CHAPTER 3

Interdisciplinary cases and disciplinary knowledge

WOLFGANG KROHN

This chapter provides an epistemological analysis of interdisciplinary knowledge and research. It points at the peculiarities of interdisciplinary and determines its place in the context of modern social epistemology. Interdisciplinary research can be subdivided into three kinds. At the center of the following analysis there is interdisciplinary problem solving, or better said, interdisciplinary case work. Of no less relevance, but of less epistemological concern, there is interdisciplinary communication as it is cultivated by many research centers. And finally there are a few cases of interdisciplinary fusion creating new disciplines. Among the suggested—but contested—examples are biochemistry, cognitive science, climate research, and public health.

In the following analysis interdisciplinary fusion is excluded as a mode of discipline formation. Even if the relevance of fusion may be underrated compared with disciplinary branching, newly fused disciplines leave observers where they started. Interdisciplinary communication will also be put aside. It can be described as the ‘irritation’ of disciplinary work. It provides scholars with fresh ideas and triggers them to redirect their research. If organized around themes and topics by the agendas of interdisciplinary research centers (e.g. Princeton, Berlin, Budapest) or foundations (e.g. Gordon Conferences), the effect may well go beyond the individual researcher. Most importantly—and opposite to the fusion zones—the themes can have this stimulating function even if they are extremely disparate. However, the function is to push the disciplines, not interdisciplinary.

Interdisciplinary case work remains the most important kind. The intuitive conviction supporting this view is that most problems when they first appear are too complex for just one or two disciplines. The problem-solving power of disciplines is strong only with respect to theoretically simplified versions of problems. If complexity is added interdisciplinary is needed. The most complex problems are so-called 'real-world problems'. The simplest way of organizing interdisciplinary research on complex problems is the multidisciplinary approach. It resembles the 'organic division' of labor in industrial production. Every component of a research problem calls for a different science. The integration of
results may cause some trouble and require several attempts, but need not lead to exceptional difficulties. The efficiency of multidisciplinarity can best be observed in industrial research. Champions of ‘true’ interdisciplinarity tend to belittle multidisciplinary work, perhaps underestimating the quasi-industrial potential of modern knowledge work and romanticizing lost ideals of intellectual craftsmanship.

If, however, the organic division of intellectual cooperation presupposes common efforts to understand and define a problem, research requires interaction between disciplines. Each participant researcher observes the others and makes or her decisions dependent on theirs. This is time-consuming, and without clear criteria for success. Investments without returns are frequent. Whatever drives people into highly complex interdisciplinary projects—curiosity, social responsibility, or money—the need for manageable objects and presentable results in their reference community drives them out again. If, however, public and political concerns are strong enough to exert a more permanent pressure, the difficult process of discovering and shaping the components of a complex problem can continue and generate a complex field of interactive interdisciplinary research. The problem, thereby, turns into a case.

The main propositions of this chapter are:

- Interdisciplinary research constitutes a relationship between individual cases and more general knowledge bases which is atypical for disciplinary research.
- This relationship demands a new mode of knowledge, in which learning about a case is equally as important as understanding causal structures. It calls for a combination between 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 deals with cases which seemingly 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 will be seen 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, whether these are 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 conceptual approach is its independence from unsatisfactory attempts to define institutionally or cognitively what a discipline is. In consequence, research fields which 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 ‘hodgepodge’ caused and shaped by real-world problems (Campbell 1969). Later in this chapter I suggest that we expand the concept of real-world cases toward a softer definition focusing on complexity and contingency. However, to start with real-world cases helps us to better understand certain features of interdisciplinarity. The main interest is not to provide managerial and methodological solutions for cooperation between disciplines but to exploit the fruitful tension between understanding a case and searching for general knowledge. The main proposition here will be 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 types of skills and competencies that scholars are not used to.

3.1 Idiographic and nomothetic knowledge

What are ‘real-world’ cases? The concept is meaningful only if contrasted with some ‘ideal’ state of something. Every scientific experiment makes things simpler than they are and theory imagines the world yet simpler. Historically, the paradigm is 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. Real things, which we can point at, are only approximations of ideal objects. The science is still called ‘earth-measuring’ (geo-metry), though there is not a single place on earth that fits its definitions of objects. Sciences which do care for real-world measurement, such as surveying, alignment, and mapping, have developed methods able to determine an area of any shape. 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 is a very important issue in the analysis of real-world objects or systems. Geometry and surveying have fruitfully interacted in history. Surveying is oriented to the real world and therefore is in itself an interdisciplinary. 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 for grasping 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 focuses on the peculiarities of given cases, while disciplinary research is characterized by substituting ideal features for given ones. Basically, many modern research fields relate to both foci and, therefore, have a tendency to become 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, and research sites—is of no concern here.

We can call the specific features of a problem, a system, or a case its 'idiographic component.' The more general features gained by taking problems, systems, or cases as exemplifying or inducing a more abstract or idealized object of knowledge its are called the 'nomothetic component.' This terminology was introduced by the neo-Kantian philosopher Wilhelm Windelband. Idiographic literally means describing the peculiar, singular, and specific. Nomothetic literally means setting the (scientific) law. The law-like quality of scientific knowledge is associated with certain features of knowledge such as the reproducibility of experimental facts, prognosis of events, the general validity of propositions, and causal explanations of relations. The definition and relation of these epistemic features are controversial. But undoubtedly they contribute to strengthening the difference between something one happens to know and theoretically corroborated knowledge. Windelband thought the idiographic structure of knowledge was best exemplified in historiography. A historian who specializes in the founding of the United States of America does not usually wish to become a specialist on foundings in general, but builds his or her reputation on knowing everything about just this case and giving it an original and surprising interpretation. If he or she cared to analyze another founding—say of the Roman Empire, Brazil, or the European Union—neither factual knowledge nor interpretation schemas can be transferred from one to the other.

When Windelband introduced this terminology he was not only a famous philosopher but also rector of Strasbourg 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 counter attack aimed at the assumed weak point that the 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 rectorial lecture in 1894 Windelband suggested equal rights for both forms of knowledge. Knowledge production is guided either by an interest in identifying 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

1 The likewise usual wording "idiographic" does not refer to the Greek idios = peculiar, but to idea = poem, Gestalt, which is no less appropriate.

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 an 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 assumes their relevance with respect to cultural heritage, identity, and value. Admittedly, one can never know in advance whether or not a single case will turn out to be culturally relevant. But if it is considered to have no potential value at all, research would not be started. Or put in more constructive language, a scholarly effort to study a case automatically attaches some sort of value to it. Windelband's neo-Kantian disciple Rickert gave 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 had become exposed to dramatic industrial changes. Today we would add to historians' conversational 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 not only expected to solve single problems but 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 idiographic 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 case 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.

3.2 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 case studies. 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). 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 which are controversial within the legal profession, those which were wrongly decided or were revised. Garvin cites another member of the faculty: '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 'situational case studies program' 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 2008). The program emphasizes cases not as legal cases but as true-to-life social configurations, for which it has yet to be decided whether or not they should be treated within the justice system. The aim is to thereby improve the students' 'lawyerly skills'. Far from introducing individual cases in Kuhn's sense as paradigm, these are examined as unscultped and uninterpreted as possible. This methodology is thus quite suited to an academic policy which places value on the grasping of complex configurations, on the identification of possible action, and on the assessment of consequences.

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). 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 case studies, the program offers courses in 'analytical tools'. The following list of academic goals is presented in Garvin (2003, p. 62):

- 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 others.

From a critical perspective, the tendency to make a quick decision should be noted. 'The case method does little to cultivate caution... Students can become trigger-happy' (Garvin 2003, p. 62).

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. Garvin quotes Tosteson, the program's founder, as saying that 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' (Garvin 2003, p. 63). The program prompts students to identify and correct their knowledge deficits. Garvin quotes Lowenstein as saying that the program's overriding goal is to 'foster a true spirit of inquiry', and quotes Moore as stating, 'I want my students to be able to identify a gap in their knowledge, feel guilty about not filling it, and have the nimbleness to learn what they need' (Garvin 2003, p. 64). Tosteson, as quoted by Garvin, adds, 'They discover that choosing what to learn is the hard part; learning it is a lot easier' (Garvin 2003, p. 64).

Further examples of curricula which have adopted the case-study method entirely or partially include engineering, sociology, psychology, education, architecture, and economics. What constitutes the success if not the superiority of the case-study method in higher education? The most notable criterion for the choice of the cases is the 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 one learns something different 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. The pressure on making a decision blocks the option of completely assembling all the relevant knowledge.
At variance with a 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 as well as differences between cases.

Case-study methodology obviously distances itself from both inductive and deductive learning strategies, which is why it has been closely analyzed here. 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?

3.3 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 real 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 precisely not the reality that the professional expert confronts.

The case-study 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. These not wholly explicable components come into play not only for professional know-how, but also in many fields of teaching and learning, like the acquisition of crafts and trades, doing sports, or mastering a musical instrument. More generally, all techniques which require the coordination of physical training with the comprehension of rules are based on skills. Here the study of introductory books and instruction manuals helps a little. The observation of the masters helps a bit more. However, is the continual exercise of physical practices until these become routine is decisive. 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 are attempts in sport and music sciences to construe such levels, what ultimately counts are skills in action.

The Harvard method and teaching methods practiced in the fields mentioned have in common that they build on the accumulation of analogies between related configurations,
have to be overcome. In this sense the idea of an interdisciplinary approach to problem solving, which can be seen as the core of the interdisciplinary perspective, does not differ significantly from traditional disciplinary approaches. The difference lies in the way in which the knowledge is integrated across disciplines. The interdisciplinary approach emphasizes the need for integration at a higher level of abstraction than the traditional disciplinary approach, and it places greater emphasis on the ability of the interdisciplinary team to generate new knowledge and to develop new problem-solving strategies. This is in contrast to the traditional disciplinary approach, which tends to emphasize the development of new knowledge within a single discipline. Therefore, the interdisciplinary approach is more likely to lead to the development of new solutions to complex problems, which can be more effective than solutions based on traditional disciplinary approaches.
within a certain field of knowledge. Since some interdisciplinary competency is required for this type of research, this expert would work in a team with other experts so that the professional know-how would consist in the coordination of an overall cognitive understanding of the situation distributed among diverse experts.

One of the best analyses of the design of case studies in sociology (also 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).

3.4 Individual cases and epistemic knowledge

The idiographic aspects of interdisciplinary research have now been sufficiently explored. It was important to begin with these, since they are quite removed from standard philosophy of science and from learning theories of higher education. However, to end with the case-study 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, the validity and applicability of which are accepted, even if they do not suffice to grasp all the details of a specific case.

The question to be raised is how the two paths of nomothetic and ideographic research can be commonly pursued, when they are, as Windelband argued, separated by diverse explanatory ideals. Windelband showed that nomothetic and ideographic knowledge can function as alternate resources for one another. In describing an individual case, one must unavoidably reach back to some sort of general knowledge. This can even consist in prescientific everyday convictions. Among his examples are psychological background assumptions concerning the behavior of historical figures. The reverse perspective is that every nomothetic statement—as abstract as it may be—must be exemplified in a context which unavoidably plays into everyday reality, despite the idealization of the objects referred to. Windelband gives the example of an explosion. On the one hand, an explosion follows the laws of chemistry, which allow for an explanation of the process; on the other hand, it happens in the here and now under singular circumstances, whose tiniest details might possibly interest a criminal detective. The core idea derived from Windelband is that interdisciplinary research projects are usually set up in such a manner that both ideals are pursued concurrently: the goal of dissolving a concrete case down to its smallest detail, and the goal of extracting generalized causal knowledge from this case.

The interconnection between law-like causality and the singularity of a case can be illustrated using the example of an interdisciplinary research project dealing with the rehabilitation of an atrophied lake in Switzerland (Sempacher Lake, Gross et al. 2005, p. 135 ff.). The starting point was the scientifically ascertained causal knowledge that the reduction of phosphate content, either by directly decreasing the input or increasing the output of phosphate, would reduce algal growth. On the basis of this knowledge a theoretical model was developed and an aerating technology implemented which already operated successfully in a nearby lake. Surprisingly, the expected effect of decreasing phosphate content failed to appear. Careful study of the sediment layers and the highly complex seasonal dynamics at the boundary led to a quite different view of the relationship between aeration and phosphate concentration. The findings did not completely invalidate the underlying model but suggested protecting it through additional assumptions (so-called 'ceteris paribus' clauses). If the findings can explain the failure of the theoretical prognosis for an individual case this unearths less turbulence than debunking the theoretical model. In conjunction with the steadfast core of causal knowledge they describe the individual situation all the better. In the case of this project it became clear that without measures to reduce the feed charge of phosphates the project would fail. Since the intensive agribusiness of the region made stakeholders averse to general constrictions, fine-tuned analysis led to the establishment of differential ecobalances. The case shows how an explanatory model of the lake satisfactorily capturing its manifold causal interactions was achieved step by step over a period of 20 years.

Obviously, the procedure of this rehabilitation project is opposed to the radical version of the case-study method. Interdisciplinary cooperation rests upon bringing together reliable knowledge from independent disciplines into case-specific modeling. The current status of scientific knowledge as organized within disciplines presents an enormous potential for interdisciplinary work and especially for modeling a specific case. Working with the model will probably lead to surprises. It is precisely because the individual case counts as such that its investigation leads to surprises, which cannot be ignored. Only after incorporating these will the model become sufficiently fine-tuned in terms of an idiographic understanding of the lake. In turn, surprises induce causal analysis and can expand our knowledge about atrophied alpine lakes. In the case of the rehabilitation of Sempacher Lake, the specific knowledge gained from sediment core analysis can be applied to geologically similar lakes exposed to high phosphate input.

3.5 The relevance of concreteness and the questionable concept of law

3.5.1 Individual case 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 don't 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, rain drops, 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. Stephen's dome in Vienna. Even the joint forces of mechanics, fluid dynamics, and computer simulation methods wouldn’t come close to a correct prediction.

From a pragmatic point of view, Cartwright's objection is 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 (1999) called 'the dappled world'. 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 rather than rigid laws.

Cartwright's strong statement regarding the presence, if not the predominance, of the idiographic in the scientific description of the world is highly controversial (Earman et al. 2002). It has at least shattered 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 'onomatological 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.

### 3.5.2 Individual case and conditional laws

Some laws of physics still possess the elevated status of being general. Laws typical for sciences such as biology, psychology, and economics are burdened from the beginning with the acknowledgement 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:

1. that the respective specific conditions cannot be listed completely and definitively,
2. that 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: although the mutual attraction of bodies and the conservation of energy and entropy are considered unavoidably and eternally valid, intervening factors arise in the calculation of concrete cases. These factors are not part of the models and are incompletely understood. For conditional laws such as Mendel's laws of heredity in 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.

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 idiographic 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—thereby 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.

3.5.3 Individual case 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, and sociology), the generalizations of empirical findings have not achieved the status of recognized laws. Despite this, generalizations are being considered. 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 Winelband's and Rickert's ideas. His goal was to justify that social sciences can also search for objectively valid and controllable propositions in attempting understanding 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 dealing concept with which the real situation or action is compared and surveyed or the explication of certain of its significant components... In this function especially, he ideal-type is an attempt to analyze historically unique configurations or their individual components by means of categorical concepts" (Weber 1922, p. 194).

1.6 Summary: epistemic qualities of interdisciplinary research

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

Our starting point was the observation that interdisciplinary projects are often tied to idiosyncratic phenomena and expectations. Whereas disciplinary research too often aims at diminishing incidental factors in order to achieve concise models and causal explanations, interdisciplinary research is forced to recognize and incorporate details. Generally, these resuress are imposed by the respective interdisciplinary programs. In some cases even the voices of local actors are influential. Even when the motivation for interdisciplinary research originates with inner-scientific concerns, it aims to master a higher degree of complexity than a disciplinary research agenda would allow.

I have tried to demonstrate that the study of cases is essential in the learning of capacities and skills. The most important claim here is that learned know-how encompasses the recognition of both similarities and differences between relevant cases. Based on the presented examples, this holds true for professional training in existing fields such as business/management, law, and medicine. Modifications result when this finding is transferred from professional training to scientific research. The safety-rails of curricular regulation fall by the wayside. Research works without corrective instruction from those who have already mastered the matter at hand. Nevertheless, an important attribute of interdisciplinary research can be extracted from the comparison with professional case-study training—namely that of professional expertise.

The next step was to investigate the role allotted to the individual case within philosophy of science. Surprisingly enough, the individual case is present everywhere, even though it has been traditionally overlooked or dismissed. The conflict between the all-encompassing and simultaneously exact grasp of an individual case and its inadequate description through general laws is demonstrable deeply down to the most fundamental laws of physics. The individual case becomes more and more relevant for the conditional laws of the specialized sciences and the ideal types of the social sciences until, in the end, a symmetrical balance between the investigation of universal cognitions and localized idiosyncrasies is achieved.

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 dynamics. This is an extremely idiographic situation. Enormous constraints arise from being tied into a heterogeneous configuration of political and scientific actors—the Intergovernmental Panel on Climate Change, whose ultimate goal is not cognition, but rather 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 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.

The example of research into the effects of climate change furthermore demonstrates the relevance of developing methods for integrating core disciplinary knowledge. The method of choice here is integration within simulation models. The interdisciplinary goal is fitting to the singular case of Earth's climatic dynamics into the most widely accepted simulation model. The process of model development mirrors the tension between the nomothetic (core disciplinary knowledge) and the idiographic (unique features of
our current climate). The optimization of the model’s fit resulted from integrating research results from rather heterogeneous disciplines and from an almost arbitrary model tweaking with the help of empirically non-interpretable factors. All this happens for the purpose of keeping the individual case in focus. Because of its complexity and contingency the currently accepted model could probably no longer be programmed by a single researcher. Its prognostic power can no longer be identified as stemming from certain disciplinary explanations. The unique dynamics of the individual case has been translated into the unique dynamics of the model (Lenhard et al. 2007).

The example of the giant project of research into the effects of climate change is used here because it explicitly brings together the case-study aspect and the disciplinary knowledge core aspect of interdisciplinary research. More than that, given its public status, it is of paradigmatic importance for the interfacing of societal innovation with scientific research. Interdisciplinary projects of all magnitudes exhibit a similar structure: Research results are expected to provide expert knowledge for case analysis and problem solving. The know-how of the researchers consists in establishing networks of individual cases, within which their similarities and differences are worked out. (This applies within climate research to comparative cases from geological history.) Their resources consist of core disciplinary knowledge. Their instruments are models, which fit together substantiated core knowledge from various disciplines and elaborate scenarios for structuring new cases.

References


