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Sorting Things Out
Classification and Its Consequences

Geoffrey C. Bowker
Susan Leigh Star

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Envoi

We would hate to have to assign a Dewey classification number to this book, which straddles sociology, anthropology, history and information systems, and design. Our modest hope is that it will not find its way onto the fantasy shelves.

Introduction: To Classify Is Human

In an episode of *The X-Files*, a television show devoted to FBI investigation of the paranormal, federal agents Mulder and Scully investigated a spate c murders of psychics of all stamps: palm readers, astrologers, and so forth. Th plot unfolded thusly: The murderer would get his fortune read or astrologicz chart done, and then brutaly slay the fortune-teller. It emerged during th show that the reason for these visits was that he wanted to understand wha he was doing and why he was doing it, and he thought psychics could hel him understand his urges to kill people. Only one psychic, an insuranc salesman with the ability to scry the future, was able to prdict his murderou attacks and recognize the criminal. When finally the murderer met this psy chic, he burst into his impassioned plea for an explanation of what he wa doing. "Why am I compelled to kill all these people," the salesman responde in a world-weary tone such as one might take with a slow child: "Don't yo get it, son? You're a homicidal maniac." The maniac was delighted with thi insight. He then proceeds to try to kill again. The salesman's answer is bot penetrating and banal—what it says about classification systems is the topic c this book. Why is it so funny?

Our lives are henged round with systems of classification, limned b standard formats, prescriptions, and objects. Enter a modern hom and you are surrounded by standards and categories spanning th color of paint on the walls and in the fabric of the furniture, the type of wires strung to appliances, the codes in the building permits allow ing the kitchen sink to be properly plumbed and the walls to b adequately fireproofed. Ignore these forms at your peril—as a buildin owner, be sued by irate tenants; as an inspector, risk malpractice suit denying your proper application of the ideal to the case at hand; as parent, risk toxic paint threatening your children.

To classify is human. Not all classifications take formal shape or ar standardized in commercial and bureaucratic products. We all spen large parts of our days doing classification work, often tacitly, and w

make up and use a range of ad hoc classifications to do so. We sort dirty dishes from clean, white laundry from colorfast, important email to be answered from e-junk. We match the size and type of our car tires to the amount of pressure they should accept. Our desktops are a mute testimony to a kind of muddled folk classification: papers that must be read by yesterday, *but that have been there since last year;* old professional journals that really should be read and even in fact may someday be, *but that have been there since last year;* assorted grant applications, tax forms, various work-related surveys and forms waiting to be filled out for everything from parking spaces to immunizations. These surfaces may be piled with sentimental cards that are already read, *but which cannot yet be thrown out,* alongside reminder notes to send similar cards to parents, sweethearts, or friends for their birthdays, all piled on top of last year's calendar (which—who knows?—may be useful at tax time). Any part of the home, school, or workplace reveals some such system of classification: medications classed as not for children occupy a higher shelf than safer ones; books for reference are shelved close to where we do the Sunday crossword puzzle; door keys are color-coded and stored according to frequency of use.

What sorts of things order these piles, locations, and implicit labels? We have certain knowledge of these intimate spaces, classifications that appear to live partly in our hands—definitely not just in the head or in any formal algorithm. The knowledge about which thing will be useful at any given moment is embodied in a flow of mundane tasks and practices and many varied social roles (child, boss, friend, employee). When we need to put our hands on something, it is there.

Our computer desktops are no less cluttered. Here the electronic equivalent of "not yet ready to throw out" is also well represented. A quick scan of one of the author's desktops reveals eight residual categories represented in the various folders of email and papers: "fun," "take back to office," "remember to look up," "misc.," "misc. correspondence," "general web information," "teaching stuff to do," and "to do." We doubt if this is an unusual degree of disarray or an overly prolific use of the "none of the above" category so common to standardized tests and surveys.

These standards and classifications, however imbricated in our lives, are ordinarily invisible. The formal, bureaucratic ones trail behind them the entourage of permits, forms, numerals, and the sometimes-visible work of people who adjust them to make organizations run smoothly. In that sense, they may become more visible, especially when

they break down or become objects of contention. But what *are* these categories? Who makes them, and who may change them? When and why do they become visible? How do they spread? What, for instance, is the relationship among locally generated categories, tailored to the particular space of a bathroom cabinet, and the commodified, elaborate, expensive ones generated by medical diagnoses, government regulatory bodies, and pharmaceutical firms?

Remarkably for such a central part of our lives, we stand for the most part in formal ignorance of the social and moral order created by these invisible, potent entities. Their impact is indisputable, and as Foucault reminds us, inescapable. Try the simple experiment of ignoring your gender classification and use instead whichever toilets are the nearest; try to locate a library book shelved under the wrong Library of Congress catalogue number; stand in the immigration queue at a busy foreign airport without the right passport or arrive without the transformer and the adaptor that translates between electrical standards. The material force of categories appears always and instantly.

At the level of public policy, classifications such as those of regions, activities, and natural resources play an equally important role. Whether or not a region is classified as ecologically important, whether another is zoned industrial or residential come to bear significantly on future economic decisions. The substrate of decision making in this area, while often hotly argued across political camps, is only intermittently visible. Changing such categories, once designated, is usually a cumbersome, bureaucratically fraught process.

For all this importance, classifications and standards occupy a peculiar place in studies of social order. Anthropologists have studied classification as a device for understanding the cultures of others—categories such as the raw and the cooked have been clues to the core organizing principles for colonial Western understandings of "primitive" culture. Some economists have looked at the effects of adopting a standard in those markets where networks and compatibility are crucial. For example, videotape recorders, refrigerators, and personal computer software embody arguably inferior technical standards, but standards that benefited from the timing of their historical entry into the marketplace. Some historians have examined the explosion of natural history and medical classifications in the late nineteenth century, both as a political force and as an organizing rubric for complex bureaucracies. A few sociologists have done detailed studies of individual categories linked with social movements, such as the

diagnosis of homosexuality as an illness and its demedicalization in the wake of gay and lesbian civil rights. Information scientists work every day on the design, delegation, and choice of classification systems and standards, yet few see them as artifacts embodying moral and aesthetic choices that in turn craft people's identities, aspirations, and dignity.[1] Philosophers and statisticians have produced highly formal discussions of classification theory, but few empirical studies of use or impact.

Both within and outside the academy, single categories or classes of categories may also become objects of contention and study. The above-mentioned demedicalization of the category homosexual in the American Psychiatric Association's (APA) *Diagnostic and Statistical Manual 3* (the DSM, a handbook of psychiatric classification) followed direct and vigorous lobbying of the APA by gay and lesbian advocates (Kirk and Kutchins 1992). During this same era, feminists were split on the subject of whether the categories of premenstrual syndrome and postpartum depression would be good or bad for women as they became included in the DSM. Many feminist psychotherapists were engaged in a bitter argument about whether to include these categories. As Ann Figert (1996) relates, they even felt their own identities and professional judgments to be on the line. Allan Young (1995) makes the complicating observation that psychiatrists increasingly use the language of the DSM to communicate with each other and their accounting departments, although they frequently do not believe in the categories they are using.

More recently, as discussed in chapter 6, the option to choose multiple racial categories was introduced as part of the U.S. government's routine data-collection mission, following Statistical Directive 15 in October 1997. The Office of Management and Budget (OMB) issued the directive; conservatively, its implementation will cost several million dollars. One direct consequence is the addition of this option to the U.S. census, an addition that was fraught with political passion. A march on Washington concerning the category took the traditional ultimate avenue of mass protest for American activists. The march was conducted by people who identified themselves as multiracial, and their families and advocates. At the same time, it was vigorously opposed by many African-American and Hispanic civil rights groups (among several others), who saw the option as a "whitewash" against which important ethnic and policy-related distinctions would be lost (Robbin 1998).

Despite the contentiousness of some categories, however, none of the above-named disciplines or social movements has systematically addressed the pragmatics of the invisible forces of categories and standards in the modern built world, especially the modern information technology world. Foucault's (1970; 1982) work comes the closest to a thoroughgoing examination in his arguments that an archaeological dig is necessary to find the origins and consequences of a range of social categories and practices. He focused on the concept of order and its implementation in categorical discourse. The ubiquity described by Foucault appears as an iron cage of bureaucratic discipline against a broad historical landscape. But there is much more to be done, both empirically and theoretically. No one, including Foucault, has systematically tackled the question of how these properties inform social and moral order via the new technological and electronic infrastructures. Few have looked at the creation and maintenance of complex classifications as a kind of work practice, with its attendant financial, skill, and moral dimensions. These are the tasks of this book.

Foucault's practical archaeology is a point of departure for examining several cases of classification, some of which have become formal or standardized, and some of which have not. We have several concerns in this exploration, growing both from the consideration of classification work and its attendant moral dimensions. First, we seek to understand the role of invisibility in the work that classification does in ordering human interaction. We want to understand how these categories are made and kept invisible, and in some cases, we want to challenge the silences surrounding them. In this sense, our job here is to find tools for seeing the invisible, much as Émile Durkheim passionately sought to convince his audience of the material force of the social fact—to see that society was not just an idea—more than 100 years ago (Durkheim 1982).

The book also explores systems of classification as part of the built information environment. Much as a city planner or urban historian would leaf back through highway permits and zoning decisions to tell a city's story, we delve the dusty archives of classification design to understand better how wide-scale classification decisions have been made.

We have a moral and ethical agenda in our querying of these systems. Each standard and each category valorizes some point of view and silences another. This is not inherently a bad thing—indeed it is inescapable. But it *is* an ethical choice, and as such it is dangerous—not

bad, but dangerous. For example, the decision of the U.S. Immigration and Naturalization Service to classify some races and classes as desirable for U.S. residents, and others as not, resulted in a quota system that valued affluent people from northern and western Europe over those (especially the poor) from Africa or South America. The decision to classify students by their standardized achievement and aptitude tests valorizes some kinds of knowledge skills and renders other kinds invisible. Other types of decisions with serious material force may not immediately appear as morally problematic. The collective standardization in the United States on VHS videotapes over Betamax, for instance, may seem ethically neutral. The classification and standardization of types of seed for farming is not obviously fraught with moral weight. But as Busch (1995) and Addelson (1994) argue, such long-term, collective forms of choice are also morally weighted. We[2] are used to viewing moral choices as individual, as dilemmas, and as rational choices. We have an impoverished vocabulary for collective moral passages, to use Addelson's terminology. For any individual, group or situation, classifications and standards give advantage or they give suffering. Jobs are made and lost; some regions benefit at the expense of others. How these choices are made, and how we may think about that invisible matching process, is at the core of the ethical project of this work.

Working Infrastructures

Sorting Things Out stands at the crossroads of the sociology of knowledge and technology, history, and information science. The categories represented on our desktops and in our medicine cabinets are fairly ad hoc and individual, not even legitimate anthropological folk or ethno classifications. They are not often investigated by information scientists (but see Kwasnik 1988, 1991; Beghtol 1995; Star 1998). But everyone uses and creates them in some form, and they are (increasingly) important in organizing computer-based work. They often have old and deep historical roots. True, personal information managers are designed precisely to make this process transparent, but even with their aid, the problem continues: we still must design or select categories, still enter data, still struggle with things that do not fit. At the same time, we rub these ad hoc classifications against an increasingly elaborate large-scale system of formal categories and standards. Users

of the Internet alone navigate, now fairly seamlessly, more than 200 formally elected Internet standards for information transmission each time they send an email message. If we are to understand larger scale classifications, we also need to understand how desktop classifications link up with those that are formal, standardized, and widespread.

Every link in hypertext creates a category. That is, it reflects some judgment about two or more objects: they are the same, or alike, or functionally linked, or linked as part of an unfolding series. The rummage sale of information on the World Wide Web is overwhelming, and we all agree that finding information is much less of a problem than assessing its quality—the nature of its categorical associations and by whom they are made (Bates, in press). The historical cultural model of social classification research in this book, from desktop to wide-scale infrastructure, is a good one through which to view problems of indexing, tracking, and even compiling bibliographies on the Web. In its cultural and workplace dimensions, it offers insights into the problematics of design of classification systems, and a lens for examining their impact. It looks at these processes as a sort of crafting of treaties. In this, a cross-disciplinary approach is crucial. Any information systems design that neglects use and user semantics is bound for trouble down the line—it will become either oppressive or irrelevant. Information systems mix up the conventional and the formal, the hard technical problems of storage and retrieval with the hard interactional problems of querying and organizing.

Information systems are undergoing rapid change. There is an explosion of information on the Web and associated technologies, and fast moving changes in how information may converge across previously disparate families of technology—for instance, using one's television to retrieve email and browse the Web, using one's Internet connections to make telephone calls. Whatever we write here about the latest electronic developments will be outdated by the time this book sees print, a medium that many would argue is itself anachronistic.

Conventions of use and understandings of the impact of these changes on social organization are slower to come. The following example illustrates the intermingling of the conventional and the local in the types of classificatory links formed by hypertext. A few years ago, our university was in the enviable position of having several job openings in library and information science. Both the authors were on

the search committee. During the process of sifting through applications and finding out more about candidates, the need arose to query something on the candidate's resume. We used the Alta Vista search engine to find the candidate's email address. (Of course, the first thing one really does with Alta Vista is ego surfing—checking one's own name to see how many times it appears on the Web—but we had already done that.) His email address and formal institutional home page appeared in about fifteen seconds on our desktop, but so did his contributions to a discussion on world peace, a feminist bulletin board, and one of the more arcane alt.rec Usenet groups. We found ourselves unable to stop our eyes from roving through the quoted Usenet posts—category boundaries surely never meant to be crossed by a job search committee. Fortunately for us as committee members, we interpreted what we found on the Web as evidence that the applicant was a more well rounded person than his formal CV resume had conveyed. He became a more interesting candidate.

But of course, it might have gone badly for him. In less than a minute we had accessed information about him that crossed a social boundary of de facto privacy, access, and awareness context (Glaser and Strauss 1965). The risk of random readership had been there in some sense when he posted to a public space, but who on a search committee in the old days of a couple of years ago could possibly be bothered searching listserv archives? Who would have time? There are many ethical and etiquette-related questions here, of course, with the right to privacy not least among them. The incident also points to the fact that as a culture we have not yet developed conventions of classification for the Web that bear much moral or habitual conviction in daily practice. The label alt.rec does not yet have the reflex power that the label private does on a desk drawer or notebook cover. We would never open someone's desk drawer or diary. We are not usually known to be rude people, but we have not yet developed or absorbed routine similar politeness for things such as powerful Web search engines. We were thus somewhat embarrassed and confused about the morality of mentioning the alt.rec postings to the committee.

As we evolve the classifications of habit—grow common fingertips with respect to linkages and networks—we will be faced with some choices. How standardized will our indexes become? What forms of freedom of association (among people, texts and people, and texts) do we want to preserve and which are no longer useful? Who will decide these matters?

Investigating Infrastructure

People do many things today that a few hundred years ago would have looked like magic. And if we don't understand a given technology today it looks like magic: for example, we are perpetually surprised by the mellifluous tones read off our favorite CDs by, we believe, a laser. Most of us have no notion of the decades of negotiation that inform agreement on, inter alia, standard disc size, speed, electronic setting, and amplification standards. It is not dissimilar to the experience of magic one enjoys at a fine restaurant or an absorbing play. Common descriptions of good waiters or butlers (one thinks of Jeeves in the Wodehouse stories) are those who clear a table and smooth the unfolding of events "as if by magic." In a compelling play, the hours of rehearsal and missteps are disappeared from center stage, behind a seamless front stage presentation. Is the magic of the CD different from the magic of the waiter or the theater ensemble? Are these two kinds of magic or one—or none?

This book is an attempt to answer these questions, which can be posed more prosaically as:

- What work do classifications and standards do? Again, we want to look at what goes into making things work like magic: making them fit together so that we can buy a radio built by someone we have never met in Japan, plug it into a wall in Champaign, Illinois, and hear the world news from the BBC.
- Who does that work? We explore the fact that all this magic involves much work: there is a lot of hard labor in effortless ease.[3] Such invisible work is often not only underpaid, it is severely underrepresented in theoretical literature (Star and Strauss 1999). We will discuss where all the "missing work" that makes things look magical goes.
- What happens to the cases that do not fit? We want to draw attention to cases that do not fit easily into our magical created world of standards and classifications: the left handers in the world of right-handed magic, chronic disease sufferers in the acute world of allopathic medicine, the vegetarian in MacDonald's (Star 1991b), and so forth.

These are issues of great import. It is easy to get lost in Baudrillard's (1990) cool memories of simulacra. He argues that it is impossible to sort out media representations from "what really happens." We are unable to stand outside representation or separate simulations from

nature. At the same time, he pays no attention to the work of constructing the simulations, or the infrastructural considerations that underwrite the images or events (and we agree that separating them ontologically is a hopeless task). The hype of our postmodern times is that we do not need to think about this sort of *work* any more. The real issues are scientific and technological, stripped of the conditions of production—in artificial life, thinking machines, nanotechnology, and genetic manipulation. . . . Clearly each of these *is* important. But there is more at stake—epistemologically, politically, and ethically—in the day-to-day work of building classification systems and producing and maintaining standards than in abstract arguments about representation. Their pyrotechnics may hold our fascinated gaze, but they cannot provide any path to answering our moral questions.

Two Definitions: Classification and Standards

Up to this point, we have been using the terms classification and standardization without formal definition. Let us clarify the terms now.

Classification

A classification is a spatial, temporal, or spatio-temporal segmentation of the world. A "classification system" is a set of boxes (metaphorical or literal) into which things can be put to then do some kind of work—bureaucratic or knowledge production. In an abstract, ideal sense, a classification system exhibits the following properties:

1. *There are consistent, unique classificatory principles in operation.* One common sort of system here is the *genetic* principle of ordering. This refers not to DNA analysis, but to an older and simpler sense of the word: classifying things by their origin and descent (Tort 1989). A genealogical map of a family's history of marriage, birth, and death is genetic in this sense (even for adopted children and in-laws). So is a flow chart showing a hierarchy of tasks deriving from one another over time. There are many other types of classificatory principles—sorting correspondence by date received (temporal order), for example, or recipes by those most frequently used (functional order).

2. *The categories are mutually exclusive.* In an ideal world, categories are clearly demarcated bins, into which any object addressed by the system will neatly and uniquely fit. So in the family genealogy, one mother and one father give birth to a child, forever and uniquely attributed to them as parents—there are no surrogate mothers, or issues of shared custody or of retrospective DNA testing. A rose is a rose, not a rose sometimes and a daisy other times.

3. *The system is complete.* With respect to the items, actions, or areas under its consideration, the ideal classification system provides total coverage of the world it describes. So, for example, a botanical classifier would not simply ignore a newly discovered plant, but would always strive to name it. A physician using a diagnostic classification must enter *something* in the patient's record where a category is called for; where unknown, the possibility exists of a medical discovery, to be absorbed into the complete system of classifying.

No real-world working classification system that we have looked at meets these "simple" requirements and we doubt that any ever could. In the case of unique classificatory systems, people disagree about their nature; they ignore or misunderstand them; or they routinely mix together different and contradictory principles. A library, for example, may have a consistent Library of Congress system in place, but supplement it in an ad hoc way. Best sellers to be rented out to patrons may be placed on a separate shelf; very rare, pornographic, or expensive books may be locked away from general viewing at the discretion of the local librarian. Thus, the books are moved, without being formally reclassified, yet carry an additional functional system in their physical placement.

What Are You?

I grew up in Rhode Island, a New England state largely populated by Italian-Americans and French-Canadians that is known chiefly for its small stature. When I was a kid in our neighborhood, the first thing you would ask on encountering a newcomer was "what's your name?" The second was "what are you?" "What are you" was an invitation to recite your ethnic composition in a kind of singsong voice: 90 percent of the kids would say "Italian with a little bit of French," or "half-Portuguese, one-quarter Italian and one-quarter Armenian." When I would chime in with "half-Jewish, one-quarter Scottish and one-quarter English," the range of responses went from very puzzled looks to "does that mean you're not Catholic?" Wherein, I guess, began my fascination with classification, and especially with the problem of residual categories, or, the "other," or not elsewhere classified.

—Leigh Star

For the second point, mutual exclusivity may be impossible in practice, as when there is disagreement or ambivalence about the membership of an object in a category. Medicine is replete with such examples, especially when the disease entity is controversial or socially stigmatized. On the third point, completeness, there may be good reasons to ignore data that would make a system more comprehensive. The discovery of a new species on an economically important development site may be silenced for monetary considerations. An anomaly may be acknowledged, but be too expensive—politically or bureaucratically—to introduce into a system of record keeping. In chapter 2, we demonstrate ways of reading classification systems so as to be simultaneously sensitive to these conceptual, organizational, and political dimensions.

Consider the International Classification of Diseases (ICD), which is used as a major example throughout this book. The full title of the current (tenth) edition of the ICD, is: "ICD-10—International Statistical Classification of Diseases and Related Health Problems; Tenth Revision." Note that it is designated a statistical classification: Only diseases that are statistically significant are entered here (it is not an attempt to classify all diseases).

The ICD is labeled a "classification," even though many have said that it is a "nomenclature" since it has no single classificatory principle (it has at least four, which are not mutually exclusive, a point developed in chapter 4). A nomenclature simply means an agreed-upon naming scheme, one that need not follow any classificatory principles. The nomenclature of streets in Paris, for example, includes those named after intellectual figures, plants and trees, battles, and politicians, as well as those inherited from former governments, such as Rue de Lutèce (Lutèce was the ancient Roman name for Paris). This is no classificatory system. Nomenclature and classification are frequently confused, however, since attempts are often made to model nomenclature on a single, stable system of classification principles, as for example with botany (Bowker, in press) or anatomy. In the case of the ICD, diagnostic nomenclature and the terms in the ICD itself were conflated in the American system of diagnosis-related groups (DRGs), much to the dismay of some medical researchers. In many cases the ICD represents a compromise between conflicting schemes." The terms used in categories C82–C85 for non-Hodgkin's lymphomas are those of the Working Formulation, which attempted to find common ground among several major classification systems. The terms used in these schemes are not given in the Tabular List but appear in the Alphabetical Index; exact equivalence with the terms appearing in the Tabular List is not always possible" (ICD-10, 1: 215).

The ICD, however, presents itself clearly as a classification scheme and not a nomenclature. Since 1970, there has been an effort underway by the WHO to build a distinct International Nomenclature of Diseases (IND), whose main purpose will be to provide: "a single recommended name for every disease entity" (ICD-10, 1: 25).

For the purposes of this book, we take a broad enough definition so that anything consistently called a classification system *and treated as such* can be included in the term. This is a classic Pragmatist turn—things perceived as real are real in their consequences (Thomas and Thomas 1917). If we took a purist or formalist view, the ICD would be a (somewhat confused) nomenclature and who knows what the IND would represent. With a broad, Pragmatic definition we can look at the work that is involved in building and maintaining a family of entities that people call classification systems rather than attempt the Herculean, Sisyphian task of purifying the (un)stable systems in place. Howard Becker makes a cognate point here:

> Epistemology has been a . . . negative discipline, mostly devoted to saying what you shouldn't do if you want your activity to merit the title of science, and to keeping unworthy pretenders from successfully appropriating it. The sociology of science, the empirical descendant of epistemology, gives up trying to decide what should and shouldn't count as science, and tells what people who claim to be doing science do. (Becker 1996, 54–55)

The work of making, maintaining, and analyzing classification systems is richly textured. It is one of the central kinds of work of modernity, including science and medicine. It is, we argue, central to social life.

Standards

Classifications and standards are closely related, but not identical. While this book focuses on classification, standards are crucial components of the larger argument. The systems we discuss often do become standardized; in addition, a standard is in part a way of classifying the world. What then are standards? The term as we use it in the book has several dimensions:

1. A "standard" is any set of agreed-upon rules for the production of (textual or material) objects.
2. A standard spans more than one community of practice (or site of activity). It has temporal reach as well in that it persists over time.

3. Standards are deployed in making things work together over distance and heterogeneous metrics. For example, computer protocols for Internet communication involve a cascade of standards (Abbate and Kahin 1995) that need to work together well for the average user to gain seamless access to the web of information. There are standards for the components to link from your computer to the phone network, for coding and decoding binary streams as sound, for sending messages from one network to another, for attaching documents to messages, and so forth.

4. Legal bodies often enforce standards, be these mandated by professional organizations, manufacturers' organizations, or the state. We might say tomorrow that volapük, a universal language that boasted some twenty-three journals in 1889 (Proust 1989, 580), or its successor Esperanto shall henceforth be the standard language for international diplomacy. Without a mechanism of enforcement, however, or a grassroots movement, we shall fail.

5. There is no natural law that the best standard shall win—QWERTY, Lotus 123, DOS, and VHS are often cited as examples in this context. The standards that do win may do so for a variety of other reasons: they build on an installed base, they had better marketing at the outset, or they were used by a community of gatekeepers who favored their use. Sometimes standards win due to an outright conspiracy, as in the case of the gas refrigerator documented by Cowan (1985).

6. Standards have significant inertia and can be very difficult and expensive to change.

It was possible to build a cathedral like Chartres without standard representations (blueprints) and standard building materials such as regular sizes for stones, tools, and so forth (Turnbull 1993). People invented an amazing array of analog measuring devices (such as string lengths). Each cathedral town posted the local analog metric (a length of metal) at its gates, so that peripatetic master builders could calibrate their work to it when they arrived in the town. They did not have a wide-scale measurement system such as our modern metric or decimal systems. (Whether as a result of this local improvisation or not, Turnbull notes, many cathedrals did fall down!)

It is no longer possible to build a complex collective project without standardized measurements. Consider a modern housing development where so much needs to come together from distant and proximate sources—electricity, gas, sewer, timber sizes, screws, nails and so on. The control of standards is a central, often underanalyzed feature of economic life (see the work of Paul David—for example David and Rothwell 1994—for a rich treatment). It is key to knowledge production as well. Latour (1987) speculates that far more economic resources are spent creating and maintaining standards than in producing "pure" science. There are a number of histories of standards that point to the development and maintenance of standards as being critical to industrial production.

At the same time, just as with classifications, these dimensions of standards are in some sense idealized. They embody goals of practice and production that are never perfectly realized, like Plato's triangles. The process of building to a standardized code, for example, usually includes a face-to-face negotiation between builder(s) and inspector(s), which itself includes a history of relations between those people. Small deviations are routinely overlooked, unless the inspector is making a political point. The idiom "good enough for government use" embodies the common-sense accommodations of the slip between the ideal standard and the contingencies of practice.

In this and in many other ways, then, classifications and standards are two sides of the same coin. Classifications may or may not become standardized. If they do not, they are ad hoc, limited to an individual or a local community, and/or of limited duration. At the same time, every successful standard imposes a classification system, at the very least between good and bad ways of organizing actions or things. And the work-arounds involved in the practical use of standards frequently entail the use of ad hoc nonstandard categories. For example, a patient may respond to a standardized protocol for the management of chronic back pain by approximating the directions and supplementing them with an idiosyncratic or alternative medical classification scheme. If the protocol requires a number of exercises done three times a day, patients may distinguish good days from bad days, vacation days from working days, and only do the exercises when they deem them necessary.

Classifications and standards are related in another sense, which concerns the use of a classification by more than one social world or community of practice, and the impact that use has on questions of membership and the taken-for-grantedness of objects (Cambrosio and Keating 1995). Throughout this book, we speak of classifications as objects for cooperation across social worlds, or as boundary objects (Star and Griesemer 1989). Drawing from earlier studies of

interdisciplinary scientific cooperation, we define boundary objects as those objects that both inhabit several communities of practice *and* satisfy the informational requirements of each of them. In working practice, they are objects that are able both to travel across borders and maintain some sort of constant identity. They can be tailored to meet the needs of any one community (they are plastic in this sense, or customizable). At the same time, they have common identities across settings. This is achieved by allowing the objects to be weakly structured in common use, imposing stronger structures in the individual-site tailored use. They are thus both ambiguous and constant; they may be abstract or concrete. In chapter 9, we explore in detail the abstract ramifications of the use of classifications by more than one community and the connection with the emergence of standards.

The Structure of This Book

To explore these questions, we have written a first chapter detailing some key themes of the work to follow. We have then divided the middle of the book into three parts, which look at several classification systems. We have structured these studies around three issues in turn: classification and large-scale infrastructures (part I), classification and biography (part II), and classification and work practice (part III). Weaving these three themes together, we can explore the texture of the space within which infrastructures work and classification systems from different worlds meet, adjust, fracture, or merge. In two concluding chapters, we elaborate some theoretical conclusions from these studies.

Part I: Classification and Large-Scale Infrastructures

Classification systems are integral to any working infrastructure. In part I (chapters 2 to 4) we examine how a global medical classification system was developed to serve the conflicting needs of multiple local, national, and international information systems.

Our investigation here begins in the late nineteenth century with another kind of information explosion—the development of myriad systems of classification and standardization of modern industrial and scientific institutions.

In the nineteenth century people learned to look at themselves as surrounded by tiny, invisible things that have the power of life or death: microbes and bacteria. They learned to teach their children to

wash their hands of germs before eating, and later, to apply antiseptic salve to a cat scratch or an inflamed fingernail. Company washrooms sprouted signs admonishing employees to wash hands before returning to work, especially if they worked with food served to others. In this period, people also learned how to perform surgery that would not usually be fatal and how to link gum disease with bacteria between the teeth.

At the same time they learned these practices about germs, another ubiquitous set of tiny, invisible things were being negotiated and sewn into the social fabric. These were formal, commodified classifications and standards, both scientific and commercial. People classified, measured, and standardized just about everything—animals, human races, books, pharmaceutical products, taxes, jobs, and diseases. The categories so produced lived in industry, medicine, science, education, and government. They ranged from the measurement of machine tools to the measurement of people's forearms and foreheads. The standards were sometimes physically tiny measures: how big should a standard size second of time be, an eyeglass screw, or an electrical pulse rate?[4] At other times, they were larger: what size should a railroad car be, a city street, or a corporation? Government agencies, industrial consortia, and scientific committees created the standards and category systems. So did mail-order firms, machine-tool manufacturers, animal breeders, and thousands of other actors. Most of these activities became silently embodied in the built environment and in notions of good practice. The decisions taken in the course of their construction are forever lost to the historical record. In fact, their history is considered by most to be boring, trivial, and unworthy of investigation.

There are some striking similarities to our own late twentieth-century historical moment in that faced by Europeans at the end of the nineteenth century. A new international information-sharing and gathering movement was starting, thanks to the advent of wide-scale international travel, international quasigovernmental governance structures, and a growing awareness that many phenomena (like epidemics and markets) would not be confined to one country. In the nineteenth century, for the first time people faced large numbers of bodies and their microbes moving rapidly across national borders and between large bureaucracies—and at an unprecedented rate. Especially in the case of epidemics, international public health became an urgent necessity. Attempts to control these passengers represent one of the first large-scale western medical classification schemes: ships that

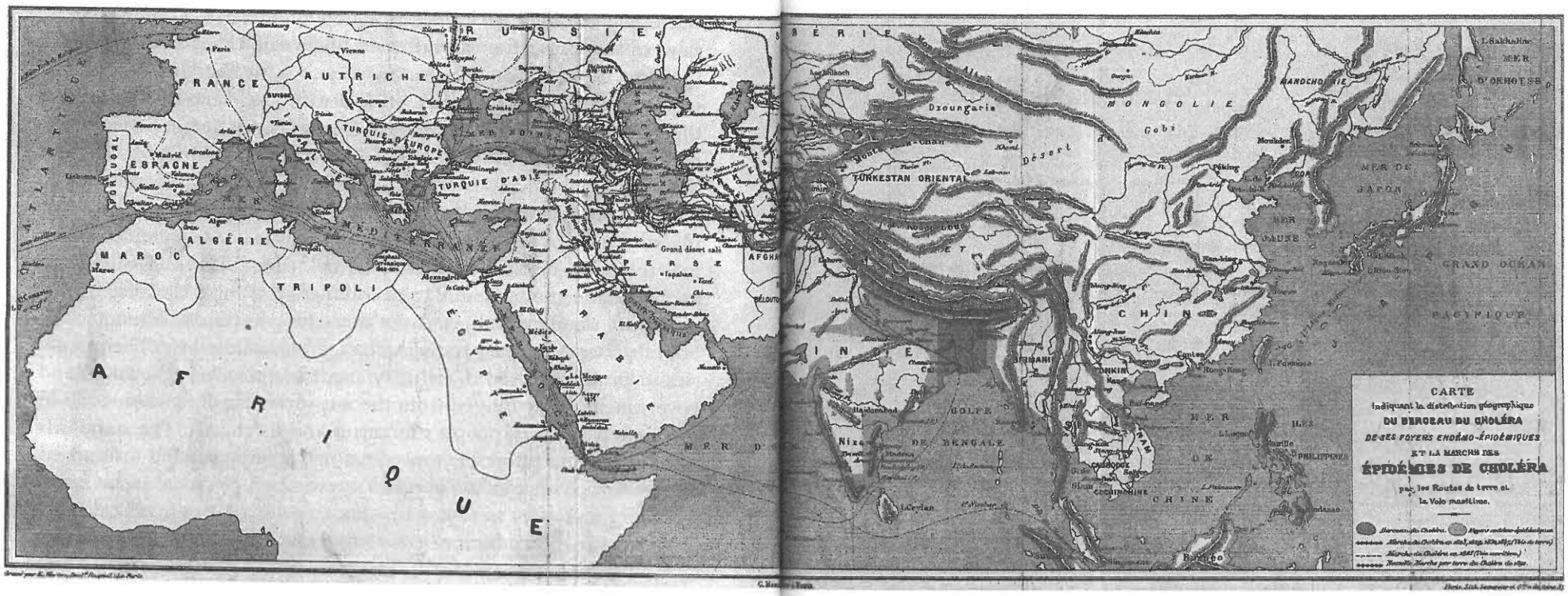

Figure I.1
Map indicating the geographical distribution of the sources of cholera and "the progress of cholera epidemics" by land and sea routes. The progression by land is shown by the line with small vertical marks (1823–1847), by sea in 1865 via ship, and new progressions overland from 1892. Note the sea routes marked between Mecca and Marseilles.
Source: A. Proust 1892.

called at ports on the way back from Mecca had to follow a period of quarantine during which anyone infected would become symptomatic—thus emulating the slower timeline of horse or camel travel (see figure I.1).

After quarantine, one was given a "clean bill of health" and allowed freedom of transport. This was a costly delay for the ships, and so a black market in clean bills of health appeared shortly thereafter . . . . The problem of tracking who was dying of what and where on earth became a permanent feature of international bureaucracy (see figure I.2).

Constructing such a list may appear to be to us a comparatively straightforward task, once the mechanisms for reporting were in place. For over 100 years, however, there has never been consensus about disease categories or about the process of collecting data. So one culture sees spirit possession as a valid cause of death, another ridicules this as superstition; one medical specialty sees cancer as a localized phenomenon to be cut out and stopped from spreading, another sees it as a disorder of the whole immune system that merely manifests in one location or another. The implications for both treatment and classification differ. Trying to encode both causes results in serious information retrieval problems.

In addition, classifications shift historically. In Britain in 1650 we find that 696 people died of being "aged"; 31 succumbed to wolves, 9 to grief, and 19 to "King's Evil." "Mother" claimed 2 in 1647 but none in 1650, but in that year 2 were "smothered and stifled" (see figure I.3). Seven starved in 1650 (Graunt 1662), but by 1930 the WHO would make a distinction: if an adult starved to death it was a misfortune; if a child starved, it was homicide. Death by wolf alone becomes impossible by 1948, where death from animals is divided between venomous and nonvenomous, and only dogs and rats are singled out for categories of their own (ICD-5 1948, 267).

N°

PATENTE DE SANTÉ

Nom du bâtiment... .
Nature du bâtiment..
Pavillon.....
Tonneaux.....
Canons.....
Appartenant au port d
Destination .....
Nom du capitaine.....
Nom du médecin.....
Équipage (tout compris).....
Passagers.....
Cargaison..... ...
État hygiénique du navire.....
État hygiénique de l'équipage (couchage, vêtements, etc.)....
État hygiénique des passagers..... .
Vivres et approvisionnements divers.....
Eau.....

Malades à bord

État sanitaire { du port..... des environs

Il a été constaté dans le port ou ses environs pendant la dernière semaine écoulée :

..... cas de choléra.
..... cas de fièvre jaune.
..... cas de peste.

Délivrée le du mois d 189 ,
à heure du .

ADMINISTRATION SANITAIRE DE FRANCE

N° RÉPUBLIQUE FRANÇAISE PORT

ADMINISTRATION SANITAIRE

PATENTE DE SANTÉ

Nous, de la santé à
certifions que le bâtiment ci-après désigné part de ce port dans les conditions suivantes, dûment constatées :

Nom du bâtiment.....
Nature du bâtiment...
Pavillon .....
Tonneaux.....
Canons.....
Appartenant au port d
Destination .....
Nom du capitaine.....
Nom du médecin.....
Équipage (tout compris)
Passagers .....
Cargaison..... .....

Malades à bord
État hygiénique du navire.....
État hygiénique de l'équipage (couchage, vêtements, etc.).....
État hygiénique des passagers .....
Vivres et approvisionnements divers.....
Eau.....

Conformément aux articles 30, 31, 32 et 33 du règlement, l'état sanitaire du navire a été vérifié, la visite médicale a été passée au moment de l'embarquement des passagers et il a été constaté qu'il n'existait à bord, *au moment du départ*, aucun malade atteint d'affection pestilentielle (choléra, fièvre jaune, peste), ni linge sale, ni substance susceptible de nuire à la santé du bord.

Nous certifions, en outre, que l'état sanitaire { du port est..... des environs est.....

et qu'il a été constaté dans le port (ou ses environs) pendant la dernière semaine écoulée { .....cas de choléra .....cas de fièvre jaune .....cas de peste

En foi de quoi, nous avons délivré la présente patente, à , le du mois d 189 , à heure du

L'Expéditionnaire de la Patente,

Sceau de l'Administration,

LE DE LA SANTÉ,

PRESCRIPTIONS EXTRAITES DU RÈGLEMENT GÉNÉRAL DE POLICE SANITAIRE MARITIME

VOIR AU VERSO.

Figure I.2
French bill of health. An original "clean bill of health."
Source: A. Proust 1892.

The first part of this book is dedicated to understandig the construction of the International Classification of Diseases (ICD): a classification scheme with its origins in the late nineteenth century but still present today—indeed, it is ubiquitous in medical bureaucracy and medical information systems. The ICD constitutes an impressive attempt to coordinate information and resources about mortality and morbidity globally. For the background research for understanding international processes of classification, we went to Geneva and studied the archives of the WHO and its predecessors such as the League of Nations and the Office Internationale d'Hygiène Publique. Roughly every ten years since the 1890s, the ICD has been revised. The UN and the WHO have kept some records of the process of revision; others are to be found in the file cabinets of individuals involved in the revision process.

What we found was not a record of gradually increasing consensus, but a panoply of tangled and crisscrossing classification schemes held together by an increasingly harassed and sprawling international public health bureaucracy. Spirit possession and superstition never do reconcile, but for some data to be entered on the western-oriented death certificate, it becomes possible from the WHO point of view for a death to be assigned the category "nonexistent disease."

One of the other major influences on keeping medical records has been insurance companies, as we discuss in chapter 4. As the working lives of individuals became more closely tied up with the state and its occupational health concerns, the classification of work-related diseases (including industrial accidents) became very important. Life expectancy measures were equally important, both for estimating the available labor force and for basic planning measures. Of course, occupational and nonwork related medical classifications did not always line up: companies might have been reluctant to take responsibility for unsafe working conditions, latency in conditions such as asbestosis makes data hard to come by; thus there may have been moral conflicts about the cause of such illnesses.

In similar fashion, any classification that touched on religious or ethical questions (and surprisingly many do so) would be disputed. If life begins at the moment of conception, abortion is murder and a fetus dead at three months is a stillbirth, encoded as a live infant death. Contemporary abortion wars in the United States and western Europe attest to the enduring and irreconcilable ontologies involved in these codifications.

The Table of CASUALTIES.

The Years of our Lord	1647	1648	1649	1650	1651	1652	1653	1654	1655	1656	1657	1658
Abortive and Stil-born	335	329	327	351	389	381	384	433	483	419	463	467
Aged	916	835	889	696	780	834	864	974	743	892	869	1176
Ague and Fever	1260	884	751	970	1038	1212	282	1371	689	875	999	1800
Apoplex and Suddenly	68	74	64	74	106	111	118	86	92	102	113	138
Bleach			1	3	7	2				1		
Blasted	4	1			6	6			4		5	5
Bleeding	3	2	5	1	3	4	3	2	7	3	5	4
Bloody Flux, Scouring and Flux	155	176	802	289	833	762	200	386	168	368	362	233
Burnt and Scalded	3	6	10	5	11	8	5	7	10	5	7	4
Calenture	1			1		2	1	1			3	
Cancer, Gangrene and Fistula	26	29	31	19	31	53	36	37	73	31	24	35
Wolf				8								
Canker, Sore-mouth and Thrush	66	28	54	42	68	51	53	72	44	81	19	27
Child-bed	161	106	114	117	206	213	158	192	177	201	236	225
Chrisoms and Infants	1369	1254	1065	990	1237	1280	1050	1343	1089	1393	1162	1144
Colick and Wind	103	71	85	82	76	102	80	101	85	120	113	179
Cold and Cough							41	36	21	58	30	31
Consumption and Cough	2423	2200	2388	1988	2350	2410	2286	2868	2606	3184	2757	3610
Convulsion	684	491	530	493	569	653	606	828	702	1027	807	841
Cramp			1									
Cut of the Stone		2	1	3		1	1	2	4	1	3	5
Dropsie and Tympany	185	434	421	508	444	556	617	704	660	706	631	931
Drowned	47	40	30	27	49	50	53	30	43	49	63	60
Excessive drinking			2									
Executed	8	17	29	43	24	12	19	21	19	22	20	18
Fainted in a Bath					1							
Falling-Sickness	3	2	2	3		3	4	1	4	3	1	
Flox[1] and small Pox	139	400	1190	184	525	1279	139	812	1294	823	835	409
Found dead in the Streets	6	6	9	8	7	9	14	4	3	4	9	11
French-Pox	18	29	15	18	21	20	20	20	29	23	25	53
Frighted	4	4	1		3		2		1	1		
Gout	9	5	12	9	7	7	5	6	8	7	8	13
Grief	12	13	16	7	17	14	11	17	10	13	10	12
Hanged, and made-away themselves	11	10	13	14	9	14	15	9	14	16	24	18
Head-Ach		1	11	2		2	6	6	5	3	4	5
Jaundice	57	35	39	49	41	43	57	71	61	41	46	77
Jaw-faln	1	1			3			2	2		3	1
Impostume	75	61	65	59	80	105	79	90	92	122	80	134
Itch		1										
Killed by several Accidents	27	57	39	94	47	45	57	58	52	43	52	47
King's Evil	27	26	22	19	22	20	26	26	27	24	23	28
Lethargy	3	4	2	4	4	4	3	10	9	4	6	2
Leprosie			1									1
Liver-grown, Spleen and Rickets	53	46	56	59	65	72	67	65	52	50	38	51
Lunatick	12	18	6	11	7	11	9	12	6	7	13	5
Meagrom	12	13		5	8	6	6	14	3	6	7	6
Measles	5	92	3	33	33	62	8	52	11	153	15	80
Mother	2					1	1	2	2	3		3
Murdered	3	2	7	5	4	3	3	3	9	6	5	7
Overlaid and Starved at Nurse	25	22	36	28	28	29	30	36	58	53	44	50
Palsie	27	21	19	20	23	20	29	18	22	23	20	22
Plague	3597	611	67	15	23	16	6	16	9	6	4	14
Plague in the Guts				1		110	32		87	315	446	
Pleurisie	30	26	13	20	23	19	17	23	10	9	17	16
Poisoned		3		7								
Purples and Spotted Fever	145	47	43	65	54	60	75	89	56	52	56	126
Quinsie and Sore-throat	14	11	12	17	24	20	18	9	15	13	7	10
Rickets	150	224	216	190	260	329	229	372	347	458	317	476
Mother, rising of the Lights	150	92	115	120	134	138	135	178	166	212	203	228
Rupture	16	7	7	6	7	16	7	15	11	20	19	18
Scal'd head	2				1				2			
Scurvy	32	20	21	21	29	43	41	44	103	71	82	82
Smothered and stifled			2									
Sores, ulcers, broken and bruised	15	17	17	16	26	32	25	32	23	34	40	47
Shot (Limbs												
Spleen	12	17					13	13		6	2	5
Shingles												
Starved		4	8	7	1	2	1	1	3	1	3	6
Stitch				1								
Stone and Strangury	45	42	29	28	50	41	44	38	49	57	72	69
Sciatica												
Stopping of the Stomach	29	29	30	33	55	67	66	107	94	145	129	277
Surfet	217	137	136	123	104	177	178	212	128	161	137	218
Swine-Pox	4	4	3				1	4	2	1	1	1
Teeth and Worms	767	597	540	598	709	905	691	1131	803	1198	878	1036
Tissick	62	47										
Thrush											57	66
Vomiting	1	6	3	7	4	6	3	14	7	27	16	19
Worms	147	107	105	65	85	86	53					
Wen	1		1		2	2			1		1	2
Suddenly												

[1] Probably a name for confluent small p

1659	1660	1629	1630	1631	1632	1633	1634	1635	1636	1629 1630 1631 1632	1633 1634 1635 1636	1647 1648 1649 1650	1651 1652 1653 1654	1655 1656 1657 1658	1629 1649 1659	In 20 Years.
421	544	499	439	410	445	500	475	507	523	1793	2005	1342	1587	1832	1247	8539
909	1095	579	712	661	671	704	623	794	714	2475	2814	3336	3452	3680	2377	15759
2303	2148	956	1091	1115	1108	955	1279	1622	2560	4418	6235	3865	4903	4363	4010	23784
91	67	22	36		17	24	35	26		75	85	280	421	445	177	1306
												4	9	1	1	15
3	8	13	8	10	13	6	4		4	54	14	5	12	14	16	99
7	2	5	2	5	4	4	3			16	7	11	12	19	17	65
346	251	449	438	352	348	278	512	346	330	1587	1466	1422	2181	1161	1597	7818
6	6	3	10	7	5	1	3	12		25	19	24	31	26	19	125
								3			4	2	4	3		13
63	52	20	14	23	28	27	30	24	30	85	112	105	157	150	114	609
											8					8
73	68	6	4	4	1			5	74	15	79	190	244	161	133	689
226	194	150	157	112	171	132	143	163	230	590	668	498	769	839	490	3364
858	1123	2596	2378	2035	2268	2130	2315	2113	1895	9277	8453	4678	4910	4788	4519	32106
116	167	48	57					37	50	105	87	341	359	497	247	1389
33	24	10	58	51	55	45	54	50	57	174	207	00	77	140	43	598
2982	3414	1827	1910	1713	1797	1754	1955	2080	2477	5157	8266	8999	9914	12157	7197	44487
742	1031	52	87	18	241	221	386	418	709	498	1734	2198	2656	3377	1324	9073
				1	0	0	0	0	0	01	00	01	0	0	1	2
6	4				5	1	5	2	2	5	10	6	4	13	47	38
646	872	235	252	279	280	266	250	329	389	1048	1734	1538	2321	2982	1302	9623
57	48	43	33	29	34	37	32	32	45	139	147	144	182	215	130	827
												2			2	2
7	18	19	13	12	18	13	13	13	13	62	52	97	76	79	55	384
													1			1
4	5	3	10	7	7	2	5	6	8	27	21	10	8	8	9	74
1523	354	72	40	58	531	72	1354	293	127	701	1846	1913	2755	3361	2785	10576
2	6	18	33	20	6	13	8	24	24	83	69	29	34	27	29	243
51	31	17	12	12	12	7	17	12	22	53	48	80	81	130	83	392
	9	1			1				3	2	3	9	5	2	2	21
14	2	2	5	3	4	4	5	7	8	14	24	35	25	36	28	134
13	4	18	20	22	11	14	17	5	20	71	56	46	59	45	47	279
11	36	8	8	6	15		3	8	7	37	18	48	47	72	32	222
35	26							4	2	0	6	14	14	17	46	051
102	76	47	59	35	43	35	45	54	63	184	197	180	212	225	188	998
		10	16	13	8	10	10	4	11	47	35	02	5	6	10	95
105	96	58	76	73	74	50	62	73	130	282	315	260	35	428	228	1639
						10				00	10	01				11
55	47	54	55	47	46	49	41	51	60	202	201	217	207	194	148	1021
28	54	16	25	18	38	35	20	20	69	97	150	94	94	102	66	537
6	4	1		2	2	3		2	2	5	7	13	21	21	9	67
	2	2						2		2	2	1		1	3	06
8	15	94	12	99	87	82	77	98	99	392	356	213	269	191	158	1421
14	14	6	11	6	5	4	2	2	5	28	13	47	39	31	26	158
5	4			24					22	24	22	30	34	22	05	132
6	74	42	2	3	80	21	33	27	12	127	83	133	155	259	51	757
1	8	1							3	01	3	2	4	8	02	18
70	20			3	7		6	5	8	10	1[illegible]	17	13	27	77	86
46	43	4	10	13	7	8	14	10	14	34	46	111	123	215	86	529
17	21	17	23	17	25	14	21	25	17	82	77	87	90	87	53	423
36	14		1317	274	8		1		10400	1599	10401	4290	61	33	103	16384
253	402									00	00	61	142	844	253	991
12	10	26	24	26	36	21		45	24	112	90	89	72	52	51	415
						2			2	00	4	10	00	00	00	14
368	146	32	58	58	38	24	125	245	397	186	791	300	278	290	243	1845
21	14	01	8	6	7	24	04	5	22	22	55	54	71	45	34	247
441	521						14	49	50	00	113	780	1190	1598	657	3681
210	249	44	72	99	98	60	84	72	104	309	220	777	585	809	369	2700
12	28	2	6	4	9	4	3	10	13	21	30	36	45	68	21	201
												2	1	2		05
95	12	5	7	9		9		00	25	33	34	94	132	300	115	593
			24							24		2			2	26
61	48	23		20	48	19	19	22	29	91	89	65	115	144	141	504
7	20														07	27
7	7											29	26	13	07	68
1						1					1				1	2
7	14									1[illegible]		19	5	13	29	51
												1				1
22	30	35	39	58	50	58	49	33	45	114	185	144	173	247	51	937
	2				1	3		1	6	1	4					13
186	214								6		6	121	295	247	216	669
202	192	63	157	149	86	104	114	132	371	445	721	613	671	644	401	3094
2		5	8	4	6	3		10		23	13	11	5	5	10	57
839	1008	440	506	335	470	432	454	539	1207	1751	2632	2502	3436	3915	1819	14236
		8	12	14	34	23	15	27		68	65	109			8	242
		15	23	17	40	28	31	34		95	93			123	15	211
8	10	1	4	1	1	2	3	6	3	7	16	17	27	69	12	136
		19	31	28	27	19	26	27		105	74	424	224		124	830
1	1			1		4				1	4	2	4	4	2	15
		63	59	37	62	58	62	78	34	221	233				63	454
															34190	229250

ox. See Creighton, i., 462—463.

This Table to face *page* 206.

Figure I.3

The table of casualties, England in the seventeenth century.
Source: J. Graunt 1662.

For a bureaucracy to establish a smooth data collection effort, a means must be found to detour around such higher order issues. The statistical committee discussed in chapter 4, assigned with determining the exact moment of the beginning of life by number of attempted breaths and weight of fetus or infant, cuts a Solomon-like figure against such a disputed landscape. At the same time, there is an element of reductionist absurdity here—how many breaths equals "life"? If not specified, another source of quality control for data is lost; if specified, it appears to make common sense ironic. This is an issue we will revisit as well in the discussion of nursing interventions, in chapter 7.

Algorithms for codification do not resolve the moral questions involved, although they may obscure them. For decades, priests, feminists, and medical ethicists on both sides have debated the question of when a human life begins. The moral questions involved in encoding such information—and the politics of certainty and of voice involved—are much more obscure.

Forms like the death certificate, when aggregated, form a case of what Kirk and Kutchins (1992) call "the substitution of precision for validity" (see also Star 1989b). That is, when a seemingly neutral data collection mechanism is substituted for ethical conflict about the contents of the forms, the moral debate is partially erased. One may get ever more precise knowledge, without having resolved deeper questions, and indeed, by burying those questions.

There is no simple pluralistic answer to how such questions may be resolved democratically or with due process. Making all knowledge retrievable, and thus re-debatable, is an appealing solution in a sense from a purely information scientific point of view. From a practical organizational viewpoint, however, this approach fails. For example, in 1927, a manual describing simultaneous causes of death listed some 8,300 terms, which represented 34 million possible combinations that might appear on the face of a death certificate. A complete user manual for filling out the certificate would involve sixty-one volumes of 1,000 pages each. This is clearly not a pragmatic choice for conducting a task that most physicians also find boring, low-status, and clinically unimportant.

As we know from studies of work of all sorts, people do not do the ideal job, but the doable job. When faced with too many alternatives and too much information, they satisfice (March and Simon 1958). As an indicator of this, studies of the validity of codes on death certificates repeatedly show that doctors have favorite categories; these are regionally biased; and autopsies (which are rarely done) have a low rate of agreement with the code on the form (Fagot-Largeault 1989).

Even when there is relatively simple consensus about the cause of death, the act of assigning a classification can be socially or ethically charged. Thus, in some countries the death certificate has two faces: a public certificate handed to the funeral director so that arrangements can be made quickly and discreetly, and a statistical cause filed anonymously with the public health department. In this case, the doctor is not faced with telling the family of a socially unacceptable form of death: syphilis can become heart failure, or suicide can become a stroke. For example, as we discuss in chapter 4, the process of moving to an anonymous statistical record may reveal hidden biases in the reporting of death. Where the death certificate is public, stigma and the desire to protect the feelings of the family may reign over scientific accuracy.

Over the years, those designing the list of causes of death and disease have struggled with all of these problems. One of the simple but important rules of thumb to try to control for this degree of uncertainty is to distribute the residual categories. "Not elsewhere classified" appears throughout the entire ICD, but nowhere as a top-level category. So since uncertainty is inevitable, and its scope and scale essentially unknowable, at least its impact will not hit a single disease or location disproportionately. Its effects will remain as local as possible; the quest for certainty is not lost, but postponed, diluted, and abridged.

With the rise of very-large-scale information systems, the Internet, the Web, and digital libraries, we find that the sorts of uncertainties faced by the WHO are themselves endemic in our own lives. When we use email filters, for example, we risk losing the information that does not fit the sender's category: junk email is very hard to sort out automatically in a reliable way. If we have too many detailed filters, we lose the efficiency sought from the filter in the first place. As we move into desktop use of hyperlinked digital libraries, we fracture the traditional bibliographic categories across media, versions, genres, and author. The freedom entailed is that we can customize our own library spaces; but as Jo Freeman (1972) pointed out in her classic article, "The Tyranny of Structurelessness," this is also so much more work that we may fall into a lowest level convenience classification rather than a high-level semantic one. In one of our digital library projects at Illinois, for example, several undergraduates we interviewed in

focus groups stated that they would just get five references for a term paper—any five—since that is what the professor wanted, and references had better be ones that are listed electronically and available without walking across campus.

The ICD classification is in many ways an ideal mirror of how people designing global information schemes struggle with uncertainty, ambiguity, standardization, and the practicalities of data quality. Digging into the archives, and reading the ICD closely through its changes, reveals some of the upstream, design-oriented decisions informing the negotiated order achieved by the vast system of forms, boxes, software, and death certificates. At the same time, we have been constantly aware of the human suffering often occasioned by the apparently bloodless apparatus of paperwork through which these data are collected.

Part II: Classification and Biography

The second part of this book looks at two cases where the lives of individuals are broken, twisted, and torqued by their encounters with classification systems. This often invisible anguish informs another level of ethical inquiry. Once having been made, the classification systems are applied to individual cases—sometimes resulting in a kind of surreal bureaucratic landscape. Sociologist Max Weber spoke of the "iron cage of bureaucracy" hemming in the lives of modern workers and families. The cage formed by classification systems can be constraining in just this way, although cage might be too impoverished a metaphor to describe its variations and occasional stretches. In chapters 5 and 6 we look at biography and classification. We chose two examples where classification has become a direct tool mediating human suffering. Our first case concerns tuberculosis patients and the impact of disease classification on their lives. We use historical data to discuss the experience of the disease within the tuberculosis asylum.

Tuberculosis patients, like many with chronic illness, live under a confusing regime of categories and metrics (see also Ziporyn 1992). Many people were incarcerated for years—some for decades—waiting for the disease to run its course, to achieve a cure at high altitudes, or to die there. They were subjected to a constant battery of measurements: lung capacity, auscultation, body temperature and pulse rate, x-rays, and, as they were developed, laboratory tests of blood and other bodily fluids. The results of the tests determined the degree of freedom from the sanatorium regime as well as, ultimately, the date of release.

Of no surprise to medical sociologists, the interpretation and negotiations of the tests between doctor and patient were fraught with questions of the social value of the patient (middle-class patients being thought more compliant and reliable when on furlough from the asylum than those from lower classes), with gender stereotypes, and with the gradual adaptation of the patient's biographical expectations to the period of incarceration. Thomas Mann's *The Magic Mountain* and Julius Roth's *Timetables* are full of stories of classification and metrication. We examine how different time lines, and expectations about those time lines, unfold in these two remarkable volumes. Biography, career, the state of the medical art with respect to the disease, and the public health adjudication of tuberculosis are all intertwined against the landscape of the sanatorium.

Life in the sanatorium has a surreal, almost nightmarish quality, as detailed by Mann, Roth, and many other writers throughout the twentieth century. This sense comes precisely from the misalignment of a patient's life expectations, the uncertainties of the disease and of the treatment, and the negotiations laden with other sorts of interactional burdens. It is one thing to be ill and in the hospital with an indefinite release date. It is quite another when the date of release includes one's ability to negotiate well with the physicians, their interpretation of the latest research, and the exigencies of public health forms and red tape. We call this agglomeration *torque*, a twisting of time lines that pull at each other, and bend or twist both patient biography and the process of metrication. When all are aligned, there is no sense of torque or stress; when they pull against each other over a long period, a nightmare texture emerges.

A similar torque is found in the second case in this section, that of race classification and reclassification under apartheid in South Africa. Between 1950 and the fall of apartheid forty years later, South Africans were ruled under an extremely rigid, comprehensive system of race classification. Divided into four main racial groups—white/European, Bantu (black), Asian and coloured (mixed race)—people's lives were rigidly segregated. The segregation extended from so-called petty apartheid (separate bus stops, water fountains, and toilets) to rights of work, residency, education, and freedom of movement. This system became the target of worldwide protest and eventually came to a formal end. These facts are common knowledge. What

has been less well documented or publicized are the actual techniques used to classify people by race. In chapter 6, we examine in detail some cases of mixed-race people who applied to be reclassified after their initial racial designation by the state. These borderline cases serve to illuminate the underlying architecture of apartheid. This was a mixture of brute power, confused eugenics, and appropriations of anthropological theories of race. The scientific reason given for apartheid by the white supremacist Nationalist party was "separate development"—the idea that to develop naturally, the races must develop separately.

In pursuing this ideology, of course, people and families that crossed the color barrier were problematic. If a natural scientific explanation was given for apartheid, systematic means should be available to winnow white from black, coloured from black and so on. As the chapter delineates, this attempt was fraught with inconsistencies and local work-arounds, as people never easily fit any categories. Over 100,000 people made formal appeals concerning their race classification; most were denied.

Although it lies at a political extreme, these cases form a continuum with the classification of people at different stages of tuberculosis. In both cases, biographies and categories fall along often conflicting trajectories. Lives are twisted, even torn, in the attempt to force the one into the other. These torques may be petty or grand, but they are a way of understanding the coconstruction of lives and their categories.

Part III: Classification and Work Practice

In part III, chapters 7 and 8, look at how classification systems organize and are organized by work practice. We examine the effort of a group of nursing scientists based at the University of Iowa, led by Joanne McCloskey and Gloria Bulechek, to produce a classification of nursing interventions. Their Nursing Intervention Classification (NIC) aims at depicting the range of activities that nurses carry out in their daily routines. Their original system consisted of a list of some 336 interventions; each comprised of a label, a definition, a set of activities, and a short list of background readings. Each of those interventions is in turn classified within a taxonomy of six domains and twenty-six classes. For example, one of the tasks nurses commonly perform is preparing and monitoring intravenous medication. The nursing intervention "epidural analgesia administration" is defined as:

"preparation and delivery of narcotic analgesics into the epidural space;" another common one, "cough enhancement," groups activities designed to help respiration.

The Iowa NIC researchers built up their system of nursing interventions inductively. They created a preliminary list that distinguished between nursing interventions and activities, then nurtured a large grassroots network of nursing researchers.[5] This group narrowed the preliminary list of interventions to the original 336 published in NIC and further validated them via surveys and focus groups. Different interventions were reviewed for clinical relevance, and a coding scheme was developed. The classification system grew through a cooperative process, with nurses in field sites trying out categories, and suggesting new ones in a series of regional and specialist meetings. Since 1992 the nurses have added over 50 interventions to their original list. We attended a number of these meetings, and interviewed many of the nurses involved.

Caring work such as calming and educating patients, usually done by nurses, often cuts across specific medical diagnostic categories. The NIC investigators use their list of interventions to make visible and legitimate the work that nurses do. The idea is that it will be used to compare work across hospitals, specialties, and geographical areas, and to build objective research measures for the outcomes. NIC, although still relatively young, promises to be a major rallying point for nurses in the decades to come. Before NIC, much nursing work was invisible to the medical record. As one nurse poignantly said, "we were just thrown in with the cost of the room." Another said, "I am not a bed!" The traditional, quintessential nurse would be ever present, caregiving, and helpful—but not a part of the formal patient-doctor information structure. Of course, this invisibility is bound up with traditional gender roles, as with librarians, social workers, and primary school teachers.

But as with the ICD, classifying events is difficult. In the case of NIC, the politics move from a politics of certainty to a politics of ambiguity. The essence of this politics is walking a tightrope between increased visibility and increased surveillance; between overspecifying what a nurse *should* do and taking away discretion from the individual practitioner.

When discretion and the tacit knowledge that is part of every occupation meet the medical bureaucracy, which would account for every pill and every moment of health care workers' time, contradictions

ensue. This is especially true in the "softer" areas of care. Social-psychological care giving is one of the areas where this dilemma is prominent. For example, NIC lists as nursing interventions "anticipatory guidance" and "mood management"—preparation for grief or surgery. Difficult though these are to capture in a classification scheme, one much more difficult is "humor." How can one capture humor as a deliberate nursing intervention? Does sarcasm, irony, or laughter count as a nursing intervention? When do you stop? How to reimburse humor, how to measure this kind of care? No one would dispute the importance of humor, but it is by its nature a situated and subjective action. A grey area of common sense remains for the individual staff nurse to define whether some of the nursing interventions are worth classifying.

There are continuing tensions within NIC between just this kind of common sense and abstracting away from the local to standardize and compare, while at the same time rendering invisible work visible. Nurses' work is often invisible for a combination of good and bad reasons. Nurses have to ask mundane questions, rearrange bedcovers, move a patient's hand so that it is closer to a button, and sympathize about the suffering involved in illness. Bringing this work out into the open and differentiating its components can mean belaboring the obvious or risking being too vague.

One of the battlefields where comparability and control appear as opposing factors is in linking NIC to costs. NIC researchers assert that the classification of nursing interventions will allow a determination of the costs of services provided by nurses and planning for resources needed in nursing practice. As the nurse above says, nursing treatments are usually bundled in with the room price. NIC is used in the development of nursing health care systems and may provide a planning vehicle for previously untracked costs. As we shall see, NIC can also be problematic for nurses. Like any other classification scheme that renders work visible, it can also render surveillance easier—and it could in the end lead to a Tayloristic dissection of the tasks of nursing (as the NIC designers are well aware). So-called unskilled tasks may be taken out of their hands and the profession as a whole may suffer a loss of autonomy and the substitution of rigid procedure for common sense.

As in the case of the ICD, there are many layers of meaning involved in developing and implementing nursing classification. NIC might look like a straightforward organizational tool: it is in fact much more than that. It merges science, practice, bureaucracy, and information systems. NIC coordinates bodies, impairments, charts, reimbursement systems, vocabularies, patients, and health care professionals. Ultimately, it provides a manifesto for nursing as an organized occupation, a basis for a scientific domain, and a tool for organizing work practices.

Why It Is Important to Study Classification Systems

The sheer density of the collisions of classification schemes in our lives calls for a new kind of science, a new set of metaphors, linking traditional social science and computer and information science. We need a topography of things such as the distribution of ambiguity; the fluid dynamics of how classification systems meet up—a plate tectonics rather than a static geology. This new science will draw on the best empirical studies of work-arounds, information use, and mundane tools such as desktop folders and file cabinets (perhaps peering backwards out from the Web and into the practices). It will also use the best of object-oriented programming and other areas of computer science to describe this territory. It will build on years of valuable research on classification in library and information science.

We end this introduction with a future scenario that symbolizes this abstract endeavor. Imagine that you are walking through a forest of interarticulated branches. Some are covered with ice or snow, and the sun melts their touching tips to reveal space between. Some are so thickly brambled they seem solid; others are oddly angular in nature like esplanaded trees.

Some of the trees are wild, some have been cultivated. Some are old and gnarled, and some are tiny shoots; some of the old ones are nearly dead, others show green leaves. The forest is still wild, but there are some parks, and some protocols for finding one's way along, at least on the known paths. Helicopters flying overhead can quickly tell you how many types of each tree, even each leaf, there are in the world but they cannot yet give you a guidebook for bird-watching or forestry management. There is a lot of underbrush and a complex ecology of soil bacteria, flora, and fauna.

Now imagine that the forest is a huge information space and each of the trees and bushes are classification systems. Those who make them up and use them are the animals and plants, and the soil is a mix of the Internet, the paper world, and other communication infrastructures.

Your job is to describe this forest. You may write a basic manual of forestry, or paint a landscape, compose an opera, or improve the maps used throughout. What will your product look like? Who will use it?

In this book, we show from our studies of medical, scientific, and race classification that, like a good forest, some areas will be left wild, or in darkness, or even unmapped (that is, some ambiguity will remain). We will show that abstract schema that do not take use into account—say, maps that leave out landmarks or altitude or how readers use maps—will simply fail. (That is, common sense will be seen as the precious resource that it is.) We intuit that a mixture of scientific, poetic, and artistic talents, such as that represented in the hypertextual world, will be crucial to this task. We will demonstrate the value of a mixture of formal and folk classifications that are used sensibly in the context of people's lives.

1

Some Tricks of the Trade in Analyzing Classification

My guess is that we have a folk theory of categorization itself. It says that things come in well-defined kinds, that the kinds are characterized by shared properties, and that there is one right taxonomy of the kinds.

It is easier to show what is wrong with a scientific theory than with a folk theory. A folk theory defines common sense itself. When the folk theory and the technical theory converge, it gets even tougher to see where that theory gets in the way—or even that it is a theory at all.

(Lakoff 1987, 121)

Introduction: A Good Infrastructure Is Hard to Find

Information infrastructure is a tricky thing to analyze.[6] Good, usable systems disappear almost by definition. The easier they are to use, the harder they are to see. As well, most of the time, the bigger they are, the harder they are to see. Unless we are electricians or building inspectors, we rarely think about the myriad of databases, standards, and instruction manuals subtending our reading lamps, much less about the politics of the electric grid that they tap into. And so on, as many layers of technology accrue and expand over space and time. Systems of classification (and of standardization) form a juncture of social organization, moral order, and layers of technical integration. Each subsystem inherits, increasingly as it scales up, the inertia of the installed base of systems that have come before.

Infrastructures are never transparent for everyone, and their workability as they scale up becomes increasingly complex. Through due methodological attention to the architecture and use of these systems, we can achieve a deeper understanding of how it is that individuals and communities meet infrastructure. We know that this means, at the least, an understanding of infrastructure that includes these points:

- A historical process of development of many tools, arranged for a wide variety of users, and made to work in concert.
- A practical match among routines of work practice, technology, and wider scale organizational and technical resources.
- A rich set of negotiated compromises ranging from epistemology to data entry that are both available and transparent to communities of users.
- A negotiated order in which all of the above, recursively, can function together.

Table 1.1 shows a more elaborate definition of infrastructure, using Star and Ruhleder (1996), who emphasize that one person's infrastructure may be another's barrier.

This chapter offers four themes, methodological points of departure for the analysis of these complex relationships. Each theme operates as a gestalt switch—it comes in the form of an *infrastructural inversion* (Bowker 1994). This inversion is a struggle against the tendency of infrastructure to disappear (except when breaking down). It means learning to look closely at technologies and arrangements that, by design and by habit, tend to fade into the woodwork (sometimes literally!).

Infrastructural inversion means recognizing the depths of interdependence of technical networks and standards, on the one hand, and the real work of politics and knowledge production[8] on the other. It foregrounds these normally invisible Lilliputian threads and furthermore gives them causal prominence in many areas usually attributed to heroic actors, social movements, or cultural mores. The inversion is similar to the argument made by Becker (1982) in his book *Art Worlds*. Most history and social analysis of art has neglected the details of infrastructure within which communities of artistic practice emerge. Becker's inversion examines the conventions and constraints of the material artistic infrastructure and its ramifications. For example, the convention of musical concerts lasting about three hours ramifies throughout the producing organization. Parking attendants, unions, ticket takers, and theater rentals are arranged in cascading dependence on this interval of time. An eight-hour musical piece, which is occasionally written, means rearranging all of these expectations, which in turn is so expensive that such productions are rare. Or paintings are about the size, usually, that will hang comfortably on a wall. They are also the size that fits rolls of canvas, the skills of framers,

Table 1.1
A definition of infrastructure

- *Embeddedness.* Infrastructure is sunk into, inside of, other structures, social arrangements, and technologies,
- *Transparency.* Infrastructure is transparent to use in the sense that it does not have to be reinvented each time or assembled for each task, but invisibly supports those tasks.
- *Reach or scope.* This may be either spatial or temporal—infrastructure has reach beyond a single event or one-site practice;
- *Learned as part of membership.* The taken-for-grantedness of artifacts and organizational arrangements is a sine qua non of membership in a community of practice (Lave and Wenger 1991, Star 1996). Strangers and outsiders encounter infrastructure as a target object to be learned about. New participants acquire a naturalized familiarity with its objects as they become members.
- *Links with conventions of practice.* Infrastructure both shapes and is shaped by the conventions of a community of practice; for example, the ways that cycles of day-night work are affected by and affect electrical power rates and needs. Generations of typists have learned the QWERTY keyboard; its limitations are inherited by the computer keyboard and thence by the design of today's computer furniture (Becker 1982).
- *Embodiment of standards.* Modified by scope and often by conflicting conventions, infrastructure takes on transparency by plugging into other infrastructures and tools in a standardized fashion.
- *Built on an installed base.* Infrastructure does not grow de novo; it wrestles with the inertia of the installed base and inherits strengths and limitations from that base. Optical fibers run along old railroad lines, new systems are designed for backward compatibility; and failing to account for these constraints may be fatal or distorting to new development processes (Monteiro and Hanseth 1996).
- *Becomes visible upon breakdown.* The normally invisible quality of working infrastructure becomes visible when it breaks: the server is down, the bridge washes out, there is a power blackout. Even when there are backup mechanisms or procedures, their existence further highlights the now visible infrastructure.
- *Is fixed in modular increments, not all at once or globally.* Because infrastructure is big, layered, and complex, and because it means different things locally, it is never changed from above. Changes take time and negotiation, and adjustment with other aspects of the systems involved.[7]

Source: Star and Rohleder 1996.

and the very doorways of museums and galleries. These constraints are mutable only at great cost, and artists must always consider them before violating them.

Scientific inversions of infrastructure were the theme of a path-breaking edited volume, *The Right Tools for the Job: At Work in Twentieth-Century Life Sciences* (Clarke and Fujimura 1992). The purpose of this volume was to tell the history of biology in a new way—from the point of view of the materials that constrain and enable biological researchers. Rats, petri dishes, taxidermy, planaria, drosophila, and test tubes take center stage in this narrative. The standardization of genetic research on a few specially bred organisms (notably drosophila) has constrained the pacing of research and the ways the questions may be framed, and it has given biological supply houses an important, invisible role in research horizons. While elephants or whales might answer different kinds of biological questions, they are obviously unwieldy lab animals. While pregnant cow's urine played a critical role in the discovery and isolation of reproductive hormones, no historian of biology had thought it important to describe the task of obtaining gallons of it on a regular basis. Adele Clarke (1998) puckishly relates her discovery, found in the memoirs of a biologist, of the technique required to do so: tickle the cow's labia to make her urinate. A starkly different view of the tasks of laboratory biology emerges from this image. It must be added to the processes of stabling, feeding, impregnating, and caring for the cows involved. The supply chain, techniques, and animal handling methods had to be invented along with biology's conceptual frame; they are not accidental, but constitutive.

Our infrastructural inversion with respect to information technologies and their attendant classification systems follows this line of analysis. Like the cow's urine or the eight-hour concert, we have found many examples of counterintuitive, often humorous struggles with constraints and conventions in the crafting of classifications. For instance, as we shall see in chapter 5, in analyzing the experience of tuberculosis patients in Mann's *The Magic Mountain,* we found the story of one woman who had been incarcerated so long in the sanatorium that leaving it became unthinkable. She recovered from the disease, but tried to subvert the diagnosis of wellness. When the doctors took her temperature, she would surreptitiously dip the thermometer in hot water to make it seem that she still had a fever. On discovering this, the doctors created a thermometer without markings, so that she could not tell what the mercury column indicated. They called this

"the silent sister." The silent sister immediately becomes itself a telling indicator of the entangled infrastructure, medical politics, and the use of metrics in classifying tubercular patients. It tells a rich metaphorical story, and may become a concept useful beyond the rarified walls of the fictional Swiss asylum. What other silent sisters will we encounter in our infrastructural inversion—what surveillance, deception, caring, struggling, or negotiating?

In the sections below, four themes are presented that require the special double vision implied in the anecdotes above. They frame the new way of seeing that brings to life large-scale, bureaucratic classifications and standards. Without this map, excursions into this aspect of information infrastructure can be stiflingly boring. Many classifications appear as nothing more than lists of numbers with labels attached, buried in software menus, users' manuals, or other references. As discussed in chapter 2, new eyes are needed for reading classification systems, for restoring the deleted and dessicated narratives to these peculiar cultural, technical, and scientific artifacts.

Methodological Themes for Infrastructural Inversion

Ubiquity

The first major theme is the *ubiquity* of classifying and standardizing. Classification schemes and standards literally saturate our environment. In the built world we inhabit, thousands and thousands of standards are used everywhere, from setting up the plumbing in a house to assembling a car engine to transferring a file from one computer to another. Consider the canonically simple act of writing a letter longhand, putting it in an envelope, and mailing it. There are standards for paper size, the distance between lines in lined paper, envelope size, the glue on the envelope, the size of stamps, their glue, the ink in a pen, the sharpness of its nib, the composition of the paper (which in turn can be broken down to the nature of the watermark, if any; the degree of recycled material used in its production, the definition of what counts as recycling), and so forth.

Similarly, in any bureaucracy, classifications abound—consider the simple but increasingly common classifications that are used when you dial an airline for information ("if you are traveling domestically, press 1"; "if you want information about flight arrivals and departures. . . ."). And once the airline has you on the line, you are classified by them as a frequent flyer (normal, gold or platinum); corporate or

Becoming an Irate

Howard Becker relates a delightful anecdote concerning his classification by an airline. A relative working for one of the airlines told him how desk clerks handle customer complaints. The strategy is first to try to solve the problem. If the customer remains unsatisfied and becomes very angry in the process, the clerk dubs him or her "an irate." The clerk then calls the supervisor, "I have an irate on the line," shorthand for the category of an irritated passenger.

One day Becker was having a difficult interaction with the same airline. He called the airline desk, and in a calm tone of voice, said, "Hello, my name is Howard Becker and I'm an irate. Can you help me with this ticket?" The clerk began to sputter, "How did you know that word?" Becker had succeeded in unearthing a little of the hidden classificatory apparatus behind the scenes at the airline. He notes that the interaction after this speeded up and went particularly smoothly.

individual; tourist or business class; short haul or long haul (different fare rates and scheduling apply).

This categorical saturation furthermore forms a complex web. Although it is possible to pull out a single classification scheme or standard for reference purposes, in reality none of them stand alone. So a subproperty of ubiquity is interdependence, and frequently, integration. A systems approach might see the proliferation of both standards and classifications as purely a matter of integration—almost like a gigantic web of interoperability. Yet the sheer density of these phenomena go beyond questions of interoperability. They are layered, tangled, textured; they interact to form an ecology as well as a flat set of compatibilities. That is to say, they facilitate the coordination of heterogeneous "dispositifs techniques" (Foucault 1975). They are lodged in different communities of practice such as laboratories, records offices, insurance companies, and so forth.[9] There *are* spaces between (unclassified, nonstandard areas), of course, and these are equally important to the analysis. It seems that increasingly these spaces are marked as unclassified and nonstandard.

It is a struggle to step back from this complexity and think about the issue of ubiquity rather than try to trace the myriad connections in any one case. The ubiquity of classifications and standards is curiously difficult to see, as we are quite schooled in ignoring both, for a variety of interesting reasons. We also need concepts for understanding movements, textures, and shifts that will grasp patterns within the ubiquitous larger phenomenon. The distribution of residual categories ("not elsewhere classified" or "other") is one such concept. "Others" are everywhere, structuring social order. Another such concept might be what Strauss et al. (1985) call a "cumulative mess trajectory." In medicine, this occurs when one has an illness, is given a medicine to cure the illness, but incurs a serious side effect, which then needs to be treated with another medicine, and so forth. If the trajectory becomes so tangled that you cannot turn back and the interactions multiply, "cumulative mess" results. We see this phenomenon in the interaction of categories and standards all the time—ecological examples are particularly rich places to look.

Materiality and Texture

The second methodological departure point is that classifications and standards are *material*, as well as symbolic. How do we perceive this densely saturated classified and textured world? Under the sway of cognitive idealism, it is easy to see classifications as properties of mind and standards as ideal numbers or floating cultural inheritances. But they have material force in the world. They are built into and embedded in every feature of the built environment (and in many of the nature-culture borderlands, such as with engineered genetic organisms).

All classification and standardization schemes are a mixture of physical entities, such as paper forms, plugs, or software instructions encoded in silicon, and conventional arrangements such as speed and rhythm, dimension, and how specifications are implemented. Perhaps because of this mixture, the web of intertwined schemes can be difficult to see. In general, the trick is to question every apparently natural easiness in the world around us and look for the work involved in making it easy. Within a project or on a desktop, the seeing consists in seamlessly moving between the physical and the conventional. So when computer programmers write some lines of Java code, they move within conventional constraints and make innovations based on them; at the same time, they strike plastic keys, shift notes around on a desktop, and consult manuals for various standards and other information. If we were to try to list all the classifications and standards involved in writing a program, the list could run to pages. Classifications include types of objects, types of hardware, matches between requirements categories and code categories, and metacategories such

Authors in this tradition warn against the dangers of anachronism. Hacking (1995) on child abuse is a sophisticated version that we discuss in chapter 7. If a category did not exist contemporaneously, it should not be retroactively applied.

The other school of thought holds that we should use the real classifications that progress in the arts and sciences has uncovered. Often history informed by current sociology will take this path. For example, Tort's (1989) work on "genetic" classification systems (which were not so called at the time, but which are of vital interest to the Foucaldian problematic) imposes a post hoc order on nineteenth-century classification schemes in a variety of sciences. Even though those schemes were perceived by their creators as responding solely to the specific needs of the discipline they were dealing with (etymology, say, or mineralogy), Tort demonstrates that there was a link between many different schemes (both direct in people shifting disciplines and conceptual in their organization) that allows us to perceive an order nowhere apparent to contemporaries.

From a pragmatist point of view, both aspects are important in analyzing the consequences of modern systems of classification and standardization. We seek to understand classification systems according to the work that they are doing and the networks within which they are embedded. That entails both an understanding of the categories of those designing and using the systems, and a set of analytic questions derived from our own concerns as analysts.

When we ask historical questions about the deeply and heterogeneously structured space of classification systems and standards, we are dealing with a four-dimensional archaeology. The systems move in space, time, and process. Some of the archaeological structures we uncover are stable, some in motion, some evolving, some decaying. They are not consistent. An institutional memory about an epidemic, for example, can be held simultaneously and with internal contradictions (sometimes piecemeal or distributed and sometimes with entirely different stories at different locations) across a given institutional space.

In the case of AIDS, classifications have shifted significantly over the last twenty years, including the invention of the category in the 1980s—from gay-related immune disorder (GRID) through a chain of other monikers to the now accepted acquired immune deficiency syndrome (AIDS). It is now to some extent possible to look back at cases that might previously have been AIDS (Grmek 1990) before we had

When Is It a Harley?

One of the ways the past becomes indeterminate is through gradual shifts in what it means to "really be" something—the essence of it.

Sitting in a tattoo parlor, surrounded by people I do not usually hang out with. Young men in black leather vests and sun-bleached hair. I turn to the waiting room reading material, which in this case is the monthly *Thunder Press,* a newsletter for motorbike aficionados. The lead article asks the question: "Is It Still a Harley" if you have customized your bike yourself? The Oregon Department of Motor Vehicles makes the definitive call: "Anything that is not totally factory built will make it a reconstructed motorcycle, and it will be called 'assembled' on the title" (69).

A major activity in the Harley social world is customizing features of one's motorcycle, and there are important symbolic and affiliative signs attached to the customizing process. Deleting the name Harley from the registration form is perceived as an insult to the owner, and this insult is stitched together in the article with others that come from the government toward bikers (restricting meeting places, insisting on helmet-wearing, being overly enthusiastic in enforcing traffic violations by bikers).

This is a pure example of the politics of essence, of identity politics. It is echoed in many areas of life, for example, in James Davis' (1991) classic study *Who Is Black?* where the question of the one-drop rule in the United States, and the rejection of mixed-race people as a legitimate category is an old and a cruel story. The central process here is the distillation of the sine qua non out from the messy and crenellated surrounds—the rejection of marginality in favor of purity.

When this occurs, the suffering of the marginal becomes privatized and distributed, creating the conditions for pluralistic ignorance ("I'm the only one"). Meeting the purity criteria of the essentialized category also becomes bureaucratized and again the onus is shifted to the individual alone. Only when the category is joined with a social movement can the black box of essence be reopened, as for example with the recent uprisings and demonstrations of mixed race Hispanic people toward the U.S. census and its rigid categories. The problem becomes clear if one is both black and Hispanic, a common combination in the Caribbean. Through which master trait will the government perceive you?

—Leigh Star

Source: Anonymous, "Is It Still a Harley," *Thunder Press* 5:4 (July 1996, 1 and 69).

the category (a problematic gaze to be sure, as Bruno Latour (forthcoming) has written about tuberculosis). There are epidemiological stories about trying to collect information about a shameful disease; there is a wealth of personal and public narratives about living with it. There is a public health story and a virology story, which use different category systems. There are the standardized forms of insurance companies and the categories and standards of the Census Bureau. When an attempt was made to combine these data in the 1980s to disenfranchise young men living in San Francisco, from health insurance, the resultant political challenge stopped the combination of these data from being so used. At the same time, the San Francisco blood banks refused for years to employ HIV screening, thus denying the admission of another category to their blood labeling, as Shilts (1987) tells us, with many casualties as a result. Whose story has categorical ascendancy here? That question is forever morally moot—all of the stories are important and all of the categories tell a different one.

Practical Politics

The fourth major theme is uncovering *the practical politics of classifying and standardizing*. This is the design end of the spectrum of investigating categories and standards as technologies. There are two processes associated with these politics: arriving at categories and standards, and, along the way, deciding what will be visible or invisible within the system.

It follows from the indeterminacy discussed above that the spread or enforcement of categories and standards involves negotiation or force. Whatever appears as universal or indeed standard, is the result of negotiations, organizational processes, and conflict. How do these negotiations take place? Who determines the final outcome in preparing a formal classification? Visibility issues arise as one decides where to make cuts in the system, for example, down to what level of detail one specifies a description of work, of an illness, of a setting. Because there are always advantages and disadvantages to being visible, this becomes crucial in the workability of the schema. As well, ordinary biases of what should be visible, or legitimated, within a particular scheme are always in action. The trade-offs involved in this sort of politics are discussed in chapters 5 on tuberculosis and 7 on nursing work.

Someone, somewhere, must decide and argue over the minutiae of classifying and standardizing. The negotiations themselves form the

There's No Such Thing as a Rodent

An article in the *San Jose Mercury News* by Rick Weiss declares: "Researchers say there's no such thing as a rodent." He quotes an article from *Nature*, which argues that the 2,000 species of animals ordinarily considered rodents—including rats, mice, and guinea pigs—did not evolve from a common ancestor. The finding is deeply controversial. Weiss says, "On one side are researchers who have spent their careers hunched over fossils or skeletal remains to determine which animals evolved from which." On the other, the article continues, are those who would use DNA analysis to make the determination. The fossil studiers say that DNA is not yet accurate enough. The classification of species has always been deeply controversial. Biologists speak of a rough cut among their ranks: lumpers (those who see fewer categories and more commonalties) versus splitters (those who would name a new species with fewer kinds of difference cited). There are always practical consequences for these names. Splitters, for example, often included people who wanted a new species named after them, and the more species there are, the more likely is an eponymous label. The deliberately provocative headline of this article demands a response: "well, don't tell that to my cat." We often refer implicitly in this fashion to the power of naming—blurring the name of the category with its members. (*San Jose Mercury News*, June 13, 1996: 5A by Rick Weiss)

basis for a fascinating practical ontology—our favorite example is when is someone really alive? Is it breathing, attempts at breathing, or movement? And how long must each of those last? Whose voice will determine the outcome is sometimes an exercise of pure power: We, the holders of western medicine and scions of colonial regimes, will decide what a disease is and simply obviate systems such as acupuncture or Aryuvedic medicine. Sometimes the negotiations are more subtle, involving questions such as the disparate viewpoints of an immunologist and a surgeon, or a public health official (interested in even *one* case of the plague) and a statistician (for whom one case is not relevant).

Once a system is in place, the practical politics of these decisions are often forgotten, literally buried in archives (when records are kept at all) or built into software or the sizes and compositions of things. In addition to our archaeological expeditions into the records of such negotiations, this book provides some observations of the negotiations in action.

Finally, even where everyone agrees on how classifications or standards should be established, there are often practical difficulties about how to craft them. For example, a classification system with 20,000 bins on every form is practically unusable for data-entry purposes. The constraints of technological record keeping come into play at every turn. For example, the original ICD had some 200 diseases not because of the nature of the human body and its problems but because this was the maximum number that would fit the large census sheets then in use.

Sometimes the decision simply about how fine-grained to make the system has political consequences as well. For instance, describing and recording someone's tasks, as in the case of nursing work, may mean controlling or surveilling their work as well, and may imply an attempt to take away discretion. After all, the loosest classification of work is accorded to those with the most power and discretion who are able to set their own terms. There are financial stakes as well. In a study of a health insurance company's system of classifying for doctor and patient reimbursement, Gerson and Star (1986) found that doctors wanted the most fine-grained of category systems, so that each procedure could be reimbursed separately and thus most profitably. Data-entry personnel and hospital administrators, among others, wanted broader, simpler, and coarser-grained categories for reasons of efficiency. These conflicts were, however, invisible to the outside world, which received only the forms for reimbursement purposes and a copy of the codebook for reference. Both the content of the categories and the structure of the overall scheme are concerns for due process within organizations—whose voice will be heard and when will enough data, of the right granularity, have been collected?

Infrastructure and Method: Convergence

These ubiquitous, textured classifications and standards help frame our representation of the past and the sequencing of events in the present. They can best be understood as doing the ever local, ever partial work of making it appear that science describes nature (and nature alone) and that politics is about social power (and social power alone). Consider the case of psychoanalysts discussed at length in Young (1995), Kirk and Kutchins (1992), and Kutchins and Kirk (1997). To receive reimbursement for their procedures, psychoanalysts now need to couch them in a biomedical language (using the DSM).

Fitting Categories to Circumstances

An academic friend on the East Coast tells an anecdote of negotiation with her long-term psychoanalyst about how to fill out her insurance forms. She was able to receive several free sessions of therapy a year under her health insurance plan. Each year, she and her therapist would discuss how best to categorize her. It was important to represent the illness as serious and long-term. At the same time, they were worried that the information about the diagnosis might not always remain confidential. What could they label her that would be both serious and nonstigmatizing? Finally, they settled on the diagnosis of obsessive-compulsive. No academic would ever be penalized for being obsessive-compulsive, our friend concluded with a wry laugh! (Kirk and Kutchins (1992) document similar negotiations between psychiatrists and patients.)

Theoretically, this rubric is anathema to them, systematically replacing the categories of psychoanalysis with the language of the pharmacopoeia and of the biochemistry of the brain. The DSM, however, is the lingua franca of the medical insurance companies. Thus, psychoanalysts use the categories not only to obtain reimbursement but as a shorthand to communicate with each other. There are local translation mechanisms that allow the DSM to continue to operate in this fashion and, at the same time, to become the sole legal, recognized representation of mental disorder. A "reverse engineering" of the DSM or the ICD reveals the multitude of local political and social struggles and compromises that go into the constitution of a "universal" classification.

Standards, categories, technologies, and phenomenology are increasingly converging in large-scale information infrastructure. As we have indicated in this chapter, this convergence poses both political and ethical questions. These questions are by no means obvious in ordinary moral discourse. For all the reasons given above, large-scale classification systems are often invisible, erased by their naturalization into the routines of life. Conflict and multiplicity are often buried beneath layers of obscure representation.

Methodologically, we do not stand outside these systems, nor pronounce on their mapping to some otherworldly "real" or "constructed" nature. Rather, we are concerned with what they do, pragmatically speaking, as scaffolding in the conduct of modern life. Part of that

analysis means understanding the coconstruction of classification systems with the means for data collection and validation.

To clarify our position here, let us take an analogy. In the early nineteenth century in England there were a huge number of capital crimes, starting from stealing a loaf of bread and going on up. Precisely because the penalties were so draconian, however, few juries would ever impose the maximum sentence; and indeed there was a drastic reduction in the number of executions even as the penal code was progressively strengthened. There are two ways of writing this history: one can either concentrate on the creation of the law; or one can concentrate on the way things worked out in practice. This is very similar to the position taken in Latour's *We Have Never Been Modern* (1993). He argues that we can either look at what scientists say they are doing (working within a purified realm of knowledge) or at what they actually are doing (manufacturing hybrids of nature-culture). We think both are important. We advocate here a pragmatic methodological development—pay more attention to the classification and standardization work that allows for hybrids to be manufactured and so more deeply explore the terrain of the politics of science in action.

The point is that both words and deeds are valid kinds of account. Early sociology of science in the actor-network tradition concentrated on the ways in which it comes to appear that science gives an objective account of natural order: trials of strength, enrolling of allies, cascades of inscriptions, and the operation of immutable mobiles (Latour 1987, 1988). Actor network theory drew attention to the importance of the development of standards (though not to the linked development of classification systems), but did not look at these in detail. Sociologists of science invited us to look at the process of producing something that looked like what the positivists alleged science to be. We got to see the Janus face of science as both constructed and realist. In so doing we followed the actors, often ethnographically. We shared their insights. Allies must be enrolled, translation mechanisms must be set in train so that, in the canonical case, Pasteur's laboratory work can be seen as a direct translation of the quest for French honor after defeat in the battlefield (Latour 1988).

By the very nature of the method, However, we also shared the actors' blindness. The actors being followed did not themselves *see* what was excluded: they constructed a world in which that exclusion could occur. Thus if we just follow the doctors who create the ICD at the WHO in Geneva, we will not see the variety of representation

systems that other cultures have for classifying diseases of the body and spirit; and we will not see the fragile networks these classification systems subtend. Rather, we will see only those who are strong enough and shaped in such a fashion as to impact allopathic medicine. We will see the blind leading the blind.

This blindness occurs by changing the world such that the system's description of reality becomes true. Thus, for example, consider the case where all diseases are classified purely physiologically. Systems of medical observation and treatment are set up such that physical manifestations are the only manifestations recorded. Physical treatments are the only treatments available. Under these conditions, then, logically schizophrenia may only result purely and simply from a chemical imbalance in the brain. It will be impossible to think or act otherwise. We have called this the principle of *convergence* (Star, Bowker and Neumann in press).

Resistance

Reality is 'that which resists,' according to Latour's (1987) Pragmatist-inspired definition. The resistances that designers and users encounter will change the ubiquitous networks of classifications and standards. Although convergence may appear at times to create an inescapable cycle of feedback and verification, the very multiplicity of people, things and processes involved mean that they are never locked in for all time.

The methods in this chapter offer an approach to resistance as a reading of where and how political work is done in the world of classifications and standards, and how such artifacts can be problematized and challenged. Donald MacKenzie's (1990) wonderful study of "missile accuracy" furnishes the best example of this approach. In a concluding chapter to his book, he discusses the possibility of "uninventing the bomb," by which he means changing society and technology in such a way that the atomic bomb becomes an impossibility. Such change, he suggests, can be carried out in part at the overt level of political organizations. Crucially for our purposes, however, he also sensitizes the reader to the site of the development and maintenance of technical standards as a site of political decisions and struggle. Standards and classifications, however dry and formal on the surfaces, are suffused with traces of political and social work. Whether we wish to uninvent any particular aspect of complex information infra-

structure is properly a political and a public issue. Because it has rarely been cast in that light, tyrannies of various sorts flourish. Some are the tyrannies of inertia—red tape—rather than explicit public policies. Others are the quiet victories of infrastructure builders inscribing their politics into the systems. Still other are almost accidental—systems that become so complex that no one person and no organization can predict or administer good policy.

The magic of modern technoscience is a lot of hard work involving smoke-filled rooms, and boring lists of numbers and settings. Tyranny or democracy, its import on our lives cannot be denied. This chapter has offered a number of points of departure for evaluation, resistance, and better analysis of one of its least understood aspects.

I

Classification and Large-Scale Infrastructures

In the following three chapters, which analyze the international classification of diseases (ICD) we look at the operation of classification systems in supporting large-scale infrastructural arrangements. Chapter 2 concentrates on the text of the ICD itself, producing a reading of this classification which has over the past century ingrained itself in a multiplicity of forms, work arrangements, and laws worldwide. We examine how its internal structure affords the prosecution of multiple agendas. Chapter 3 discusses the history of the ICD, showing how it has changed over time in step with changing information technology and changing organizational needs. Chapter 4 draws general design implications from the study of this highly effective, long-term, and wide-scale classification scheme.