affords' (Hutchby, 2001) certain socio-political aims, but rather that those political aims have themselves contributed to the establishment of this technology (outside, as well as within, forensic science – such as in the vast market of paternity testing).

The approach we take resonates with that of Hess' (1997) 'heterogeneous constructivism' insofar as we recognise that scientific and technical innovations are both affected by particular social relations and at the same time, bring into being new forms of social relations. The interrogation of the mutual determination of both technologies and the social networks within which they are realised is essential to understand the ways in which DNA profiling and databasing in the UK has moved from the 'local uncertainties' (Star, 1985) of their initial deployment within a small number of serious crime investigations to the 'global certainties' of their routine use for the investigation of volume crime.

A nuanced interpretation of the historical development and socio-political context of the NDNAD is required to understand the ways in which it now appears as a central scientific policing tool imbued with the rhetorical promise of a 'weapon' which can be legitimately deployed to tackle crime. As such, therefore, it is important to understand the differing contexts in which this development has been negotiated and to discern the ways in which relevant actors have invested, and contested, the implementation of DNA forensic databasing.

Our overall aim is to tease out the density of the NDNAD as an operational assemblage by locating its historical development across certain key sites, in particular those of the genetic sciences, the government's legislative programme; and policing policy and practice. This is a large task, and this paper represents an early contribution to its eventual achievement. Therefore, following some brief remarks about the overall shape of relevant scientific developments, we focus more detailed attention on the complexity of the legislative and operational

frameworks which have enabled, sustained and enhanced the application of these developments as well as the relatively uncontested way in which they have been implemented.

The Development of Forensic Genetic Profiling in the UK

The initial development of technologies for capturing and displaying individual differences based on repeat sequences in DNA was carried out by Alec Jeffreys and his colleagues at the University of Leicester. Studies in the mid-1980s (Gill *et al.*, 1985; Jeffreys *et al.*, 1985) established that forensic samples from potentially crime relevant objects could contain sufficienty high quality DNA to enable profiling to take place. These objects include blood, semen, saliva, hair, dandruff, skin, vaginal and nasal secretions, sweat and urine. The possibility of deriving DNA from the 'abandoned property' of criminal suspects left at crime scene generated huge interest amongst police investigators. These DNA methods had a number of important advantages over previous forensic identification technologies based on the analysis of blood: DNA is more resistant than protein markers to degradation through time or heat; DNA is found in all cells, so the amount of potentially analyzable material is widened; only very small samples are required, and, perhaps most importantly, the individual variability detected by DNA analysis is much greater than that measurable by comparison of protein polymorphisms. This means there is far less chance of two people having the same set of markers and enables much larger populations of suspects to be analysed without the possibility of them having the same profile.

A series of scientific, technical and industrial changes in the late 1980s enabled DNA profiling to be undertaken at high speed and volume. Many of the scientific weaknesses of the first generation of DNA fingerprinting were overcome by the use of a new molecular biology technique developed in the late 1980s by Mullins and others – the Polymerase Chain Reaction (PCR). So called High Throughput Screening (HTS) systems based on miniaturisation and the use of industrial robots has enabled a dramatic reduction in both the time and cost of sample processing. As well as this, the development of large bioinformatics systems has made it technically possible to create databases containing information on tens of thousands of suspects.

The recent history of forensic DNA technology can therefore be told as a story dependent on the parallel development of a number of scientific, technical and commercial innovations. These advances together afforded an increase in the successful application of the technology to a wider variety of biological materials left at scenes of crime. Automation and cost reduction encouraged the collection and profiling of samples from a widening range of criminal suspects. Yet, despite these significant advances in DNA profiling technology, the potential for their investigative exploitation would not have been possible without the enabling legislative framework which has been enacted between 1994 and 2001 by successive UK governments. Developments in DNA profiling have occurred in symbiosis with the state commitment to its application in forensic crime investigation and without

this governmental commitment the technology would have remained limited in its development and applications.

Operationalizing the Database – the Legislative Framework

The state commitment to the establishment of the NDNAD has been made, alongside continual financial support, through a series of Acts of Parliament that have empowered the police to utilize DNA technology in increasingly expanded ways. Parliamentary moves towards the implementation of a more systematic legislative framework can be seen to begin in 1993 when, in view of the (albeit modest) success of DNA profiling in criminal prosecution, the *Royal Commission on Criminal Justice* recommended that 'there should be clear legislative provision for the more extensive storage of DNA samples or data both for the purpose of identifying offenders and for the purpose of keeping a frequency data base overseen by an independent body' (Royal Commission on Criminal Justice, 1993). It is important to note that the impetus for the Royal Commission was generated through concern about public confidence in the criminal justice system as a whole, and the contribution of forensic science to the justice process in particular (the commission was announced on the day that the Court of Appeal quashed the conviction of the 'Birmingham Six' in 1991). Therefore, whilst the commission did make a series of recommendations for the more extensive use of DNA, which were subsequently translated into legislation, one emphasis of their consideration was that the police be allowed to obtain DNA samples more easily 'since the resulting DNA profile might prove the suspect's innocence'. The commission can therefore be seen to endorse a view of DNA evidence as a more objective form of forensic identification with the potential to solve some of the evidential issues central to public confidence in the criminal justice system. Whilst DNA profiling was no doubt believed to be a more 'foolproof' method capable of offering secure and speedy convictions, it's potential for eliminating innocent suspects was also seen as central.

In the same year as the Royal Commission, the House of Lords' *Select Committee on Science and Technology* recommended, in the absence of a clear legislative framework for the collection, use and retention of DNA samples by the police, and its admissibility as evidence in criminal prosecution, that 'the Government clarify the law in this area at the earliest opportunity, on the basis of close consultation with the scientists concerned' (1993: 43). The Select Committee were enthusiastic, viewing DNA profiling as a 'classic case of the results of academic research being successfully applied in the "real" world' (1993: 43) and argued for coherent legislative provision to support the forensic use of DNA. After an announcement in early 1994, by the then Home Secretary Michael Howard, that the 'first step' would be taken towards establishing a national DNA database the Forensic Science Service (FSS) and the Metropolitan Police Forensic Science Laboratory were commissioned to carry out a pilot study to assess how DNA technology could best be used for the purpose of supporting a DNA database. Their remit was to consider: the IT implications and associated costs for operating the database;

how the database would most effectively work; and the costs involved in processing samples and running the database. Following this commission the first significant piece of legislation was enacted by Parliament.

The 1994 *Criminal Justice and Public Order Act* (CJPOA) can be seen to be a direct legislative measure enabling both the establishment of the database and the facilitation of its immediate growth. The central, and most far reaching, aspect of the CJPOA was the new framework it created for the police administration of DNA sample collection necessary for profiling. First, the CJPOA encouraged the routinization of DNA collection by changing the circumstances in which a non-intimate sample may be taken without consent. The Act amended the type of offence for which a sample may be taken from any person charged with a 'serious arrestable offence', as outlined in the 1984 *Police and Criminal Evidence Act* (PACE), to allow sampling from those charged with any 'recordable offence'. This obviously widened the scope for sampling from a wider 'pool' of criminal suspects yet this itself would have made little impact without the other significant change enacted in the CJPOA concerning the redefinition of 'samples' themselves. Through a reclassification of the sample types defined as "intimate" and "non-intimate", the CJPOA redefined PACE to incorporate saliva and mouth samples in that category of non-intimate bodily samples which can be taken without consent and, crucially, by the police themselves. These samples – of which the most common is a scrape of buccal cells from the inside of the mouth – can be administered without the use of qualified medical assistance. Redefining the mouth as a non-intimate part of the body can be seen as a move towards both the facilitation of DNA sample collection during routine police procedure and a response to the fiscal considerations of such procedure. Replacing costly blood samples with the modest mouth swab, allowing the sampling of much larger numbers of individuals, and using the technological developments in profiling outlined above, provided the police far greater scope (both fiscally and practically) in their use of DNA profiling.

In April 1995 the NDNAD went live and within four months the first successful match between a criminal justice sample and a crime scene was made. In December, just eight months later, the FSS boasted over 100 positive matches and calculated that the database held 19,000 profiles. As specified by the CJPOA only samples from those convicted of an offence could be held on the database and the Home Office provided reassurance that a sample taken from those later exonerated of any charge would be destroyed (although specific information from profiles could be retained for 'statistical purposes'). It would therefore be incorrect to assume that the CJPOA was aimed at establishing anything approaching a universal database of the 'active criminal population' and no such rhetoric was in existence at that time. Indeed the aims of the CJPOA were modest in terms of the future expansion of the NDNAD and, as such, were almost immediately reviewed in light of several significant problems that arose once the NDNAD was operationalized.

One of the most salient aspects of the NDNAD is its capacity to enact an automated and continuous series of searches

of all new database entries against crime scene profiles and criminal justice profiles already on the database. Crime scene DNA samples are collected daily by scene examiners in all 43 police forces of England and Wales and these are sent to the FSS for profiling and inclusion on the database where they remain and are continually compared to already existing profiles. At the time this legislative framework demanded that all profiles and samples contained on the NDNAD of those who were not convicted of any offence be destroyed. Yet it became clear that the database retained records of those who should not have been present, under the required guidance for inclusion of DNA profiles. When positive matches were made on the database between those criminal justice profiles which had not been removed (i.e. the profiles of innocent individuals who had been one-time suspects) and samples collected at subsequent scenes, the police and the criminal justice system encountered a serious set of problems. In some cases evidence presented by the police rested on the initial detection of suspects through the NDNAD in a manner which was illegal. In the appeal made in the cases of R v Weir & R v B (Attorney General, 1999), the court ruled, in line with the legislative framework, that the use of DNA evidence obtained from defendants in previous criminal cases that had not resulted in successful convictions, but used by the police in subsequent prosecutions, was not admissible. However, in a subsequent hearing of this case by The House of Lords it was ruled that where a DNA sample fell to be destroyed, but had been retained by the police, it did not make evidence obtained through a failure to comply with that prohibition inadmissible. The question of admissibility should be, they argued, left to the discretion of the trail judge.

The situation in which DNA matches made using the database, and the subsequent generation of evidence through investigation, could be subject to discretionary rulings by trial judges was not inherently problematic. What seemed difficult was the idea that the NDNAD was providing the police with the capacity to correctly detect suspects of crime, but that this fell outside the legislative provision. Such a situation was deemed by Lord Steyn as 'contrary to good sense' in the Weir case and, because of the nature of the prosecution for murder, this view gained popular support in the press. The most interesting aspect of this was not that it gave rise to an immediate necessity to rectify the illegal holding of profiles on the database – a situation addressed by Blakey (Her Majesty's Inspectorate of Constabulary 2000) in his assessment of forensic practices in policing – but the impetus it gave to legislating for the retention of all profiles obtained by the police in the legitimate course of investigation. Relevant provisions of the 2001 *Criminal Justice and Police Act* can be seen as a direct outcome of the problems of admissibility and retention. The act allows for the indefinite retention of DNA samples on the NDNAD taken from suspects not convicted or cautioned for a crime, and also those samples given voluntarily, such as through mass screenings, if written consent had been obtained. In short, it allowed the police to retain the DNA sample and profile of any person that, in the course of investigation, becomes the suspect of a crime.

The 2001 legislation can be seen to be the key foundation for the construction of a database comprising the 'active criminal population'. It allowed the police to retain, for indefinite speculative searching, the profiles of those who, acquitted of previous offences, may come to their subsequent attention as suspects of further crime. With the ability to enact such searches the potential for detection using the database was vastly increased. An inherent proposition of this legislative framework was that the database will hold the profiles of people who, in all other circumstances, are deemed to be innocent.

Putting Genetics Into Forensics

The legislative framework that supports the operation of the NDNAD is evidence of a broad based governmental consensus regarding the usefulness of genetic identification for forensic purposes. However, an understanding of this is incomplete without the background of a wider set of considerations surrounding the growth of the police use of forensic science in the 1990's. The decade had begun with a variety of critical organisational and judicial commentaries concerned with forensic science provision in the criminal justice system. We have already noted that both the *House of Lords Select Committee on Science and Technology* and the *Royal Commission on Criminal Justice* undertook reviews of the provision of forensic science against the background of a series of significant miscarriages of justice, which had been partly based on the abuse of scientific evidence. The two resulting reports made recommendations that acknowledged both the positive potential contribution of forensic science to criminal justice alongside the necessity for the reform of some aspects of its governance. For example, the Royal Commission (1993: 9) stated that: 'It is important that the police make the most effective use possible of the technical means at their disposal including forensic pathology, forensic science, fingerprinting, DNA profiling and electronic surveillance.'

This general commitment to an increased use of science for crime detection in the UK came shortly after the start of a major review of scientific support to policing based on an external evaluation of the quality of current provision (Touche Ross,1987), and a subsequent government study of the effectiveness of criminal detection (Audit Commission, 1993). Several Home Office funded studies of scientific support to crime investigation published in the mid-1990's (notably McCulloch, 1996; Tilley and Ford, 1996) undertook more systematic evidence-based examinations of the uses made of forensic information and expertise within the police service. These studies played a central role in advancing the general understanding of the forensic process in crime investigation and were also used to promote 'good practice' in the collection and utilisation of forensic information for intelligence and evidential purposes (especially in the ACPO/FSS/Audit Commission report published in 1996).

Early uses of DNA profiling in the UK and elsewhere focused on the detection of serious crime – most often murder and rape – and normally involved the comparison of crime scene DNA with DNA samples taken from people already suspected of involvement with the crime

or from a wider group of individuals invited to provide samples for elimination purposes. However, the encouraging results obtained from the application and development of this technology quickly gained wide police interest, and assertions of the operational usefulness of DNA databases for the investigation of a wide variety of types of crime were made in many of the reports cited above. The early decision to limit the collection, profiling and databasing of Criminal Justice samples from those suspected of involvement in serious crime was largely designed to prevent a large back-log of such samples. The potential intelligence value of the inclusion of CJ samples obtained from those suspected of involvement in less serious offences was well understood, based as it was on understandings of the career patterns of offenders and the longstanding image of the persistent offender. However, it was also recognised that significant delays in the processing of DNA material could well result in decreased police interest in the deployment of the technology in all but the most serious cases of crime.

Throughout the mid and late 1990's, Regular HMIC force and thematic inspections drew on, and interpreted, a restricted range of data on scientific support activity as part of their more general evaluations of force and divisional performance. These investigations – which provide a substantial performance leverage on individual forces – gradually included greater consideration of the routine collection of DNA evidence and the use of the NDNAD alongside more traditional forms of forensic identification – especially that of fingermark collection and fingerprint examination.

However, more strategic leverage for the enhancement of the potential of DNA profiling and the use of the NDNAD was provided by the government's 'Crime Reduction Strategy' published on November 29th 1999. This strategy required each police authority to set five year targets for the reduction of volume crime – especially vehicle crime, burglary and robbery. The level of these targets were set to bring each force at least 'level with the performance of the top 25 per cent of their peers', and annual performance against these targets would be assessed by HMIC and the Audit Commission. The strategy envisaged an important role for forensic identification technology in contributing to crime detection as an element in the overall effort at reduction of these crime types. The use of DNA evidence and the expansion of the NDNAD were given particular attention and additional funding:

> the Government has provided additional funding of £34 million to double the number of offender and crime scene samples entered onto the database during each of the next two years. The extra money will enable half a million extra DNA profiles to be added to the database. This should mean thousands more matches and detections, and many more criminals taken out of circulation (Home Office, 2002).

Regardless of the eventual conclusion reached by systematic and statistically sensitive attempts to measure the effectiveness and cost effectiveness of this method of criminal identification and crime detection, the police themselves regard the use of DNA profiling in the investigation of both 'serious' and 'volume' crime as providing a routine resource which is legitimated through the

reliability of its standardised technology and the security of its scientific underpinnings. To this reason for its popularity should be added the public impact affected by the successful detection of 'cold cases', in which DNA recovery and profiling is achieved from crime scene samples several decades after the original event. Whilst there is always a gap between what the NDNAD can actually deliver and its construction as a 'weapon' designed to combat, detect, and solve crime, police commitment to its development and use has been consistently positive and they continue to argue for the expansion of the database.

Conclusion

In this paper we have examined some of the ways in which the use of DNA in criminal investigations has both contributed to and been shaped by the creation of a national DNA database. In particular, this paper has mapped a number of important scientific, technical, legislative and policy developments, which have together transformed the forensic use of DNA. Contemporary UK investigative practice now involves the routine search for DNA evidence, potentially at every one of the hundred of thousands of crime scenes attended by scene examiners, and the collection of DNA samples from all those suspected by the police of involvement in a recordable offence.

This transformation has not just rested on important scientific and technical developments, but has been fundamentally shaped by key legislative and policy developments. First, there was the redefinition of what constituted an intimate sample, which allowed the mass use of the simple and cheap collection technique (the buccal scrape) by police officers. Secondly, the criteria for inclusion were expanded to embrace any person charged on suspicion of a crime. Thirdly, the law was changed to allow samples and profiles to be held indefinitely. Finally, national policy has played a key factor in the shaping of the databases. In 1999 the NDNAD was rhetorically reconstructed and financially facilitated as a key scientific tool in the detection and reduction of volume crime. This both drove its subsequent massive expansion, but also critically depended on both the legislative and technical changes that had previously occurred.

Yet it would be a mistake, in our view, to see this legislative history in any simple linear form as moving, from the outset, towards any clearly defined hegemonic aims. Legislative changes have been born out of proactive, and reactive, responses to arising situations within the criminal justice system, through scientific progress, and from policing demands and practices. Whilst it is arguable that the government are committed to an expanded database, and to a broad based surveillance over a target population, this itself was not the State's original aim.

The aim of government was not, nor is it now, the inclusion on the database of the entire population but of a 'pool' of suspects made up of all those involved in criminal activity. Certain problems with such a proposition were inherent in the legislative framework up until the 2001 Act, following which authority was given for the retention (and retrospective retention) of profiles on the database of those who, being at one time criminal suspects, had been later exonerated of all charges. At the present mo-

ment, therefore, we are at another crucial stage in the development of the NDNAD. In one decade we have witnessed the enactment of a series of legislative changes which have secured the capacity of the database to function as, what is now rhetorically called, a crucial 'weapon' against crime. The growth of the legislative framework to expand the database and empower the police to maximize its utilization has been swift, and there has been strong public support for these developments.

None of this should negate the significance of the scientific and technical developments which underpin the NDNAD. The epistemic authority of molecular biology has been used to enhance police investigations through technical developments (such as the introduction of high-throughput screening, which make the storage and analysis of DNA faster, easier and cheaper) that have in turn contributed to the transformation of what was once a complex, and expensive bespoke laboratory procedure into a highly automated and routine analytical practice.

Nevertheless, there remain many policy questions concerning the use of DNA and the NDNAD for crime investigation. These range in scope, but include: whether the use of the NDNAD sustains, or even enhances asserted inequities in the criminal justice system; whether tissue samples used for DNA profiling should be destroyed or retained along with the digital profiles; under what circumstances may the convicted be allowed to reopen cases to seek exoneration by DNA analysis; the relationship between DNA profiling, 'double jeopardy' and 'statutes of limitation'; how is the public accountability of the custodians and users of the NDNAD assured; and what privacy rights are attached to information potentially recoverable from the biological materials held by the laboratories that supply profiles to the NDNAD? These questions will not only structure future research on the NDNAD but will provide the foundations for debates about the important social, ethical and legal issues which are raised by the operation of this increasingly important police resource.

Acknowledgements

The work reported here was carried out during a Wellcome Trust funded study: 'Genetic Information and Crime Investigation: Social, Ethical and Public Policy Aspects of the Establishment, Expansion and Police Use of the National DNA Database'. We are grateful for the advice of a number of colleagues, especially Peter Ablett, Chris Asplen, Robert Dingwall, Jim Fraser, Keith Fryer & Paul Roberts.

References

Attorney General
1999 "Opinion of the Lords of Appeal for Judgement in the Cause, Attorney General's Reference No.3 of 1999". December 2000. London: House of Lords.

Allen, R. & Redmayne, M.
1997 Bayesianism and Juridical Proof - Special Issue of Evidence and Proof Vol. 1(6).

Bereano, P.L.
1992 The Impact of DNA-based Identification Systems on Civil Liberties. DNA On Trial: Genetic Identification and Criminal Justice. P. R. Billings. New York: Cold Spring Harbour Laboratory Press: 119-128.

Callen, C.R.
1997 "Inference from the Secondary Evidence of Ordinary Witnesses and Scientific Experts". Proceedings of the First World Conference on New Trends in Criminal Investigation and Evidence. J. F. Nijboer and J. M. Reijntjes. Lelystad: Konninklijke Vermande.
Coleman, H. & Swenson, E.
1994 DNA In the Courtroom: A Trial Watcher's Guide. Seattle: Genelux Press.
Duster, T.
2003 Backdoor to Eugenics. London: Routledge.
Edmond, G.
2000 "Judicial Representations of Scientific Evidence." Modern Law Review 63: 216-.
Ericson, R.V.
1993 Making Crime: A Study of Detective Work. Toronto: University of Toronto Press.
Ericson, R.V. & Haggerty, K.D.
1997 Policing the Risk Society. Oxford: Clarendon Press.
Ericson, R.V. & Shearing, C.D.
1986 The Scientification of Police Work. The Knowledge Society: The Growing Impact of Scientific Knowledge on Social Relations. G. Bohme and N. Stehr. Dordrecht: D. Reidel Publishing Company: 129-159.
Evett, I.W. & Weir, B.S.
1998 Interpreting DNA Evidence: Statistical Genetics for Forensic Scientists. Sunderland Mass.: Sinauer.
Foreman, L.A. et al.
1997 "Bayesian Analysis of DNA Profiling in Forensic Identification Applications." Journal of the Royal Statistical Society 160: 429-469.
Forensic Science Service
(n.d.) DNA - Present and Correct, A Guide to DNA Profiling. FSS.
Foucault, M.
1979 "Governmentality." Ideology and Consciousness 6.
Freeman, M. & Reece, H. (Eds.)
1998 Science in Court. Aldershot: Ashgate.
Fujimura, J. H. & Fortun.
1996 "Constructing Knowledge Across Social Worlds" in Nader, L. (ed) Naked Science: Anthropological Inquiry into Boundaries, Power and Knowledge. New York: Routledge.
Garland, D.
2001 The Culture of Crime Control. Oxford: Oxford University Press.
Gieryn, T.F.
1999 Cultural Boundaries of Science: Credibility on the Line. Chicago: Chicago University Press.
Gill, P. et al.
1985 "Forensic Application of DNA 'Fingerprints'." Nature 318: 577-579.
Giusti, A. et al.
1986 "Application of Deoxyribonucleic Acid (DNA) Polymorphisms to the Analysis of DNA Recovered From Sperm." Journal of Forensic Science 31: 409-417.
Haggerty, K. D. & Ericson, R.
2000 "The Surveillant Assemblage." British Journal of Sociology 51: 605-622.
Her Majesty's Inspectorate of Constabulary
2000 Under the Microscope: Thematic Inspection Report on Scientific and Technical Support. London: Home Office.
Hess, D.J.
1997 Science Studies: An Advanced Introduction. New York: New York University Press.
Home Office
2002 http://www.crimereduction.gov.uk/crimered.htm
2003 Police Science & Technology Strategy 2003-2008. London: Home Office: 1-28.
Hutchby, I.
2001 "Technologies, Texts and Affordances." Sociology 35(2): 441-456.
Jasanoff, S.
1998 "Witnessing DNA in the Simpson Trial." Social Studies of Science 28: 713-40.
Jeffreys, A. et al.
1985 "Hypervariable 'Minisatellite' Regions in Human DNA." Nature 314: 67-72.
Jones, C.A.G.
1994 Expert Witnesses: Science, Medicine and the Practice of Law. Oxford: Clarendon Press.

Jordan, K. & Lynch, M.
1998 "The Dissemination, Standardisation and Routinization of a Molecular Biological Technique." Social Studies of Science 28: 773-800.
Kanter, E. et al.
1986 "Analysis of Restriction Fragment Length Polymorphisms in Deoxyribonucleic Acid (DNA) Recovered From Dried Bloodstains." Journal of Forensic Science 31: 403-408.
Lynch, M.
1998 "The Discursive Production of Uncertainty: the OJ Simpson Dream Team and the Sociology of Knowledge Machine." Social Studies of Science 28: 829-68.
Lyon, D.
1991 Queen's Quarterly 98: 596-617.
2001 Surveillance Society: Monitoring Everyday Life. Buckingham: Open University Press.
Lyon, D. & Zureik, E. (eds)
1996 Computers, Surveillance and Privacy. Minneapolis: University of Minnesota Press.
Marx, G.T.
2002 "What's New About the 'New Surveillance'? Classifying for Change and Continuity." Surveillance and Society 1: 9-29.
Miller, P. & Rose, N.
1988 "The Tavistock Programme: the Government of Subjectivity and Social Life." Sociology 22: 171-92.
Morgan, J.B.
1990 The Police Function and the Investigation of Crime. Averbury: Aldershot.
Nakamura, Y. et al.
1987 "Variable Number of Tandem Repeat (VNTR) Markers for Human Gene Mapping." Science 235: 1616-1622.
Norris, C. & Armstrong, G.
1999 The Maximum Surveillance Society: The Rise of CCTV. Oxford: Berg.
Norris, C., Moran, J. & Armstrong, G. (Eds.)
1996 Surveillance, Closed Circuit Television and Social Control. Aldershot: *A*ldgate.
O'Malley, P.
1992 "Risk, Power and Crime Prevention." Economy and Society 21: 252-75.
Redmayne, M.
2001 Expert Evidence and Criminal Justice. Oxford: Oxford University Press.
Roberts, P. & Willmore, C.
1993 The Role of Forensic Science Evidence in Criminal Proceedings. Royal Commission on Criminal Justice Study 11. London: HMSO.
Robertson, B. & Vignaux, G.A.
1997 "DNA On Appeal." New Zealand Law Journal.
Sanders, W.B.
1977 Detective Work: A Study of Criminal Investigations. New York: Free Press.
Scottish Law Commission
1989 Report on Evidence: Blood Group Tests, DNA Test and Related Matters. Edinburgh: HMSO.
Star, S.L.
1985 "Work and Uncertainty." Social Studies of Science 15: 391-427.
Stenson, K.
1993 "Community Policing as a Governmental Technology." Economy and Society 22: 373-399.
Tyler, M.G. et al.
1986 "Human Blood Stain Identification and Sex Determination in Dried Blood Stains Using Recombinant DNA Techniques." Forensic Science International 31: 267-272.
Wyman, A.R. & White, R.
1980 "A Highly Polymorphic Locus in Human DNA." Proceedings of the National Academy of Science USA 77: 6754-6758.

Paul Johnson and Robin Williams
Department of Sociology
and Social Policy,
University of Durham,
P.J.Johnson@durham.ac.uk,
Robin.Williams@durham.ac.uk

Paul Martin
Institute for the Study of Genetics,
Biorisks and Society
University of Nottingham,
Paul.Martin@nottingham.ac.uk