BEYOND MIMESIS AND CONVENTION

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BEYOND MIMESIS AND CONVENTION

Representation in Art and Science

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Preface

This volume has grown out of a conference that the editors organized at the London School of Economics and the Courtauld Institute of Art in June 2006. The aim of the conference was to bring together philosophers of science and historians of art to discuss representation. A topic of central importance to both the arts and the sciences, representation has generated similar conceptual problems in both fields, largely unbeknownst to the other community. Opening dialogue, we thought, would be productive and timely. In response to the call for papers, we received over eighty submissions, thirty of which were chosen for presentation by the program committee. As the present volume took shape, we sought to complement the conference's focus on visual art by soliciting further contributions. Thus, seven of the papers included here were presented in early form at the conference in 2006, while four have been added subsequently.

In organizing the conference and putting this book together, we have incurred many debts. We would like to thank Peter Ainsworth, Elisabeth Schellekens, Christine Stevenson, and Sabine Wieber for serving on the conference's program committee. The conference itself would not have been possible without the support of the Courtauld Institute of Art's Research Forum, and especially its former director, Pat Rubin; the Institute of Philosophy of the University of London; and the London School Economics. While we were still working on the program, Ingrid van Laarhoven of Springer encouraged us to submit a book proposal, and her continued enthusiasm for the project has been crucial. We have been lucky enough to be able to count on Lucy Fleet whose guiding hand and sustained support have helped keep the project on course. We would like to thank all of the speakers who made the 2006 conference such a memorable event and, especially, the contributors to this volume for their stimulating work. Each essay in the collection was read by two anonymous referees, whose input made an invaluable contribution. Finally, we would like to thank Andrew Goldfinch and Daphne Kouretas for their excellent assistance in organizing the event and preparing the manuscript.

Contents

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Dawna Schuld teaches Modern and Contemporary American Art in the Department of the History of Art at Indiana University. Trained as an artist, her focus remains the intersections between artistic practice and questions of perception and cognition. She received her PhD at the University of Chicago.

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Introduction

Roman Frigg and Matthew C. Hunter

Representation is a concern crucial to the sciences and the arts alike. Scientists devote substantial time to devising and exploring representations of all kinds. From photographs and computer-generated images to diagrams, charts, and graphs; from scale models to abstract theories, representations are ubiquitous in, and central to, science. Likewise, after spending much of the twentieth century in proverbial exile as abstraction and formalist aesthetics reigned supreme, representation has returned with a vengeance to contemporary visual art. Representational photography, video and ever-evolving forms of new media now figure prominently in the globalized art world, while this "return of the real" has re-energized problems of representation in the traditional media of painting and sculpture. If it ever really left, representation in the arts is certainly back.

Central as they are to science and art, these representational concerns have been perceived as different in kind and as objects of separate intellectual traditions. Scientific modeling and theorizing have been topics of heated debate in twentieth century philosophy of science in the analytic tradition, while representation of the real and ideal has never moved far from the core humanist concerns of historians of Western art. Yet, both of these traditions have recently arrived at a similar impasse. Thinking about representation has polarized into oppositions between mimesis and convention. Advocates of mimesis understand some notion of mimicry (or similarity, resemblance or imitation) as the core of representation: something represents something else if, and only if, the former mimics the latter in some relevant way. Such mimetic views stand in stark contrast to conventionalist accounts of representation, which see voluntary and arbitrary stipulation as the core of representation. Occasional exceptions only serve to prove the rule that mimesis and convention govern current thinking about representation in both analytic philosophy of science and studies of visual art.

This conjunction can hardly be dismissed as a matter of mere coincidence. In fact, researchers in philosophy of science and the history of art have increasingly found themselves trespassing into the domain of the other community, pilfering ideas and approaches to representation. Cognizant of the limitations of the accounts of representation available within the field, philosophers of science have begun to look outward toward the rich traditions of thinking about representation in the visual

and literary arts. Simultaneously, scholars in art history and affiliated fields like visual studies have come to see images generated in scientific contexts as not merely interesting illustrations derived from "high art", but as sophisticated visualization techniques that dynamically challenge our received conceptions of representation and aesthetics.

Beyond Mimesis and Convention: Representation in Art and Science is motivated by the conviction that we students of the sciences and arts are best served by confronting our mutual impasse and by recognizing the shared concerns that have necessitated our covert acts of kleptomania. Drawing leading contributors from the philosophy of science, the philosophy of literature, art history and visual studies, our volume takes its brief from our title. That is, these essays aim to put the evidence of science and of art to work in thinking about representation by offering third (or fourth, or fifth) ways beyond mimesis and convention. In so doing, our contributors explore a range of topics—fictionalism, exemplification, neuroaesthetics, approximate truth—that build upon and depart from ongoing conversations in philosophy of science and studies of visual art in ways that will be of interest to both interpretive communities. To put these contributions into context, the remainder of this introduction aims to survey how our communities have discretely arrived at a place wherein the perhaps surprising collaboration between philosophy of science and art history has become not only salubrious, but a matter of necessity.

Before doing so, one qualifying remark is in order. In recent decades, interactions between art and science have commanded substantial attention in the humanities and social sciences. This stimulating work has often employed representation to advance broader theses about the nature of art and science.[1] The aim of our introduction is not to provide an exhaustive survey of that ever-expanding literature or the range of social, political and other contacts it has elaborated.[2] Because the concerns of the essays gathered here are largely conceptual in their focus on representation, our aim is to indicate the major trends in understanding representation in both scientific and artistic domains, emphasizing salient cross-disciplinary connections between them.

From Science to Art

Modern philosophy of science has its roots in the empiricist philosophy that emerged at the end of the nineteenth century in the works of Ernst Mach, Henri Poincaré, and Pierre Duhem, and which found its culmination in the logical positivism of the Vienna Circle and the Berlin Group.[3] This tradition understood

[1] Influential examples of this approach include Fyfe and Law (1988); and Lynch and Woolgar (1990).

[2] For a capacious survey of recent humanities-based scholarship on art/science interactions in the twentieth century, see Henderson (2004). More broadly, see Galison and Jones (1998), and Latour and Weibel (2002).

[3] The history of this movement is discussed in Kraft (1953) and Stadler (2001).

scientific representation as linguistic: scientific theories are descriptions of their subject matter articulated in a concise formal language. More specifically, logical positivism advocated what is now commonly referred to as the "syntactic view of theories".[4] According to this view, the backbone of a scientific theory is a formal calculus, consisting of axioms and rules of inference. This calculus contains both logical and non-logical terms. The former are connectives such as "and" and "or", and quantifiers like "for all" and "there exists". These are provided by the formal apparatus and are taken for granted in the context of empirical science. The latter are terms that provide the empirical content of a theory. Newtonian mechanics, for instance, contains the terms "*a*" and "*F*", which are interpreted as standing for acceleration and force respectively. Since the logical terms are assumed to be unproblematic, the main issue facing this paradigm is to explain in what way terms like "*a*" and "*F*" come to stand for something. Considerable efforts have been made to answer this question, and various different proposals have been put forward. The detail of these, as well as their relative advantages and weaknesses, need not occupy us here. The important point is that the problem of scientific representation was conceived to be a special case of a more general problem: the relation of language to reality. Accordingly, understanding the semantics of scientific theory was considered by logical positivists to be a problem pertaining to the philosophy of language.

Scientific models, which are now seen as a central concern for questions of representation in science, had a rather fluctuating fate in the philosophical debate about science. In the logical positivist picture of science, models were regarded as otiose in a systematic exposition of a scientific theory. Rudolph Carnap famously remarked that "the discovery of a model has no more than an aesthetic or didactic or at best heuristic value, but it is not at all essential for a successful application of the physical theory" (1938, 210). Similarly, Carl G. Hempel held that "all reference to analogies or analogical models can be dispensed with in the systematic statement of scientific explanations" (1965, 440). Although some writers, in particular Richard Braithwaite (1953, Chapter 4) and Ernest Nagel (1961, Chapter 6) tried to canvass a more favourable picture of the use and function of models in science, in particular by emphasizing their heuristic function, the positivist take on the subject matter remained deflationary.

The tides changed in the 1960s, when the syntactic view of theories came under attack from various sides. The main tenor of these criticisms was that the syntactic view did not only get the details wrong; it in fact started off on the wrong foot. Indeed, the very idea of the syntactic view—that theories are linguistic entities providing a description of the theory's subject matter—was increasingly deemed untenable.[5] By 1970, the syntactic view had largely been surmounted by a new analysis of theories, the so-called "semantic view of theories". On this view, a scientific

[4] Canonical statements of the syntactic view are Carnap (1938, 1956), Braithwaite (1953), and Nagel (1961).

[5] For survey of these criticisms see Suppe (1977).

theory is a collection of models rather than sentences, where models are construed as non-linguistic entities. This move is important for two reasons. First, by construing theories as families of models, the semantic view assigned models a central role in the edifice of science, thereby paving the way for a substantive discussion of the roles and functions that models perform in science. Secondly, by emphasizing the non-linguistic character of models, the semantic view had come to pose the problem of understanding scientific representation in a completely different way. The problem was no longer a matter of understanding the language of science, but rather of cashing out how something non-linguistic can represent a part or aspect of the real world. The question had become: how does a model represent its target system?

Over the years, the semantic view has been developed in different ways. Details aside, these approaches can be divided into two classes according to their understanding of the ontology of models and the representational relation between model and target. Originating with Patrick Suppes and now held by most writers in the field, this first category takes models to be mathematical structures, which represent their target systems by being isomorphic to them.[6] According to this view, a mathematical structure *S* is a collection of objects that enter into certain relations. The structure required by this account is a *mathematical* structure insofar as nothing is assumed about either the nature of the objects it contains or about the nature of the relations between those objects. These objects are taken to be featureless dummies: all that we can say about them is that they are objects. Not assuming anything about the nature of a relation means simply that it is stipulated to hold between a certain number of things but without assuming anything about what the relation itself is. For instance, if we have three objects *a*, *b*, and *c*, a relation *R* is the set consisting of the ordered pairs ⟨a, b⟩ and ⟨b, c⟩. Thus, the relation *R* holds between *a* and *b*, and *b* and *c*, but not between, say, *a* and *c*. Whether this relation in itself is "being in love with" or "standing to the left of" is irrelevant as far as mathematics is concerned.

Structures thus understood are not in themselves "about" anything in the world. According to the semantic view, they acquire representational power if an isomorphism is established between such a structure and the part of the real world in which we are interested.[7] This involves identifying objects in the world and pairing them up with the objects in the structure so that two conditions are satisfied. First, the pairing has to be one-to-one, meaning that to each object in the given structure corresponds exactly one object in the world, and *vice versa*. Second, these pairings have to be such that their relations are preserved. In other words, if a relation *R* holds between certain objects *a*, *b*, *c*, ... in the structure, there must be a relation *R'* in the world which holds between (and only between) those objects in the world that have been paired up with *a*, *b*, *c*, ... The relations in the structure have to mirror

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[6] See Suppes (1960). Further proponents of this view include Suppe (1989), van Fraassen (1980), French and Ladyman (1999), Da Costa and French (1990), and with a different emphasis by Balzer et al. (1987).

[7] Some versions of the semantic view postulate other mappings such as embedding (Redhead 2001) or partial isomorphism (French and Ladyman 1999).

relations in the world. Thus, the structural isomorphism demanded by this version of the semantic view of theories is strongly mimetic in nature.

This first, formal iteration of the semantic view stands in contrast to the work of philosophers like Ronald Giere (1988) who take models to be abstract objects in a rather different sense. Instead of viewing them as structures in the abstract mathematical sense, Giere understands models to be idealized objects. For instance, in mechanics when we want to calculate the frequency of a pendulum bob, we do not make calculations on the real bob. Rather, we neglect air resistance, assume the bob is an ideal sphere, assume the spring has no friction, and so on. The object we thus construct—the object consisting of an ideally spherical bob and so on—is the model. According to Giere's view, this model represents its target by being similar to it in certain respects and to certain degrees. Like the isomorphism sought in the mathematical version of the semantic view, then, Giere's analysis of similarity envisions a mimetic conception of representation. Thus, both prominent versions of the semantic view of scientific theories presents us with an approach to representation that is squarely located within a time-honoured tradition of analyzing representation in terms of mimesis.

Yet, this conception of models and representation has not been universally accepted. Particularly, it has come under attack by writers who stand in a tradition of thinking about models and theories that is driven by a focus on scientific practice and whose method is based on case studies rather than rational reconstruction and formal analysis. In general, these writers have shared the semantic view's dismissal of the syntactic view and agreed that models have to occupy center stage in a tenable analysis of scientific theorizing. However, in a tradition that dates back to the 1960s, these philosophers have disagreed with the semantic view's analysis of models and, in particular, its claim to universality. Peter Achinstein (1968), for example, pointed out that there are many different kinds of models; while some models are irreducibly linguistic, no overarching theory can account for all of them. Focusing on examples like wooden models of cars tested in wind tunnels, Max Black (1960) demonstrated the importance of material models—models that are actually built and used in the laboratory. Mary Hesse (1963), meanwhile, emphasized the many different analogical relations models can hold to their target systems, showing that no one single relation accounts for the representational function of all models. The more recent work of Nancy Cartwright (1983), Margaret Morrison (1998), Mary Morgan (1997), and others in the "models-as-mediators" project (Morgan and Morrison 1999) have argued that both the relations between models and theories and between models and their target systems are far more complex than the semantic view has allowed. It is precisely because models are autonomous from theory and the world alike, according to this approach, that they can meaningfully function as mediators between the two. For this reason, this group has rejected isomorphism and similarity views of representation, emphasizing that models relate to the world in much more complex ways.

But, the utility of isomorphism and similarity to the analysis of representation has had other critics. A long line of thought in the Western tradition has sought to explain pictorial representation in terms of mimesis: a picture represents its target

because it resembles the target. If an almost equally long tradition has criticized this analysis, few have done so more powerfully than the modern *locus classicus*: Nelson Goodman's *Languages of Art* (1976). Goodman points out that, for an analysis of representation, similarity is a red herring: it is neither necessary nor sufficient for representation. Goodman's arguments have sparked repeated debate in discussions of the nature of pictorial representation—debates that are ongoing in philosophical aesthetics. Indeed, arguments that have emerged in this debate have recently been brought to bear on scientific representation. Roman Frigg (2002, 2006) and Mauricio Suárez (2003, 2004) have aimed to show that mimetic conceptions of scientific representation based on either similarity or isomorphism are blind alleys. In response to these criticisms, revised similarity and isomorphism accounts have been proposed by Giere (2004) and Bas van Fraassen (2004), yet they remain controversial. An elegant way around the problem seems to be to opt for the other extreme end of the spectrum and declare that conventional stipulation is the core of representation. On such a view, nothing but a voluntary act of stipulation is involved in making something represent something else. Although this view is the foil against which many accounts of representation have been formulated, it is rarely carefully articulated.[8] Craig Callender and Jonathan Cohen (2006) give an explicit endorsement of this view—an argument that Adam Toon's contribution to this volume claims to be untenable.

If neither strongly mimetic nor rigorously conventionalist views can satisfactorily account for the complex, variegated field of scientific representations now studied by philosophers of science, the moment has arrived for us to re-examine our conceptions of representation more comprehensively. As the foregoing criticisms of the isomorphism account demonstrate, work towards such an expanded analysis has drawn parallels between representation in art and science as a way to think through the relations of the mimetic and the conventional. However, where salient parallels have traditionally been identified between science and pictorial representation, more recent work has emphasized the crucial comparison with literature. Relations between storytelling and modeling have become particularly important to this conversation. Donald McCloskey (1990) has drawn attention to the parallels of economic modeling and storytelling; Stephan Hartmann (1999) and Morgan (2001) have emphasized that stories are an integral part of models that cannot be omitted from an analysis of modeling; and Till Grüne-Yanoff and Paul Schweinzer (2008) argue that stories are crucial to applying abstract models to real-world scenarios. Nancy Cartwright takes the parallels between models and literature particularly seriously, and has developed an account of representation by likening them to literary fables. First proposed in her (1999), Cartwright's view is further elaborated in her contribution to this book. Similarly, Toon's contribution to this book takes the

[8] Such a view is often attributed to Goodman himself on the basis that he held that denotation was the core of representation. While there is a grain of truth in this, Goodman's view seems to have been more nuanced because he recognized that denotation is not always rooted (solely) in act of conventional stipulation. Goodman's views are discussed in Elgin's and Chakravartty's contributions to this book.

argument into a different direction. By his reading, Kendall Walton's (1990) pretense theory of fiction offers promising resources for elaborating a powerful account of representation in science.

In the wake of the critique of the semantic view of scientific theories, an account of modeling now faces two central questions: what are models and how do they represent? If most of the available literature has focused upon the latter, representational question, Frigg (2003, 2010) and Peter Godfrey-Smith (2006) have argued that literary fiction also provides the clue for an answer to the former, ontological question. Models, in this account, should be seen as the same kind of entities as imaginary places and characters in literary fiction. This basic idea can be cashed out in different ways. In his contribution, Frigg develops an account of models that, like Toon's, draws on Walton's theory of fiction. Manuel García-Carpintero shares the view that the ontology of literary fiction and models are identical, which he defends in his contribution through an account of fiction based on Stephen Yablo's theory of metaphor.

This renewed interest in exploring contacts between artistic and scientific representation does not stop at semantics and ontology. Catherine Elgin (1996) has argued that science and art share important epistemic practices in common. In her contribution to this volume, she builds upon this approach and presents an account of the acquisition of knowledge based on the notion of exemplification. Few scientists would claim that even our best theories are true; but most would submit that they get essential elements right. In other words, our best theories are approximately true. Anjan Chakravartty sets out to analyze the notion of approximate truth in science by drawing attention to representational practices in the arts. Commensurately, while thought experiments have played an important role in science at least since Galileo, David Davies' contribution to this volume demonstrates that there is much to be learned about how such experiments work by examining their similarity to the plots of literary fiction. What fictions are and how we learn from them, so these contributors suggest, are questions that now need to be shared between students of representation in science and art.

From Art to Science

Contemporary to and often conversant with later nineteenth century philosophers of science, the founders of academic art history looked askance upon a venerable tradition of thinking about representation in art.[9] According to that tradition, the visual arts shared a common root with literature, music and a vast array craft practices in their mutual derivation from imitation. Classical Greek philosophers had designated such arts as *mimesis*, a term that would occupy a central but conflicted

[9] On contacts between science and art history's disciplinary formation in nineteenth century Germany, see Mallgrave and Ikonomou (1996). A standard intellectual history of key figures in art history is Podro (1984).

place in the Western tradition (Auerbach 1953, Halliwell 2002). Writing in the wake of Greek art's naturalistic efflorescence of the fifth century BCE, Plato's philosophy keenly registered this vexed position. In the infamous argument set out in *The Republic*, Plato's (1961) Socrates reasons that because works of mimetic art are but second-hand simulacra—imitations made from the material copies of their ideal Forms—painters, sculptors and poets amount to dangerous dissemblers who should be banned from the *kallipolis*, the ideal state. An ostensibly more sympathetic account of art's mimetic nature and its transformative capacities was advanced by Plato's student Aristotle. In the *Poetics*, for example, Aristotle (1982) noted how a visual art like theatre represented men as better than they really are (as in tragedy) or worse than they really are (as in comedy), thereby yielding versions of human action that depart from reality. These creative (and therefore non-*re*presentational) dimensions of art were significantly expanded by some theorists of the European Renaissance who advocated a new conception of art as the product of a divinely-gifted subject: the artist of genius (Panofsky 1968, Koerner 1993, Belting 1994). But, for many Renaissance writers, the imitation of nature by art was a matter of progressive, observable, and almost miraculous fact. Heir to the reclamation of one-point pictorial perspective, the deployment of oil as a painting medium and a host of other ingenious innovations, Renaissance art would be narrated by theorists like Giorgio Vasari (1998) in the mid-sixteenth century as moving progressively toward the perfection of imitative skill.

For nineteenth century Germanic academics keen to establish the credentials of art history as a science, neither this privilege of naturalistic European art nor the narration of mimetic ascent (or decline) could satisfactorily constrain analysis. Alois Riegl, Heinrich Wölfflin and their art-historical contemporaries understood their project to demand the interpretation of the diverse, but equally-valid, styles of representation through which the art of geographically and historically varying cultures developed from its own, autonomous causes. Instead of assuming some universal standard against which a work's imitative accomplishment could be measured, the intellectual credentials of art history would be established through its ability to historicize the mode of representation in which an artwork was made and to elucidate the desires and cognitive demands expressed by it. So Wölfflin would famously put it: "Every artist finds certain visual possibilities before him, to which he is bound. Not everything is possible at all times. Vision itself has a history, and the revelation of these visual strata must be regarded as the primary task of art history" (1950, 11). Even if mimesis could still then be assumed as a guiding intention for much of the high art produced in the Western tradition, imitative "content" counted less than the stylistic form in which it was materialized.

By the first decades of the twentieth century, however, the demolition of even this diminished role for mimesis was well under way. Systematically, modernist artists had dispensed with the clever modulations of painterly tone, the perspectival constructions of space developed by Renaissance painters and the even the fundamental assumption that a work of art would serve some representational capacity. These were challenges that historians of art could hardly ignore. Indeed, when publishing his seminal *Art and Illusion: A Study in the Psychology of Pictorial Representation*

in the heyday of the non-figurative art of Abstract Expressionism, Ernst Gombrich acknowledged the need to justify studying the traditions of pictorial representation that had been so ruthlessly negated by modernism. Citing then-recent psychological research and its revelation of what he called "a radical reorientation of all traditional ideas about the human mind, which cannot leave the historian of art unaffected", Gombrich catalogued the force of formulas and schemata in the production of convincingly representational images (1961, 27). In the sympathetic reading that he sought to give it, such illusionistic representation would be understood as the product of conventions projected onto the visible world, not copying data received from it. Beginning "not with his visual impression but with his idea or concept", Gombrich argued, the artist selectively introduces information from to the observed target "as it were, upon a pre-existing blank or formulary. And, as often happens with blanks, if they have no provisions for certain kinds of information we consider essential, it is just too bad for the information" (1961, 73). Writing at the apex of High Modernism, Gombrich could recuperate the artistic and intellectual credibility of representational art not by appeal to mimesis, but by elaborating the evolving conventions underpinning it.

Reviewing *Art and Illusion* in 1960, philosopher Nelson Goodman found much to admire in Gombrich's work. Goodman emphasized the book's insight into what he called "the nature of vision and of representation, and the problem of reconciling the objectivity of the latter with its conventionality and the relativity of vision" (1972, 142). Although they parted company over the extent to which Renaissance perspective constituted a convention, Goodman integrated Gombrich's work into the devastating critique of mimetic or resemblance theories of representation that he outlined in *Languages of Art* (1968), a work which stands as one of the most powerful examples of a conventionalist reading of representation.[10] "The plain fact", Goodman claimed therein:

> is that a picture, to represent an object must be a symbol for it, stand for it, refer to it; and that no degree of resemblance is sufficient to establish the requisite relationship of reference. Nor is resemblance *necessary* for reference; almost anything may stand for almost anything else. A picture that represents—like a passage that describes—an object refers to and, more particularly, *denotes* it. Denotation is the core of representation and is independent of resemblance (1976, 5).

Far from following from some heightened degree of resemblance, "realism" in Goodman's iconoclastic analysis turned out to be a residue of habit, a symptom of a representation's adherence to acculturated stereotype. Moreover, by analyzing representation in the arts as systems of symbols, Goodman's work suggested significant possibilities for studying varieties of images that deployed conventions utterly foreign to those of the canon of western art.

Although often in ways contrary to the rigorous analytic tenor of his work, Goodman's "conventionalism" and his attention to non-canonical imagery are broadly instructive of the direction of much recent work on representation in art

[10] For Gombrich's response to Goodman's reading of perspective, see Gombrich (1972).

history. Since the 1970s, contact with structuralist linguistics, semiotics and related interpretive frameworks has transformed art-historical thinking about artistic representations, calling attention to the codes and conventions of socio-economic, political, racial or other interests embodied in them.[11] Simultaneously, the discipline has expanded dynamically outward; art historians have come to recognize the necessity of placing the canonical core of European aesthetic objects in dialogue with both the art of "non-Western" cultures and non-elite, non-art images native to the Western tradition itself.[12] If interdisciplinary fields like visual culture and media studies that privilege these questions have had their detractors, one of the most productive topics in this ambit has been the humanities-based study of scientific imagery. Because our own volume touches upon some of the questions this literature has asked, it is instructive to briefly consider how problems of representation have been approached therein.

To several leading scholars, mimetic ambition has stood as a crucial point of conjunction between science and visual art. As the artistic ability to draw empowered Leonardo da Vinci or Galileo to perceive scientific features of natural entities which remained completely unintelligible to their contemporaries[13], so scholars like Svetlana Alpers (1983), Martin Kemp (1990) and Pamela Smith (2004) have argued for strong continuities between the "mirroring of nature" in art and science ca. 1400–1850. An instructively different approach has been taken in historian of science Peter Galison's *Image and Logic*, which analyzes twentieth century particle physics as a struggle between "two competing traditions" (1997, 19). On one side, Galison plots the "image tradition," or those theories and experimental instruments designed to produce representations that are "presented, and defended, as *mimetic*—they purport to preserve the form of things as they occur in the world" (1997, 19). The opposing "logic" tradition, meanwhile, is organized around theories and instruments engineered to yield statistical data, constituting what Galison calls "'homologous' representation" (1997, 19). This strategy of narrating scientific visualization through the opposition of mimetic and conventional representations has recently been developed further by art historian David Freedberg in his *The Eye of the Lynx*. Seventeenth century Italian natural history, Freedberg argues, can be interpreted as a decline of pictures and the rise of conventional diagrams as mimesis was effectively outpaced by the needs of science: "The graphic description of the surfaces of things could not yield the principles of order; these could only be achieved by penetrating beneath the surface, by counting, and by reducing the fullness of pictorial description to their essential geometrical abstractions" (2002, 4). For Freedberg, pictures and diagrams not only map respectively onto the

[11] For work that has specifically appealed to Goodman for these ends, see Mitchell (1986). Although this broader art-historical literature is massive, an indicative range of approaches to representation and leading scholars thereof is Bryson et al. (1991).

[12] See, for example, Levenson (1991); and Farago (1995).

[13] See Panofsky (1954, 1962); Edgerton Jr. (1984); and Bredekamp (2000).

resemblance-based epistemological order of the Renaissance and the representational signs of Enlightenment knowledge as theorized by Michel Foucault, but they constitute a "clear, serious, and instructive" polarity (2002, 476 footnote 1). Thus, mimesis and convention have come to be seen not only as different ways of representing natural targets, but as opposing strategies that signal broader intellectual (or other) commitments.

Importantly, the need to think beyond such an opposition of mimesis and convention is one that has already registered within this literature. Especially in studies of the photographic technologies used increasingly in the sciences by the end of the nineteenth century, researchers have aimed to theorize the resulting images in terms of their "indexicality". As influentially articulated by art historian Rosalind Krauss based upon the writings of C.S. Peirce, photography could be understood to produce indexical signs that exceed the mimetic relations of "icons" and conventional relations of "symbols" by means of their causal relation to target objects (1977a, b). "Every photograph", Krauss claimed, "is the result of a physical imprint transferred by light reflections onto a sensitive surface. The photograph is thus a type of icon, or visual likeness, which bears an indexical relationship to its object" (1977a, 75). If the limits of indexical relations upon scientific photography have now been vigorously argued (Snyder 2007, Ellenbogen 2008), attention to the index has developed less in relation to scientific images than in conversations about the implications of photographic aesthetics (Saltzman 2006). More expansive approaches beyond the mimesis/convention opposition—and indeed beyond the art/science binary—have been suggested in the pioneering work of James Elkins (see for example 1999, 2007, 2008). Central to Elkins' work in this direction and as argued in his essay included here, is a contention that the artistic images privileged by humanities-based scholarship possess nothing like interpretive purchase or theoretical hegemony imagined by art historians and visual theorists. So Elkins argues—and as the exhibition and book reported on in his essay sought to enact—humanities-based researchers can only begin to truly theorize our "increasingly visual society" by listening to and engaging in technical detail with the profuse, complicated ways in which visual materials are produced and accorded representational values in the sciences.

The contributions of Matthew C. Hunter, Dawna Schuld and John Hyman all engage with available studies of relations between art and science. Hunter's essay focuses upon the material models and broader visual activities of Robert Hooke in later seventeenth century London. Trained as a painter but best known for his numerous accomplishments as an experimental scientist, Hooke has stood for humanities-based interpreters as an arch example of the mutual hold of mimesis upon early modern art and science. Drawing upon recent work from the philosophy of science, Hunter demonstrates how Hooke's material models frustrate mimetic readings in departing not only from the natural targets they were intended to represent, but from the theories they ostensibly aimed to elucidate. Theorizing this complexity of Hooke's models, Hunter calls attention to the devilish sophistication of thinking and working with representations in art and science at the cusp of the Enlightenment. Although examining a case from some three hundred years later, Dawna Schuld's essay also considers visual practices generated through the direct

interaction between artists and scientists. Schuld shows how the artistic activities developed through a collaboration between experimental psychologists and artists Robert Irwin and James Turrell in late 1960s Los Angeles need to be seen as offering a powerful critique of the Formalist models of modernist aesthetic experience which continue to inform the interpretation of their work. For, drawing upon their experiences in sensory-deprivation chambers, Irwin and Turrell made "conditional art" by eliminating the aesthetic object and manipulating the conventional gallery space in which it would appear. As Schuld argues, this artistic project not only discloses compelling alignments between Formalism and behaviorist psychology, but shows how the work of Irwin and Turrell speaks instructively to recent research in cognitive neuroscience. A suggestive juxtaposition to this approach is offered by John Hyman who critically examines recent studies of visual art by neuroscientists. Considering the work of leading figures in "neuro-aesthetics" like V.S. Ramachandran and Semir Zeki, Hyman analyzes what scientific concepts like "peak shift" can or cannot tell us about artistic representation and assesses the broader prospects of a "neurobiological definition of art".

For readers from the history and theory of art, the essays by contributors like Anjan Chakravartty and Nancy Cartwright may well come as a pleasant surprise. Chakravartty outlines the need to develop a theory of "approximate truth" capable of answering to the significant departures scientific representations make from their target systems. Distinguishing between scientific representations that abstract and those that idealize their targets, Chakravartty argues for different "conditions of approximation" by which each type of representation can be evaluated—and does so by appealing to works of twentieth century art as cognitive resources. Commensurately, Cartwright's essay explores what she calls "highly idealized" models used in the sciences—models that are markedly unlike the real world entities and systems they ostensibly represent. Cartwright turns to the theory of the fable proposed by G.E. Lessing, comparing and contrasting the interpretations required of models to those of fables and parables. Echoing the strong interest in the philosophy of literature that marks our collection as a whole, these essays exemplify the broader desire of the project to put works of art and theories of science "to work" in the shared enterprise of thinking representation beyond mimesis and convention.

Problems and Prospects

It goes without saying that substantial work remains to be done in rethinking our familiar stories about representation. To scholars coming from the humanities, the conceptions of representation to be found in the pages that follow may seem extremely foreign. The visual features that we like to attribute to scientific photographs or illustrations (precision, meticulous attention to detail, and "realism" in numerous variants) are thrown into abeyance, while even the fundamental privilege of visualization that we have come to envision as central to science—an iconophilia seen to be meaningfully coextensive with visual art—is brought into question. Likewise, philosophers of science may find the conceptions of models,

representation, truth, and learning suggested in this volume eccentric, if not outlandish. Formidable though such challenges are, it is our conviction that the vitality of our conversations demands that we look beyond binary categories, our discrete intellectual traditions, and our comfortable pathways. The aim of this volume is to make the concerns we share salient, and to suggest how they might best be addressed through collaborative enterprise. If studies of art and science are now moving from contraband traffic to officially-sanctioned trade in our parallel but discrete disciplinary zones, our call is for a more global expansion of trading alliances. Granting amnesty to pirates and honor to brave privateers, the aim of *Beyond Mimesis and Convention: Representation in Art and Science* is to demonstrate the necessity and advantage of rethinking representation together.

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Telling Instances

Catherine Z. Elgin

Science, we are told, is (or at least aspires to be) a mirror of nature, while art imitates life. If so, both disciplines produce, or hope to produce, representations that reflect the way the mind-independent world is. Scientific representations are supposed to be complete, accurate, precise and distortion-free. Although artistic representations are granted more leeway, they too are supposed to resemble their subjects. Underlying these clichés is the widespread conviction that representations are intentional surrogates for, or replicas of, their objects. If so, a representation should resemble its referent.

This stereotype is false and misleading. It engenders unnecessary problems in the philosophy of science and the philosophy of art. It makes a mystery of the effectiveness of sketches, caricatures, scientific models, and representations with fictional subjects. Indeed, the stereotype strongly suggests that there is something intellectually suspect about such representations. Caricatures exaggerate and distort. Sketches simplify. Models may do all three. Many pictures and models flagrantly fail to match their referents. Representations with fictional subjects have no hope of matching, since they have no referents to match. The same subject, real or fictive, can be represented by multiple, seemingly incongruous representations. These would be embarrassing admissions if representations were supposed to accurately reflect the facts.

Mimetic accounts of representation fail to do justice to our representational practices. Many seemingly powerful and effective representations turn out on a mimetic account to be at best flawed, at worst unintelligible. Nor is it clear why we should want to replicate reality. As Virginia Woolf allegedly said, "Art is not a copy of the real world. One of the damn things is enough!"[1] To replicate reality would simply be to reproduce the blooming buzzing confusion that confronts us. What is the

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[1] Goodman (1968, 3). Goodman was not able to find the original source for this quotation. Although a number of sources credit Woolf with it, I have found none that knows where in her work it is to be found.

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value in that? Our goal should be to make sense of things—to structure, synthesize, organize, and orient ourselves toward things in ways that serve our ends.

Nominalism is of no help with this task, for it is undiscriminating. According to nominalism, there are no natural kinds. Since, except for paradoxically self-referential cases, every collection of entities constitutes an extension, every two or more objects resemble each other in virtue of their joint membership in some extension. Thus mere resemblance cannot serve as a ground for representation, else everything would represent everything else. This is true but unhelpful. That there are no natural kinds tells us virtually nothing about how representations function.

The problem lies in the metaphor of the mirror and the ideal of replication. Neither art nor science is, can be, or ought to be, a mirror of nature. Rather, I will argue, effective representations in both disciplines embody and convey an *understanding* of their subjects. Since understanding is not mirroring, failures of mirroring need not be failures of understanding. Once we recognize the way science affords understanding, we see that the features that look like flaws under the mirroring account are actually virtues. A first step is to devise an account of scientific representations that shows how they figure in or contribute to understanding. It will turn out that an adequate account of scientific representation also affords insight into representation in the arts.

Representation

The term "representation" is irritatingly imprecise. Pictures represent their subjects; graphs represent the data; politicians represent their constituents; representative samples represent whatever they are samples of. We can begin to regiment by restricting attention to cases where representation is a matter of denotation. Pictures, equations, graphs, charts, and maps represent their subjects by denoting them. They are representations *of* the things that they denote.[2] It is in this sense that scientific models represent their target systems: they denote them. But, as Bertrand Russell notes, not all denoting symbols have denotata (Russell 1968, 41). A picture that portrays a griffin, a map that maps the route to Mordor, a chart that records the heights of Hobbits, and a graph that plots the proportion of caloric in different substances are all representations, although they do not represent anything. To be a representation, a symbol need not itself denote, but it needs to be the sort of symbol that denotes. Griffin pictures are representations then because they are animal pictures, and some animal pictures denote animals. Middle Earth maps are representations because they are maps and some maps denote real locations. Hobbit height charts are

[2]This use of "denote" is slightly tendentious, both because denotation is usually restricted to language and because even within language it is usually distinguished from predication. As I use the term, predicates and generic non-verbal representations denote the members of their extensions; see Elgin (1983, 19–35).

representations because they are charts and some charts denote magnitudes of actual entities. Caloric proportion graphs are representations because they are graphs and some graphs denote relations among real substances. So whether a symbol is a representation is a question of what kind of symbol it is. Following Goodman, let us distinguish between representations *of p* and *p*-representations. If *s* is a representation *of p,* then *p* exists and *s* represents *p*. But *s* may be a *p*-representation even if there is no such thing as *p* (Goodman 1968, 21–26). Thus, there are griffin-pictures even though there are no griffins to depict. There is an ideal-gas-description even though there is no ideal gas to describe. There are also mixed cases. The class of dog-representations includes both factual and fictional representations. Factual dog-representations are representations of dogs; fictional dog-representations lack denotata.

Denoting symbols with null denotation may seem problematic. Occasionally philosophers object that in the absence of griffins, there is no basis for classifying some pictures as griffin pictures and refusing to so classify others. Such an objection supposes that the only basis for classifying representations is by appeal to an antecedent classification of their referents. This is just false. We readily classify pictures as landscapes without any acquaintance with the real estate—if any—that they represent. I suggest that each class of *p*-representations constitutes a small genre, a genre composed of all and only representations with a common ostensible subject matter. There is then a genre of griffin-representations and a genre of ideal-gas-representations. And we learn to classify representations as belonging to such genres as we study those representations and the fields of inquiry that devise and deploy them. This is no more mysterious than learning to recognize landscapes without comparing them to the terrain they ostensibly depict.

Some representations denote their ostensible objects. Others do not. Among those that do not, some—such as caloric-representations—simply fail to denote. They purport to denote something, but there is no such thing. They are therefore defective. Others, such as ideal-gas-representations are fictive. They do not purport to denote any real object. So their failure to denote is no defect. We know perfectly well that there is no such animal as a griffin, no such person as Othello, no such gas as the ideal gas. Nonetheless, we can provide detailed representations *as if* of each of them, argue about their characteristics, be right or wrong about what we say respecting them and, I contend, advance understanding by means of them.

Representation As

x is, or is not, a representation *of y* depending on what *x* denotes. And *x* is, or is not, a *z*-representation depending on its genre. This enables us to form a more complex mode of representation in which *x* represents *y as z*. In such a representation, symbol *x* is a *z*-representation that as such denotes *y*. Caricature is a familiar case of representation-as. Winston Churchill is represented as a bulldog; George W. Bush is represented as a deer in the headlights. According to R. I. G. Hughes,