RHETORIC AND ARGUMENTATION IN THE BEGINNING OF THE XXIst CENTURY

EDITED BY

Henrique Jales Ribeiro

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IMPRENSA DA UNIVERSIDADE DE COIMBRA
COIMBRA UNIVERSITY PRESS

• COIMBRA 2009

Coordenação editorial
Imprensa da Universidade de Coimbra
Email: imprensauc@ci.uc.pt
URL: http://www.uc.pt/imprensa_uc
Vendas online: http://siglv.uc.pt/imprensa/

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[PMP]

Execução gráfica
Sereer, Soluções Editoriais

ISBN
978-989-8074-77-5

Depósito Legal
??????????????????????????

OBRA PUBLICADA COM A COLABORAÇÃO DE:

FCT Fundação para a Ciência e a Tecnologia
MINISTÉRIO DA CIÊNCIA, TECNOLOGIA E ENSINO SUPERIOR Portugal

Ciência.Inovação 2010 Programa Operacional Ciência e Inovação 2010
MINISTÉRIO DA CIÊNCIA, TECNOLOGIA E ENSINO SUPERIOR

Unidade I&D | Linguagem, Interpretação e Filosofia

CHAPTER 12

SOLVING THE MYSTERY OF PRESENCE: VERBAL/VISUAL INTERACTION IN DARWIN'S *STRUCTURE AND DISTRIBUTION OF CORAL REEFS*

Alan G. Gross*

ABSTRACT: In *Chaïm Perelman*, Ray Dearin and I contend that presence transcends the isolated effects that Perelman and Olbrechts-Tyteca catalogue; we contend that there is a global form, a synergy of effects in which "to be persuaded is to live in a world made significantly different by the persuader." Later, on my own, I extend this form of presence from the verbal to the visual. In this paper, I attempt to further this analysis of presence, to offer a systematic account of the verbal-visual interaction on which it depends, to offer, in effect, a genealogy of presence. Such an account is essential if we are to explain the mystery of verbal-visual presence, to explain what is, in fact, the central mystery of Perelmanian presence, the transformation of the perceptual into the argumentative. My example is Darwin's first masterpiece, *The Structure and Distribution of Coral Reefs*.

In *Chaim Perelman,* Gross and Dearin (2002) contend that presence transcends the isolated effects that Perelman and Olbrechts-Tyteca catalogue; they contend that there is a global form, a synergy of effects in which "to be persuaded is to live in a world made significantly different by the persuader" (151). In "Presence as Argument in the Public Sphere", Gross extends this form of presence from the verbal to the visual. In this paper, I attempt to further the analysis of presence, to offer a systematic account of the verbal-visual interaction on which it depends, to offer, in effect, a genealogy of presence. I contend that such a broadly based account is essential if we are to explain the mystery of verbal-visual presence, to explain what is, in fact, the central mystery of Perelmanian presence, the transformation of the perceptual into

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the argumentative and the narrative. According to *The New Rhetoric,* presence is based on the fact that "the thing on which the eye dwells, that which is best or most often seen is, by that very circumstance, overestimated." Initially, then, presence is perceptual; its effect is "to [fill] the whole field of consciousness." But, according to Perelman and Olbrechts-Tyteca, such is the nature of presence that what is "at first a psychological phenomenon, becomes an essential element in argumentation" (Perelman and Olbrechts-Tyteca 1969: 116-118).

Although for Perelman and Olbrechts-Tyteca presence is the product of verbal interaction alone, this cannot be true of any text, like *Structure,* in which information--bearing images contribute significantly to meaning. A genealogy of the presence that is a consequence of verbal-visual interaction requires recourse to theories that are broader in scope. Accordingly, I employ Köhler's Gestalt theory to account for our perceptions, and Peirce's semiotics to account for their interpretation. Both theories suffer from a visual bias. Gestalt categories that apply flawlessly to the visual apply only awkwardly to other modes of perception. Peirce himself acknowledges a visual bias in his thinking: "I do not think I ever reflect in words. I employ visual diagrams, firstly, because this way of thinking is my natural language of self-communion and secondly, I am convinced that it is the best system for the purpose" (cited in Leja 2000: 97). While such a bias leads to difficulties when we try to incorporate the other senses in a general hermeneutic of presence, they suit my present purposes exactly, the analysis of presence in Darwin's first masterpiece, *The Structure and Distribution of Coral Reefs.*

THE GENEALOGY OF PRESENCE

Presence has its beginnings in the patterns of perception our sensory systems produce, organized in accord with the 'laws' of Gestalt psychology. Köhler and his followers were certainly mistaken when they hypothesized that perceptual processes were actually organized along Gestalt lines, hard-wired into the brain (Köhler 1947). Given the current state of our knowledge of such processes, it would probably be best to regard the Gestalt "laws of organization [as] opportunistic guides to the viewer as to what will afford desired visual information," and to support the view "that they probably vary widely in level, speed, and power" (Hochberg 1998: 291). On one plausible accounting, there are six Gestalt principles. According to *figure-ground,* we see objects automatically as shaped, framed against a shapeless background, one that may, in fact, also have a shape, though we do not perceive it as such. When this background actually does have a shape – as in the case of the cell structure of tables or the latitude-longitude coordinates of maps – we can direct our attention alternately to it and to the foreground of data elements. We see a second Gestalt principle in operation, *good continuation,* when we complete in our mind's eye the rectangular shape of a whiteboard despite the fact that the man is standing in front of it is partially blocking our view. Scientific tables are characterized by a third Gestalt principle, *enclosure;* on the other hand, relationships among their cells are highlighted by means of the fourth principle, *similarity and contrast.* A fifth principle, *proximity,* groups adjoining letters of the alphabet into

words (Pinker 1990: 84 ; Hochberg 1998: 260-61 ; see also Pinker 1983). A final and overriding principle is *Prägnanz,* the perception of an overall Gestalt. When we arrive home after a long journey what we see is not windows, doors, and roof, but home.

Gestalt patterns are meaningful only in so far as they participate in a system of value-laden differences. Saussure articulates this principle for language:

> In all these cases what we find, instead of *ideas* given in advance, are *values* emanating from a linguistic system. If we say that these values correspond to certain concepts, it must be understood that the concepts in question are purely differential. That is to say they are concepts defined not positively, in terms of their content, but negatively by contrast with other items in the same system. What characterizes each most exactly is being whatever the others are not. (Saussure 1916: 115; emphasis his)

Saussure's principle applies generally to any semiotic system. For example, traffic signals and electrical wiring diagrams also rely for their interpretation on value-laden differences. To differentiate these systems from languages, let us call them codes.

Patterns of perception made potentially meaningful according to Saussure's principle are interpreted as Peircian symbols, icons, or indexes. Patterns recognized as verbal are understood as symbols, whose relation to their objects may be, but need not be arbitrary. Alphabets are systems of wholly arbitrary signs; ideograms are symbols that are not wholly arbitrary. Patterns recognized as non-verbal are understood either as symbols, icons, or indices. An icon is a sign that depicts; a photograph or a drawing of a microbe is an icon. An index is a sign whose relation to its object is causal or indicative. Geiger counter readings are causally linked to the external world; in a photograph an arrow pointing to a cell nucleus is merely indicative. To avoid ambiguity, let us call this latter category of signs deictic.

For the purposes of exegesis, Peirce's categories are insufficiently fine-grained to capture all meaningful transactions within a system of signs. Accordingly, to interpret the verbal, I borrow from linguistics, narrative theory, logic, and rhetorical theory, analytical perspectives that are, I judge, compatible with his semiotics. I single out as linguistic a semantic concern for the relationship between words and the world, a syntactic concern for the legitimate combinational possibilities of words in sentences, and a pragmatic concern for the effect of natural-language utterances on interlocutors.

Utterances also partake of larger systems of meaning, organized either in chronological sequences or according to logical operations. There are two types of chronological sequences: those that are repeated without change and those that are unique. The first we call processes; the second, narratives. I single out as logical the following operations: definition, classification, implication/inference, and generalization by induction. Definition operates by genus and differentia: a chair is an article of furniture designed for sitting; it has a back and four legs. The genus is furniture; the differentia, designed for sitting, having a back, having four legs. Classification operates by division; it creates hierarchies of categories,

each level of which has the same cognitive status within the system specified: for example, the animal kingdom can be divided into creatures with and without backbones. Implication is a property of propositions whereby to commit to one is to commit to another. If All men are mortal, then by implication, All Armenians are mortal. Inference is the psychological process by which this implication is realized. Induction is generalization from a necessarily limited set of instances: from the genetics of some peas to the genetics of all peas, from the genetics of all peas to all genetics.

I single out as rhetorical the three traditional canons that are the sources of persuasion in oral and written communication: the invention of arguments that, however persuasive, would not pass muster in formal logic, the arrangement or organization of discourses with persuasion in mind, and style, the systematic use of persuasively significant variations in the means of expression. Traditionally, invention is subdivided into three forms of appeal: *logos,* appeals from reasoning, *ethos,* appeals based on the trust that the author creates in the reader, and *pathos,* appeals to the emotions of the auditor or reader.

I now move from the verbal to the visual. While we see images, we do not ordinarily see words; rather, we see through them to their underlying concepts. This is what reading means. The verbal and the visual also differ in the way they are organized. Words are ordered in sequential hierarchical structures composed of combinations of smaller units. A paragraph is composed of a sequence of sentences, composed of sequences of clauses and phrases, composed of sequences of words, composed of sequences of letters. Images, on the other hand, are ordered into synchronous hierarchies or nested sets. A face is composed of a nested set of eyes, eyebrows, nose, mouth, teeth, ears, brow and cheeks. When organized into larger units, moreover, words never entirely lose their separate identities ; the components of images, on the other hand, tend to lose their separate identity as they become imbedded or nested. We see a face, not its components; we see, not an intricate nesting of various Gestalts but, as a consequence of *Prägnanz,* a single Gestalt. The verbal and the visual are also processed differently. Words are processed sequentially; in contrast, images can be processed not only sequentially, but also in parallel and simultaneously.

Images differ from words in one other important respect: they are subject to semiotically relevant spatial transformations. They can be rotated on their axes: subjected to this transformation, topographical surfaces reveal geological depths. Three-dimensional objects may also be projected onto two-dimensional surfaces; we do so when we create a map. One image, moreover, may be superimposed on another, an effect achieved when lines of latitude or longitude are applied to maps. In addition, a sequence of visuals may be animated; this is how temporal progression is routinely represented in films.

Other transformations are possible. Some take place within a particular category of sign. For example, a photograph of an eye may be used to construct a drawing of the eye, a shift from one iconic mode to another. Some transformations involve a shift from one category of sign to another. For example, a series of measurements may be used to construct a line graph, a shift from the symbolic to the iconic. The iconic may also be transformed into symbolic: photographs of *an* eye may become a

diagram of *the* eye. Finally, the iconic may be transformed into the indexical: a chest x-ray may reveal the cause of a persistent cough. Sebeok makes the essential point about the plasticity of the Peircian categories:

> In general, it is… inane to ask whether any given subject "is," or is represented by, an icon, an index, or a symbol, for all signs are situated in a complex network of syntagmatic and paradigmatic contrasts and oppositions, i. e., simultaneously participate in a text as well as a system; it is their position at a particular moment that will determine the predominance of the aspect in focus. (Sebeok 1976: 1433n)

As Gérard Deladalle points out: "we must insist... on the functional character of these distinctions: what is an index in one semiosis may be a symbol in another. Take, for instance, the symptom of an illness... If this symptom is referred to in a lecture on medicine as always characterizing a certain illness, the symptom is a symbol. If the doctor encounters it while he is examining a patient, the symptom is an index of an illness" (Deladalle 2000: 19-20). The contention of Sebeok and Deladalle that context is central to semiotic interpretation is a generalization of Saussure's principle that meaning is constituted by difference.

This understanding of Peirce's taxonomy is consonant with the views of Nelson Goodman in meaning-making, a position worth quoting at length:

> Comparative judgments of similarity often require not merely selection of relevant properties but a weighing of their relative importance, and variation in both relevance and importance can be rapid and enormous. Consider the baggage at an airport check-in station. The spectator may notice, shape, size, color, material, and even make of luggage; the pilot is more concerned with weight, and the passenger with destination and ownership. Which pieces of luggage are more alike than others depends not only upon what properties they share, but upon who makes the comparison, and when. Or suppose we have three glasses, the first two filled with colorless liquid, the third with a bright red liquid. I might be likely to say the first two are more like each other than either is like the third. But it happens that the first glass is filled with water and the third with water colored by a drop of vegetable dye, while the second is filled with hydrochloric acid – and I am thirsty. Circumstances alter similarities. (Goodman 1972: 445)

Texts that combine words and images constitute a wide-ranging category of communication, one that includes genres as different as comic strips and scientific monographs. These mean as a consequence of the interaction of their verbal and visual components, interpreted in all cases as Peircian signs ever and exquisitely sensitive to the changes in context to which Sebeok, Deladelle and Goodman refer. Figure 1 makes this verbal-visual interdependence clear.

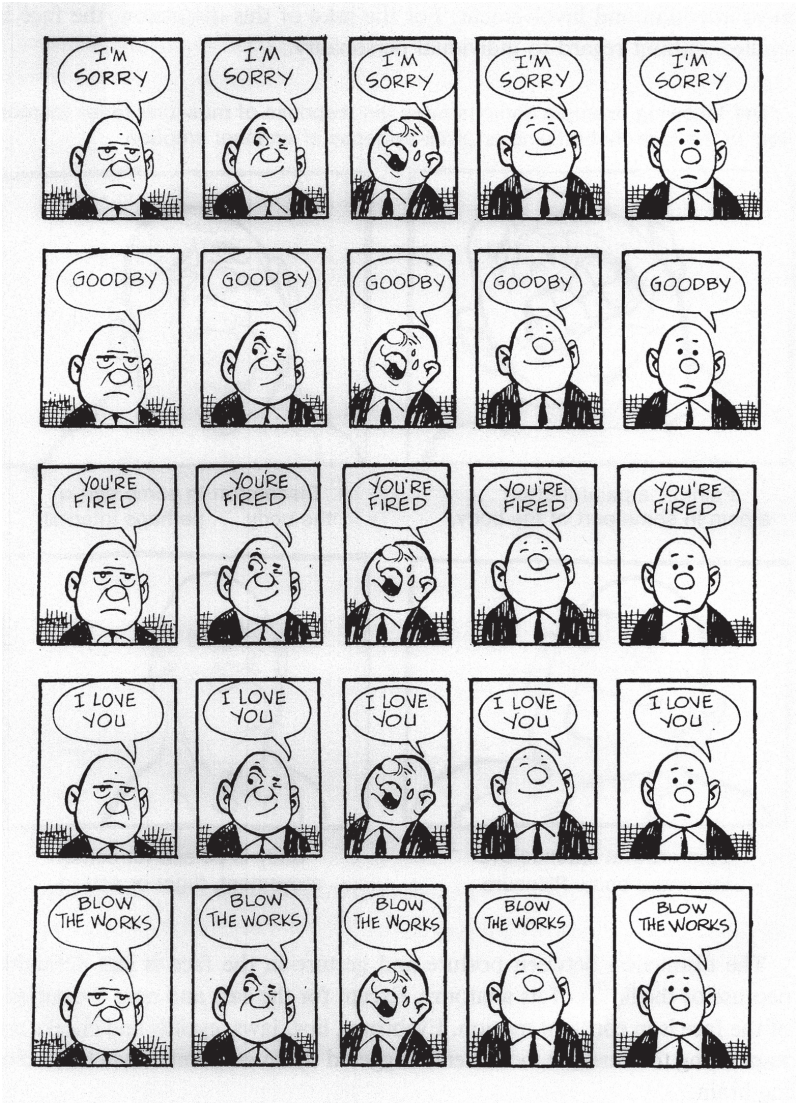

Figure 1: The interaction between words and pictures. From Eisner 1985: 110.

Row by row, this cartoon character conveys same verbal message while displaying different facial expressions. In the first panel of the first row, verbal–visual interaction conveys puzzlement or consternation, while in the penultimate panel smug satisfaction is conveyed – he is not *really* sorry. Column by column, this character conveys different verbal messages while displaying the same facial expression. In the penultimate column, a smiling"Goodby [sic]" indicates relief at your departure, while a smiling "Blow the works" indicates approval.

Combing Gestalt psychology and Peirce's semiotics, I have outlined a process by which the interaction of the verbal and the visual leads from perception to meaning.

In so doing, seemingly, I face a difficulty: surely, a theory of meaning and a theory of presence are not the same. This difficulty, however, is only apparent. In *Chaim Perelman,* Gross and Dearin defined a "superordinate" form of presence as the "cumulative effect of interactions" among arrangement, style, and invention (Gross and Dearin 2002: 135). But to say this, I think, is the equivalent of saying that, while rhetoric's function is, in Aristotle's words, "to see the available means of persuasion in each case" (Aristote 1991: 1355a), the effective employment of these means in a particular case creates a single Gestalt that is the psychological equivalent of presence. In persuasive texts, to trace the genealogy of presence is to reveal it as the synergy of "all the available means of persuasion." In this paper, I solve the mystery of presence in Darwin's *The Structure and Distribution of Coral Reefs* by showing how the synergy of all of the available verbal and visual means of persuasion creates a perceptual, argumentative, and narrative Gestalt.

THE PERCEPTUAL BASE

Because the creation of perceptual presence is Darwin's first task, he begins his monograph by describing Keeling Atoll, a description so detailed that readers are cast in the role of virtual witnesses who can attest to the congeries of facts soon destined to be transformed into evidence for his argument. Below is an example of this stylistic technique, this thick description that creates perceptual presence, a presence that is, at the same time, a testament to Darwin's meticulousness, a projection in every sentence of the *ethos* of the careful researcher who, literally, leaves no stone unturned:

> On the outside of the reef much sediment must be formed by the action of the surf on the rolled fragments of coral; but, in the calm waters of the lagoon, this can take place only in a small degree. There are, however, other and unexpected agents at work here: large shoals of two species of Scarus, one inhabiting the surf outside the reef and the other the lagoon, subsist entirely, as I was assured by Mr. Liesk, the intelligent resident before referred to, by browsing on the living polypifers. I opened several of these fish, which are very numerous and of considerable size, and I found their intestines distended by small pieces of coral, and finely ground calcareous matter. This must daily pass from them as the finest sediment; much also must be produced by the infinitely numerous vermiform and molluscous animals, which make cavities in almost every block of coral. Dr. J. Allan, of Forres, who has enjoyed the best means of observation, informs me in a letter that the Holothuriæ (a family of Radiata) subsist on living coral; and the singular structure of bone within the anterior extremity of their bodies, certainly appears well adapted for this purpose. (Darwin 1984: 14)

In his creation of perceptual presence, Darwin now shifts to the visual. He begins with a navigator's chart. In Figure 2, the first Gestalt principle foregrounds the atoll against its surrounding ocean and enclosed lagoon, while the Gestalt principle of contrast differentiates the atoll from the coral base on which it is superimposed. Figure 2 is the basis for a diagram Darwin will soon produce, a semiotic spatial transformation that

will reveal aspects of the atoll's structure that will prove pertinent to the persuasive case he wishes to make.

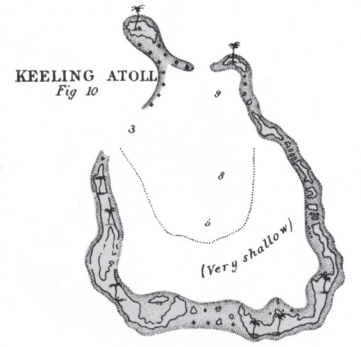

Figure 2: A navigator's chart of Keeling Atoll. From Darwin 1984: Plate I.

In constructing Figure 3 from this chart, Darwin rotates it 90^0 on its axis, a rotation that discloses it in vertical section. To do so, he employs a new code, a graphic code that simplifies the atoll's contours to reveal its essential structural features. By means of considerable distortion he also clarifies aspects of those features that would be masked by a rendering in true proportions.[1]

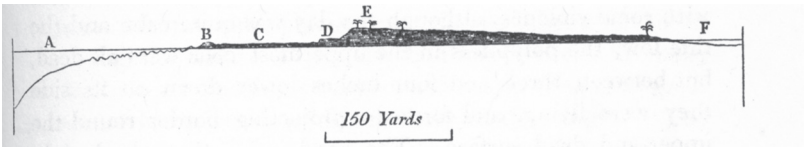

Figure 3: A diagram displaying the structural features of Keeling Atoll. Darwin 1984: 5.

A—Level of the sea at low water: where the letter A placed, the depth is 25 fathoms, and the distance rather more than 150 yards from the edge of the reef.

B—Outer edge of that flat part of the reef, which dries at low water: the edge either consists of a convex mound, as represented, or of rugged points, like those a little farther seaward, beneath the water.

C—A flat of coral-rock, covered at high water.

D—A low projecting ledge of brecciated coral-rock, washed by the waves at high water.

E—A slope of loose fragments. Reached by the sea only during gales: the upper part, which is from six to twelve feet high, is clothed with vegetation. The surface of the islet slopes gently to the lagoon.

F—Level of the lagoon at low-water.

[1] "The section is true to the scale in a horizontal line, but it could not be made so in a vertical one, as the average greatest height of the land is only between six and twelve feet above high-water mark" (6). See Brown I, facing p. 271 for Darwin's original sketch.

The diagram permits us to see the island's structural features as a single Gestalt, a task no words could accomplish, But it is only words that can identify these as features; moreover, it is only words that can highlight the crucial role of one particular feature: "The wood-cut represents a section across one of the islets on the reef, but if all that part which is above the level of C were removed, the section would be that of the simple reef, as it occurs where no islet has been formed. It is this reef which essentially forms the atoll" (Darwin 1984: 10). Words and diagram are closely interwoven, a linkage marked by the letter 'C', not in this case primarily a symbol, but a Peircian deixis.

The diagram has undergone another semiotically significant transformation. In creating it, Darwin has displaced the atoll from its geographical context; he has re-contextualized it geometrically by means of a superimposed grid that signals a significant epistemic shift: from an object in the world of nature to an object in the world of theory. The diagram's geometrical character is now at the center of our field of attention: the atoll has become its structure.

It will be crucial to Darwin's argument to show that the structure of Keeling atoll is, in all its essential aspects, typical. In pursuit of this goal , Chapters 2 through 4 detail the similarities among the three classes of reef-island systems – atolls, barrier reefs, and fringing reefs. They do so by means of an extensive catalogue of reef-island systems and a comprehensive anthology of charts whose comparison is made simpler by the adoption of a uniform visual code the chart of Keeling Atoll exemplifies.[2] This catalogue and these charts demonstrate that reef-island systems share all of their essential structural features; in effect, they form a single Gestalt:

> The general resemblance between the reefs of the barrier and atoll classes may be seen in the small, but accurately reduced charts… [T]his resemblance can be further shown to extend to every part of the structure… If we look at a set of charts of barrier-reefs, and leave out in imagination the encircled land, we shall find that, besides the many points already noticed of resemblance, or rather of identity in structure with atolls, there is a close general agreement in form, average dimensions, and grouping (Darwin 1984: 41, 45).

By the end of the first part of *Structure*, Keeling Atoll has come to stand for all reef-island systems. This is a transformation from the iconic to the symbolic, effected through verbal-visual interaction.

Darwin's initial model is static, a status emphasized by the assignment of agency to persons rather than to geological forces. Darwin and Fitzroy observe and measure ; Liesk and Allan observe and inform; the earth holds still for its portrait. Nevertheless, Darwin anticipates the dynamic theory he will soon reveal, a theory that accounts for the structural features he has just uncovered. In a first step, in the first part of Structure, he suggests that these feature are "the effect of uniform laws… that some

[2] "In the several original surveys, from which the small plans on this plate have been reduced, the coral-reefs are engraved in very different styles. For the sake of uniformity, I have adopted the style used in the charts of the Chagos Archipelago, published by the East Indian Company, from the survey by Captain Moresby and Lieutenant Powell." (Darwin 1984: xvii)

renovating agency (namely subsidence) comes into play at intervals, and perpetuates their original structure" (Darwin 1984: 24; see also 31). This hint foreshadows a transformation that will allow us to re-read a passage like the one below as evidence in an argument for the theory of subsidence Darwin will soon proffer:

> On the western side, also, of the atoll, where I have described a bed of sand and fragments with trees growing out of it, in front of an old beach, it struck both Lieutenant Sulivan and myself, from the manner in which the trees were being washed down, that the surf had lately recommenced an attack on this line of coast. Appearances indicating a slight encroachment of the water on the land, are plainer within the lagoon: I noticed in several places, both on its windward and leeward shores, old cocoa-nut trees falling with their roots undermined, and the rotten stumps of others on the beach, where the inhabitants assured us the cocoa-nut could not now grow. Captain Fitzroy pointed out to me, near the settlement, the foundation posts of a shed, now washed by every tide, but which the inhabitants stated, had seven years before stood above high watermark. (Darwin 1984: 17-18)

THE ARGUMENTATIVE SUPERSTRUCTURE

The same facts that were employed in the first part of *Structure* to build a static model of the reef-island system form in its second part the inductive basis of a causal argument for a dynamic theory based on the subsidence of large portions of the earth's crust. In this radical re-contextualization, we move from description secured by facts to theory secured by evidence; we move from perceptual to argumentative presence. Despite his theory's actual origin in a bold analogical leap – a heroic re-envisioning "in imagination" –[3] Darwin understood that it was only by means of accumulation of overwhelming evidence that he could convince his professional peers of its truth. He devoted five years to this tedious but necessary task: "it is very pleasant easy work putting together the frame of a geological theory," he wrote, "but it is just as tough a job collecting & comparing the hard unbending facts" (*Correspondence,* II, 207).

If his argument was to be given a fair hearing, however, an opportunity to become fully present in the minds of readers, Darwin had to give a fair hearing to competing theories. It was his personal and professional misfortune, however, that his chief competitor was his mentor and friend, Charles Lyell. "The circular or oval forms of the numerous coral isles of the Pacific with the lagoons at their centre," Lyell had

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[3] Darwin did not arrive at his theory by an inductive route; far from it: "No other work of mine was begun in so deductive a spirit as this, for the whole theory was thought out on the west coast of South America, before I had seen a true coral reef. I had therefore only to verify and extend my views by a careful examination of living reefs. But it should be observed that I had during the previous two years been incessantly attending to the effects on the shores of South America of the intermittent elevation of the land, together with denudation and the deposition of sediment. This necessarily led me to reflect much on the effects of subsidence, and it was easy to replace in imagination the continued deposition of sediment by the upward growth of corals. To do this was to form my theory of the formation of barrier reefs and atolls." (Darwin 1959: I, 58)

asserted in his magisterial *Principles of Geology*, "naturally suggest the idea that they are nothing more than the crests of submarine volcanoes, having the rims and bottoms of their craters overgrown by corals" (Lyell 1991: II, 290). In Darwin's view, Lyell's theory had to be abandoned because it could not explain the existence of fringing or of barrier reefs. Neither could it explain the fact that all reef-island systems were low-lying or that the coral of which they were mainly composed could live only in relatively shallow waters. In addition, the theory was undermined by the general distribution of reef-island systems far from volcanic areas.

Darwin solved his rhetorical problem – his need to dismiss Lyell's theory without criticizing Lyell – by an exercise in diplomacy. Throughout the monograph, Lyell is treated as an authority and, in one particular case, an authority on subsidence, the very mechanism behind Darwin's own theory: "It is very remarkable that Mr. Lyell, even in the first edition of his *Principles of Geology*, inferred that the amount of subsidence in the Pacific must have exceeded that of elevation, from the area of land being very small relatively to the agents there tending to form it, namely, the growth of coral and volcanic action" (Darwin 1984: 95; see also 29, 71-72, 118, 137, 143, 175).

This strategy succeeded. When Darwin published his theory, Lyell's concurrence was virtually immediate and especially gratifying: "I must give up my volcanic theory for ever," Lyell wrote, "though it cost me a pang at first, for it accounted for so much, the annular [circular] form, the central lagoon, the sudden rising of an isolated mountain in a deep sea" (Darwin 1959: I, 293). Vital to that acceptance is the fact that Darwin's rival theory is at bottom Lyellian, an application of Lyell's own central insight that the earth's current configuration is the result of gradual change over eons of geological time.

Having dealt with and dismissed rival theories, most especially that of his mentor, Darwin can now devote the penultimate chapter of *Structure* to an argument in favor of his own. According this theory, subsidence, the gradual descent of large portions of the earth's crust, when accompanied by slow coral growth, causes the transformation from fringing to barrier reefs and from barrier reefs to atolls. This is a *vera causa* argument with a tripartite structure: subsidence exists, is competent as a cause of the evolution of reef-island systems, and is in fact responsible for that evolution.[4]

This causal claim is an inference from two sets of facts, introduced by Darwin in the form of a rhetorical question:

> What cause, then, has given to atolls and barrier-reefs their characteristic forms? Let us see whether an important deduction [that is, inference] will not follow from the consideration of these two circumstances, first, the reef-building corals flourishing only at limited depths; and secondly, the vastness of the areas interspersed with coral-reefs and coral-islets, none of which rise to a greater height above the level of the sea, than that attained by matter thrown up by the waves and winds. (Darwin 1984: 90)

[4] The argument in *Structure* is therefore a precursor to the central argument in *Origin of Species,* as analyzed by Hodge (1977): natural selection exists, is competent to cause the evolution of species, and is in fact responsible for that evolution.

Because it is characterized by these defining features, Bora Bora will be the exemplar for Darwin's dynamic theory. An island surrounded by a barrier reef, it is in an intermediate stage between fringing reef and atoll. Readers first meet Bora Bora in the form of a woodcut, seeing it as a traveler would. In Figure 4, Mt. Otemanu, dotted with coconut palms, dominates the foreground of the scene. Behind the mountain is a placid lagoon. In the background is a barrier reef, surmounted by an atoll. Although the atoll is partially obscured, the Gestalt principle of good continuation permits us accurately to reconstruct what we cannot see. Even in this realistic depiction, Bora Bora's re-contextualization as a theoretical object has stealthily begun. Darwin says that he has "taken the liberty of simplifying the foreground, and leaving out a mountainous island in the far distance" (Darwin 1984: 2n). The woodcut has begun to reveal Bora Bora's essential structural features. The march toward argumentative presence has begun.

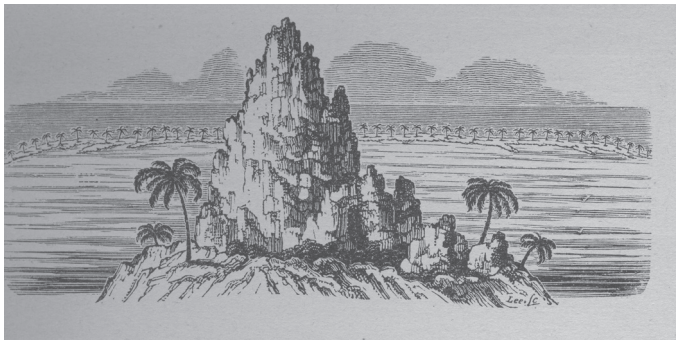

Figure 4: View of Bolabola [Bora Bora] featuring Mt. Otemanu, the island's highest point. From Darwin 1984: 3, Figure 2.

The next step toward a dynamic theory is the transformation of Bora Bora into a chart, a semiotically significant 90^0 rotation of its eye-level depiction. In this rendering, the illusion of depth in Figure 4 – the product of an artistic code composed of shading and perspective – has been replaced by the imposition of a scale: what was perceived is now measured.[5] In the interest of bringing the reef-island's structure unequivocally in the foreground, the actual has also been simplified: some lagoon islets have been omitted and no attempt has been made to depict the distribution of the island's flora. In line with this purpose, the actual has also been enhanced: the depth of the lagoon in fathoms is variously indicated, and the lagoon is, as it were, drained in order to reveal the contours of its underlying reef. In this transformation, what is representational in the realistic rendering is symbolized in the chart so as not to distract from the its essential purpose. In the realistic rendering, light and shade represented the mountain as a three-dimensional object; in the chart, the height of the mountain is symbolized by parallel lines, signaling a change from an artistic to a cartographic code. In the artistic rendering, the size and location of the coconut palms is reproduced; in the chart, the repeated coconut palms are transformed into symbols designed to help

[5] The scale is presented separately on p. 216.

viewers differentiate by contrast the land from the reef below (Darwin 1984: 215). It is this uniformity of representation that facilitates structural comparisons among reef-island systems, a uniformity that in turn facilitates the transformation of facts on the ground into evidence for Darwin's argument for his dynamic theory.

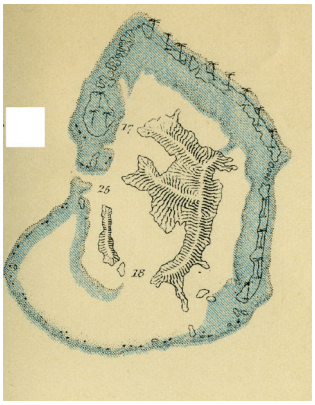

Figure 5: Chart of [Bora Bora]. From the survey of Capt. Duperrey in the *Coquille.* Scale ¼ inch to a mile. The tinted area shows the extent of the reef. The area that encloses the coconut trees (exaggerated in scale) represents the coral islets. The numbers 17, 28, and 25 are the depth of the lagoon in fathoms of six English feet. From Darwin 1984*:* Plate I, Figure 5.

In transforming the chart of Bora Bora into the companion diagrams in Figures 6 and 7, Darwin advances farther into the realm of theory. He now rotates the chart 90^0 on its axis to disclose a vertical section, simplifying the atoll's contours to place its essential structural features in the Gestalt foregound; at the same time, by means of considerable vertical distortion, he clarifies aspects of those features that would be masked by a rendering in true proportions. Finally, he superimposes a grid so that the reader can view those features through a geometrical lens.

So far, he is following the procedure he used in the case of Keeling Atoll; in the case of these diagrams of Bora Bora, however, the static has been transformed into the dynamic. In contrast to Figure 3, Figure 6 depicts evolutionary succession as a consequence of subsidence, a result Darwin asks the reader to reproduce by animating the foregrounded Gestalt "in imagination":

> Let us in imagination place within one of the subsiding areas, an island surrounded by a «fringing reef,» – that kind, which alone offers no difficulty in the explanation of its origin. Let the unbroken lines and the oblique shading in the woodcut [Figure 6] represent a vertical section through such an island; and the horizontal shading will represent the section of the reef. Now, as the island sinks down, either a few feet at a time or quite insensibly, we may safely infer from what we know of the conditions favourable to the growth of coral, that the living masses bathed by the surf on the margin of the reef, will soon regain the surface. The water, however, will encroach, little by little, on the shore, the island

becoming lower and smaller, and the space between the edge of the reef and the beach proportionally broader. (Darwin 1984: 98-99)

Figure 6 stands for any reef-island system: the anchored boat stands for the depth of any lagoon; the palm trees, the existence of land on any coral reef; the differential hatchings, any reef and its island ; the solid lines, the current state of any reef-island system; the dotted lines, its future. Animated, this diagram is simultaneously iconic and indexical. It possesses an argumentative presence.

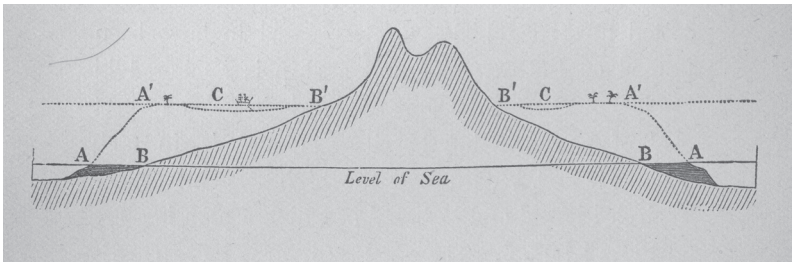

Figure 6: A vertical section of Bolabola [Bora Bora], showing formation of a fringing reef at AA and a barrier reef at A' A'.

"A A – Outer edge of the reef at the level of the sea.

BB – Shores of the island.

A' A' – Outer edge of the reef, after its upward growth during a period of subsidence.

C C – The lagoon-channel between the reef and the shores of the now encircled island.

B' B' – The shores of the encircled island."

"N. B. In this, and the following wood-cut, the subsidence of the land could only be represented by an apparent rise in the level of the sea."

Note the ship at anchor to the right of C.

(From Darwin, *The Structure and Distribution of Coral Reefs.* Figure 4. Page 98.)

In Figure 7, Bora Bora has subsided further still: the barrier reef has become an atoll. Now A'' designates the sea, C', to the lagoon. The island has disappeared.

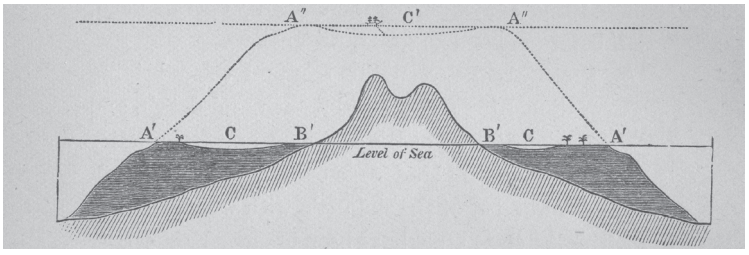

Figure 7: Vertical view of Bobola [Bora Bora], showing the formation of an atoll.

"A' A'—Outer edges of the barrier-reef at the level of the sea. The cocoa-nut trees represent coral islets formed on the reef.

C C—The lagoon-channel.

B' B'—The shores of the island, generally formed of low alluvial land and of coral detritus from the lagoon-channel.

A" A"—The outer edges of the reef now forming a atoll.

C'—The lagoon of the newly-formed atoll. According to the scale, the depth of the lagoon and the lagoon channel is exaggerated."

Note the ship anchored in the lagoon to the left of C'.
From Darwin 1984: 100, Figure 5.

In Figures 6 and 7, Darwin has shifted our attention from the appearance of Bora Bora at any one time to the evolution of any reef-island system over time. This is a transformation from the indexical to the symbolic. Bora Bora has become a model for the dynamics of all reef-island systems:

> We are now able to perceive that the close similarity in form, dimensions, structure and relative position … between fringing and encircling barrier-reefs, and between these latter and atolls, is the necessary result of the transformation, during subsidence, of the one class into the other. On this view the three classes of reefs ought to graduate into each other. (Darwin 1984: 102)

As a consequence of this transformation, Darwin's initial classification of reef-island systems is revealed as a convenient fiction, a concession to the short life-span of human beings who, though they cannot see, can by means of argument bring to the forefront of their consciousness the evolution of these systems and the *vera causa* of that evolution.[6] Darwin's causal argument for the evolution of reef-island systems is now fully present.

THE NARRATIVE SUPERSTRUCTURE

Three years before *Structure,* in the *Voyage of the Beagle,* Darwin had envisioned the unique history of the earth as the interplay of tectonic forces over geological time: "We may thus, like unto a geologist who had lived his ten thousand years," he said, "and kept a record of the passing changes, gain some insight into the great system by which the surface of this globe has been broken up, and land and water interchanged" (Darwin 1962: 480). To realize this vision in fact, however, the master argument of *Structure* must be transformed into a master narrative: argumentative must be transformed into narrative presence. Because geology is a historical science, geological theories cannot stop at process explanations.

[6] Species will have a similar status in Darwin's *Origin of Species.*

Unlike their fictional counterparts, scientific narratives are credible only so long as their underlying arguments hold true. In a historical science like geology, arguments and the narratives inferred from them are therefore epistemologically equivalent. By the time Darwin concludes his argument in favor of his theory of subsidence, Keeling Atoll and Bora Bora have been transformed into typical reef-island systems; at the same time, they have been turned from material into theoretical objects, defined by their geometry in relation to their surrounding seas, and characterized by subsidence, a fundamental force that alters that relationship. But they have not yet been transformed into historical objects.

To do so, what has been de-contextualized in the interest of theory must be re-contextualized under the dominance of theory: "the history of [a particular] atoll" can be reconstructed only if the general argument for subsidence is "modified by occasional accidents which might have been anticipated as probable" (Darwin 1984: 114). Only in so far as the geological features of a particular reef-island system are taken into consideration can we imagine what its past might have been and what its future is likely to be. The particular geological features of New Caledonia, for example, allow us to turn a general process into a specific narrative, to envision the story of a unique future that stems from a unique past:

> if, in imagination, we complete the subsidence of that great island, we might anticipate from the present broken condition of the northern portion of the reef, and from the almost entire absence of reefs on the eastern coast, that the barrier-reef after repeated subsidences, would become during its upward growth separated into distinct portions; and these portions would tend to assume an atoll-like structure, from the coral growing with vigour round their entire circumference, when freely exposed to an open sea. (Darwin 1984: 110)

The final chapter of *Structure* demonstrates that what applies to New Caledonia applies to every reef-island system. In Figure 8, we see a map of the Pacific Ocean that indicates, by its contrasting colors, the location of such systems and of the "Ring of Fire", the chain of volcanoes at the margins of the Pacific. On this map, the systems colored light brown designate areas that "have remained stationary or have been upraised" (Darwin 1984: 124). Areas of volcanic activity are colored vermillion. In contrast, reef-island systems colored blue designate areas of general subsidence. In accordance with Darwin's persuasive purpose, the Gestalt principles of proximity and foregrounding give visual prominence to this chain of reef-island systems that subsidence has created.

In this map, the reversion to iconicity is only apparent; in this final chapter, we are asked to see the Pacific "under the theoretical point of view of the last chapter" (Darwin 1984: 123). Given this point of view, the map is simultaneously a representation of the network of reef-island systems and a representation of a theory of their distribution in space and time: it is "corroborative of the truth of the theory" that reef-island systems are distributed according to whether the surrounding areas have subsided, been elevated, or remained stationary (Darwin 1984: 124). In other words, map is, at the same time, iconic and indexical: it is an effect that points its cause. The map is also symbolic – it stands for the truth of Darwin's theory of subsidence.

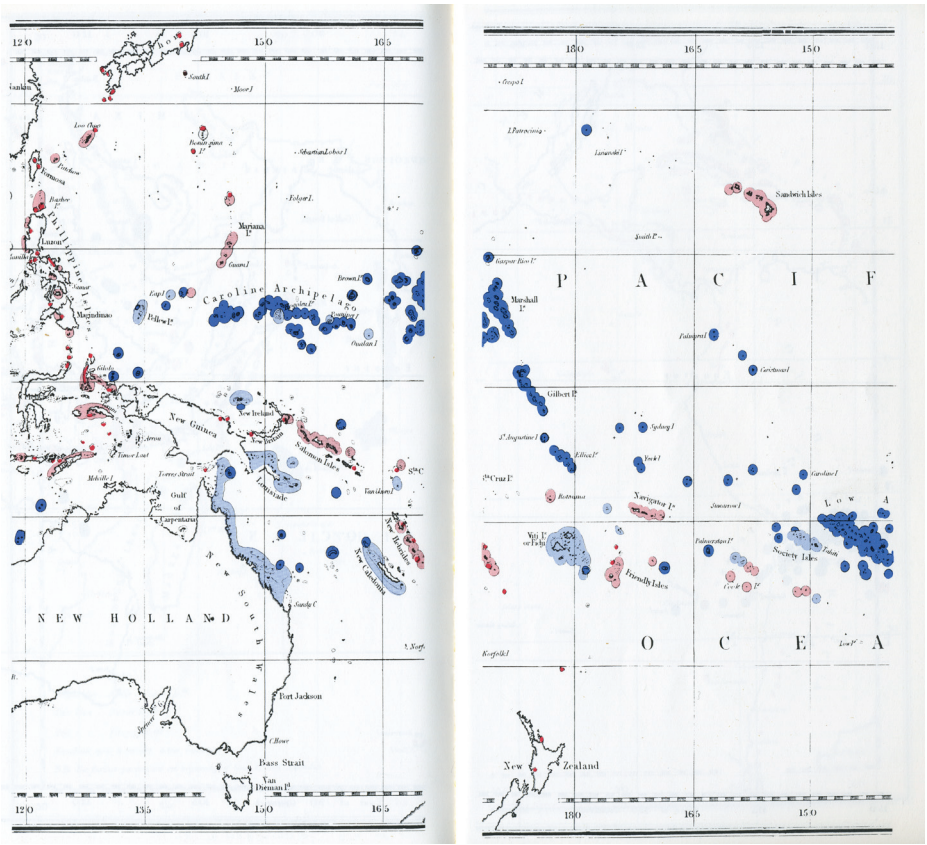

Figure 8: Atolls, barrier, and fringing reefs of the Pacific. The scale is such that each square contains 810,000 square miles.[7] The dark blue represents atolls, the light blue, barrier, the light brown, fringing reefs. From Darwin 1984: Plate III. For an updated version of Darwin's map, see Schuhmacher 1976, inside front and back covers and their flyleafs.

Darwin's insight looks forward to Wegener's famous theory of continental drift: the idea that shifts in the tectonic plates over time account for the configuration of the earth's land-masses and oceans. From the superimposition of the outline of these plates in Figure 9, we see from the cartographic code that barrier reefs (●) and atolls (▼) exist predominately in mid-plate regions. These are far from the destructive plate boundaries of subduction zones, regions where portions of the earth's tectonic plates dive beneath other plates into the earth's interior. This map is a conceptual *Prägnanz:* it simultaneously summarizes Wegener's theory and provides evidence in its favor.

[7] From the southern end of the Low Archipelago – the dark blue mass at the lower right margin – to the northern end of the Marshall Archipelago – the dark blue mass at the fold – the distance is 4500 miles (Darwin 1984: 143), the length of a round-trip between New York City and El Paso.

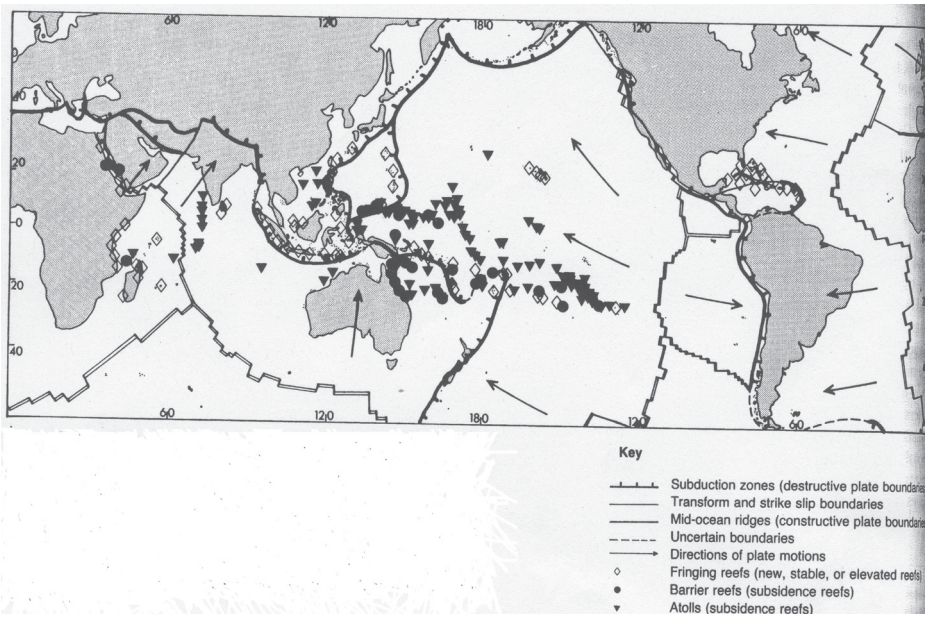

Figure 9: Bora Bora is at the center in the Pacific tectonic plate, far from "The Ring of Fire," the string of active volcanoes marked by destructive plate boundaries. From Rosen 1982: 520, Figure 2.

CONCLUSION

I have explored the exegetical possibilities inherent in Gestalt theory and Peirce's semiotics in order to trace the genealogy of argumentative and narrative presence back to its perceptual base. In Darwin's first masterpiece, *The Structure and Distribution of Coral Reefs,* details that originated in visual perception, expressed initially by means of description and depiction, are transformed into evidence for an argument in favor of a dynamic geological theory. But because geology is a historical science, this argument has to undergo a further transformation into a narrative specific to science, one that compels only so long as the argument that supports it holds.

The organization of *Structure* firmly undergirds this argumentative and narrative structure. In its first part, the text moves deliberately from the description and depiction of one reef-island system to the description and depiction of all reef-island systems. It is this generalization that forms the inductive base of Darwin's theory. In the second part of *Structure*, in arguing for subsidence as the *vera causa* of all reef- island systems, the text moves from a static model to its dynamic counterpart, a model that, however general its constitutive forces, produces a unique story in the case of each reef-island system, one that incorporates the accidents of a particular geological past. In the historical sciences, perceptual presence is regularly transformed into its argumentative counterpart; in turn, argumentative is transformed into narrative presence, a final transformation.

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