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ABSTRACT

A set of much examined scientific papers which specifically portray a controversial topic and also manifest ally-peer and competitor-peer enscripted audiences are those written by James Watson and Francis Crick concerning their discovery of the structure of deoxyribose nucleic acid (DNA). The theoretical perspective of an ally-peer and competitor-peer audience which scientist-writers enscript within their published works is a natural extension of theories of audience developed by Walter Ong, Adrea Lunsford and Lisa Ede, Jay Gragson and Jack Selzer, Lawrence Prelli and Bruno Latour. Watson and Crick's first publication, "A Structure for Deoxyribose Nucleic Acid," is a masterpiece of cautious, deferential rhetoric and was published on April 25, 1953 in the journal "Nature." As members of a small international research community or "invisible college," Watson and Crick were asking their ally/competitor peers to evaluate, write about, and discuss their text in hopes such attention would validate their proposed structure. By the time Watson and Crick wrote their second paper, they were more confident than ever about the truth of their claim to the structure of DNA. Deference appeared only through carefully inserted phrases which reflected cautious rhetoric, preventing their audience from picking up on an inappropriate, brash attitude from the lines of their text. Although written to discuss the possibility of a mechanism for self-duplication of DNA, their second paper was also written to enhance their position in the community and to keep their proposed structure in the minds of their audience. (Contains 16 references and 3 notes.) (RS)

Susan Perry

Allies and Competitors as Enscripted Audiences in Scientific Writing

Having reached a successful conclusion in the race to find the structure of deoxyribose nucleic acid, James Watson and Francis Crick elatedly shared their discovery with the the various other scientists who were each doing their own simultaneous work on the same puzzle. In turn, Maurice Wilkins, Rosalind Franklin, Linus Pauling, and the others who took their turn at the game board came to look at the model and each confirmed that the "structure was too pretty not to be true" (Watson 134). Thus approved, their vastly important discovery needed to be announced to the world. Watson and Crick prepared a series of drafts for publication, picked the scientific journal *Nature* as their vehicle, and with the finalized approved draft in their hands persuaded Elizabeth Watson, James Watson's sister, to type it "on the last weekend of March [1953]" (140). In The Double Helix, Watson describes the scene:

> There was no problem persuading her to spend a Saturday afternoon this way, for we told her that she was participating in perhaps the most famous event in biology since Darwin's book. Francis and I stood over her as she typed the nine-hundred-word article that began, 'We wish to suggest a structure for the salt of deoxyribose nucleic acid (DNA). This structure has novel features which are of considerable biological interest.' (159)[1]

The discovery rocked the world of science, most particularly biology; Watson and Crick hoped it would. When the last approvals from their immediate peers were in, the two scientists knew

publication of their findings was the next important step. In writing a paper for publication and world-wide exposure, Watson and Crick became scientist-writers and entered the realm of published writers seeking feedback from their peers.

In Science and Action, Bruno Latour explains the necessity of the publishing process, and states that scientists hope to "have written a paper that settles a fierce controversy once and for all. . ." (40). In order for new theories to be accepted as fact, published work requires attention from the scientist-writer's peers. All scientist-writers who publish in scientific journals hope for their work to be read, evaluated and even argued over. This process will hopefully validate the years of arduous research and careful writing for publication. And as Latour says, being ignored is far worse than "being either criticized or dismantled by careless readers . . . "(40). For a scientist-writer, never being read denies the existence of the research and inhibits subsequent discovery. If "readers ignore [the work], it cannot be turned into fact; it simply *cannot*" (40). Lawrence Prelli discusses the process scientific claims must go through to gain acceptance:

> A fresh claim, can of course, be accepted in full; but the "career" of a scientific claim could also be first appreciative understanding then further discussion, refining and testing by claimant and authorizers, and finally, confirmation of the origional claim and incorporation into the official body of knowledge. (112)

Thus, the scientist-author understands he/she is possibly writing for an audience which can simply ignore the written evidence of the work of careful discovery. For this reason, an evaluative audience

becomes a necessity, and the scientist-writer must understand and address and fictionalize the readers.

The scientist-writer, in writing for publication, understands the community in which his published work is received. "The relationship between writer and community can be conceptualized in at least two ways: the individual writer may be seen as an embodiment of the larger community's ethos, or the community may be seen as an audience which constrains the writer's options" (Sullivan 2). So, the scientist-author envisions addressing a human community who "are a specially trained audience that is authorized to establish that discourse as knowledge" (Overington 144). As such, the scientist sees himself as part of this community, visualizing a collection of people who have, as Kuhn argues, "undergone similar education and professional initiations"(379). The scientist, in preparing to write and publish, sees himself as a member of the scientific community, and as Greg Myers says, he writes "presenting--or creating--in a text [his] role in the scientific community" (43). He doesn't simply think of a nameless audience who will objectively read his work, and act on it arbitrarily. Although the scientist-writer is aware of a peer audience who is nameless, he is aware of specific collegues whom he hopes will read with care the text before them, and validate the theories presented by evaluating, possibly personally checking the data and eventually acknowledging the scientist's-writer's claims as valuable new information. This envisioned audience adds a sense of subjectivity to the group of peers he addresses in his text. A scientist inherently knows some peers will agree with his findings; some will not, dividing into camps. Therefore, the

scientist-writer enscripts within his text an audience of peers who will align with his work, and those who will question his work, possibly aggressively.

Since a critical audience is necessary for the scientist-writer, particular rhetorical care is given to addressing, engaging and involving the audience. In this paper, I present a theoretical perspective of an ally-peer and competitor-peer audience which the scientist-writer enscripts within his work. This ally-peer/competitor-peer theory is a natural extension of theories of audience developed by Walter Ong, Andrea Lundsford and Lisa Ede, Jay Gragson and Jack Selzer, Lawrence Prelli and Bruno Latour. These three lines all address the rhetorical consideration of audience. Walter Ong suggests a "fictionalized" audience and he says: "Scientists. . .all fictionalize their audiences, casting them in a made-up role and calling on them to play the role assigned" (17). Although they rely on Ong's theory of fictionalized audience, Ede and Lundsford acknowledge a real audience exists but that it becomes fictionalized when enscripted. Writers need to "adapt their discourse to meet the needs and expectations of an addressed audience" (166). In order to be read, (of primary importance to scientists) the writer:

> may analyze these reader's needs, anticipate their biases, even defer to their wishes. But it is only through the text, through language that writers *embody or give life to their conception of the reader*. . . .which implies that the writer somehow creates a mold to which the reader adapts . . . . (167, Italics added.)

So, according to Ede and Lundsford, the audience is invoked and molded in the writer's text, and they have an "understanding of audience addressed, with its focus on the reader, and audience invoked, with its focus on the writer" (167).

Gragson and Selzer develop this concept further by describing an enscripted audience (especially in scientific writing) which the writer "invokes explicitly [with] the shared information and common interests of that field" (31). Gragson and Selzer's mention of "common interests" suggests an understanding of the writer's audience and their identity as the audience invoked. But, Selzer, in a later work, also refers to the audience addressed as "concrete people," an audience of real people whom the writer can picture clearly in his mind ("More" 165). Properly written, the science manuscript, as explained in an earlier work by Douglas Park, presents a "writer [who] understands the identity of the audience and grasps a wealth of tacit and explicit knowledge about the form of the discourse and the way the subject can be treated" (189).

It is not just the distinction between the addressed and invoked audience that is of concern in this paper. Supplemental to that issue is the concept of the audience and authorization. From rhetorical studies in speech, Lawrence Prelli offers insight into the scientist's need to seek authorization from their peers:

> In science, authorization of new claims requires that a rhetor tacitly or explicitly comfirm commonplace concerns held by the scientific audience addressed. Claims must be grounded in that which the community considers reasonable. Scientific discourse is a rhetorical discourse because,

> among its other rhetorical features, it must offer content situationally defined as reasonable. (112)

As Prelli says, "scientists think strategically about what claims will be acceptable to audiences they value most. . . . scientists think rhetorically about audiences throughout their research work. Problems are chosen according to whether they are likely to be judged significant by the most valued audience"(111). Therefore, scientific audiences are "gatekeepers" who can grant the reasonableness of claims (112).

Latour, a social scientist, brings the argument down to the last definition needed for my theory. As stated above, scientist-writers know their peers divide into camps when a published text appears announcing new claims. The scientist-writer has a tacit understanding of competitors, and when he publishes, he "fends off opposition by enrolling many other allies"(43). Friendly peers who hold similar views are brought into the written text in order to brace the work for "survival in this world" (44). The scientist-writer works deliberatively towards this "survival" with careful rhetoric, quoting allies, and citing "stable statements over and over"(43). All of this is in an attempt "to avoid being misunderstood, destroyed, dismembered, ignored. . ."(44). However, the scientist-writer knows he will also generally be met with opposition by some members of his community who will argue with the newly published discovery, or at least check the data to verify the work. These are the competitor-peers, and for the publishing scientist their presence in his audience can cause him to "find himself immersed in a storm of political passions" (Latour 252). By their very nature, some knowledge claims are more controversial than

others. The controversy, on a certain level, is welcomed by scientist-writers since it provides the attention necessary for validation.

James Watson and Francis Crick's First Paper

Although much examined, one set of papers which specifically portray controversial publication and, also, manifest ally and competitor-peer enscripted audiences are those written by James Watson and Francis Crick concerning their discovery of the structure of DNA in their papers published approximately one month apart in the spring of 1953. Because the search for the structure of DNA became a race, Watson and Crick fictionalized an audience of divided peers, some who would receive their work positively, and others who would find fault with it. Since it is understood within the scientific community that attention to published works covering research is needed to finally validate the theory discussed, the two scientists enscript these two audiences within their work, imagining a storm of controversy they welcome. The publication of the two papers in 1953 was not the first time the two scientists claimed a discovery of the structure of DNA. "Twice already, Watson and Crick had proudly announced that they had solved the riddle and both times their model had been reduced to ashes" (Latour 2). Their work reflects an enscripted audience in the way the authors employ such things as understood levels of deference, the roles they ask their readers to fill, and a choice of journal for publication. The two papers, published approximately one month apart, were intended by the authors to accomplish something primarily different each time; therefore, they will be discussed successively.

Watson and Crick's first publication, "A Structure for Deoxyribose Nucleic Acid," is a masterpiece of cautious, deferential rhetoric. It was published on April 25, 1953, in *Nature*.[2] When the two scientists prepared the draft of the first paper to announce their discovery to the world, they made some important rhetorical decisions; they understood that the scientific community into which their important discovery was about to be received would expect the writers to project an orthodox ethos. Michael Overington explains a scientific ethos suitable for emerging scientists: "the education of the young scientist seeks to inculcate the norms, traditions, and beliefs of those masters with whom the individual is apprenticed. In that relationship, the neophyte learns how to think with the traditions that the master incarnates and ostentates" ("Scientific" 147). Theirs was a community with established power, and the two scientists enscripted this power into the paper knowing the work's survival depended upon it.[3] Any presentation of research is argumentation, and the first DNA paper was no exception, since "scientific knowledge involves argumentation before an audience" (144). Watson and Crick weren't working in a vacuum; rather, they were a part of a small international research community, or invisible college, as Overington describes:

> Indeed, invisible colleges are the communities within which scientific consensus is constructed. It is precisely these groups of persons which represent the scientific community to the individual. It is their attitude that is taken toward work,[sic] it is their judgement that is sought.(148)

Once the scientific community's demands were established in Watson and Crick's minds, the paper they sent to *Nature* included a balanced argument. To create this balance, the scientist-writers incorporate a cursory discussion covering their competitors' work on DNA, even adding a dismissive statement about Fraser's suggested three-chain structure, saying, "This structure as described is rather ill-defined, and for this reason we shall not comment on it" ("Structure" 737). In mentioning the model proposed by Pauling and Corey, a triple-chained model, Watson and Crick dismiss the work because it appears to be "the salt, not the free acid,"and the distances between the chemical bonds "appear to be too small" (737).

Not only does a discussion of a scientist peers' work on a given subject become a necessary rhetorical inclusion to create a balance in a published scientific text, it also shows deference to the others who are respected in the scientific community and as such must be recognized. Along with enscripting a scientific community which expected its etiquette to be practiced, Watson and Crick faced a challenging audience which they knew could invalidate their work by ignoring them as scientists, since both were novices. Understanding and enscripting deference to established scientists into the written text makes the work's acceptance more likely, and although their work was an enormous breakthrough, they knew immediate sustantiation was necessary, and deference to competitor-peers is enscripted into their first publication, since "publication makes research 'public' it does not make it knowledge" (Overington 148). Watson and Crick's first deferential action was to enlist friendly forces (ally-peers) before publication. This enlistment process was made clear in The Double Helix when the two scientists

invited their immediate collegues in to view the model constructed from their theory. Also, before publication, they sent copies of the paper to all close competitor-peers, seeking their opinions about how the text was handled. One in particular, Sir Lawrence Bragg, suggested, "a minor stylistic alteration," and Rosalind Franklin and Maurice Wilkins also requested a minor addition (Watson 138). By seeking their immediate peers' suggestions about their first text, the two scientists adopted a necessary deferential attitude which carried through into publication and is reflected in the writing itself.

Additionally, Watson and Crick displayed deference to their renowned competitors in the first DNA text by their careful use of language, refering to their DNA model as "A structure," not the structure. The text also includes other instances of deferential wording such as: "It is assumed," and "we have assumed," (737). For example, when the two writers disprove Pauling's theory, deference appears in their statement: "In our opinion, this structure is unsatisfactory for two reasons:. . .(737). By using the phrase "In our opinion," Watson and Crick remind their audience that they respected the more established scientist. And even though the scientist- authors dismissed Pauling and Corey's DNA model, they displayed deference when they say: "They kindly made their manuscript available" (737). Furthermore, since as Prelli says, Watson and Crick "suggest that their model was empirically adequate," they still carefully state, "so far as we can tell, it is roughly compatible with experimental data, but it must be regarded as unproved until it has been checked against more accurate

results"(737). Although the paper is "quietly confident," as Michael Halloran suggests it also:

> is the initial move in a rhetorical strategy at gaining and holding the attention of an audience. As such it presumes an understanding of science as a human community in which neither facts or ideas speak for themselves, and the attention of an audience must be courted. (Halloran 77)

The work must address with correct homage the members of the scientific community and carefully "court" the members of the writer's audience, and as Halloran says, Watson and Crick "in offering their model of DNA to the scientific world. . . simultaneously offered a model of the scientist, of how he ought to hold ideas and present them to his peers" ("The Birth" 78).

What do scientist writers, particularly Watson and Crick, ask of their audience? Validation of a discovery is the end-goal, and in writing and publishing, Watson and Crick primarily sought announcement and secondarily validation. "Watson and Crick's article is an example of rhetoric that induced expert audiences to cooperate in thought and practice with the symbolic orientation the rhetoric provided" (Prelli 236). Therefore, they a ked the scientific community to receive the announcement, envisioning an audience which was there to receive actively the information they so badly wished to impart. Since their work was done alongside a group of competitors, they had contact with along the way, they understood the concept of competitor-peers very clearly. When Watson and Crick came to a model for the structure of DNA that they were confident answered the question the biological community had been asking, they

enlisted their competitor-peers by showing them the model of their structure, thus turning them into ally-peers. They would not have felt particulary confident with their published announcement had they not been able to do so. This active audience switching from competitor to ally gave the scientist-writers a subjective feeling of their greater audience.

Once the paper was received, the Watson and Crick audience was further asked to validate the proposed DNA structure, requiring reading and consideration. Once the paper was read, their audience must think clearly about and understand the paradigm before them on the printed page. As Latour says, "a statement is fact or fiction not by itself but only by what the other sentences made of it later on" (38). Watson and Crick were asking their ally/competitor peers to evaluate, write about and discuss their text in hopes such attention would validate their proposed structure, ultimately wishing to have themselves accepted as scientists and be made a valid part of the scientific community, since "Fact construction is so much a collective process that an isolated person builds only dreams, claims and feelings, not facts" (41). We are again reminded of Ede and Lundsford's theory of "audience invoked," which they say places a focus on the writer. The two scientists, by asking their audience to read, evaluate and validate their written text inadvertantly focus on themselves and their need to become an accepted part of community.

As any scientist knows, a new discovery requires publication as has been established earlier in this paper. The choice of journal for publication is prescribed by the scientist's community and members of the future scientist-writer's audience, showing once more

the existence of ally/competitor-peers who almost hover around in ghost-like fashion. Watson and Crick chose *Nature* for their grand announcement to the scientific community. Why is *Nature* such a good choice for their particular discovery? 1) Subscribed to by established scientists and undergraduates alike, *Nature* is broad-based with a widely-read universal audience Not only is *Nature* read by a broad audience, "it is not specialized in any particular discipline" (Halloran 72). 2) *Nature* commands respect within the scientific community. 3) Watson and Crick were assured *Nature* "would publish the article promptly" (72). In The Double Helix, Watson writes, "On Tuesday [April 1, 1953] the manuscript was sent off to Bragg's office and On Wednesday, April 2, it went off to the editors of *Nature*" (140). "A Structure for Deoxyribose Nucleic Acid" appeared in *Nature* on April 25, thus proving the speed with which the scientist-authors were published. The search for the structure of DNA being the fierce race it was, the two scientists got their proposed structure out to as many of their competitor-peers as quickly as possible. This expeditiousness was necessary for two reasons: 1)They needed to announce the structure they knew the world was waiting for, hoping to cut into the race and claim first prize. 2)They also needed to enlist any ally-peers who would come forward and help with the validation process. There, naturally, is an excitement in competition, and no scientist wants to be the "Me Too." Prompt publication in a prestigious, broad-based journal helps to preclude this phenomenon from happening. In "Kairos in the Rhetoric of Science," Carolyn Miller says, "The persuasive task is much different in a time when a paradigm is just beginning to be challenged than it is in a period when everyone

believes a new one is needed" (319). This is why, she reasons, Watson and Crick chose a "short communication" for the announcement of their discovery. Also, as is stated above, Watson and Crick's strategy exemplifies community power as they show deference to established scientists, and in their choice of a journal for publication.

Watson and Crick's Second Paper

In a closing line of Watson and Crick's first paper, they told their audience: "It has not escaped our notice that the specific pairing we have postulated immediately suggests a possible copying mechanism for the genetic material" (727). This closing suggestion in the first paper was the stated basis for publication of their second paper. Their second text published in *Nature* on May 30, 1953 titled, "General Implications of the Structure of Deoxyribonucleic Acid," settled right in with the statement: "We have recently proposed a structure for the salt of deoxyribonucleic acid which if correct, immediately suggests a mechanism for its self-duplication" (964). The scientist-writers implied with the above statement that their second text was written simply because they wished to show the possibilities of a "mechanism for self-duplication," a mechanism illustrated in their first paper. Watson and Crick also were aware of a diminishing group of competitor-peers, and they wished to discuss further their model, thereby hoping to enlist a more significant ally-peer audience which would help them to establish a niche in the scientific community.

The community in which Watson and Crick hoped to establish themselves is a community, as Overington asserts, "where normal

science is the order of the day and revolutionary science an occasional event" (149). These established scientists who scrutinize "revolutionary science" were the individuals Watson and Crick had to impress. It is a community of considerable power and its members are the "validators of scientific knowledge" (Kuhn 22). With their second text, the two scientist-writers intended to solidify their claim to a place within the community, understanding the formidable challenge they faced. Since, as Overington suggests, young, unproven scientists must handle their claims with care and learn to "inculcate the norms, traditions, and beliefs of those masters," deference was still carefully enscripted into the text of their second publication (147).

By the time Watson and Crick wrote their second paper, they were more confident than ever about the truth of their claim to the structure of DNA. Their need for a balanced argument had fallen away, causing the second paper to be less lengthy. At this point, deference appeared only through carefully inserted phrases which reflected cautious rhetoric, preventing their audience from picking up on an inappropriate, brash attitude from the lines of their text. Despite these signals of deference, the second paper reflects the writers' sense that the audience was shifting from competitor-peers to ally-peers. The scientist-writers now wrote phrases such as: "which, if correct," "If this is true," "So far as is known," and "we are assuming." To modify their deferential phrases, however, Watson and Crick tell their audience: "Though the structure will not be completely proved until a more extensive comparison has been made with the xray data, we now feel sufficient confidence in its general correctness to discuss its genetical implications" (965). This one

sentence stands out from the rest of the paper, illustrating the scientist-authors' understanding of the need for deference, at the same time showing a confidence in the existence of an ally-peer audience.

The title has more strength. Instead of "A structure," Watson and Crick now say "the structure." Also, the general tone of the second text is more declarative. Although, the paper contains a few scattered cautious phrases, its general mood is far more declarative than the April publication. Sentences which suggest more strength, enscripting a larger ally-peer audience, are included such as the writer's discussion of the structure's base pairs: "The important point is that only certain pairs of bases will fit into the structure" (966). Also, their paper is strenghtened by their claim, "This pairing is strongly supported by recent analytical results" (967). Watson and Crick felt they could reasonably take a stronger, more positive tone in their second paper as they correctly assume their competitive-peer audience has diminished. Additionally, stronger, more declarative phrases and words add further to the tone of confidence. Portraying confidence which assumes a larger allied audience, the scientists wrote, "the other chain *must always* be thymine," and "The bases *are* joined together in pairs,. . ." (966, italics added). This same confidence undoubtedly helped to persuade remaining competitor peers that the issue was settled.

Conclusion

In both papers, the scientist-writers asked their audience to assume an active role. In the second paper, Watson and Crick's audience was not asked to receive, (the first paper placed a heavier emphasis on reception); rather they, were asked to evaluate the

second discussion with the hope that competitor-peers and ally-peers would finally come together and validate their knowledge. Although, the second paper formally was written to discuss the possibility of a "mechanism for self-duplication" in their proposed structure of DNA, Watson and Crick also wrote to enhance their position in the community and to keep their proposed structure in the minds of their audience. As Latour says: "Enough is never enough: years later in India and New Zealand other researchers were working on a so-called 'warped zipper' model that did everything the double helix does--plus a bit more" (13).

Because they had made previous ill-timed announcements, and ally/competitor-peers were firmly placed in their minds, Watson and Crick knew they needed to announce their discovery to the world as quickly as possible. Due to this problem, and since the two scientists were involved in a close race to discover the elusive structure for DNA, (the "secret of life" as Francis Crick called it) their first text, was carefully written, enscripting proper deference, and published in a well-chosen journal to get the word of their proposed structure out to their community. "Watson and Crick's article is an example of rhetoric that induced expert audiences to cooperate in thought and practice with the symbolic orientation the rhetoric provided" (Prelli 236). The continued existence of ally/competitor peers is further illustrated by the two scientist-writer's second publication. A more positive tone reflects their understanding of a changing peer audience. "The pair decided to present their claims more boldly when they realized how strongly the x-ray evidence contained in [companion papers published along with Watson and Crick's first announcement] supported their

proposed structure" (Prelli 347). With all of this in mind, Watson and Crick "dramatize themselves as intellectual beings in a particular style," and create for themselves "a particular image of the scientist speaking" (Halloran 75).

Notes

[1] James Watson wrote a popularized version of the discovery of DNA. Written in the form of a mystery novel, the text was also helpful in giving me a more personal understanding of the process the two scientists went through from beginning quest to publication of their triumphant discovery. For further reading, see Watson, James. The Double Helix. New York: Mentor, 1969.

[2] Watson and Crick primarily meant this first publication to be an announcement. The text contains simple unlabled drawings of their proposed structure, and the discussion is short and straightforward, composed of only nine paragraphs. It appeared in *Nature* and other scientific publications around the world.

[3] A friend of mine who has a PH.D. in biology and who has published papers over his research discussed the accepted format scientists are taught they must follow for publication. The inclusion of a balanced argument is not only a necessary rhetorical consideration, it also affords the scientist-writer the chance to evaluate other's evidence, discount it, thereby avoiding closing himself in.

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