





CHAPTER ONE

MAPPING NATIONAL DRIVERS OF INTERDISCIPLINARY CHANGE



Preparing for interdisciplinary change requires two mappings—the first national and the second local. Skipping to the second map shortchanges the answers to two of the three questions that are uppermost in the minds of faculty and administrators: What changes are occurring? and What is happening on other campuses? Shared awareness of the national picture will enable individuals to locate themselves within the larger landscape of higher education, reduce their sense of isolation, lessen ignorance and skepticism about activities in other areas, heighten awareness of the plurality of local activities, and foster a common commitment to easing barriers. This chapter presents an overview of major developments associated with interdisciplinarity today in science and technology, social sciences, and humanities.

The book adopts a root meaning of interdisciplinarity based on two authoritative definitions from the National Academy of Sciences (NAS) report, *Facilitating Interdisciplinary Research* (2004), and Klein and Newell (1997) in *Handbook of the Undergraduate Curriculum*. Interdisciplinary research (IDR) and interdisciplinary studies (IDS) integrate content, data, methods, tools, concepts, and theories from two or more disciplines or bodies of specialized knowledge in order to advance fundamental understanding, answer questions, address complex issues and broad themes, and solve problems that are too broad for a single approach (*Facilitating Interdisciplinary Research*, 2004; Klein and Newell, 1997).

The consensus meaning, though, is only a literal definition. The root term has many connotations, distinguishing a variety of goals and contexts that will become clear in this chapter. The differences are dramatically evident in disputes over what constitutes real or genuine interdisciplinarity. Awareness of the multiple connotations is not an idle exercise in etymology or history. Differences surface in local arguments for and against certain forms of interdisciplinarity. To help readers navigate the debate on meaning, this chapter also introduces a core vocabulary that can be used on campuses and ends with a summary statement of the conceptual vocabulary of the book.

SCIENCE AND TECHNOLOGY

When scientists hear the word *interdisciplinary* some mention historical precedents ranging from the Greek philosopher Anaximander to Charles Darwin. By and large, though, scientists are inclined to cite modern developments in defense-related research during the 1930s and 1940s, especially the Manhattan Project to build an atomic bomb. It was the first large government-funded example of IDR. In subsequent decades, IDR became part of the profiles of the Department of Defense, the National Science Foundation, the National Institutes of Health, and the National Aeronautics and Space Administration. Scientists also tend to cite major discoveries and initiatives, such as x-ray crystallography and the human genome project. The current momentum is documented in a 2004 report from NAS. *Facilitating Interdisciplinary Research* identifies four primary drivers of IDR today (pp. 2, 40):

1. the inherent complexity of nature and society
2. the desire to explore problems and questions that are not confined to a single discipline
3. the need to solve societal problems
4. the power of new technologies

Drivers 2 and 3 are not new. However, they gained momentum in the closing decades of the twentieth century. The heightened profile of driver 3 was signaled in 1982, when the Organization for Economic Cooperation and Development declared in *The*

University and the Community (1982) that interdisciplinarity exogenous to the university now takes priority over endogenous university interdisciplinarity based on the production of new knowledge. The exogenous originates in real problems of the community and the demand that universities perform their pragmatic social mission. International economic competition in science-based fields of high technology propelled increased activity and investment from the late 1970s forward in areas such as engineering and manufacturing, computers, biotechnology, and biomedicine. Complex problems of practice in professional and vocational education have also fostered interdisciplinary approaches in law, medicine, social work, education, and business.

The National Research Council (NRC) tracked changes in a series of reports. In 1986, the authors of *Scientific Interfaces and Technological Applications* announced that almost all significant growth in knowledge production in recent decades was occurring at the interdisciplinary borderlands between established fields. The five prominent areas in fundamental research were biological physics, materials science, the physics-chemistry interface, geophysics, and mathematical physics and computational physics. The six outstanding areas of technical applications were microelectronics, optical technology, new instrumentation, the fields of energy and environment, national security, and medical applications. Four years later a new NRC report, *Interdisciplinary Research* (1990), tracked developments that were promoting increased collaborations between life sciences and medicine and between physical sciences and engineering. New intellectual understandings of biological systems, problem complexity, the costs of instrumentation and facilities, and the desire to transfer knowledge rapidly from laboratory to hospital practice have been strong catalysts for change.

These developments signaled a double form of boundary crossing between disciplines and commercial sectors, leading Rustum Roy to suggest that the more accurate term is not *interdisciplinary* but *interactive research* (2000). The escalation of boundary crossing between academic science and commercial sectors, in combination with recent discoveries in molecular and cell biology, prompted the National Institutes of Health to issue a new road map for research and funding in 2002. Collaborative teams, new combinations of skills and disciplines, a better toolbox, and new

technologies are all needed to understand the combination of molecular events that lead to disease. The NIH has accelerated this trend with the aim of creating a new discipline of clinical and translational research capable of catalyzing new knowledge and techniques for patient care (<http://nihroadmap.nih.gov/overview.asp>; <http://nihroadmap.nih.gov/clinicalresearch/overview-translational.asp>).

Driver 4 is apparent in new technologies of molecular imaging, nanomedicine, and bioinformatics. In addition, new tools of quantitative and computer-assisted mathematical analysis also facilitate the sharing of large quantities of data across disciplinary boundaries in areas as diverse as medicine and the geosciences, the latter of which already experienced an interdisciplinary transformation in the mid-twentieth century fueled by the theory of plate tectonics. Driven by Web 2.0 technologies, information sharing across the infrastructure of distributed information is also enabling individuals and networks in dispersed locations to collaborate. The implications are not merely technical. In the journal *Science*, Alan Leshner (2004) observed that “new technologies are driving scientific advances as much as the other way around,” allowing new approaches to older questions and posing new ones (p. 729).

In the midst of these major developments, the quiet daily flow of borrowing methods, concepts, and tools continues. The impact varies greatly, from auxiliary or supplementary borrowing to a degree of assimilation that is no longer considered foreign. Many physical techniques that originated in one discipline, such as spectroscopies, have become so fully integrated into biological research that their origin may be forgotten. Researchers also apply knowledge from one discipline in order to contextualize another, akin to the engineering profession’s inclusion of social contexts of practice. When new laws comprise the basic structure of an original discipline, such as electromagnetics or cybernetics, a new domain takes shape. Methodologies of statistics, oral history, and econometrics were the foundation for other specialties as well, and other interactions led to the formation of new fields and hybrid interdisciplinary fields such as biochemistry, cognitive science, and computational biology (Heckhausen, 1972; Boisot, 1972).

Another development, the emergence of new communities of practice, is part of a wider process of boundary work. Individuals

and groups work directly and through institutions to create, maintain, break down, and reformulate boundaries between domains. The term *trading zones* arose in science studies to describe the heterogeneous interactions that give rise to new social and cognitive formations centered on common interests. These formations range from a *pidgin* zone, in the linguistic sense of an interim form of communication, to a *creole* zone, a new main subculture or native language (Galison, 1996; Star and Griesemer, 1989; Fisher, 1993; Klein, 1996). Interactions have been sources of continual advances in concepts and applications across the science of molecules and atoms, surfaces and interfaces, and fluids and solids. The current interface between physics and chemistry, for example, has been crossed so often in both directions that the authors of *Scientific Interfaces and Technological Applications* (1986) remarked “its exact location is obscure” and “its passage is signaled more by gradual changes in language and approach than by any sharp demarcation in content” (p. 53). As a result, Norman Burkhard reflected, the difference between a physicist and a chemist is no longer obvious: “Now we have chemists who are doing quantum-level, fundamental studies of material properties, just like solid-state physicists. There’s almost no difference” (cited in *Facilitating Interdisciplinary Research*, 2004, p. 54).

Three implications follow for thinking about the definition of interdisciplinarity, the nature of disciplines, and the curriculum. Taking definition first, much of scientific IDR today is instrumental in nature, in the sense that it is motivated by strategic or opportunistic goals (Weingart, 2000). Economic, technological, and scientific problems tend to take priority over epistemological motivations, aligning interdisciplinarity with managerialism, commercialism, and entrepreneurism (Sá, 2005). The heightened profile of instrumental interdisciplinarity (ID) is linked with a historical shift in the performance of scientific research from individual investigators to multidisciplinary groups driven by external demands. Some research programs have grown so large that they are stimulating new understandings in multiple fields, evident in the wide impact of the theory of plate tectonics, global climate modeling, and the human genome project. IDR may also add value to traditional fields. Researchers in nanoscience, for instance, bridge several disciplines while using their nanoscience

experience to open new disciplinary research directions and applications, such as incorporating nanostructures into bulk materials (*Facilitating Interdisciplinary Research*, 2004).

As for the second implication, the argument for interdisciplinarity is often countered by a demand to protect the disciplines. Yet since the 1950s, many disciplines have become more porous and multi- or interdisciplinary in character (Bender and Schorske, 1997). Some domains, such as physics and biology, have also become so large and heterogeneous that they have been called federated disciplines. Specialization has a double effect. It reinforces fragmentation, but it also gives rise to connection and, in some cases, mutual interdependence (Winter, 1996). The inner development of the sciences has posed ever broader tasks leading to interconnections among natural, social, and technical sciences. The same object—an organism, for instance—is simultaneously a physical (atomic), chemical (molecular), biological (macromolecular), and physiological, mental, social, and cultural object. As mutual relations are reconsidered, new aggregate levels of organization are revealed, and *multidisciplinary* is becoming a common descriptor of research objects (Habib, 1990).

The third implication calls to mind the oft-remarked gap between new research and the curriculum. The gap persists, but Jerry Gaff (1997) likens scholarship to the molten mass of radioactive material that forms the core of the earth. Periodically it erupts in a volcano, or a shift in tectonic plates occurs. In accounting for interdisciplinarity in the science curriculum, Wubbels and Girgus (1997) report that faculty are incorporating new knowledge of genetics, cognition, and the solar system. They are organizing courses around complex technical and social problems and topics. They are also designing curricula that reflect the blurring of boundaries in contemporary research, including an introductory course integrating mathematics, physics, and chemistry; a joint biochemistry and biophysics program that integrates physics, chemistry, and biology classes; courses that teach general chemistry based on the context of physical materials; and project-based laboratories for general chemistry using lasers. Other reports add to the roster of examples. *BIO 2010* (2003) offers a blueprint for bringing undergraduate education in biology up to the speed of contemporary research in an interdisciplinary curriculum that

integrates physical sciences with information technology and mathematics with life sciences. Pellmar and Eisenberg's 2000 report, *Bridging Disciplines in the Brain, Behavioral, and Clinical Sciences*, presents models of interdisciplinary teaching and training at all levels, from undergraduate through postdocs.

More broadly, the NAS report, *Facilitating Interdisciplinary Research* (2004), presents a series of recommendations for science education drawn from survey data, interviews, and literature review. The top advice for educators is to develop curricula that incorporate ID concepts, participate in teacher development courses on ID topics, and provide students opportunities to participate in IDR. The report also urges a multifaceted and broadly analytical approach to problem solving and revising foundation courses such as general chemistry to include materials that show how subjects are related to other fields and to complex societal problems. Favorable policies for team teaching are recommended as well, along with modifying core course requirements to allow more room for breadth and for team-building and leadership skills. Undergraduate students, for their part, are encouraged to seek courses at the interfaces of traditional disciplines that address basic research problems, courses that address societal problems, and research experiences spanning more than one traditional discipline. The top recommendation for graduate students is to broaden their experience by gaining requisite knowledge and skills in one or more fields beyond their primary subjects. Like faculty, they also need experience in using new instrumentation and techniques from other disciplines. Graduate students might also be admitted into broad fields, such as biological sciences and engineering, with no requirement for specialization until the end of the first or second year. Institutions, in turn, are urged to offer opportunities for students to work with and learn from students in other disciplines and with multiple advisers or dual mentors who contribute diverse perspectives on research problems.

SOCIAL SCIENCES

When social scientists hear the word *interdisciplinary*, they tend to cite historical precedents such as Auguste Comte's vision of a unified social science and the founding of the Social Science

Research Council (SSRC) in the early 1920s. At SSRC the term *interdisciplinary* was shorthand for research that crossed more than one of the 'council's seven disciplinary societies, breaking down boundaries by cross-fertilizing ideas and joining methods and techniques. Representatives of five major social science disciplines, statistics, and history were brought together with the aim of producing purposive and empirical social problem-oriented applied research, including targeted programs in fields such as social security and public administration (Frank, 1988; Fisher, 1993). The first twentieth-century appearance of *interdisciplinarity* under stewardship of the SSRC, Calhoun and Rhoten (forthcoming) recall in an overview of its history in social sciences, was characterized by a desire to revive the quest for a Comtian style "science of the social" that would both analyze and address social ills. Problem focus was also a strong catalyst for the rise of applied social science concerned with societal issues such as war, labor relations, population shifts, housing shortages, crime, and welfare (Landau, Proshansky, and Ittelson, 1962). (This account draws on Klein, 2007.)

Landau, Proshansky, and Ittelson made a distinction in the early history of social sciences that illustrates the difference between two basic metaphors of interdisciplinarity identified by the Nuffield Foundation: bridge building and restructuring. *Bridge building* occurs between complete and firm disciplines, but they do not change as a result. *Restructuring* detaches parts of several disciplines to form a new coherent whole (*Interdisciplinarity*, 1975). The difference is evident in Landau, Proshansky, and Ittelson's comparison of the first and second phases of interdisciplinarity (1962). The first phase, dating from the close of World War I to the 1930s, was embodied in the founding of SSRC and the University of Chicago school of social science. The interactionist framework at Chicago fostered integration, and members of the Chicago school were active in efforts to construct a unified philosophy of natural and social sciences. The impact of these efforts was widely felt and the scope and data of disciplines altered. On occasion disciplinary spillage even led to the early formation of hybrid disciplines, such as social psychology, political sociology, physiological psychology, and social anthropology. Yet traditional categories of knowledge, structures of fields, and the organization

of academic work remained intact. Social scientists also tended to emulate natural sciences, heightening concern for objectivity, precision, and quantification. In the interests of scientific analysis, techniques and instruments were borrowed to support testing and measurement.

In sum, the first phase was largely empirical and instrumental bridge building. The second phase, dating from the close of World War II, was stimulated by new developments in logic and in philosophy and sociology of science that illustrate restructuring. The difference was embodied in integrated social science courses, a growing tendency for interdisciplinary programs to become integrated departments, and the concept of behavioral science. The traditional categories that anchored the disciplines were questioned, and lines between fields began to blur, paving the way toward a new theoretical coherence and alternative divisions of labor. The emergence of area studies in the late 1930s is a well-known example. In contrast to earlier and limited forms of interdisciplinary borrowing, it was a new integrative conceptual category with greater analytical power, stimulating a degree of theoretical convergence and potential in the concepts of role, status, action, exchange, information, communication, and decision making. The behavioral science movement also sought an alternative method of organizing social inquiry based on theories of behavior that went beyond borrowing and tacking methods and concepts onto traditional categories. The culture-personality movement and decision making are additional examples. When a political scientist, for instance, adopts decision making explicitly as a frame of reference, the nature of the field of focus changes, and the work is not just politics. It is also sociological or psychological, or both.

The early history of interdisciplinarity in social science illustrates another important distinction, between methodological and theoretical interdisciplinarity. Methodological ID typically aims to improve the quality of results. In a typology of cross-disciplinary approaches in social sciences, Raymond Miller (1982) identified two types. *Shared components* include techniques of statistical inference and conceptual vehicles. *Cross-cutting organizing principles* focus on a particular concept or a fundamental social process, such as role or exchange. New engineering and technological methods that evolved from operational research during World War

II, feedback systems, and computer manipulation also stimulated borrowing of the mathematics of probability, cybernetics, systems theory, information theory, and game theory, as well as new conceptual tools of communication theory and decision theory. Techniques of surveying, interviewing, sampling, polling, case study techniques, cross-cultural analysis, and ethnography belong on the list of examples too. And in the latter half of the twentieth century, a third methodological movement emerged, stimulating new borrowings that combine quantitative and qualitative traditions (Mahan, 1970; Smelser, 2004; Teddlie and Tashakkori, 2003).

In contrast, theoretical interdisciplinarity typically fosters a comprehensive conceptual framework, synthesis, or integration across disciplines. This aim was evident in the boundary work of advancing new integrative concepts such as “behavior” and “area” and in the macrosocial theories of Emile Durkheim, Georg Simmel, Max Weber, Robert Park, and Talcott Parsons. More recent efforts include Anthony Giddens’s search for a new synthesis of social sciences, Randall Collins’s call for a comprehensive theory of every area of society, Jeffrey Alexander’s attempt to create a convergence of major classical and contemporary sociological theories, Jürgen Habermas’s work toward an encompassing theory of communicative action, and Niklas Luhmann’s aim of building a synthetic framework for a comprehensive theory of everything social (Camic and Joas, 2004).

Theoretical forms of interdisciplinarity are also associated with the concept of transdisciplinarity, a term that originally connoted an overarching synthesis or a common axiom that transcends the narrow scope of disciplinary worldviews. General systems theory, structuralism, Marxism, feminist theory, sociobiology, and phenomenology have been leading examples. More recently in Europe, two new connotations have emerged: a new structure of unity informed by the worldview of complexity in science and trans-sector problem solving involving the collaboration of academics and stakeholders in society. Conceptualized as a form of transcendent interdisciplinary research, the transdisciplinary team science movement in the United States is also fostering new theoretical frameworks for understanding social, economic, political, environmental, and institutional factors in health and well-being (Rosenfield, 1992).

In the latter half of the twentieth century, the scope of IDR in social sciences expanded with two further sets of developments. One looked to the sciences. Propelled by the growing sophistication of scientific tools and approaches, new biological explanations of human behavior became possible, and the hybrid fields of cognitive science and neurosciences expanded. Technologies of brain imaging and magnetic resonance imaging also facilitate mapping brain functions with increasing precision (Yates, 2004). The other set of developments looked toward humanities, informed by new postpositivist, poststructural, constructivist, interpretive, and critical paradigms (Teddlie and Tashakkori, 2003). By 1980, Clifford Geertz proclaimed that a broader shift was occurring across intellectual life in general and within social sciences in particular. The model of physical sciences and a laws-and-instances ideal of explanation was being supplanted by a case-and-interpretation model and symbolic form analogies. Social scientists were increasingly representing society as a game, a drama, or a text rather than a machine or a quasi-organism. Crossing the traditional boundary of explanation and interpretation, they were also borrowing methods of speech-act analysis, discourse models, and cognitive aesthetics. Conventional rubrics remain, but they are often jerry-built to accommodate a situation Geertz deemed increasingly “fluid, plural, uncentered, and ineradicably untidy” (p. 166).

The mainstream disciplines remain anthropology, economics, political science, psychology, and sociology. Yet Neil Smelser (2004) cautions that describing social sciences solely with reference to the “big five” distorts reality in two ways. First, under those headings, subareas of investigation rely on variables and explanations outside the commonly understood scope of social sciences. Geopolitics, sociobiology, behavioral genetics, and behavioral neuroscience all appeal to nonsocial and nonpsychological explanatory variables and explanations. Second, another range of disciplines could be labeled behavioral and social-scientific, although not entirely so. Demography, for example, might be considered a separate social science or as part of sociology, economics, and anthropology. Archaeology might be classed as part of anthropology or an independent social science. Geography, history, psychiatry, law, and linguistics present similar complications

for taxonomy. So do relations with intersecting fields such as genetics, behavior, and society; behavioral and cognitive neurosciences; area and international studies; and urban studies and planning public policy. Assignment to one category of inquiry or another would vary according to the criteria used.

Furthermore, multiple types of interdisciplinarity occur within a single discipline. Geography's broad scope is evident in a multitude of conceptual and analytical approaches, ranging from technologies of earth sciences to interpretive theories of humanities. Synthetic work of a different kind occurs in efforts to combine basic research findings from a large number of subfields in order to integrate results from cognate disciplines and merge existing and new knowledge about a particular place or region. Another type of activity occurs in applied research on societal problems (Association of American Geographers, 1995). Sociology, for its part, aspires in principle to be the most synthetically encompassing of all social sciences. Yet Craig Calhoun (1992) reports that beyond holistic and generalist claims, it is also an interstitial discipline that fills in gaps among other social sciences and working along their borders. In anthropology, connections pluralized as the discipline expanded beyond the "sacred bundle" of four fields that Franz Boas defined as biological history, linguistics, ethnology, and prehistoric archaeology. Since 1983, George Stocking Jr. (1995) notes, many "adjectival anthropologies" have emerged, and the number of subsidiary professional groups has increased. Anthropologists were also more open to poststructuralist and postmodernist thought than other social scientists, destabilizing intellectual categories at the same time a general blurring of genres and disciplinary boundaries was underway. Even economics, which patrols its boundaries more closely than other disciplines, has multiple affiliations with mathematics, political science, history, sociology, psychology, philosophy, and law (Becher, 1990).

The formation of new fields is an important part of this history. Miller (1982) identified four catalysts for interdisciplinary fields and hybrid specializations. *Topics* are associated with problem areas. Crime, for instance, is a social concern that appears in multiple social science disciplines and in criminal justice and criminology programs. The concepts of area studies, labor, cities,

the environment, and the aged also led to the founding of new programs. The category of *life experience* became prominent in the late 1960s and 1970s with the development of ethnic studies and women's studies. *Hybrids* formed interstitial cross-disciplines, such as social psychology, economic anthropology, political sociology, biogeography, culture and personality, and economic history. *Professional preparation* also led to new fields with a vocational focus, such as social work and nursing and, Smelser (2004) adds, fields of application to problem areas such as organization and management studies, media studies and commercial applications, and planning public policy.

All fields are not the same, however. Some, Jill Vickers (1997) noted in an overview of Canadian studies, have congealed to the point that they have a recognized canon or foundational theory. Effecting a partial closure, they act like disciplines because they have a shared epistemological base, journals, learned societies, and, in some cases, separate departments. In contrast, "open or cross-roads interdisciplinary fields" do not necessarily settle on a paradigm, canon, foundation, or epistemology. They remain open to new ideas, especially identity fields centered on self-studies that emanated from broad societal movements for change, such as women's, Quebec, and First Nations' movements for self-determination. Moreover, in open cross-roads fields, two forces may be at work: an integrative tendency, and a self-asserting disintegrating tendency that tries to draw the focus away from the center of existing knowledge systems, strongly evident in critical, oppositional, and self-studies. Older fields have changed as well. American studies, for instance, was one of the earliest exemplars of an interdisciplinary field. After emerging in the 1930s and 1940s, it took a more critical turn in the 1960s and 1970s and embraced a new plurality of practices that expanded in the late twentieth century to include new methods and concepts linked with cultural studies. In education, Hendershott and Wright (1997) report, change is also occurring as a result of interdisciplinary developments. Increased attention is being paid to multicultural and gender interests, evident in the titles of undergraduate social science textbooks using the keywords *diversity*, *multiculturalism*, and *global*. Growing numbers of ethnic studies and gender studies majors in departments of English and literary studies, though,

raised concern about the lack of attention to demography, quantitative research methods, statistics, or immigration public policy. In general education programs, new understandings from social sciences are informing general and liberal education themes of citizenship, leadership, health, and family life. More broadly, a heightened problem focus is apparent across the curriculum in units and courses focusing on social problems and bridging theory and practice in service learning. And new alliances are being forged in interdisciplinary courses focused on complex societal problems such as crime, juvenile violence, infant mortality, AIDS, ethnic tensions, and pollution.

Reflecting on the latter half of the twentieth century, Calhoun and Rhoten (forthcoming) called the 1960s and 1970s a period of “reflection and intervention.” The 1960s ushered in a wave of epistemological segmentation and polarization. Positivists aimed to intensify trends toward scientific universalization and hyperspecialization, manifested in the dominance of neo-classic economics. Yet increasing numbers of researchers sought approaches that would privilege a mix of theoretical prospects, disciplinary perspectives, and societal purposes. Civil tensions, political conflicts, and social movements also spawned field creation in Miller’s categories of life experience (for example, ethnic studies, women’s studies) and topics (for example, environmental studies, labor studies, and development studies). During the 1970s, researchers with an ID problem orientation began tackling issues in poverty studies and social medicine, using methods that brought together academic experts and local stakeholders in action research programs akin to transsector transdisciplinarity. The turn of the century has been a time of extension and computation. This development is not driven by philosophical faith in or epistemic hope for interdisciplinarity; rather, intellectual demands and design strategies responsive to disciplinary limitations have come with the advancement of science. The diversity of paradigms and heterogeneity of perspectives that motivate and propel interdisciplinary practice today, Calhoun and Rhoten concluded, also tend to complicate its processes and prospects. The very conditions of possibility are often the very causes of difficulty that stall its varied forms.

HUMANITIES

Humanists have the longest genealogical reach, tracing interdisciplinarity to foundational ideas of synthesis, holistic thought, and unified knowledge in ancient Greece. These ideas were transmitted in the traditions of humanism and liberal education and subsequently formed the basis for the unified model of culture and knowledge at the heart of the first American colonial college. At the dawn of the twentieth century, the historical warrants for interdisciplinarity were the generalist model of culture, a synoptic view of subjects, and interart comparison. Period style was the most powerful basis of synchronic relation, grounded in common motifs, themes, and genres within historical eras. When the modern disciplines were taking shape in the late nineteenth and early twentieth centuries, the traditional humanist model also found a new home in interdisciplinary theme-based general education programs grounded in a canon of “great books” and ideas.

Over the course of the century, traditional canons of wholeness were challenged by new approaches to culture, history, and language. New forms of interdisciplinarity also arose in a history extending from the importation of European philosophy and literary theories in the 1950s to social and political movements in the 1960s, structuralism and the language-based psychoanalysis of Jacques Lacan, newer kinds of Marxist criticism and deconstruction, and, during the 1970s and 1980s, widening interest in feminism and semiotics. Further into the 1980s, an array of practices lumped under the umbrella term *poststructuralism* took root, including new historicism, Foucauldian studies of knowledge, and cultural and postcolonial critique. By the 1990s, multiculturalism was a major theme, and the belief that humanities was evolving into cultural studies was gaining favor. More recently, digital humanities has become a growing field of research, teaching, and technological innovation at the intersections of computing and the disciplines and fields of arts and humanities, media and communication studies, and library and information science.

Interdisciplinarity has been implicated at every turn. Each movement differed in some way, but together they fostered a new generalism that challenged both the modern system of

disciplinarity and the older model of unified knowledge and culture. The new generalism is not a unified paradigm. It is a cross-fertilizing synergism in the form of shared methods, concepts, and theories about language, culture, and history. A new rhetoric of interdisciplinarity developed in kind. *Plurality* and *heterogeneity* replaced *unity* and *universality*. *Interrogation* and *intervention* supplanted *synthesis* and *holism*, and older forms of *interdisciplinarity* were challenged by new *anti-*, *post-*, *non-*, and *de-disciplinary* formulations. The keywords of the new rhetoric signified the defining values of critical interdisciplinarity. This form interrogates the dominant structure of knowledge and education with the aim of transforming them, while raising epistemological and political questions of value and purpose silent in instrumental ID.

The values of critical ID are apparent in Salter and Hearn's definition of interdisciplinarity (1996) as the necessary churn in the system, aligning the concept with a dynamic striving for change. In humanities, the concepts of new interdisciplinarity and transdisciplinarity are also associated with new critical and theoretical approaches. Critical ID gained a certain orthodoxy in humanities. Yet it is not the only interdisciplinary practice. Older forms of interart comparison and borrowing continue, embodied in studies of authorship, connoisseurship, and the influence of one art form on another. Even so, in conducting interviews with faculty in humanities and social sciences, Lisa Lattuca (2001) found that an increasing number of them do interdisciplinary work with the explicit intent of deconstructing disciplinary knowledge and boundaries. This trend is especially apparent in cultural studies, women's and ethnic studies, and literary studies, where "the epistemological and the political are inseparable" (p. 100).

The traditional disciplines of humanities are implicated as well. Their broadening scope led to a pluralization of subdomains that intersect with interdisciplinary fields, including "new histories" and "music." As humanities disciplines moved away from older paradigms of historical empiricism and positivist philology, increasing attention was paid to the contexts of aesthetic works and the responses of readers, viewers, and listeners. The concept of culture also expanded from a narrow focus on elite forms to a broader anthropological notion, and once discrete objects were reimagined as forces that circulate in a network of forms and actions. As a result, interdisciplinary practices today are often hybrid. Close

reading of a text or technical analysis of a painting or a musical composition may be combined with psychoanalytical, sociological, semiotic, deconstructionist, or feminist approaches. Disciplinary categories have not been abandoned. Yet their meaning has broadened to encompass more subject matter, conditions of artistic production, social science methods and concepts, and previously marginalized groups and other cultures. This development was reinforced by heightened interests in history, sociology, politics, and an anthropological definition of culture that have reshaped thinking about both disciplinarity and interdisciplinarity.

Changes of this kind once again expose the limits of the conventional dichotomy of disciplinarity and interdisciplinarity. Part of the problem of interdisciplinarity, Stanley Bailis (1974) reflected, is how disciplines have been taught. They were presumed to be topically coalescent, solidified, and monolithic. Furthermore, they were rarely taught with reference to each other, and the bridges built between them tended to become separate domains or subdisciplines practiced differently within parent fields. Disciplines, in actuality, are highly differentiated, and authorized practices are contested. Reflecting on changes in the discipline of history, Carl Schorske (1997) noted a generational shift that is not unique to it alone. As a graduate student, Schorske had to learn the methods of other disciplines from colleagues. By 1995, students were taking seminars in art, literature, and psychoanalysis to acquire their analytical techniques. Students of other disciplines were also appearing in history department seminars in search of a more professional way of entering the discipline's discourse.

Changes of this kind are not easy to map either. Giles Gunn (1992) identified four approaches to mapping in literary studies that are applicable across all disciplines. The simplest strategy is on disciplinary ground. The conventional conjunctive strategy traces the relationship of one discipline to another, such as literature and philosophy. The map changes, though, if another question is asked. What new subjects and topics have emerged? Many examples appear, including history of the book, psychoanalysis of the reader, and the ideology of gender, race, and class. Each topic in turn projected further lines of investigation. This degree of complexity seems to defy mapping. "The threading of disciplinary principles and procedures," Gunn observed, "is frequently doubled, tripled, and quadrupled in ways that are not only

mixed but, from a conventional disciplinary perspective, somewhat off center” (pp. 248–249). They do not develop in a linear fashion and are not traceable in all their effects. They are characterized by overlapping, underlayered, interlaced, cross-hatched affiliations, collations, and alliances that have ill-understood and unpredictable feedbacks. The final and most difficult approach is rarely acknowledged. Correlate fields such as philosophy and other disciplines have changed. These changes challenge assumptions about the strength of boundaries while working to erode them.

The charge of superficiality, though, still haunts interdisciplinary work. In considering concepts in the interdisciplinary study of culture, Mieke Bal (2002) addressed the concern. Concepts have the theoretical and analytical force to go beyond multidisciplinary diffusion, illustrated by the examples of image, *mise-en-scène*, framing, performance, tradition, intention, and critical intimacy. They exhibit both specificity and intersubjectivity. Concepts do not mean the same thing to everyone, but they foster common discussion as they travel between disciplines, between individuals, between academic communities, and between historical periods. In the process of travel, their meaning and use change. Their productive propagation prompts a new articulation with a new ordering of phenomena within the cultural field. The basis of interdisciplinary work, Bal maintains, is selecting one path while bracketing others. Cultural analysis is not medium bound, and it does not exist without connections to other disciplines and recognizes that fields such as postcolonial studies have been catalysts for disciplinary change. At the same time, interdisciplinary analysis has a specificity that is not lost in superficial generalisms. Informed borrowing, Bal admonishes, is crucial. “Surfing” and “zapping” produce only “muddled multidisciplinary,” not the productive interdisciplinarity that results from paying a “good quality of attention” to the subjects and objects that make up a culture.

Ultimately, W.J.T. Mitchell (1995) concluded, everything depends on what sort of interdisciplinarity is being practiced. Mitchell distinguished three major types:

- *Top down*: Comparative, structural formations that aim to know an overarching system or conceptual totality within which all disciplines are related

- *Bottom up*: A compulsive and compulsory interdisciplinarity dictated by a specific problem or event
- *Inside out*: The indisciplined or anarchist moment, a site of convergence and turbulence

The top-down model hearkens back to a Kantian architectonic of learning in a pyramidal organization of knowledge production capable of regulating flows of information from one part of the structure to another. It appears in philosophy and critical theory, in claims for a utopian convergence of theory and practice, and in the promotion of semiotics as a universal metalanguage for studying culture. The bottom up emerges in response to emergencies and opportunities. Cultural studies is a general form of the bottom-up model. The inside out is the indiscipline of breakage or rupture. It disturbs continuity and practice. Ruptures, though, can become routinized, evidenced in the rapid transformation of deconstruction into an institutionalized method of literary and cultural interpretation. The “anarchist” moment, Mitchell maintains, may well be the most important event. Like Salter and Hearn’s “churn in the system” (1996), it is the time before routine or ritual is reasserted.

Interdisciplinarity, Gunn (1992) concluded, is ultimately a double-sided question: “The inevitable result of much interdisciplinary study, if not its ostensible purpose, is to dispute and disorder conventional understandings of relations between such things as origin and terminus, center and periphery, focus and margin, inside and outside” (p. 249). Relational studies of the conjunctive kind proceed from the question of what literature has to do with other disciplines. Genuine interdisciplinarity, in his view, alters the constitutive question that generates interdisciplinary inquiry in the first place, asking how insights and methods of another field or structure can remodel understanding of literature and the ways literary conceptions and approaches remodel allied fields and subject materials.

Gunn’s view is widely shared in humanities, though Stanley Fish (1989) challenged the underlying premise of new interdisciplinarity on institutional grounds. Its agenda seemed to flow naturally from new theories and practices that are critical of the structures by which lines of political authority are maintained and

disciplines establish and extend their territorial claims. Yet, Fish contended, any strategy that calls into question the foundations of disciplines theoretically negates itself if it becomes institutionalized. The majority of activities center on straightforward tasks that require information and techniques from other disciplines, expand imperialistically into other territories, or establish a new discipline couched in the language of antidisciplinarity but producing a new breed of counter professionals. This objection resurfaces in Chapter Four in the discussion of institutionalization.

As for the humanities curriculum, Lyn Maxwell White (1997) identified several trends in innovations, including greater collaboration across departments and merging traditional viewpoints with new scholarship. Content has also broadened to include more comparative study, informed by new scholarship on culture. Poststructuralist theories of language and meaning, coupled with new understandings of the nature of texts and reading, have changed the way traditional and new texts and subjects are taught. Faculty in English departments, for example, are adding a new plurality of cultural texts while drawing on social history and new theories of language and meaning. History teachers are applying quantitative methods from the social sciences and borrowing qualitative strategies of understanding texts from literary theory. As a result, White concluded, boundary lines have become harder to draw. In arts education, Ellen Harris (1997) reported, multiculturalism and cultural contextual studies bring history and sociology into greater focus while expanding the canon beyond its traditional Eurocentric foundation. New technology has also opened new modes of learning and understanding the creative process, stimulating new philosophical inquiries about the nature of object of study. (For a fuller discussion of ID humanities, see Klein, 2005.)

TRANSITION TOWARD LOCAL CHANGE

Summing up the most recent period in higher education, Carol Geary Schneider and Robert Shoenberg (1998) characterized it as a time of transformative change. A complete transformation has not occurred. However, every element of a new academy is visible across the country. The new academy is a broad-based

movement that has grown up around the edges and increasingly within the departments of the old academy. It comprises new forms of scholarship and modes of teaching and learning, reconfigurations of disciplines, and a new relational pluralism (Minnich, 1995). Interdisciplinarity is a major variable in the new academy. However, organizational charts and taxonomies rarely capture its full extent and the fluidity of faculty identities (Brew, 2008) that Marcia Bundy Seabury and Gail Dubrow have observed over the course of their careers.

Seabury (1999), who has administered and taught in the University of Hartford's interdisciplinary general education program, reports that faculty teaching in the program usually have conventional departmental homes. Yet "if you look beneath the surface you often find people who have been covert boundary crossers all along." The complexity of their lives and interests belies the "relative linearity of their departmental careers" (p. 5). Gail Dubrow (2007), who has led a major national study of fostering interdisciplinary inquiry, concurs. Over the long arc of academic careers, Dubrow has found that "intellectual interests of faculty may extend far beyond the boundaries of a single discipline and/or take them into entirely new area of inquiry" ("Facilitating Intellectual Mobility," 2005). Each year, some perform work beyond their department homes, and some are awarded joint or adjunct appointments reflecting the evolution of their cross-disciplinary connections and commitments. As their teaching and research unfold over time, knowledge domains, realms of discovery, and constellations of collaboration may reach well beyond original disciplinary backgrounds and appointments.

Only a hologram could do justice to the changing trajectories of knowledge and education that Seabury and Dubrow observe. Chapter Two moves from the mapping of national drivers in this chapter to the organizational forms and practices they take on local campuses. In doing so, it addresses another pressing question in the minds of faculty and administrators: Where does interdisciplinarity fit? When Lynton Caldwell (1983) posed the question in environmental studies, he argued that the metaphor of fit prejudices the epistemological problem at stake in their emergence. Many fields arose because of a perceived misfit among need, experience, information, and the structuring of knowledge

and curriculum embodied in disciplinary organization. If the structure of the academy must be changed to accommodate a new development, Caldwell admonished, then perhaps the structure itself is part of the problem. Caldwell is not alone in this view, though as we shall see in Chapter Four opinion differs on the best approach to institutionalization.

Chapter Two also deepens the conceptual framework of this book. Summing up key concepts of the framework introduced in this chapter, it is clear from the overview of science and technology, social sciences, and humanities that interdisciplinarity is a pluralistic idea. It is embodied in a heterogeneity of modes and forms of work that have fostered a distributed interdisciplinary intelligence and relational pluralism in the academy. Individual activities have discrete locations, but they also diffuse and intersect with other movements, adding to the greater hybridity of knowledge today, more frequent boundary crossing, and a growing multidisciplinary thrust of faculty work. Hybrid communities of practice range from trading zones where like-minded researchers and educators interact, to matrix structures of centers and programs, to emerging fields and, with sufficient critical mass, new paradigmatic fields. Hybrid discourses range from interim pidgin forms of communication to creoles that comprise a subculture or native language of a new domain. Local context results in added variability, manifested in differing degrees of in/visibility in the balance of overt and concealed interdisciplinarity across the surface and shadow structures of institutions. Creating a campus culture that is conducive to interdisciplinary research and education is a form of boundary work that requires identifying points of convergence, leveraging existing resources, building capacity and critical mass, platforming and scaffolding the architecture for a networked campus, benchmarking and adapting best practices, creating a resource bank, and institutional deep structuring of a robust portfolio of strategies aimed at programmatic strength and sustainability.