

Introduction

Narratives and Comparisons: Adversaries or Allies in Understanding Science?

Martin Carrier, Rebecca Mertens, Carsten Reinhardt

1. Practices of Comparing and Narrating in the Sciences and Humanities

In this volume, we aim to explore the ways in which comparing is related to other social and epistemic activities in knowledge generation processes in the sciences, humanities and the arts.¹ We particularly emphasize the relationship between comparing and narrating in epistemic practice. One of our central goals is to clarify the potential of narratives for drawing comparisons, that is, the way in which narratives can enable, support or hinder the practice of comparing. Furthermore, this volume seeks to locate narrating and comparing within the conceptual and methodological, material, and discursive practices that are involved in knowledge generation processes. The focus on practice also means for us to look more closely at the relations between those activities and processes which form the conditions for using both comparisons and narratives successfully in the production of knowledge. We do this

¹ The following chapters have been composed in the framework of the Collaborative Research Center SFB 1288 “Practices of Comparing. Changing and Ordering the World”, Bielefeld University, Germany: “Introduction,” “Historical Narrative versus Comparative Description? Genre and Knowledge in Alexander von Humboldt’s Personal Narrative,” “Narrating and comparing in the organization of research projects,” “Seeing, Comparing, Narrating, Making—of the Middle-Ages in the Early History of Art,” “Narrating Art History: Practices of Comparing in Exhibitions and Written Surveys with regard to documenta I.” The work has been funded by the German Research Foundation (DFG), subproject CO4: Vergleichshindernisse in den Naturwissenschaften und ihre Überwindung. Das Beispiel der Molekulargenetik. We thank Gina Maria Klein for her support in finalizing the manuscript.

by taking into account related activities, such as measuring and classifying, modeling, and establishing norms and categories, as well as the organization and popularization of knowledge. In particular, we discuss and hopefully contribute to dissolving the often assumed opposition between the role of narratives in scientific explanation, on the one hand, and in understanding, on the other. We propose that narrative practice is closely linked to, if not even part of, what many scientific explanations achieve. We thus pay close attention to the explanatory role and potential of narratives as used in the natural sciences and the humanities, among others in historiography, anthropology and paleontology, as well as physics, biology and chemistry. In line with Kaiser et al. (2014) and Glennan (2010),² we see a close connection between the use of narratives in unfolding historical events, on the one hand, and as explanatory tools in the sciences, on the other.

It does not come as a surprise that we emphasize comparing as a crucial part in practicing the sciences and humanities. Comparing is such a powerful tool in the production of knowledge that it even became part of the very names of disciplines: comparative anatomy, comparative law, and comparative literature studies. In historiography, comparing became one of the methodological cornerstones of modern social and cultural history.³ In general, and not related to just the sciences and the humanities, the importance and ubiquity of comparison in the establishment of social order and norms, as well as a means of grasping the unknown in (inter-)cultural encounters, has recently been emphasized by Angelika Epple and Walter Erhart. Drawing comparisons is understood here as an activity which is always situated within particular cultural practices, enforcing certain ways and ends of comparing and suppressing others, thereby strongly shaping social discourses and structures.⁴ One of the best known postulates about the constitutive role of certain

2 Kaiser, Marie, and Daniel Plenge, "Introduction: Points of Contact between Biology and History." In *Explanation in the Special Sciences. The Case of Biology and History*, edited by M.I. Kaiser, O.R. Scholz, D. Plenge, and A. Hüttemann. Amsterdam: Springer, 2013. See as well Glennan, Stuart, "Mechanisms, Causes, and the Layered Model of the World," *Philosophy and Phenomenological Research* 81(2), 2010: 362-381.

3 Welskopp, Thomas, "Comparative History," *European History Online (EGO)*, published by the Institute of European History (IEG), Mainz 2010-12-03. URL: <http://www.ieg-ego.eu/welskoppt-2010-en> URN: urn:nbn:de:0159-20100921414 [2019/06/24].

4 Epple, Angelika, and Walter Erhart, "Die Welt beobachten. Praktiken des Vergleichens." In *Die Welt beobachten. Praktiken des Vergleichens*, edited by A. Epple and W. Erhart, Frankfurt a.M.: Campus, 2015, 7f.

forms of comparison for modern culture has been introduced by Michel Foucault in *The Order of Things*, where he identifies difference making as one of the most important epistemic activities in the history of modern Western thought, while claiming that “difference making” partially replaces analogical thinking and similarity-driven strategies. In keeping with such approaches, we underline the epistemic significance of comparing. Drawing comparisons involves at least two *comparata* and a *tertium comparationis*, the latter defining the perspective of the comparison in question.⁵ Thus, over the last 50 years, comparing has been established as a well developed, and well connected, epistemic activity in the sciences and humanities, placed alongside and demarcated from other methodologies.

While science and cultural studies have by now carved out a widely recognized role for comparing in the sciences and humanities, the same cannot be said about narrating. Although recent studies emphasizing the crucial importance of metaphors and analogies in research⁶ can in parts be traced back to classics in the field, such as the work of Ludwik Fleck,⁷ the study of narration has entered science studies at a broader scale only very recently.⁸ Partially, this might be due to the preconceived notion that telling a story is, at best, part of communicating results, and certainly not crucial in producing them. This view is challenged at several levels in the contributions to this volume. Moreover, even well founded claims about establishing the central role of narratives

5 Epple, Angelika, “Ein praxeologischer Zugang zur Geschichte der Globalisierung/en.” In *Die Welt beobachten. Praktiken des Vergleichens*, edited by A. Epple and W. Erhart, Frankfurt a.M.: Campus, 2015, 163. See as well Sass, Hartmut von, “Vergleiche verstehen. Einleitende Vorwegnahmen.” In *Hermeneutik des Vergleichens. Strukturen, Anwendungen und Grenzen komparativer Verfahren*, edited by A. Mautz and H.v. Sass, Würzburg: Königshausen & Neumann, 2011, 27.

6 Mertens, Rebecca, *The Construction of Analogy-Based Research Programs. The Lock-and-Key Analogy in 20th Century Biochemistry*, Bielefeld: transcript Verlag, 2019. Frigg, Roman and Stephan Hartmann, “Models in Science,” *The Stanford Encyclopedia of Philosophy* (Summer 2018 Edition), edited by Edward N. Zalta, <https://plato.stanford.edu/cgi-bin/encyclopedia/archinfo.cgi?entry=models-science>. Morgan, Mary S., *The World in The Model. How Economists Work and Think*, Cambridge (UK): Cambridge University Press, 2012.

7 Fleck, Ludwik, *Genesis and Development of a Scientific Fact*, Chicago: University of Chicago Press, 1979.

8 Morgan, Mary S., and Norton Wise, “Narrative Science and Narrative Knowing. Introduction to Special Issue on Narrative Science,” *Studies in History and Philosophy of Science* 62, 2017: 1-5.

in research have been disputed. An example is Hayden White's *Metahistory*,⁹ which was criticized for its rather narrow methodological approach and the fact that it kept being restricted to a single field. The contributors to this volume both increase the number of methodological access points and widen the range of study fields. As a result, the role of narratives in a wide spectrum of scientific and humanistic fields is brought into view.

Arguably, the reasons for changing the status of narrating in the sciences and humanities for the better have emerged from two recent developments. The first has its origins in the field of science studies proper. Since the beginning of social studies of science, the influence of the social context in one way or another on scientific practice and content has been a defining feature, giving rise to new subfields, such as social epistemology. Among those, the claim that social, cultural and political validity are crucial sources of scientific authority has recently become a staple of studies in political epistemology.¹⁰ The key question that follows from this view for us is how do social acceptance, societal validity and epistemic authority act back on research practices, and in what circumstances do narratives play a role in this? Recently, Safia Azzouni and Stefan Böschen, in their introduction to a volume linking narration and scientific validity, have pointed to some general characteristics in this regard.¹¹ In their view, scientific and social actors create narrations, or scenarios, of how the features of the scientific problem at hand are related to each other. These scenarios often compete with or even exclude each other, and this adds to the difficulty for achieving scientific and societal consensus. The debates on climate change are a case in point where questions of evidence come to the fore: evidence by whom, for what aim, and to what outcome? Narratives play a central role in such debates, and justly have become a key entry point of science studies for analyzing various constellations of science in society.

9 White, Hayden, *Metahistory. The Historical Imagination in Nineteenth Century Europe*, Baltimore: Johns Hopkins Univ. Press, 1973.

10 Straßheim, Holger, "Politics and Policy Expertise." In *Handbook of Critical Policy Studies*, edited by F. Fisher et al., Cheltenham UK / Northampton MA: Edward Elgar, 2015, 319-340.

11 Azzouni, Safia, and Stefan Böschen, "Erzählung und Geltung. Ein problemorientierter Ausgangspunkt und viele Fragen." In *Erzählung und Geltung. Wissenschaft zwischen Auktorschaft und Autorität*, edited by S. Azzouni, S. Böschen, and C. Reinhardt, Weilerswist: Velbrück Wissenschaft, 2015, 9-31.

This fruitful development in science studies has been strengthened by a movement in narrative studies that has broadened the concept of narrative and at the same time has introduced additional fields of analysis. This is the second development that we wish to highlight here. More and more it has become accepted in literature studies to include non-fictional texts in studying narration. This has not been traditionally the case, though. In the last decade or so, however, the narrative border between non-fiction and fiction has been blurred by highlighting their structural similarities. While the range for studying narratives has been widened, so has the understanding of narrative. In this view, narratives are not just stories, and narrating is much more than mere story-telling even though it includes the latter. Here, narratives are understood as higher-order structures of how stories are related to each other. They constitute patterns of story-telling in both their temporal and structural dimensions. While single stories are based on a certain timeline or stage-setting, and establish individual links between the events told and the agents described, narratives in addition often implement general temporal and configurational patterns of what counts as a gripping timeline and a convincing plot. “Good beats Evil,” or “Success after severe obstacles have been overcome” are examples.¹² It is important to note that narratives contain both temporal and structural or configurational dimensions in constituting such higher order patterns of both timeline and stage-setting (see below sect. 4).

Thus, the study of narratives points to key features of reasoning in the sciences and humanities. Narratives contribute to the analysis of causality and contingency in offering patterns of how the entities in question are linked and in outlining what kinds of processes play a role in their evolution. It thus may very well be that narratives support epistemic practices of drawing comparisons in the sciences and the humanities. Narratives sometimes enable or facilitate comparisons and explanations.

2. Comparison and Narrative as Methodological Tools

In the following sections, we stress this productive role of narratives for drawing comparisons by addressing features of scientific practice. Drawing comparisons is an important methodological tool for producing order in conceptual respect and for coping with new and unaccustomed objects and phenom-

12 Azzouni and Böschen, “Erzählung und Geltung,” 17.

ena. What we do in creating order is assimilating what is unknown in part to what we are familiar with. Thus, we isolate and delimit the novel and unexpected elements. This is achieved by invoking relations of similarity so that hopefully merely a few elements are left that do not fit established categories. Accordingly, the method of drawing comparisons serves to anchor new items at familiar piers and helps us navigate through uncharted waters of bewilderment and surprise.

However, the handy tool of comparing does not always work well in generating transparency and clarity. Drawing comparisons is jeopardized by obstacles and barriers. Sometimes it is difficult to establish a common ground or a shared yardstick that could provide a standard of similarity against which differences could be compared. For instance, it is difficult to assess whether a sufficient amount of significant features is shared between the concepts of chemical element before and after the Chemical Revolution. Prior to the Revolution, chemical elements were thought to be abstract bearers of chemical properties such as combustibility or acidity. Their abstract nature was supposed to imply that elements are not material in themselves. Elements are no substances and cannot be isolated in chemical analysis for this reason. They rather explain properties of material substances. If they were material themselves, we would run into a circularity. After the Chemical Revolution, elements were conceived as end-points of chemical analysis and are thus definitely to be found in the laboratory. The explanatory and the operational concepts of chemical element are widely disparate and threatened by *non-commensurability*, i.e., the lack of significant shared properties.

In a different vein, Kuhnian *semantic incommensurability* is produced by a cross-classification of similarity classes. For instance, the early notion of virus broke the confines of the then-contemporary cluster of properties assigned to bacteria and toxins, respectively. Viruses are contagious and reproduced in organisms, which showed them to be of the same kind as bacteria, but they pass through filters that withhold bacteria. Therefore, viruses could not be cells and looked rather like toxins. As a result, applying the standard procedures for categorizing biological entities generated conflicting judgments. The newly discovered entities transcended existing conceptual boundaries and defied comparative analysis for this reason.

How can such obstacles to comparison be overcome? One of the options is to introduce intermediate stages that combine features from both ends of the conceptual spectrum or to invoke transitory steps that gradually lead from one end to the other. A bridge notion of chemical element introduced the idea

of active substances. Elements are recognized as material substances, to be sure, but they are considered capable of imposing their properties on other, more passive substances. Regarding viruses, early researchers conceived them as cellular fluids. They were supposed to be part of cells and thus reproduced within and together with cells, but they were thought to migrate among host cells and could move independently of them. Such intermediate conceptual states are often produced by appealing to analogies and metaphors. This volume thus aims to clarify the role narratives could play in the endeavor of establishing relations of similarity and making comparisons possible.

3. Narratives in the Temporal Sense and their Roles in Comparison and Explanation

As we said before, providing a narrative means outlining a plot and a stage setting. The primary understanding of story-telling is to produce a time series of events. Two disparate stages are connected by a temporal sequence of intermediate states, and narratives are patterns for how to trace such time evolution in the phenomena studied. In this vein, each of the relevant steps involves only a small-scale change, but adding up such steps may serve to connect seemingly contrasting states of affairs. Consequently, narratives may enable or facilitate comparisons. Likewise, narratives provide explanations in virtue of the ties that bind subsequent states together. Such states may be bound by causation or by biological evolution, and in virtue of such connections the common ground between apparently unrelated or incomparable stages is revealed.

For instance, sun-like stars, red giants, and white dwarfs look utterly dissimilar in their characteristics, but they are easily comparable once they are recognized as phases of stellar development. When sun-like stars have exhausted their hydrogen resources in the core, thermonuclear fusion moves outward to the shell surrounding the core. Their size is thereby greatly expanded while the surface temperature is reduced because in virtue of their vastness the radiation emitted is distributed over an enormous surface. When nuclear fuel is used up eventually, the star collapses into a tiny and dense stellar remnant of faint luminosity. This story gives a causal explanation of stellar evolution and shows that these apparently disparate phenomena can be compared by placing them on a causal and temporal scale.

Biological evolution is another stronghold of narratives. The Darwinian mechanism of inheritance with variation and the selection of organisms by environmental conditions means to account for the present state of affairs by invoking past constellations. Such historical explanations are sometimes contrasted with rational explanations in that seemingly less than optimal results are traced back to different, earlier conditions. Think of the Brazilian variant of the green sea turtle (*Chelonia mydas*) which reproduces only under environmental conditions that are different from their usual habitat. This variant migrates over a thousand miles to the mid-Atlantic Ascension Island for laying its eggs, although suitable conditions also exist much closer to their home turf. The assumption is that this seemingly bizarre behavior evolved at a time when the Atlantic Ocean was much smaller. The reproductive pattern was sensible at its inception but grew increasingly peculiar by continental drift.¹³ The evolutionary narrative restores biological sense to an apparently odd behavior. This is achieved by positing an initial state and then tracing intermediate steps to the present condition. The explanatory power of this story is based on bridging this initial state and the observed situation with a sequence of transitional states. In this way, earlier and later stages are made comparable.

A similar case can be made for conceptual development in the history of science. Oxygen, as conceived by Lavoisier, has barely anything in common with the modern notion. Oxygen in its present-day understanding does not underlie the nature of acidity, nor is it bound to the matter of heat that it gives off in forming a compound in combustion, which was both the case in Lavoisier's conceptual frame. But in tracking gradual conceptual changes in history, we can realize that earlier and later stages are connected. They are not connected by one thread running through all stages, but by a variety of shared features changing in each step. That is, historical sequences may be tied together by narratives that establish Wittgensteinian family resemblance among the stages.¹⁴

In sum, narratives may tell a causal story or an evolutionary history in virtue of which we are able to grasp the relationship between two seemingly distinct states of affairs. The two states become comparable in that a gradual transition leads from one to the other. In this vein, time sequences have been claimed to provide explanatory resources in fields traditionally considered to

13 Gould, Stephen Jay, *The Panda's Thumb*, New York: Norton, 1980, 30-33.

14 Chang, Hasok, "The Persistence of Epistemic Objects Through Scientific Change," *Erkenntnis* 75, 2011: 413-429.

be governed by universal and eternal laws of nature. In addition to realizing the importance of temporal developments in fields like astrophysics (e.g., stellar evolution), philosophers and historians of science have claimed that a marked methodological shift is underway. This shift involves the growing importance of computer simulations. The primary mode of explanation is said to be no longer to subsume phenomena under higher-order laws of nature. Rather, phenomena are understood by pursuing how more elementary objects build up or are grown into more complex ones. As Norton Wise claims, simulation techniques trace the development of an object through changing conditions and elucidate in this way the features of this object. Such techniques provide a story as to how this object has come about and explain its properties by following its development through a series of changes. As a result, there is no opposition between narrative and explanation. On the contrary, computer simulation widens the scope of explanation by bringing individual variation into its purview. Real snowflakes, in contrast to their idealized image, are non-symmetrical and variable, and these features can be accounted for by simulating the growth of snowflakes under a variety of conditions. Such diversity can be expounded best by tracing many individual trajectories under different initial and boundary conditions. This is what computer simulations accomplish, and this is why they usher in a new narrating mode of explanation.¹⁵

Turning to evolutionary biology, Wise's claim that variability can best be explained by narrative explanations is confirmed from a different angle by John Beatty. He argues that giving explanations by following historical lines is of chief importance in evolutionary biology and claims that an essential element of valuable narrative explanations is contingency. More specifically, narrative explanations are indispensable when we are faced with a branching-tree scenario in which alternative pathways open up at various junctures. The path picked at such "turning points" makes a difference for the future course. Put conversely, a particular outcome can only be explained by tracing the choices at the turning points and pursuing the actual pathway through the branching tree of non-actualized possibilities. As Beatty emphasizes, it

15 Wise, Norton, "Introduction: Dynamics all the Way Up." In *Growing Explanations. Historical Perspectives on Recent Science*, edited by N. Wise, Durham: Duke University Press, 2004, 1-20. Wise, Norton, "Science as (Historical) Narrative," *Erkenntnis* 75, 2011: 349-376.

is the existence of such turning points that makes narratives essential and a story worth being told.

Contingency is a critical factor of a persuasive narrative. We could develop a phenomenon governed by deterministic laws (such as the motion of planets) into a series of events (giving the positions of the planets at different times). But this would be entirely pointless. Valuable narratives need to contain contingency or turning points. Beatty distinguishes between contingency *per se*, such that an event was not bound to occur and could have come to be otherwise, and contingency upon previous events, in the sense that a subsequent event depends on earlier events for happening. The turning points of an interesting narrative need to be contingent in both senses. If a sequence of organismic states is to be accounted for by an interesting evolutionary narrative, two conditions need to be realized: First, later states of this sequence need to be contingent on earlier states such that the later states would not have evolved if the earlier states had been different. Second, early states need to be contingent *per se*. It might well have been the case that earlier stages of the organism might have gone extinct. This makes the survival of the earlier stage a turning point and transforms the whole episode into a worthwhile narrative.¹⁶

Staying with evolutionary explanation, one of the traditional complaints about such a narrating mode of explanation concerns the arbitrary nature of the historical steps assumed. In a celebrated contribution, Stephen J. Gould and Richard C. Lewontin have castigated the carelessness of biologists in thinking up evolutionary stories for accounting for an observed state. Countless unsupported hypotheses are produced for explaining why a given trait of an organism is useful for survival. For instance, it was reported that male bluebirds are more jealous before mating than after completed copulation. This was supported by registering the number and fierceness of attacks of bluebirds on dummy birds close to their nest. The explanation lies right at hand: when mating is accomplished the male bluebird can be sure that his genes are in the eggs. Jealousy would be futile; the optimum evolutionary strategy is to let the competitor exhaust his forces in vain. However, the result of the study could not be reproduced in a follow-up experiment. In this second experiment, jealousy was observed to be weak all the time and no changes

16 Beatty, John, "What are Narratives Good for?," *Studies in History and Philosophy of Biological and Biomedical Sciences* 58, 2016: 22-40.

were recorded. Biologists were quick to produce alternative hypotheses. Obviously, female bluebirds were available abundantly and the best strategy for a male bluebird was simply to leave an unfaithful female rather than running the risk of entering into a fight with a competitor. Gould and Lewontin are highly critical of such “pan-adaptationist” strategies which invent selective advantages copiously and arbitrarily and replace them without much ado in the rare event of counterevidence arising. “Just-so stories” fail to explain.¹⁷

Being mindful of arbitrariness and insisting on independent empirical support is certainly a recommendation worth being heeded. The initial and intermediate states introduced or appealed to an acceptable explanatory narrative should be confirmed by observational evidence. However, this important caveat should not be exaggerated either. Sometimes evolutionary explanations are of the “how possible” variety. That is, how is it conceivable that a certain complex organ developed by variation and selection and that a certain species grew out of a *prima-facie* quite distinct ancestor species? In such cases, evolutionary trajectories that are merely possible serve the purpose of dispelling the mystery. It is true, it would be better even in such cases if supporting evidence were offered. But even without such assistance, the main explanatory purpose is served by the evolutionary narrative, namely, showing that an evolutionary pathway is available in the first place that connects the two states in question.

This sketch of some of the key positions on offer is supposed to show that narratives in the temporal sense are able to establish comparability and explain features in the physical and biological world. Reconstructing how an outcome has been produced and how it has grown out of preceding states can illuminate key features of this outcome. The sequence of subsequent states exhibits how these states are related to each other and how the causal factors are involved in the production and variability of its features. In this vein, narrative accounts may yield explanations of the particulars of the phenomena at hand that are inaccessible to more abstract and universalist approaches,

17 Gould, Stephen J., and Richard C. Lewontin, “The Spandrels of San Marco and the Panglossian Paradigm. A Critique of the Adaptationist Programme.” In *Conceptual Issues in Evolutionary Biology. An Anthology*, edited by E. Sober, Cambridge MA: MIT Press, 1984, 252-270 [1978]. Recently, Kaiser and Plenge have challenged the explanatory value of “just-so-stories” in the context of historical narratives, building up on Gould’s and Lewontin’s canonical argument. See Kaiser, Marie, and Plenge, Daniel, “Introduction: Points of Contact between Biology and History.” In *Explanation in the Special Sciences: The Case of Biology and History*, 1-23, on p. 9.

and giving such explanations invokes and presupposes comparisons by introducing transitory stages that mediate between posited initial states and the observed outcome.

4. Narratives in the Coherentist Sense and their Roles in Comparison and Explanation

A non-temporal understanding of narratives has been developed in the past decades and has been found increasingly appealing more recently. In this approach, the chief role of narratives is to establish a colligation of phenomena or to create coherence. An early proponent of this view is Stephan Hartmann who studied the relationship between a formal theory or theory-based equations, on the one hand, and “stories” (in a non-temporal sense to be clarified), on the other. Hartmann’s account features the relationship between Quantum Chromodynamics (QCD), the theory of strong interaction that is effective in the atomic nucleus, and the properties of hadrons, i.e., particles made of three quarks. Since the formal equations are insufficient for reaching concrete explanations and predictions, models have been developed that take special initial and boundary conditions into account and achieve such explanations for restricted features of the particles under consideration. As Hartmann portrays the situation, two such models are in play that emphasize different features and neglect others. In order to justify these one-sided approaches, stories are told, respectively, why the selected features are important and the neglected ones are insignificant. Models thrive on the story told.

The models mostly provide causal mechanisms. These mechanisms are neither part of the theory nor deducible from it, but they are inspired by its formalism. The story complements the formalism and fits the model into a larger framework in a non-deductive way. In other words, a model is an interpreted formalism enriched by a story. For instance, one of the competing models, the so-called MIT-Bag Model, owes its popularity to the convincing story going along with it. The model concerned the failure to observe free quarks, and the attached narrative sketched a causal process by which a quark created an interaction-free space around it. This means that the quark was shielded from outside intervention and could not be exposed. Although reference to a causal mechanism contains an implicit time element, this was not

actually used in the narrative. By adding a causal account to the theory, the narrative provides an understanding of the physical processes in play.¹⁸

The non-temporal understanding of narrative explanations has chiefly been advanced by Mary S. Morgan. In her “configurational” account, a narrative explanation is characterized by its ability to order materials by temporal, spatial, theoretical or conceptual relations. Such an explanation is achieved by binding events together (colligation) or by contrasting them (juxtaposition). This means that sets of relevant elements are picked out and contrasted with less than relevant items. Morgan insists that this production of order is the crucial achievement of narratives, not the use of temporal relations for this purpose.

Narratives are distinguished from models by being concrete and particular. However, they use theoretical categories and conceptual elements for sorting concrete items and this is why they can be generalized to different cases. Narratives are thus generic by nature, and thanks to their conceptual structure they can be transferred to other fields. One of Morgan’s examples is a study on the “street corner society” in a Boston slum area, conducted by William Foote Whyte in 1943. The study introduced a variety of groups and examined their relations: for instance, ill-educated and impoverished young men in contrast to better educated and better-off young college men, their relations with racketeers in contrast to those with the police. Slums had been considered socially amorphous venues before, while in the light of the study they appeared as organized social bodies with a social hierarchy in place and a recognized system of social obligations.

The study employed group behavior, leadership, and community as concepts for colligating and juxtaposing behavior and thus for creating coherence. The use of such general concepts made it possible to transfer the discovered phenomena to other communities. The study effectively coined the generic term “slum society.” Such narrative explanations work by showing that events are related in a certain way so that they become significant and intelligible. Morgan compares such narrative explanations to mosaics, jigsaws or collages, in which the parts acquire their significance through their relation

18 Hartmann, Stephan, “Models and Stories in Hadron Physics.” In *Models as Mediators. Perspectives on Natural and Social Sciences*, edited by M.S. Morgan and M. Morrison, Cambridge: Cambridge University Press, 1999, 326-346.

to other elements. They lack a story line, but they resemble documentaries which also analyze and show how the elements involved hang together.¹⁹

Narratives in this configurational or coherentist sense are characterized by turning to the details and particulars. They may be invoked to provide causal mechanisms or to establish order by sorting items into categories. Time order does not play a significant role in either variant. Rather, explanations are supplied and order is created by attending to concrete events and phenomena by using general concepts. In this way, narratives are usually related to theories, but the claims they entail are independent of theories. Yet, thanks to drawing on theoretical categories, narratives are generalizable and thus pave the way toward giving explanations.

The relationship of such narratives to comparison leaps to the eye. Morgan's emphasis on creating clusters of similarity and dissimilarity obviously thrives on drawing comparisons. Hartmann's stress on causal stories involves comparisons between the envisaged mechanisms and their theoretical embedding. In both accounts drawing comparisons is a key activity in providing narrative explanations.

In sum, narratives in the temporal and the configurational sense establish relations among entities in question and thereby enable comparisons. Such comparisons are in their turn an important element in providing explanations. On the whole, narratives are of instrumental significance in many epistemic practices in the sciences.

5. Overview of the Volume

Part I of the volume centers on the general, conceptual dimensions of the interplay of narrating and comparing in the sciences. Norton Wise opens the volume with the chapter "Does Narrative Matter? Engendering Belief in Electromagnetic Theory." He takes up and develops further the configurational account of narratives. In agreement with Hartmann, Wise stresses that the familiar criteria for judging theories, such as empirical adequacy or mathematical consistency, are often not sufficient for singling out a particular account as superior. What is needed in addition for supplying credibility is a narrative.

19 Morgan, Mary S., "Narrative Ordering and Explanation," *Studies in History and Philosophy of Science* 62, 2017: 86-97.

Wise's examples are taken from the nineteenth-century electrodynamic theories of Maxwell and Weber. Both crafted an avowedly fictional framework which, in Maxwell's case, assigned a place to lines of force and, in Weber's case, to action at a distance. These frameworks established relations, if imaginary, among the various elements involved. Both were anchored in features existing in the real world, such as flow analogies in the case of Maxwell or operations in the case of Weber, and introduced fictional features into these familiar settings. In Maxwell, conceptual metaphors such as "lines of force" served to link up events in the everyday world to the fictional features.

Hybrid constructions of this sort constitute narratives in Wise's understanding. Following Sarah Johnston's account of Greek mythology, Wise uses her concept of a "story world" for denoting this combination of an existing and familiar setting with interspersed imaginary components. Fictitious entities are embedded in a realistic framework, and it is this connection to the real world that conveys plausibility to the fictitious parts. Accordingly, the distinctive feature of a narrative is to bring characteristics of different kinds together in one conceptual scheme. While narratives may use time-order to achieve such colligation, they need not. Rather, narratives serve to bind various aspects and details together and introduce contingency, possibility, probability, and alternatives. Narratives produce coherence by distinguishing such constellations from alternative ones. As a result, narratives emerge from drawing comparisons and they lead to comparisons.²⁰

In contrast to Wise, Christine Peters takes up the temporal view of narratives in her chapter "Historical Narrative versus Comparative Description? Genre and Knowledge in Alexander von Humboldt's *Personal Narrative*." As she argues, depending on how narratives are conceived they can support or undermine the explanatory role of narratives. The latter possibility emerges if narratives are viewed as autobiographical stories. A "historical narrative" conjoins subsequent states of experience of an observer. The link between different such states is produced by the chronological order in which they were registered. With regard to the activity of comparing this means that similar states or comparable processes may be separated by a time lag; they enter the mind under different circumstances. Narratives based in this way on personal history can impede significant comparison and fail to arrive at substantial explanation.

20 See Morgan and Wise, "Narrative Science and Narrative Knowing."

Humboldt prefers a different narrative style that does not follow the traveler's experiences but rather renders the relations among the phenomena observed. Such "comparative description" is achieved by emancipating oneself from the accidental features of sequences of impressions supplied by the senses and by focusing instead on the relations among different observations. For instance, when Alexander von Humboldt managed to compare the changes in wild plants upon moving northward with such changes when moving upward to higher altitudes, he abstracted from the contingent circumstances of the relevant observations. In order to draw such comparisons, Humboldt needed to connect what was not linked by an uninterrupted temporal flow of observations. Rather, in his comparative description of volcanoes, Humboldt highlighted geological relations and causal connections. Description emphasizes the sequence of natural events.

This outline shows that Peters draws on the temporal understanding of narratives and locates the explanatory power of such narratives in their invocation of objective relations among natural events. Uncovering causal chains is an appropriate basis for a narrative explanation. The relevant time sequence is shifted away from the observer and toward the phenomena (see section 3 above). Both historical narratives and comparative descriptions are based on drawing comparisons. But only the latter are able to establish relations of similarity that pertain to the course of nature, and thus only the latter are suited to giving explanations.

Hans-Jörg Rheinberger deals with the "Narrative Order of Experimentation." The tradition of letting the objects of study tell their own stories has accompanied the sciences from their inception. Rheinberger argues that the extended process of experimentation can indeed itself be regarded as a form of narration. Furthermore, he distinguishes three levels on which such narratives can be accounted for historiographically. One level is experimental systems. Such systems stimulate the production of histories of exploration or micro-histories. The narratives created at this level are case-studies. However, second, such micro-histories stand for some more general state of affairs and therefore need to be embedded. Moving on to the temporal meso-range of a century rather than a decade brings experimental cultures into view. In-vitro experimentation is an example of an experimental culture. Taking such cultures as the object of a narrative upholds the emphasis on practice but transcends particular experimental conditions and laboratories. Such cultures are more fine-grained than disciplines and exhibit a focus on practice. Specific narratives can be told by regarding experimental cultures

as the engine of innovation and by trying to generalize their impact to analogous cases.

A third level (in addition to experimental systems and experimental cultures) is represented by the macro-histories that can be unfolded by the transition to scientific concepts. For instance, around 1800, the concept of heredity changed its meaning profoundly in that emphasis was now placed on organisms as carriers of intergenerational property transmission. This understanding became encapsulated in later decades in the notion of the gene. This notion also underlies twentieth-century grand narratives such as the “geneticization of society.” All in all, experimental practices in the sciences are intertwined with activities of narrating, and the latter can shed light on what scientific scrutiny and scientific change is all about.

Part II of the volume deals with the social, economic and political conditions of research practice, particularly with the role of comparing and narrating in research organization and popularization.

Oliver Hochadel explores the relationship between comparing and narrating in research on Neanderthals at the interface of archeology, paleontology and paleofiction. In the course of the prominent archeological finds in the Shanidar cave in Northern Iraq in the early 1950s, the image of the Neanderthals was about to be transformed from “beast to brother”—an image so powerful to lastingly influence our view of prehistoric life until the present day. Hochadel retraces the narratives that led to the rehabilitation of the Neanderthals, depicting them as social individuals with human-like behavior. He analyzes the work of the former anthropologist Ralph Solecki who was among the first researchers and popular science writers, portraying the Neanderthals from the Shanidar cave as compassionate and almost human individuals. In his analysis of Solecki’s influential book “*Shanidar. The First Flower People*,”²¹ Hochadel shows that the depiction of the Neanderthal rituals resulted from Solecki’s “double field-work,” involving the interpretation of archeological findings, on the one hand, and the observation of Kurdish life in contemporary Northern Iraq, on the other. As a result, a continuum between “the deep past and the present” and a convincing narrative of the relationship between *Homo sapiens* and Neanderthals was established. In the following decades, prehistorians and novelists would depict the Neanderthals as emotional and even social individuals who deeply cared for their community. Especially Solecki’s depiction of the burial of one of the Shanidar Ne-

21 Solecki, Ralph S., *Shanidar, the First Flower People*, New York: Knopf, 1971.

anderthals under a “bed of flowers” became a key image in the new search for similarities between Neanderthal and human behavior and was picked up by Jean Auel in her prehistoric fiction series “Earth’s children,” first published in 1980.²² Hochadel shows that these narratives, which could flourish due to the close interaction between archeological research and science pop culture, naturalized the comparison between prehistoric and modern life.

Rebecca Mertens analyzes the role of narrating for successful comparisons in the context of research management at the California Institute of Technology (Caltech) in the 1940s and 1950s. She claims that comparisons drawn between different research areas and their objects in the biological and chemical sciences gained their validation and persuasive power from what she calls “project organization narratives.” Her case is the history of work pursued at Caltech’s Chemistry and Biology Divisions, led by Linus Pauling and George Beadle, respectively. The basis of their joint work was the assumption that structural or spatial complementarity at a molecular level was the key to unlock the secrets of life. The successful model for this assumption was the antibody-antigen theory, which had gained traction already in the interwar period. Its success led the way to a systematic approach guiding many scientific and medical sub-specialties of the 1940s and 1950s into an era of collaborative research. Thus, the origin of the molecular life sciences can be seen much more directly in the paradigm of structural complementarity than in the arguably better known ideas of sequence complementarity and information that grew to dominance with the influx of physicists and the discovery of DNA’s double helix structure. However, the role of structural complementarity kept being strong throughout this period, and was the base for the comparability of many different research agendas.

Support for the Caltech program in joint chemistry and biology of the molecular understanding of life came from the Rockefeller Foundation. Mertens’s claim is that the Foundation did not only provide financial support but also the crucial narrative. Their program officers and science journalists were key actors in authoring the mentioned project organization narratives. The key part of the Rockefeller narrative in the immediate Post-WW II period was the story of lost opportunities during the war, the exploitation of basic research (which was deemed a limited resource), and the crucial role of making up lost ground by a concerted effort featuring collaborative work. Moreover, the essence of such successful research was to build the basis for

22 Auel, Jean M., *The Clan of the Cave Bear*, New York: Crown, 2011 [1980].

later application in industry, medicine, and society in general. Scientific comparative practice in a collaborative mode was thus made possible in the frame of a narrative of basic research, highlighting both its former shortcomings and its future promises.

Part III focuses on the material aspects of narrating and comparing with a special emphasis on the reception and historiography of art. The thought that epistemic practice is constituted not only by interconnected human activities, but also by instruments and objects that themselves develop a certain kind of material agency has been well developed in the course of the sociology of experimentation and laboratory practice.²³ For the recent history and sociology of culture techniques in the arts and the sciences, the relationship between material and human agency is a crucial subject of analysis.²⁴

Joris Corin Heyder explores the relations between practices of seeing, comparing and narrating in early historical reconstructions of medieval art. The question of Heyder's analysis is how comparing images and aspects of images leads to the formation of what he calls a "narrative network," a "non-hierarchical interplay of actants and their narrative potential." With this approach, Heyder begins a new section in the present volume by introducing images into the interplay of comparisons and textual narratives. Starting from studying visual comparisons, Heyder includes paintings in the creation of narratives. He focuses on the role of medieval art in challenging the text-based view of the Middle Ages as a dark historical epoch. Heyder draws especially on the work of an eighteenth-century connoisseur and art critic Jean

23 See, for instance, Callon, Michel, and Bruno Latour, "Unscrewing the Big Leviathan: How Actors Macro-Structure Reality and How Sociologists Help them to do so." In *Advances in Social Theory and Methodology. Toward an Integration of Micro- and Macro Sociologies*, edited by K. Knorr-Cetina and A.V. Cicourel, Boston, London, Henley: Routledge & Kegan Paul 1981, 277-303. Latour, Bruno, *Science in Action. How to Follow Scientists and Engineers through Society*, Cambridge MA: Harvard University Press 1987. From a philosophical angle, Andrew Pickering has reflected on sociological concepts of human and material agency in: Pickering, Andrew, "The Mangle of Practice: Agency and Emergence in the Sociology of Science," *American Journal of Sociology* 99, 1993: 559-589. And likewise in his book: *The Mangle of Practice: Time, Agency, And Science*, Chicago: The University of Chicago Press, 1995. For the role of material agency in practice theory, see Schatzki, T., K. Knorr-Cetina, and E. Savigny, *The Practice Turn in Contemporary Theory*, London: Routledge, 2000.

24 See, for instance, Reckwitz, Andreas, "Toward a Theory of Social Practices: A Development in Culturalist Theorizing." *European Journal of Social Theory* 5(2), 200, 243-263. <https://doi.org/10.1177/13684310222225432> [2019/02/12].

Baptiste Séroux d'Agincourt. This enables Heyder to scrutinize the impact of re-producing and re-presenting medieval art in the context of the Enlightenment, which has been notorious for depicting the Middle Ages as a mere link between antiquity and the Renaissance. Thus, while Séroux d'Agincourt's textual account follows the established narrative of the degenerate Middle Ages, the paintings chosen, assembled, and described create a different narrative that grants medieval art an independent role and impact that it did not have in previous historical works.

In challenging long established paradigms, such as the incompatibility of narrative and the pictorial, and in invoking practice theory and Actor Network Theory, Heyder establishes the concept of a visual-narrative network. He does so by analyzing in a step-wise fashion the practices of seeing, comparing, and narrating. Alluding to the analysis of the nineteenth-century art historian Franz Wickhoff, Heyder brings to the fore a visual narrative that relies on the basic mental practices of complementing, continuing, and distinguishing. Comparative arrangements of images, such as Séroux d'Agincourt's *Histoire de l'art par les monumens*, afford the opportunity to introduce the cultural persona of the beholder who creates stories even out of single images and forges connections between series of images. These are often based on comparing and lead to new comparisons, for example, by bringing in new *tertia comparationis* or standards of comparison. Here, the pictorial domain is more fruitful than the textual, there are "almost endless possibilities of identifying *tertia*." Of course, in the subsequent descriptions these *tertia* lead to new (textual) narratives: In Heyder's view, analysis of images and story-telling are creatively linked through practices of comparing. However, he ends with a note of caution. Each single configuration chosen by Séroux d'Agincourt can set free its own narrative, no sign-posts for generalization and abstraction are possible. But with this caveat attached, comparative image analysis can both enrich and limit narratives.

Britta Hochkirchen explores the relationship between comparing and narrating in the history of modern art. She examines how practices of comparing in art exhibitions supported the narrative of modern art. Hochkirchen specifies practices of comparing and narrating in written texts and curatorial activities in the historiography of modern art in the 1950s, the latter of which is exemplified by the first *documenta* in Kassel in 1955. Key to her argument is the analysis of comparisons in Werner Haftmann's canonical volumes *Malerei im 20. Jahrhundert* as well as in the exhibition space and their respective role in the temporal order of the narration of modern art in post-war

Germany. As Hochkirchen shows, both text-based and curatorial comparative practices created a narrative of modern art as a unified European project, establishing a temporal link between German art after World War I and the art in other European countries before and during World War I. However, the way in which comparisons were used for narration and also the narratives themselves differed decisively at the linguistic and the curatorial level of practice, even though Haftmann himself was responsible for the historical basis of the first *documenta* exhibition. Hochkirchen explains the different narrative strategies by distinct rationales of temporal ordering and experiences: In Haftmann's written text, the narrative of modern European art was created by means of its *distinction* from the old mimetic style of mirroring reality, attributed to the period of the Renaissance, on the one hand, and from the contemporary art style of the Soviet Union, on the other. Thus, discontinuity played a crucial role in Haftmann's narrative of the development of modern art in Europe. However, the exhibition entirely focused on the *continuity* of the abstract mode of art works within the European context of modern art. The arrangement of the exhibition pieces (e.g., Picasso's *Girl before a Mirror* and Winter's *Komposition vor Blau und Gelb*) encouraged a comparative view emphasizing their similarity with respect to the "progress" of the abstract mode.

In this third part we go beyond the sciences and explore the role of narratives and comparisons in the humanities. Interestingly enough, both contributions discuss how comparisons may produce narratives. Thus, they invert the transition from narrating to comparing that has been expounded as the dominant mode in the sciences. In reconstructing the historical evolution of art, comparison is the means to producing narratives. Such narratives play the role of explanations in that they make sense of the similarities and differences exhibited. Whether this feature happens to come up only in these two contributions to this volume and is thus peculiar to these cases or whether it is generalizable to a wider realm remains an open question.

The volume has grown out of the workshop "Practices of Comparing and Narrating in the Sciences" within the collaborative research center Practices of Comparison (SFB 1288, Praktiken des Vergleichens). The workshop took place at Bielefeld University in April 2018 and was organized by Veronika Hofer. We thank Veronika for her continued effort.

