Forensic Identification in the Aftermath of Human Rights Crimes in Chile: A Decentered Computer History

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A Decentered Computer History

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ABSTRACT: As computer historians extend the bounds of what constitutes computer history, they must also take care not to write histories that overstate the importance of these technologies. "Decentering" the computer in computer history provides a way for historians to study the role of computers in more domains without exaggerating their importance. Here I illustrate how the use of a computer system for forensic identification formed part of Chile's complicated history of truth, justice, and reconciliation in the aftermath of the Pinochet dictatorship. While computers are not, and should not be, the central focus of how we understand processes of truth and reconciliation in history, in this case they illuminate the dynamics of how those working within the Chilean government, including its justice system, have approached Chile's history of human rights abuses.

At the beginning of the 1998 Chilean documentary *Fernando ha vuelto* (Fernando is back), two forensic scientists from the Chilean Medical Legal Service (SML) work to identify bones exhumed from Patio 29, a plot in the General Cemetery of Santiago, Chile used by the military to dispose of corpses during the Pinochet dictatorship.[1] The scientists identify the re-

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1. Patio 29 is now one of the most significant memorials for violations of human rights in Chile. Several filmmakers have documented its history as a site of mass burial. See for example Silvio Caiozzi, *Fernando ha vuelto*; Esteban Larraín, *Patio 29*; and Elvira Díaz, *El patio*. Scholars and journalists have also written about this history of Patio 29, among them Steve J. Stern, *Reckoning with Pinochet*; Verónica Torres, "Patio 29"; Marivic Wyndham and Peter Read, "From State Terrorism to State Errorism" and *Narrow but Endlessly Deep*; and Javiera Bustamante and Stephan Ruderer, *Patio 29*. These works

mains as belonging to Fernando Olivares Mori, a young political activist who disappeared nearly twenty-five years earlier. The documentary shows the identification process, a combination of forensic science and computer technology. For example, the scientists digitally superimpose images of the recovered skull on photographs of Olivares lent by his family. On the computer screen one image dissolves into the other in jerky increments. The photo of Olivares disappears, replaced in stages by a skull (fig. 1).

The result allows the scientists to compare the brow, nose, and eye sockets. The scientists also compare the teeth in the skull to a photograph in which Olivares is smiling broadly. "To us this is very accurate," the forensic pathologist Patricia Hernández declares. "Teeth are much like your fingerprint. There can be only one in 300 million. So the chances that this could be another person's [teeth] are close to zero."[2] Later in the documentary the scientists meet with Olivares's widow, Agave Díaz, to share their findings and return Olivares's remains to his family for burial. The computer-generated images helped give his family members something they had wanted for twenty-five years: knowledge of what had happened to their loved one. Nearly two decades later Díaz would recall that upon seeing the images in the offices of the SML, "I felt absolutely convinced that it was him."[3]

What the documentary did not say, and what audiences did not know, was that the identification of Olivares constituted the first time the SML scientists had used this computer system to identify a set of remains exhumed from Patio 29. In fact, the Olivares case constituted the ninety-third identification the SML scientists had made of remains exhumed from the Patio 29 site. For the previous ninety-two sets, the scientists had used traditional techniques from forensic anthropology and a simpler, non-computer-based form of the superimposition technique. The computer-based practice portrayed as routine on film was, in fact, exceptional. The documentary, perhaps unwittingly, inflated the importance of computer technology in making identifications and in the scientific capabilities of the SML. Yet the computer system had allowed the SML scientists to produce visual representations that not only connected a specific skull to a specific victim but did so in a way that convinced family members, the judge overseeing the case, and the audience watching the film that the identification was correct. It allowed viewers to analyze and evaluate the identification with their own eyes.

In 2006 the results of DNA tests revealed that at least forty-eight of ninety-six sets of remains from the Patio 29 site had been misidentified. The

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do not examine the Patio 29 story from the perspective of science and technology history, the focus of this article.

2. Caiozzi, *Fernando ha vuelto*.

3. Agave Díaz interview. Translations of written and oral sources in Spanish are mine.

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FIG. 1 A screenshot of the image the SML created by superimposing a skull identified as that of Fernando Olivares on a photograph of him. This image appeared in the documentary *Fernando ha vuelto*. (Source: Reprinted with permission from Andrea Films Caiozzi y García Ltda.)

SML had used the computer system featured in *Fernando ha vuelto* to make three of these identifications. DNA testing showed that all three were wrong.

Decentering Computers in Computer History

Historical studies of computing have focused largely on the role of computing machines in the military, university, government, and business contexts of the Cold War period.[4] However, as historians have started to write computer history of the 1990s and 2000s, new topics have emerged, including studies of Silicon Valley startup culture, global climate modeling, outsourcing, cloud computing, machine learning, and the global spread of the Internet, to cite a few.[5] Given the ways that computers have become increasingly intertwined with how we experience, understand, and interact with the world around us, it is reasonable to expect that computer

4. The literature on computing during the Cold War is large and diverse. See, for example, Janet Abbate, *Inventing the Internet*; Atsushi Akera, *Calculating a Natural World*; Paul Ceruzzi, *A History of Modern Computing*; Paul Edwards, *The Closed World*; Nathan Ensmenger, "Beards, Sandals"; Jennifer Light, *From Warfare to Welfare*; Eden Medina, *Cybernetic Revolutionaries*; David Mindell, *Digital Apollo*; and Ben Peters, *How Not to Network a Nation*.

5. For example, see Fred Turner, *From Counterculture to Cyberculture*; Paul Edwards, *A Vast Machine*; Dinesh Sharma, *The Outsourcer*; Tung-Hui Hu, *A Prehistory of the Cloud*; Joanna Radin, "Digital Natives"; and Carolina Aguerre, "The Internet in Argentina and Brazil."

history will become more prominent in the literature of the history of technology as more members of the field pursue topics set in the late twentieth and early twenty-first centuries.

Such developments promise exciting times and opportunities to grow the field in new directions. By following computers into the diverse domains where people live and work, computer historians can build bridges to other literatures, contribute to conversations outside their subfield, and acquire the ability to tell other kinds of stories. However, the subfield places a primacy on computers and their associated practices that risks overstating the importance of computers as computer history moves into new domains. To put it another way, computer historians run a risk of propagating enthusiasm for computers, despite our training to be skeptical about this enthusiasm when we find it in our source materials.

In this article I contribute to this special issue on new directions in the history of computing by telling a history of computing that recognizes this potential pitfall as well as the value of using computer history—and by extension technology history—to understand seemingly unrelated historical events. I do this by decentering the role of the computer in the larger narrative. To decenter means to "shift from an established center or focus . . . to disconnect from practical or theoretical assumptions of origin, priority, or essence."[6] My motivation for writing a form of decentered analysis differs from the scholarly projects that are more frequently associated with the term. However, as this article shows, writing a decentered computer history (in the sense of deprioritizing the machine in the analysis) is not antithetical to these other projects and may even contribute to them.

Historians often use the term to challenge the assumptions found in dominant historical frames, including the voices, places, forms of knowledge, and analytical categories that historians privilege and deem valuable. As Natalie Zemon Davis writes, "Decentering involves the stance and the subject matter of the historian. The decentering historian does not tell the story of the past only from the vantage point of a single part of the world or of powerful elites, but rather widens his or her scope, socially and geographically, and introduces plural voices into the account."[7] Decentered histories give greater attention to members of lower classes, experiences of women, and experiences of marginalized and subaltern groups. They include histories from parts of the world outside the United States and Europe and histories of colonization told from the perspective of the colonized. Such histories illuminate the plurality of experiences while also detailing the lives of those formerly overlooked by the historical canon.

The recent push for global or transnational frames in historical analysis, including by scholars in the history of technology, has also been de-

6. *Merriam-Webster's Collegiate Dictionary*, 11th ed. (Springfield, MA: Merriam-Webster, 2014), s.v. "decenter."

7. Natalie Zemon Davis, "Decentering History," 190.

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scribed as a kind of decentering. Such histories challenge the centrality of the nation-state by following the ways that peoples, objects, and ideas cross borders, connect across space, and change during their travels.[8] Historians of science also have invoked decentering as a way to draw attention to different forms of knowledge production around the world and move away from privileging forms of knowledge classifiable as Western science.[9]

Outside history, scholars such as Uma Narayan and Sandra Harding have used the term to draw attention to multicultural, global, and postcolonial perspectives in the interdisciplinary field of feminist philosophy.[10] The geographers Doreen Massey, Ash Amin, and Nigel Thrift invoke decentering to highlight the centralization of British power in London, its contribution to regional inequalities, and the need for "a wholly different geography of the national."[11] John Law develops an approach for decentering the object in technoscience by telling different stories about a military aircraft. Through these stories he illustrates how an object, such as an aircraft, exists in different versions of the story and how these versions can be brought together in "fractional coherence," a way of "drawing things together without centering them."[12] Thus scholars in different fields have used the idea of decentering in multiple ways to bring attention to what previously was the focus of scholarly inquiry and to shift that focus elsewhere by changing the analytic frame.

This article proposes a different kind of decentering, but one that still sits comfortably under the larger umbrella of how the term has been used. Specifically, it seeks to understand the relationship of technology and society within a frame of analysis that explicitly limits the role of technology and draws attention to the larger context of which technology is but one part. Writing a decentered computer history in this vein may seem contradictory because this approach simultaneously seeks to draw attention to computing while positioning it on the periphery. I approach this paradoxical endeavor in several ways. In the context of what happened in Chile, I first convey to the reader the broader contours of how the state responded to calls for truth, justice, and reconciliation during the democratic transition of the 1990s, both at the national level and within the SML. Second, I explain how this larger context shaped the actions of Chilean justice system operatives—a category that includes judges as well as those involved in investigating the facts of a case, including the SML scientists who recommended identifications of the exhumed remains to the judge so that they could be made official. Third, I connect the use of computers in the identification work to types of visual representations that the SML had already

8. Erik van der Vleuten, "Toward a Transnational History of Technology."
9. Carla Nappi, "The Global and Beyond."
10. Uma Narayan and Sandra Harding, *Decentering the Center*.
11. Doreen Massey, Ash Amin, and Nigel Thrift, *Decentering the Nation*, 4.
12. John Law, *Aircraft Stories*, 2.

been using. That is, the use of computer technology represented a form of continuity, rather than a rupture, for the SML scientists. However, the introduction of computer technology strengthened the credibility of their identifications in the more difficult cases. While the argument I make here is not limited to identifications related to Patio 29, most of the remains identified during the 1990s came from that site.

Finally, I acknowledge from the outset that computer technology played a smaller role in the identification process than might be inferred from *Fernando ha vuelto*, as well as other images and articles that appeared in the popular media at the time. For example, in early 1992 the *New York Times* ran the headline "Computers Help Chilean Dead Tell Their Tales" on the front page of its science section.[13] The article focused on the exhumation of remains from Patio 29 and the identification work that was then in its early stages. Although some scientists involved in the exhumations did develop a limited computer-based system for their records, traditional techniques from forensic anthropology and odontology played a much larger role in helping the scientists learn about the bones and to whom they might belong, as did analysis of the information families provided about their missing loved ones and records generated by the morgue and cemetery during the early years of the dictatorship.[14] Indeed, computers played a minimal role in the *New York Times* story and in the identification work that was then taking place. Perhaps editors thought mentioning the technology in the headline would grab more attention.

However, acknowledging the limited role of computing in the identification work does not mean that computer history is irrelevant to understanding the Chileans' attempts to identify the remains and the dynamics of the country's democratic transition. As Eric van der Vleuten observes in the pages of this journal, "advocates of the new transnational history did not advocate giving up that analytical category [of the nation-state], but rather placing it in proper historical context."[15] Here I make a similar argument about computers. Writing a computer history that deprioritizes the computer provides space for contextualizing this technology while also making space for a wider set of practices, actors, and priorities.

This approach allows me to take computer history into the difficult domain of human rights work by attending to the ways that technology history might illuminate, or distort, understandings of the struggles, practices, and stakes within that domain. It permits me to ask how computers have contributed to the ways that victims of human rights crimes, and national processes of reconciliation, are benefited or harmed while emphasizing that it is not the computers that have caused these benefits and harms but the structures, contexts, and social relationships in which his-

13. Malcolm Browne, "Computers Help Chilean Dead," C1.
14. Iván Cáceres, e-mail to author.
15. van der Vleuten, "Toward a Transnational History of Technology," 983.

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torical actors have used them. Such an emphasis also allows me to offer a different narrative of Chile during the 1990s, one that connects Chile's history of truth and reconciliation during the democratic transition to the history of science and technology.

This approach allows me to also perform other kinds of decentering in the story I tell. For example, unlike previous histories of Chilean computing, which focused on machines from the U.S. companies IBM and Burroughs or the French company CII, the story of forensic computing in Chile casts light on the history of forensic computing in China and the role of police officers and police institutions in the creation of these forensic systems.[16] Following the computer into spaces of historical inquiry in which these machines play a more marginal role may, somewhat paradoxically, permit computer historians to draw attention to new actors in computer history, the activities of less-studied parts of the world, and networks of exchange that break the North-South paradigm and suggest future avenues for scholarship. Still, readers should be aware that computers do not appear until late in the analysis here, and then as a way to draw different historical threads together and help explain the course of subsequent events.

My findings are based on archival research and oral history interviews conducted since 2014, primarily in Chile but also in the United States, Argentina, and Spain. Given the public nature of the events I describe in the pages that follow, much information is available from public sources, including government reports, court records, and newspapers. I have supplemented these public sources with documents, photographs, and videos from the private files of those involved in this history as well as documents that I obtained under open records laws.

The Chilean Context

The military junta took control of Chile on 11 September 1973 by means of a coordinated attack on Chile's democratic institutions that began with Hawker Hunter fighter jets dropping bombs on the presidential palace. That day Salvador Allende, the democratically elected socialist president, died, and the military arrested or executed those who had stayed with him until the end. Some survivors would be detained in prison camps for years. Once in power, the military disbanded Congress and eventually rewrote the Chilean constitution. Chile would not have another presidential election for sixteen years.

From the outset, military authority was based on a show of force. After taking the presidential palace, the military moved to secure the universities, shantytowns, and industrial sectors of Santiago. It identified and

16. Eden Medina, "Big Blue in the Bottomless Pit"; Juan Alvarez and Claudio Gutierrez, "History of Computing in Chile."

rounded up known supporters of the previous socialist government, broadcasting their names on the radio so that they would turn themselves in for questioning or by taking them from their homes and the homes of those who sheltered them. The military also instituted a curfew in the capital that gave soldiers and police an excuse to kill or arrest anyone caught violating that order. The military raided Chilean factories and shantytowns to round up people it deemed politically subversive. The generals justified these actions as necessary to save the country from the threat of leftist paramilitaries. When this threat failed to materialize, the generals continued the fiction of civil war to legitimize their consolidation of power, which they achieved through terror, detention, torture, and homicide.

The Chilean military had immediately established prison camps throughout the country. Pinochet created the Directorate for National Intelligence (DINA), an autonomous secret police whose agents and informants collected information about people deemed a threat to national security; the DINA director reported to Pinochet. Members of the DINA made extralegal arrests, used torture as an interrogation technique, and executed people. They also set up clandestine sites in Santiago for detention and torture.[17] Pinochet also created a transnational network of terror (Operation Condor) that allowed Chile and other military governments in Latin America to track and kill their political enemies as they crossed national borders.[18] The dictatorship detained many who seemingly had disappeared without a trace.

Disappearance is a crime that inflicts violence through its ongoing uncertainty. As Héctor Contreras, a Chilean lawyer who worked for the human rights organization Vicaría de la Solidaridad, explained, "Enforced disappearance has this poison, that the only way to not keep looking for your family members is for you to decide to kill them in your heart, something that is impossible."[19] The term *disappearance* is a Latin American innovation that emerged to describe the actions of military governments in countries such as Guatemala, Chile, and Argentina during the 1960s, 1970s, and 1980s. In Chile enforced disappearance included instances of both people who disappeared because they had been detained and were never seen again and individuals who were known to have been executed but whose remains never were located and returned to their families. I use *disappearance* to refer to both types of disappearance, unless I specify why someone was disappeared. According to official figures, 3,216 people were killed as a result of the Pinochet dictatorship, including roughly 2,000 victims of execution and 1,200 detained-disappeared.[20]

17. For more on the DINA, see Mark Ensalaco, *Chile Under Pinochet*, 55–58.
18. See John Dinges, *The Condor Years*.
19. Héctor Contreras interview.
20. In August 2011 the Advisory Commission on the Classification of Disappeared

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In the Chilean context enforced disappearance occurred when the military or police detained someone and then systematically hid or denied information about that person's fate. The military's desire to hide the extent of its violent actions, including the identities of those it killed, led to the creation of records that would later pose substantial challenges in identifying remains. For example, morgue and cemetery records of victims of state violence often contained incomplete, erroneous, or missing information, if there were records at all.[21] Additionally, many bodies were buried anonymously in sites such as Patio 29 or were disposed in places where an exhumation would be impossible, such as the sea. Determining the universe of victims would later present a substantial challenge to human rights organizations and truth commissions and would add an additional layer of difficulty to the identification work.

Chile returned to democracy on 11 March 1990, when Patricio Aylwin, the candidate from the center-left coalition Concertación, became the president of Chile, its first democratically elected president in seventeen years. Aylwin had incorporated in his platform an expression of outrage about the human rights abuses committed by the dictatorship, a position that contributed to his victory. For example, his campaign promised to repeal the 1978 amnesty law that protected the military.[22]

However, Aylwin became president in a political context in which the military continued to exert substantial power. Chile had returned to democracy in the form of elections, but the country would not enter a post-Pinochet era until 1998, when Pinochet stepped down as commander-in-chief of the armed forces and was arrested in London for crimes of genocide and terrorism. Chilean democracy was also constrained by a constitution written during the dictatorship and still in effect after the transition of power. These institutional forms of power, combined with tensions between the military and the newly elected president, prevented Aylwin from pursuing his promise to repeal the amnesty law and prosecute Pinochet and other members of the military. Fearing a second coup, the government opted for a strategy of prudence that emphasized consensus building among elites and negotiations with the military. As the new president put it, Chile would pursue justice for the human rights crimes committed by the dictatorship but only "to the extent possible."[23]

Within this context, Aylwin managed to make important strides in the

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Detainees, Victims of Political Executions and Victims of Political Imprisonment and Torture confirmed 3,216 cases of detained-disappearance and political execution. Instituto de Investigación en Ciencias Sociales, "Cifras de víctimas y sobrevivientes."

21. Pascale Bonnefoy and John Dinges, "Ejecuciones en Chile septiembre–diciembre 1973."

22. Cath Collins, "Human Rights Trials in Chile."

23. Former president Patricio Aylwin made this comment repeatedly during his presidency. See for example Patricio Aylwin, "En ceremonia de conmemoración," 121.

area of human rights. Six weeks after his inauguration in 1990, he created the National Commission on Truth and Reconciliation to investigate the abuses. In its 1991 report, known colloquially as the Rettig Report, the commission documented 2,115 cases of human rights violations (those killed or disappeared by government agents or people in their service) and an additional 164 deaths from political violence. Locating and identifying the remains of those the military had disappeared and executed emerged during this period as central to the beginnings of Chile's truth and reconciliation process. It also conformed to what the historian Steve Stern has described as the Aylwin government's vision of a "bounded healing process."[24] This included plans to address truth and justice in the area of human rights but within limits and framed not only as a means for social repair, but also as the basis for fortifying Chile's democratic future and the ability of the nation to move forward.

Identification allowed the government to publicly acknowledge the suffering of the victims' families. It allowed the government to give the families truth without the promise of justice in the form of criminal penalties. Moreover, it articulated a limited conception of truth tied to the location, identification, and burial of remains rather than to knowledge of who committed acts of disappearance, execution, and torture in each case. Locating and identifying the remains of victims also permitted the Aylwin government to further consolidate its power by drawing attention to, and denouncing, the acts of state violence under Pinochet. The exhumation of remains of suspected victims began in March 1990, shortly after Aylwin's inauguration.

Scientific epistemology and legal epistemology come together in the act of identification. Chile uses an inquisitorial legal system to investigate human rights cases from the Pinochet era. In this system, judges rule on the facts as well as on the law. This is different from the adversarial system found in the United States, where lawyers representing the prosecution and defense each assemble the evidence for their case, which they then present in court. In Chile, judges lead the investigation and designate the scientific experts who will help collect evidence.[25] Only the judge has the power to identify a set of unnamed remains. Forensic experts may recommend an identity based on their findings, but the judge makes the identification official. Once remains are identified, the state can return them to the family. Identification thus requires a scientific recommendation of sufficient credibility to convince a judge. Although the judge can question the work or seek the opinion of additional experts, neither the scientific work nor the scientist that performed it is subjected to courtroom interrogation.

24. Stern, *Reckoning with Pinochet*, 121.

25. Chile began moving toward an adversarial system in 2000 as part of a judicial reform. However, many human rights cases still use the older inquisitorial system since it was the system in place at the time of the offense.

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In the late 1980s Sola Sierra, the president of the Agrupación de Familiares de Detenidos Desaparecidos (association of relatives of the detained and disappeared, hereafter Agrupación), reached out to a group of young anthropology graduates from the University of Chile. Sierra knew of the identification work under way in Argentina by a newly trained group of Argentine forensic anthropologists; they had already made substantial contributions to exposing what had happened during Argentina's Dirty War. She knew that Chile would also need expertise to identify the remains of the disappeared once Chile returned to democracy, and she arranged for the Chileans to meet with members of the Argentine team, known as the EAAF, and their U.S. mentor, Clyde Snow.[26] The meeting would prompt the young Chileans to train in forensic anthropology and form the Grupo de Antropología Forense (GAF), an independent organization dedicated to exhuming and identifying remains in human rights cases.

GAF members performed much of the exhumation work that took place between 1990 and 1994. They also led the exhumations at the Patio 29 site and wrote some of the first reports analyzing those remains.[27] However, although a judge had appointed the group to work as ad hoc experts on the Patio 29 case, the SML and others criticized GAF members for their youth, lack of professional credentials, and for being anthropologists rather than doctors. At the same time members were leaving the GAF because of pay that was below subsistence levels, other opportunities such as graduate study, and infighting. As a result, the identification work moved completely to scientists in the Medical Legal Service, or SML, the only state entity authorized to conduct autopsies and issue death certificates. As a state institution that was comprised of medical doctors officially tasked with performing forensic work, the SML projected the scientific authority the young Chilean anthropologists lacked. The location of the SML within the Ministry of Justice also gave the institution authority within the Chilean justice system. However, some families and their representatives had trouble trusting the organization because it had been complicit in acts of disappearance by writing incomplete autopsy reports, not taking sufficient steps to identify the bodies that arrived at the morgue, and assisting in their anonymous burial. Members of the GAF also had concerns because the SML scientists were trained to work with soft tissue and did not have expertise or formal training in the analysis of bones.

Although the state regarded the SML as having greater scientific credi-

26. Iván Cáceres, "Antropología Forense: El GAF, Método y Orientaciones," Grupo Chileno de Antropología Forense, n.d., in IR. For more on the history of the Argentine EAAF and its role in shaping the field of human rights forensic anthropology, see Adam Rosenblatt, *Digging for the Disappeared*; and Christopher Joyce and Eric Stover, *Witnesses from the Grave*.

27. See for example Iván Cáceres and Isabel Reveco, "4° informe pericial," October 1993, 22° Juzgado del Crimen de Santiago, Rol de la causa: 4.449–AF, inhumación ilegal, Tomo III, p. 1226, in PDH.

bility than the GAF, the GAF did bring certain advantages to the work that the SML did not, including a good relationship with the families and key Chilean human rights organizations, such as the Vicaría de la Solidaridad; training in forensic anthropology for human rights cases; and a professional connection to the Argentine EAAF and Clyde Snow. The SML eventually hired Isabel Reveco, a forensic anthropologist from the GAF team, to assist with the identification work. She was the first anthropologist the SML ever hired.

In 1994 Aylwin's successor, Eduardo Frei Ruiz-Tagle, gave the SML 46 million pesos (approximately US$181,000 in 2017) to help it solidify its creation of a new forensic identification unit and hire experts such as Reveco.[28] Frei would serve as Chile's president from 1994 to 2000. His priorities included economic growth, developing infrastructure, reducing poverty, and modernizing the state but not human rights. For Frei, moving the country forward meant bringing aspects of Chile's struggle for truth, justice, and reconciliation to a close.

Craniofacial Superimposition

The techniques used in the early years of identification reflected the expertise of the scientists performing the work. The team included forensic odontologists, who used techniques from forensic dentistry on the exhumed remains. SML reports also included the analysis of the bones to determine sex, age, height, signs of trauma, and any other information about the person that might be gleaned from the bones, including old injuries or medical conditions. Forensic pathologists performed a substantial amount of this work because the SML had only one anthropologist on staff. The SML scientists also reviewed the documentary evidence from human rights organizations and state institutions, medical records when available, clothing and other artifacts that had been exhumed with the remains, and the premortem data from the families about the deceased. The SML compared this information with the postmortem data gleaned from the bones.

The SML also regularly used a technique known as craniofacial superimposition. In a general sense, craniofacial superimposition refers to the forensic practice of superimposing a photographic image of a recovered skull over a photograph of a victim to see if they might be the same person.

28. The amount was roughly US$109,477 in 1994. For the conversion from Chilean pesos to U.S. dollars in 1994, see data.worldbank.org. For the conversion to U.S. dollars in 2017, see www.measuringworth.com for the different ways of making this calculation (I used the purchasing power conversion). The budget figure comes from Cámara de Diputados, "Legislatura 354a. Sesión 90a., en jueves 19 de octubre de 2006," Diario de Sesiones, p. 78, in BCN; Servicio Médico Legal, "Proyecto de identificación médico legal y de determinación de la causa de muerte de las osamentas exhumadas en el patio 29 del Cementerio General," June 1994, in IR, lists the figure requested by the SML as precisely 46,858,176 CLP and itemizes the requested items and their estimated cost.

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The term can refer to low-tech procedures that overlay x-ray images and photographs as well as high-tech versions involving computers and computer-assisted forms of analysis. It is related to the technique of facial reconstruction, whereby scientists and artists attempt to reconstruct the contours of a face based on the contours of a skull, as the goal of both techniques is to predict the form of soft tissue from the foundation of hard bone. SML's use of the superimposition technique traces to the forensic pathologist Patricia Hernández, who had joined the SML in 1985 to work in its museum and on sex crime forensics. During that time she completed a project on forensic facial reconstruction, which she found appealing because of her interest in art.[29] Hernández started working on the Patio 29 identifications in 1992 and would become the first director of the SML Identification Unit and Museum when it was formed officially in 1995.[30] However, although she had trained as a medical doctor, she did not have formal training in forensic anthropology. Source materials do not mention her receipt of formal training in craniofacial superimposition before she began using the technique in 1992, although her use of it may have stemmed from her earlier facial reconstruction work.

Craniofacial superimposition has a long history in forensics. The Smithsonian anthropologist Douglas Ubelaker has traced its origins to the nineteenth century and attempts made by Wilhelm His to confirm the identity of remains that had been attributed to Johann Sebastian Bach.[31] However, in criminal law the history of the technique is more commonly linked to a 1935 case in Scotland, in which the scientists John Glaister and James Brash used photographs and x-ray images to prove that two recovered skulls belonged to missing women, Isabel Ruxton, the wife of Dr. Buck Ruxton, and Mary Rogerson, a nursemaid employed by him. The technique helped convict Ruxton of murder.[32] In the 1970s scientists began using video cameras to facilitate the alignment of a skull and a photograph. By the 1980s computer technology was playing a role in the procedure.[33]

The technique received considerable attention during the high-profile identification of the remains of Josef Mengele, the notorious Nazi physician who had vanished into South America in 1949. A man suspected of being Mengele had drowned in Brazil in 1979 and was buried under a different name. Brazilian authorities exhumed the body in 1985 and took it to the Medico-Legal Institute in São Paulo for further analysis. There, an in-

29. Annie Kutscher Wach, "Una luz de esperanza," 25.

30. Departamento Asesoría Jurídica Servicio Médico Legal, "Crea la Unidad de Identificación y Museo del Servicio Médico Legal Resolución Exenta No 400," 10 August 1995; Departamento Tanatología Servicio Médico Legal, "Unidad Identificación y Museo," n.d., both in IR.

31. Douglas H. Ubelaker, "Craniofacial Superimposition," 1143; see also Franklin Mall, "Wilhelm His," 150.

32. John Glaister and James Couper Brash, *Medico-legal Aspects of the Ruxton Case*.

33. Ubelaker, "Craniofacial Superimposition," 1413.

ternational team confirmed that the remains did indeed belong to Mengele. According to the 1985 report of the investigation published in the *American Journal of Forensic Science and Pathology*, scientists eventually made the identification by examining the teeth; analyzing the bones for age, sex, and stature; and using "*advanced techniques* . . . including facial and skull superimposition, utilizing photos, transparencies and drawings . . . as well as TV images" (emphasis added).[34]

The images opened new spaces for experts but also appealed to the visual sensibilities of nonscientists. In contrast to sketches or drawings, photographs and radiographs have the authority of mechanical objectivity. As scholars in the history of science, law, and related fields have shown, photographs and radiographs seem to allow nature to speak for itself while enhancing it in ways that make previously unseen levels of detail accessible to the human eye and open to study.[35] In her article about the history of photographs as evidence in U.S. courts, Mnookin describes photographic images as "vivid displays that seem almost to compel belief" and notes that they have been likened to both an illustrative form of evidence that can enrich witness testimony and a "silent witness" that in itself is of evidentiary significance.[36] Like the camera, computers introduced new ways of seeing that produced particular understandings of complex realities. As Vertesi writes in her study of the Mars Rover, digital image processing techniques "revealed an otherwise invisible phenomena" in the images the rover acquired and helped transform the observations of an individual scientist into a "collective vision" of the scientific group.[37]

The photographed faces of the disappeared Chileans also have moral, emotional, and political power. These photographs preserve the memory of a loved one whose fate remains unknown, and they are the images that appear on signs at marches and demonstrations, often accompanied by the phrase *¿dónde están?*—Where are they? (fig. 2). When a skull is superimposed on such a photograph and the two align, the result seems to offer an answer: Where is Fernando Olivares? His bones are here. As Keenan and Weizman note, the act of superimposing skull images on faces and seeing a match has an aesthetic with the power to unite the living and dead. "A series of different functions within the image processor," they write, "could show Josef Mengele alternately dead and alive, half dead and half alive—a spectral presence—present and represented at one and the same time."[38] The technique of superimposition thus served to solidify a relationship

34. William G. Eckert and Wilmes R. G. Teixeira, "The Identification of Josef Mengele."

35. Lorraine J. Daston and Peter Galison, *Objectivity*; Bettyann Kevles, *Naked to the Bone*; Barbara Duden, *Disembodying Women*; Catelijne Coopmans et al., *Representation in Scientific Practice Revisited*; Jennifer Mnookin, "The Image of Truth."

36. Mnookin, "The Image of Truth," 3, 73.

37. Janet Vertesi, "Drawing as: Distinctions and Disambiguation," 16.

38. Thomas Keenan and Eyal Weizman, *Mengele's Skull*, 37.

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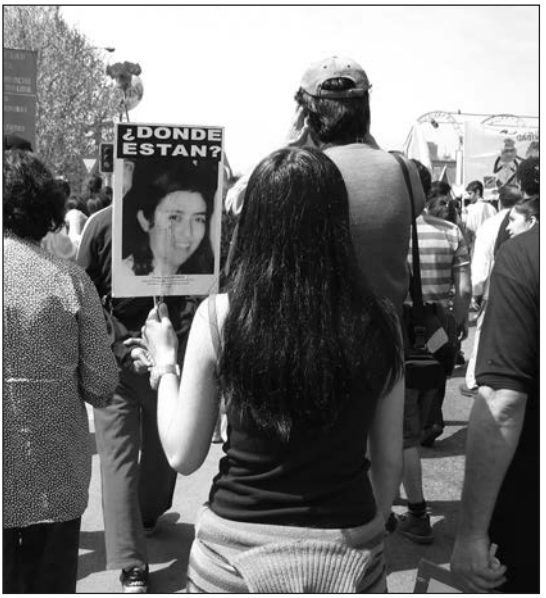

FIG. 2 On the thirtieth anniversary of the military coup, a marcher in Santiago, Chile, holds a sign in memory of the victims of enforced disappearance. (Source: Photograph by author.)

between two otherwise independent images and bring the histories of the entities they represent—a person, a skull—into alignment. In a context of enforced disappearance, which is defined by uncertainty, the ability to make such connections not only furthered the scientific work but also had evidentiary and historical value.

The SML used the technique of craniofacial superimposition as early as 1992 to identify bones exhumed from Patio 29, and did so initially without the assistance of computer technology. In 1992 the SML sent fifteen identifications from the Patio 29 site to Judge Andrés Contreras, the judge handling the Patio 29 case, and recommended that they be made official. In many ways, these early identifications were among the easier cases—some autopsy reports listed names or fingerprints that could be connected to cemetery records and a set of remains, and many had anthropomorphic records stored with human rights organizations such as the Vicaría de la Solidaridad. Two teams within the SML performed the initial identification work on these first fifteen sets of Patio 29 remains. The Chilean scientists used craniofacial superimposition, performed by Hernández, to assist in the identification of ten. Her identification reports often included, beneath her signature, the lines "medical examiner specialist in photographic superimposition and facial reconstruction."[39]

39. See for example Patricia Hernández, "Informe superposición fotográfica cráneo-facial," December 1992, 22º Juzgado del Crimen de Santiago, Rol de la causa:

At the time Hernández used nothing more advanced than a photograph, radiograph, and pen to generate the superimposition images. In one report from December 1992, Hernández described the process thusly:

> Radiography was performed on the skulls previously mentioned at the same angle as the photograph . . . In each case, I marked the 15 craniometric points that corresponded to the points of the face, and photographed both marked radiographic images. The photograph of [the] face was enlarged to a size of 13 x 18 cm and I marked the 15 points on it that had a correspondence with the craniometric points and photographed the photo. Later I made the photographs of the skulls and the photograph of his face transparent in a size relationship of 1:1, and superimposed each skull on the photograph of the face looking for the alignment of the aforementioned points.[40]

Hernández considered correspondence of all fifteen points evidence in support of positive identification. She highlighted this connection in her reports, sometimes by noting the alignment of all fifteen points but at other times writing that there was "100% agreement" (*coincidencia del 100%*) of the skull and photograph (fig. 3).[41] This assessment conveyed the results of the superimposition work as well as her authority as an SML forensic expert and her confidence in the findings. The families would later interpret such claims of 100 percent agreement not as a simple statement that all fifteen points were in alignment, but rather as absolute certainty about the results (fig. 3).

The SML recommended to the judge a total of twenty-three identifications in 1992 and 1993, including the initial fifteen.[42] These recommendations typically included a report on the analysis of the bones, a report on the analysis of the teeth, and a report on the results of the superimposition analysis. Hernández aimed to make an additional fifty-five identifications by November 1994 and came close to meeting this ambitious goal.[43] Making identifications would permit the SML scientists to give closure to the families and show progress on the cases. The pace of the work can also

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4.449–AF, inhumación ilegal, Tomo I, p. 446; Patricia Hernández, "Informe de estudio no 22942/91," 16 December 1992, 22º Juzgado del Crimen de Santiago, Rol de la causa: 4.449–AF, inhumación ilegal, Tomo I, p. 492, both in PDH.

40. Patricia Hernández, "Informe superposición fotográfica cráneo-facial," December 1992, 22º Juzgado del Crimen de Santiago, Rol de la causa: 4.449–AF, inhumación ilegal, Tomo I, p. 439, in PDH.

41. See for example Patricia Hernández, "4ª hoja de informe estudio nº 2848/91," 16 December 1992, 22º Juzgado del Crimen de Santiago, Rol de la causa: 4.449–AF, inhumación ilegal, Tomo I, p. 472, in PDH.

42. "Lista de casos de identificados del Patio 29 del Cementerio General," 1996, in IR.

43. Patricia Hernández to Alfonso Claps, 3 October 1994, in IR. According to "Lista de casos de identificados del Patio 29 del Cementerio General," 1996, in IR, the SML recommended fifty identifications in 1994.

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FIG. 3 An example of the superimposition technique used at the SML before the arrival of the TLGA-213 computer system. The alignment of all fifteen points provided further proof of positive identification. (Source: 22º Juzgado del Crimen de Santiago, Rol de la causa: 4.449–AF, inhumación ilegal. Public document.)

be explained in part by a political context that linked truth to location and identification of remains, the more controversial belief that location and identification were essential to reconciliation, and a desire within the government to finish with the human rights issue and look to the future. Positive identifications also gave Chile's public image a boost in the area of human rights. For example, the U.S. State Department's annual report on human rights practices in Chile during 1995 explicitly mentions the identifications of remains from the Patio 29 site as a sign "some progress has been made in locating a number of those who disappeared" (although the report inaccurately inflated the number of identifications that had been made by the end of 1995).[44]

Progress had been made in 1994, but the prospects for future progress remained in doubt as the cases became increasingly difficult. For example, ten sets of remains did not have premortem data, which made identification impossible.[45] In other cases the scientists did not have enough data to

44. U.S. Department of State, "Chile Human Rights Practices."

45. For example, none of the four exhumed skeletons identified as female matched the characteristics of the known female victims of disappearance and execution. Using cemetery and morgue records, the scientists were able to make a potential connection between an additional six sets of remains and fingerprints the morgue had collected in 1973. However, the scientists could not locate any family members who could provide

individualize the remains, meaning the remains could be matched to more than one victim.[46] The scientists also found that some remains did not match the information in any of the known cases of disappearance and execution, suggesting that the universe of victims was larger than they had originally thought.[47] SML scientists thought that DNA testing or more advanced superimposition techniques that used video would allow them to continue the work. Chile had limited capacity in both areas, but the SML did have ties to a lab in Scotland that could perform the work. This meant an additional expense, but it might also allow Chile to use the newer techniques and technologies to resolve the Patio 29 cases without the delay that developing the capacity in-house would entail.[48]

Moreover, the SML already had one of its own working in the Glasgow lab who could assist with the work. The SML pathologist América González was completing her Ph.D. at the University of Glasgow under the supervision of Dr. Peter Vanezis, chair of the Department of Forensic Medicine. Her thesis sought to improve methods for craniofacial identification by using a laser scanner and video superimposition. González served as the liaison for the SML and Vanezis's forensic laboratory. The SML formally reached out to the Glasgow lab in 1994 in hopes that the Glasgow scientists would help the Chileans make progress with the more difficult remaining cases.

DNA

In June 1994 Vanezis visited the SML at the invitation of Alfonso Claps, the SML director, as part of the SML's multistage plan for making progress on the more difficult Patio 29 identification cases. Following the visit, the SML submitted its plan to the government, and President Frei approved it in July.[49] On 3 November 1994, Claps asked Judge Contreras, who was overseeing the Patio 29 case, for permission to send bone samples from the Patio 29 remains to Glasgow for "the identification of the people to whom these bones belong."[50] The judge granted permission five days later, and later that month Hernández traveled to Scotland to deliver twenty-one femur samples from unidentified Patio 29 skeletons to Glasgow for DNA analysis. SML also sent forty blood samples from people

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premortem information about the people to whom the fingerprints belonged, making it impossible to arrive at a positive identification. Unidad de Identificación, "Informe completo Patio 29," 1994, in IR.

46. Ibid.

47. Ibid.

48. Servicio Médico Legal, "Proyecto de identificación médico legal y de determinación de la causa de muerte de las osamentas exhumadas en el Patio 29 del Cementerio General," June 1994, in IR.

49. Patricia Hernández to Alfonso Claps, 3 October 1994, in IR.

50. Cámara de Diputados, "Legislatura 354a. Sesión 90a., en jueves 19 de octubre de 2006," Diario de Sesiones, Santiago, Chile, p. 95, in BCN.

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thought to be maternal relatives, as well as twenty-one plaster casts of skulls from the skeletons under study (the judge would not allow the originals to be shipped), twenty-two photographs of the victims, twenty-six antemortem records, and twenty postmortem records (including dental analyses).[51] The SML hoped that the DNA results would corroborate the superimposition results and allow the Chileans to make further progress on the Patio 29 cases. Claps also authorized González to use the Glasgow equipment to perform superimposition.[52]

However, the Glasgow DNA results proved unsatisfactory. In a report from 23 October 1995, Vanezis described the DNA results as unhelpful because they did not match any of the bone samples with the blood samples provided by relatives. In contrast, González made sixteen identifications using superimposition. She reached her conclusions after reviewing the exhumation and anthropomorphic data provided by the SML, recalculating the estimated stature of the person from the data provided about the remains, and applying facial identification techniques such as craniofacial superimposition and computational facial reconstruction using a laser beam. An independent lab checked half of these results and arrived at the same conclusions.[53]

However, her analysis raised concerns within the SML. For example, her final results contradicted at least three identifications the SML had already made in 1995, and the SML had returned these remains to the families. The final results also contradicted the findings of the preliminary report González had submitted in July 1995, when she made thirteen "possible identifications," most differing from those in her final report. She had made the thirteen identifications after noting significant challenges in the work, such as the difficulty of placing craniometric points on casts of skulls that had required reconstruction because projectiles such as bullets had deformed the originals. González further observed that the premortem dental records were incomplete and that the Glasgow lab did not have enough anthropomorphic data to differentiate one case from another. Many of the available photographs, she noted, were also of substandard quality for analysis.[54]

The Glasgow results disappointed the Chilean scientists. The DNA work had come at substantial expense to the SML but had proved useless. Moreover, the Chilean scientists found lacking the level of rigor applied to the superimposition work. The SML anthropologist Isabel Reveco stated

51. Peter Vanezis, "DNA Analysis of Bone Samples"; Vanezis, "Report on Personal Identification." Documents obtained from the Servicio Médico Legal by means of transparency law requests.

52. Cámara de Diputados, "Legislatura 354a. Sesión 90a., en jueves 19 de octubre de 2006," Diario de Sesiones, pp. 83, 86, in BCN.

53. Vanezis, "Report on Personal Identification."

54. Excerpts of this report appear in Comisión de Derechos Humanos, "Informe de la Comisión de Derechos Humanos," 23.

that González's contradictory identifications made Reveco question the scientific work, as did González's willingness to identify remains even though she had complaints about the quality of the plaster casts, among other things, and never examined the original bones.[55] The SML scientists also claimed to have additional information about the cases that contradicted several identifications Glasgow had recommended.

Yet even before the SML received the final October 1995 report from Glasgow, its scientists had set in motion plans to acquire the computer system used by the independent lab that would verify González's results. The acquisition of the system coincided with the expertise of unit director Hernández in the technique of craniofacial superimposition and would permit the SML to quickly modernize its capabilities in forensic identification without the expense required to build its own capacity in DNA identification.

Vanezis had been collaborating with the Chinese superimposition expert Yuwen Lan in the area of craniofacial identification. Lan's lab confirmed half of the sixteen identifications González made in the October 1995 Glasgow report, although the lab is listed in the report only as "another parallel centre."[56] Hernández learned of Lan's system through González, who had learned about it during her doctoral work in Glasgow. Hernández pushed to improve SML capabilities in forensic identification by acquiring the Chinese computer system.

Chile's decision to acquire a computer system to modernize the superimposition technique rather than acquire capacity in DNA analysis presents a bit of a puzzle. Neighboring Argentina began building a genetic databank for human rights work in 1984 to reunite grandmothers with the grandchildren the military had taken after their mothers had given birth in detention.[57] The Argentine work furthered scientific capabilities in the use of DNA for human rights work and led to the development of the "index of grandpaternity," a genetic test used to determine the likelihood of a grandchild-grandparent relationship.[58] Chile would not begin to assemble a genetic databank until 1998, more than a decade later.

The different policies of repression implemented in Argentina and Chile can help explain part of this puzzle. The theft and illegal adoption of hundreds of children born to political prisoners during the dictatorship constitutes a distinguishing feature of Argentina's military government and shaped how families and human rights advocates looked to science and technology as a form of repair following Argentina's return to democracy.[59]

55. Cámara de Diputados, "Legislatura 354a. Sesión 90a., en jueves 19 de octubre de 2006," Diario de Sesiones, p. 107, in BCN.

56. Vanezis, "Report on Personal Identification."

57. Lindsay Adams Smith, "Identifying Democracy"; Banco Nacional de Datos Genéticos, *Una pregunta*.

58. Ana Maria Di Lonardo et al., "Human Genetics and Human Rights."

59. Smith, "Identifying Democracy"; see also Sarah Wagner, *To Know Where He Lies*, on DNA as a technology of repair in investigations of human rights crimes.

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Moreover, the grandparental testing developed for Argentine human rights work in the 1980s depended on the extraction of DNA from blood, not bone.

In Chile the application of science and technology in the domain of human rights work emerged not as a way to reunite living relatives but as a way to return the remains of deceased victims to their families. By the 1990s scientists outside of Chile had started to develop techniques to extract mitochondrial DNA from bone, including from bones that had been interred for decades, as was the case for Chilean human rights victims. Such techniques had begun to emerge by the time the Chileans started their identification work but had yet to become standard practice. The techniques were also expensive. Congressional records show that the SML paid the Glasgow lab £23,000 (approximately US$57,500 in 2017) for mitochondrial DNA testing for a maximum of twenty-five cases.[60] Moreover, Chile did not have the trained personnel or laboratory resources that such analyses require.

Additionally, in the early 1990s the shortcomings of craniofacial superimposition had not yet become clear. At the time it appeared to be an advanced technique that was improving with new technological developments. One way to see this is in the flurry of scientific activity in craniofacial superimposition by reputable forensic laboratories and research groups. Ubelaker notes that requests to the FBI for photographic superimposition peaked in 1990–94, with the last request in 1996. "These frequencies," he writes, "appear to reflect the availability of the necessary equipment and expertise in 1990, coupled with awareness of the value of this approach in the forensic science and law enforcement communities."[61] This equipment included the availability of computers, which had become fairly widespread by the 1990s. Ubelaker attributes the sharp decline in the technique's use to the increased awareness of its limitations and the availability of more precise molecular methods.[62] Other research groups, such as the laboratory run by Vanezis in Glasgow, spent part of the 1990s developing new methods for facial recognition that integrated new technologies, such as video superimposition and a laser scanner to image the skull, and published these results in international conference proceedings and journals.[63] The Argentine Forensic Anthropology Team had also used superimposition to assist in the 1997 identification of the remains of Ernesto "Che" Guevara in Bolivia, although it seems worthwhile to note that the team used the technique to assist in matching one set of remains to one

60. For the conversion from British pounds in 1994 to U.S. dollars in 2017, see www.measuringworth.com. Figure for DNA testing comes from Cámara de Diputados, "Legislatura 354a Sesión 90a, en jueves 19 de octubre de 2006," Diario de Sesiones, p. 78, in BCN.

61. Ubelaker, "A History of Smithsonian-FBI Collaboration."

62. Ibid.

63. A. Shahrom et al., "Techniques in Facial Identification."

potential identity, not to draw conclusions about a universe of more than one hundred sets of remains and hundreds of potential victims.[64]

While the SML was behind in acquiring DNA capabilities for the identification of exhumed remains, it was not terribly far behind, considering the newness of the techniques and the rapidly changing state of the field. Moreover, it acquired a system for craniofacial superimposition that an internationally recognized forensic laboratory had used in its analyses. However, by placing this computer system in the larger context of the identification work, it becomes apparent that the acquisition of this technology gave the SML's existing practices and capabilities a modern sheen while also enhancing the scientific authority of the identification unit and its director, Patricia Hernández. Additionally, the system gave the SML the appearance of practicing cutting-edge forensic science to identify bones at a substantially smaller investment of time, money, and human resources than a DNA lab would require. Acquiring this computer system also allowed the SML to continue making identifications, despite its scientists' limited formal training in the identification of bones and the limitations of the data available for each case. I say this not to suggest that the SML had ulterior motives but rather to point out that the decisions the SML made about its scientific practices occurred within a larger context that desired identification and required SML scientists to make recommendations with a level of certainty that they found convincing enough to sign off on and also convince the judge. In practice, this meant that only the SML scientists had to be reasonably certain of the identifications they were recommending, because the work had not yet been subjected to an external review and the judge did not have scientific expertise in forensic identification. Yet even the scientists' judgments of certainty reflected the limitations of their expertise and of the scientific and technical resources made available to them.

Although the Chileans viewed the Glasgow work as deeply flawed, this did not deter them from doubling down on craniofacial superimposition and the computer system used in the Glasgow work. By 7 March 1995 the undersecretary of justice had begun the process of bringing Lan and his computer system to Chile.[65]

Yuwen Lan and the TLGA-213 System

Historically, those working in the field of craniofacial identification have come from diverse backgrounds. Some come from medical pathology or anthropology. Others have come from such technical fields as computer science. Yuwen Lan was a crime scene photographer who conducted his

64. EAAF, "Bolivia," 37.

65. Undersecretary of Justice Eduardo Jara Miranda to SML National Director Raúl Wünkhaus Ried, 7 March 1995, Ministerio de Justicia vol. 22656, in ANA.

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scientific work while working for the Chinese police. His connection to craniofacial superimposition came in 1980, when the Tieling Public Security Bureau charged Lan and his colleague Dongsheng Cai with identifying the bones of a murder victim who had been dismembered and thrown in a well.[66] When the police went to the well to extract the bones, they found 140 bone fragments, and could not determine whether any belonged to the murder victim. Inspired by Japanese research on craniofacial superimposition, Lan and Cai decided to develop their own system, including the parameters for using the system on the Chinese skull.[67] Lan continued his superimposition work at the Tieling Public Security Bureau, securing government grants and helping to solve identification cases. In 1982 Lan and Cai developed a "directional reflected skull-photo superimposition apparatus." Two years later, Lan became the director of the Craniofacial Identification Institute in China.[68]

The application of computer technology to the technique of craniofacial superimposition illustrates how some working in the field perceived the technique's limitations. In their book *Objectivity*, Lorraine Daston and Peter Galison argue that the history of objectivity and its different meanings over time can be studied through changing understandings of subjectivity and the dangers associated with it. This observation draws attention to a key point of concern for those working to align skulls and faces: the error invariably introduced by the human practitioner. Lan believed computer technology could solve this problem of subjectivity and "make more conclusive identifications" by using "painstaking comparison and analysis."[69] His system also included mechanisms to account for differences in the rotation and pitch of the skull and photograph, another significant source of error.

In 1989 Lan's institute created an initial version of an identification system known as TLGA-213, which he and his team would continue to improve. It consisted of an AST 486 microcomputer running under DOS; special software; an image-processing card and a multimedia card; a digital camera; a video synthesizer; and a stand and platform for adjusting the skull (fig. 4).[70] The system used the camera to digitize the photograph. Once the photograph was digitized, the user would use the software to draw calibration lines on the photo for calculating the rotation, pitch, and

66. Guangyou Shao, *Kulou buzai chenmo*. Jianfei Jia provided me with translations of sources in Chinese.

67. According to Shao, *Kulou buzai chenmo*, Cai read an article by the Japanese researcher Nakadate Kyūhei on "skull photo superimposition."

68. Shao, *Kulou buzai chenmo*, 61.

69. Yuwen Lan, "Development and Current Status."

70. "Identificación craneana: Método computacional por sobreposición de imágenes sistema TLGA-213," Manual de Utilización Institute Tieling 213 Provincia de Laoning, n.d., 22º Juzgado del Crimen de Santiago, Rol de la causa: 4.449–AF, inhumación ilegal, Tomo V, pp. 2324–43, in PDH.

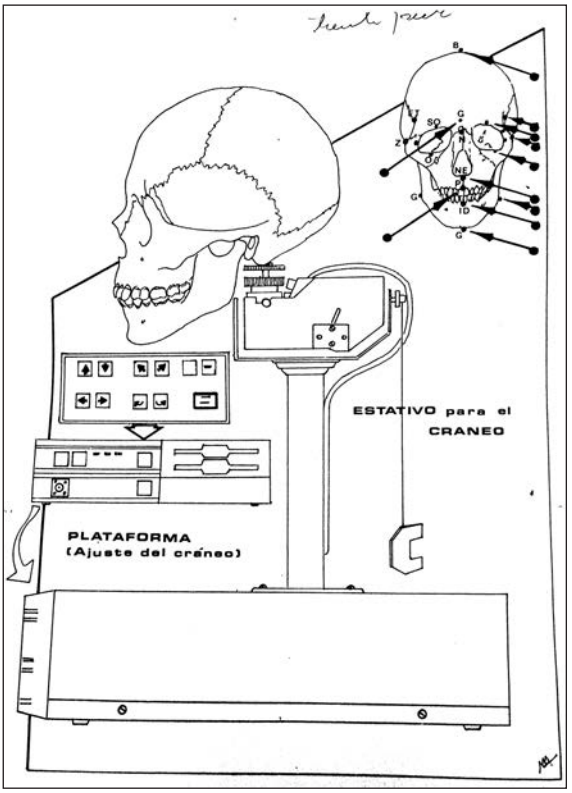

FIG. 4 Page from the TLGA-213 manual translated into Spanish for use by the SML. This image shows the platform the scientists used to position the skull to match the angle of the face in the photograph. (Source: 22º Juzgado del Crimen de Santiago, Rol de la causa: 4.449–AF, inhumación ilegal. Public document.)

size. The user would save this image to a disk, then adjust the stand and camera to capture an image of the skull at the same orientation. Calibration lines would determine whether the rotation angle and pitch aligned with the photo (they could not be different by more than three degrees). The user then responded to prompts to enter the measurements from the photo and skull one at a time. The system also asked the user to verify whether the contours of the cranium aligned with those in the photo. The software then analyzed the data it had been given and printed the results of the analysis. The TLGA-213 system measured fifty-two points for frontal images and thirty points for profiles, a substantial advance over the fifteen points the SML used to make its comparisons in 1992.[71]

Lan traveled to Chile in November 1995, a month after the Chileans

71. Lan, "Development and Current Status," 133.

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received the disappointing DNA results and the sixteen identifications from González that they would discount. He arrived with a translator and trained Hernández and others at the SML to use his system, which the SML had purchased by then. Such connections highlight the transnational dimensions of human rights work in the area of science and technology and contribute to the growing body of literature that documents the multidirectional flows of scientific and technological knowledge, including those flows that break the paradigm of North-South exchange.

The results the SML obtained from Lan's TLGA-213 system appeared in the 1998 documentary *Fernando ha vuelto*. The Chinese system generated the images that showed the teeth of the skull in seemingly perfect alignment with the teeth in Olivares's photograph. This visual, easy-to-comprehend, and seemingly objective evidence of identity made Agave Díaz "absolutely convinced" the remains belonged to her husband. Indeed, the technology seemed to bring her expert recollections of her husband's visage into alignment with the expertise of the scientists and their analysis of the bones.

The report generated by the SML about Olivares expressed a similar level of confidence. "In this case," it reads, "we made the comparison with: a frontal photograph, a semifrontal, and a profile, and one of the lower third of the face, and in all of them the correspondence was absolute, that is, 100%."[72] This visual evidence, combined with forensic analysis of the teeth and bones, led four forensic experts at the SML and the judge handling the case to conclude that the bones did indeed belong to Olivares.[73] The claim of 100 percent correspondence echoed the conclusions previously drawn from the low-tech superimposition practices at the SML, where Hernández had placed the image of the skull over a photograph and checked the alignment of fifteen points. The superimposition technique had become more sophisticated, but the way that Hernández conveyed her certainty in the results remained unchanged.

What did change, however, was the documentation. Using the Chinese system allowed the SML to generate longer reports with pages of photographic evidence and to make decisions that were grounded in part on the automated processes of a machine. This in turn gave the expert greater authority in her interpretation of the bones. The SML also submitted the manual from the system for inclusion in the official court records, further creating a sense of technical authority. The quality of the composite image

72. Patricia Hernández, "Informe de video superposición cráneo facial," n.d., 22º Juzgado del Crimen de Santiago, Rol de la causa: 4.449–AF, inhumación ilegal, Tomo Vc, p. 2277, in PDH.

73. Isabel Reveco, Luis Ciocca, Jaime Mery, and Patricia Hernández, "Conclusión final protocolo 3018/91," n.d., 22o Juzgado del Crimen de Santiago, Rol de la causa: 4.449–AF, inhumación ilegal, Tomo Vc, p. 2320; Andrés Contreras Cortes, 17 April 1998, 22º Juzgado del Crimen de Santiago, Rol de la causa: 4.449–AF, inhumación ilegal, Tomo Vc, pp. 2321–23, both in PDH.

also changed. Instead of the ghostly superimposition image of the early 1990s that showed the viewer limited features of the photograph through the image of the radiograph, by the end of the 1990s the scientists had a way to wipe one image into the other. This visual representation permitted the scientist to peel back the photograph to reveal the skull underneath. Indeed, the images generated by the TLGA-213 system were both accessible and inaccessible—accessible because they visually placed the photograph in relation to the skull and invited comparison, and inaccessible because untrained observers must defer to the expert to interpret the validity of the points and lines drawn on the image and how these representations lead to a positive match.

For family members such as Díaz, the images the scientists showed using Lan's system, and the accompanying analysis of the bones they offered, became a kind of truth that not only convinced her but also offered her a form of closure after decades of uncertainty. "Imagine my desire for wanting [Olivares's identification] to be so," Díaz said in a 2014 interview. "I felt that because they [the SML] had given very few bodies [to the families], I felt that it was a prize."[74] In the Olivares case, the desire to identify thus amplified the credibility of the computer-generated images and the truth they seemed to convey.

Conclusion: Decentering the Computer in Computer History

The TLGA-213 system illuminates the scientific practices, challenges, and claims of expertise within the SML and their connection to the negotiations among political elites, the military, and members of the human rights community, including affected families, about how the nation should address the violence of the past. The SML's decision to acquire and use a computer system for craniofacial superimposition emerged in a period in which the military still had substantial institutional power and the center-left Concertación governments viewed the issue of human rights within a framework of truth and justice "to the extent possible," or as an issue to resolve so that the country could move forward. In practice this meant focusing state efforts on naming the victims of the most heinous human rights abuses, execution and disappearance, and not focusing on the perpetrators or holding them accountable. Locating the remains of victims of enforced disappearance emerged as a way to address the suffering of families and provide closure.

Identifying remains posed a substantial challenge to the scientists involved in the work, especially given the large number of remains (126 sets total) exhumed from the Patio 29 site, many from anonymous graves. In addition, most of the remains belonged to men of similar age and height

74. Díaz interview.

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who died under similar circumstances, making the remains even more difficult to individualize. Cemetery, morgue, and other records from the era contained missing, incomplete, or erroneous information, the extent of which the scientists uncovered as they were working.

At the same time the scientists were working in a space that had come into being because of the government's desire to address—and, for some, finish with—the human rights issue, its linking of truth to location and identification of remains, and its recognition that both were essential to this feasible, albeit narrow, path toward reconciliation and the ability of the nation to move forward. Identification represented scientific closure, but it also offered emotional closure to the families and the possibility of moral closure to the nation. Given these stakes, the scientists worked to identify and did so using the resources available to them. They pursued the work even though they did not have the proper training. This lack of training resulted in conclusions that overstated confidence in the work, such as claims of 100 percent alignment when forensic science is known to be probabilistic. They pushed to continue the work even as they became increasingly aware of the insurmountable uncertainty within the data they had at their disposal, which included a universe of victims that would continue to expand. They worked to identify even as the frontier of science in the area of forensic identification was undergoing a seismic shift. When the SML scientists realized they had hit a wall, they looked to technology for a solution, in particular to a technology that would enhance the expertise that the forensic identification unit already possessed (Hernández) and that was being used by another member of the SML (González) as part of her doctoral research.

The acquisition of the TLGA-213 system and its use thus embody this larger history and facilitate its study. They show how Chileans working in different spheres tried to bring certainty to historical events that were defined by their uncertainty. In the process we gain greater understanding of how material, political, and bureaucratic constraints shaped scientific practices and the creation of legal truths. We also see how desire and faith can counter skepticism in the domain of forensic science and result in erroneous conclusions by justice system operatives who were investigating the facts of the Patio 29 case.

The history of this computer system also illustrates why the history of science and technology matters to the history of the Chilean democratic transition. The images provided by the TLGA-213 system bolstered the public credibility of the SML and provided a way for it to make identifications in cases that previous methods could not resolve. For example, a picture of Hernández using the TLGA-213 system to identify Olivares appeared in the Chilean magazine *Hoy* as part of a 1998 article about the identification work, its significance, and the capabilities of the identifica-

tion unit.[75] Moreover, the system's visual representations made family members such as Díaz "absolutely convinced" the remains given to her were those of her husband, and the images persuaded the judge to make these new identifications official. However, the legacy of this computer system is not how it allowed the SML to advance the reconciliation process. Rather, this history is a cautionary tale about what can happen when we place too much faith in the certainties that computer systems seem to offer or view the use of these machines as a sign of expertise. Indeed, the system allowed the SML to continue making identifications without the benefit of more accurate DNA results and to use identification techniques, including craniofacial superimposition, in ways that were deeply flawed.

In 2002 the public learned of the 1995 Glasgow report and the three identifications that contradicted those of the SML. The ensuing scandal prompted the SML to commission a review, by Spanish scientists at the University of Granada, of the SML's scientific practices for identifying victims of enforced disappearance. The SML had already established a positive working relationship with the university in forensic genetics—the Spanish university had signed an agreement in 2001 to provide technical assistance to the SML in human rights cases, especially in the area of genetics—and the Spanish scientists were already familiar with SML practices.[76]

The resulting report, which came to be known as "the Granada report," was highly critical of SML practices, especially in the area of forensic anthropology. It drew attention to poor record keeping, superimposition work that did not conform to best practices because it used low-resolution photographs and skulls deformed by projectiles, and bone measurements that lacked the rigor of international standards. Part of the problem, the report observed, was that the SML scientists did not have the proper tools for taking the most basic bone measurements, including tools for properly measuring the length of long bones. "If you do not know the techniques [of forensic anthropology] and you do not have the material to take measurements, little or nothing can be done," the Granada report noted.[77] That the SML team lacked the basic tools for measuring bones according to international standards, yet had acquired a little-known computer system for superimposition, demonstrates the degree to which the SML had been out of step with international norms in forensic anthropology. Rather than illustrating the SML's modern scientific practices, the computer system came to represent the lack of scientific expertise within the team and raised doubts about the accuracy of the work overall. The overall report suggested that while the Chilean government had devoted resources to the identifi-

75. "La búsqueda de la identidad," 25.

76. Loreto Flores, "Chile y España firmaron convenio."

77. Miguel Botella, "Informe acerca del análisis." Document obtained from the Servicio Médico Legal by means of a transparency law request.

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cation work, they were insufficient for doing the work with the necessary level of rigor and accuracy.

In July 2003 the Patio 29 investigation passed to Judge Sergio Muñoz, who decided to recheck the Patio 29 identifications independently. As Muñoz conducted his investigation, new challenges to the accuracy of the Patio 29 identifications arose. For example, DNA tests carried out in relation to a different human rights case definitively revealed the misidentification of a set of remains from Patio 29.[78] In 2005 Muñoz ordered DNA testing for the previously identified Patio 29 victims; this required the exhumation of remains that in some cases had been reinterred for more than a decade.[79] When Muñoz was reassigned to the Supreme Court in 2006, the Patio 29 case passed to Judge Carlos Gajardo. He met with the families that April to share the results of the genetic tests: of the ninety-six sets of Patio 29 remains the SML had thus far identified, eighty-five were problematic—forty-eight sets had been misidentified, and there were doubts about thirty-seven more.[80] All three identifications the scientists had made using Lan's system were incorrect, including the identification of Fernando Olivares that had been featured in the documentary film. The effect on the families was devastating. "I cannot explain how the world went and fell on me," Díaz said, describing her response to the news.[81]

Although most of the misidentifications were made before Chile had the TLGA-213 computer system, the use of the computer arguably represents an important point of transition, from identifications based on more traditional techniques to the SML's attempts to modernize its practices through the acquisition of new technological capabilities. It also illustrates how the Chilean identification work was simultaneously transnational, in the sense that its scientists sought the assistance of forensic researchers in Scotland and China, and insular, in the sense that they did not commission an outside audit of the work until 2002 (and then only after a public scandal). The transnational nature of the work shows that the Chileans were not alone in valuing the superimposition technique and the use of the TLGA-213 system. The group's insularity allowed it to use techniques in ways that strayed from best practices and increased the likelihood of error. This insularity also encouraged the group to defend itself when doubts were raised about the accuracy of the work early on. For example, when two Chilean anthropologists raised doubts about identifications the SML had made in 1994, the SML responded that the critics had incomplete information about the cases.[82] The SML gave the same response when challenged later about the conflicting identifications in the Glasgow report.

78. David Muñoz, "Viví diez años creyendo."
79. Bustamante and Ruderer, *Patio 29*, 10.
80. Ibid.
81. Díaz interview.
82. Comisión de Derechos Humanos, "Informe de la Comisión de Derechos Humanos," 143.

This article has shown how the adoption and use of a computer system contributed to the creation of truth claims in the context of human rights work in Chile, but it has told this history without losing sight of the broader scientific and political context and how such truth claims can help as well as harm. As such, this computer history also has important lessons for not only how we understand the history of truth and reconciliation in Chile, but also for how we regard the use of computer systems more broadly in the context of human rights work and judicial decision making. It reminds us that computers, and the representations they create, can seem to bring certainty about what happened in the past, but that these representations also have the power to torque lives and historical processes.

Bibliography

Archival and Oral Sources

Archivo Nacional de la Administración, Santiago (ANA)
Biblioteca del Congreso Nacional de Chile, Santiago (BCN)
Contreras, Héctor. Interview with the author, 11 December 2015, Santiago.
Díaz, Agave. Interview with the author, 18 December 2014, Santiago.
Personal archive of Isabel Reveco (IR)
Programa de Derechos Humanos, Ministerio de Justicia, Santiago (PDH)

Published Sources

Abbate, Janet. *Inventing the Internet*. Cambridge, MA: MIT Press, 2000.

Aguerre, Carolina. "The Internet in Argentina and Brazil: The Origins of Networking Experiences." *Information & Culture* 52, no. 2 (2017): 264–94.

Akera, Atsushi. *Calculating a Natural World: Scientists, Engineers, and Computers During the Rise of U.S. Cold War Research*. Cambridge, MA: MIT Press, 2007.

Alvarez, Juan, and Claudio Gutierrez. "History of Computing in Chile, 1961–1982: Early Years, Consolidation, and Expansion." *IEEE Annals of the History of Computing* 34, no. 3 (2012): 22–33.

Aylwin Azocar, Patricio. "En ceremonia de conmemoración de los 42 años de la Declaración de Derechos Humanos y el 12º aniversario de la Comisión Chilena de Derechos Humanos, 10 Diciembre 1990." In *La transición chilena: Discursos escogidos, Marzo 1990–1992*. Santiago: Editorial Andres Bello, 1992.

Banco Nacional de Datos Genéticos. *Una pregunta. 30 años. Memoria escrita del Banco Nacional de Datos Genéticos*. Buenos Aires: Ministerio de Ciencia, Tecnología e Innovación Productiva, 2017.

Bonnefoy, Pascale, and John Dinges. "Ejecuciones en Chile septiembre–diciembre 1973: El circuito burocrático de la muerte." *ArchivosChile*, 11 January 2012. http://archivoschile.org/2012/01/ejecuciones-chile-septiembre-diciembre-1973/ (accessed 16 August 2017).

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Botella, Miguel. "Informe acerca del análisis de una muestra de protocolos de la unidad de identificación del servicio médico legal. Valoración de los estudios antropológico-forenses." Anexo II of the Acta de entrega de informes periciales of the Grupo Internacional de Expertos en Identificación Humana (Granada Report), 31 October 2002.

Browne, Malcolm. "Computers Help Chilean Dead Tell Their Tales." *New York Times*, 14 January 1992, C1.

Bustamante, Javiera, and Stephan Ruderer. *Patio 29: Tras la cruz de fierro*. Santiago: Ocho Libros, 2008.

Cáceres, Iván, GAF archaeologist. E-mail to author, 11 April 2016.

Caiozzi, Silvio, dir. *Fernando ha vuelto*. Andrea Films. 1998.

Ceruzzi, Paul. *A History of Modern Computing*. Cambridge, MA: MIT Press, 1998.

Collins, Cath. "Human Rights Trials in Chile During and After the 'Pinochet Years.'" *International Journal of Transitional Justice* 4, no. 1 (March 2010): 67–86.

Comisión de Derechos Humanos, Nacionalidad y Ciudadanía. Informe de la Comisión de Derechos Humanos, Nacionalidad y Ciudadanía acerca de las eventuales irregularidades cometidas en el servicio médico legal, las que condujeron a la errónea identificación de los cuerpos humanos hallados en el "Patio 29" del Cementerio General de la cuidad de Santiago. Santiago: Comisión de Derechos Humanos, Nacionalidad y Ciudadanía, 2006.

Coopmans, Catelijne, Janet Vertesi, Michael Lynch, and Steve Woolgar. *Representation in Scientific Practice Revisited*. Cambridge, MA: MIT Press, 2014.

Daston, Lorraine J., and Peter Galison. *Objectivity*. Cambridge, MA: MIT Press, 2007.

Díaz, Elvira, dir. *El patio*. Cosmographe Productions, 2016.

Di Lonardo, Ana Maria, Pierre Darlu, Max Baur, Cristián Orrego, and Mary-Claire King. "Human Genetics and Human Rights: Identifying the Families of Kidnapped Children." *American Journal of Forensic Medicine and Pathology* 5, no. 4 (December 1984): 339–47.

Dinges, John. *The Condor Years: How Pinochet and His Allies Brought Terrorism to Three Continents*. New York: New Press, 2004.

Duden, Barbara. *Disembodying Women: Perspectives on Pregnancy and the Unborn*. Cambridge, MA: Harvard University Press, 1993.

EAAF. "Bolivia." *1996–1997 Biannual Report*. http://eaaf.typepad.com/pdf/1996_1997/03Bolivia96_97.pdf (accessed 7 May 2017).

Eckert, William G., and Wilmes R. G. Teixeira. "The Identification of Josef Mengele: A Triumph of International Cooperation." *American Journal of Forensic Medicine and Pathology* 6, no. 3 (September 1985): 188–91.

Edwards, Paul. *A Vast Machine: Computer Models, Climate Data, and the Politics of Global Warming*. Cambridge, MA: MIT Press, 2010.

_____. *The Closed World: Computers and the Politics of Discourse in Cold War America*. Cambridge, MA: MIT Press, 1997.

Ellman, Ira Mark, and David H. Kaye. "Probabilities and Proof: Can HLA and Blood Group Testing Prove Paternity?" *New York University Law Review* 54 (1979): 1131–62.

Ensalaco, Mark. *Chile Under Pinochet: Recovering the Truth*. Philadelphia: University of Pennsylvania, 2000.

Ensmenger, Nathan. "'Beards, Sandals, and Other Signs of Rugged Individualism': Masculine Culture within the Computing Professions." *Osiris* 30, no. 1 (2015): 38–65.

Flores, Loreto. "Chile y España firmaron convenio para acelerar identificación de desaparecidos." *EMOL*, 8 May 2001. www.emol.com/noticias/todas/2001/05/08/54257/chile-y-espana-firmaron-convenio-para-acelerar-identificacion-de-desaparecidos.html (accessed 26 July 2017).

Glaister, John, and James Couper Brash. *Medico-legal Aspects of the Ruxton Case*. Edinburgh: E. & S. Livingstone, 1937.

Hu, Tung-Hui. *A Prehistory of the Cloud*. Cambridge, MA: MIT Press, 2015.

Instituto de Investigación en Ciencias Sociales. "Cifras de víctimas y sobrevivientes de violaciones masivas a los ddhh oficialmente reconocidas por el Estado chileno." Observatorio de DD.HH. Universidad Diego Portales, August 2013. www.icso.cl/wp-content/uploads/2013/09/Cifras-valech_AGOSTO-2013.pdf (accessed 24 May 2018).

Joyce, Christopher, and Eric Stover. *Witnesses from the Grave: The Stories Bones Tell*. New York: Ballantine Books, 1992.

Keenan, Thomas, and Eyal Weizman. *Mengele's Skull: The Advent of Forensic Aesthetics*. Berlin: Sternberg, 2012.

Kevles, Bettyann. *Naked to the Bone: Medical Imaging in the Twentieth Century*. New York: Basic Books, 1996.

"La búsqueda de la identidad." *Revista Hoy*, 12 October 1998, 24–25.

Lan, Yuwen. "Development and Current Status of Skull-image Superimposition –Methodology and Instrumentation." *Forensic Science Review*, no. 4 (1992): 125–36.

Larraín, Esteban, dir. *Patio 29: Historias de silencio*. Piranha Films. 1998.

Law, John. *Aircraft Stories: Decentering the Object in Technoscience*. Durham, NC: Duke University Press, 2002.

Light, Jennifer. *From Warfare to Welfare: Defense Intellectuals and Urban Problems in Cold War America*. Baltimore: Johns Hopkins University Press, 2003.

Mall, Franklin P. "Wilhelm His: His Relation to Institutions of Learning." *American Journal of Anatomy* 4, no. 2 (1905): 139–61.

Massey, Doreen, Ash Amin, and Nigel Thrift. *Decentering the Nation: A Radical Approach to Regional Inequality*. London: Catalyst, 2003.

Medina, Eden. "Big Blue in the Bottomless Pit: The Early Years of IBM Chile." *IEEE Annals of the History of Computing* 30, no. 4 (2008): 26–41.

_____. *Cybernetic Revolutionaries: Technology and Politics in Allende's Chile*. Cambridge, MA: MIT Press, 2011.

Mindell, David. *Digital Apollo: Human and Machine in Spaceflight*. Cambridge, MA: MIT Press, 2011.

Mnookin, Jennifer L. "Image of Truth: Photographic Evidence and the Power of Analogy." *Yale Journal of Law and the Humanities* 10, no. 1 (1998): 1–74.

Muñoz, David. "Viví diez años creyendo que había sepultado a mi marido." *El Mercurio*, 20 March 2005. http://diario.elmercurio.com/detalle/index.asp?id=7aa6c04f-dc78-4f61-ab71-0374b09f99ac (accessed 27 July 2017).

Nappi, Carla. "The Global and Beyond: Adventures in Local Historiographies of Science." *Isis* 104, no. 1 (March 2013): 102–10.

Narayan, Uma, and Sandra Harding. *Decentering the Center: Philosophy for a Multicultural, Postcolonial, and Feminist World*. Bloomington: Indiana University Press, 2000.

Peters, Ben. *How Not to Network a Nation: The Uneasy History of the Soviet Internet*. Cambridge, MA: MIT Press, 2016.

Radin, Joanna. "'Digital Natives': How Medical and Indigenous Histories Matter for Big Data." *Osiris* 32, no. 1 (2017): 43–64.

Rosenblatt, Adam. *Digging for the Disappeared: Forensic Science After Atrocity*. Stanford, CA: Stanford University Press 2015.

Shahrom, A. W., P. Vanezis, R. C. Chapman, A. Gonzales, C. Blenkinsop, and M. L. Rossi. "Techniques in Facial Identification: Computer-Aided Facial Reconstruction Using a Laser Scanner and Video Superimposition." *International Journal of Legal Medicine* 108 (1996): 194–200.

Shao, Guangyou. *Kulou buzai chenmo: Zhongguo lumian jianding dashi Lan Yuwen chuanqi*. Beijing: Qunzhong chubanshe, 2004.

Sharma, Dinesh C. *The Outsourcer: The Story of India's IT Revolution*. Cambridge, MA: MIT Press, 2015.

Smith, Lindsay Adams. "Identifying Democracy: Citizenship, DNA, and Identity in Postdictatorship Argentina." *Science, Technology & Human Values* 41, no. 6 (July 2016): 1037–62.

Stern, Steve J. *Reckoning with Pinochet: The Memory Question in Democratic Chile, 1989–2006*. Durham, NC: Duke University Press, 2010.

Torres, Verónica. "Patio 29: La doble tragedia de las familias obligadas a devolver sus muertos." *CIPER Chile*, 2011. ciperchile.cl/2011/08/03/patio-29-la-doble-tragedia-de-lasfamilias-obligadas-a-devolver-sus-muertos/.

Turner, Fred. *From Counterculture to Cyberculture: Stewart Brand, the Whole Earth Network, and the Rise of Digital Utopianism*. Chicago: University of Chicago Press, 2006.

Ubelaker, Douglas H. "A History of Smithsonian-FBI Collaboration in Forensic Anthropology, Especially in Regard to Facial Imagery."

Forensic Science Communications 2, no. 4 (October 2000). www2.fbi.gov/hq/lab/fsc/backissu/oct2000/ubelaker.htm.

_____. "Craniofacial Superimposition: Historical Review and Current Issues." *Journal of Forensic Sciences* 60, no. 6 (November 2015): 1412–19.

U.S. Department of State. "Chile Human Rights Practices, 1995." March 1996. U.S. Department of State Electronic Archives 1990–1997. http://dosfan.lib.uic.edu/ERC/democracy/1995_hrp_report/95hrp_report_ara/Chile.html (accessed 21 May 2018).

Van der Vleuten, Erik. "Toward a Transnational History of Technology: Meaning, Promises, Pitfalls." *Technology and Culture* 49, no. 4 (October 2008): 974–94.

Vanezis, Peter. "DNA Analysis of Bone Samples from Patio 29." 23 July 1996, University of Glasgow.

_____. "Report on Personal Identification of Human Remains from Patio 29, Santiago, Chile." 23 October 1995, University of Glasgow.

Vertesi, Janet. "Drawing as: Distinctions and Disambiguation in Digital Images of Mars." In *Representation in Scientific Practice Revisited*, edited by Catelijne Coopmans, Janet Vertesi, Michael Lynch, and Steve Woolgar, 15–36. Cambridge, MA: MIT Press, 2014.

Wach, Annie Kutscher. "Una luz de esperanza." *Ercilla*, 19 February 2001, 24–5.

Wagner, Sarah. *To Know Where He Lies: DNA Technology and the Search for Srebrenica's Missing*. Berkeley: University of California Press, 2008.

Wyndham, Marivic, and Peter Read. "From State Terrorism to State Errorism: Post-Pinochet Chile's Long Search for Truth and Justice." *Public Historian* 32, no. 1 (February 2010): 31–44.

_____. *Narrow but Endlessly Deep: The Struggle for Memorialisation in Chile since the Transition to Democracy*. Acton, AU: ANU Press, 2016.

Zemon Davis, Natalie. "Decentering History: Local Stories and Cultural Crossings in a Global World." *History and Theory* 50, no. 2 (May 2011): 188–202.