

Sorting Things Out: Classification and Its Consequences  
[Forwarded by permission and heavily reformatted.]

Date: Thu, 04 Nov 1999 17:02:55 -0800  
From: "Geoffrey C. Bowker" <bowker@ucsd.edu>

## SORTING THINGS OUT: CLASSIFICATION AND ITS CONSEQUENCES

Geoffrey C. Bowker and Susan Leigh Star  
Cambridge, MA: MIT Press, 1999.

<http://mitpress.mit.edu/book-home.tcl?isbn=0262024616>

### TABLE OF CONTENTS

Introduction: To Classify is Human

Chapter One: Some Tricks of the Trade in Analyzing Classification

Part One: Classification and Large Scale Infrastructures

Chapter Two: The Kindness of Strangers - Kinds and Politics in Classification Systems

Chapter Three: The ICD as Information Infrastructure

Chapter Four: Classification, Coding and Coordination

Part Two: Classification and Biography, or System and Suffering

Chapter Five: Of Tuberculosis and Trajectories

Chapter Six: The Case of Race Classification and Reclassification under Apartheid

Part Three: Classification and Work Practice

Chapter Seven: What a Difference a Name Makes - The Classification of Nursing Work

Chapter Eight: Organizational Forgetting, Nursing Knowledge, and Classification

Part Four: The Theory and Practice of Classifications

Chapter Nine: Categorical Work and Boundary Infrastructures; Enriching Theories of Classification

Chapter Ten: Why Classifications Matter

Introduction: To Classify Is Human

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

To classify is human. Not all classifications take formal shape or are standardized in commercial and bureaucratic products. We all spend large parts of our days doing classification work, often tacitly, and make up and use a range of ad hoc classifications in order 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 which must read by yesterday, but which have been there since last

year; old professional journals which really should be read and even in fact may someday be, and which 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 which are already read but which can't yet be thrown out alongside reminder notes to send similar cards to parents, sweethearts, or to 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 seem 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 seven 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 between 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. 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 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 post partum 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 judgements 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 don't 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 US Government routine data collection mission, following Statistical Directive 15 in October, 1997. The Office of Management and Budget issued the directive, and conservatively, its implementation will cost several million dollars. One direct consequence is the addition of this option to the US 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 multi-racial, 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).

However, despite the contentiousness of some categories, 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 in order to find the origins and consequences of a range of social categories and practices. He focussed 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.

We take Foucault's practical archaeology as 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 Emile Durkheim passionately sought to convince his audience of the material force of the social fact - to see that society was not just an idea - over one hundred years ago (Durkheim, 1982).

We also explore 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 in order better to understand 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 US Immigration and Naturalization Service to classify some races and classes as desirable for US residents, and others as not, resulted in a quota system which 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 fraught. We 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 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 don't 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 two hundred formally elected Internet standards for information transmission each time we 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 World Wide 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 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 egosurfing - 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 15 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 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 ftp 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 normally known to be a rude people -- but we haven't 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 (between people, between texts and people, between 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. We all know versions of this banal assertion - we've probably all made it in one form or another or ourselves at some point. And if we don't understand a given technology 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. A common description of a good waiter or butler (one thinks of Jeeves in the Wodehouse stories) is that she clears a table and smoothes 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 this question, 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. 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 don't fit? We want to draw attention to cases that don't 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/events (and we agree that separating them ontologically is a hopeless task). The hype of our postmodern times is that we don't 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; they cannot provide any path to answering our moral questions.

### What Are You?

I grew up in Rhode Island, a New England state which is largely Italian-American and French-Canadian, 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% 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

## 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 in order 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 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 find themselves 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.

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. In terms of 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 will be one of our major examples throughout this book. The full title of the current (10th) 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. By this is meant that only diseases which are statistically significant are to be entered in (it is not an attempt to classify all disease).

The ICD calls itself 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 (this point is developed in Chapter 4)). A nomenclature simply means an agreed-upon naming scheme, and 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). There is no classificatory system. Nomenclature and classification are frequently confused, however, since often attempts are 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).

However, the ICD presents itself clearly as a classification scheme and not a nomenclature. Since 1970, there has been an effort underway by the World Health Organization 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 that is 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, Sisyphean 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 (cf. Abbate and Kahin, 1995) which need to work together well in order 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 professional organizations, manufacturers' organizations or the State. We might say tomorrow that volapük (a universal language that boasted some 23 journals in 1889 (Proust, 1989: 580)) or its successor Esperanto shall henceforth be the standard language for international diplomacy. Without a mechanism of enforcement, 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 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, and 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 (regular sizes for stones, tools etc.) (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; too 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 (but see the work of Paul David - for example David and Rothwell, 1994 - for a rich treatment). They are 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 which 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 workarounds involved in the practical use of standards frequently entail the use of ad hoc non-standard 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, the patient 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. 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

In order 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 1); classification and biography (Part 2) and classification and work practice (Part 3). Weaving these three themes in combination, 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 1: Classification and Large-Scale Infrastructures

Classification systems are integral to any working infrastructure. In Part 1 (Chapters 2-4) 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 which 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 as they learned these practices with respect to 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 be a standard size second of time, or an eyeglass screw or an electrical pulse rate? At other times, they were larger: what size should a railroad car be, or 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, and 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 20th century historical moment in that faced by Europeans at the end of the 19th century. A new international information-sharing and gathering movement was starting, thanks to the advent of wide-scale international travel, international quasi-governmental governance structures, and a growing awareness that many phenomena (like epidemics and markets) would not be confined to one country. In the 19th century, people faced for the first time 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 who had 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.

Figure 1. Map of Cholera Epidemics. Source: A. Proust, 1892.

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, of course, a black market in clean bills of health appeared shortly thereafter ... . The problem of tracking who was dying of what, where on earth became a permanent feature of international bureaucracy.

Figure 2. French Bill of Health. Source: A. Proust, 1892.

Constructing such a list may seem to us like a comparatively straightforward task, once the mechanisms for reporting were in place. However, for over one hundred years 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 which 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.' Seven starved in 1650 (Graunt, 1662), but by 1930 the World Health Organization 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 non-venomous, and only dogs and rats are singled out for categories of their own (ICD 5, 1948, p. 267).

Insert Figure 3. Mortality Table, England in Seventeenth Century. Source: J. Graunt, 1662.

The first part of this book is dedicated to understanding the construction of the International Classification of Diseases (ICD): a classification scheme with its origins in the late 19th 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 World Health Organization and its predecessors such as the League of Nations and the Office Internationale d'Hygiene 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 in order that some data 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 'non-existent 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 in terms of estimating the available labor force and for basic planning measures. Of course, occupational and non-work 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; 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 3 months is a stillbirth, encoded as a live infant death. Contemporary abortion wars in the U.S. and Western Europe attest to the enduring and irreconcilable ontologies involved in these codifications.

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 seems to make common sense ironic. This is an issue we will revisit as well in the discussion of nursing interventions, 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 call “the substitution of precision for validity” (1992; 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 them.

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. However, from a practical organizational viewpoint this 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 61 volumes of 1,000 pages each. This is clearly not a pragmatic choice for conducting a task which 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 anyway) 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 which is handed to the funeral director in order that arrangements be made quickly and discreetly, and a statistical cause which is 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 World Wide 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 doesn’t 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's what the professor wanted, and they'd 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 2: Classification and Biography

Our second section 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.

As will be 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 timelines, and expectations about those timelines, unfold in the 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 between 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 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 timelines 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 our 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 Colored (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 re-classified 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 in order 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, colored 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 co-construction of lives and their categories.

### Part 3: Classification and Work Practice

In Part 3, Chapters 7 and 8, we will look at how classification systems organize and are organized by work practice. We will look at the effort of a group of nursing scientists based at the University of Iowa and led by Joanne McCloskey and Gloria Bulechek to produce a classification of nursing interventions. Their Nursing Intervention Classification (NIC) aims to depict 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 26 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. This group narrowed the preliminary list of interventions to the original 336 published in Nursing Interventions Classification, 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 in order 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 over-specifying 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 caregiving is also 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 its importance, 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 in order 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 costing. 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 which renders work visible, it can also render surveillance easier - and 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 static geology. This new science will draw on the best empirical studies of workarounds, 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.

Let us finish this introduction with a future scenario that symbolizes this abstract endeavor. Imagine that you're walking through a forest of inter-articulated 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 birdwatching 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 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, used sensibly in the context of people's lives.