Archives, promises, values: Forensic infrastructures in times of austerity

EJ Gonzalez-Polledo
Goldsmiths, University of London, UK

Silvia Posocco
Birkbeck, University of London, UK

Abstract
This article analyses the role of infrastructures in the 'bioinformational turn' in forensic science and examines processes through which evidence is constituted, validated or challenged in and through domains of expertise that engage different techniques, data, objects and knowledges through infrastructural arrangements. While the digitisation of the infrastructures that underpin forensic service delivery promised connectivity, prosperity and wellbeing, in reality it also brought forward new levels of risk and vulnerability, generating new tensions and frictions in the body politic. As genetic science reaches post-archival horizons through new genetic sequencing technologies, forensic science in post-archival times raises questions concerning the differential impact of the fragmentation of analytical and archival infrastructures and increasingly asynchronous bureaucracies whose role is displaced by the relative autonomy of datasets and computational architectures that elude governance, oversight and citizens' scrutiny.

Keywords
Archives, austerity, bioinformation, data, England and Wales, forensic science, infrastructures

Corresponding author:
EJ Gonzalez-Polledo, Goldsmiths University of London, Lewisham Way, New Cross, London, SE14 6NW, UK.
Email: e.gonzalez-polledo@gold.ac.uk

In 2015, in a report entitled *Forensic Science and Beyond: Authenticity, Provenance and Assurance* (Government Office for Science, 2015), the Government Chief Scientific Adviser envisioned the infrastructure underpinning forensic science in the United Kingdom as a cosmotechnical project where human ingenuity, natural resources, social bonds and political communities coalesce into organised and densely networked infrastructural spaces:

> Our resilience depends on the quality of our infrastructure. This falls into three categories. The first is our human built, engineered, manufactured and technological infrastructure. The second is our natural infrastructure, comprising human, animal and plant health, and our geophysical environment including water, weather and climate. The third is our social infrastructure, of family, friends and communities, including the social infrastructure of the nation state. This social infrastructure is shaped by the physical organisation of our countries, cities, towns and villages and is now also virtually located in cyberspace, linked by social media and search engines. Forensic analysis is crucial to understanding all types of infrastructure and our interactions with it. (Government Office for Science, 2015: 4)

In this integrative vision of technics and the social relations they can engender, forensic science enables a deeper understanding of the infrastructural quality of the world, drawing on a framework for interpretation based on engagement with details in any sphere of activity. The role of the scientific adviser, according to this cosmotechnical vision, 'is to provide the best evidence on objective measures of benefit or harm' (Government Office for Science, 2015: 6), a mission that can enable better decision-making in linking science, technics and human values. However, this holistically imagined infrastructural future stands in sharp contrast to the landscape of increasing fragmentation of forensic science provision currently in place in the United Kingdom. Forensic scientists stress that forensic science is not one thing or domain. When considering the meanings of forensic science across different jurisdictions and contexts, they acknowledge that there is no singular or unified model but rather a plurality of arrangements and understandings in operation, and this plurality is found at the level of infrastructures, institutions and professional domains. As dashboards, digital interfaces, algorithms, data aggregators and supranational databases have been incorporated into the practice of forensic science, forensic infrastructures emerge as new sensorial interfaces and information architectures produce new forms of surveillance and population control. Transforming biological specimens obtained from bodily substances into data, and into evidence that can be used in court proceedings, infrastructural arrangements have become key to the particular challenges and temporalities involved in identifying bodies.

Forensic science has long been a key site of future governance, establishing epistemological certainty around the capacity of technology to deliver population management (Gabe et al., 2015; M'Charek, 2008; Wienroth, 2018). These infrastructures evolve as products of complex sets of relations that implicate new actors,

technologies and politics in processes of identification, inclusion and exclusion (Amankwaa and McCartney, 2019; M'Charek, 2018). In this article, we explore how these transformations map onto broader shifts that entangle infrastructural and political worlds. They are connected to restructuring processes affecting modern infrastructures such as grids, pipelines, roads and railways, and their remodelling alongside networks of logistics (Harvey and Knox, 2012; Mezzadra and Neilson, 2019; Nelson and Braun, 2017). As Tsing (2009) has shown, logistics integrate diversity in the structure of supply chain capitalism in networks of relations that redefine the status and meanings of commodities. While the rise of logistics does not entail the complete dissolution of existing infrastructures, it does imply transformations that can lead to infrastructural displacement, obsolescence and decay. Infrastructural transformations are concrete manifestations of the reorganisation of economic and political rationalities. Far from being free of contradictions, infrastructures are intensely socially mediated processes (Harvey et al., 2017). The transformations of forensic infrastructures reflect social and political public service adjustments in sectors as diverse as health care, migration and asylum (Tazzioli, 2018, 2019) which accelerate and deepen in times of austerity.

Infrastructures have profound effects on how evidence is constituted, validated or challenged in and through domains of expertise that engage different techniques, data, objects and knowledges (Besteman and Gusterson, 2019). Materials and concepts shift and change as they traverse technical procedures and domains of expert knowledge and evidence continues to cohere – as well as fragment and unravel – in and through processes of data generation, analysis and archiving. Automated computational operations make forensic datasets a malleable and shifting object against which governmental, social and political demands for certainty and truth are organised. Notions of value are also reshaped through computational processes, as bioinformation is taken out of the domain of the public good and turned into a commodity in increasingly saturated markets performatively created through the operations of consultancies reporting prospects of financial gain and profitability (Callon and Muniesa, 2005, MacKenzie et al., 2008; Rajan, 2006).

These speculative bioeconomies, and their often light empirical foundations, stand in sharp contrast to the strong rhetorical appeal of their promise of profitable futures. Platform and device infrastructures emerge as key sites where forensic science is 'reinvented' as a positivist science. And yet, our case study in England and Wales illustrates that the becoming of forensic bioinformation infrastructures, as Fortun (2008) has noted, also incorporate the modifier 'fantastic'. For Fortun, just as infrastructural materialities possess a degree of endurance, they are also 'an "ever unstable equilibrium", a volatile chiasmus where fantasies, dreams and visions are meshed and mashed with mundane tools' (2008: 36). For example, technologies of DNA profiling and fingerprinting draw from multiple sets of biotechnological promises, as they straddle the particular ways in which science, criminal justice systems, and enforcement cultures make sense and truth by using data

in ways that deeply entangle technologies, practice cultures and human values (McCartney, 2010). The bioinformational turn is also characterised by fast acceleration in the production of surplus derivative data through techniques organising, processing and sifting through sequenced genomic bioinformation,[1] which poses new challenges of regulation and governmentality (Parry, 2012).

Through an analysis of the role of digital infrastructures in the 'bioinformational turn' in forensic science, this article presents a conceptual and historical discussion of how bioinformation that was initially sourced from individuals through technologies such as fingerprinting and photography in the late 19th century has progressively become digitised, sequenced and archived at scale in the 21st century. We then explore how shifts in corporate and state-run bioinformational bureaucracies have acquired the capacity of being linked together and made interoperative to an unprecedented degree, with considerable potential implications for people's lives. The article goes on to consider what happens when bioinformation becomes algorithmic in the shift to post-archival platforming of bioinformational infrastructures. The post-archival turn in genomics denotes a move from genomic and biological databases to logistics, that is, to data sequencing and cross-linking (Mackenzie et al., 2016). We explore the multiple implications of this turn toward logistics in forensics, in relation to shifts to post-archival infrastructures and cognitive capitalism which came hand in hand with the transformation of forensic science infrastructures in the United Kingdom.

The last two decades have seen the progressive erosion of integrated forensic public services, particularly in England and Wales, where archival and scientific infrastructures were dismantled in the pursuit of a market-driven model of forensic service provision defined in terms of flexibility and cost reduction. In this transition, the Forensic Science Service (FSS) – a government-owned company and former Home Office executive agency, the sole provider of forensic services in England and Wales for decades – was dismantled, as police services integrated forensic analysis in-house or drew on non-integrated commercial service providers, justifying privatisation in pursuit of faster turnaround times. However, this displacement towards 'post-archival logistics' has come at a cost for forensic service provision. The deterritorialisation of the archive, which came hand in hand with the privatisation of the national FSS, involved further transformations moving towards the commodification of forensic services. In this context, forensic bioinformation is becoming a shifting object ever more difficult to track as it moves across governmental, market and other systems of record-keeping, storage and retrieval, blurring distinctions between public and private domains in its transit. The logic of fragmentation that emerged following the dissolution of the FSS in England and Wales translated into 'fragmentation-as-operation' (Mezzadra and Neilson, 2019), that is, a form of organisation that dissolved a state monopoly over forensic science provision into a cottage industry made up of small to medium-sized specialised companies and police forces, all struggling in equal measure to turn forensics into a profitable business. However, in a climate of competition which made research facilities unsustainable, forensic science provision failed to

fully transform into a profitable form of cognitive capitalist enterprise (Cocco and Cava, 2018; Moulier-Boutang, 2011). The financialisation of forensic techniques and operations never actually materialised, despite the hopes invested by management consultants employed to envision the potential and opportunities of automation and digital forensics in the aftermath of the FSS closure. Forensics failed to become fully immaterial.

Bioinformation bureaucracies in the age of algorithms

The emergence of bioinformation connects to processes of state formation and the establishment of bureaucracies linked to bioinformation storage, handling and circulation. Photography, fingerprinting and birth certificates emerged as identity and surveillance technologies in the 19th century in the context of the consolidation of the modern state and related bureaucratic cultures (Cole, 2001). While more rudimentary apparatuses and procedures existed in the early modern period, the Industrial Revolution, urbanisation and the consolidation of modern bureaucracies converged to engender an expansion of technical and political rationalities focused on documenting and tracking individual lives (Cole, 2001). In colonial centres and peripheries, 'archival governments' and 'paper regimes' proliferated through local practices of registration and record-keeping, which might encompass writing on paper, but also on the skin, as evidenced in the analysis of colonial practices of registration by writing on the bodies of people and animals in Southern Africa (Van Sittert, 2014). Paper regimes may be 'hubristic, interventionist, Benthamite and intensely archival' (Breckenridge, cited in Van Sittert, 2014: 75), but they fell in and out of favour, as their reliability to 'tie individuals to the written record' was called into question engendering a shift towards 'forms of indelible biometric writing on the skins of black subjects and settler livestock which, married with a travelling archive enabled by print capitalism, stabilised and expanded the reach of documentary control by making people and animals reliably recognisable' (Van Sittert, 2014: 75). The vicissitudes and alternating fortunes of paper regimes have not made them less pervasive. Rather, bureaucracies continue to be heavily invested in the project of identifying individuals, developing increasingly sophisticated forms of biometric writing which maps onto the skin in complex ways.

Although bureaucracies have not waned, the technological apparatuses deployed to identify and track individual subjects have multiplied, opening up new registers through recording or writing. Administrative systems depend on taxonomic classifications that have performative rather than constative ascription (Dean, 1999; Spade, 2011). They seek to consolidate and stabilise categories of social difference which are in practice fluid and changeable, as well as difficult to evidence (Spade, 2011). Areas such as border controls and surveillance, for example, increasingly rely on the use of biometrics and forensic bioinformation in order to ascertain the identity of individuals, notably undocumented migrants (Fassin and d'Halluin, 2005; M'Charek, 2018). Forensic science for humanitarian purposes

occupies a similarly hybrid terrain, operating within states, markets and NGOs, across national and supranational jurisdictions (Madianou, 2019). Forensic science therefore connects to the histories of governmental projects aimed at identifying individuals. Over the latter part of the 20th century and into the 21st century, it evolved into a distinctly transnational project, notably through the emergence of forensic humanitarianism (Moon, 2016) and the increasingly prominent role of forensic scientists in investigations of human rights violations (Keenan and Weizman, 2012).

In fact, forensic science deployed in the investigation of human rights violations has been a key domain where the production of evidence has been framed as a process whereby material objects, most notably, human remains, have been said to unambiguously 'speak'. Forensic humanitarianism operates through a variety of organisations, programmes and institutions, ranging from state-led and state-sponsored forensic teams to non-governmental organisations (NGOs) that work to service national as well as international criminal courts leading in the investigation and prosecution of human rights infringements (Collins, 2018). The management and governance of forensic bioinformation in this field is, however, also largely obscured from public scrutiny. More specifically, it is unclear what parameters, principles and bureaucratic structures might regulate the analysis and storage of biological specimen and bioinformation. After all, forensic bioinformation to identify victims of forced disappearance in post-conflict settings is processed through commercial software such as the Mass Fatality Identification System (M-FISys). It therefore shuttles across transnational data ecologies and is eventually stored, discarded or commercialised beyond the context that led to its production. A key and often overlooked aspect of these dynamics is the production of bioinformation not only about the dead but, with crucial implications, about the living, as survivors respond in large numbers to calls for donations of DNA samples in the search of the missing and disappeared, but might be unaware of the 'data journeys' (Leonelli, 2016) of their genetic bioinformation through datasets, environments and ecologies traversing institutions and markets. In other words, as is the case for other bioinformation infrastructures, DNA sample donation for forensic identification in cases of human rights violations entail entrance into a de facto marketised environment whose boundaries and mechanisms are occluded from view and difficult to track. Similar dynamics are in play in the processing of forensic information in the market-led forensic service provision in the United Kingdom, notably in England and Wales, where entities ranging from local police forces to private providers collect, process, analyse, store and discard bioinformation through logics that respond to national policy, but that are bound by local rules and increasingly fragmented practice cultures. In the real world of fragmented infrastructural ecologies, as we illustrate in the next section, the boundaries of bioinformation processing and commercialisation become increasingly unclear.

Archives in post-archival times

Arguably, novel dimensions of the widespread use of genetic and forensic bioinformation are its marketisation and commodification. As genetic and biochemical materials and information are accessioned into ever larger collections, they are also simultaneously made into commodities, financialised in economies propelled by bioprospecting and other future-oriented forms of bioinformation resource extraction (Parry, 2004). State institutions and supranational bodies have provided the context for the shifts in governance of bioinformation and attempted to regulate bioinformation in a number of registers and scales. However, state-regulated databases are no longer the primary sites where bioinformation management is taking place. In fact, bioinformation gathering was never the exclusive prerogative of the state. Corporations routinely engage in fashioning worker mortality records, or 'corporate mortality files' (CMF), closely monitoring the health of employees (Little, 2018). The archives fashioned through these practices of surveillance and corporate record-keeping have been instrumental in numerous lawsuits that challenged corporate social responsibility frameworks and sought redress for environmental and occupational health hazards of 'late industrial necropolitics' (Little, 2018; see also Fortun, 2001; Petryna, 2002). In these corporate processes, the mobilisation of bioinformation is socially stratified and records may be used to occlude histories of toxic exposure rather than support the claims made by former employees or those living in the proximity of contaminating plants.

Corporate bioinformation gathering and use raises questions as to the nature and status of corporate bioinformation harvesting and archiving that resonate with the political frictions that come into view through the commodification of forensic infrastructures and services. They foreground the difficulties that emerge when governmental oversight over forensic biorepositories is suspended and handed over to the market. A key prospect is uncertainty, as it becomes progressively more unclear what might happen to bioinformation collections and databases should the commercial entities entrusted with their care fail and go bankrupt. Problems with the marketisation of forensic services in England and Wales show that this is not an unlikely outcome, given the difficulties that emerged when seeking to craft a forensic commodity form.

In the course of the transition from archival to post-archival bioinformation infrastructures, data have become newly implicated in processes of living and dying, and in the uneven and unequal distributions of life chances. Documents, samples, records, specimens and media define the way in which the lives of individuals and populations are understood, classified and managed through live, platformed bioinformational systems that have unprecedented reach and have become increasingly interoperative, that is, able to interact and exchange information in ways that are often opaque and difficult to track. Data mediates everything from public transport use to an individual's capacity to access public services, but its connection to living and dying is predicated on maintaining infrastructural capacities to hold ever more data. Particularly, in digital archives, as

Blom (2017) has noted, content is no longer independent from infrastructure, as archives themselves become data circulating through electronic circuits and flows. In this context, Blom argues, archives connect visions of modernity based on a capacity for memory and recall with a vision of the social which relies on the positive realist qualities of the archived object, where data emerge as 'a distinct, finite entity or substance that can be represented and hence also theorised, analysed, compared, questioned, managed' (2017: 14). The implications of this vision are far reaching – and not only in terms of engendering a vision of mediated modernity. Digital archives produce new temporalities by operating in timescales which are barely thinkable in human terms, and by introducing complexity through automated processes which transform what humans, and data, can do. The power of the archive to generate relations across ways of knowing and remembering becomes the basis of generative architectures which bring forth forms of social control, but which also produce unforeseeable situations, and fail in unexpected ways as they are subject to appropriations, aggregations and frictions which produce and alter their affordances.

   Archives are circulating signs which take on multiple identities, as they are shaped by practices and uses that range from concretion to abstraction. The vision of the archive as an aggregative and productive apparatus supports the idea of the 'total archive' (Lemov, 2015, 2018) and 'total access' (Reardon, 2018), that is, of an archival infrastructure that can contain totality and can exist across disparate fields. Jardine explores multiple iterations of the 'total archive' in relation to social structures and social fictions about the archives as 'concrete instances of totality' in the 19th and 20th centuries (Jardine and Drage, 2018; see also Kaplan, 2018). In this context, the centrality of computational processes, adding levels of abstraction that afford forms of aggregation and analysis, has been understood to transform knowledge through distance (Berry, 2017). Archival accumulation has gone in and out of favour over time, but the age of 'big data' has brought to the forefront questions and concerns about the size and ever-increasing magnitude of data holdings and datasets. As Carrier (1994) claimed of the transformation of retail objects through abstract, 'alienating' relations, now, infrastructural processes relating to dataset cleaning, organisation and processing determine the capacities of archival infrastructures to shape the present. Yet the paradox of the becoming-temporal of the archive, the fact that archiving and de-archiving at once stacks and flattens, is particularly salient at a time in which physical archives are understood to have become obsolete. For example, a shift toward a post-archival turn in the biosciences places emphasis on analytics based on sequence data and metadata (so-called next generation sequencing, or NGS) over the storage and retrieval of biomaterials (Leonelli and Ankeny, 2012; Mackenzie et al., 2016). However, the relation between the promise of these technologies and how they can make a difference in research, policy and service delivery is far from settled. Despite the capacity of post-archival infrastructures to make the institutional and geographical location of the archive obsolete, important discrepancies continue to emerge at the level of data and metadata, for example in the

context of genomic databases such as the Sequence Read Archive (Mackenzie et al., 2016), or differences in significance driven by the particulars of clinically significant drivers of growth, as is the case with the expansion of next generation sequencing in virology (Radford et al., 2012). The epistemic power of post-archival infrastructures, in both cases, relies on providing diverse instruments to pursue new problems, improving discoverability and access, while ensuring new operations of transferability and aggregation of datasets and analyses.

As technological processes mediate the production of precarious forms of existence in the context of social exclusion, dispossession, violence and crisis (Eubanks, 2017; O'Neil, 2016), data infrastructures make relevant Foucault's theorisations of biopower and biopolitics as a theoretical register to grapple with relations between institutions, forms of knowledge and expertise, and technological practices of 'letting live' and 'making die' (Foucault, 1990). A focus on biopolitics has progressively highlighted the ways in which forms of vulnerability, exposure and expendability are constitutive of – and not external to – forms of governance and sovereignty, with deadly consequences for differently gendered, sexualised, racialised, and genetic, illness and HIV status-marked subjects and populations (Gossett, 2014). While Foucault (1990: 138) focused on biopower as 'a power to *foster* life or *disallow* it to the point of death', a sustained emphasis on sovereign power as fundamentally concerned with death-making has emerged (Fassin, 2010; Mbembe, 2003). This scholarship has highlighted progressive, routinised forms of structural violence and how 'letting die' connects to modes of precarious existence and the normalisation of extreme suffering, as illness and premature death are linked to deprivation and gendered and racialised inequalities. Archives of living and dying, and the forms of social stratification they track and sediment, are increasingly the focus of private and public managerial interest through forms of restructuring or intensified mining. Thus, while the ubiquity and centrality of archives makes it difficult to resist their moral imperative, public bodies retreat from their responsibility to protect the public function of the archive. Frictions and tensions between infrastructural dynamics and bioinformation materials emerge as a result, particularly as they traverse orders of existence in the transformation of public services.

Disappearing archives

The Forensic Archive Limited (FAL) is as an example of the type of hybrid entities that have resulted from current transformations in bioinformation infrastructures. FAL is a distinctly divergent political form from the state-controlled, integrated and quite possibly autocratic FSS that preceded it. In England and Wales, the FSS was the main provider of forensic services to the Crown Prosecution services, British Transport Police and HM Revenue & Customs, employing around 1300 scientists and assisting more than 60 countries worldwide with services ranging from consultancy to training and infrastructural development, establishing itself as an international forensic resource, particularly in terms of DNA technology. On 14 December

2010, as part of a new austerity policy of David Cameron's newly elected conservative government, the UK government announced its intention to 'support the wind down of FSS, transferring or selling off as much of its operations as possible' (House of Commons Science and Technology Committee, 2011: 3). Being at first a public contractor-operated organisation since 2003, a consultation among staff considered the government's privatisation model a 'failed experiment' with great financial repercussions for the company. Staff did not share the government's view that a public–private partnership would solve problems of funding and competitiveness in the industry.[2] Evidence collected from scientists in the context of the inquiry further highlighted their awareness that forensic science provision was an essential service 'requiring government support, in order to serve its sole function: to contribute toward a successful criminal justice system' (Andrea Grout, FSS scientist, quoted in House of Commons Science and Technology Committee, 2011: 13).

A review of the impact of the FSS closure highlighted procedural complaints about how the decision to dismantle it was taken, and particularly about the absence of the Chief Scientific Adviser to the Home Office from the deliberations. The report also notes how government decision-making deeply affected how the FSS was managed, with the rise of the privatised forensic service market, and its potential to undermine public enquiries through fragmentation and geographic dispersion of samples and laboratories, and the government's own complicity in funding the commissioning by police of private forensic services. The committee leading the inquiry recommended that the government should introduce measures to ensure no further in-sourcing by the police, by monitoring expenditure through the Forensic Science Regulator. The FSS had got into financial trouble due in part to a shrinking forensic market affected by the changes in the procurement processes as well as changes in demand, which saw some forensic services brought in-house by police, or undertaken by smaller, unaccredited private laboratories. These developments effectively turned the main customer of forensic services into a main competitor in an increasingly crowded market. With the dissolution of the FSS, concerns emerged about the lack of laboratories of comparable quality to be employed in public service. The FSS had become the main entity holding public case files, working to ensure these remained in a single, accessible form. While forensic services markets suffered due to these factors, police expenditure on external forensics continued to increase from 2005 to 2011, as is evident from government figures published for a government-led spending review in 2010. These wider market transformations in forensic science services were not transparent to providers in the industry, however. While the widespread belief was that changes were driven by the need to drive down prices, the wider implications of the shift towards smaller providers and smaller-scale services,[3] was soon noted by FSS scientists, who highlighted problems in quality of delivery and problems of integration leading to evidential failures in court. The National Forensic Framework Agreement that followed (the so-called 'next generation' Forensic Science Strategy, published in 2016) , was endorsed by the National Policing Lead in a move that situated forensic services at the forefront of the government's vision 'for a clearer

system of governance', underwriting the government's intention to ensure ethical practice as well as contributing to policing outcomes and efficiency through a combination of services provided in forensic facilities and a digital strategy encompassing biometrics and digital forensics (House of Commons Science and Technology Committee, 2016: 6). The rise in digital forensic service demand, according to the new strategy, responded to the rise in digital forensics methodologies and infrastructures, which themselves evolved as an attempt to make sense of unprecedented amounts of digital information held in digital devices.

The digital transformation in forensic services came hand in hand with changes in the way providers delivered services. Local police forces sought ways to streamline activities through collaboration and digital tools, which led to collaborative procurement and sharing support services (House of Commons Science and Technology Committee, 2016: 14). In this process, digital forensics emerged as a key tool in the majority of investigations, gaining centrality as a key new stream of the national forensic science strategy. However, the emergence of digital forensics is a key area where there is, as yet, little regulatory oversight. The displacement of substance and the new focus on sequenced data relocates the archive in cloud storage – a data storage system reliant on 'server halls' or 'server farms', now increasingly also 'serverless' operations produced by the fragmentation of computational functions. As cloud geographies become ever more spatially and ontologically complex, outsourcing infrastructural requirements, such as storage and processing, to specialist providers, data repositories can no longer be clearly circumscribed and locatable in geographically discrete physical structures, but become the result of deterritorialisation and displacement of 'the personal to the mobile digital service' (Amoore, 2018: 4).

As a result of the dismantling of FSS, the government funded an archive where a limited amount of open and historic cases would be held, a secretive facility operating as the Forensic Archive Limited. Although this archive does not deliver scientific analyses, nor does it engage in interpretative work, it became the only government-owned institution linked to the disappeared FSS, retaining and managing some of its case files. As a government-funded company, FAL retained its status as a public authority; however, it only responded directly to public enquiries via the Freedom of Information Act (2000).[4] FAL serves police forces, investigating bodies (such as HM Revenue and Customs, the Serious Organised Crime Agency, and the Independent Police Complaints Commission), the Crown Prosecution Service and the Criminal Cases Review Commission, as well as the National Database Unit and replacement bodies.[5] However, unlike the FSS before it, FAL does not provide scientific advice or support, but is entrusted with the custodianship of the archive, and has statutory powers in relation to the preservation and production of files and materials. According to a government report, following the closure of the FSS, FAL catalogued 4 million items, the majority of which were physical evidence relating to ongoing cases, and of which there were no further copies.[6] A new cataloguing system was approved in December 2012, involving recording headline information for case files, including ID numbers and types of

case, but not the full digitisation of case files. In this way, on the one hand, police forces became the main clients of forensic science services, and police needs, rather than those of the criminal justice system as a whole, shaped forensic service delivery. Although the aim to diversify services to police forces was highlighted in the National Forensic Strategy, this direction of national policy did not lead to diversifying services or improving market competitiveness. Rather, the government relied on new research on digital bioinformatics – and particularly biometrics – conducted by private companies to revise its strategy. According to evidence provided by the Forensic Regulator in a public proceeding, the government outsourced independent quality control to the statutory powers of the Forensic Regulator but failed to return savings in overall expenditure to resourcing forensic science.

Gradually, FAL gained importance as an archive of last resort, constituted in order to provide back-up in the event of a breakdown of private forensic services. The Nuffield Council on Bioethics' assessment of the conceptual and policy dimensions of forensic bioinformation, notably in the context of the criminal justice system but also encompassing cognate areas such as biosecurity and surveillance, raises questions regarding the civil liberty implications and broader ethical dimensions inherent in these technological developments. While the possibility of errors leading to miscarriages of justice looms large, other profound ethical dimensions extend to the technical, institutional and legal aspects of the forensic use of bioinformation and the meanings of consent in this shifting landscape (Nuffield Council on Bioethics, 2007). Current concerns over the ethics and politics of forensic bioinformation have a longer history that, at the very minimum, harks back to the inception of modern forensic science. It is therefore important to trace the interconnections between technological change currently posited as a 'new frontier', and the history of methods and devices for criminal identification more broadly (Parry and Greenhough, 2018).

As governments forfeit their monopoly over forensic science provision in order to create more efficient markets for services, the mission of forensic science to provide services for the public good is reframed as a commodity market. The emergence of the forensic commodity form, however, posits new challenges. As the forensic scientist Sue Willis put it in a witness statement to the House of Commons Science and Technology Committee enquiry and in personal communication with the authors, the commoditisation of forensic science in fact places the integrity of the entire service in the hands of police forces. While privatisation has aided police forces in directing investigations without reliance on public services, the lack of forensic science expertise leading the investigation on targeted tests lowers the reliability of investigations by weighing and assessing holistically processes involved in a given case. Second, Willis notes that lack of funding had grave repercussions for the availability of expertise, affecting response times and widening the gap between scientific and investigative priorities. Finally, Willis highlights that the loss of a strong science culture in the forensic science community affects practices of expectation, experimentation and evaluation in the forensic science field, so the significance of negative findings is underestimated. In this way, the

commodification of forensic services reduces forensic science provision to technical expertise to be provided in efficient and timely fashion. Scientific research and innovation are not prioritised, and thus considerably reduced, as providers are contracted to offer results through a 'commodity approach'.

Conclusion

This article has focused on the way digital infrastructures, particularly as these underpin forensic analyses, deliver promises of connectivity, prosperity and well-being, as well as risk, toxicity and exposure, which, we argue, are generative of tensions and frictions in the body politic. Infrastructure studies place emphasis on the promissory socio-material status of infrastructures, which often stands in sharp contrast to their actual instability and fragmentation. Through practices of targeting, prediction and ranking, infrastructures extend life- and death-making practices into emergent technological domains of social practice which, while offering opportunities for connectivity, sociality and identification, also entail differential burdens of risk and vulnerability. In the midst of these ongoing adjustments, data infrastructures have brought forward new ways of making and performing evidence, as decisions based on data enabled by widespread modelling, prediction and simulation techniques make themselves 'easy to love and difficult to doubt' by scientists and general publics. As big data analytics replace 'traditional' classification practices and methods in the sciences with the promise of process sensitive, 'real-time', data-driven significant results, archives and databases become essential sites that illustrate the entanglements and frictions between technics, cultures of evidence, and public interests.

Our analysis of the major transition in the governance of forensic science services in England and Wales in the aftermath of the closure of the FSS has sought to unpack how holistic visions of fully socially, politically and technically integrated infrastructural worlds in fact fail to give an account of successive failures to turn forensic science fully into logistics – in the sense given to the term by analyses of post-archival genomics as much as in relation to immaterial or cognitive commodity forms for 'just-in-time' operations. Archival forms in the age of post-archival genomics signal the emergence of new platforms and repositories which process and hold sequenced genetic bioinformation. The movement of data through these infrastructures has been said to consolidate the centrality of 'the logistics rather than the biology of sequence data' (MacKenzie et al., 2016: 1). In this view, contextualisation and cross-referencing have given ground to flows of sequence data that are 'polymorphous' and produced through a range of ever-expanding technical operations and devices which are no longer bound to a specific site and are instead de-territorialised. A key consequence of the post-archival turn, then, is the intensification and increased complexity of data processing, leading to greater 'lability' and elasticity in sequence data. Further, post-archival systems entail a move away from assumptions that framed biology as the bedrock of genomics. 'Logistics' in post-archival genomics is therefore a conceptual marker for biology's

'loss' of ground and power of referentiality, as well of an increased epistemological instability or openness of data. The agential capacities of architectures, instruments and devices foreground the performative processes leading to genomic sequence data in these intensely relational data ecologies.

In this context, the privatisation of forensic services in England and Wales foregrounds controversies over access to and interpretation of the bioinformation histories that sediment in institutional repositories, and shows that bioinformation governance and management is not the exclusive prerogative of the state. Rather, a range of entities are implicated in complex variegated sovereignties and fragmented jurisdictions, where competing interests, strategies and logics operate simultaneously (Ong, 2006). Issues of transparency and governance remain, as the opacity of bioinformation analysis, processing, movement, storage and disposal continue to be a feature of bioinformation infrastructures and markets. The privatisation of forensic science services has been shown to affect the availability and quality of forensic science through the loss of technical skills, risks of contamination by splitting of biological material across multiple providers, and the lack of sustained funding for research.

ORCID iD

EJ Gonzalez-Polledo https://orcid.org/0000-0001-8153-2217

Notes

1. Mackenzie et al. (2016) argue that in the field of genomics, DNA sequence data produced through NGS, or 'next generation sequencing' platforms are assembled in repositories such as the SRA, or Sequence Read Archive.
2. The government decided to proceed to test the GovCo model in 2005. In November, the then parliamentary under-secretary of state Andy Burnham stated that the GovCo structure 'should be given an opportunity to succeed in its own right' (House of Commons Science and Technology Committee, 2011: 12).

3. Indeed, prices for DNA casework fell by 40% while turnaround was reduced by half, according to commercial information recorded by the Home Office Forensic Marketplace Management Team (House of Commons Science and Technology Committee, 2016: 12).
4. At a cost of £450, or one and a half day's worth of a working archivist to verify and locate the information sought
5. See FAL website: www.forensicarchive.com/the-archive/, accessed January 2019.
6. See the report of the House of Commons Science and Technology Committee on the future of the forensic archive at: https://publications.parliament.uk/pa/cm201314/cmse lect/cmsctech/610/61008.htm#note314, last accessed January 2019.

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Author biographies

EJ Gonzalez-Polledo is a Senior Lecturer in the Anthropology Department at Goldsmiths, University of London, UK. Gonzalez-Polledo's research interests encompass gender and social theory; the biosciences; and digital infrastructures. Gonzalez-Polledo is currently developing two major research projects on community biology and forensic bioinformation.

Silvia Posocco is a Senior Lecturer in the Department of Psychosocial Studies, Birkbeck, University of London, UK. Posocco's research focuses on gender, sexuality, violence, life and death. Current projects include a monograph on transnational adoption circuits in the aftermath of war in Guatemala and new research on forensic biorepositories, bioinformation and evidence.