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Knowledge Formations: An Analytic Framework

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Abstract and Keywords

Knowledge is socially distributed, and the distribution of knowledge is socially structured, but the distribution and the structures within which it is produced and reproduced—often two separate things—have varied enormously. Disciplines are one knowledge formation of special significance. They can be thought of as very old, or as a very recent phenomenon: In the very old sense, disciplines begin with the creation of rituals of certification and exclusion related to knowledge; in the more recent sense, they are the product of university organization, and especially that part of university organization that joins research and teaching, knowledge production and reproduction, in the modern research university. If we understand the general structural constraints on knowledge formations, we can understand the peculiar strengths of disciplines, as well as the historical alternatives to disciplines and the motives for finding alternatives.

Keywords: knowledge formation, discipline, research, organization, university, foundation, Mode 2

KNOWLEDGE is socially distributed, and the distribution of knowledge is socially structured, but the distribution and the structures within which knowledge is produced and reproduced—often two separate things—have varied enormously. Disciplines are one knowledge formation of special significance, for reasons that are explained in this chapter. They can be thought of as very old, or as a very recent phenomenon: In the very old sense, disciplines begin with the creation of rituals of certification and exclusion related to knowledge; in the more recent sense they are the product of university organization, and especially that part of university organization that joins research and teaching, knowledge production and reproduction, in the modern research university.

Interdisciplinarity, as an identifiable phenomenon with its own justification, begins as a response to disciplines in the modern sense of the term, and to the specific forms of the organization of disciplines in the modern research university as it emerged in the United States in the first two decades of the twentieth century (Graham & Diamond 1997). Interdisciplinary work has generated its own knowledge formations, which we consider at the end of the chapter. Yet interdisciplinarity, transdisciplinarity, and multidisciplinarity can also be thought of in terms of the older senses of “disciplines,” and thus be given a long history.

In this chapter I give a general picture of the structural constraints on knowledge formations, introduce the idea of disciplines, and discuss the historical alternatives to disciplines and the motives for finding alternatives. I conclude with a discussion of the more recent history and some issues with current nondisciplinary forms. There is a literature on these issues, concerning such things as the internal organization of disciplines (Whitley [1984] 2000; Jacobs 2013; Collins 1998; Fuchs 1996). My approach is slightly different: to provide a general account of the preconditions and constraints under which knowledge formations that produce and reproduce knowledge operated, with a stress on the tensions between these constraints, and the various ways in which these tensions are managed.

(p. 10) 2.1 Some Basics of Knowledge Formation

To understand the range and differences between the various forms of the social organization of knowledge production and reproduction, it is useful to keep in mind some basic constraints that all of these forms operate under. These constraints can be handled or solved for in different ways, and it is the different combinations of solutions that produce the different forms. The issues of disciplinarity and those of forms of nondisciplinarity and interdisciplinarity make more sense in relation to these considerations, as do arguments for the reform of the current disciplinary order and its replacement. What follows is a list of what can be regarded as the basic elements of knowledge formations, of which disciplines are only one type.

2.1.1 Knowledge Sources

Knowledge has a history and source, and the sources constrain the way a knowledge formation is configured. There are multiple sources of “knowledge” but a basic set of distinctions might be borrowed from one of the most deeply rooted and historically important bodies of knowledge—law. A traditional distinction is made between (1) revelatory law, (2) rational law, and (3) customary law. A version of this might be adapted more generally: There is (1) knowledge that is eternal and unchanging and comes from a source appropriate to it; (2) empirical or factual knowledge, with a source in the changing world of empirical fact or socially constructed fact or even literary fashion; and (3) nonexplicit knowledge, involved in application, such as craft knowledge, or things learned as a tacit precondition to possessing the other kinds of knowledge. There is a difference between fields in which the participants generate the knowledge and those in which there are external sources, or supposed external sources, such as revelation, or the law as enacted by legislatures or passed down, that provide the core content of the subject matter. The type of knowledge involved is important as a determinant of the way in which it is taught, though arguably there are elements of each of these three sources in every knowledge formation.

Each of these, as a living body of knowledge that is transmitted and taught, involves a common language and a common understanding of that language, which is often specialized and distinct from ordinary language, as well as accepted forms of argument and reasoning, which are “shared” as a result of more or less standardized training or education of some kind that is a condition of communication rather than a form of communication. This tacit background may be highly specialized or relatively open and extensive, consisting of conversation and shared activity, or may be the product of quite rigid training hurdles, or a matter of overlapping areas of mutual intelligibility in which some of the common ground is very partial and unsystematic (see Galison 1997; Warwick 2003).

In the traditional disciplines central to the history of the European university there were dogmas—theological and legal—that students needed to master. Applying them was (p. 11) a different matter. Empirical knowledge and discovery played no role in these fields, but they did change through doctrinal refinement and gap filling. There were, moreover, tensions between these kinds of knowledge—between theory and practice, legal orthodoxy and application, and so forth—that generated new forms of knowledge production, including such things as casuistics and modes of empirical revision of principles and innovations in craft knowledge. The kinds of knowledge involved constrain the other parts of the knowledge formation.

2.1.1.1 Resources

Producing and reproducing knowledge requires people whose lives are to a significant extent dedicated to these tasks, and this means they must have sources of income that support the intellectual work that they do. The Romans sometimes had Greek slaves who

advised and taught; tutors, secretaries, and librarians have often played this role, as have monks and priests. The arrangements vary widely, but both antedate and parallel the model of the university teacher.

2.1.1.2 Means of Communication

To the extent that new knowledge is generated or new interpretations are proposed, or even when the doctrine of the knowledge in question holds it to be complete or fixed but requires it to be taught and applied to new situations, some means of communicating this to others—"publication" in the literal sense of making known to some relevant persons—is essential.

2.1.1.3 Norms of Conduct and Conventions of Discourse and Exchange

Robert Merton wrote about the norms of science ([1942] 1973), describing a world that has largely vanished; Edward Shils did the same with the academic ethic (1984), and philosophers discuss the epistemic norms and values of science. Norms are part of the conditions for knowledge production and also of the reproduction of knowledge. These may vary significantly by field, and across time, but without them it is difficult for communication and exchange to result in something commonly recognized to be "knowledge." These norms, however, limit as well as facilitate communication, and because they vary from group to group and discipline to discipline, they are also the source of mutual incomprehension and disagreement.

2.1.2 Exclusion/Inclusion and Marks of Recognition

A pervasive feature of intellectual communities is the existence of marks of membership, explicit or implicit. Certification in the form of degrees, membership in societies or academies, peer review in a variety of contexts implying a definite notion of "peer," and the like are examples. Often there is a symbolic or ceremonial representation of membership, such as the granting of a degree, or some sort of physical evidence of having been trained.

(p. 12) 2.1.2.1 External Legitimacy

Normally the community or group communicating knowledge has some sort of respect and recognition by nonmembers. This may be highly formal and come with a developed theory of the status of the particular kind of knowledge. The theory may be accepted by those who do not share the knowledge, or be part of the rationale for a particular institutional structure, such as an education system, bureaucratic order, or religious system. In the institutional history of the European university a particular hierarchy of faculties and their relations was important, had consequences for the development of knowledge, and was linked to the larger ecclesiastical order and its legitimacy. Schemes of public understanding of science and popular science as well as science education

designed to instill respect for science are contemporary examples of proactive attempts to secure legitimacy, as is the use of press releases to announce research findings.

2.2 Solving for a Workable Structure: Why Disciplines Work

The conflict between teaching and research in the modern university is a familiar example of the tension between the constraints arising from the different problems of knowledge production and reproduction. The ideal of the scholar-teacher is a response to this tension, which solves the problem of resources by embedding the role within a university that supplies certification and generates income to support the scholar-teacher, and has acquired a generalized legitimacy on which the scholar-teacher can rely. This solution, in its usual forms, is associated with disciplinarization, because certification is done within the university mostly in terms of disciplines. Knowledge production is possible within this system because of the surplus extracted from the paying activity of reproduction or teaching, though this is increasingly supplemented and even replaced by the grant system, which diminishes, sometimes to nil, the role of reproduction. This provides one opening for going beyond disciplinarity, but nevertheless making such alternatives work requires that they provide a solution for the other constraints identified above.

One may think of the problem in this way: The constraints are a problem space in which there are many “solutions”—namely, knowledge formations, which need to achieve a certain stability over time, but which allow for a great deal of variation in the emphasis placed on each constraint and for a great deal of variation in the way each constraint is dealt with. The issue of legitimation is an example of the possible variations in solutions for a single constraint. Legitimation is for an audience. But audiences may vary, and may be satisfied in various ways. The model of “public understanding of science,” to which we return later, is the product of a long history of thinking about the fundamental problem that results from the dependence of science on the public for support and the inability of the public to understand the content of science. A tradition that can be dated at least from Condorcet and expressed forcefully in the writings of Karl Pearson ([1892] 1911, 1919) argued that science education for the public was necessary, and that it should produce respect for scientists. Pearson went so far as to call for the public to regard scientists as priests (1888, p. 20). This idea was associated with a particular presentation of science through science education, directed especially at (p. 13) the working class, which taught elementary science with an eye to impressing students with the absoluteness of scientific truth and the power of science to manipulate the world.

An external presentation such as this does not determine an account of the nature of scientific knowledge internal to science itself, but it presents a problem of consistency: The practices of science and the practices and justifications internal to scientific practice

cannot, unless there are barriers of secrecy, self-deception, and so forth, ignore the fact that what is taught externally takes a different form. The doctrine that there is a scientific method is a case in point. Long ridiculed by philosophers, and difficult to apply to much of what is normally recognized as science, the idea nevertheless persists as an external validator and means of policing the boundaries of science. The constraints involve both facing inward, to the community of knowers, and outward, to a public audience. Slogans like “the aim of science is to predict and control” serve similar purposes.

Disciplines solve the problem of resources by tying their internal processes—journal communication, associations, departments, degree programs, and so forth—to a hierarchical system that is both an internal and external market (Whitley [1984] 2000). The external market is the nonacademic market for graduates; the internal market is the exchange of graduates, both at the level of graduate students and PhDs and the movement of post-PhD scholars from position to position within the hierarchy. The strength of this system depends on its hierarchical character, for reasons that are explained shortly, and on its exclusive or monopolistic character. The issue of exclusive control is central: A discipline defines its domain, its objects of knowledge, and rejects the claims of others to intellectual authority over these objects. This does not mean that there is no contestation over topics and over who understands them best. But the tendency is for this contestation to be resolved by mutual respect for boundaries and the legitimacy claims that disciplines make externally and to other disciplines.

Disciplines prize their legitimacy and autonomy, and protect both in various ways: by standards, certification practices, licensing, and through the control of accepted means of communication. Typically disciplines have a professional association, a set of journals, meetings, and other structures. Facts like these go without saying: They are part of the everyday professional experience of contemporary academics. But these structures did not always exist, and the legitimacy of the disciplines themselves had to be established. The market character of the exchange of scholars—the fact that disciplinary departments are both buyers through hiring and sellers through producing—determines hierarchy, a hierarchy of market valuation of a degree from a certain department or graduate advisor, publication in a certain outlet or by a certain publisher, and so forth. The achievements of a scholar are implicitly valued and ranked. The value of an achievement is revealed by the importance that is placed on it in competitions for positions, grants, and so forth. Credibility, and the power to coerce other scholars to respond and take seriously particular work, is closely associated with these markers.

The phenomenon of intellectual “imperialism” is stigmatized precisely because it represents a disruption of these boundaries and a breakdown of the legitimacy claims on which they depend. Nevertheless, as Uskali Maki points out (2009, p. 353), expanding the explanatory domain of a theory is generally regarded as a good thing. It is evidence of the power of the theory and a source of new explanations for the target subject. So there is a tension between boundaries and monopolistic claims and quite ordinary processes of

intellectual improvement. This conflict is at the heart of many of the criticisms of the system of disciplines (Jacobs 2013).

(p. 14) We can think of this conflict as arising from the way in which disciplines bind two things together: the production and reproduction of knowledge, teaching and research. There is nothing absolute about this binding: It is possible that, and indeed there are many cases in which, the production of knowledge is entirely divorced from any sort of training or instructional function. The story of how this happened can be briefly recapitulated. There were many knowledge formations that preceded the university, and existed—and to some extent still exist—parallel to and largely independent of universities. The university model is usually taken to have originated in the Islamic world, where there was a differentiation of faculties and a form of recognition of study, as well as funding by wealthy patrons, presumably with religious motivations, which also supported legal and clerical careers for the graduates.

In Europe, universities themselves initially followed one of two basic models. The universities of southern Europe were focused on law (especially canon law) and medicine, while those of northern Europe, principally Paris, but also later Oxford and Cambridge, focused on theology. In each of the latter cases they were essentially training schools for clerics. The colleges of the new world, such as Harvard and the Universidad Nacional Autnonoma de Mexico, founded in 1551 under the name Royal and Pontifical University of Mexico, were also oriented to this task. Harvard, until the twentieth century, was primarily a training school for Congregational ministers, and providing ministers was the motivation for founding many later American colleges.

The teaching of theology and law, as well as medicine, was not explicitly concerned with the *production* of knowledge: The sources of knowledge were given, external to the university, and took the form of dogma. “Discipline” meant the protection of the dogma. As late as the middle of the seventeenth century, “a Doctor of Medicine was compelled by the English College of Physicians to retest a proposition he had advanced in opposition to the authority of Aristotle under threat of imprisonment” (Rashdall [1895] 1936b, p. 453). Training was training in dogmas. There was a need to formulate these dogmas, and apply the dogmas in new circumstances, through legal and theological casuistry, and this led to a certain amount of innovation. But innovation was not prized.

These patterns were the distant source of a key element of the model of disciplines. It is worth recalling that much of what we take for granted today as a part of university education was inherited from the medieval university, which was oriented to the transmission of dogma alone. As the authors of the Cambridge historical survey of the medieval universities put it,

> It is not necessary that a definite line of study should be marked out by authority, that a definite period of years should be assigned to a student’s course, or that at

> the end of that period he should be subjected to examination and receive, with more or less ceremony, a title of honour. All this we owe to the Middle Ages.
>
> (Rashdall [1895] 1936b, p. 459)

This was part of the inheritance of disciplinarization, but disciplines themselves, that is to say well-defined identities with markets of exchange of scholars and graduates, did not yet exist. Yet the rudiments of a market were there. The system, by licensing graduates of certain universities to teach anywhere, provided the means of mobility, and, through the system of disputations, scholars could distinguish themselves without doing anything to produce new knowledge.

(p. 15) Internal disciplinary hierarchies follow their own market logic: What is prized within the discipline is prized because it meets internal market needs. This is the basic fact of disciplinarity that runs through this chapter. The medieval universities had a form of this as well. The source of prestige in the market of the early university was the ability to attract students, especially students from afar. The thing that attracted them to the Italian universities was the systematic exposition of universal legal concepts in Roman and Canon law. In the case of law, adapting Roman law to local legal orders was an activity that was not general and not tied as closely to training in the system of Roman legal concepts. Hence it was not prized.

This, however, is a case of a fundamental conflict between activities in a predisciplinary setting. The great achievement of the legal scholars was the production of glosses on ancient texts. This is what they were there to lecture on and expound: legal dogma. The standardization of understandings of the law was essential to its value for students: Legal knowledge became transportable to other places, indeed “universal” at least to the universe of Europe. But this had a bad effect on scholarship. The original glossators were great scholars, and their influence was enormous. Their successors chose, or were condemned, to comment on them.

> The professors had come to busy themselves more with the gloss than with the text. Instead of trying really to develop the meaning of the text, they aimed at tediously exhaustive recapitulation and criticism of all the glosses and comments they could collect. In short, they lost sight of the aim of their work, which consequently became more and more stagnant and pedantic.
>
> (Rashdall [1895] 1936a, p. 257)

This was true, mutatis mutandis, of other domains of thought as well. In theology, “the ‘Sentences’ of Peter the Lombard” had “the same narrowing influence” (Rashdall [1895] 1936a, p. 256). The granting of advanced degrees reflected this emphasis on mastering a scheme of dogma or a system. Ironically, the key to the academic culture was disputations —over the received texts. Performance in these disputations was a mode of knowledge exhibition; but it was not oriented to sources of knowledge outside the canonical texts, either of theology or law. Philosophy was taught in the same way. Yet at the same time the

teaching of dogmas was a solution to the problem of what it was that the scholars could sell. Students got what they wanted: They learned a common language that opened up to them the possibility of careers in state administration and the law, or in the Church.

One might wonder how the great philosophers of the period, such as Occam, Aquinas, and Duns Scotus, survived in this system. In fact they did not: Although they typically spent some time at the universities, for the most part they were part of the parallel educational system internal to the monastic orders. The monastic orders whose members contributed to intellectual life, such as the Dominicans and Franciscans, solved the problems of money and external legitimacy, in different ways. Both of these orders were mendicant, and in any case had their own hierarchies, which freed some of their members from other duties, and they had forms of collegial communication that extended across Europe, as well as means of publication through manuscripts and libraries maintained by the orders and Cathedrals—which themselves constituted an educational system.

(p. 16) 2.3 The Scientific Revolution

The medieval university was a structure that lasted for centuries. It solved the problem of responding to the constraints listed above. It was, however, not good for the development of science. The scientific revolution happened for the most part outside the universities, and in different organizational forms, and with a different structure of patronage. The reformation and counter-reformation produced more changes, and the Protestant universities of the north, such as Leiden, freed from the limitations of clerical control, developed in new ways. These two stories, the development of nonuniversity knowledge formations and the development of the university into the modern disciplinary form, require some background.

The scientific revolution was carried out for the most part by nonacademics organized in groups and communicating with one another, as well as by some academics who were participants in learned circles outside the university and supported by patrons. They were either courtiers, such as Galileo (Biagioli 1993), often with positions such as court mathematician; or supported by their own wealth, such as Tycho, or by sinecures which allowed them to pursue their scientific work; or monks. A representative figure is Galileo's friend and supporter Federico Cesi (1585–1630), who founded the Accademia dei Lincei, a novel kind of institution whose "members lived communally and almost monastically in Cesi's house, where he provided them with books and laboratory equipment." The participants included Galileo, "the mathematician Francesco Stelluti, the physician Johannes Eck from the Low Countries, and the polymath Anastasio De Fillis" (Rice University http://galileo.rice.edu/gal/lincei.html). This list is a good indication of the range of participants in the scientific revolution. There was a moral content to their work as well: "not only to acquire knowledge of things and wisdom, and living together justly and piously, but also peacefully to display them to men, orally and in writing, without any harm," as a 1605 document of the academy put it (Rice University http://galileo.rice.edu/gal/lincei.html). This was an external face, but an internal code as well, and one at variance with that of the university, which prized its control of authority over knowledge.

The term "Renaissance man" is apposite: These people were not specialists in a discipline, but dabbled in various branches of knowledge, including theology and astrology. They benefited from personal contact with one another as well as from the circulation of books, a new technology of communication of the time, and the synergies provided by intellectual work in different domains and in contact with persons with different and varied interests. They also communicated with other circles, especially by letters but also by the new technology of printed books.

This process of creation of new communities combined with patronage continued in many more famous cases—the Royal Society, which began as meetings with no name at Gresham College—a nonuniversity non-degree-granting institution—before gaining Royal sponsorship in 1660. Paris followed in 1666, and other ambitious states and courts

followed with their own versions. Leibniz convinced the elector of Brandenburg to establish what eventually was to be called the Prussian Academy of Science in 1710. It was funded, at the suggestion of Leibniz, by granting it a monopoly on the sale of calendars. One important innovation of these societies, a change both confirmed and advanced by the explicit rules generated by the British Royal Society, was in the rules of discourse (Lynch 2001). The practice of disputation, (p. 17) which had both defined and limited the medieval university, was replaced by the practice of experimental proof, and topics that were part of the tradition of disputation and not subject to experimental evidence were excluded. The academies were models of exclusion and inclusion that set the identity and hierarchy of scientists (Hahn 1971). Yet they were also schemes that solved problems of external legitimacy, especially by serving the state, and of course solved the problem of finance without depending on teaching.

The university system was not wholly resistant to the changes outside of it. Teaching, the primary activity, eventually morphed, in nonlegal and nontheological contexts, from teaching and disputing dogmatic systems into teaching one's own system. This was an evolution with peculiar intermediate points. As Constantine Fasolt points out, the expectation for a dissertation in the seventeenth century, and in many places long after, was that the student write up the professor's lectures. In many cases the professor wrote the dissertation himself (Fasolt 2004, pp. 96–97). The emphasis was on the defense, or *disputatio*, which proved the competence and in some sense the originality of the student performing the defense. There were many variations on this, but the idea that the student would reproduce and systematize the lectures of his teacher reflected the idea that one was transmitting a dogmatic system. But on becoming a professor, one presented lectures transmitting the system one propounded.

Freed of the control of the Church, the Protestant universities of northern Europe became hotbeds of this kind of teaching. This morphed again into a system in which a "Seminar" or protodepartment organized under a professor would teach the same doctrine, so that eventually there emerged multiple variant doctrines. Well into the last half of the twentieth century, indeed, this system prevailed at some universities, especially in Scandinavia. This was still not disciplinarization, however. That would require something more—an exchange of professors and students under a common label and a more or less common idea of the boundaries and exclusions implied by the label, and of the signs of membership. But the rise of Protestant universities, by freeing the market from the involvement of the church, allowed for a step in this direction.

The two major forms of knowledge organization, the Royal (and later national) Academies of science and the universities, together with various nonuniversity forms of public education and lecturing, developed in parallel over the last half-millennium, taking various forms, but sharing many features. Universities remained wedded to the practice of education as indoctrination into a dogma, proof of competence to some form of "defense" or disputation, and the building of intellectual systems by professors. The importance of each of these elements varied, but they were wedded to one another. Disciplinarization built on these practices, but transformed them in a different direction.

Internal legitimation did not rest, as much on the power of individual professors to attract students or attract them to the system propounded by the professor, as on education in the discipline itself. Disciplines themselves sought and gained external legitimacy as disciplines, that is to say as the locus and guardian of specific competences and bodies of knowledge shared with others trained in the same discipline. And the definition of originality changed to reflect the practices of nonacademic circles, especially in science. Now something akin to discovery was a requirement for obtaining an advanced degree—though in reality discovery was rare, and the notion of originality extended to the most common kind of originality, the extension of established dogmas.

Between 1800 and 1910 the modern model of disciplinarization emerged and solidified. Along with it came discontents and anxieties about disciplinarization, involving the sense of a loss of the unity of knowledge (Weingart 2010). The process was led by the reformed (p. 18) universities of Germany, notably Halle and Göttingen (which demoted theology—a sign of the breakup of the old hierarchy of the university). Reform allowed new models of disciplinarization to develop. At Geissen, the chemist Wilhelm Liebig attracted and trained many foreign students, started a fertilizer and meat extract business, and became the model for modern science, combining research, teaching, and economic impact within the framework of a strong disciplinary structure. This model proved to be transportable: Its elements are found in the Land-grant universities of the United States in the last half of the nineteenth century, modified to become the ideal of teaching, research, and extension. In the late twentieth century this became the notion that a professor was to contribute to teaching, research, and service.

By the end of the nineteenth century a worldwide revolution in practice was beginning, with the idea of combining research and teaching at its core, and new hierarchies between universities developed, and new investment in universities, motivated by nationalism. The desire to emulate German universities led to the modern university in one country after another. Disciplines developed in association with licensing regulations or their de facto surrogates, and disciplinary organizations developed to define portions of academic turf. By 1910 the modern disciplines, and the modern research university, had been defined. The attempt to overcome disciplinary divisions followed in the twenties, under the influence of the Rockefeller philanthropies, and led in the 1950s to a movement for interdisciplinarity in teaching.

It goes without saying that much of the medieval regime of doctrinal reproduction persists in academic life, in part because of its preservation by the system of disciplinarization, which used its forms, especially the degree system. What separates researchers in different disciplines today is the way they are trained, and this includes “paradigms” and everything that is associated with them, as well as methods of argument, tacit understandings, instrumentation and the knowledge of how to use it, and so forth. However, perhaps the most important consequences of the system of disciplines for the intellectual substance of disciplines result from the hierarchies that develop through the market competition in the exchange of graduates and in the competition for research funds and other subsidies. The economist Milton Friedman, after retiring, while

visiting a group of young economists, complained about the direction the discipline had taken, which he thought involved a substitution of mathematical prowess for intellectual substance. One of the younger economists responded by observing that this was what the market—by which he meant the internal market in economics as a discipline—demanded (cf. Frodeman, 2014). Because conformity is rewarded, the market produces a level of coercion that inculcates standards and attitudes that are very resistant to change.

2.4 The Interdisciplinary Alternative

This points to one of the three major strands of critiques of disciplinarity and to the various motivations for interdisciplinarity. The earliest critiques in the nineteenth century involved the ideal of the unity of knowledge, which disciplinarization threatened. Similar charges were made in the twentieth century about the threat to liberal education of a system which taught and rewarded disciplinary rather than educationally significant topics, (p. 19) or simply ignored topics that were not prestigious in the disciplines in which they would have been taught, such as film studies, a neglected child in both English departments and the Arts (Damrosch 1995, p. 61), but were nevertheless deserving of attention. Jerry Jacobs (2013) highlights several cases in which this kind of concern has led to interdisciplinary movements, but notes that they have tended to disciplinarize themselves. This should be no surprise: Teaching, or student demand for these areas, is the only available source of significant funding.

The important Rockefeller philanthropic response of the 1920s and 1930s concerned practical value: In the social sciences, for example, the Laura Spelman Rockefeller Foundation program supported the improvement of the social sciences in a “realistic” direction, with an aim of more or less rapidly producing useful knowledge. In the sciences, Rockefeller support was important to the phage group, a well-funded effort at integrating physics and biology that led to the molecular biology revolution: something that would not have occurred in the normal course of development within disciplinary zoology and botany departments. In the course of doing so they created new relationships through such institutions as Cold Spring Harbor. Philip Mirowski (2002) has pointed to the wartime RAND experience of many future economists with operations research and how its distinct cognitive value of minimalistic mathematical representation—in a nonacademic collective work setting—had major consequences for the development of postwar economics. The postwar bombing surveys, which brought together social scientists, psychologists, and psychiatrists, had formative effects on the postwar attempt to constitute these “behavioral sciences.”

A significant part of these changes had to do with the creation of new, and for the most part temporary, social formations. But these needed to solve in some fashion the problems of coping with the constraints discussed earlier—particularly funding, external legitimacy, common norms and language, and so forth. Yet short-term structures like

these can have long-term effects: The works of Aristotle were produced in an interesting collaborative “interdisciplinary” institution in one generation, but reproduced for two millennia.

Present discussions of changes in science and scholarship generally, notions of postacademic, postnormal, and Mode 2 science, have attempted to theorize these new forms of research, which are beyond the disciplinary. But they are faced with the same constraints; they simply deal with them in different ways. Each of the advantages of disciplinarity comes with limitations: the need to service students, the intellectual coercion that results from the disciplinary hierarchy that comes from the market exchange of students, the constraints on communication resulting from common training and norms, and the exclusions and limitations that go with them. Each limitation and exclusion produces an alternative unpopulated space, often involving practical problems, that “belong” to no discipline and cannot be easily addressed by any of them. The difficulties, however, are commensurate with the opportunities.

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