At this site, we present the introduction, first two chapters and concluding chapters of our book on classification systems published by MIT Press in 1999. Related work can be found at my publications site. Here is a real audio interview with Geof Bowker about classification systems.

SORTING THINGS OUT:

CLASSIFICATION AND ITS CONSEQUENCES

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Introduction: To Classify Is Human

Our lives are henged 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 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 – 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, 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 (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 <u>and</u> 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.

Nº

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 { du port.....
sanitaire{ 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

Nº   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...	Malades à bord {
Pavillon	
Tonneaux............	État hygiénique du navire...............
Canons................	État hygiénique de l'équipage (couchage, vêtements, etc.)....
Appartenant au port d	
Destination	État hygiénique des passagers ....
Nom du capitaine.....	Vivres et approvisionnements divers......
Nom du médecin.....	
Équipage (tout compris)	
Passagers	
Cargaison....	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, { du port est..........
que l'état sanitaire { des environs est.....

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

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

L'Expéditionnaire   Sceau de l'Administration,
de la Patente,

            Lu   DE LA SANTÉ,

PRESCRIPTIONS EXTRAITES DU RÈGLEMENT GÉNÉRAL

DE POLICE SANITAIRE MARITIME

VOIR AU VERSO.

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'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 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 asylumthan 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.

Chapter One: 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).*

Information infrastructure is a tricky thing to analyze. Really 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 sub-system 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:

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

The following shows a more elaborate definition of infrastructure, following Star and Ruhleder (1996), who emphasize that one person's infrastructure may be another's barrier:

Figure 4 Star and Ruhleder's 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, e.g. 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 back-up 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.

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 which, 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 on the other. It foregrounds these normally invisible Lilliputian threads, and furthermore gives them causal prominence in many areas normally 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, 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 pathbreaking 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 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, in the memoirs of a biologist, of the technique required to do so: tickle the cow's labia in order 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 8-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, we present four themes that require the special double vision implied in the anecdotes above. They frame the new way of seeing which 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 we discuss in Chapter 2, new eyes are needed for reading classification systems, for restoring the deleted and desiccated narratives to these peculiar cultural/technical/scientific artifacts.

Methodological Themes for Infrastructural Inversion

1. 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 (inter alia): 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 your 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 hold of you, you are classified by them as a frequent flyer (normal, gold or platinum); corporate or individual; tourist or business class; short haul or long haul (different fare rates and scheduling apply).

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 *very* 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.

This categorical saturation furthermore forms a complex web. While 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 co-ordination of heterogeneous 'dispositifs techniques' (Foucault, 1975). They are lodged in different communities of practice - such as laboratories, records offices, insurance companies and so forth. There *are* spaces between (unclassified, non-standard areas), of course, and these are equally important to the analysis. It seems that increasingly these spaces are marked as unclassified and non-standard.

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, etc. 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 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 a computer programmer writes some lines of Java code, she moves within conventional constraints and

makes innovations based on them; at the same time, she strikes plastic keys, shifts notes around on a desktop, and consults manuals for various standards and other information. If we were to try to list out 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 meta-categories such as the goodness of fit of the piece of code with the larger system under development. Standards range from the precise integration of the underlying hardware to the 60Hz power coming out of the wall through a standard size plug.

Merely reducing the description to the physical aspect such as the plugs does not get us anywhere interesting in terms of the actual mixture of physical and conventional or symbolic. A good operations researcher could describe how and whether things would work together, often purposefully blurring the physical/conventional boundaries in making the analysis. But what is missing is a sense of the landscape of work as experienced by those within it. It gives no sense of something as important as the texture of an organization: it is smooth or rough? Bare or knotty? What is needed is a sense of the topography of all of the arrangements -- are they colliding? co-extensive? gappy? orthogonal? One way to get at these questions is to take quite literally the kinds of metaphors that people use when describing their experience of organizations, bureaucracies, and information systems, discussed in more detail in Chapter 9.

When we think of classifications and standards as both material and symbolic, we adapt a set of tools not usually applied to them. There are tools for analysing built structures, such as structural integrity, enclosures and confinements, permeability, and durability, among many others. Structures have texture, and depth. The textural way of speaking of classifications and standards is common in organizations and groups. Metaphors of tautness, knots, fabrics and networks pervade modern language (Lakoff and Johnson, 1980).

The Indeterminacy of the Past: Multiple times, multiple voices

The third methodological theme concerns **the past as indeterminate**. We are constantly revising our knowledge of the past in light of new developments in the present. This is not a new idea to historiography, or to biography. We change our resumes as we acquire new skills to seem like smooth, planned paths of development, even if the change had been unexpected or undesired. When we become members of new social worlds, we often retell our life stories in new terminology. A common example of this is religious conversion, where the past is retold as exemplifying errors, sinning and repentance (Strauss, 1959). Or when coming out as gay or lesbian, childhood behaviors and teenage crushes become indicators of early inklings of sexual choice (Wolfe and Stanley, 1980).

At wider levels of scale, these revisions also mean the introduction of new voices – many possible kinds of interpretations of categories, texts, and artifacts. Multiple voices and silences are represented in any scheme that attempts to sort out the world. No one classification organizes reality for everyone -- e.g. the red light-yellow light-green light traffic light distinctions don't work for blind people (who need sound coding). In looking to classification schemes as ways of ordering the past, it is easy to forget those who have been overlooked in this way. Thus, the indeterminacy of the past implies recovering multi-vocality; it also means understanding how standard narratives that seem universal have been constructed (Star, 1991a).

There is no way of ever getting access to the past except through classification systems of one sort or another - formal or informal, hierarchical or not ... . Take the apparently unproblematic statement: "In 1640, the English Revolution occurred; this led to a twenty year period in which the English had no monarchy". The classifications involved here, all problematic, include:

- the current segmentation of time into days, months and years. Accounts of the English revolution generally use the Gregorian calendar, which was adopted some hundred years later - so causing translation problems with contemporary documents;
- the classification of 'peoples' into English, Irish, Scots, French and so on. These designations were by no means so clear at the time - the whole discourse of 'national genius' or character really only arose in the nineteenth century;
- the classification of events into revolutions, reforms, revolts, rebellions and so forth (cf. Furet, 1978 on thinking the French revolution). There really was no concept of 'revolution' at the time; our current conception is marked by the historiographical work of Karl Marx.
- what do we classify as being a 'monarchy'? There is a strong historiographical tradition that says that Oliver Cromwell was a monarch - he walked, talked and acted like one after all. Under this view, there is no hiatus at all in this English institution; rather a usurper took the throne.

There are two major historiographic schools of thought with respect to using classification systems on the past. One maintains that we should only use classifications available to actors at the time, much as an ethnographer tries faithfully to mirror the categories of their respondents. Authors in this tradition warn against the dangers of anachronism. Hacking (1995) on child abuse is a sophisticated version which 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), he demonstrates that there was a link between many different schemes (both direct in terms of people shifting disciplines and conceptual in terms of 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 always 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 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 don't 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." (p. 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 re-opened, as for example with the recent uprisings and demonstrations of mixed race Hispanic people toward the US Census and its rigid categories. The problem becomes clear if one is both Black and Hispanic, a common combination in the Caribbean. Which shall be the master trait through which the government perceives you?

--Leigh Star

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

When we ask historical questions about the deeply and heterogeneously structured space of classification systems and standards, we are dealing with a 4-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, for example, an epidemic, 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 20 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). It is now to some extent possible to look backwards at cases which might previously have been AIDS (Grmek, 1990) before we had 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 this 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 the 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 tradeoffs involved in this sort of politics are discussed in Chapters 5 (on tuberculosis) and 7 (on nursing work).

Someone, somewhere, often a body of people in the proverbial gray suits and smoke-filled rooms, must decide and argue over the minutiae of classifying and standardizing. The negotiations themselves form the

basis for a fascinating practical ontology -- our favorite example is when is someone really alive? Is it breathing, attempts at breathing, 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).

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 thatthe 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) vs. 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)

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 International Classification of Diseases 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). In order to receive reimbursement for their procedures, they now need to couch them in a biomedical language (the DSM). 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. However, the DSM 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 which go into the constitution of a 'universal' classification.

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 non-stigmatizing? 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.)

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 co-construction of classification systems with the means for data collection and validation.

In order 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 up. However, precisely because the penalties were so draconian, few juries would ever impose the maximum sentence; and indeed there was actually 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 that 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 are advocating 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 for us 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 seem 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). It 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 which 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).

However, by the very nature of the method, 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 International Classification of Diseases at the World

Health Organization 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 and Bowker, 1994; 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. While convergence may seem 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. However, and crucially for our purposes, 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 infrastructure 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 really predict or administer good policy.

The magic of modern technoscience is a lot of hard work, 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.

PART ONE

CLASSIFICATION AND LARGE SCALE INFRASTRUCTURES

In the following three chapters, which analyze the International Classification of Diseases (ICD) we shall look at the operation of classification systems in supporting large-scale infrastructural arrangements. In Chapter 2 we concentrate on the text of the ICD itself, producing a reading of this classificationwhich 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. In Chapter 3, we will discuss the history of the ICD, showing how it has changed over time in step with changing information technology and changing organizational needs. In Chapter 4, we draw general design implications from the study of this highly effective, long-term and wide-scale classification scheme.

TABULAR LIST

XII.—OLD AGE.

154. Senility.

This title includes:

Age (70y+)
Asthenia (70y+)
Atony (70y+)
Atrophy (70y+)
    of old age
Cachexia (70y+)
    of old age
Debility (70y+)
    of old age
Decline (70y+)
Degeneration (70y+)
Dementia of old age
Euthanasia (70y+)
Exhaustion (70y+)
    of old age
General atrophy (70y+)
    breaking down (70y+)
    debility (70y+)
    decline (70y+)
    marasmus (70y+)
    senile failure
    weakness (70y+)
Gradual decline (70y+)
Imbecility of old age
Inanition (from disease, 70y+)
Infirmity (70y+)
Malassimilation (70y+)
Malnutrition (70y+)
Marasmus (70y+)
    of old age
Morbus senilis
Old age

Progressive asthenia (70y+)
    weakness (70y+)
Prostration (70y+)
Senectus
Senile asthenia
    atrophy
    cachexia
    debility
    decay
    degeneration
    dementia
    exhaustion
    fibrosis
    heart
    imbecility
    insanity
    mania
    marasmus
    melancholia
    paresis
    prostration
    psychosis
    softening
    vascular degeneration
    weakness
Senility
Vital degeneration (70y+)
Want of vitality (70y+)
Wasting (70y+)
Weakness (70y+)
Worn out (70y+)

This title does not include: Senile gangrene (142).—Senile paralysis (66).

PART TWO

CLASSIFICATION AND BIOGRAPHY; OR SYSTEM AND SUFFERING

In the last three chapters we have looked at classification and wide-scale coordination between multiple organizations. In the next two chapters, we shall examine the relationship between classification and biography. How do classification systems that intimately interpenetrate our lives – shaping and being shaped by them – affect our experience? We shall look in Chapter 5 at the intimate classification systems developed by sufferers of tuberculosis and their doctors. So doing, we shall develop the themes of trajectory (the movement through time of lives, diseases and institutions) and torque (the twisting of that biography in the framework of a classification system). In Chapter 6 we shall develop these themes further through an analysis of race classification schemes in South Africa under apartheid. Through this extreme example we shall explore how difficult it is to operate a simple dichotomous classification scheme: and how the lives of those caught in its interstices are torqued.

PART THREE

CLASSIFICATION AND WORK PRACTICE

In these next two empirical chapters we shall look at classification and work practice. Taking the example of the design of a system for classifying nursing work (NIC), we shall examine how classification systems which represent work embody multiple tensions – notably in this case between control and autonomy (Chapter 7) and the representation of current work practice and learning from previous generations of practice (Chapter 8). Such tensions are integral to the operation of work classifications. Due attention should be paid to their occurrence in order to evaluate the political and ethical implications of the introduction of new classificatory infrastructures.

Humor

5320

DEFINITION: Facilitating the patient to perceive, appreciate, and express what is funny, amusing, or ludicrous in order to establish relationships, relieve tension, release anger, facilitate learning, or cope with painful feelings

ACTIVITIES:

Determine the types of humor appreciated by the patient

Determine the patient's typical response to humor (e.g., laughter or smiles)

Determine the time of day that patient is most receptive

Avoid content areas about which patient is sensitive

Discuss advantages of laughter with patient

Select humorous materials that create moderate arousal for the individual

Make available a selection of humorous games, cartoons, jokes, videos, tapes, books, and so on

Point out humorous incongruity in a situation

Encourage visualization with humor (e.g., picture a forbidding authority figure dressed only in underwear)

Encourage silliness and playfulness

Remove environmental barriers that prevent or diminish the spontaneous occurrence of humor

Monitor patient response and discontinue humor strategy, if ineffective

Avoid use with patient who is cognitively impaired

Demonstrate an appreciative attitude about humor

Respond positively to humor attempts made by patient

BACKGROUND READINGS:

Buxman, K. (1991). Make room for laughter. American Journal of Nursing, 91(12), 46-51.

Kolkmeier, L.G. (1988). Play and laughter: Moving toward harmony. In B.M. Dosseyk, L. Keegan, C.E. Guzetta, & L.G. Kolkmeier (Eds.), Holistic Nursing: A Handbook for Practice (pp. 289-304). Rockville, MD: Aspen.

Snyder, M. (1992). Humor. In M. Snyder (Ed.), Independent Nursing Interventions (2nd ed.) (pp. 294-302). Albany: Delmar Publishers.

Sullivan, J.L., & Deane, D.M. (1988). Humor and health. Journal of Gerontological Nursing, 14(1), 20-24.

PART FOUR

THE THEORY AND PRACTICE OF CLASSIFICATIONS

In this final part of the book, we attempt to weave the threads from each of the chapters into a broader theoretical fabric. Throughout the book we have demonstrated that categories are tied to the things that people do; to the worlds to which they belong. In large-scale systems, those worlds often come into conflict. The conflicts are resulted a variety of ways. Sometimes boundary objects are created which allow for cooperation across the borders. At other times, such as in the case of apartheid, voices are stifled, and violence obtains.

Chapter 9 discusses an abstract model of the several processes involved in both the development of boundary objects, or any other alternatives. The key concept in this chapter is multiplicity; the multiplicity both of people's memberships, and of the ways in which objects are naturalized simultaneously in more than one world. People become members of many communities of practice. They do so it different rates, and with different degrees of completeness. Some communities are all encompassing, others occupy very little of one's life space. Some things in shared quite locally; others become standardized across thousands of social worlds. While it is impossible, and will always be impossible, fully to map the myriad of relationships even a simple situation contains, it is possible to get at least a gestalt sense of the issues involved.

The chapter discusses the multiple trajectories of membership and naturalization. It discusses the consequences of some memberships being silenced, ignored, or devalued. It examines the notion of "cyborg," as a term for discussing the relationships between memberships and the naturalization of objects. The categorical exile of people and objects creates a monstrous landscape, such as those seen in chapters 5 and 6.

The chapter concludes with recognition of the language that people often use in describing the complexities of people, things and their relationships. We often turn to metaphors of texture to describe our sense we moral, emotional and organizational feeling of these relationships. A situation can be knotty and tangled; it can be handled smoothly and without ruffles. Following Lakoff and Johnson (1980), we take these "metaphors we live by" as more than poetic but imprecise means of expression. The metaphors are more systematic and more telling than that. Indeed, they are a key to understanding and perhaps to modeling some of the more complex phenomena facing us in what Ina Wagner (personal communication) has called "the classification society."

The book concludes with a discussion of the ways in which research on classification and standards can inform a larger program of research into the building and maintaining of infrastructure -- and its

simultaneous material/cultural nature.

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

Where do categories come from? How do they span the boundaries of the communities that use them? How can we see and analyze something so ubiquitous and infrastructural -- something so "in between" a thing and an action? These questions have been at the heart of much of social science over the past one hundred years. Sociology and history are both concerned with relationships -- which are invisible except through indicators such as the actions people perform. One cannot directly *see* relations such as membership, learning, ignoring or categorizing. They are names we give to patterns and indicators. If someone is comfortable with the things and language used by a group of others, we say that he or she is a member of that group. In this sense, categories -- our own and those of others -- come from action, and in turn from relationships. They are, as sociologists like Aaron Cicourel remind us, continually re-made and refreshed, with a lot of skilled work (1964). The cases in this book are framed in dialogue with an extensive literature on language, group membership and classification.

In this chapter, we make several aspects of that dialogue more explicit. However, our goal here is much more modest than a thoroughgoing analysis of categorization and language. We examine classification systems as historical and political artifacts, very much as part of modern Western bureaucracy. Assigning things, people or their actions to categories is a ubiquitous part of work in the modern, bureaucratic state. Categories in this sense arise from work and from other kinds of organized activity, including the conflicts over meaning that occur when multiple groups fight over the nature of a classification system and its categories.

In this chapter, we pick up the theoretical strands of the cases in this volume, to begin to develop a more general notion of classification systems. So doing, we take a step bacnk and look at how the various kinds of classifcation we have discussed knit together to form the texture of a social space. We move from classifying and boundary objects to *categorical work and boundary infrastructures*, weaving along the way the many strands that our cases have presented. As we noted in Chapter 1, maintaining a vision that allows us to see the relationships between people, things, moral order, categories and standards is difficult. It requires a good map and a working compass – which we shall try to provide below.

The journey begins by clearing away some of the theoretical brush surrounding the very notions of categories and classification. Many scholars have seen categories as coming from an abstract sense of "mind," little anchored in the exigencies of work or politics. The work of attaching things to categories, and the ways in which those categories are ordered into systems, is often overlooked (except by theorists of language such as Harvey Sacks, 1975; 1992).

We present classification systems in modern organizations as tools that are both material and symbolic. As information technologies used to communicate across the boundaries of disparate communities, they have some unique properties. Next, we present some basic propositions about large-scale information systems.

We examine how they are used to communicate across contexts. These systems are always heterogeneous. Their ecology encompasses the formal and the informal, and the arrangements that are made to meet the needs of heterogeneous communities – some cooperative, and some coercive.

The third part of the journey involves understanding two sets of relationships: first, and analytically, between people and membership; and between things and their naturalization by communities of practice.

The fourth step moves away from the analytical device of single person-single membership and single object – single naturalization, to describing a more complex set of multiple relationships. Everyone is part of multiple communities of practice. Things may be naturalized in more than one social world -- sometimes differently, sometimes in the same fashion. Both people's memberships and the naturalization of objects are multiple – and these processes are, furthermore, intimately intertwined.

The fifth part of the chapter introduces the idea of categorical work – the work that people do to juggle both these multiple memberships and the multiple naturalizations of objects. In this work is the genius of what Sacks called "doing being ordinary" (1975) or what Strauss pointed to in his "continual permutations of action" (1993). In the simplest-seeming action, such as picking an article of clothing to wear, is embedded complex knowledge of situations (Where will I go today? What should I look like for the variety of activities in which I will participate?) involving multiple memberships and how objects are used differently across communities (will this shirt "do" for a meeting with the dean, lunch with a prospective lover, and an appointment with the doctor at the end of the day?). Many of these choices become standardized and built into the environment around us -- for example, the range of clothing we select is institutionalized by the retail stores to which we have access, traditions of costuming, and so forth. To think of this formally, the institutionalization of categorical work across multiple communities of practice, over time, produces the structures of our lives, from clothing to houses. The parts that are sunk into the built environment we call here boundary infrastructures -- objects that cross larger levels of scale than boundary objects.

Finally, we conclude the chapter with a discussion of future directions for research into classifications, standards and their complex relationships with memberships in communities of practice. This includes ways we might visualize and model these intricate relationships.

The overall goal of the chapter is to trace theoretically what we have shown empirically and methodologically throughout the volume: that categories are historically situated artifacts, and like all artifacts, are learned as part of membership in communities of practice. We want as well to talk about this insight beyond the individual "mind, " task, or the small scale -- classifications as technologies are powerful artifacts that may link thousands of communities, and span highly complex boundaries.

1. What sort of thing is a category?

In so far as the coding scheme establishes an orientation toward the world, it constitutes a structure of intentionality whose proper locus is not the isolated, Cartesian mind, but a much larger organizational system, one that is characteristically mediated through mundane bureaucratic documents such as forms. (Goodwin, 1996: 65)

Classification is a core topic within anthropology, especially cognitive anthropology, and within computer science, as the quote from Goodwin attests. Recently, as we discuss in Chapter 2, there has been a move to understand the practical, work-related aspects of classification, as part of a larger project of revisioning cognition (e.g. Suchman, 1988; Hutchins, 1996; Keller and Keller, 1996; Lave, 1986).

Revisioning Cognition

Within anthropology, psychology and the sociology of science, the last two decades have seen a resurgence of the struggle to understand the material, social and ecological aspects of cognition. The work in this book has been deeply informed by that intellectual movement. In brief, the research in this tradition seeks to ground activities previously seen as individual, mental and non-social as situated, collective and historically specific. On this view, for example, solving a mathematical problem is not a matter of mentally using an algorithm and coming up with the correct answer, in a fashion that exists outside of time or culture. Rather, it is a process of assembling materials close to hand, and using them with others in specific contexts. Jean Lave, for example, studied mathematical problem-solving in everyday life, and contrasted it with formal testing situations (1986; 1988). She followed adults shopping for the best buy in a supermarket, people in Weight Watchers weighing cottage cheese in order to get the correct unit for the diet's specifications, and a variety of other mundane activities. She observed people performing highly abstract, creative mathematical problem-solving in these circumstances: creating new units of analysis transposed against given ones in order to measure units, literally cutting up the cottage cheese and moving these material units around, or holding one can against another. These tasks were performed successfully by people who tested badly in a traditional math test. There was, she argued, no way to separate the material circumstances of the problem-solving from the mathematical challenges. Those who seem to solve mathematics problems without such outside help are not working in a putative realm of pure number. Rather, they and their observers have so naturalized the structures within which they are operating that they have become invisible. Lucy Suchman makes a similar argument for the process of planning as material resource; Ed Hutchins for navigation problems (1993); Janet and Charles Keller for designing and measuring in doing iron blacksmithing work (1996). In this book, we join their effort at reforming the notion of categorizing and classifying -- so often seen as purely mental.

The problem of conceptualizing classifications is also akin to Cole's (1996) search for the nature of artifacts in mediated action. Cole notes that:

> An artifact is an aspect of the material world that has been modified over the history of its incorporation into goal-directed human action. By virtue of the changes wrought in the process of their creation and use, artifacts are simultaneously *ideal* (conceptual) and *material.* They are ideal in that their material form has been shaped by their participation in the interactions of which they were previously a part and which they mediate in the present (Cole, 1996: 117).

The materiality of categories, like that of other things associated with the purely cognitive, has been difficult to analyze. The Janus-faced conceptual/material notion of artifacts suggested by Cole, combined with the attention to the use in practice of categories is a good way to begin. Classifications are both

conceptual (in the sense of persistent patterns of change and action, resources for organizing abstractions) and material (in the sense of being inscribed, transported, and affixed to stuff).

Cole's intent is to emphasize the conceptual and symbolic sides of things often taken as only materials, tools and other artifacts. It is similarly felicitous to emphasize the brute material force of that which has been considered ideal, such as categories.

1.1 The Pragmatist Turn

The most radical turn taken by Pragmatist philosophers such as Dewey and Bentley, and closely followed by Chicago School sociologists such as Thomas and Hughes, is perhaps the least understood. It is related, both historically and conceptually, to the cognitive reforms detailed above. Consequences, asserted Dewey against a rising tide of analytic philosophy, are the thing to look at in any argument -- not ideal logical antecedents. What matters about an argument is who, under what conditions, takes it to be true. Carried over into sociology, W. I. And Dorothy Thomas used it (as Howard Becker would some decades later) to argue against essentialism in examining so-called deviants or problem children (Thomas and Thomas, 1917; Becker, 1964). If social scientist do not understand people's definition of a situation, they do not understand it at all. That definition -- whether it is the label of deviant or the performance of a religious ritual -- is what people will shape their behavior towards.

This is a much more profound cut on social construction than the mere notion that people construct their own realities. It makes no comment on where the definition of the situation may come from -- human or nonhuman, structure or process, group or individual. It powerfully draws attention to the fact that the materiality of anything (action, idea, definition, hammer, gun or school grade) is drawn from the consequences of its situation.

The Pragmatist turn, like the activity theoretical turn taken by Cole and others, emphasizes the ways in which things perceived as real may mediate action (Star, 1996). If someone is taken to be a witch, and elaborate technical apparatus with which to diagnose her or him as such is developed, then the reality of witchcraft obtains in the consequences -- perhaps death at the stake. Classification systems are one form of technology, used in the sense Cole employs, linked together in elaborate informatic systems and enjoining deep consequences for those touched by them.

The following section discusses the problems of scaling up, from boundary objects and classifications systems on the one hand, to a notion of boundary infrastructure. This draws together the notions of multiplicity and the symbolic/material aspects of categories as artifacts discussed above.

2. Information Systems across Contexts

At its most abstract, the design and use of information systems involves linking experience gained in one time and place with that gained in another, via representations of some sort. Even seemingly simple replication and transmission of information from one place to another involves encoding and decoding as time and place shift. Thus the context of information shifts in spite of its continuities; and this shift in context imparts heterogeneity to the information itself. Classifications are a very common sort of

representation used for this purpose. Formal classification systems are, in part, an attempt to regularize the movement of information from one context to another; to provide a means of access to information across time and space. The ICD, for example, moves information across the globe, over decades, and across multiple conflicting medical belief and practice systems.

One of the interesting features of communication is that, broadly speaking, in order to be perceived, information *must* reside in more than one context. We know what something is by contrast with what it is not. Silence makes musical notes perceivable; conversation is understood as a contrast of contexts, speaker and hearer, words, breaks and breaths. In turn, in order to be meaningful, these contexts of information must be *re-linked* through some sort of judgment of equivalence or comparability. This occurs at all levels of scale, and we all do it routinely as part of everyday life.

None of this is new in theories of information and communication: we have long had models of signals and targets, background, noise and filters, signals and quality controls. We are moving this insight to the level of social interaction. That is, people often cannot see what they take for granted until they encounter someone who does not take it for granted.

A radical statement of this would be that information is only information when there are *multiple* interpretations. One person's noise may be another's signal, or two people may agree to attend to something -- but it is the tension between contexts that actually creates representation. What becomes problematic under these circumstances is the relationships between people and things, or objects, the relationships that create representations, not just noise. The ecological approach we have taken in this volume adds people as active interpreters of information, who themselves inhabit multiple contexts of use and practice (Star 1991). This multiplicity is primary, not accidental nor incidental.

Consider, for example, the design of a computer system to support collaborative writing. Eevi Beck (1995: 53) studied the evolution of one such system: "how two authors, who were in different places, wrote an academic publication together making use of computers. . .The work they were doing and the way in which they did it was inseparable from their immediate environment and the culture which it was part of". To make the whole system work, they had to juggle time zones, spouses' schedules, and sensitivities about parts of work practice such as finishing each other's sentences *as well as* manipulating the technical aspects of the writing software and hardware. They had to build a shared context in which to make sense of the information. Beck is arguing against a long tradition of de-contextualized design where only the technical, or narrowly construed considerations about work hold sway.

We lack good relational language here. There is a permanent tension between the formal and the empirical, the local/situated and attempts to represent information across localities. It is this tension itself which is under-explored and under-theorized. It is not just a set of interesting metaphysical observations. It can also become a pragmatic unit of analysis. How can something be simultaneously concrete and abstract? The same and yet different? People are not (yet, we hope) used to thinking in this fashion in science or technology. As information systems grow in scale and scope, however, the need for such complex analyses grows as well. In opposition to the old hierarchical databases, where relations between classes had to be decided once for all at the time of original creation, many databases today incorporate object-oriented

views of data whereby different attributes can be selected and combined on the fly for different purposes. The tailorability of software applications similarly becomes very important for customizing use in different settings (Trigg and Bødker, 1994).

If we look at these activities in the context of practice, we see what Suchman and Trigg (1993) call the 'artful integration' of local constraints, received standardized applications, and the re-representation of information. The tension between locales remains. This tension it is not something to be avoided or deleted. When the sort of "artful integration" discussed by Suchman and Trigg becomes a) an ongoing, stable relationship between different social worlds, and b) shared objects are built across community boundaries, then boundary objects arise.

Boundary objects are one way that the tension between divergent viewpoints may be managed. There are of course many other ways. All of them involve accommodations, workarounds, and in some sense, a higher level of artful integration. It too is managed by people's artful juggling, gestalt switching, and on the spot translating.

Too often, this sort of work remains invisible to traditional science and technology, or to rational analyses of process. This tension is itself collective, historical, and partially institutionalized. The medium of an information system is not just wires and plugs, bits and bytes, but also conventions of representation, information both formal and empirical. A system becomes a system in design and use, not the one without the other. The medium *is* the message, certainly, and it is also the case that both are political creations (Taylor and Van Every, 1993). In Donna Haraway's words:

> No layer of the onion of practice that is technoscience is outside the reach of technology of critical interpretation and critical inquiry about positioning and location; that is the condition of embodiment and mortality. The technical and the political are like the abstract and the concrete, the foreground and the background, the text and the context, the subject and the object. (Haraway, 1993: 10)

A fully developed method of multiplicity/heterogeneity for information systems must draw on many sources and make many unexpected alliances (Star 1989a: Chapter 1; Star 1989b; Hewitt 1986; Goguen 1997). If both people and information objects inhabit multiple contexts, and a central goal of information systems is to transmit information across contexts, then a representation is a kind of pathway that includes everything populating those contexts. This includes people, things/objects, previous representations, and information about its own structure. The major requirements for such an ecological understanding of the path of re-representation are thus:

1. How objects can inhabit multiple contexts at once, and have both local and shared meaning;

2. How may people who live in one community, and draw their meanings from people and objects situated there, communicate with those inhabiting another?

3. How relationships form between 1) and 2) above – that is, how can we model the information ecology of people and things, across multiple communities?

4. What range of solutions to these three questions is possible, and what moral and political consequences attend each of them -- *cui bono*?

Standardization has been one of the common solutions to this class of problems: if interfaces and formats are standard across contexts, then at least the first three questions become clear, and the fourth seems to become moot. But we know from a long and gory history of attempts to standardize information systems that standards don't remain standard for very long, and that one person's standard is another's confusion and mess (Gasser, 1986; Star, 1991b). We need a richer vocabulary than that of standardization or formalization with which to characterize the heterogeneity and the processual nature of information ecologies.

3. Boundary Objects and Communities of Practice

The class of questions posed by the slippage between classifications and standards on the one hand, and the contingencies of practice on the other, form core problematics in both sociology of science and in studies of use and design in information science. A rich body of work has grown up in both fields which documents the clever ways people organize and re-organize when the local circumstances of their activities do not match the prescribed categories or standards (see e.g. Gasser, 1986; Kling and Scacchi, 1982; Lave, 1988; Sacks, 1975; Star, 1983). Making or using any kind of representation is a complex accomplishment, a balance of improvisation and accommodation to constraint.

People learn how to do this everyday, impossible action as they become members of what Lave and Wenger (1991) call *communities of practice*, or what Strauss (1978) calls *social worlds*. A community of practice (or social world) is a unit of analysis that cuts across formal organizations, institutions like family and church, and other forms of association such as social movements. It is, put simply, a set of relations between people doing things together (Becker, 1986). The activities, with their stuff, their routines and exceptions, are what constitute the community structure. Newcomers to the community learn by becoming "sort of" members, what Lave and Wenger (1991) call the process of 'legitimate peripheral participation.' They have investigated how this membership process unfolds, and how it is constitutive of learning.

We are all in this sense members of various social worlds – communities of practice -- that conduct activities together. Membership in such groups is a complex process, varying in speed and ease, with how optional it is, and how permanent it may be. One is not born a violinist, as we all know, but gradually becomes a member of the violin-playing community of practice through a long period of lessons, shared conversations, technical exercises, and participation in a range of other related activities.

People live, with respect to a community of practice, along a trajectory (or continuum) of membership, which has elements of both ambiguity and duration. They may move from *legitimate peripheral participation* to full membership in the community of practice, and it is extremely useful in many ways to conceive of learning this way.

How does this include categories?

Learning the ropes and rules of practice in any given community entails a series of encounters with the

objects involved in the practice: tools, furniture, texts, and symbols, among others. It also means managing encounters with other people, and with classes of action. Membership in a community of practice has as its *sine qua non* an increasing familiarity with the categories that apply to all of these. As the familiarity deepens, so does one's perception of the object as strange or of the category itself as something new and different. Anthropologists call this the *naturalization* of categories or objects. The more at home you are in a community of practice, the more you forget the strange and contingent nature of its categories seen from the outside.

Illegitimacy, then, is seeing those objects as would a stranger -- either as a naïf or by comparison with another frame of reference in which they exist. And this is not to be equated with an idealized notion of skill, but with membership. One does not have to be Isaac Stern to know fully and naturally what to do with a violin, where it belongs, and how to act around violins and violinists. But if you use a Stradivarius to swat a fly (but not as part of an artistic Futurist event!) you have clearly defined yourself as an outsider, in a way that a schoolchild practicing scales has not.

Membership can thus be described individually as the *experience* of encountering objects, and increasingly being in a naturalized relationship with them. (Think of the experience of being at home, and how one settles down and relaxes when surrounded by utterly familiar objects; think of how demented one feels in the process of moving house.)

From the point of view of learning-as-membership and participation, then, the illegitimate stranger is a source of learning. Someone's illegitimacy appears as a series of interruptions to experience (Dewey 1916; Dewey 1929), or a lack of a naturalization trajectory. In a way, then, individual membership processes are about the resolution of interruptions (anomalies) posed by the tension between the ambiguous (outsider, naive, strange) and the naturalized (at home, taken-for-granted) categories for objects. *Collectively,* membership can be described as the processes of managing the tension between naturalized categories on the one hand, and the degree of openness to immigration on the other. Harvey Sacks, in his extensive investigations into language and social life, notes that categories of membership form the basis of many of our judgments about ordinary action. "You can easily enough come to see that for any population of persons present there are available alternative sets of categories that can be used on them. That then poses for us an utterly central task in our descriptions; to have some way of providing which set of categories operate in some scene -- in the reporting of that scene or in its treatment as it is occurring" (1991a: 116). Sacks draws attention to the ways in which being ordinary are not pre-given but are in fact a kind of job -- a job which asserts the nature of membership:

> Whatever we may think about what it is to be an ordinary person in the world, an initial shift is not to think of an "ordinary person" as some person, but as somebody having as their job, as their constant preoccupation, doing "being ordinary." It's not that somebody *is* ordinary, it's perhaps that that's what their business is. And it takes work, as any other business does. And if you just extend the analogy of what you obviously think of as work -- as whatever it is that takes analytic, intellectual, emotional energy -- then you can come to see that all sorts of normalized things -- personal characteristics and the like -- are jobs which are done, which took some kind of effort, training, etc.. So I'm not going to be talking about to an "ordinary

person" as this or that person, or as some average, i.e., a non--exceptional person on some statistical basis, but as something that is the way somebody constitutes themselves, and, in effect, a job that they do on themselves. Fate and the people around and may be coordinatively engaged in assuring that each of them are ordinary persons, and that can then be a job that they undertake together, to achieve that each of them, together, are ordinary persons (1992b: 216)

The performance of this job includes the ability to choose the proper categories under which to operate, to perform this ordinariness. The power of Sack's work, like that of John Dewey (e.g., 1929), is that he draws attention to the ways in which the ordinary -- and the interruption to the expected experience -- are delicate constructions, made and re-made every day.

3.1 Boundary Objects

Science and technology are good places to study the rich mix of people and things brought to bear on complex problem solving questions, although the points made here are more generally applicable as well. Categories and their boundaries are centrally important in science, and scientists are especially good at documenting and publicly arguing about the boundaries of categories. Thus, in turn, science is a good place to understand more about membership in communities. This point of departure has led us to try to understand people and things ecologically, both with respect to membership and with respect to the things they live with, with a focus on scientists (Star, 1995a). One of the observations is that scientists routinely cooperate across many communities of practice. They thus bring different naturalized categories with them into the partnerships.

In studying scientific problem solving, we have been concerned for a number of years to understand how scientists *could* cooperate without agreeing about the classification of objects or actions. Scientific work is always composed of members of different communities of practice (we know of no science that is not interdisciplinary in this way, especially if - as we do - you include laboratory technicians and janitors). Thus, memberships (and divergent viewpoints, or perspectives) present a pressing problem for modeling truth, the putative job of scientists. In developing models for this work, Star coined the term 'boundary objects' to talk about how scientists balance different categories and meanings (Star and Griesemer, 1989; Star, 1989b). Again, the term is not exclusive to science, but science is an interesting place to study such objects because the push to make problem-solving explicit gives one an unusually detailed amount of information about the arrangements.

Boundary objects are those objects that both inhabit several communities of practice and satisfy the informational requirements of each of them. Boundary objects are thus both plastic enough to adapt to local needs and constraints of the several parties employing them, yet robust enough to maintain a common identity across sites. They are weakly structured in common use, and become strongly structured in individual-site use. These objects may be abstract or concrete. Star and Griesemer (1989) first noticed the phenomenon in studying a museum, where the specimens of dead birds had very different meanings to

amateur bird-watchers and professional biologists, but "the same" bird was used by each group. Such objects have different meanings in different social worlds but their structure is common enough to more than one world to make them recognizable, a means of translation. The creation and management of boundary objects is a key process in developing and maintaining coherence across intersecting communities.

Another way of talking about boundary objects is to consider them with respect to the processes of naturalization and categorization we discussed above. Boundary objects arise over time from durable cooperation between communities of practice. They are working arrangements that resolve anomalies of naturalization without imposing a naturalization of categories from one community or from an outside source of standardization. (They are therefore most useful in analyzing cooperative and relatively equal situations; issues of imperialist imposition of standards, force and deception have a somewhat different structure.) In terms of this book, sets of boundary objects arise directly from the problematics created when two or more differently naturalized classification systems collide. Thus nursing administrators create classification systems which serve hospital administrators and nursing scientists; soil scientists create classifications of soil to satisfy geologists and botanists (Chatelin, 1979). Other outcomes of these meetings are explored as well – the dominance of one over another; how claims of authority may be manipulated to higher claims of naturalness.

The processes by which communities of practice manage divergent and conflicting classification systems are complex, the more so as people are all members in fact of many communities of practice, with varying levels of commitment and consequence. Under those conditions, how are boundary objects established and maintained? Does the concept scale up? What is the role of technical infrastructure? Is a standard ever a boundary object? How do classification systems, as artifacts, play a role?

4. Membership and Naturalization: People and Things

As Engeström (1990b) and other activity theorists note so well, tools and material arrangements always mediate activity. People never act in a vacuum or some sort of hypothetical pure universe of doing, but always with respect to arrangements, tools, and material objects. Strauss has recently made a similar point, emphasizing the continuity and permeability of such arrangements -- action never really starts from scratch, from a tabula rasa (1993). Both Engeström and Strauss go to great lengths to demonstrate that an idea, or something that has been learned, can also be considered as having material/objective force in its consequences and mediations.

"Object" includes all of this: stuff and things, tools, artifacts and techniques, and ideas, stories, and memories -- those objects which are treated as consequential by community members (Clarke and Fujimura 1992a; 1992b). They are used in the service of an action, and mediate it in some way. Something actually *becomes* an object only in the context of action and use -- it then becomes as well something that has force to mediate subsequent action. It is easier to see this from historical examples than it may be to look to contemporary ones. For instance, the category of hysteria was naturalized in medicine and in popular culture at the end of the 19th-century. As with the example of witchcraft discussed above, people used the diagnosis of hysteria for purposes of social control as well as for medical treatment. It became a

category through which physicians, social theorists, and novelists discussed pain and anxiety and, arguably, the changing social status of women. The point is not who believed what when, but rather that the category itself became an object existing in both communities. It was a medium of communication, whatever else it may also have been.

A community of practice is defined in large part according to the co-use of such objects, since all practice is so mediated. The relationship of the newcomer to the community largely revolves around the nature of the relationship with the objects -- and not, counterintuitively, directly with the people. As noted above with respect to action, this sort of directness only exists hypothetically -- there is always mediation by some sort of object. Acceptance or legitimacy derives from the familiarity of action mediated by member objects.

But familiarity is a fairly sloppy word. We mean it here not instrumentally, as in proficiency, but relationally, as a measure of taken-for-grantedness. (An inept programmer can still be a member of the community of practice of computer specialists, albeit a low status one in that she takes for granted the objects to be used.) A better way to describe the trajectory of an object in a community is as one of *naturalization.* Naturalization means stripping away the contingencies of an object's creation and its situated nature. A naturalized object has lost its anthropological strangeness. It is in that narrow sense de-situated -- members have forgotten the local nature of the object's meaning, or the actions that go into maintaining and recreating its meaning We no longer think much about the miracle of plugging a light into a socket and obtaining illumination, and must make an effort of anthropological imagination to remind ourselves of contexts in which it is still not naturalized.

Objects become natural in a particular community of practice over a long period of time (see Latour's (1987) arguments in *Science in Action* for a good discussion of this). Objects exist, with respect to a community, along a trajectory of naturalization. This trajectory has elements of both ambiguity and duration. It is not pre-determined whether an object will ever become naturalized, or how long it will remain so -- rather, practice/activity is required to make it so and keep it so. The more naturalized an object becomes, the more unquestioning the relationship of the community to it; the more invisible the contingent and historical circumstances of its birth; the more it sinks into the community's routinely forgotten memory. Light switches, for instance, are ordinary parts of modern life. Almost all people living in the industrialized world know about light bulbs and electricity, even if they live without it, and switches and plugs are naturalized objects in most communities of practice. People don't think twice about their nature, only about whether or not they can find them when needed.

Commodity and infrastructure technologies are often naturalized in this way. In a sense, they become a form of collective forgetting, or naturalization, of the contingent, messy work they replace. We wrote this chapter on Macintosh and IBM computers; cutting and pasting with it are no longer phenomenologically novel operations, although we can remember when they once were. We have naturalized the mouse, the operation of selecting text, and the anachronistic "cut and paste" metaphor.

Multiplicity

In this chapter so far, there are, then, analytically two sets of relationships: between people and

membership, on the one hand; and objects and naturalization on the other hand. In any given instance, *both membership and naturalization are relations along a trajectory*. In saying this, we do not want to re-create a great divide between people and objects, reifying an objectless human or wild child. Ironically in a way, social science has spent incredible resources on precisely this sort of search. There is something compelling about the idea of a person without "a society," naked even of touch or language. The sad case of "Genie," a child kept captive by her parents for many years (Rymer, 1993; Star, 1995d), or the "wild child of Aveyron" which amazed 18th century philosophers, are emblematic of this propensity. They have been seen as holding the key to language, or in a way to what it is to be human.

However, exactly the opposite is true. People-and-things, which are the same as people-and-society, cannot be separated in any meaningful practical sense. At the same time, it is possible for analytical purposes to think of two trajectories travelling in tandem, membership and naturalization. Just as it is not practically possible to separate a disease from a sick patient, yet it is possible to speak of the trajectories of disease and biography operating and pulling at one another, as we have done in Chapter 5, in the case of tuberculosis.

Residual categories, marginal people, and monsters

People often seen multiplicity and heterogeneity as accidents or exceptions. The marginal person, who is for example of mixed race, is portrayed as the troubled outsider; just as the thing that doesn't fit into one bin or another gets put into a "residual" category. This habit of purity has old and complicated origins in western scientific and political culture (e.g. as explicated by Dewey, 1916). The habit perpetuates a cruel pluralistic ignorance. No one is pure. No one is even average. And all things inhabit someone's residual category in some category system. The myriad of classifications and standards that surround and support the modern world, however, often blind people to the importance of the "other" category as constitutive of the whole social architecture (Derrida, 1980).

Communities vary in their tastes for openness, and in their tolerance for this ambiguity. Cults, for example, are one sort of collective which is low on the openness dimension and correspondingly high on the naturalization/positivism dimension -- us *vs.* them.

In recent years social theorists have been working toward enriching an understanding of multiplicity and misfit, and decentering the idea of an unproblematic mainstream. The schools of thought grappling with this include feminist research (e.g. Haraway, 1997), multi-cultural or race-critical theory (e.g. Ferguson, et al., 1990), symbolic interactionism, and activity theory (e.g., Cole, 1996; Wertsch, 1991; 1998). During the same period, such issues have become increasingly of concern to some information scientists. As the information systems of the world expand and flow into each other, and more kinds of people use them for more different things, it becomes harder to hold to pure or universal ideas about representation or information.

Some of these problems are taken up in the intellectual common territory sometimes called cyborg. Cyborg, as used for example by Donna Haraway (1991) and Adele Clarke (1993; 1998), means the intermingling of people, things (including information technologies), representations and politics in a way that challenges both the romance of essentialism and the hype about what is technologically possible. It

acknowledges the interdependence of people and things, and just how blurry the boundaries between them have become. The notion cyborg has clearly touched a nerve across a broad spectrum of intellectual endeavors. The American Anthropological Association has hosted sessions on cyborg anthropology for the past several years; the weighty *Cyborg Handbook* was published a few years ago (Gray, 1995).

Through looking at ubiquitous classification systems and standards, it is possible to move towards an understanding of the stuff that makes up the networks that shape much of modern daily life in cyborg fashion. We draw attention here to the places where the work gets done of assuring that these networks will stick together: to the places where human and non-human are constructed to be operationally and analytically equivalent. So doing, we explore the political and ethical dimensions of classification theory.

Why should computer scientists read African-American poets? What does information science have to do with race critical or feminist methods and metaphysics? The collective wisdom in those domains is one of the richest places for which to understand these core problems in information systems design: how to preserve the integrity of information without *a priori* standardization and its often-attendant violence. In turn, if those lessons can be taken seriously within the emerging cyber world, there may yet be a chance to strengthen its democratic ethical aspects. It is easy to be ethnocentric in virtual space; more difficult to avoid stereotypes. The lessons of those who have lived with such stereotypes are important, perhaps now more than ever.

Borderlands and Monsters

People who belong to more than one central community are also important sources for understanding more about the links between moral order and categorization. Such "marginal" people have long been interest to social scientists and novelists alike. Marginality as a technical term in sociology refers to human membership in more than one community of practice; here we are emphasizing those people who belong to communities that are different in key, life-absorbing ways, such as racial groups (as per our discussion in Chapter 6). A good example of a marginal person is someone who belongs to more than one race, i.e. half white and half Asian. Again, we are not using marginality here in the sense of center/margin or center/periphery (e.g., not 'in the margins'), but rather in the old-fashioned sense of Robert Park's marginal man, the one who has a double vision by virtue of having more than one identity to negotiate (Park 1952; Stonequist 1937; Simmel 1950 {1908}; Schütz, 1944). Strangers are those who come and stay a while, long enough so that membership becomes a troublesome issue -- they are not just nomads passing through, but people who sort of belong and sort of don't.

Marginality is an interesting paradoxical concept for people and things. On the one hand, membership means the naturalization of objects, which mediate action. On the other, everyone is a member of multiple communities of practice. Yet since different communities generally have differently naturalized objects in their ecology, how can someone maintain multiple membership without becoming simply schizophrenic? How can they naturalize the same object differently, since naturalization by definition demands forgetting about other worlds?

There are as well some well-known processes in social psychology for managing these tensions and conflicts: passing, or making one community the shadow for the other; splitting, or having some form of

multiple personality/chameleon; fragmenting or segmenting the self into compartments; becoming a nomad, intellectually and spiritually if not geographically (Larsen (1986) covers many of these issues in her exquisite fiction).

One dissatisfaction we have with these descriptions is that they all paint each community of practice as ethnocentric, as endlessly hungry and unwilling collectively to accommodate internal contradictions. There is also an implicit idea of a sort of imperialist über-social world (the mainstream) that is pressing processes of assimilation on the individual (e.g. Americanization processes in the early 20th century). Communities vary along this dimension of open/closedness, and it is equally important to find successful examples of the nurturing of marginality (although it is possible that by definition they exist anarchically and not institutionally/bureaucratically). Here again, feminism has some important lessons. An important theme in recent feminist theory is resistance to such imperializing rhetoric and the development of alternative visions of coherence without unconscious assumption of privilege. Much of it emphasizes a kind of double-vision, such as that taken up in the notion of borderlands by Anzaldúa (1987), or the qualities of partiality and modesty of Haraway's cyborg (1991).

Charlotte Linde's book on the processes of coherence in someone's life stories also provides some important clues. She especially emphasizes accidents and contingency in the weaving together of a coherent narrative (Linde 1993). The narratives she analyses are in one sense meant to reconcile the heterogeneity of multiply naturalized object relations in the person, where the objects in question are stories/depictions of life events. Linden (1993) and Strauss (1959) have made similar arguments about the uncertainty, plasticity, and collectivity of life narratives.

In traditional sociology this model might have overtones of functionalism, in its emphasis on insiders/outsiders and their relations. But functionalists never considered the nature of objects or of multiple legitimate memberships. If we think in terms of a complex cluster of *multiple* trajectories *simultaneously* of both memberships and naturalizations, it is possible to think of a many-to-many relational mapping.

The mapping suggested here pushes us further into the analysis of the cyborg. On the one hand, cyborgs as an image are somehow grotesque. Imagining the relationships between people and things such that they are truly inter-penetrated means rethinking human nature itself. It is reminiscent somehow of bad science fiction. Yet analytically, it is a crucial notion for understanding technoscience, and classifications as artifacts.

How can we think of cyborgs in terms of the analysis presented in this chapter? The mapping between things, people, and membership provides a way in. Anzaldúa's work on borderlands rejects any notion of purity based on membership in a single, pristine racial, sexual, or even religious group (1987). Haraway's work pushes this analysis a bit further. In speaking of borderlands, both those concerning race and those concerning the boundaries between humans and things, she employs the term "monsters."

A monster occurs when an object refuses to be naturalized (Haraway 1992); a borderland occurs when two communities of practice coexist in one person (Anzaldúa 1987). Borderlands are the naturalized home of those monsters known as cyborgs.

If we read monsters as persistent resisters of transparency/naturalization within some community of practice, then the experience of encountering an anomaly (such as that routinely encountered by a newcomer to science, for instance a woman or man of color) may be keyed back into membership. A person realizes that they don't belong when what seems like an anomaly to them seems natural for everyone else. Over time, collectively, such outsider experiences (the quintessential stranger) can become monstrous in the collective imagination. History and literature are full of the demonizing of the stranger. Here is what Haraway (1992) has called 'the promise of monsters' and one of the reasons that for years they have captured the feminist imagination. Frankenstein peering in the warmly-lit living room window; Godzilla captured and shaking the bars of his cage are intuitions of exile and madness, and symbols of how women's resistance and wildness has been imprisoned and reviled, kept just outside.

In a more formal sense, monsters and freaks are also ways of speaking about the constraints of the classifying and (often) dichotomizing imagination. Ritvo (1997) writes of the proliferation of monsters in the 18th and 19th century, linking it to a simultaneous increase in public awareness of scientific classification and hunger for the exotic. As classification schemes proliferated, so did monsters:

> Monsters were understood, in the first instance, as exceptions to or violations of natural law. The deviations that characterized monsters, however, were both so various and in some cases, so subtle as significantly to complicate this stock account…. As a group, therefore, monsters were united not so much by physical deformity or eccentricity as by their common inability to fit or be fitted into the category of the ordinary – a category that was particularly liable to cultural and moral construction (Ritvo, 1997: 133-134).

In a practical sense, this is a way to talk about what happens to any outsider. For example, it could refer to experience in the science classroom when someone comes in with no experience of formal science, or to the transgendered person who does not fit cultural gender dichotomies (Stone, 1991). It is not simply a matter of the strangeness, but of the politics of the *mapping* between the anomalies and the forms of strangeness/marginality.

In accepting and understanding the monsters and the borderlands there may be an intuition of healing and power, as Gloria Anzaldúa (1987) shows us in her brilliant and compassionate writing. In her essay, "La conscientia de la mestiza," the doubleness and the ambiguity of the male/female, straight/gay, Mexican/American borderland becomes the cauldron for a creative approach to surviving, a rejection of simplistic purity and of essentialist categories (1987). At the same time, she constantly remembers the physical and political suffering involved in these borderlands, refusing a romanticized version of marginality that often plagued the early sociological writers on the topic.

The path traced by Anzaldúa is not an easy healing and certainly not a magic bullet, but a complex and collective twisted journey, a challenge to easy categories and simple solutions. It is, in fact, a politics of ambiguity and multiplicity -- this is the real possibility of the cyborg. For scholars, this is necessarily an exploration that exists in interdisciplinary borderlands and crosses the traditional divisions between people, things, and technologies of representation.

Engineered vs. Organic Boundary Objects

Would be possible actually to design boundary objects? To engineer them in the service of creating a better society? On the surface, this idea is tempting. In some sense, this has been the goal of progressive education, multiculturalism in the universities, and, the goal of the design of information systems that may be accessed by people with very different points of view.

Most schools now are lousy places to grow boundary objects, because they both strip away the ambiguity of the objects of learning, and impose or ignore membership categories (except artificial hierarchically assigned ones). In mass schooling and standardized testing, an attempt is made to insist on an engineered community of practice, where the practices are dictated, and the naturalization process is monitored and regulated while ignoring borderlands. They are virtual factories for monsters. In the 1970s and 1980s many attempts were made to *include* other communities in the formula via affirmative action and multicultural initiatives. But where these lacked the relational base between borderlands and the naturalization of objects, they ran aground on the idea of measuring progress in learning. This is partly a political problem and partly a representational one. As feminists learned so painfully over the years, a politics of identity based on essences can only perpetuate vicious dualisms. That is, if one as a white male science teacher were to bring in an African American woman as a (Platonic) representative of African American-ness and/or woman-ness, then attempt to match her essential identity to the objects in the science classroom (without attending much to how they are fully naturalized objects in *another* community of practice), costly and painful mismatches are inevitable. The teacher risks causing serious damage to her self-articulation (especially where she is alone), and her ability to survive (a look at the dismal retention statistics of women and minority men in many sciences and branches of engineering will underscore this point). Any mismatch becomes her personal failure, since the measurement yardstick remains unchanged although the membership criteria seem to have been stretched. Again, both borderlands and anomalous objects have been deleted. Kal Alston (1993), writing of her experience as an African-American Jewish feminist, has referred to herself as a unicorn -- a being at once mythical and unknowable, straddling multiple worlds.

But *all* people belong to multiple communities of practice -- it's just that in the case of the African-American woman in science, the visibility and pressure is higher, and her experience is especially dense in the skill of surviving multiplicity. Thus Patricia Hill Collins' title, "Learning from the Outsider Within" has many layers and many directions to be explored as we all struggle for rich ways of mapping that honors this experience and survival (1986). Karla Danette Scott (1995) has recently written about the interwoven languages of Black women coming to university, and how language becomes a resource for this lived complexity. They 'talk black' and 'talk white' in a seamless, context-driven web, articulating the tensions between those worlds as a collective identity. This is not just code switching, but braided identity, a borderland.

Wildness

Things and people are always multiple, although that multiplicity may be obfuscated by standardized inscriptions. In this sense, with the right angle of vision, things can be seen as heralds of other worlds, and

of a wildness that can offset our naturalizations in liberatory ways. Holding firmly to a relational vision of people-things-technologies, in an ethical political framework, there is a chance to step off the infinite regress of measuring the consumption of an object naturalized in one centered world, such as the objects of Western science, against an infinitely-expanded set of essentially-defined members as consumers.

By relational here we argue against misplaced concretism, or a scramble unthinkingly to assimilate the experiences of things to pre-given categories. We affirm the importance of process and ethical orientations. We also mean to take seriously the power of membership, its continual nature (i.e. we are never *not* members of some community of practice), and the inherent ambiguity of things. Boundary objects, however, are not just about this ambiguity, they are not just temporary solutions to disagreements about anomalies. Rather, they are durable arrangements between communities of practice. Boundary objects are the canonical forms of all objects in our built and natural environments. Forgetting this, as people routinely do, means empowering the self-proclaimed objective voice of purity that creates the suffering of monsters in borderlands. Due attention to boundary objects entails embracing the gentle and generous vision of *mestiza* consciousness offered by Anzaldúa.

Casual vs. Committed Membership

Another dimension to take into account here is the degree to which membership demands articulation at the higher level. Being a woman and African American and disabled are three sorts of membership that are non-optional, diffused throughout life, and embedded in almost every sort of practice and interaction. So it's not equitable to talk about being a woman in the same breath as being a scuba diver -- although there are ways in which both can be seen under the rubric community of practice. But if we go to the framework presented above, there is a way to talk about it. To the extent that the joint objects are both multiply naturalized in conflicting ways and diffused through practices that belong to many communities they will pose a sticking point that defies casual treatment. So for scuba diving -- it is primarily naturalized in a leisure world, and not especially central to any others. Its practice is restricted and membership is contained, neither contagious nor diffuse. On the other hand, learning mathematics is multiply naturalized across several powerful communities of practice (mathematics and science teachers and practitioners); at the same time it is both strange and central to others (central in the sense of a barrier to further progress). It is also diffused through many kinds of practices, in various classrooms, disciplines and workplaces (Hall and Stevens, 1995). Some communities of practice expect it to be fully naturalized -- a background tool or a substrate/infrastructure -- in order to get on with the business of being, e.g. a scientist. (Lave 1988). However, there is no map or sense of the strangeness of the object across other memberships. Here, too, information technologies are both diffused and strange, with rising expectations of literacy across worlds.

These relations define a space against which and into which information technologies of all sorts enter. These technologies of representation are entering into all sorts of communities of practice on a global scale, in design and in use. They are a medium of communication and broadcast, as well as of standardization. The toughest problems in information systems design are increasingly those concerned with modeling cooperation across heterogeneous worlds, of modeling articulation work and multiplicity. If we do not learn to do so, we face the risk of a franchised, dully standardized infrastructure ('500 channels and nothing on,' in Mitch Kapur's words), or of an Orwellian nightmare of surveillance.

Feminism and race-critical theory offer traditions of reflective denaturalization, of a politics of simultaneity and contradiction intuited by the term cyborg. Long ago feminists began with the maxim that the personal is political, and that each woman's experience has a primacy that we must all learn to afford. Feminism went from reductionist identity politics to cyborg politics in less than twenty years. Much of this was due to the hard work and suffering of communities of practice who had been made monstrous or invisible, especially women of color and their articulation of the layered politics of insider/outsider and borderlands. One part of the methodological lesson from feminism read in this way is that experience/experiment incorporates an ethics of ambiguity, with both modesty and anger. This means that how we hear each other is a matter of listening forth from silence -- listening is active, not passive; it means stretching to affiliate with multiplicity. In Nell Morton's words, this is "hearing to speech":

- Not only a new speech but a new hearing.
- Hearing to speech is political
- Hearing to speech is never one-sided. Once a person is heard to speech she becomes a hearing person.
- Speaking first to be heard is power over. Hearing to bring forth speech is empowering. (Morton, 1985: 210).

Part of the moral vision of this book concerns how we may, through challenge and analysis of infrastructure, better hear each other to speech.

5. Multiple Marginality, Multiple Naturalizations: Categorical Work

The model proposed here takes the form of a many-to-many relational mapping, between multiple marginality of people (borderlands and monsters) and multiple naturalizations of objects (boundary objects and standards). Over time, the mapping is between the means by which individuals and collectives have managed the work of creating coherent selves in the borderlands on the one hand, and to create durable boundary objects on the other.

It is also not just many-to-many relational, but meta-relational. By this we mean that the map must point simultaneously to the articulation of selves and the naturalization of objects. One of the things that is important here is honoring (we won't say capturing) the work involved in borderlands and boundary objects. This work is almost necessarily invisible from the point of view of any single community of practice: as Collins (1986) asks, what white really *sees* the work of self-articulation of the black who is juggling multiple demands/audiences/contingencies? It is not just willful blindness (although it can be that), but much more akin to the blindness between different Kuhnian paradigms, a revolutionary difference. Yet the juggling is both tremendously costly and brilliantly artful. Every community of practice has its overhead: *paying your dues, being regular, hangin', being cool, being professional, people like us*, *conduct becoming*, *getting it, catching on ...* . And the more communities of practice one participates in, the higher the overhead -- not just in a straightforwardly additive sense, but interactively. Triple jeopardy (i.e. being old, Black, and female) is not just three demographic variables or conditions added together, but a tremendously challenging situation of marginality requiring genius for survival. *The overheads interact.*

From Articulation Work to Categorical Work

What is the name for this work of managing the overheads and anomalies caused by multiple memberships on the one hand, and multiply naturalized objects on the other? Certainly, it is invisible. Most certainly, it is methodological, in the sense of reflecting on differences between methods and techniques. At first glance, it resembles articulation work, that is, work done in real time to manage contingencies; work that gets things back on track in the face of the unexpected, that modifies action to accommodate unanticipated contingencies. Within both symbolic interactionism and the field of computer-supported cooperative work, the term articulation work has been used to talk about some forms of this invisible juggling work (Schmidt and Bannon 1992; Gerson and Star 1986).

Articulation work is richly found for instance in the work of head nurses, secretaries, homeless people, parents, and air traffic controllers, although of course all of us do articulation work in order to keep our work going. Modeling articulation work is one of the key challenges in the design of cooperative and complex computers and information systems. This is because real time contingencies, or in Suchman's (1987) terms, situated actions, always change the use of any technology (for example, when the host of a talk forgets to order a computer projector, can one quickly print out and assemble a handout?)

Other aspects of cooperative work concerns novelty and the ways in which one person's routine may be another's emergency or anomaly (Hughes, 1970), or in the words of Schmidt and Simone (1996), both the consequences and the division of labor of cooperative work. The act of cooperation is the interleaving of distributed tasks; articulation work manages the *consequences* of this distributed aspect of the work. Schmidt and Simone note the highly complex dynamic and recursive relationship between the two -- managing articulation work can itself become articulation work, and vice versa, ad infinitum.

The consequences of the distribution of work, and its different meanings in different communities, must be managed for cooperation to occur. The juggling of meanings (memberships and naturalizations), is what we term *categorical work*. For example, what happens when one clerk, User A, entering data into a large database does not think of abortion as a medical matter, but as a crime; while another, User B, thinks of it as a routine medical procedure? Person A's definition excludes abortion from the medical database, Person B's includes it. The resulting data will be, at the least, incomparable, but in ways that may be completely invisible to User C, compiling statistics for a court case arguing for the legalization of abortion based on prevalence. When this aspect of the coordination of work is deleted and made invisible in this fashion, then voices are suppressed and we see the formation of master narratives and the myth of the mainstream universal (Star and Strauss, 1999).

Thus, we can see categorical work as partly about managing the mismatches between memberships and naturalization. One way to think about this is through the management of anomalies -- as a tracer. Anomalies or interruptions, the cause of contingency, come when some person or object, from outside the world at hand, interrupts the flow of expectations. One reason that glass box technology or pure transparency is impossible is that anomalies always arise when multiple communities of practice come together, and useful technologies cannot be designed in all communities at once. Monsters arise when the legitimacy of that multiplicity is denied. Our residual categories in that case become clogged and bloated.

Transparency is in theory the endpoint of the trajectory of naturalization, as complete legitimacy or centrality is the endpoint of the trajectory of membership in a community of practice. However, due to the multiplicity of membership of all people, and the persistence of newcomers and strangers, as well as the multiplicity of naturalization of objects, this is inherently nonexistent in the real world. For those brief historical moments where it seems to be the case, it is unstable.

In place of transparency – and it is a good enough counterfeit to work most of the time as transparency – one encounters convergence: the mutual constitution of a person or object and their representation. People get put into categories, and learn from those categories how to behave. Thus there is the ironic observation that East Enders in London learn cockney (and how to be cockney) through watching the soap opera East Enders on television: "I am an East Ender therefore I must talk like this; and I must drink such and such a brand of beer … ". Aided by bureaucratic institutions, such cultural features take on a real social weight. If official documents force an Anglo-Australian, say, to choose one identity or the other; and if friends and colleagues encourage that person, for the convenience of small talk, to make a choice – then they are likely to become ever more Australian: suffering alongside his or her now fellow-countrypeople if new immigration measures are introduced in America or if 'we' lose a cricket test. The same process occurs with objects – once a film has been thrown into the X-rated bin, then there is a strong incentive for the director to make it *really* X-rated; once a house has been posted as condemned, then people will feel free to trash it.

Where the difference lies between transparency and convergence is that where transparency ideally just produces a reflection of the way things really are (and so, in Jullien's (1995) beautiful phrase captures the 'propensity of things' in any situation); convergence can radically break down – over time or across geographical borders. When categories do break down in this fashion they leave no continuous trace back to the previous regime. So, for instance, when the category of 'hysteric' became medically unfashionable, then people with (what used to be called) hysteria were distributed into multiple widely scattered categories. At that juncture, there was no point in their seeing the same doctors, or learning from each other what hysteria was …

Scaling Up: Generalization and Standards

"Similarity is an institution." --Mary Douglas (1986: 55)

In this whole complicated co-construction process, what are the things that make objects and statuses seem given, durable, real? For, as DesrosiÀ res (1990) reminds us, partly through classification work, large scale bureaucracies are very good at making objects, people and institutions hold together. Some objects *are* naturalized in more than one world. They are not then boundary objects, but rather they become *standards* within and across the multiple worlds in which they are naturalized. Much of mathematics, and in the West, much of medicine and physiology fits this bill. In the Middle Ages a lot of Christian doctrine fit this too. The hegemony of patriarchy arose from the naturalization of objects across a variety of communities of practice, with the exclusion of women from membership and the denial of our alternative interpretations of objects (Kramarae 1988; Merchant 1980; Croissant and Restivo, 1995).

When an object becomes naturalized in more than one community of practice, its naturalization gains

enormous power -- to the extent that a basis is formed for dissent to be viewed as madness or heresy. It is also where ideas like "laws of nature" get their power, because we are always looking to other communities of practice as sources of validity, and if as far as we can look we find naturalization the invisibility layers up and becomes doubly, triply invisible. Sherry Ortner's (1974) classic essay on man:culture/woman:nature shows that this has held for the subjugation of women even where specific cultural circumstances vary widely, and her model of the phenomenon rests on the persistent misunderstanding of borderlands and ambiguity in many cultures. Before her, Simone de Beauvoir (1948) wrote of the ethics of ambiguity, showing the powerful negative consequences of settling for one naturalized mode of interaction. We still need an ethics of ambiguity, still more urgently with the pressure to globalize, and the integration of systems of representation through information technologies across the world.

We have presented here a model of memberships, naturalizations, and the work we do in managing their multiplicity. Further analysis is needed here to examine different types of categorical work, and how they emerge under different circumstances. In the next section, we continue with a discussion of categorization and pragmatism.

Boundary Infrastructure

Any working infrastructure serves multiple communities of practice simultaneously – be these within a single organization or distributed across multiple organizations. A hospital information system, for example, has to respond to the separate as well as the combined agendas of nurses, records clerks, government agencies, doctors, epidemiologists, patients and so forth. In order to do so, it must bring into play stable regimes of boundary objects – such that any given community of practice can interface with the information system and pull out the kinds of information objects that it needs.

Clearly boundary infrastructures are not perfect constructions. The chimera of a totally unified and universally applicable information system (still regrettably favored by many) should not be replaced by the chimera of a distributed, boundary-object driven information system fully respectful of the needs of the variety of communities it serves. To the contrary, as we saw in the case of NIC, nurses have needed to make a series of serious concessions about the nature and quality of their data before hoping to gain any kind of entry into hospital information systems. As we have seen, these difficulties generalize – though they are to some extent counterposed by processes of convergence.

Boundary infrastructures by and large do the work that is required to keep things basically moving along. Because they deal in regimes and networks of boundary objects (and not of unitary, well-defined objects), boundary infrastructures have sufficient play to allow for local variation together with sufficient consistent structure to allow for the full array of bureaucratic tools (forms, statistics and so forth) to be applied. Even the most regimented infrastructure is ineluctably also local: if workarounds are needed they will be put into place. The ICD, for example, is frequently used to code cultural expectations (such as low heart attack rates in Japan) even though these are nowhere explicitly part of the classification system.

What we gain with the concept of boundary infrastructure over the more traditional unitary vision of infrastructures is the explicit recognition of the differing constitution of information objects within the diverse communities of practice which share a given infrastructure.

6. Future Directions: Texture and Modeling of Categorical Work and Boundary Infrastructures

If you could say it, you would not need metaphor. If you could conceptualize it, it would not be metaphor. If you could explain it, you would not use metaphor. (Morton, 1985: 210)

So far in this chapter we have given a series of analytic categories which we hope will prove useful in the analysis and design of information infrastructures. At the limit, as Nelle Morton points out, we arrive at the sets of metaphors which people use to describe information networks of all kinds. These metaphors we live by are powerful means of organizing work and intellectual practice. We will now look at one cluster of metaphors – centered on the concept of filiations – which we believe, offers promise for future analytical work.

How are Categories Tied to People? : Filiations

"The frequency with which metaphors of weaving, threads, ropes and the like appear in conjunction with contextual approaches to human thinking is quite striking." (Cole, 1996: 135)

filiation (fIlI'eIS&schwa.n). Also 6 filiacion.

1 Theol. The process of becoming, or the condition of being, a son.

Many Dicts. have a sense 'adoption as a son,' illustrated by the first of our quotes from Donne. The sense is etymologically justifiable, and may probably exist; but quot. 1628 seems to show that it was not intended by Donne.

2 The designating (of a person) as a son; ascription of sonship.

3 The fact of being the child of a specified parent. Also, a person's parentage; 'whose son one is.'

4 The fact of being descended or derived, or of originating from; descent, transmission from.

5 The relation of one thing to another from which it may be said to be descended or derived; position in a genealogical classification.

6 Formation of branches or offshoots; chiefly concr., a branch or offshoot of a society or language.

7 = AFFILIATION 3. lit. and fig. (Oxford English Dictionary, 2)

Categories touch people in a variety of ways -- they are assigned, they become self-chosen labels, they may be statistical artifacts. They may be visible or invisible to any other group or individual. We use the term filiation here – related via Latin to the French "fil" for thread -- a thread that goes from a category to a person. This metaphor allows a rich examination of the architecture of the multiple categories that touch people's lives. Threads carry a variety of textural qualities that are often applied to human interactions: tension, knottiness or smoothness, bundling, proximity, thickness. We select a small number here to focus on in the worked example below.

Loosely coupled — tightly coupled

A category (or system of categories) may be loosely or tightly coupled with a person. Gender and age are very tightly coupled with a person as categories. One of the interesting aspects of the investigation of virtual identities in MUDs and elsewhere on line is the loosening of these traditionally tightly coupled threads under highly constrained circumstances (e.g. Turkle, 1994). Loosely coupled categories may be those that are transient, such as the color one is wearing on a given day or one's position in a waiting line. Somewhere in the middle are hair color, which may shift slowly over a lifetime or change in an afternoon, or marital status.

Scope

Categories' filiations have variable scope. Some are durable threads which cover many aspects of someone's identity and which are accepted as such on a very wide or even global scale. (Noting for the record that none are absolute, none cover all aspects of someone's identity, and there is no category, which is completely globally accepted.) The category alive or dead is quite thick and nearly global. So we can think of two dimensions of scope: thickness and scale. How thick is the individual strand: gossamer or thickest rope? With how many others is it shared?

What is its ecology?

Classifications have habitats. That is, the filiations between person and category may be characterized as inhabiting a space or terrain with some of the properties of any habitat. It may be crowded or sparse, peaceful or at war, fertile or arid. In order not to mix too many metaphors, two important questions about filiations and their ecology that may be visualized in threadlike terms are:

How many ties are there? That is, how many other categories are tied to this person, and in what density?

Do these threads contradict or complement (torque vs. boundary object of cooperation)? That is, are the threads tangled, or smoothly falling together?

Who controls the filiation?

The question of who controls any given filiation is vital to an ethical and political understanding of information systems whose categories attach to individuals. A first crude characterization concerns whether the filiation was chosen or imposed (an echo of the sociological standard, achieved or ascribed); whether it may be removed and by whom; and under whose control and access is the apparatus to do so. Questions of privacy are important here, as with medical information classifying someone with a social stigmatized condition. The nature of the measure for the filiation here is important loci of control as well. For example, an IQ test may be an important way to classify people. People at some remove from those who take the test developed it. The measure, IQ, is controlled from afar. Past criticisms of IQ tests charge that this control is racially biased and biased by gender, on these grounds.

Is it reversible or irreversible?

Finally, there is the important question of whether the filiation is reversible. The metaphor of branding someone is not accidental in this regard, branding meaning that a label is burned into the skin and completely irreversible. Some forms of filiation have this finality for the individual, regardless of how the judgment was later regarded (e.g. a charge of guilt for murder may mean permanent public guilt regardless of a jury's verdict, as with the decades' long attempt of Sam Shepard's son to prove his father's innocence). Many are somewhere between, but knowing how reversible is the filiation is important for understanding its impact.

The metaphor of filiation presented here could be used to characterize a texture of information systems where categories touch either individuals or things. The aesthetics of the weave and the degree to which the individual is bound up or supported by it are among the types of characterizations that could be made. There are brute renderings, such as having two thick, irreversible threads tying one person to conflicting categories, as with the examples above. More subtly, it is possible to think in terms of something like Granovetter's strength of weak ties, and characterize the thousand and one classifications which weakly tie people to information systems as binding or torquing in another way.

To summarize. The metaphor of filiation is useful to the extent that it can be used to ask questions of working infrastructures in new and interesting ways. Two questions that rise directly out or our treatment of the metaphor for any individual or group filiation are:

- What will be the ecology and distribution of suffering?
- Who controls the ambiguity and visibility of categories?

Conclusion

We have in this chapter argued that there is more to be done in the analysis of classification systems than deconstructing universal master narratives. Certainly, such narratives should be challenged. However, we have attempted to show that there are ways of scaling up from the local to the social, via the concept of boundary infrastructures, and that we can in the process recognize our own hybrid natures without losing our individuality. The value of this approach is that it allows us to intervene in the construction of infrastructures - which surely exist and are powerful - as not only critics but also designers.

Chapter Ten: Why Classifications Matter

Classifications are powerful technologies. Embedded in working infrastructures they become relatively invisible without losing any of that power. In this book we demonstrate that classifications should be recognized as the significant site of political and ethical work that they are. They should be reclassified.

In the past 100 years, people in all lines of work have jointly constructed an incredible, interlocking set of categories, standards, and means for inter-operating infrastructural technologies. We hardly know what we have built. No one is in control of infrastructure; no one has the power centrally to change it. To the extent that we live in, on, and around this new infrastructure, it helps form the shape of our moral, scientific and esthetic choices. Infrastructure is now the great inner space.

Ethnomethodologists and phenomenologists have shown us that what is often the most invisible is right under our noses. Everyday categories are precisely those that have disappeared -- into infrastructure, into habit, into the taken for granted. These everyday categories are seamlessly inter-woven with formal, technical categories and specifications. As Cicourel notes:

> The decision procedures for characterizing social phenomena are buried in implicit common sense assumptions about the actor, concrete persons, and the observer's own views about everyday life. The procedures seem intuitively "right" or "reasonable" because they are rooted in everyday life. The researcher often begins his classifications with only broad dichotomies, which he expects his data to "fit," and then elaborates on these categories if apparently warranted by his "data." (1964:21).

The hermeneutic circle is indeed all around us.

There is no simple unraveling of the built information landscape, or, *pace* Zen practice, of unsettling our habits at every waking moment. Black boxes are necessary, and not necessarily evil. The moral questions arise when the categories of the powerful become the taken for granted; when policy decisions are layered into inaccessible technological structures; when one group's visibility comes at the expense of another's suffering.

There are as well basic research questions implied by this navigation into infrastructural space. Information technology operates through a series of displacements, from action to representation, from the politics of conflict to the invisible politics of forms and bureaucracy. Decades ago, Max Weber wrote of the iron cage of bureaucracy. Modern humans, he posited, are constrained at every juncture from true freedom of action by a set of rules of our own making. Some of these rules are formal, most are not. Information infrastructure adds another level of depth to the iron cage. In its layers, and in its complex interdependencies, it is a gossamer web, with iron at its core.

We have looked at several sets of classification schemes – the classifications of diseases, viruses, tuberculosis, race, and of nursing work. These are all examples of working classification systems: they are or have been maintained by organizations, governments and individuals. We have observed several dances between classifier and classified, but have nowhere seen either unambiguous entities waiting to be classified or unified agencies seeking to classify them. The act of classification is of its nature infrastructural, which means to say that it is both organizational and informational, always embedded in practice (Keller and Keller, 1996).

In our interviews of public health officials, nurses or scientists, we have found that they recognize this about their own classification systems. At the same time, there is little inducement to share problems across domains. Because of the invisible work involved in local struggles with formal classification systems and standards, a great deal of what sociologists would call "pluralistic ignorance" obtains. This is the feeling that "I am the only one". People often have a picture that somehow their problems are unique: they believe that other 'real' sciences do not have the same set of makeshift compromises and workarounds.

It is important in the development and implementation of classifications (and many related fields – such as

the development and deployment of standards or archives) that we get out of the loop of trying to emulate a distant perfection that on closer analysis turns out to me just as messy as our own efforts. The importance lies in a fundamental rethinking of the nature of information systems. We need to recognize that all information systems are necessarily suffused with ethical and political values, modulated by local administrative procedures. These systems are active creators of categories in the world as well as simulators of existing categories. Remembering this, we keep open and can explore spaces for change and flexibility that are otherwise lost forever.

Such politics are common to most systems employing formal representations. Rogers Hall, in his studies of algebra problem solving by both children and professional math teachers, talks about the shame that children feel about their unorthodox methods for arriving at solutions. Often using innovative techniques such as imaginary devices, but not traditional formulaic means, they achieved the right answer the wrong way. One child called this "the dirt way." A grown-up version of the dirt way is related by the example given earlier of the "good organizational reasons for bad organizational records" (Bitner and Garfinkel, 1967). There are good organizational reasons for working around formal systems; these adaptations are necessarily local. What is global is the need for them.

We have in this book attempted to develop tools for maintaining these open spaces. Michel Serres has best expressed the fundamental ethical and political importance of this task. He has argued that the sciences are very good at what they do: the task of the philosopher is to keep open and explore the spaces that otherwise would be left dark and unvisited because of their very success, since new forms of knowledge might arise out of these spaces. Similarly, we need to consistently explore what is left dark by our current classifications ('other' categories) and design classification systems that do not foreclose on rearrangements suggested by new forms of social and natural knowledge.

There are many barriers to this exploration. Not least among them is the barrier of boredom. Delving into someone else's infrastructure as we discussed in the introduction, has about the entertainment value of reading the white pages of the phone book. One does not encounter the dramatic stories of battle and victory, of mystery and discovery that make for a good read.

In an introductory chapter, we laid the theoretical framework for the discussion of classification as an infrastructural practice, stressing the political and ethical texturing of classification schemes. In Part 1, we examined the International Classification of Diseases (ICD) as a large-scale long-term system ingrained in the work practices of multiple organizations and states. We argued that their organizational roots and operational exercise texture such systems. Such texture is an inescapable, appropriate feature of their constitution, and it is a feature that merits extended consideration in a discussion of the politics of infrastructure. In Part 2, we looked at the intersection between classification and individual biography in the case of the classification of tuberculosis and of race classification under apartheid in South Africa. Generalizing the arguments made in these chapters, we maintained that individuals in the modern State operate within multiple classification systems – from the small-scale, semi-negotiated system as with the informal classification of tuberculosis patients negotiated with doctors up to enforced universal systems such as race classification. We drew attention to the torquing of individual biographies as people encounter these reified classifications. Finally, we examined classification and work practice, taking the example of

the classification of nursing work. We argued that multiple tensions between representation and autonomy, disability and discretion, forgetting the past and learning its lessons make such classifications a key site of political and professionalization work. We are all called upon to justify our productivity when we are embedded in complex modern organizations. The dilemma faced by nurses in accounting for their work is on the present in the modern organization. Even children are not exempt.

We have seen throughout this book that people (and the information systems they build) routinely conflate formal and informal, prototypical and Aristotelian aspects of classification. There is no such thing as an unambiguous, uniform classification system (indeed the deeper one goes into the spaces of classification expertise – for example librarianship or botanical systematics – the more perfervid one finds the debates between rival classificatory schools). This in turn means that there is room in the constitution of any classification system with organizational and political consequences - and few schemes if any are without such dimensions – for technical decisions about the scheme to systematically reflect given organizational and political positions. Since, then, we are dealing with an agonistic field, there will be no pure reflection of a single position, but rather dynamic tensions between multiple positions. And finally, since the classification system is not a pure reflection of such positions (an impossible aim in its own right – no classification system can reflect either the social or the natural world fully accurately) but also integrally a tool for exploring the real world, there is no simple prediction from how a given set of alliances or tensions leads invariably to a given classification used in a given way.

As sets of classification systems coalesce into working infrastructures they become integrated into information systems of all sorts. Thus we have argued throughout this book that information systems design should be informed by organizational and political analysis at this level. We are not offering this as an *ex cathedra* design principle. Rather, we have – along with many researchers in the field of social informatics - demonstrated empirically that invisible organizational structures influence the design and use of systems: the question is not whether or not this occurs but rather *how* to recognize, learn from and plan for the ineluctable presence of such features in working infrastructures. We have suggested one design aid here: long term and detailed ethnographic and historical studies of information systems in use, so that we can build up an analytic vocabulary appropriate to the task.

Working infrastructures contain multiple classification systems, which are both invisible, in the senses above, and ubiquitous. The invisibility of infrastructure makes visualization or description difficult. The metaphors we reached for to describe infrastructure are ironic and somehow childish. We speak of "way down in the underwear," "underneath the system," or use up/down metaphors such as "runs under," or "runs on top of." Lakoff and Johnson (1980) write of metaphors we live by. Our infrastructural metaphors show how baffled we often are by these systems. They are like undergarments, or tunnel dwellers.

Another set of metaphors often used in organizations speaks indirectly to the experience of infrastructure. These are the metaphors of texture, omnipresent in human relationships. Texture metaphors speak to the densely patterned interaction of infrastructures and the experience of living in the "classification society." Texture speaks to the way that classifications and standards link the individual with larger processes and structures. These links generate both enabling/constraining patterns over a set of systems (texture), and developmental patterns for an individual operating within a given set (trajectory). Thus we have used the

metaphor of the texture of a classification system to explore the fact that any given classification provides surfaces of resistances (where the real resist its definition), blocks against certain agendas and smooth roads for others. Within this metaphorical landscape, the individual's trajectory – often, for all that, perceived as continuous and self-consistent – is at each moment twisted and torqued by classifications and vice versa.

Therefore we have, through our analysis of various classification systems, attempted to provide a first approximation to an analytic language which recognizes that the architecture of classification schemes is simultaneously a moral and an informatic one. This book has brought to light as crucial to the design process the reading of classification schemes as political and cultural productions. We have stressed that any classification scheme can be read in this fashion. We initially deliberately eschewed cases like DSM-IV, where categories have often already become explicit objects of political contention, such as "homosexual" or "pre-menstrual tension." In the psychiatric case, there can in this sense often be a more direct read-off from political exigencies to disease categories. Although such readings are of course highly valuable in their own right (see Kirk and Kutchins, 1992; Kutchins and Kirk, 1997 and Figert, 1996), we first took the more muted cases posed by the ICD, where the politics were quieter. This we hoped would show the generalizability of the thesis that all category systems are moral and political entities. This was balanced later in the volume with an analysis of the much more obviously politically laden categories generated by the pro-apartheid government and its scientific apologists.

This book has implications for both designers and users (and we are all increasingly both) of complex information spaces. It provides intellectual and methodological tools for recognizing and working with the ethical and political dimensions of classification systems. In particular we have underlined several design exigencies, that speak both to the architecture of information systems encoding classification systems and to their development and change:

- *Recognizing the balancing act of classifying.* Classification schemes always represent multiple constituencies. They can do so most effectively through the incorporation of ambiguity – leaving a certain terms open for multiple definitions across different social worlds: they are in this sense boundary objects. Designers must recognize these zones of ambiguity, protecting them where necessary in order to leave free play for the schemes to do their organizational work.
- *Rendering voice retrievable.* As classification systems get ever more deeply embedded into working infrastructures they risk getting black-boxed and thence made both potent and invisible. By keeping the voices of classifiers and their constituents present, the system can retain maximum political flexibility. This includes the key ability to be able to change with changing natural, organizational and political imperatives. A caveat here, drawn from Chapter 7's lesson about the invisibility of nursing work: we are not simply celebrating visibility, or naively proposing a populist agenda for the empire of classification. Visibility is not an unmitigated good. Rather, by retrievability, we are suggesting that under many circumstances, the "rule by no one" or the "iron cage of bureaucracy" is strengthened by its absence. When classification systems and standards acquire inertia because they are part of invisible infrastructure, the public is *de facto* excluded from policy participation.
- *Being sensitive to exclusions.* We have in particular drawn attention here to the distribution of residual categories (who gets to determine what is other). Classification systems always have 'other'

categories, to which actants (entities or people) who remain effectively invisible to the scheme are assigned. A detailed analysis of these others throws into relief the organizational structure of any scheme (Derrida, 1998). Residual categories have their own texture that operates like the silences in a symphony to pattern the visible categories and their boundaries.

Stewart Brand's (1994) wonderful book, *How Buildings Learn*, gives many examples of how buildings get designed as they are used as much as on the architect's drawing-board. Thus a house with a balcony and numerous curlicues around the roof will become a battened-down square fortress block under the influence of a generation of storms from the northeast. Big single-family mansions become apartment buildings as a neighborhood's finances change. These criteria generalize to classification systems. Through these three design criteria we are drawing attention to the fact that architecture becomes archaeology over time. This in turn may become a cycle.

Overall, we have argued that classifications are a key part of the standardization processes that are themselves the cornerstones of working infrastructures. People have always navigated sets of classification spaces. Mary Douglas (1984), among others, has drawn attention to this feature of all societies from the indigenous and tribal to the most 'industrialized. Today, with the emergence of new information infrastructures, these classification systems are becoming ever more densely interconnected. This integration began roughly in the 1850s, coming to maturity in the late 19th century with the flourishing of systems of standardization for international trade and epidemiology. Local classification schemes (of diseases, nursing work, viruses…) are now increasingly giving way to these standardized international schemes which themselves are being aligned with other large scale information systems. In this process, it is becoming easier for the individual to act and perceive him or her self as a completely naturalized part of the "classification society," since this thicket of classifications is both operative (defining the possibilities for action) and descriptive. As we are socialized to become that which can be measured by our increasingly sophisticated measurement tools, the classifications increasingly naturalize across wider scope. On a pessimistic view, we are taking a series of increasingly irreversible steps towards a given set of highly limited and problematic descriptions of what the world is and how we are in the world.

For these reasons, we have argued in this book that it is politically and ethically crucial to recognize the vital role of infrastructure in the "built moral environment." Seemingly purely technical issues like how to name things and how to store data in fact constitutes much of human interaction, and much of what we come to know as natural. We have argued that a key for the future is to produce flexible classifications, whose users are aware of their political and organizational dimensions, and which explicitly retain traces of their construction. In the best of all possible worlds, at any given moment the past could be reordered to better reflect multiple constituencies now and then. Only thus we will be able to fully learn the lessons of the past. In this same optimal world, we could tune our classifications to reflect new insitutional arrangements or personal trajectories - reconfigure the world on the fly. The only good classification is a living classification.

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….