

Robert Richards

Objectivity and the Theory of the Archetype

Abstract: In response to *Objectivity*, by Lorraine Daston and Peter Galison, this essay argues that that idealized depiction of creatures and plants persists powerfully into the contemporary period, often bypassing the more mechanical, self-abnegating ideals of other sciences.

Lorraine Daston has written frequently on the relationship between art and science, most notably in two influential books. In *Wonders and the Order of Nature*, she and Katherine Park recounted the collecting activities of medieval and early modern scholars, who discovered certain curiosities (e.g., a tusk of a narwhal) believing them to be wonders of artistic delight (e.g., the horn of a unicorn).¹ This was followed by *Objectivity*, in which she and Peter Galison constructed the history of scientific objectivity.² They argued that the idea of objectivity had gone through three historical phases. The first stemmed from the early modern period through the mid-nineteenth century, when naturalists attempted to represent kinds of things—e.g., a species of flower, bird, or mammal—focusing on the essential features of the type, those universal structures that were “true to nature.” Such types were illustrated, often by gifted artists, in collections of botanical and zoological atlases. In the second period, as scientists grew wary of the possibilities of subjective bias, they introduced instruments, such as the camera and the kymograph, to achieve “mechanical objectivity” in their illustrations. Thus scientist guarded against incursions of subjective preference by focusing on the concrete individual, rather than succumbing to unstable assumptions about types and essences. And then in the early twentieth century, methods of “trained judgment” were deployed to guard against the wiles of subjectivity, even when hand-drawn illustrations were used.

Naturalists who attempted to render objects “true to nature” would base their illustrations on particular objects, which might be brought back from a collecting expedition. Such illustrations did not, however, picture an individual organism—not, for example, *a* Nankeen Night Heron, but *the* Nankeen Night Heron, say as rendered by John Gould (1804–1881), chief ornithologist at the British Museum.

1 Lorraine Daston and Katherine Park, *Wonders and the Order of Nature, 1150–1750* (New York: Zone Books, 1998).

2 Lorraine Daston and Peter Galison, *Objectivity* (New York: Zone Books, 2010).

Gould, for instance, would sketch birds from life, or more often from samples that had been preserved in spirits of wine and sent back to the museum. He would then work with artists and lithographers to produce vivid color reproductions of organisms, shed of individual peculiarities or blemishes suffered during shipment back to the museum (fig. 1).



Fig. 1: The Nankeen Night Heron; from John Gould's *The Birds of Australia*, 1840–1848.

Daston and Galison do not suppose that the three historical periods they discriminate mark abrupt transitions. They allow that older modes of depiction might continue as a regular part of a discipline. Yet, they do not indicate just how deeply techniques of representation from the first period have penetrated into scientific practice right up to the present time, especially in the biological disciplines. Three general considerations, I believe, should be given due weight. First, in many biological specialties—botany, insectology, ichthyology, ornithology, and several other areas of zoology—the color of organisms serves a crucial function in identifying a species. Color photography in monographs, however, only came into general use in the 1930s. Thus hand drawn illustrations transformed into copperplate etchings with aquatint and lithography remained the usual ways biological atlases and catalogues would represent organisms in color. Color-lithographs of original, typical organisms continued to be used through the historical boundaries set by Daston and Galison. Second, even in areas, such as embryology, where color is less important, it would be difficult to use individual specimens

displaying either marks of particularity or abnormal defects to serve as guides, say, of the stages of fetal development. Even in biology text-books today, where photography is liberally used, the important information is still carried by hand-drawn illustrations, often in color. Finally, there is the peculiar feature of their argument: though they contend they are offering a history of objectivity, they simply identify objectivity with what they call “mechanical objectivity,” contrasting objectivity (in this sense) with efforts of representations that were “true to nature.”³ This gives them leave to claim that “objectivity has not always defined science.”³ But this is anomalous. To write a history of change, as Aristotle knew, one has to specify an object having features that remain the same through the change, while other features fall out or arise. So in a history of objectivity, there ought to be a stratum of the object of inquiry that remains the same, and most historians of science would contend that stratum distinguishes science even as it emerges from other cultural activities in ancient Greece. No objectivity, no science. I will return to this consideration at the conclusion of this essay, but I need to admit that one can only bring such amendments to bear in light of the brilliant accomplishment of Daston and Galison’s book.

In this brief essay I will prescind from the first two considerations and rather concentrate on a theory of scientific representation that had its roots in the morphological ideas of Immanuel Kant (1724–1804) and Johann Wolfgang von Goethe (1749–1832), its flower in the illustrations of Carl Gustav Carus (1789–1869), and its new life in the work of Charles Darwin (1809–1882) and D’Arcy Thompson (1860–1948). This theory and its historical spread bring into focus another meaning for objectivity during the nineteenth and twentieth centuries.

The Theory of the Archetype in Kant and Goethe

In the second half of his *Critique of the Power of Judgment* (1790), Kant came very close to enunciating an evolutionary theory, at least one advancing on the transformational ideas of Georges-Louis Leclerc, Comte de Buffon (1707–1788). Kant maintained that a naturalist should try to explain the structure and function of biological organisms through the application of mechanistic principles, which alone could yield real understanding; for example, the laws of light refraction help make intelligible the operation of the vertebrate eye. Kant was yet

³ Ibid., p. 17.

persuaded that unaided mechanism was insufficient; there would be features of organisms the account of which would escape conceptual capture by mechanistic laws. Why, for example, were the various media of the eye situated where they were? What was their purpose? As investigations in the early modern period revealed, the purpose was to cast a coherent image on the retina. Kant declared that mechanism simply could not explain purpose. The naturalist could only approach a more complete understanding, say of the vertebrate eye, if he supposed that an idea had caused the design of the organism and that ultimately an *intellectus archetypus* conceived the productive idea. Kant cautioned that such assumption of an archetype as responsible for the organization of creatures could only be a regulative idea, a heuristic that might help us uncover further mechanistic laws, the only principles that would yield wissenschaftliches understanding.⁴ Yet Kant denied that a sufficient set of such principles could ever be discovered. He precluded the possibility that, as he phrased it, some Newton of the grass blade might arise.⁵ Kant was not far sighted enough to spy that Newton, almost fifty years later, disembarking from a British ship amusingly called *Beagle*.

Kant, though, was more prescient than one might suppose. He did venture a possible scheme for a mechanistic understanding of the origin of species. From the structure of already existing simple organisms, one could imagine mechanical forces deforming that structure so that it became the frame for another species of organism. So, for example, a pattern of bones in an ur-organism—say a fish—might through mechanical forces become stretched and pulled to form the bony skeleton of an amphibian. Kant, though, did not think there was any evidence for such “a daring adventure of reason,” as he called it.⁶ As I’ll indicate below, a twentieth-century scientist ingeniously supplied mathematical evidence that enabled him to propose such a daring adventure.

Johann Wolfgang von Goethe was an avid reader of Kant’s third *Critique* when it first appeared in 1790. Though he rejected much of the first *Critique*’s epistemology, he found that the *Critique of the Powers of Judgment* united his two passions—art and natural science. Even more, he discovered that his own aesthetic and morphological ideas had been traveling in the same direction as Kant’s. In his essay “Simple Imitation, Manner, Style” (1789), Goethe held that the most accomplished

4 Immanuel Kant, *Kritik der Urteilskraft*, in *Immanuel Kant Werke in Sechs Bänden*, ed. Wilhelm Weischedel, 6 vols. (Wiesbaden: Insel Verlag, 1957), 6: 535–36 (§79).

5 *Ibid.*, p. 516 (§75).

6 *Ibid.*, p. 539 (§80).

artist should be able to execute life-like drawing or sculpture (imitation), express his or her own individual character (manner), and have the acumen to move beneath the surface to catch the very essence of the object being depicted (style).⁷ Great art would thus, according to Goethe, require the artist to become cognizant of the internal structure of natural objects so as to render them in paintings or sculpture with a profound aesthetic touch. A short time later, he joined this aesthetic conception to his morphological discoveries of the plant and animal archetypes. In his *Metamorphose der Pflanzen* (1790), published just before he read Kant, Goethe argued that the various structures of a plant—the stem, the leaves, the calix, corolla, pistil, and stamen—were transformations of an underlying archetypal structure. The symbol of that structure he called the “ideal leaf.” He had, in short, reconstructed Kant’s archetype *avant la lettre*.

Goethe was persuaded that his conception of the fundamental type in botany could be extended to the animal realm, and over several essays during the early 1790s, he attempted precisely this.⁸ The essay “General Theory of Comparison” (1794) shows the impact of Kant’s *Critique*. In this essay, Goethe argued that each animal exhibited an “internal kernel” (*innerer Kern*), a structure that was common to all animals of a given type (e.g., the vertebrates), and that this internal kernel responded teleologically to its particular environment (*seine Zweckmässigkeit nach aussen*).⁹ So, for example, a seal had its external form shaped by its aquatic environment but its skeleton exhibited the same general vertebrate pattern as land animals.

Goethe thought the basic animal pattern had to be discovered by empirical comparisons done over a large number of animal species. This would allow the naturalist to abstract that fundamental structure of bones, not only from adult animals but also from the very young of a species. Goethe presumed that the “internal kernel” had a dynamic force that caused animal development. In a longish essay entitled “First Sketch of a General Introduction to Comparative Anatomy” (1795), he identified that dynamic principle with a conception drawn from Johann Friedrich Blumenbach (1752–1840), the anatomist from whom Kant also borrowed in his third *Critique*; following Blumenbach, Goethe referred to the

7 Johann Wolfgang von Goethe, “Einfache Nachahmung der Natur, Manier, Styl,” in *Sämtliche Werke nach Epochen seines Schaffens* ■ (Münchner Ausgabe, eds Karl Richter et al. 21 vols (Munich: Carl Hanser Verlag, 1985–98), 3.2: 186–91.

8 I have described these essays in animal morphology in *The Romantic Conception of Life: Science and Philosophy in the Age of Goethe* (Chicago: University of Chicago Press, 2002), pp. 434–57.

9 Goethe, “Versuch einer allgemeinen Knochenlehre,” in *Sämtliche Werke*, 4.2:146–79.

dynamic principle as a *Bildungstrieb*—a formative drive.¹⁰ Given the fluid character of this principle, it could not really be pictured; rather it was open to inspection only by the mind's eye. Had the archetype remained as an object of mental vision only, it would not have left much of a footprint in subsequent biological literature. However, Goethe's protégé Carl Gustav Carus brought the idea to graphic execution, whence it became a signal feature of nineteenth-century biology and, traveling through deeper channels, reached well into the twentieth century.

Carus's Theory of the Archetype

Carl Gustav Carus in his own time was recognized as an extraordinary polymath and author of several authoritative works in anatomy. He was also an accomplished artist, who illustrated all of his many technical manuals in anatomy and left a large cache of Romantic canvases, several inspired by his friend Caspar David Friedrich. He became a disciple of Goethe, and they conducted a lively correspondence over a ten-year period. Carus eventually wrote three books on the master. The work in anatomy that he proudly sent to Goethe, his *Von den Ur-Theilen des Knochen- und Schalengerüstes* (1828), constituted an extraordinary achievement, especially because of the detailed character of its anatomical illustrations. Though few copies of the book were printed (because of its size and expense), nonetheless the fundamental conception—as well as the pertinent illustrations—reached far beyond the German lands due especially to the transmission by Richard Owen, the doyen of biologist in England during the mid-part of the nineteenth century. Owen, though, was less than generous in recognizing his debt.

In the *Ur-Theilen*, Carus contended that Goethe was the first to observe a unifying principle in the vertebrate skeleton. The poet-scientist supposed that the various animal species had essentially common parts determined by the “formative force” (*bildende Kraft*), which gave rise to “the type in general”; he yet held that those parts could “be altered through all of the animal types and species without losing their character thereby.”¹¹ In an inchoate way, Goethe first recog-

¹⁰ Goethe, “Erster Entwurf einer allgemeinen Einleitung in die vergleichende Anatomie,” in *Sämtliche Werke*, 12: 120–55.

¹¹ Goethe as quoted by Carl Gustav Carus, *Von den Ur-Theilen des Knochen- und Schalengerüstes* (Leipzig: Gerhard Fleischer, 1828), p. viii.

nized the principle at work when he maintained that the vertebrate skull was composed of six transformed vertebra.¹² Carus briefly described the work of many anatomists at the beginning of the nineteenth century who had supposed, in hazy and in fragmented ways, that the vertebrates exhibited many aspects of unity; but he thought those naturalists had not quite locate the key to that unity. They lacked the “flexibility of imagination” to follow particular parts through various animal groups, tracing the alterations of an underlying structure and to “recognize that structure with both a sensitive and a mental eye.”¹³ Carus’s book attempted to consider the vertebrate skeleton under both kinds of vision.

Only after many years of exacting study and careful illustration, Carus thought he was able to trace the bones of the human skull back through representative mammals, birds, reptiles, and fish, showing their comparable parts and the transformation of those parts (see fig. 2, for example). Goethe was vindicated. Just as the parts of a plant could be understood as developed out of a fundamental, ur-structure (symbolized as the “ideal leaf”), so the skulls of vertebrates could be understood as composed of transfigured vertebrae, and the other major skeletal parts (e.g., ribs, pelvis, limbs, tail) could also be shown to result from further transformations of these original, elemental parts. Carus illustrated the basic plan of the vertebrates in what became known as the vertebrate archetype—a string of vertebrae with rudimentary processes (fig. 3). And since the archetype consisted only of repeated vertebrae, one could reduce that fundamental plan to a *Ur-Wirbel*, a primitive vertebra, whence through developmental transitions a given vertebrate could be constructed. Carus offered his detailed description of each bone of the vertebrate skull as it went through various transformations in different species as a powerful demonstration of the theory of the archetype.

¹² Carus noted that Lorenz Oken also claimed to have discovered that the skull was composed of vertebrae. A fierce priority dispute broke out between the two, which I describe in *The Romantic Conception of Life*, pp. 497–502.

¹³ Carus, *Von den Ur-Theilen*, p. x.



Fig. 2: Comparison of a human skull formed by altered vertebrae (nos. I–VI) and a reptile skull exhibiting essentially the same vertebral structures; from Carl Gustav Carus’s *Von den Ur-Theilen des Knochen- und Schälengerüstes*, 1828.

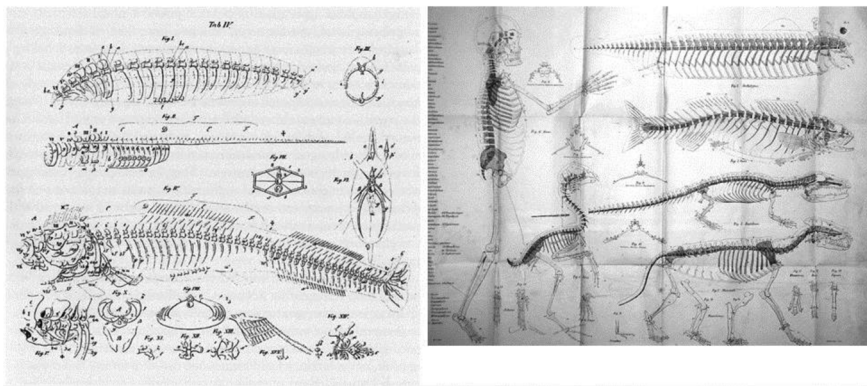


Fig. 3: Comparison of Carl Gustav Carus’s representation (1828) of the vertebrate archetype (top left), and Richard Owen’s representation (1849) of the archetype (top right).

Morphology after Carus

Richard Owen (1804–1892), the most famous zoologist in England during the mid-nineteenth century, borrowed heavily from Carus, whose book he had read and whose illustrations he used as models for his own (see fig. 3). In his book *On the Nature of Limbs* (1849), Owen made the same distinction as had Carus and Goethe: he contended that the skeletal parts of the various vertebrates displayed a common pattern, which he called their general “homology.” And like Goethe, Owen maintained that the parts had been altered for the functions exercised by the animal in its particular environment. He depicted as examples the wing of a bat and the claw of a mole, with each displaying the same topological arrangement of bones, though modified for either flying or digging. Owen concluded his account with the suggestion that God, through secondary causes, brought about the development of organisms according to archetypal ideas.¹⁴ Carus, by contrast, ground his developmental studies in a rather more abstruse metaphysics derived from Goethe, Schelling, and Oken. Nature as a whole was fecund and expressed developmental forces; we became aware of these forces because of an innate comprehension of the very nature of life.¹⁵ But these metaphysical and theological considerations become side issues, hidden under the detailed illustrations contained in the work of both Carus and Owen.

Charles Darwin (1809–1882) read Owen’s *On the Nature of Limbs* and commented, in a passage he scribbled in his copy, that the archetypal similarities exemplified by vertebrates derived not from an idea ensconced in nature (Carus) or one in God’s mind (Owen) but from the common ancestor. Homologies bespeak not metaphysics or theology but history. The similarities exhibited by vertebrates, Darwin argued, were inherited from a common ancestor and their differences resulted from adaptations to local environments.

In the penultimate chapter of the *Origin* (chap. 13), Darwin made clear the role of morphological type, which he called the “very soul” of natural history.¹⁶ Types and their transitions formed the “hidden bonds” of species affinities. In Darwin’s reconstruction, “the ancient progenitor, the archetype, as it might be called,” revealed those hidden bonds; and he especially credited Owen’s work on homology and Goethe’s on the vertebrate skull and metamorphosis of plants as foundational to his conception of species transformation. Thus those very ideas

¹⁴ Richard Owen, *On the Nature of Limbs* (London: John Van Vorst, 1849), p. 86.

¹⁵ Carus, *Von den Ur-Theilen*, p. 1.

¹⁶ Charles Darwin, *On the Origin of Species* (London: Murray, 1859), pp. 434–39.

that would underlie illustrations that were “true to nature” were woven into the fabric of modern biology by its original master, Charles Darwin.

After Goethe’s establishment of a science of morphology, German anatomists continued in the tradition of Carus, that is, they graphically investigated animal form, and integrated their morphological conceptions into Darwin’s evolutionary scheme. The current from the evolutionary morphology of such individuals as Ernst Haeckel (1834–1919) and Carl Gegenbauer (1826–1903) flowed directly into the mainstream of twentieth-century biology along very deep channels. At the beginning of the twentieth century, however, a new tributary of archetype theory sprung up, that established by the Scots classicist and biologist D’Arcy Wentworth Thompson, who introduced new mathematical methods for the understanding of animal form.

Thompson completed his manuscript of *On Growth and Form*, a book of almost 800 pages (over 1100 in the second edition of 1942), in 1914, but because of the war it appeared three years later in 1917.¹⁷ Thompson brought two novel conceptions to the study of animal form: 1) an assumption that the form of organisms reacted to physical forces in much the same way as inorganic substances did; 2) new mathematical methods for the study of organic form, the most interesting of which was a graphic method to demonstrate how physical forces might transform one species into another. Today we might consider Thompson’s first assumption as focused on physical constraints in the development of organisms. So, for example, since the volume of physical objects increases as the cube of the length while surface area increases as the square of the length (proportions remaining the same), elephants will require much thicker limbs proportional to surface area than those of a deer. Because multiple physical forces act on biological organisms, apparently no simple mathematical principle, such as the ratio of surface to volume, can capture the relationship of one species even to a related one. But Thompson did discover an ingenious graphic way of doing so, a method that harkened back to Kant.

He situated an animal form (e.g., a particular species) within a coordinate system, and then by deforming the system—thus simulating the effect of multiple forces on the organism—he was able to produce the form of a related species (fig. 4). Even as late as 1942, when the second edition of his book was published, Thompson remained skeptical that Darwin had given the full account of species evolution, especially as he relied on chance variations instead of mathematically

17 D’Arcy Wentworth Thompson, *On Growth and Form* (Cambridge: Cambridge University Press, 1917).

tractable variations. Contemporary biologists have not rushed to Thompson's scheme, though they usually admire its mathematical ingenuity. Yet, because of Thompson's work, biologists today recognize systematic constraints imposed on organisms by the physical environment.

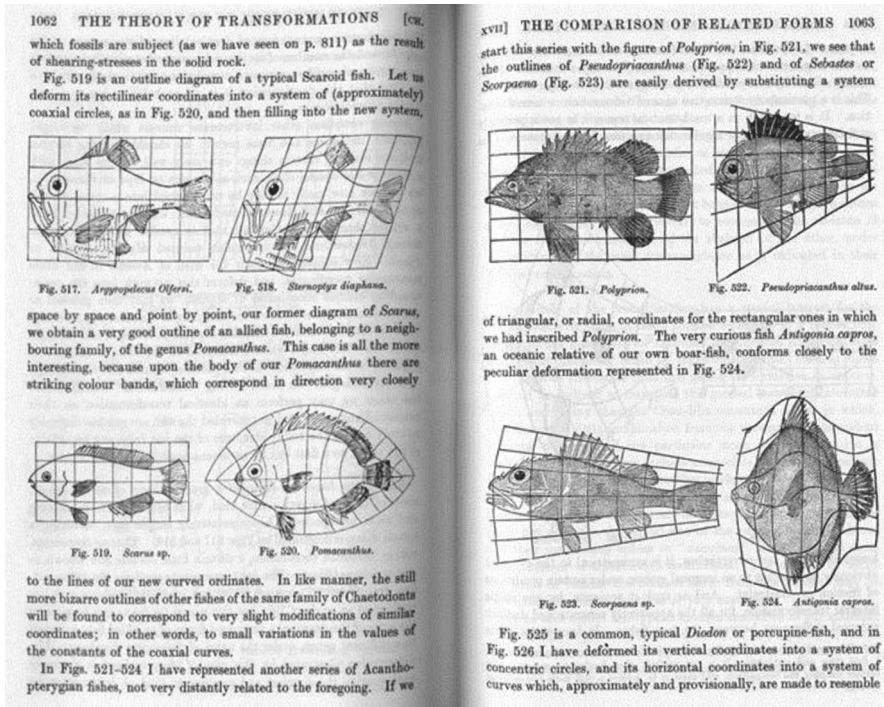


Fig. 4: Transformation of one species into another through change of scaling, from D'Arcy Thompson, *On Growth and Form* (1942).

At the distance of a century and a half, Thompson's effort yet pulses with rhythms of the Goethean morphological tradition, even reflecting Kant's suggestion that deformation of a common pattern by physical forces might explain the appearance of new species—that "daring adventure of reason" to which Goethe committed himself. Adventurous reason had become integrated into the activities of scientists over a very long historical period. What could be more objective?

Conclusion: Historical Robustness, Another Measure of Objectivity

Lorraine Daston and Peter Galison have provided a wonderfully thought-provoking analysis of the history of objectivity, focusing their account on the period from the eighteenth century through the early twentieth, the same period that this essay of mine spans. The authors suggest that the mode of being “true to nature,” that is, depicting only the essential features of organisms, gave way to “mechanical objectivity,” the use of instruments to prevent personal biases from distorting representations of scientific objects. Archetype theory appears quintessentially to exemplify the “true to nature” attitude. It seeks to show that individual species have an unsuspected unifying bond in the archetype. The archetype itself had been given different origins—the fecund and productive ability of nature or the infinite and creative mind of God, or yet the generative historical ancestor. Daston and Galison seem to suggest that the “true to nature” mode was not objective at all, insofar as they reduce “mechanical objectivity” to “objectivity” simply. They represent those scientists deploying the instruments of objectivity—cameras and other recording devices—as holding that only the individual was real, this in contrast to earlier naturalists who attempted to whittle away the particular and singular to distill the essence of an organic species. But the archetypal patterns themselves were real, not fanciful artifacts of minds tipping on a brew of *Naturphilosophie* and Goethean *Schwärmerei*. Those patterns were confirmed by several generations of morphologists and evolutionary theorists. This history manifests a notion of objectivity—the most fundamental notion, I believe—namely intersubjective agreement and historical robustness, all made palpable through the techniques of printing schematic types and their public dissemination. Goethe, Carus, Owen, Haeckel, Darwin, and Thompson looked beneath the surface of organisms and mutually confirmed a pattern of underlying unity. All science engages in exactly this same effort: to unite apparently disparate phenomena by showing their hidden bond, whether that bond be a common set of laws of motion for the earth and heavens or the archetype underlying disparate animal or plant types. Archetype theory declares the objectivity of historical robustness.