Counting Things and People: The Practices and Politics of Counting

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Many scientific and nonscientific activities involve practices of counting. *Counting is, perhaps, the most elementary of numerical practices: an ability to count is presupposed in arithmetic and other branches of mathematics, and counting also is part of innumerable everyday and specialized activities. Though it is a simple practice when considered abstractly, in specific cases counting can be quite complicated, contentious, and socially consequential. Categorical judgments determine* what counts as *an eligible case, instance, or datum, and these judgments can be difficult and controversial. By focusing on such difficulties, this article aims to elucidate practices that are crucial for the production and stabilization of natural and social orders. Cases discussed in the article are provisionally divided between counting* (nonhuman) *things and counting people. Cases of counting* things *include scientific practices of counting the number of human chromosomes and forensic procedures for counting matches in DNA profiles. Cases of counting people include estimates of crowd size and counts and recounts of election ballots. Counting people not only is a matter of including an object or person in a class or group, but also involves reciprocal performances in which the counted objects are complicit in, or resistive to, the social production of counts. Variable, and otherwise troubled and contested, instances of counting are used to elucidate the numeropolitics of counting: how assigning numbers to things is embedded in disciplined fields, systems of registration and surveillance, technological checks and verifications, and fragile networks of trust. Keywords: counting, numeropolitics, science, classification, estimation.*

> *But counting . . . is a technique that is employed daily in the most various operations of our lives. And that is why we learn to count as we do with endless practice, and merciless exactitude . . . "But is this counting only a use, then? Isn't there also some truth corresponding to this sequence?" . . . it can't be said of the series of natural numbers—that it is true, but that it is useful, and, above all, it is used.* (Ludwig Wittgenstein, *Remarks on the Foundations of Mathematics* [1978:I, 4])

Counting is ubiquitous in modern (and not-so-modern) life. Specialized variants of counting, estimation, and analysis attract technical attention in mathematics, accountancy, survey methodology, and many other fields, but the simple enumeration of objects rarely draws serious intellectual attention after being mastered in early childhood. When examined as a worldly practice, however, counting is often highly consequential, and often is a source of severe

Early versions of this article were presented at the American Sociological Association annual meeting (Atlanta, GA, August 17, 2003), the Society for Social Studies of Science annual meeting (Vancouver, November 2, 2006), and the Mind and Society meeting (University of Manchester, September 7, 2007). The authors are grateful for comments and criticisms from many people, especially Thomas Gieryn, Simon Schaffer, Christian Greiffenhagen, Suman Seth, and the editors and anonymous referees who reviewed the article for *Social Problems*. Thanks to the staff at the Montreal Children's Hospital cytogenetics laboratory, and to the director, Alessandra Duncan, for patiently describing their work. The National Science Foundation (grant #0432120) supported the cytogenetics portion of the research. Research that informed the section on DNA profiling was partly funded by grants from the National Science Foundation (Science and Technology Studies, No. 0115305) and the ESRC (R000235853). The authors thank Simon Cole and Ruth McNally, who contributed to those projects, and Steve Hilgartner and Carin Berkowitz for sharing information and insights for the section on the 2000 election. Direct correspondence to: Aryn Martin, Department of Sociology, York University, 4700 Keele St., Toronto, ON M3J 1P3, Canada. E-mail: aryn@yorku.ca.

***Social Problems*, Vol. 56, Issue 2, pp. 243–266, ISSN 0037-7791, electronic ISSN 1533-8533.**
DOI: 10.1525/sp.2009.56.2.243.

difficulty and political contention. This is especially obvious in cases of counting that are explicitly marked as political: surveys of national and world populations, estimates of wartime casualties, projections of at-risk populations, indices of the distribution of poverty and wealth, counts of "illegal aliens," and so forth. Counts and estimates of nonhuman things that are socially significant—endangered species populations, oil and natural gas reserves, global temperature trends—also are frequently bound up in controversy.

The treatment of counting in this article suggests that an ostensibly cognitive activity can be viewed as a family of variable practices in different domains of social and political activity. We use the term "numero-politics" as a reference to a broad range of disputes about particular counts, estimates, and measures. It is derived from the term "memoro-politics," coined by philosopher of science Ian Hacking (1995) to describe political and legal disputes over the evidential status of "recovered" memories of childhood abuse. Numero-politics covers methods of counting, as well as machinations associated with their instantiation. It is not limited to disputes about numbers, as it also concerns what the objects in question are being counted *for*. Numero-politics implicates the work of assigning numbers to things and performing elementary arithmetical operations, but such work is embedded in disciplined fields, systems of registration and surveillance, technological checks and verifications, and fragile networks of trust.

The perennial question *qui bono* applies to counting and the results of counting in diverse numero-political economies above and beyond those concerned with distributions of wealth and power. For example, debates in the U.S. Congress over a proposal to use sampling in the 2000 National Census brought into relief connections between methods of counting (or estimation), political-economic status, and geographic accessibility (Anderson and Fienberg 1999). The debate also exposed the fact that members of Congress were aware of such political-economic geographies, as their methodological arguments were transparent vehicles for party interests. Sampling, justified on grounds of accuracy and also fairness, would be more likely to represent individuals—presumed to be at the lower end of the socioeconomic spectrum—who lack stable residential addresses, and thus tend not to be counted in mailed or door-to-door surveys. Since congressional districts are established on the basis of census figures, enhancing the numbers of underrepresented residents would enhance the number of districts assigned to the (poorer, presumably Democratic-leaning) geographical regions in which such persons are concentrated.[1]

Counting is, or should be, of interest for social problems research, not only because it is connected with various social problems, but also because counting itself often constitutes a social problem: methods of counting often become caught up in the political and epistemic conflicts they are used to address. By making a topic of counting, we call attention to its problematic status not only as a means for knowing about the world, but also as an array of worldly practices deserving of sociological attention in its own right. In this article, we focus on a series of problematic cases in order to indicate some of the many ways that counting is embedded in the production of material and social fields; fields that afford object discrimination, categorical grouping, and enumeration. Our approach to counting emphasizes the relations between enumeration and classification, and thus it ties in with critical interests in how case-by-case "coding" generates social science data for quantitative analysis (Garfinkel 1967:18ff.). It also relates to sociological interests in how the administration of classifications, codes, and rankings produces, orders, and controls human multiplicities and individual fates (Foucault 1979; Goffman 1962).

Our article follows a science and technology studies tradition of using technical controversy as a source of insight into the construction of natural and social order (Bloor 1976;

1. The relations between counting and estimation are complex and, as the census example indicates, fraught. Much of what we say about numero-politics in this article applies to estimation no less than counting. For an illuminating treatment of the politics of counting associated with national and international policies toward the AIDS epidemic in India, see Mahajan (2008).

Collins 1985; Latour 1987) combined with an ethnomethodological orientation to practical trouble as "an aid to a sluggish imagination" that opens up taken-for-granted features of ordinary activity for detailed sociological analysis (Garfinkel 1962, 1967). At a more specific level, our discussion of controversial cases draws upon insights from ethnomethodological and ethnographic studies of ordinary mathematical and measurement practices (Churchill 1971; Lave 1988; Livingston 1986; 1987; Lynch 1991; Sacks 1988/89; Sudnow 1967), as well as social historical treatments of the history of mathematics and statistics (Gigerenzer et al. 1989; Hacking 1975; MacKenzie 1981; Porter 1995; Schaffer 1988), to examine how counting practices are bound up with the production of natural and social orders.

Counting-As: Enumeration as Classification

There are so many different occasions on which counting is done that it may seem that little of interest can be said about what they all have in common. It may seem obvious that counting involves a basic skill mastered at an early age, and thereafter relied upon as a reliable if uninteresting competency. Small children practice counting by drilling with numerals (1, 2, 3, 4, 5) and coordinating numbers with fingers, marbles, and many other things. With further mastery, they learn to manipulate numbers abstractly, and counting on fingers is suppressed, analogous to the way early readers are taught to read silently without moving their lips.

A common way to think about methods of counting is to distinguish between two components: a numerical operation and an empirical application. In an ostensibly simple case, such as counting yellow and red marbles arrayed on a table top, the numerical operation is expressed through the ability to assign specific numbers to the object domain—say, 25 yellow marbles and 35 red ones. The manufactured objects, with relatively uniform size, shape, and color are "docile" (Foucault 1979; Lynch 1985b) in the way they are readily disciplined to maintain stable arrangements that facilitate discrimination and categorical grouping, for example into sets of five red or yellow marbles arrayed in rows and columns. As long as the stable arrangement holds, the arithmetical operations involved in counting the marbles can seem separate from the work of recognizing, classifying, and arranging the things counted. Unlike Lewis Carroll's absurd croquet match played with hedgehogs as balls and flamingoes as mallets, the objects hold their places and maintain their identities for the duration of the counting game. However, even in the absence of struggle, we contend, counting is context-laden, often invisible, socially organized work. Even a straightforward case of counting marbles can be a source of contention, such as when children competitively tally results in a game: Which marbles count as "yours" or "mine"? Which marbles are within a boundary that allows them to count in a score? Often, a struggle is required to make recalcitrant objects docile enough to be counted.

How a count is produced depends very much on who is doing the counting, what the count is for, and the occupational and physical location of the counting event. When treated as a contextual performance, the situated work of counting is subject to practical, organizational, and political contingencies. For example, in his classic ethnography of death and dying, David Sudnow (1967) addresses the contextual specificity of counting deaths in hospital settings (pp. 36–42). He found that specific answers to the questions "how many deaths today?" or "how many deaths have you seen?" depended on the ward in which hospital personnel were working and the organizational relevance of a given count to the worker who presented it. Hospital personnel treated such numerical reports as marks of experience: giving a precise integer, usually under a half dozen, indicated that the worker was a novice, while a more casual remark such as "too many to count" indicated that the worker had been around for awhile and was no longer so fascinated with death. However, some death events, like a mother who dies in childbirth, remain remarkable and countable, even for more seasoned workers. For our purposes, Sudnow's account illuminates how members treat counts as expressions of competency within the political culture of an organization. As Margaret Lock (2002) describes in her ethnography of brain death and organ transplantation in Japan and the United States, surprising ambiguity also arises in the broader cultural politics of counting a specific patient as "a death."

The work of counting involves determination of *what counts as* a possible object in the field counted. Such determination often occurs at the very same time that a count is produced, contested, and reproduced. To count something is to make it *accountable* as a member in a class of relevant objects. In this sense of the word, "counting" is both a calculative operation in which numbers are used, and also a case-by-case determination of *what* to count and, correlatively, of what *counts as* something to be counted. Counting something *as* something is a condition for determining *membership* in the domain or field of things or persons counted. Counting as is akin to "seeing as" (Hanson 1961; Wittgenstein 1958; cf. Vertesi 2006, on "drawing as"). For example, seeing a "bit of scruff" on a radio-astronomy sky survey *as* evidence of a "pulsar" rather than *as* an electronic artifact implies that seeing is an *achievement* in a field of alternative epistemic categories (Garfinkel et al. 1981; Latour and Woolgar 1979; Pinch 1985). "Counting as" similarly is an epistemic achievement that involves categorical judgments. By making a topic of counting (an "epistopic" in Lynch's [1993] formulation), we aim to provide insight into how epistemological topics (e.g., categorical judgment, case-by-case reasoning) can be respecified as empirical sociological phenomena (Garfinkel 1991).

Like categories and standards, counts and counted objects acquire a taken-for-grantedness, after the fact, as though the resulting numbers were there all along (Bowker and Star 1999).[2] But the similarity runs deeper: to count is to classify as well as to enumerate. The phrase "counting as" both plays on a common way of talking and makes perspicuous the salience of classification in the context of producing numerical counts. Whether the work of categorical judgment (counting as) temporally precedes the work of counting (assigning a numerical value), or whether it is coincident with it, is an empirical question for resolution in particular cases. Counting produces object stability (if not permanence), as we shall see below.

There are, so to speak, countless examples from which we can choose, but for the sake of brevity we focus on four problematic cases, each of which distinctively exhibits the constitutive role of counting in the organization of nature and society. The four cases involve different objects: human chromosomes in twentieth-century cytology; matching alleles in DNA profiles; votes in a contested election; and persons in a protest rally. We shall also mention a number of other cases in passing. We distinguish the four cases into two instances each of counting *things* and counting *people*.

Both counting (nonhuman) things and counting people involve membership, but in cases of counting people, membership has distinctive significance as a social (voluntaristic) phenomenon that is only thinly described as inclusion in a class, category, or domain.[3] Counting things is performed by persons (often aided by technology) who use categories and numbers in conventional ways. Things may turn out to be sources of difficulty and resistance, but they are not themselves *agents* of counting—at least not obviously. They do not perform or assist with the work of counting, but are instead objects to be counted. Human bodies can be counted much in the manner of other objects, but counting persons often is performed through social

2. Bowker and Star (1999) treat classification as a ubiquitous practical activity that orders the world in some ways while precluding others. Using cases such as the International Classification of Diseases and race classification in South Africa during Apartheid, they show that classifications both require work and *do* work, acquiring a material force in the world, no matter how arbitrary or efficacious their origins may have been.

3. While we do not want to draw an essential distinction between membership in a social group and membership in a set of similar objects, we think there is relevance to Ryle's (1971) conceptual distinction between describing a "wink" and describing a "blink" (the original source of the idea of "thick description"). To give a "thin description" of a wink in terms of spatiotemporal movements of the eyelid would miss its categorical identity. Ryle does not mention this, but a physicalistic account is also likely to be inadequately "thin" for describing the interactional significance of a blink. The point is that the word's intelligibility implies different contextual descriptions.

interaction involving roll calls, self-report forms, voting, and other procedures requiring co-operation between counters and the objects being counted. Although it is conceivable that some animals can be trained like circus sea lions to sound-off or otherwise arrange themselves for the purpose of being counted by humans, typically such techniques are restricted to cases of humans counting humans (but see Eileen Crist's [2000] reinterpretation of the notorious case of Clever Hans, the horse whose alleged ability to count was debunked by Oscar Pfungst). We emphasize that this distinction is provisional. After examining some cases, we may find it necessary to discard, or at least complicate, the distinction.

Counting Things

Our first two cases involve counting *things*—entities that had already been established by name, and whose count-ability was associated with identifying marks and criteria. Both involve entities exposed by technical means and identified in prepared fields. The first is an historical controversy involving disputes about the number of human chromosomes, and the second is a more recent case of counting matching bands on displays of DNA profiles.

Counting Chromosomes

Chromosome counting first came to our attention because of a persistent "mis-count" of the number of chromosomes in normal human cells (Kottler 1974; Martin 2004). A brief historical sketch of this incident begins in the early part of the twentieth century. Cytologists produced human chromosome counts that diverged widely, and they debated whether or not the chromosome number was, in fact, a constant. In the early 1920s, zoologist T. S. Painter argued convincingly and repeatedly, primarily against a Belgian rival, Hans de Winiwarter, that the correct number was 48. After a number of independent confirmations, 48 became the textbook number for several decades. In 1952, Leo Sachs revisited the issue of the human chromosome count and reaffirmed the count of 48: "Application of the correct technique has given the correct chromosome number. Application of the correct theory has given the correct explanation" (Sachs 1952:357). In 1956, however, Joe Hin Tjio and Albert Levan published a short and persuasive article in the journal *Hereditas* alleging that 46 was the correct number of chromosomes in the nucleus of a normal human cell. The community of human chromosome counters re-established consensus around the new fact almost overnight.

This episode in the history of counting illuminates a number of practical aspects of counting relevant to our discussion here. Chromosomes are not docile objects. While many of us can imagine what a chromosome looks like from encounters with science education, genetic diagnostics, or popular iconography, that image is the result of a complicated and lengthy laboratory routine that aims to make chromosomes discrete, visible, and countable. The project of counting chromosomes requires disciplinary techniques preparatory to and during microscopy. These include obtaining tissues in which cells are dividing, arresting the chromosomes at the point of division, disentangling them from other cellular materials that may be mistaken for them, selectively staining the chromosomes, and squashing them flat so that they lie more or less in one plane. Without this preparatory and conventional manipulation, chromosomes could not be counted, and a chromosome count could not be a relevant fact about the human cell.

During microscopy, early counters used tricks to record the now-distinct (though often still overlapping) entities, which included projecting images onto paper and tracing the figures, or making sketches with one hand while the other hand operated the focus knob on the microscope. This counting activity was cited as a method for removing bias: "In making drawings of all diploid complexes the writer has followed the practice of completing the drawing before a count is made" (Painter 1924:440). However methods for visualizing chromosomes—and demonstrating counts in publications—provided a resource for rationalizing evidence that didn't appear to corroborate an expected count: "In figure 19 there are fifty elements, but since this figure is taken from two sections, the larger number is probably due to the cutting in two of some of the chromosomes. The chromosomes lying in the cut area are marked with an asterisk" (Painter 1924:440).

Techniques for counting co-evolved with the entities being counted and the entities were brought into being as ontologically distinct when they were rendered countable. Practitioners were constantly tinkering with tissues, techniques, stains, and fixation solutions in order to separate indistinct chromosomal material into distinct chromosomes *so that they could be counted*. Techniques and practices became conventional and entities were habitually maneuvered in similar ways from laboratory to laboratory. The very understanding of chromosomes as discrete entities, and theories about them as hereditary units, were constitutively tied to counting techniques that immobilized, separated, and enhanced them. Moreover, built into the skilled practices were resources for making the objects comply with expected counts, or "dis-counting" those that did not behave themselves.

While chromosome counting seems to be more politically benign than any of our other cases, the outcomes have been material to theorizing about the biology of race, a project intimately intertwined with early twentieth-century eugenics. Renowned fruit-fly geneticist Thomas H. Morgan (1914) wrote:

> It is with great interest I note in the last paragraph of Guyer's paper a hint (or is it intended as an announcement?) that the white man has more chromosomes than the negro . . . If the suggestion is established, some revision may be necessary concerning the Mendelian expectation for the inheritance of skin color in the black-white cross (p. 828).

Although he was not directly involved in human genetics, Morgan noted the chromosome counts in "man" because they fit into prevailing beliefs that racial differences are embedded in human biology. Morgan's comment about "the black-white cross" may gesture toward contemporaneous concerns about race-mixing, which Morgan's colleague Guyer referred to as "mongrelizing" (Kevles 1985). Hence, the context for counting influences the counts produced and whether or not they are considered adequate, correct, or material to broader theoretical and political debates. The answer to the question "what is this count for?" may be multiple: in addition to zoological classification and medical theorizing, counters in the early twentieth century were counting for race science.

Putting to rest the suggestion that different races and different sexes have different characteristic chromosome numbers was part of the context for Painter's aggressive campaign to settle the count at 48. When counting is meant to establish a determinate feature of nature (like a constant) or of society (like a vote), ambiguity is not long tolerated, and, in this case at least, attempts to reach closure around a particular count may be more intense than efforts to ensure that they get it "right." At the time, 48 was an adequate placeholder in catalogues of species counts. In the 1950s, however, chromosomes became more than a zoological concern. A new generation of practitioners—human cytogeneticists—were looking again at chromosomes to establish clinically relevant diagnoses of pathology. Painter's count was no longer adequate to the task at hand. The very possibility that some diseases, like cancer and genetic syndromes, were chromosomal in origin engendered new techniques for manipulating cells and for prefiguring the field to facilitate counting; the changes produced a new count (Martin 2004).

One such practice in the new medical genetics was karyotyping, which began in the early 1950s and has become the conventional way to represent and count chromosomes (see Figure 1). In a karyotype, chromosomes are lined up in pairs by length and identified by number, according to their unique characteristics (banding patterns when stained and location of the centromere, a constriction evident near the center or closer to one end on most of the chromosomes). This changes the counting game from the question "how many?" to the question "are all members accounted for?" An analogy would be counting the number of people in a

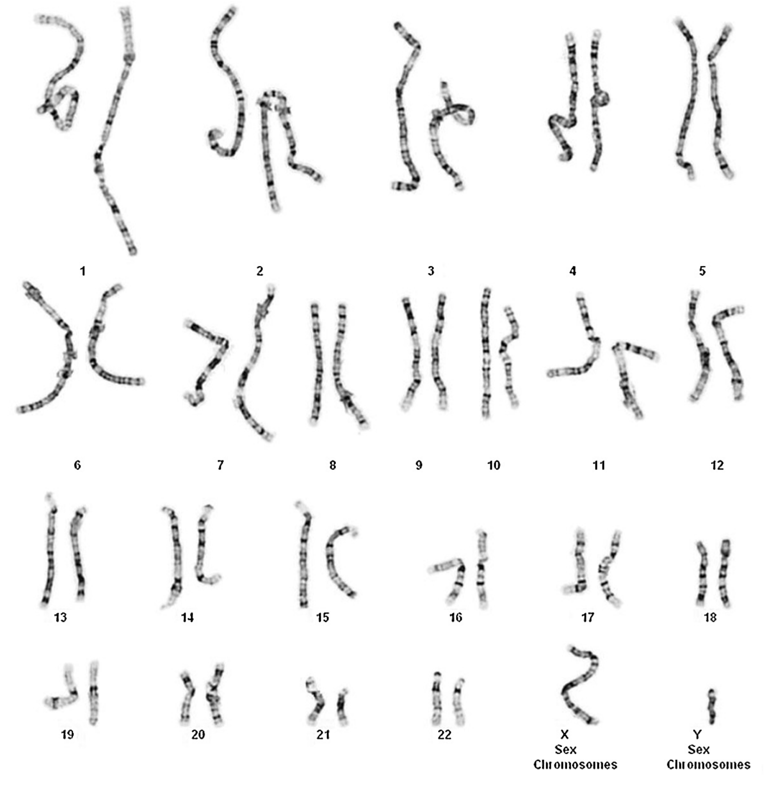


Photo courtesy of Alessandra M. V. Duncan, Montreal Children's Hospital.

Figure 1 • *Contemporary karyotype*

The preparation, staining, and computer-generated digital images make these chromosomes far more docile than the objects that 1920s cytologists would have been counting.

crowd versus taking attendance. In the first case—as in the chromosome counts produced in Painter's generation—each object is ontologically equivalent (except perhaps the X and Y chromosomes, which were subjects of much debate). In the second case—as in karyotyping—the identity and individuality of each member becomes salient. Both are practices of counting, however the latter produces an identity for particular chromosomes, and a name (in the form of a number). Karyotypes were conventionalized in the mid 1950s. In the early days of their use, microscope slides were photographed and developed (often in a laboratory dark room) and cytogeneticists or cytotechnicians would literally cut them out of their place in a metaphase spread (Figure 2) and tape them to a page upright and in the proper paired order, like so many soldiers standing at attention. More recently, the preparation of a karyotype is mostly done on a computer screen.

Assigning a number to a chromosome is a matter of skilled observation and practice. Computer programs make a "first pass" at organizing chromosomes in pairs, but technicians report that the computer has a very poor success rate. Consequently, technicians often bypass the automated karyotyping and instead use their computer mouse to click on a particular chromosome in a metaphase spread and drag it to its proper place in the lineup. Such

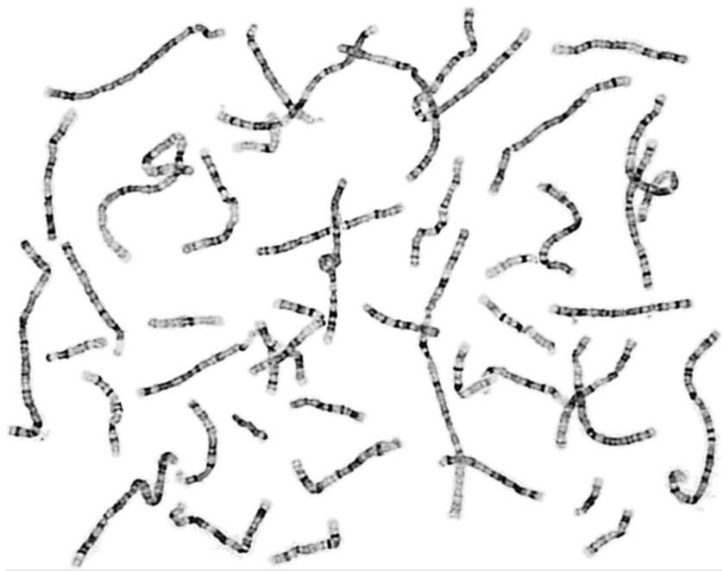


Photo courtesy of Alessandra M. V. Duncan, Montreal Children's Hospital.

Figure 2 • *Metaphase spread of an XY cell (from which the karyotype in Figure 1 was generated)*

seemingly mechanical actions involve normative judgments about which chromosomes belong together. For example, a technician in the process of analyzing chromosomes for prenatal diagnosis encountered a not uncommon phenomenon and called the ethnographer (AM) over to demonstrate. The tech was looking at a metaphase spread on the computer screen and pointed to what she called a "visitor." With her mouse she circled a long chromosome (chromosome 1) that was at the edge of a metaphase spread, but close enough that a novice would be likely to see it as part of the cell under analysis. She explained that this chromosome—the visitor—did not in fact belong to this cell and must be visiting from another cell. She proceeded to hit "delete" and the visitor disappeared from the screen, the cell, and the patient's record. When asked how she could tell that it wasn't just a third copy of chromosome 1 in this cell, she replied that the chromosome she identified as the visitor was slightly more blurry than the neighboring chromosomes and it was therefore probably in a different plane on the slide, and that you don't often see three copies of chromosome 1 anyway. In this case, she did not count the visitor as a relevant object despite its apparent placement within the field of countable objects.

Chromosomes do not have nicely defined boundaries and cytologists must decide what counts as a chromosome, and whether it belongs to "this cell" or to another. Most often practitioners make these judgments privately and while subtle discriminations are enacted on the objects to render them as members or not, the evidence of this work disappears when the result is simply "a count." Sometimes, such as when counts become controversial, images of chromosomes become work objects and discriminations are made communally. In either case, ambiguities in membership criteria make room for counts to conform to the expectation—whether the expected number is 48 or 46. While interpretive flexibility and theory-laden observation are common themes in science and technology studies, the presumed obviousness of counting objects imposes an additional demand that the result—a whole integer—be unambiguous.

Counting Matches

Much like the role of controversies in cytology, legal challenges can open up inquiries into the detailed techniques and machineries of counting. Counting has a key role in forensic science, both with fingerprinting (dactyloscopy—the familiar, Scotland Yard variety of dermal ridge analysis) and DNA profiling (commonly called DNA "fingerprinting"). In both, two items of evidence are commonly compared: a suspect (or victim) exemplar taken under controlled conditions, and a crime scene trace, mark, or sample.[4] Forensic analysis involves efforts to determine if the suspect (and/or victim) evidence *matches* the crime scene evidence.[5]

Determining a match often involves two orders of counting: one is a tally of corresponding details in the crime scene evidence and suspect (or victim) evidence, and the other is an overall judgment on whether or not to *count* the compared items as matching evidence. In between are judgments about which details count as part of the tally of relevant comparable features. When fingerprint examiners declare matches in evidence reports or trial testimony, they assert with unqualified certainty that the evidence uniquely identifies an individual. Such declarations are supported by the historical and legal status of fingerprints as unique identifiers, though lately the absolute certainty ascribed to examiners' judgments has been challenged (Mnookin 2001). No probability figures are included in fingerprint examiners' reports, unless one treats qualitative expressions of certainty as equivalent to a quantified "zero error rate" (for a criticism of such a claim, see Cole [2006]). However, in some jurisdictions examiners document their declarations by citing a threshold number of matching "points" (ridge details such as the whorls, bifurcations, and islands initially codified by Francis Galton). Counting points supports a categorical judgment—counting the evidence *as* a match—but a given number of points has no clear relation to a measured probability and for that reason it has fallen out of favor in recent years.

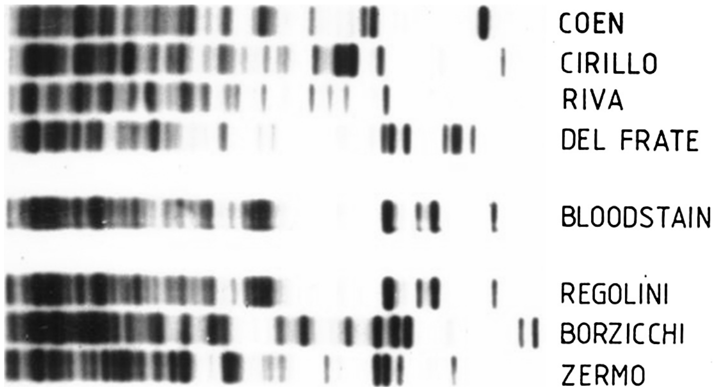
Unlike fingerprint match declarations, reports of DNA profile matches are accompanied by quantified probability estimates, even when the forensic examiner is virtually certain about the source. In recent cases, estimates as low as one in billions, trillions, or even septillions have been given for the probability of getting an adventitious match: a DNA profile match from someone other than the source of the criminal evidence. Such estimates are based upon a complicated, and occasionally contested, calculation involving estimates of the prevalence of specific DNA alleles in particular populations and "racial" subpopulations.[6] During the so-called "DNA wars" of the early 1990s, there was a prominent debate in the courts and science press about the statistical methods and population genetic assumptions used in forensic DNA profile analyses.[7] The issues were quite complicated, and we shall not go into them here (for

4. There are other variations: in a murder case, the victim's blood (or fingerprint) collected by a pathologist may be compared with blood stains (or fingerprints) found on the suspect's clothing or motor vehicle, or on a weapon, or stolen item traced to the suspect. Increasingly, as DNA evidence is compiled into criminal databases, suspects are identified by "cold hits" (Cole and Lynch 2006).

5. Both fingerprints and DNA profiles are frequently likened to signatures, but they often are held to be more credible than a signature (Cole 2001; Ginzburg 1990; Joseph 2001). A signature may be suspected of being faked or coerced, whereas a fingerprint is presumed to have been left behind despite any precautions to disguise identity. It is a sign "given off" rather than "given" (Goffman 1959), and like a slip of the tongue it may be taken as a more revealing sign than carefully managed communication. Currently, when forced to choose between a signed confession and a DNA "signature" that contradicts it, judges and juries almost invariably place their trust in the latter. But, as with many other things, an apparently unintentional trace lends itself to surreptitious intentions—if not by criminals, by the police who would entrap criminals with planted evidence.

6. Assumptions about associations between "racial" groups and genetic patterns entered into the statistical procedures, and they also arise in connection with arrest patterns that feed cases into DNA databases. For an argument about the connection between "race," genetics, DNA profiling, and racial profiling, see Ossario and Duster (2005).

7. Prominent criticisms were made by Lander (1989), Thompson and Ford (1991), Lewontin and Hartl (1991), Balding and Donnelly (1994), and Koehler (1996). For a sociological analysis of the statistical contentions and uncertainties, see Derksen (2000), and for a detailed historical analysis of the role of prominent scientists in court cases at that time see Aronson (2007).



Source: Orchid Cellmark Ltd., Abingdon, UK. Reproduced with permission.

Figure 3 • *Autoradiograph of "DNA fingerprints" using Multi-Locus Probe (MLP) technique*

Comparison between a crime bloodstain and seven suspect profiles. This MLP technique marked multiple polymorphic positions in the genome. The result is that each profile shows an indefinite number of bands, some of which occur more frequently throughout the human genome or overlap in size with others, thus showing up as darker and broader.

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elaboration, see Lynch et al. 2008). Instead, we shall briefly examine a more mundane practice that received far less public attention: counting matching details in comparisons of DNA profiles. For illustrative purposes, we refer to testimony from *Regina v. Deen*, a British appeal case in the early 1990s.[8] This was a case in which the earliest technique of "DNA fingerprinting" was used in the prosecution of a rape charge against the defendant, Andrew Deen. It is relatively rare that defense attorneys call expert witnesses to contest forensic evidence, but in the *R v. Deen* trial, the defense called several experts who contested the way the prosecution's experts presented forensic comparisons of the swab (semen) and suspect (blood) evidence. We were unable to obtain the visual evidence used in that case, but see Figure 3 for an illustration of the type of DNA profile (Multi-Locus Probe [MLP]) used in that case.

In the late 1980s and early '90s, forensic scientists used laboratory techniques that extracted DNA from bodily samples, and then used "chemical scissors" (restriction enzymes) to isolate selected strings of DNA base-pairs that were known to be highly variable in length in the human population. These fragments were run through an electrophoresis gel apparatus to separate and compare fragments of different lengths. In theory, when multiple samples were driven through a gel by means of an electrical current, a comparison of the patterns of bands documented by an autoradiograph would reveal whether different samples contained the same-sized fragments. If a complex pattern of bands matched (such as the "Bloodstain" and "Regolini" in Figure 3), the probability that the samples came from different sources was deemed to be extremely low. However, like the older form of fingerprinting, the matching evidence displays a complex, rather blurry pattern that is not easily converted to a discrete probability figure. Later techniques were developed to facilitate quantification and digitization, but for this early technique the Forensic Science Service used a simple method for quantifying the evidence. First, the analyst would count the number of matching bands between two samples within a given sector of the autoradiograph. Each match was assigned the same

8. *Regina v. Deen*, The Times (London) 10 January 1994 (C.A. 1993). The trial occurred in 1990, and the appeal was heard in 1993. We are grateful to Ruth McNally for furnishing a summary of the case.

probability figure (roughly .25, a figure supposedly based on empirical studies) and that figure would be multiplied by itself for each of the matching bands (.25 × .25 × .25 . . .). The result would then be reported as the random match probability: the probability that a profile from another person who was randomly selected from the relevant population would show the same pattern.[9]

Though often likened to a bar code, the pattern of bands in autoradiographs developed through early DNA profiling techniques did not show up as discrete and uniform lines.[10] As Figure 3 illustrates, some bands are fainter than others, and their outlines are variably blurred. A number of technical reasons are given for such variations, and some variations are expected to occur, even when different samples are known to come from the same person. However, variations between the apparent position and clarity of possibly matching bands in different samples can be crucial in criminal cases. A comparison of the "Rigolini" and "bloodstain" profiles in Figure 3 shows only slight and subtle differences that would be unlikely to raise doubts in a criminal trial. Even when such differences are more obvious, the proponent of the evidence can sometimes explain them away by citing different amounts of DNA in the samples (the amount and quality of DNA in crime samples is subject to less control), uneven composition of gel apparatus, and the degradation or contamination of one or another sample. The testimony of defense witnesses in the *Deen* case noted some striking differences between the profiles developed from Andrew Deen's blood sample and the semen stain recovered from examination of the victim, which were not so easy for the prosecution to dismiss.[11]

During the initial trial in 1990, one of the prosecution's expert witnesses, Mr. Davie, a forensic scientist working for the home office, declared ten matching bands on the autoradiograph. A defense witness (Professor Roberts) observed that there were two nonmatching bands that Davie had not counted among the ten matching bands in the region of the autoradiograph inspected. According to standard recommendations, nonmatching bands should result in a declaration that the defendant's blood did not match the crime stain. In this case, however, the prosecution experts declared a match, and *discounted* the apparent anomalies. After inspecting the evidence during an adjournment, Professor Roberts testified that one of the discrepancies could be explained as a result of an artifact of the preparation known as "excessive stringency."[12] The other anomalous band, according to Roberts, could not so easily be explained away, and he testified that the prosecution's experts should have concluded that the two profiles did not match.

It is commonplace (indeed, necessary) for experimenters to discount anomalous results by citing (sometimes unspecified) equipment malfunctions and laboratory errors (Collins 1985). Such auxiliary hypotheses can be used to ward off any conclusion that the results falsify the hypothesis being tested (Lakatos 1970). However, there are legal as well as epistemological rationales for being wary of explanations that discount apparent differences between suspect and crime scene profiles. As the defense argued in Deen's case, under the presumption of innocence it was prejudicial to the defendant to discount ambiguous and anomalous details that could possibly exonerate him. Nevertheless, despite the two anomalous bands, the judge accepted Mr. Davie's evidence (which was supported by the testimony of a second prosecution expert), and focused on the fact that ten bands matched, stating that the probability that

9. Calculation procedures are more complicated than this, as they take into account the possibility of homozygous alleles, and attempt in various ways to correct for nonrandom genetic distributions in particular populations. The same frequency was assigned to each matching band in the MLP technique, unlike later techniques that assigned different weights to specific loci based on frequencies found in empirical studies of relevant populations.

10. The currently used STR (Short Tandem Repeat) system is said to eliminate such ambiguity, by delivering exact measures of the molecular size.

11. For another illustration of striking differences in a comparison of DNA profiles, see the re-analysis of the evidence in an early U.S. case by molecular biologist Lander (1989).

12. This has to do with a phase of the procedure in which a membrane is laid on the gel apparatus in order to pick up the radioactive probe pattern in preparation for autoradiography. The membrane is rinsed to wash off excess probe material, but if the washing is excessively stringent, the traces left on the probe will be faint.

Deen was the man who left the crime stain was "pretty well to certainty." In its petition for an appeal, the defense charged the judge with confirmation bias and with misleading the jury about the incriminating weight of the forensic evidence, and the Court of Appeal agreed to hear the case.

During the appeal hearing in 1993, the DNA profile evidence was described in great detail, and even the justices got involved in the inspection of sensual qualities of bands.[13] At one point, during the testimony of a defense witness named Thomas Fedor, The Lord Chief Justice queried the witness about a particular autoradiograph in which a "greyish shadow" in the lane ("track") for the swab (semen sample) appeared to be aligned with a band in the suspect's blood sample ("the 6" is a reference to a number written along the margin of the autoradiograph, indicating one of the possible matches in question):[14]

The Lord Chief Justice: Opposite the 6 in each of these photographs that you get on the blood sample, you find on the swab not a sort of white/black but a sort of greyish shadow?

Fedor: Yes.

The Lord Chief Justice: In each of them, if you compare it with other parts of the track where there is nothing, it is just white. What causes the greyness if it is not a band that just has not gone up the autoradiograph?

Fedor: One of the things that may have caused the greyness in the swab area is some degradation perhaps of the specimen.

As noted earlier, bands are not discrete black-and-white data points, and in this case the witness refers to the datum, not as a discrete point, but as an "area" characterized by "greyness." The Lord Chief Justice asks Fedor why the "sort of grayish shadow" is not a faint indication of a matching band in the swab (semen) evidence corresponding to a more visible band in the blood (suspect) evidence, rather than evidence of absence (a blank or "white" area). Fedor responds by speculating how an artifact might have been generated from degraded material that became lodged at that particular site in the autoradiograph. He does not commit to saying that the feature was, in fact, an artifact, but suggests that it could be evidence of something other than a faintly represented band. Elsewhere in their testimony, Fedor and other defense witnesses offered two options for contending with such features: one was to declare the match inconclusive or even as nonmatching, thus supporting (or, at least, not contradicting) the defendant's claim to innocence; and the other was to assign probability values to possible causes of the anomalous features, which would complicate, and presumably weaken, the calculation of the probative value of the DNA evidence. The appeal court did not go so far as to treat the evidence as a mismatch, but instead ordered a retrial on the grounds that the prosecution and the judge had overstated the incriminating weight of the forensic evidence.[15] At the retrial, Deen was found guilty.

In our discussion of chromosome counting, we noted that discounting artifacts routinely sets up the stability of a count. Forensic scientists also deploy practices for enhancing expected but barely visible features, and discounting anomalous features by attributing them to technical artifacts. In this case, however, accounts of (possible) artifacts were featured both in efforts to destabilize a claimed match as well as to stabilize it. The dramatized scrutiny of the adversary courtroom trial tends to subject such practices and judgments to

13. Further details of the case are discussed in Lynch and colleagues (2008:ch. 5). We are grateful to Peter Donnelly, a professor of statistics at Oxford University, who was one of the defense witnesses, for furnishing us with a transcript of the testimony before the appeal court.

14. *R v. Deen*, Appeal, Fedor, 7 December 1993, p. 7.

15. We have not discussed the issue of the "prosecutor's fallacy," which had to do with the way Mr. Davie and the judge formulated the probability estimate in the courtroom; instead, the issue of counting and discounting possible matching (or mismatching) bands was more salient for our discussion. See Balding and Donnelly (1994) for a discussion of the prosecutor's fallacy.

a principled skepticism reminiscent of philosophy of science. In line with the popularized Popperianism that runs through the courts (Caudill and Redding 2000; Edmond and Mercer 2002), Deen's defense argued that a single mismatched detail should falsify the match the prosecution used as evidence, regardless of how many other details seemed to be aligned. However, whether or not such details were in fact mismatched or simply ambiguous was itself contested.

In the United States, where district attorneys are elected officials who often try to build up impressive conviction records to bolster their reputations for being "tough on crime," epistemological doubts are sometimes compounded by suspicions of organizational pressures on forensic scientists to use sloppy and even fraudulent procedures. Such suspicions were borne out in a recent investigation of a Houston Police Department crime lab (Bromwich 2007). For our purposes, however, the take-home lesson is not that apparently impressive evidence can be based on dubious judgments; instead, it is that procedures of counting and discounting—whether deemed adequate, inadequate, or fraudulent—*constitute* the substantive features of forensic data. They furnish a detailed "base" of unmeasured judgments that sets up impressive probability estimates, and, in the case of fingerprinting, absolute declarations of fact. When unchallenged, such declarations and measures stand as powerful criminal evidence, but when reviewed in detail, they are sometimes reconfigured as discrepant measures and doubtful declarations.

The practice of counting matching details sets up the probability estimates, because each band that is counted in a profile enhances the likelihood that the crime sample derived from the suspect and any nonmatching bands should (in principle, at least) exonerate the suspect by indicating that the samples derive from different sources.[16] As with chromosome counting, the production of visibly countable entities was far from simple and straightforward, and only at the end of the chain of translations (Latour 1995) could the resulting numbers be set up for interpretation and dispute.

Counting People: Members Counting Members

Although it is sometimes said that things "speak for themselves," unlike people they generally have, at best, a severely limited ability to *count* for themselves. People are often counted as objects without being aware of being counted (and, in some cases, while being deceived, or despite attempting to evade being counted), but many instances of counting involve a variable degree of collaboration between counters (persons doing the counting) and countees (persons being counted). For example, in roll calls and shows of hands, countees themselves perform or facilitate the work of counting. *Membership*, rather than personhood, is the key issue. Logically (and legally in some instances), simply being a person can be sufficient to qualify for membership, though *person* is, of course, far from an unambiguous status, as indicated by contemporary debates about the personhood of embryos and fetuses, and in historic cases such as the decision to treat slaves as 3/5ths of a "person" in the 1860 U.S. Census, or the U.S. Supreme Court's 1886 ruling that corporations count for some purposes as legal "persons" with First Amendment rights. However, in many situations when people count people, legally recognized persons do not count unless they are *members*. Various qualifications and competencies may be demanded. Sometimes, but not always, the same qualifications and competencies held by members who perform the counting also constitute conditions of eligibility to be counted.

16. DNA profiles have changed since the early 1990s, and the current techniques do not rely upon visual matching of autoradiograph "bands." Like Derksen's (2000) study, our discussion focuses on problems and sources of uncertainty with the techniques and probability measures used through the early 1990s. Although later "technical fixes" appear to have circumvented or obviated some of these problems, similar practical and interpretive problems still occur, although at a more subtle level, with current techniques (see Lynch et al. 2008:chs. 6 and 7; Thompson et al. 2003).

The remaining two of our four cases are both highly charged political instances of members counting members: counting bodies at protest marches prior to the onset of the 2003 U.S.-led invasion of Iraq, and counting votes during the contested count and recount in Florida during the 2000 U.S. presidential election. The first instance involved different methods of counting, some of which treated crowds as physical aggregates made up of tally-able (or estimable) individual bodies arrayed in a spatial field. Other methods required variable degrees of "voluntarism" from the objects being counted. Not only were discrepant counts generated, ambiguities also arose when persons who were counted as physically present (or not) registered objections to being treated (or not) as members of the protest. The contested vote count in selected Florida counties in 2000 made another ambiguity perspicuous. This was about counting ballots *as* votes. This ambiguity called into play questions about the conditions under which physical ballots are counted as intentional votes.

Counting Bodies in Protest Marches

Protest marches, demonstrations, and other public "shows of force" are organized, and organize themselves, to express political views. Size matters when it comes to the political effect of such gatherings. Organizers proactively aim for numbers—sometimes setting target figures such as in the "Million Man March" (an event that apparently drew far fewer participants than that number)[17]—and political rivals wrangle over variable estimates of the number of actual participants. Counts of bodies are thematic to the very staging and management of events, not only for organizers and various official and nonofficial counters, but also for the persons who are members of the gathering. Indeed it may be that *controversies about counts* are part of the event, insofar as discrepancies contribute to the newsworthiness of the event and a consensus about the number of bodies present might be counter to the desires of those staging the event. Although crowd counts are notoriously imprecise, just as with (seemingly) more precise systems of voting being counted is thematic to the gathering's political organization and effect. Crowd counts at political demonstrations could, in theory, be made more precise by instituting the kinds of methods that are used for enumerating attendance at other large events, such as ticket sales or controlled-entry gates. These, however, would be anathema to the character of a political protest, which is meant to be spontaneous, anonymous, and somewhat unruly.

Variations in crowd counts are expected and typically ascribed to political biases, though some sources are trusted more than others. For example, a January 2003 *San Francisco Chronicle* story (Buchanan 2003b), which covered a protest rally in San Francisco against the threatened U.S. invasion of Iraq, quoted estimates ranging from 55,000 to 200,000 people ("enough to give a statistician whiplash"), but then gave the police estimate of 150,000 as a "safe guess" (an estimate challenged by protesters who deemed the police to be aligned with their opponents). The article quoted U.C. Berkeley sociologist Neil Smelser as saying, "I have never seen an identical estimate by authorities and protesters . . . Representatives of demonstrators will forever be motivated to increase the size, while police generally tend to discount the size. Opponents to peace rallies like to have a much smaller number."

Whether biased or not, counts and estimates are achieved through variable methods and from different geographical vantage points. In some instances countees estimate the size of a crowd from within, while in others there is a division of labor and considerable "objective" distance between counters and countees. At the low end of the distance continuum are estimates generated from persons embedded in the crowd. For example, an Internet posting by "Christine" on October 26, 2002, described a series of attempts to estimate the size of an anti-war rally:

17. According to Buchanan (2003a) the National Park Service used to conduct crowd counting in Washington, DC, but "Congress stopped that after the park service estimated the 1995 Million Man March at 400,000 people and were threatened with a lawsuit and charged with racism."

> I attempted to count the crowd from a fixed point. There were so many people that it was very difficult to do.
>
> I decided to use this methodology for counting people at the IAC march 10/26/02. I started at 12 o'clock at civic center to count people already at the end point. I got a pretty accurate count of 433. The march started to pass by UN plaza at 12:25, adn it was clear that there were so many people that I couldn't possibly press my clicker fast enough to keep up. After reaching 1023—totally underestimating the huge number of people passing by in the first 5 min, I started counting by tens. Because about 10 people were passing per second or more, I couldn't only vaguely keep up with my clicker, but I reached 20,000—but this was haphazard guessing and I couldn't see the other side of the street, plus parts of the march got diverted down side streets as it got backed up down market. This includes no estimate of people who used BART etc either. I decided that an alternate method would be to take the time of the march 12:25–1:57 pm and and multiply by people per second. That would be at least 8 per second for 70 minutes of that time, probably going up to 15/second during much of this time (stretching all across market street) and then 3–5 per second for the other 20 min. So that would be a minimum $70 \times 60 \times 8 + (3 \times 20 \times 60) = 37{,}200$ (Christine 2002; spelling and punctuation in original).

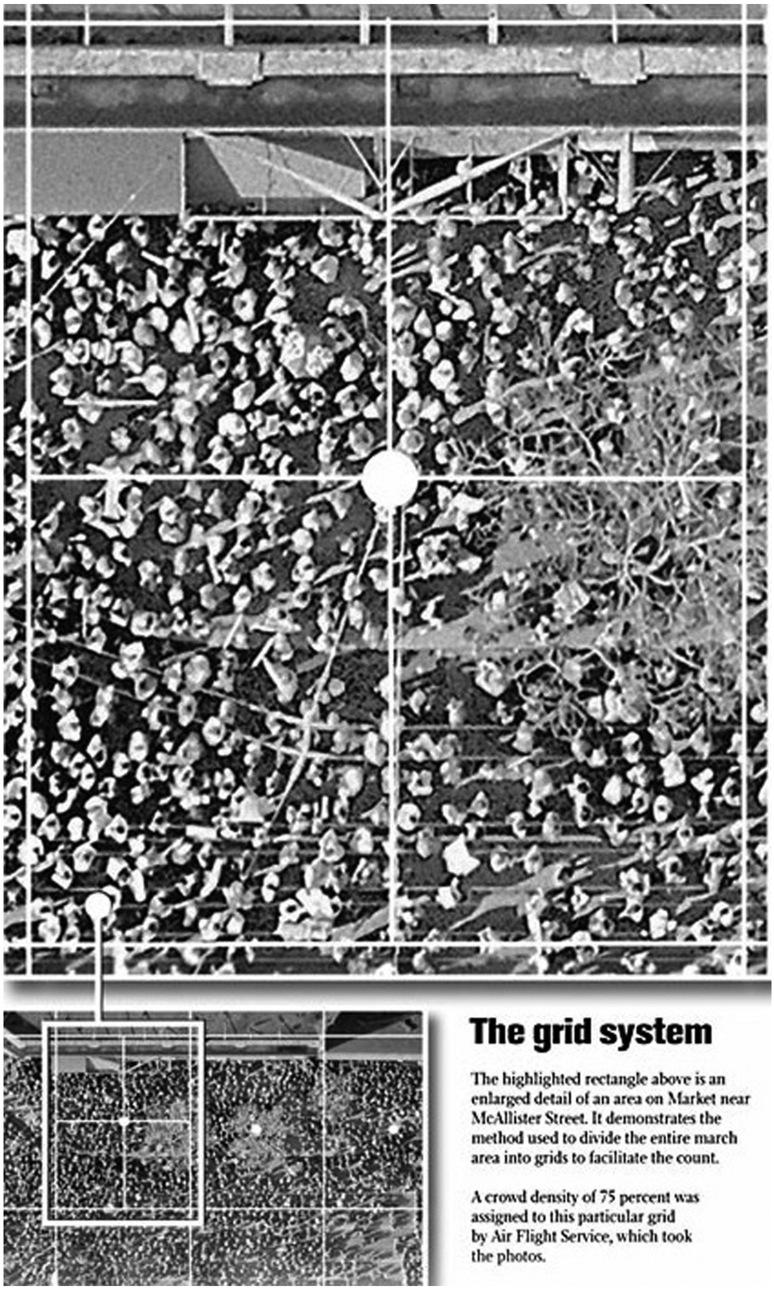
Surveys taken from satellite or aerial photographs are often credited with being more reliable and objective, such as in this *San Francisco Chronicle* article about a survey commissioned by that newspaper:

> In a series of detailed, high-resolution photographs, the aerial survey shows that around 65,000 people were in the area of Market Street and Civic Center Plaza at 1:45 p.m. Sunday, which organizers said was when crowd size was at its peak. That number does not take into account marchers who dropped out before or arrived after the moment the photo sequence was shot. Calculating a precise number of protesters for the entire rally is not possible from this survey, but the result is much more accurate than the visual scan method most commonly used by police and organizers . . . Using a fixed camera mounted in the floor of the plane, the crew made images of the rally from 2,000 feet. The photographs—taken directly above Market Street and Civic Center Plaza and enlarged—provide a perspective that allows a discrete count of individuals and a view of the spaces between them, a view that is impossible from ground-level (Buchanan 2003a).

Though more "objective" in the sense of being detached from the politics and perspectives of the bodies on the ground, this method was not without its critics, as the same newspaper article noted: "When told of *The Chronicle*'s survey, Alex S. Jones, the director of Harvard University's Joan Shorenstein Center on the Press, Politics, and Public Policy, said, 'The number of people (in a crowd) is a mythical number, and now you're going to turn it into a fact, and that won't be welcomed.'" Instances in which counters make conspicuous displays of their independence from countees might be called "nonmembers counting members," but membership becomes salient when such counters are charged with overtly or covertly aiding the opposition.

Protesters' accusations against police and city officials went well beyond technical questions about how crowd numbers were counted, as they also covered the way crowds were policed to prevent or delay individuals from getting to the sites of protests. Like voters blocked from easy access to polling places (see the next section), would-be protesters who arrived late or not at all were unable to "vote with their feet."

An inverse situation also occurred when persons who were *in* the crowd claimed not to be *of* the protest. This situation is analogous to the "visitor" described above in the chromosome example, except in that case the alien chromosome was flagged by the technician as not belonging to the relevant field, while in this case, nothing visible at an aerial level distinguished the nonprotester from the protester. In comments posted to Christine's (2002) post on www.indybay.org, a commenter identified as "Pedestrian" claimed: "I (along with thousands of others) were simply trying to walk down polk street. When we were blocked by 10 or 15 smelly freaks professing their Hatred for America and blocking the sidewalk near the civic center. Please leave us Out of your stupid count. If anything we were hostages to your silly nonsense" (October 26, 2002, 9:13 pm). Another response ("WOW," by Sheepdog, October 26,



Source: *San Francisco Chronicle*, February 21, 2003. Reproduced with permission.

Figure 4 • ***"The Grid System"***

2002, 9:25 pm) raised the skeptical question: "Thousands of you blocked by just a few smelly freaks? WOW! Power to the smelly!" And "Number Nine" added sarcastically, "There were only eleven of us. We fooled you all by milling around and changing hats a lot" (October 29, 2002, 4:55 pm).

Counting and being counted thus involved stratagems that constituted the very political spectacle in question. Though banners, shouted slogans, and other symbolic expressions are undoubtedly important for registering a political message, as far as counting is concerned mere bodily presence in a crowd can be enough to express alignment with the gathering's intentional organization. Moreover, as the dispute over the "smelly freaks" charge indicates, in addition to the contested numbers, disputed characterizations of a crowd's membership implicated their normality and representativeness. Such connections between material presence, political intentions, and demographic representation were drawn out to an excruciating level of detail in a contested election in the year 2000.

A Problematic Election

The contested 2000 U.S. presidential election, and especially the extended disputes about the extraordinarily close count of the vote in Florida, provides an especially clear case for elucidating the contentious politics of how members count members (Lynch, Hilgartner, and Berkowitz 2005). The dispute over the election results made a number of "technical" contingencies salient, together with suspicions about the nonaccidental, politically motivated character of many of those contingencies. For example, the Florida Secretary of State (using an outsourced company) vigorously sought to purge registered voter lists of ex-felons, who were not eligible to vote in that state. Critics suspected that the zeal with which this purge was conducted reflected a deliberate strategy to reduce the vote for Democratic candidates, under the assumption that persons correctly or mistakenly identified as ex-felons were differentially African American, 90 percent of whom tend to vote Democratic.[18] Similar criticisms were made about various real or alleged counter-counting strategies that placed hurdles in the way of (presumably eligible) voters in predominantly African American precincts. These hurdles included fewer polling places and older, less efficient, voting technologies (and thus greater distance traveled and longer lines). Although the literacy tests that were once used to deter illiterates and nonnative English speakers were now illegal, confusing ballot designs and inadequate instructions on how to operate the voting machinery acted as de facto literacy tests.

Eligibility requirements placed burdens on potential voters to act in accordance with legal and mechanical requirements. Being eligible to be counted did not automatically transfer to *being* counted. A series of actions was required in order to register *for* the count—not only to register to vote, but to register a vote in accordance with a series of technical and legal requirements. There was thus a double-register: registration *to* vote and registration *of* a recorded vote. Some requirements were formal-legal, while others were informal and still others had (at best) debatable legal status.

The extraordinarily close vote in Florida—and the fact that the outcome of the national contest turned on that vote—led to a protracted dispute over procedures for counting and recounting votes in specific county districts. As mentioned earlier in the section on chromosome counting, there was obvious interest in getting the count "right," but "the interest of finality" was arguably more salient in the U.S. Supreme Court's 5 to 4 majority vote that officially closed the dispute. As Justice Stevens stated in his dissenting opinion:

18. For a discussion of more recent controversies about the voting rights of ex-felons in several states, see *New York Times* (2006).

> In the interest of finality . . . the majority effectively orders the disenfranchisement of an unknown number of voters whose ballots reveal their intent—and are therefore legal votes under state law— but were for some reason rejected by ballot-counting machines.[19]

The question of how to read (and count) "intent" from the material condition of ballots was perhaps the most highly publicized aspect of the dispute, and much of the focus was on the detailed conditions of ballots produced with the Votomatic™ machine, a simple mechanical device that was developed decades ago by IBM. The contingency that attracted the most attention from the press and courts was the question about what to do about partially or wrongly marked ballot cards that the machines failed to read when votes were tallied on election day. An entire vocabulary became popularized—pregnant chad, dimpled chad, hanging door chad, and swinging door chad—to denote intermediate conditions between a fully marked and machine readable ballot card and a completely unmarked ballot card in which a small perforated square (chad) was not dislodged, as it should have been when the voter punched the card with a stylus.

A fierce dispute broke out after Al Gore (who trailed by a few hundred votes after the first count) petitioned for manual inspection of uncounted ballots in selected districts that used the Votomatic™. Not surprisingly, the George Bush camp argued for trusting the machines, as articulated in a much-quoted statement in November 2000 by long-time Bush family operative James Baker: "our democracy over the years has moved increasingly from hand counting of votes to machine counting. Machines are neither Republicans nor Democrats, and therefore can be neither consciously nor unconsciously biased."[20]

Despite Baker's proposal to accept machine counts at face value, various Florida election officials and judges allowed hand counting to go forward. An interminable public debate ensued about whether it was fair and reasonable to count a ballot card as a *vote* when it showed a dimpled, or partially dislodged, chad corresponding to a candidate's name. As one county election official expressed it, "We do not recognize a soft indentation or a dimple to be voter intent . . . I believe . . . that that is going too far into the mind of the voter" (County Election Official, quoted in Barstow 2000:44). Once again, we see that counting depended upon discounting technical contingencies that might have resulted in the less-than-discrete appearance of the object being counted. Interestingly, however, in this instance vernacular accounts made an issue of subtle differences in the material condition of a ballot that supported different determinations about "the mind of the voter." With crowd counting, on the contrary, no mind reading is involved. Presence implies countability, to the dismay of the angry "Pedestrian" quoted above. One salient difference between votes and crowds is that the performance of precision—of the existence of an actual and achievable count—is critical to the democratic process while crowd counting is accepted to be a "mythic number."

The Bush team initiated legal action to stop the manual counts, and the *Bush v. Gore* lawsuit worked its way through the courts, shadowing the election contest and ultimately resolving it. The Florida Supreme Court allowed the count to go forward on the ground that Florida law mandated a manual recount in such a close election, but the decision was quickly appealed to the U.S. Supreme Court, which reversed the decision in a 5 to 4 ruling, effectively resolving the election in Bush's favor. Two conceptual issues raised in the oral arguments and written opinions were, first, what was meant by the demand for *uniform standards* for counting ballots as votes, and, second what was meant by a *legal* vote. On the first question, attorney David Boies, representing Gore in the oral arguments, submitted that the operative standard for counting a vote throughout Florida was "whether or not the intent of the voter is reflected in the ballot." The material basis for such a judgment could vary from

19. *Bush v. Gore,* 531 U.S. Sup. Ct., No. 00-949, Dec. 12, 2000, J. Stevens, dissenting, p. 5.

20. Porter (2000) pointed out in a *Washington Post* editorial that when Baker placed his trust in machines, he invoked a familiar theme in history of science: mechanical objectivity (see Daston and Galison 1992; Porter 1995).

county to county, and even from one election official to another. The legal rationale for this argument about recognizing intent was of the "you know it when you see it" variety. As one of the justices put it during the oral arguments: "That's very general. It runs throughout the law. Even a dog knows the difference in being stumbled over and being kicked. We know it, yes."[21] The idea was that election officials must necessarily be trusted under the circumstances to make good-faith judgments about voter intentions. Although Boies cited legal doctrines and precedents to support a flexible standard that would avoid rigid criteria and delegate reasonable judgment to the individuals charged with performing the manual counts, this argument did not satisfy the court majority. As one of Boies's questioners put it: "But here you have something objective. You are not just reading a person's mind. You are looking at a piece of paper, and the supreme courts in the states of South Dakota and the other cases have told us that you will count this hanging by two corners or one corner, this is acceptable to a uniform standard."[22] Whether or not one agrees with either side of the argument, or with the use of a subjective-objective dichotomy to delineate the sides, it is clear that the different interpretations of how to count ballots as votes would lead to different numbers of votes counted.

The second issue—what counts as a legal vote—was dramatically expressed in a concurring opinion by Justices Rehnquist, Thomas, and Scalia—generally regarded as the three most conservative justices on the court at the time. Their opinion proposed to bypass the whole question of voter intent by shifting attention to voter *competence*. The three justices invoked a rule posted at polling places in which the Votomatic™ and related systems were used: "After voting, check your ballot card to be sure your voting selections are clearly and cleanly punched and there are no chips left hanging on the back of the card." Competency in this case involved preparing a ballot so that the machines could count it, a requirement not unlike the standards of competent preparation in clinical and forensic laboratories. Rehnquist, Thomas, and Scalia argued that "when electronic or elecromechanical equipment performs precisely in the matter designed, and fails to count those ballots that are not marked in the manner that those voting instructions explicitly and prominently specify," then it is not an "error of vote tabulation," it is a failure to vote as instructed, and thus a failure to cast a legal vote. The court majority did not go along with this line of argument, but it shows how the emphasis on the infallibility of machine counts was not simply a matter of trusting machines to operate in an error-free way. It involved a reallocation of what counted as machine error and human mistake, implicating what, if anything, should be done to compensate for them.

Conclusion

Each of the cases of counting described in this article involved procedures for assigning numbers to objects, but how the numbers were deployed depended upon *what* was being counted, and the categorical identity of this what was itself constituted through the *work* of counting and being counted. Assigning numbers to things required particular practices for rendering things accountable, and many of these practices were specific to the political contexts and disciplinary activities in which they were performed. Substantive qualities of the things did not simply precede and constrain the work of counting them; instead, those qualities were themselves assembled by and assimilated within the work of counting. The case of counting chromosomes elucidated some of the techniques for constituting gestalt properties that facilitated the work of counting; material qualities such as object continuity,

21. *Bush v. Gore*, No. 00-949, U.S. Sup. Ct., December 11, 2000, Oral Argument, p. 49.
22. *Bush v. Gore*, No. 00-949, U.S. Sup. Ct., December 11, 2000, Oral Argument, pp. 49–50.

separation, boundedness, and categorical identity. The case of counting forensic evidence as matching highlighted how probabilistic assessments of evidential weight depended upon elementary judgments about identity and difference in comparisons of trace evidence. Adversary interrogation opened up an indefinite horizon of contingencies that came into play when traces were counted *as* matching. Disputed crowd counts opened up the interface between techniques of counting and strategies for displaying or suppressing a "show of force" expressed through estimates of crowd size. Finally, a contested election highlighted disputes about counting traces or marks left on ballots as indications of voter intent. Like forensic scientists' efforts to read traces as indications of identity (and, ultimately, as evidence of guilt or innocence) disputes about legal votes opened up questions and administrative judgments about competency, and differential trust in humans versus machines, but the focus in the voting dispute was placed as much upon the intentions and competencies of countees who generated the traces as well as the counters who attempted to discern their meaning.[23]

After considering these cases, we may wonder what these instances have in common and where "counting" begins and ends. All instances involve an abstract use of numbers of the kind that children master through practice in different contexts, but we have emphasized contextual differences in the work of preparing fields, making similarity judgments, or discriminating between the things counted. One could argue that these differences are *not* part of counting, as such, but are matters of preparing particular things to be counted and applying counting in different circumstances. After all, a child can count to 46 (or 48) without having to know anything about counting chromosomes. Mastery of the techniques of cytology may be necessary for the latter, but surely not for *counting* as such! However, when we look into how counting is performed in situ, there seems little warrant for making a general distinction between (quantitative) counting and (qualitative) categorical judgment, even though that very distinction can act as a warrant for the stability and transportability of the procedures and results of counting. Such judgments are crucial for setting up the *rationality* (in both the epistemological and bureaucratic senses of the word) ascribed to quantified information in science, law, and politics. As we have tried to show with contentious instances, the status of a number as a credible count, *in all instances*, depends upon local categorical judgments and discriminatory actions that create an infrastructure of accountability. Moreover, when results of counting are challenged, the practices through which fields are prepared, vantage points secured, and entities mobilized come under review.

Numero-politics—the politics of numbers, as well as the machinations involved in generating and resisting the production of numbers—was prominent in all of the cases we described, especially in the maneuvers to block or facilitate the registration of votes and organizational efforts to enhance or diminish the (ac)countability of members in a protest gathering. At a less obvious level, numero-politics was featured in decisions about what to count in cytology and forensic DNA analysis. Though more restricted in scope, these disputes about numbers in particular organizational and epistemic contexts also involved broader assumptions and ascriptions involving race, and guilt or innocence.

As noted earlier, members count members by means of social relationships with the persons being counted, who in turn intentionally or unintentionally act to facilitate, thwart, or evade being counted. Particular chromosomes and bands on an autoradiograph also become "members" of a class when they are counted, but they do not stand up to be counted or otherwise *act* in accordance with requirements of membership. Or do they? It is commonplace

23. One could argue that, at a deeper level, the intention and competence of the person who committed a crime also is implicated in forensic analysis of trace evidence (for example, the question of what the perpetrator of an alleged rape *thought he was doing* when he "donated" (to use forensic argot) the semen sample recovered during examination of the victim), but such ascriptions of intention are (officially, at least) left for the jury and not the forensic analyst (see Lynch et al. 2008 for elaboration of how stories of the crime enter into forensic analysis).

for cell biologists to speak of materials as agents of their own visibility and identity: as showing and hiding themselves; presenting deceptive appearances; obediently complying with procedures or remaining recalcitrant. Such attributions of material agency (Pickering 1995) are more than a figure of speech. They involve material interventions: specimen materials are marked, aligned, and otherwise disciplined in ways that facilitate identification and enumeration (Goodwin 1994; Lynch 1985a, 1985b). Moreover, counting and discounting are reciprocally involved when, for example, a voter's production of a hanging chad disqualifies the vote from being counted on technical and/or legal grounds, or a laboratory technician's effort to count misaligned bands on an autoradiograph is successfully challenged in court, thus reducing the probative value of the evidence. Consequently, the reflexive properties of members counting members may help illuminate aspects of "counting things" that otherwise seem less perspicuous.

We would not want to reduce counting to a single ubiquitous activity, but we are no more inclined to ascribe it to a completely heterogeneous field of practices in which the human/nonhuman distinction is inoperative (Latour 1987). Even though we agree that there is not one grand metaphysical "divide" between counting humans versus counting other objects, in our view, differences between humans and nonhumans are empirically salient in many instances, as are differences between social membership and membership in an impersonal set or category. More refined similarities and differences also come into play in an occasional and often contentious way. Although, as we have argued, counting is done in distinctive ways on different occasions, actual and possible relations among settings also are relevant. As Harvey Sacks once noted in a discussion with Harold Garfinkel, questions of equivalent treatment (or, in the Supreme Court's language, "equal protection") can be raised when membership criteria vary from one counting game to another (Sacks and Garfinkel 1962). So, for example, a person who is ineligible to vote might complain that they are eligible to pay taxes. Like games, counting practices exhibit family resemblances.[24] Polls, surveys, and censuses use many of the same practices, but as the dispute in the U.S. Congress over a proposal to employ sampling in the 2000 census indicated, the apparent independence and transferability of counting exists in a state of tension with the local practices that identify, constitute, or restrict accountability. In order to come to terms with such contextual relations, it is necessary to pay attention to the specific cases, not only to understand distinctive local competencies, but also to address moral and legal efforts to link or de-link one counting game to others.

So what do we gain if we treat the *work* of counting as an inseparable part of counting, rather than as an endlessly variable array of local practices for setting up and applying a coherent and transposable numerical procedure? One advantage is that it alerts us to the contingent origins of the numbers that are used to justify so many public programs, policies, rankings, and administrative decisions. Although, as we have seen, lawyers, protesters, laboratory technicians, and many others are highly aware of those origins, they tend to get washed out of the picture when counts are cited and recited in public discourse. At a more abstract level, elaborating on the theme of "members counting members" has enabled us to see connections between cognate uses of the mathematical concept of membership in a *set* with the sociological concept of membership in a *group*. It is not just that group memberships can be enumerated, but that such enumeration is performed reflexively, and that conditions of membership rights, competencies, and responsibilities are part of being counted, and of counting oneself in or out, of the relevant group. And, finally, we should be able to recognize that counting *as* simultaneously establishes *what* is in the world as well as how much there is of it.

24. In *Philosophical Investigations* (1958), Wittgenstein introduces the concepts language games and family resemblances to which we are alluding here.

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