CHAPTER 4

INTERDISCIPLINARY CASES AND DISCIPLINARY KNOWLEDGE

Epistemic Challenges of Interdisciplinary Research

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This chapter provides a conceptual framework and determines the place of interdisciplinarity in the context of contemporary philosophy of science and social epistemology. It describes a widespread tension between the interdisciplinary commitment to complex real-world problems and the disciplinary strategies of designing and understanding simplified models. The epistemological challenge of interdisciplinarity is to relate knowledge about cases that are complex and singular with knowledge about concepts and causalities that are purified and general. While real-world problems call for highly specific and context-sensitive solutions, disciplinary problems serve as exemplars of a more general type. Finding solutions to real-world problems usually implies shaping a piece of reality in a satisfying way; solving disciplinary problems usually means having to find a sufficient causal explanation. What are the epistemological features of interdisciplinary research if it is supposed to serve the case as well as to advance knowledge?

4.1 Overview

The main propositions of this chapter are:

- Interdisciplinary research projects constitute a relationship between individual cases and more general knowledge bases untypical for disciplinary research.
- This relationship demands a new mode of knowledge, in which learning about a case is equally important as understanding causal structures. It calls for a combination of

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the "humanistic" ideal of understanding the individual specificities of just one case, and the "scientific" search for common features of different cases.
- Reflection on the character of interdisciplinary knowledge supports a critical reassessment of the received concept of scientific law and exemplary application.

If it is taken as a point of departure that most interdisciplinary research projects are organized around real-world cases, it is implied that these cases have to be understood with all their contingent features and circumstantial conditions. Each case is more or less different from every other case and has a certain value in itself. A paradigmatic example is global climate research. It aims at understanding the climate just exactly as it is, its origins and its future, in all its complexity and vagueness. Even if climate change is a broad topic, it is a unique one. It needs to be understood by means of a highly specific or even unique model to which many specialties contribute.

Interdisciplinary research also aims at cases that exist in several exemplars: cities and buildings in urban planning and architecture; prairies, sand dunes, or estuaries in restoration ecology and adaptive management; refugees in migration research; and prototypes in technological innovation. Here it seems possible to transfer knowledge gained in one case to similar cases. However, as discussed later, relying on similarities without respecting differences can be misleading. In any case, reference to real-world cases is the essential cognitive and political dimension of interdisciplinary research.

This approach deviates from other approaches in not attempting to define interdisciplinarity on the basis of and as a derivative of the disciplinary structure of knowledge. Rather it is assumed that real-world cases necessarily integrate heterogeneous knowledge bases, be these gathered under the institutional cover of a discipline or not. Any research field or research project that addresses real-world problems is considered to be essentially interdisciplinary. An advantage of this approach is its independence from unsatisfactory attempts to define institutionally or cognitively what a discipline is. In consequence, research fields that are rhetorically addressed as disciplines can be considered to be epistemologically interdisciplinary. Moran (2002) has nicely made this point with respect to the humanities—English, literary criticism, cultural studies, feminism, psychoanalysis, and the like. They are all interdisciplines, or disciplines with interdisciplinary features, because they tend to accept cases in their complexity and contingency. The same point was made earlier by Donald Campbell with respect to anthropology, sociology, psychology, geography, political science, and economics, which he called "hodgepodges" caused and shaped by real-world problems (Campbell 1969).

To start with real-world cases helps to understand certain features of interdisciplinarity. Later in this chapter the focus shifts from cases to processing contingency and complexity. The main interest is not to provide managerial and methodical solutions for cooperation between disciplines but to exploit the fruitful tension between understanding a case and searching for general knowledge. The main proposition here is that taking cases seriously implies a kind of learning considerably different from received views of inductive or deductive methods. Doing research in the context of real-world problems demands and develops skills and competencies that scholars are not used to.

4.2 Idiographic and Nomothetic Knowledge

What are "real-world" cases? The concept is meaningful only if contrasted with some "ideal world" of something. Every scientific experiment makes things simpler than they are, and theory imagines the world yet simpler. Historically, the paradigm was set by the invention of geometry. Since there is no *real* line, curve, or body that fits the demands of mathematical definition, they are ideally constructed. The ontological status of ideal objects has always been controversial, but this is not our point. The point is the epistemic change in hierarchical order. Real things, those which we can point at, are only approximations of ideal objects. The science of ideal objects is still called "earth measuring" (geometry), though there is not a single place on earth that fits its definitions. Sciences that do care for real-world measurement such as surveying, alignment, and mapping have developed methods able to determine any shape of an area. Limits to precision are not set by the methods but by changing and melting borders—as between land and water, forest and prairie, city and suburban sprawl.

Open boundaries present a very important issue in the analysis of real-world objects or systems. Geometry and surveying have fruitfully interacted in history. Surveying is real-world oriented and therefore is an interdiscipline. Geometry is a classical discipline (or subdiscipline, if mathematics is the discipline). Both come together in the earth sciences, in which on the one hand sites, events, and (hi)stories are important and on the other the objects, models, and methods of the lab. Frodeman (2003) has provided an epistemological analysis of the earth sciences showing how difficult it is to integrate the interdisciplinary strands into a coherent self-understanding of the discipline.

There are numerous other examples where, in a roughly identical segment of reality, strategies to grasp peculiar cases as they are coexist with strategies to construct cases as they are wanted for theory. The general proposition to be made with respect to this distinction is simply this: Interdisciplinary research is needed to focus on the peculiarities of given cases, while disciplinary research is characterized by substituting ideal features for given ones. Many modern research fields relate to both foci and are simultaneously driven by these two tendencies. They aim at becoming more of a discipline, as well as a place of integration for potential contributors from various disciplines. How this is balanced institutionally—in terms of journals, societies, handbooks, curricula, research sites—is of no concern here.

Call the specific features of a problem, a system, or a case its "idiographic component." And call the more general features gained by taking problems, systems, or cases as exemplifying or inducing a more abstract or idealized object of knowledge its "nomothetic component." The terminology was introduced by the neo-Kantian philosopher Wilhelm Windelband (1894). Idiographic literally means describing the peculiar, singular, and specific.[1] Nomothetic literally means setting the (scientific) law. The law-like quality of scientific knowledge is associated with certain features such as the reproducibility of experimental facts, prognosis of events, general validity of propositions, and causal explanation of correlations. Even if the definition and relation of these epistemic features are controversial, they undoubtedly strengthen the difference between something one happens to know and

[1] The likewise usual wording "ideographic" does not refer to Greek *idios* = peculiar, but to idea = form, Gestalt, which is no less appropriate.

theoretically corroborated knowledge. The ideographic structure of knowledge Windelband believed to be best exemplified by historiography. A historian who specializes in the founding of the United States of America usually does not wish to become a specialist for foundations in general, but builds his reputation on knowing everything about just this case and giving it an original and surprising interpretation. If he cared to analyze another founding—say of the Roman Empire, Brazil, or the European Union—neither factual knowledge nor interpretation schemata can be transferred from one to the other.

When Windelband introduced this terminology he was not only a famous philosopher but also rector of Strasbourgh University. He found himself in a position to reconcile a heated controversy between the natural/technical and the cultural sciences/humanities. The rapid ascent of the natural sciences led to claims that true knowledge would only reside in laws. Eventually all knowledge fields including the humanities were to be converted into law-seeking disciplines. The counterattack aimed at the assumed weak point that natural sciences are completely unable to develop a coherent understanding of something as complex as a culture and its history, or even some part of it, such as a specific city, not to mention art, literature, and religion.

In his presidential lecture in 1894, Windelband suggested equal rights to both forms of knowledge. Knowledge production is guided either by an interest to identify laws, which implies turning things into variables, or by an interest "to describe as complete as possible a singular event or chain of events spread over a limited time." Examples of events worth scholarly interest are, according to Windelband, "Actions of a person, the character and life of a single man, or of an entire people, the character and development of a language, a religion, a legal order, of a product of literature, art, or science: and each of these subjects demands a treatment corresponding to its peculiarities" (Windelband 1907, p. 363). For Windelband, the distinction is not built on different classes of objects—natural events versus human affairs—but on methods. In principle, everything can become the object of a nomothetic as well as idiographic analysis. His examples are language, physiology, geology, and astronomy. If objects in these fields are considered in their specificity, "the historical principle is carried over to the realm of the natural sciences" (Windelband 1907, p. 365). If the objects are taken as types or exemplars, the methods of the natural sciences apply.

By the traditional views of philosophy of science, it seems obvious that the sciences should search for laws, principles, and other forms of generalized explanations. It is less obvious why they should care for singular or even unique cases. Windelband assumed their relevance with respect to cultural heritage, identity, and value. Admittedly, one can never know in advance whether or not a single case turns out to be culturally relevant. But if it were considered to have no potential value at all, research would not be started. Or put in a more constructive language, a scholarly effort to study a case automatically attaches some sort of value to it. Windelband's neo-Kantian disciple Rickert offered the following equation: "There is not only a necessary connection between the *generalizing* and the *value-free* observation of objects, but also an equally necessary connection between the *individualizing* and *value-laden* perception of objects" (Rickert 1924, p. 58). Even if this general statement may be doubtful, obviously all real-world problems have a value dimension, be it economical, social, cultural, or environmental. Windelband and Rickert chose historical research as their paradigmatic field because the preservation of cultural goods and values seemed to be even more important in a society that became exposed to dramatic industrial changes. Today we would add to the historian's work pressing problems caused by misguided developments.

Real-world problems are problems because values are at stake. Solutions are only accepted if they address these values.

Concern for idiographic cases does not invalidate more general knowledge. Usually, interdisciplinary case studies are expected not only to solve single problems but also to contribute to stocks of knowledge. However, the epistemic structure of these stocks of knowledge is different from knowledge condensed in theories or paradigms. The relationship between ideographic and nomothetic orientations of interdisciplinary research needs to be analyzed and interpreted in a new way. The first step will be to better understand the nature of cases by looking at variants of the so called case-study method practiced in professional schools. Certainly, higher education of professionals and experts aims at goals different from doing research. However, the reasons why the case study method seems to be successful in professional training are important for understanding how cases contribute to interdisciplinary knowledge.

4.3 Learning Based on Case Studies

The methodology of using case studies in educational programs originated in the pioneering achievements of the Harvard University professional schools. As early as 1870, the Harvard Law School shifted the study of law from the classical systematic approach to the analysis of cases. In 1920, the Harvard Business School developed a new curriculum based on case studies. In 1985, the Harvard Medical School followed suit with its New Pathway Program, which was considered revolutionary within the field of medical training. The following presentation is concerned not with an evaluation of this educational method, but rather with the question of what can be learned from individual cases.

David Garvin—himself a faculty member of the Harvard Business School—emphasizes the three dominant goals of case study methodology: "learning to think like a lawyer"; "developing the courage to act"; "fostering a spirit of inquiry" (Garvin 2003, subheadings). Competencies from three professional fields merge here: the logical expertise of a lawyer, the decision-making capacity of a manager, and the curiosity of a researcher. Cases that have been of paradigmatic importance for the development of laws are not central to the training at the Harvard Law School. The focus is rather on those cases that are controversial within the legal profession, those that were wrongly decided or were revised. Garvin cites another member of the faculty who notes, "We have conflicting principles and are committed to opposing values. Students have to develop some degree of comfort with ambiguity" (Garvin 2003, p. 58). The analysis of individual cases frequently does not lead to a clear result. "Students often leave class puzzled or irritated, uncertain of exactly what broad lessons they have learned" (Garvin 2003, p. 59). On the contrary, they learn that general legal doctrines are rarely unambiguously applicable and that the smallest distinctions can play a role in their application. Furthermore, these cases help students practice dealing with unknown and unforeseen circumstances, with varying conditions, and with surprises.

The description of Stanford Law School's "case study teaching method" is similar to Harvard's: "Case studies and simulations immerse students in real-world problems and situations, requiring them to grapple with the vagaries and complexities of these problems in a relatively risk-free environment—the classroom" (Stanford Law School 2015). Far from

introducing individual cases in Kuhn's sense as paradigms, these are examined as unsculpted and uninterpreted as possible. This methodology is thus quite suitable to an academic policy that places value on the grasping of complex configurations, on the identification of possible action, and on the assessment of consequences. It aims at an interdisciplinary training portfolio: "Students identify for themselves the relevant legal, social, business, and scientific issues presented, and identify appropriate responses regarding those issues" (Stanford Law School 2015).

Education at the Harvard Business School is also guided by the principle that greater competence can be acquired through constant rehashing of case studies than through studying theoretical and methodical knowledge and the intended applications thereof. Underlying the choice of these individual cases are the following criteria:

> Typically, an HBS case is a detailed account of a real-life business situation, describing the dilemma of the "protagonist"—a real person with a real job who is confronted with a real problem. Faculty and their research assistants spend weeks at the company. . . . The resulting case presents the story exactly as the protagonist saw it, including ambiguous evidence, shifting variables, imperfect knowledge, no obvious right answers, and a ticking clock that impatiently demands action. (Harvard Business School, 2008; for a more recent account, see Harvard Business School 2015)

The students are presented with about 500 of these cases in the course of their studies, the main goal being to school their decision-making behavior. The large number of cases is not seen as an inductive basis for statistically generalizable knowledge, but rather as preparation for a maximum number of diverse situations. In addition to these cases studies, the program offers courses in "analytical tools." The following list of academic goals is presented in Garvin (2003):

- training of diagnostic skills in a world where markets and technologies are constantly changing
- assessment of the ambiguity of constellations
- consideration of the incompleteness of the information at hand
- recognition of the existence of a multitude of possible solutions
- preparedness to make decisions in the face of uncertainty and time pressure
- development of persuasive skills. Management is a social art; it requires working with and through

From a critical perspective, the tendency to quick decision should be noted. "The case method does little to cultivate caution. . . . Students can become trigger-happy" (Garvin 2003, p. 62). For a more balanced view, see Srikant et al. (2009).

Inaugurated in 1985, Harvard Medical School's New-Pathway Program has supplanted the classic basic training in medical fields and has with some delay affected applications at the sickbed. It also highlights the point that every single case is self-contained. To cite Tosteson, the program's founder, medicine "is a kind of problem solving" and each medical encounter is "unique in a personal, social and biological sense. . . . All these aspects of uniqueness impose on both physician and patient the need to learn about the always new situation, to find the plan of action that is most likely to improve the health of that particular patient at that particular time" (Tosteson, cited in Garvin 2003, p. 63). Since then, the program

underwent several revisions, seeking the optimal combination of disciplinary knowledge development and practical responsibility for the individual case.

Further examples of curricula that have adopted the case method entirely or partially include engineering, sociology, psychology, education, architecture, and economics. What constitutes its success if not superiority in higher education? The most notable criterion is its insistence on the individuality of cases. They are not cases in point, not exemplars of a type—at least not in the first place. The didactic concept is not to present a general structure via a number of examples, whose special features quickly retreat behind the emerging abstraction. No case can be exchanged for another, since something different is learned from each case. Concentrating on the idiographic nature of each case means to develop a sense for its details and the seemingly incidental aspects that make it special. Every case study of this kind is unavoidably connected to deficits in information, to ambivalent interpretations, and to the risky effects of possible interventions.

At variance with more traditional academic education, the focus is on grasping both the differences and the similarities between cases. Identifying case-specific gaps in knowledge is as important as applying knowledge gained from other cases. The background philosophy seems to be that professional realities are not determined by general rules or even scientific laws, but are constituted by a vast network of particular cases. The competency of the professional consists in deriving operative gain from comparing similarities and differences between cases.

Traditionally, the two pillars of scientific methodology are inductive generalization leading to theory and deductive specification via application to cases. Here, however, neither is applied. Rather, both are substituted by the expansion of a network of cases, in which the mesh density of analogous relationships is continually tightened. Does this indicate a third path that avoids the alternative between generalization and specification? Does such professional training develop a learning core not contained in the traditional theories of the growth of knowledge?

4.4 Knowledge and Skills: The Professional Perspective

The launching point for the educational programs described in the previous section is the shortcoming of academic training with respect to professional competencies. The criticism is that the academy is unable to deal with the complexities of true life, but must reduce these in accord with theoretical concepts. Academic training follows the paradigm of alternating theoretical construction and experimental research by which the object of study is subjected to the ideal conditions of the laboratory. This is not the reality that the professional expert confronts.

The case method cultivates certain capacities that are most often termed "skills." Skills do encompass rational pieces of knowledge, but equally important are routines, habits, and trained intuitions, all of them are not completely explicable components. They come into play not only for professional know-how, but in many fields of learning like the acquisition of crafts and trades, doing sports, or mastering a musical instrument. More generally,

all techniques that require the coordination of physical training with the comprehension of rules and readiness to act are based on skills. Here the study of introductory books and instruction manuals helps little. The observation of masters helps a bit more.

Decisive, however, is the continual exercise of physical practices until these become routine. Situational assessment, spontaneous coordination of action, and a repertoire of strategies are all conditions for success. The important point in our context is this: Even when skills have been developed, each individual case retains its particular meaning. There is no overarching level of competence comparable to theoretical knowledge, in which skillful action could be adequately reconstructed as theoretical objects. Although there have been attempts in the scientific analysis of sports and music to construe such levels, what ultimately count are skills in action.

The Harvard method and the teaching methods practiced in the fields mentioned above have in common the accumulation of analogies between related configurations, whereby it is as important to attend to differences as to similarities. In this way, the learner knots together a network of configurations that is fed by individual cases and used for situating further cases. This is what defines the professional expert (e.g., the lawyer, doctor, or manager), the specialized expert (e.g., the craftsman, athlete, musician), and even, if one can say so, the everyday expert (e.g., the habitual walking in uneven terrain, parenting, driving). It may be assumed that in the background of the case method a much deeper mechanism of analogical reasoning is at work, which Hofstadter and Sander (2013) have called the "fuel and fire of thinking." By the same token, analogical reasoning enables us to categorize as well as differentiate the world and makes us experts when we apply it and scale it up.

It is beyond this chapter to explore cross-links between the case method and Hofstadter's model. As applied to interdisciplinary research, one can conclude that learning from case studies is suited primarily for expanding the professional know-how of experts. In keeping with the traditional concept of professions, one could coin the term "professional researcher." Such a professional would be an expert in the investigation of open problems in contingent and complex individual cases, which occur within a certain domain of action. Their expertise is based on a network of experiences gathered and expanded case by case. From a scientific point they are not less equipped with disciplinary knowledge the use of which makes them professionals. As real-world cases usually call for several disciplinary competencies, interdisciplinary cooperation between professional experts is required for this type of research.

One of the best analyses of the design of case studies in sociology (inspired, by the way, by the Harvard methodology) confirms this grounding of research in expertise. "Common to all experts is that they operate in their fields of expertise on the basis of an intimate understanding of many thousands of concrete cases. Context-dependent knowledge and experience constitute the core of expert praxis. . . . Only through experience in dealing with cases can one develop from a beginner to an expert" (Flyvbjerg 2006, p. 222). Based on Aristotle, Flyvbjerg has developed a conceptual frame that relates three categories of doing research—the epistemic approach to universal knowledge, the technical approach to functional know-how, and the social approach to phronetic judgment or practical reasoning. As is demonstrated in several case study reports, the successful solution of complex societal problems presupposes the operative use of the three sources (Flyvbjerg et al. 2012).

4.5 Individual Case and Epistemic Knowledge

The idiographic aspects of interdisciplinary research have now been sufficiently explored. It was important to begin with these, as they are quite removed from standard philosophy of science and from learning theories of higher education. However, to end with the case method would mean to declare theory based epistemic knowledge a needless encumbrance. The important point was that sensitivity to cases cannot be derived from theory. This does not imply that theory cannot contribute to understanding cases, nor that cases cannot advance theory. The statement that contingency in interdisciplinary research cannot be eliminated gains its epistemological value only because important resources of knowledge can be tapped into, whose validity and applicability are accepted, even if they do not suffice to grasp all details of a specific case.

4.5.1 Individual Cases and Unconditional Laws

The relationship between the specification of causal knowledge toward individual cases and the generalization of on-site findings appears at first sight to be that between a deductive strategy of applying substantiated knowledge and an inductive strategy of developing hypotheses for new knowledge. But this distinction does not allow the methodological challenge of interdisciplinary research to come to light. The challenge is to balance the tension between understanding a case in its real-life context and contributing to a stock of theoretical knowledge. This section relates this tension to current discussions in philosophy of science.

In her influential book *How the Laws of Physics Lie* (1984), Nancy Cartwright presented the thesis that the fundamental laws of physics hold true only for highly idealized theoretical objects that do not exist in the real world. Strictly interpreted, these laws are false when taken as empirical descriptions of reality. The well-known example is that of Galileo's Law of Falling Bodies. Its real-world validity is modified by friction, wind force, raindrops, and the shape of the body. Cartwright loves to illustrate the problem by an example already used by the Vienna Circle philosopher Otto Neurath (Cartwright 1999, p. 27): the calculation of the trajectory of a bill dropped from St. Stephan's dome in Vienna. Even the joint forces of mechanics, fluid dynamics, and computer simulation methods would not come close to a correct prediction.

From a pragmatic point of view, Cartwright's objection seems to be of no effect. In the laboratory objects are stylized to better fit theory, and theorists acknowledge practical limitations to the absolutely perfect realization of causal assumptions. Within these limits, knowledge can be put to work. From a philosophical perspective, however, her thesis continues to provoke unrest. If under close scrutiny universal laws have no empirical content, then the project of interpreting reality through reductionism remains ungrounded. At best, it can be played through for simple cases from which one cannot extrapolate, what Cartwright called "the dappled world" (1999). This world can be scientifically captured only by a broad variety of laws with limited range and with no consistent logical order. In describing this world we can better speak of capacities, tendencies, and potentialities than of rigid

laws. Recently Cartwright and Hardie have applied her philosophy to the risks of transferring policy projects. "It is a long road from 'it works somewhere' to . . . 'it will work here' " (Cartwright & Hardie 2012, p. 6).

Cartwright's strong statement regarding the presence, if not predominance, of the idiographic in the scientific description of the world is highly controversial (see Earman et al. 2002). It has challenged the privileged position of the concept of natural law as the standard and compass for scientific theorizing. Moving beyond Cartwright's proposal, Giere (1999) suggested that the concept of law should be completely struck from the language of philosophy of science. He is of the opinion that we cannot rid ourselves of the theological origin of the concept. Only God as the external legislator of the world would be in the position to command by general rules completely obedient natural things. Since the Kantian project of anchoring fundamental laws in the structure of reason failed, for Giere no further candidate remains that could guarantee the universality and necessity of the laws of nature. In Giere's reconstruction, lawful regularities become systems of equations that pertain, not to reality, but rather to imaginary models created for their verification—an idea for which Cartwright coined the term "nomological machine." Real-world constellations cannot be grasped precisely.

Whether, despite these objections, it will remain meaningful to speak of general and unconditional laws of nature can be left an open question here. It suffices to ascertain that the classical notion of a law's universal validity no longer fully captures the "cases" that fall within the law's domain. The take-home message of this philosophical discussion concerning the relationship between the nomothetic and idiographic in science is that the tension between universal validity and exemplary cases is already contained within the unconditional laws of physics.

4.5.2 Individual Cases and Conditional Laws

Some laws of physics still possess the elevated status of being general. Laws typical for sciences as biology, psychology, and economics are burdened from the beginning with the acknowledgment that their predictions and causal explanations are valid only under specific conditions or to a certain degree. The two central problems of such laws are that (1) the respective specific conditions cannot be listed completely and definitively and (2) exceptions to the rule can always be included in the collection of excluded conditions. The difference with regard to the laws discussed in the above section is this: General laws such as the mutual mass attractions, the conservation of energy, and entropy are considered unavoidably and eternally valid, even if the calculation of concrete cases is difficult or impossible. For conditional laws such as Mendel's laws of heredity genetics, the law of diminishing return in economics, or the Gestalt laws in psychology, the lawful connections are defined for objects whose uniformity, continuity of existence in time, and independence from their environment are not guaranteed.

Following in the footsteps of the evolutionary biologist Stephen Jay Gould, Sandra Mitchell asserted the following for biological regularities: "If we rewound the history of life and 'played the tape again', the species, body plans, and phenotypes that would evolve could be entirely different. The intuition is that small changes in initial 'chance' conditions can have dramatic consequences downstream. . . . Biological contingency denotes the historical

chanciness of evolved systems, the 'frozen accidents' that populate our planet, the lack of necessity about it all" (Mitchell 2002, p. 332). Conditional laws can be investigated only in tandem with the historical development of the objects and their contingent context. In this manner, the idiographic is officially granted entrance into the grasp of the law-like generalization under consideration. The conjecture of a conditional empirical law usually emerges with the reservation that intervening contingencies are to remain irrelevant (the ceteris paribus clause). If and when they do become relevant, the question must be confronted whether they dissolve the assumed law or alter the set of conditions. An exhaustive philosophical discussion of the ceteris paribus topic and its implications on the idea of law-like knowledge can be found in Reutlinger et al. (2014).

It is possible to reinterpret the epistemological problem of the validity of contingent laws as an answer to the question of how the tense relationship between the nomothetic and the ideographic can be combined. Within the realm of biological research, it is as productive to search for conditional laws as it is to identify configurations of restricted validity. It is as interesting to reduce contingency through ceteris paribus clauses—expanding the effective domain of a law, as it is to increase contingency—thereby pursuing the relevance of configurations not yet understood. Mitchell writes:

> In systems that depend on specific configurations of events and properties, . . . which include the interaction of multiple, weak causes rather than the domination of a single, determining force, what laws we can garner will have to have accompanying them much more information if we are to use that knowledge in new contexts. Thus the central problem of laws . . . is shifted . . . to how do we detect and describe the causal structure of complex, highly contingent, interactive systems and how do we export that knowledge to other similar systems. (Mitchell 2002, p. 335)

It is in this manner that the analysis of the concept of law within these specific sciences approximates learning from case studies.

4.5.3 Individual Cases and Ideal Type

The diverse efforts within the social and historical sciences to formulate diachronic and synchronic generalizations have never led to results that are in any way comparable with the status of the conditional causal laws in the natural sciences. The only exception is in modern economics, which since its origins in the eighteenth century has attempted to formulate qualitative laws (like, for example, Marx's law of falling profits) and quantitative laws of market behavior (starting with Leon Walras). All such attempts remain controversial within the economic sciences and even more as applied to political economy. In the other social sciences (such as historical sciences, cultural anthropology, sociology) a more skeptical view prevailed. Despite this, generalizations of some sort are still being considered.

For example, the concept of "ideal type" developed by Max Weber has gained widespread recognition. Weber formulated this concept in the context of the ongoing discussion of Windelband's and Rickert's ideas (Oakes 1987). His goal was to justify that social sciences can as well search for objectively valid and controllable propositions as attempt to understand highly specific and complex constellations in which elements of culture, politics, religion, and economics merge. In Weber's words, an ideal type

> is a conceptual construct which is neither historical reality nor even the "true" reality. It is even less fitted to serve as a schema under which a real situation or action is to be subsumed as one *instance.* It has the significance of a purely ideal *limiting* concept with which the real situation or action is *compared* and surveyed for the explication of certain of its significant components. . . . In this function especially, the ideal-type is an attempt to analyze historically unique configurations or their individual components by means of categorical concepts. (Weber 1949, p. 93)

4.6 Conclusion

The preceding analyses of the relationships between law-like universality and concrete case support the conclusion that this rapport may indeed be fraught with tension, but that it thereby in various ways contributes to the scientifically rooted description and construction of reality.

The goal here has been to integrate nomothetic potential and idiographic description into a model that correlates a causal explanation of reality (nomothetics) with the situational, local specifics of a case (idiography) as far as possible. In closing, this point can be briefly illustrated using the example with which this chapter began. Modern research into the effects of climate change has taken the form of a giant worldwide project. It forces the participating researchers to comprehend the singular, extraordinarily improbable case of Earth's climate in its specific state and its developmental dynamic. This is an extremely idiographic situation. Enormous constraints arise from being tied into a heterogenic configuration of political and scientific actors—the Inter-governmental Panel on Climate Change, whose ultimate goal is not cognition, but rather the science-based coping with climate change.

The background for this effort is the consensus that a certain state of climate constitutes a principle value for life on Earth. From this idiographic value component (in Rickert's sense), it follows that research into the effects of climate change does not only deliver analysis and prognosis, but also participates in articulating local and global strategies for controlling and adapting to climate change. The interdisciplinary goal is fitting the singular case of Earth's climatic dynamics into the most widely accepted simulation model. The unique dynamics of the individual case has been translated into the unique dynamics of the model (compare Lenhard et al. 2007). The research is integrated into social transformation while it is being carried out, even though its conclusive end results are still out of sight. This merger of research and innovation seems to become a decisive characteristic of the so-called knowledge society. Interdisciplinary projects play a leading role in it.

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