TALKING DOWN:

AUDIENCE CONSTRUCTION IN RECENT SCIENTIFIC POPULARIZATION

ABSTRACT. *This paper treats audience construction as a necessary precondition for text creation. To establish a theoretical floor, I deconstruct the standard style and audience used by scientists in formal intra-technoscientific communication. I then examine six scientist-authors' constructions of explicit and implicit audiences whom they seek to reach via science books for the general public (GP). I conclude with a nod to Fuller's construction of an audience that subsumes the present paper's six primary subject authors.*

I. PRIMACY OF AUDIENCE

It is a truism among professional communicators that in all communication -- formal or informal, oral or written, professional or nonprofessional, academic or commercial -- the audience one has in mind strongly influences or even determines key elements of one's outgoing message (1). These elements may extend from style or voice (*e.g.* complexity of vocabulary and syntax) through assumptions about the reader (education, prior knowledge of concepts and terms) to author decisions involving citations, material allocated to appendices, sequence of facts and ideas, and core content.

My thesis in this paper is bipartite. First, I maintain that just as a scientist *qua* experimentalist constructs a hypothetical explanans that she then holds up to nature, so a scientist *qua* author preconstructs an audience that shapes her writing. And just as nature has the final say in how well a hypothesis fits reality, so the readers of a text have the final say in how accurately an author has construed them: nature and audience are the only actors in any technoscientific network with an absolute veto. The second part of my thesis holds that an author's construct of audience or audiences may be inferred from her text. In summary: whom one talks to shapes how one talks; how one talks implies whom one talks to.

The primacy of audience construction in technoscientific communication may first of all be examined via actor network theory, as follows:

1. The existence of a boundary (interface) is a necessary precondition for direct interaction between or among distinguishable actors;
2. A boundary's emergence defines two heretofore independent entities (individual or group) as continual or continuous actors in a technoscientific network throughout the boundary's duration;
3. No boundary means no direct interaction, and no direct interaction means no boundary. That is, in terms of formal logic: *I iff B iff I* (1a);
4. The boundary between the scientist who writes a popular science book and the general-public (GP) audience for whom it is intended, consists in the book itself;
5. The book-boundary defines author as actor to the reader, and reader as actor to the author.

Until a GP science book appears, the preauthorial scientist and pre-reader GP are not mutual actors in any meaningful sense. That is, they are not yet *direct* actors with respect to one other: they have not yet become *inter*actors. Certainly, the scientist who has yet to publish a GP book may have indirectly influenced GP who have yet to read it. GP may have read of the preauthorial scientist in the popular media, especially if he or she be of high profile, *e.g*. a Dawkins or a Gould (*q.v. infra*). The preauthorial scientist may also have done work resulting in commercial technologies that the prereader GP uses or recognizes: *cf.* the Josephson junction, named for the theoretical physicist who first propounded it and now ubiquitous in the semiconductor industry.

For her part, the scientist-author will have at least a vague preconception of prereader GP before publication, and possibly well before she begins to research and write. Within a larger social set, scientist-author and her GP readers may be fellow members in a political party; they will frequently be fellow citizens in a political state; they will always be fellow occupants of Earth. But despite all such indirect influences, *direct* interaction will not yet have occurred, and scientist-author and GP will not yet have become (inter)actors.

Publication immediately changes this, with degree of change varying directly as the accuracy of GP audience preconstruction. While one may dispute McLuhan's dictum equating message content with technological vehicle (1b), one must concede that any message which misreads its audience's expectations, or misconstrues its audience altogether, is (to the degree of its misconstrual) likelier to be ineffective. And while Einstein famously remarked that one does not understand something unless he can explain it to a four-year old, that aphorism may best be understood to counsel for *all* communication, intrascientific and otherwise, the maximum clarity, simplicity, and directness consistent with normative audience expectation and cognitive ability.

To give an example: a child's book might begin *This is Leo the Lion. Each day after lunch he takes a walk. When he walks he takes a cane.* No child's book would read *On his circadian postprandial excursions the eponymously christened Leo invariably possesses a rigid linear device originally created as a load-bearing prosthetic but employed in this case to display social status via demonstrated adherence to established norms of upper-echelon style* (2). Similarly, a research report in a refereed scientific journal would incorporate specialized technical vocabulary and periodic sentence structure, both types of complexity being alien to simpler GP forms.

II. TECHNOSCIENTIFIC AUDIENCE

No arcane analysis seems necessary to identify and characterize a scientist's main professional audience. In virtually all cases of formal intrascientific text, and especially when the medium is a refereed academic journal, the target audience will comprise the set of peer colleagues currently active in the author's immediate scientific subspecialty. On occasion a review paper may aim at a larger group; but even a wider professional audience remains delimited by some subsuming *uber*-discipline. A proteomicist, for example, would be expected to synopsize her recent research aimed at, and thus tailored to, other practicing proteomicists. At the same time, consensus within this author's

scientific *uber*-group should permit or encourage review papers. Extending our arbitrary case, such a review paper might entail a survey of laboratory techniques useful to bench experimenters using HRTEMs (high-resolution transmission electron microscopes), molecular biologists, *etc.* These subspecialties, while both peripheral to proteomics *per se*, could be subsumed under a more inclusive heading of 'cell physiology' and hence could usefully be dealt with *en masse* by a review paper.

Technoscience has found it useful to construct a set of standard scientific audiences each of which remains uniform throughout short-term reportorial activity in a given discipline. Further, the all-set of these one-per-discipline audiences has been constructed over decades into a profile that is highly consistent across languages, disciplines, and geographies. Using this refined construct, a scientist authoring a formal intrascientific text can assume her audience is engaged, attentive, intelligent, and scientifically literate; eager to keep abreast of relevant technical and political developments in her field; educated to world standards in relevant terms and ideas; possessed of an attention span that permits full absorption of the text's data and ideas; and sufficiently aware of technoscience's intense intraspecific competition to manifest a probing and critical skepticism. This audience is not necessarily hostile, but neither is it easy to convince (3). Further, the standard audience for a journal paper will be consciously or unconsciously constructed as STS-naïve. Such perception will be implicit if the scientist-author shares such STS naïveté, and explicit on those infrequent occasions when she does not (4).

The scientist-author and her peer audience have constructed, and continue to adjust through continual use, what could be called the Standard Style of scientific print communication. Principal characteristics of the Standard Style include:

i. *Passive voice*. This stricture reinforces the STS-naïve intrascientific consensus that fact is not constructed by unique individual effort but rather is, like a long-forgotten temple engulfed in

jungle vines, pre-existent and waiting to be uncovered by intrepid explorers. To change the metaphor: the scientist constructs her authorial self as an empty vessel conveying Pure Truth.

ii. *Subtle rhetoric.* The empty vessel self-construct is reinforced by the Standard Style's rhetorical approach: *viz.* to conceal all overt attempts to persuade, and to pretend that an audience shall be enlisted only by the brilliance of the published experiment's design and data. Such rhetoric as is deployed is kept subtle and indirect.

iii. *Detailed exposition of experimental methodology* reinforces a group bias of the standard scientific-audience construct: *viz*. that the reported data could readily be replicated given only the methodological description in the journal text. This viewpoint, equivalent to denial of tacit knowledge, is also STS-naïve. As Collins and others have convincingly demonstrated (5), the collegial trust it initially seems to manifest ["We accept your findings since you, our esteemed peer, have taken such pains to be exhaustive"] really masks a reluctance, amounting to effective refusal, to attempt replication due to endemic lack of time and funds. The average bench scientist spends every free cent and second on her own new research; her default response to someone else's paper is "I'll take your word for it." The coexistence of such faith-based acceptance with the otherwise skeptical approach tabled on p.4 may constitute an example of cognitive dissonance.

iii. *Citation*. Referencing well-known papers from other scientists consensually accepted as first-rank is a common *argumentum ad auctoritatem* in scientific publication. The gambit is universal and is meant both to establish allies and to confirm the author, her data, and her conclusions as noteworthy yet unthreatening -- cutting-edge, yet still cutting inside the box.

Here again, STS-naïve beliefs are shared and reinforced, especially what one might call Transcendent Science -- the triumphalist, quasi-religious dogma that scientists are part of a grand unending enterprise, united to deny all differences in gender, age, class, geography, ethnicity, and

historical era. Both author and audience implicitly agree to leave unperceived, or else perceived but ignored, that citation as an authority-based argument is essentially antirepublican. Citation's *Ur*-text is: "All scientists are equal but some scientists are more equal than others" (6).

Standard Style is essentially restricted to formal technoscientific print communications. In professional discussions of practice and theory among colleagues within a given discipline, oral interactions -- via videocon, telephone, Skype, and especially in person, as well as print interactions in the form of notes and E-mails -- tend to be comparatively relaxed. Such informality may permit real-time interaction with specialist professionals by nonspecialists (*i.e.* experts in a different discipline) who have acquired what Collins terms interactional expertise (5) (7) (30).

iv. *Multiple audiences.* Intrascientific print communication may construct scientist-audiences beyond the standard type discussed above. These audiences may variously be called indirect, implicit, or meta- audiences. While techniques of "talking through as well as talking to" a principal audience are not limited to scientific text communication (7a), scientific text can use them effectively. Scientists routinely author journal papers ostensibly directed at bench peers but really intended to reach past peers to a meta-audience of more senior scientists -- laboratory directors, university presidents, deans, and the like -- who control personal promotions and project funding.

III: THE GP AUDIENCE

I present the foregoing as a theoretical ground for my main aim: to examine how scientists construct audiences when they leave the Procrustean bed of writing in Standard Style, and reach out to some subconstruct of what they call the general public (GP).

Scientist-authors tend not to define GP, assuming rather that its makeup is intuitively obvious: a further example of STS naïveté. However, by subjecting to STS analysis four recent books that six high-profile academic scientists have written for GP consumption (*see* Bibliography p.26f), one can

infer to whom they believe they are speaking. For purposes of this discussion I propose two nested definitions of GP:

i. As a theoretical absolute, by GP I mean *the set of individuals who are not now and never have been professionals directly involved in the technoscience being reported on, particularly not as bench scientists*. Perhaps *never have been* is too strong a phrase: in practice, those who leave the bench have also left the discipline. One could even argue that the eminent older professionals who rule most scientific roosts are so far from epistemic currency that for purposes of popular science communication they are more usefully regarded as GP.

ii. If one proceeds to constrain the preceding first-level definition by various practical considerations such as those constraining *e.g.* book publishers, one engineers a working definition of GP as *the set of reasonably intelligent, bibliophilic, politically engaged adults of either gender age 18 and up, largely Anglophone and possessing a curiosity that ranges from the mild to the intense about new findings in the natural and social sciences* (8). Technically, this "publishers' definition" of GP is a subset of the initial all-set in Point i above. Under analysis, this practically generated subset may further fragment into *sub*-subsets ranging from politicians and potential funders to outright ideological enemies. Any one of these third-order audiences may be, and often is, used by a scientist addressing GP as a meta-audience -- a conduit to one or more audiences not explicitly identified from the outset. For instance, two authors examined below (Oreskes and Conway) appear to have constructed a principal GP audience that includes a meta-audience of influential legislators.

The question arises why a hard-working scientist would devote c.1000-3000 hours to research, note-taking, blocking, writing, polishing, and post-publication publicity, and contribute a corresponding slice of mindshare, to create a GP-audience book at all. What are the expected or hoped-for payoffs? Is any tangible achievement sought, or is the exercise of talking to the great mass

of nonscientists undertaken in the same spirit as all support for a doomed but noble cause, *i.e*. to prove to self and fellows the rightness of an author's beliefs, in a pearls-before-swine manner?

One answer to this question is simple enthusiasm. Exuberant exposition is common to all science writers, whether scientist-authors or, like myself, nonscientists intrigued by science. I can assert, based on four decades' direct experience as one of the latter, that one reason a scientist wishes to address GP, whether by authorship or by submitting to interviews from science writers, is to share with a wider audience her amazement and delight at what she has learned -- either from colleagues or, more usually, directly from her own experiments. This motivational attitude is perfectly expressed by a quotation chiseled into the main lintel of the National Research Council's Ottawa headquarters: *Great is truth and mighty above all things; the more thou searchest the more thou shalt marvel* (9).

In a sense, such exposition is targeted only at oneself. *Aha!* is said to oneself; the classic shout of *Eureka!* has no outside audience. Both ejaculations are cases of internal reflexivity. This is not a condemnation; I do not impute solecism to such untargeted communication. It may best be described as a credo, a statement of deep personal belief; as the marvelling culmination of a search.

Popular Style. Of the seven scientist-authors examined here, all but one (Fuller) use a similar approach to creating text by employing variants of what may be termed the Popular Style. This suggests that all six have constructed at least their primary audiences in a recognizably similar way.

The Popular Style inverts most major features of the Standard Style used for formal intrascientific print communication. The Standard Style uses passive voice and omits idiosyncratic personal information that would serve to individualize writers. It suppresses anecdote, excluding it from tabled data and even resisting its illustrative use. Indeed (pp.5f) the Standard Style presents the authors who employs it hardly as human at all, but as disembodied minds: "intellects vast, cool, and unsympathetic" (10). By standardizing on this style, technoscience asserts that its standard audience

construct is motivated strictly by linear rationality, and functions as a democratic peer group joined together to converge incrementally on changeless truth. Seen from this viewpoint, every scientific paper is at least in part a reinforcement ritual. By contrast, the Popular Style admits and even celebrates the scientist-author's individuality. It uses active voice, and adduces anecdote and personal information, in an informal and even chatty way.

That being said, within my sampled authors a range of adherence to Popular Style exists. Oreskes and Conway are the most formal, though their use of rhetoric that occasionally borders on the inflammatory marks their style as Popular, not Standard. More informal than Oreskes and Conway are Harry Collins and Robert Evans. This is surprising, since Collins and Evans have constructed a primary audience containing a higher percentage of academics than the construct of Oreskes and Conway. (It is possible that Collins and Evans are exerting pressure on the Standard Style to be less rigid, distant, and unemotional: in demotic terms, to 'loosen up.') A third and yet more informal style is Steve Fuller's. Fuller writes accessibly but is kept from chattiness by an audience construct that, like Collins's and Evans's, seems to hold a high percentage of professional academics.

Richard Dawkins and Stephen Jay Gould, whom I have grouped together as proselytizers or recruiters, write in a Popular Style that is fully demotic. In fact Gould often crosses this line and treats his audience with genial (and paternalistic) contempt. In so doing Gould tumbles into a trap that is an occupational hazard of scientist-authors. (Hence my paper's title (11).)

As noted in Part IV below, Dawkins has constructed an audience that is ignorant, but aware of its ignorance; eager for instruction; both earnest and well-meaning, if not terribly bright; and teachable by a patient, learned friend, namely Dawkins himself. To Dawkins his audience construct says, as colonizing powers have imagined indigenous peoples from Macedonians to Amerinds saying: *Come over and help us* (11a). Dawkins is glad to oblige.

IV. *PROSELYTIZERS*: GOULD & DAWKINS

Stephen Jay Gould's long essay *Rocks of Ages*, which like Dawkins's books was an instant bestseller and remains in print, seeks to position Gould as an impartial mediator above today's science-religion debates. Gould's main argument is that science and religion do not conflict because they deal in different things: In Gould's term they are distinct 'magisteria', *i.e.* bodies of instruction. Science examines nature and asks how; religion (including both theistic and nontheistic value systems) examines human groups and individuals and asks why. Science is concerned with matter and energy, its forms and transformations; religion with "the foul rag and bone shop of the heart" (12). Science makes no value judgments, religion makes nothing but value judgments. The two magisteria farm different (though bordering) fields and should be peaceful neighbours, even friends.

At first glance Gould has constructed an all-audience, *viz.* every thinking person with goodwill. This all-audience construct is passive, attentive, and eager to be enlightened by Gould, the *Magister Magisteriorum*, who says: Let not your hearts be troubled! Humanity's millennia-long disputes about these issues involve a needless misunderstanding! The two worlds do not overlap!

Predictably, Gould's book received a strong welcome from those scientists, probably the majority, who devoutly wish creationists and other holy-writ literalists would strike their tents and go away (12a). Render unto Caesar, Gould says to his secondary (creationist) audience construct: don't mess with us and we won't mess with you. Accept (or at least leave undisputed) our scientific magisterium's material evidence for natural selection over geological time, and we won't push into your moral magisterium with atheistic pseudosciences such as Marxism and Social Darwinism.

Gould's cheery remonstrance (Oh *do* stop fighting, fellows) was naturally doomed from the start. Creationists continue to present every statement in Scripture as eternal and nondebatable; scientific inscriptions (*e.g.* from magnetic resonance imaging) continue to outline a human body-

mind that is not dualistic soul-in-flesh but a cacophony of competing voices with environmental origins and neurochemical intermediates. Dawkins is right: conflict is inevitable: the wars go on.

The question arises why Gould, who probably realized from the outset the hopelessness of his offer to mediate, would still bother to make it. The answer may lie in the meta-audience that is probably the real if unspecified target of Gould's book: the millions of U.S. readers currently unengaged in, or unaware of, orthodox science's struggle with politically leveraged fundamentalism. In presenting himself as a secular Christ-figure, the exemplar of sweet reason and goodwill who courageously but benignly confronts the bigots, Gould like Dawkins has an eye out to recruit. If the wars continue, and they will, the scientific army in which Gould fancies himself a supreme commander could use another battalion or two. Gould is ready to swear them in.

For his part, in his GP science book *The Greatest Show on Earth*, the atheistic-positivist *enfant terrible* (12b) Richard Dawkins builds on arguments he tabled a generation ago in *The Blind Watchmaker* (1986). He presents and evaluates multiple sources of evidence for gradualist, neo-Darwinian evolution of all life. Dawkins opposes punctuated equilibrium, especially as espoused by Gould, who even after his death remains that concept's chief spokesperson; but both this aim and the audience Dawkins constructs to support it are secondary. Dawkins's main goal is to attack, nay demolish, the arguments of Biblical creationists, whether direct (*It's in the Book!*) or indirect (so-called 'intelligent design').

Dawkins presents all creationist arguments as identically fallacious, since they begin and end with inalterable belief in a Christian Bible 'inerrant' or literally exact in every detail. Creationist doctrines are not subject to the doubt, investigation, and disproof that lie at the core of science, says Dawkins; thus they are not facts but presuppositions, even superstitions. One cannot question God.

Throughout most of *The Greatest Show on Earth* Dawkins's approach seems placid and reasonable. He constructs as his authorial avatar a kind, long-suffering teacher addressing a fair-minded if somewhat stupid class. Yet this authorial persona frequently erupts into the shrillness of frustration, "the fury of a patient man" (13). Dawkins's nominal placidity reveals itself as a thin overlay on a deep substrate, *viz.* his incomprehension why gradualist neo-Darwinism is not intuitively obvious to the meanest intelligence. Gould wants to be everyone's friend; Dawkins (like Collins) seems to relish making enemies, for he assumes large parts of his audience construct to be obdurately hostile. Though Dawkins may strive to seem impartial, he has in reality produced a polemic.

It is in fact the argumentative nature of Dawkins's rhetorical structure that sheds most light on his audience construction. He is preaching to the converted -- not the born-again Christians on whom he heaps scorn, nor even those who (like him) accept neo-Darwinism totally and seek to reinforce preexisting belief; but those who, while not convinced, are at least sufficiently broadminded to entertain Darwinian ideas by exploring their foundations and ramifications. Dawkins does not really aim to convince any creationist even to reassess his views, let alone abandon them. He remembers the logical dealbreaker imbedded in the Pauline epistles: that no matter its rigor, any logical conclusion that opposes Christian doctrine is by definition a *reductio ad absurdum.* To the creationist, the best evidence in the world is rendered null and void the instant it challenges belief. Given such adamantine armor, one cannot convince a fundamentalist. Dawkins, then, is not really emulating Sisyphus. Rather he is saying to his main audience construct: "Don't blame me, I tried."

Dawkins is clever enough to admit this, and thus to construct as his main audience a 'silent majority' who have some post-secondary education; who have heard (without knowing details) of the struggle between orthodox science and creationist fundamentalists for control of the public school curricula; and whose opinions, once they are sufficiently roused to vote accordingly, will nullify the

creationist challenge and re-establish orthodox science as modern society's sole arbiter of K-12 biology education (and indeed of all critical modern thought). To this audience of swing voters Dawkins says: *Here is my evidence, which is irrefutable. Nonetheless creationists spurn my attempts to convince them, clinging instead to a creation myth unchanged since it was dreamed up by bronze-age goat herders. If you have a brain, you will know whom to support.*

One audience for this book, it must be remarked, is conspicuous by its almost total absence: the Islamic diaspora. The literalist parsing of Abrahamic creation myths is not restricted to Christianity; the steady growth of Muslim immigration into Western societies may be nurturing a parallel resistance to Darwinism even among otherwise well-educated newcomers. Most of the bile in *The Greatest Show on Earth* is directed at Christian creationists, whom Dawkins admits to have cleverly harnessed the techniques of partisan politics and mass propaganda to spread effectively their wrong-headed ideas and so gain democratic power and profile. Yet should semi-Westernized Islam add its support to Christianity and create a united front of 'People of the Book' to oppose Darwinism, even First World countries might be pressured by majority vote to enshrine and teach creationist theology as science -- an outcome Dawkins darkly hints at but never directly states.

It is unsurprising that Dawkins, who publicly opposes the methods and very existence of STS, employs none of its approaches: he is the very model of a modern STS-naïf. He eschews both internal and external reflexivity and implicitly adopts the *weltanschauung* of orthodox science: positivist, triumphalist, Whiggish, and small -' r ' republican. In Dawkins's construct, technoscience nobly and constantly narrows the gap between humanity's collective mind and objective reality; it steadily accumulates successes and corrects errors, functioning as a virtually automatic truth producer. This ideological construct, ostensibly opposed to religion, itself seems at times a kind of religion. *The Greatest Show on Earth* seems less a communication to GP audiences than a value statement with an

audience of one. Arguably, Dawkins's overarching theme is not Logic *vs.* Illogic, but his own core declaration of personal belief.

V. *WHISTLE-BLOWERS*: ORESKES & CONWAY

Naomi Oreskes and Erik Conway are two American historians of science who have co-written a strongly worded, science-based political jeremiad, *Merchants of Doubt*. This book is an outgrowth of articles each author has independently contributed to refereed journals such as *Historical Studies in the Natural Sciences* (14) and *Environmental Science and Policy* (15). In adapting and expanding this earlier material into a general-readership bestseller, Oreskes and Conway have vastly expanded their audience (16) from subspecialized-professional to GP.

Accompanying this widened audience is a corresponding relaxation of stylistic formality. Academic gives way to demotic; Standard moves toward Popular. Text modified by this transition includes widespread use of rhetorical questions (p.41: 'What was the basis for these claims? Not much') and breathless Italics (p.189: 'greenhouse gases were increasing *exponentially*, not linearly'). Presumably Oreskes and Conway use such rhetoric to make their points more convincing to GP; yet the overall effect frequently recalls Norman Mailer's wry assessment of American education (17).

In a U.S. climate of toxic ideological polarization, Oreskes and Conway are firmly on the side of the liberal angels. They have constructed an audience in their own image: politically engaged and predisposed to accept the existence of conspiracies stage-managed by the rapacious rich against the unknowing collective (18). Oreskes and Conway make a persuasive *prima facie* case for a set of such conspiracies that comprises prolonged and systematic attacks on profit-threatening scientific consensus about key issues. These attacks come from a few (identified) neoconservative academics in the pay of big business. Documentation here is extensive: the authors provide 65 pages of notes (pp.

279-343) and mention 'millions of pages' elsewhere consulted. As an exercise in GP popular-science communication supported by solid scholarship, *Merchants of Doubt* is an impressive achievement.

Oreskes and Conway appear to have constructed a secondary audience as a subset of their main GP audience: *viz.* government personnel (bureaucrats, administrators, legislators, and judiciary) with latent or active power to coerce a dilatory, evasive business community into more altruistic behaviour. Oreskes's and Conway's secondary-audience construction is an astute rhetorical tactic. While one may doubt the likelihood of, say, a harassed congressman reading this book's closely annotated 350 pages, especially given the human tendency towards confirmation bias (19) that the authors touch on at their book's conclusion, *Merchants of Doubt* is perfectly positioned to exert political influence upward from the large GP audience of voters it aims to persuade.

Parenthetically, it is troubling that, reflecting and reinforcing how Oreskes and Conway have constructed their main GP audience, the co-authors omit key details that would have blunted some of their central arguments. For example: Oreskes and Conway state at several points that the neoconservative authors they demonize, especially Seitz and Singer, sought to increase support for the Reagan administration's arms buildup by exaggerating the military threat of communism. However, Oreskes and Conway omit to note that defectors from the Warsaw Pact during Soviet hegemony have testified that entire divisions of motorized armor were maintained with engines running 24/7 at the Polish and Czech borders, pointed west and ready for instant invasion. As no invasion did occur, Oreskes and Conway in hindsight deride Seitz *et al.* as rightist scaremongers. Nonetheless U.S. hawkishness, which according to *Merchants of Doubt* stemmed strictly from overestimates of opponents' strength, may in reality have kept Western Europe safe. Whether Oreskes and Conway are correct in their assessment does not remove the stain on their impartiality: key contrary evidence has been omitted, and Oreskes and Conway stand convicted of *suppressio veri.*

Similarly, while the verdict is in for two other obfuscatory case histories that Oreskes and Conway examine, with both the chlorofluorocarbon and tobacco industries increasingly pinned by a cleft stick of legal regulation, Oreskes and Conway undertake no impartial examination of alternative negative-modality viewpoints on climate change. Instead, Oreskes and Conway construct an audience that assumes as proven beyond debate both effect (global warming) and cause (anthropogenic fossil-fuel use). Oreskes and Conway dismiss as plutocratic stooges contrarians such as Bjorn Lomborg, who argues (19a) that global warming may bring benefits as well as problems, and that politico-social solutions (*e.g.* co-ordinated antimalaria campaigns, cessation of polar-bear hunts) might, as mitigations of climate change, be orders of magnitude more cost-effective than Kyoto-type attempts to interdict greenhouse-gas emissions at source.

In sum, Oreskes and Conway present a thoroughly researched warning that entrenched capital interests have systematically manufactured and promulgated disinformation to maximize profits over the last half-century (20). In so doing, however, the authors have abjured impartiality to construct a GP audience that is irascible, self-righteous, paranoiac, alarmist, and in the end gullible.

VI. *THEORETICIANS*: COLLINS & EVANS

Harry Collins, founder of the Bath School and now at Cardiff (21), teamed with a junior colleague to write *Rethinking Expertise,* a book aimed principally at fellow STS scholars but so engagingly written that it may well attract a secondary audience: intelligent adults outside STS seeking what Collins (having originally coined the term) calls 'primary source knowledge' (22). Is the advent of this meta-audience serendipitous, or did Collins and Evans have it in mind all along? One suspects the latter. Whatever the case, Collins and Evans are to be commended for prose that is fresh, forceful, vivid, and at times distinguished, whether or not it is principally intended for GP. Whatever the rationale, all clarity in academic writing is more welcome for its extreme scarcity.

If a GP audience was intentionally sought, however, it poses problems for Collins and Evans. All publication is "standing up to be shot at" (23): on its success (24) depend recognition, remuneration, and (for academics above all) professional status and advancement. Yet a scientist publishing for fellow scientists in language accessible enough to gain a GP audience risks having her peer community dismiss her text as at best oversimplification, at worst pandering. To stretch the analogy: writing vigorous, transparent academic prose is standing up to be shot at, stark naked in a spotlight. As Collins and Evans seem to possess too much acumen to undertake such risks unwittingly, they must be seen as deliberately reaching out to a wider GP readership. Their ultimate aim may be Promethean, a *noblesse oblige* of GP enlightenment. Equally they may, like Gould and Dawkins, be angling for allies in the everlasting science wars. The two aims are not incompatible.

That a secondary audience of intelligent laity is indeed sought here is strongly suggested by Collins's and Evans's treatment -- its 31-page extent, depth of argument, and admiring presentation -- of what they call 'ubiquitous tacit knowledge' (UTK). One way to parse this section (pp. 13-44) is as flattery, a buttering-up of the authors' GP audience construct: "Good citizens, you're smarter than you think!" (24a). However, certain theoretical objections arise from this asessment. Although presented as the least complex of the various types of expertise, the lowest layer in a hierarchy that Collins and Evans label an 'epistemic periodic table' (24b), UTK nonetheless exhibits a high degree of complexity. Collins and Evans define UTK as "all the endlessly indescribable skills is takes to live in a human society" and give examples including "natural language [= mother tongue], moral sensibility and political discrimination" (25). Unfortunately Collins's and Evans's definition of UTK, and by extension their understanding and application of the very concept they have invented, appear rather coarse. The biology of the human alimentary canal is just as complex, automatic, and species-universal as natural-language acquisition; if acquiring a mother tongue can be deemed expertise, then

so can digestion. And while the ultimate aim of all such expertise is informed intuition (26), *achieving* that automatic skill must employ the brain's executive functions. Surely focused intentionality is a major attribute of any expertise worth the name.

Yet these considerations, applying as they do to Collins's and Evans's secondary (GP) audience construct, are themselves secondary. Collins's and Evans's primary audience construct (inferable from the complexity and rigor of much of their prose) is other STS scholars. Each scholar-construct inhabits one of three camps: (A1) Known allies (A2) Known enemies (A3) Neutrals. Of these three sub-audiences one would expect Collins and Evans to reinforce A1 and woo A3; but sub-audience A2 is less easily categorizable in both description and approach. Should it be logically confuted? Silenced? One-upped? Outmaneuvered? Outflanked? Overwhelmed? Ignored? Converted? Scorned? Poached? Collins and Evans essay a bit of each approach, by turns confronting, dismissing, mocking, end-running, and wooing this hostile crew. At the end, one's impression is of cavalier dismissal -- "Here is reality; disbelieve it at your peril." Methinks the gentlemen do protest too much.

Rethinking Expertise unaccountably ignores one major sub-audience, almost certainly to the authors' eventual discomfiture: academic theoreticians in STS-bordering disciplines such as education. Such scholars were more usefully acknowledged. Good education does not just impart facts but, especially in tutorial and apprenticeship models, also involves intense coaching in the contributory expertise that according to Collins and Evans is expertise's highest form, the apex of their *soi-disant* periodic table. Yet to an audience of educators this book says little. The authors' inexplicable omission courts hostility from an influential part of the academy; that is, it unnecessarily risks alienating strong potential allies.

Indeed, many scientific audiences with knowledge of Collins's and Evans's subject matter will find much to wrinkle their noses about: the distinction between bicycle *riding* and bicycle *balancing*,

for example. Collins and Evans present balancing as pure physics, riding as pure enculturation. Here one acutely misses comment from someone more in the know: a motor physiologist, say, or a cognitive neuropsychologist. Does the human brain indeed distinguish between acquiring the subtle physical rules of machines *per se* (conservation of angular momentum, gyroscopic stabilization, push-right-go-right countersteer) and the equally arcane though more arbitrary prescriptions of a local traffic act? True, the latter comprises social conventions while the former are rooted in the material universe; but it is not immediately apparent that the brain of a trainee rider distinguishes between these component-sets of expertise when learning to use a bicycle effectively.

Which raises a broader question. Are the rules of expertise acquisition truly as inexplicable as Collins and Evans maintain, or have Collins and Evans simply sloughed off all responsibility to table *explanandes*? The blitheness with which Collins and Evans skate over this matter courts critical savaging by scholarly audiences who might otherwise have joined a new technoscientific network advancing the authors' more controversial theoretical suggestions.

In sum, and as evidenced in the book's Acknowledgements, Collins and Evans have constructed an STS academic audience that gives them as much fear as hope: "We even thank those colleagues whose attempts to stop our work from being published, or even referenced, make novels of academic life seem dull; they reassured us that whatever we were doing it was not run-of-the-mill." (27) From the get-go, then, Collins (28) is indeed standing up to be shot at.

Is such defiance inverted boasting? Does Collins inflate the importance of his ideas by anticipating their wholesale rejection? "Socrates was a gadfly; I am a gadfly; therefore I am like Socrates." Certainly, as the poets have stated (29), most of us prefer opposition to neglect. Collins's assumption of rampant hostility in his primary audience may say as much about his professional ego as about his construction of readership.

So may Collins's cut-and-paste writing style. Any academic attempting to promulgate new ideas, especially ideas she feels are likely to be opposed, may be expected to stress those ideas using a consistent vocabulary, amounting at times to stock phraseology. One must establish the brand, as the marketers say. Such standardization of voice is especially noticeable in Collins, whose gift for phrase makes any given paper of his readable, memorable, and high-profile in both the short and long terms. Yet a scholarly author who is both eloquent *and* repetitive, and whose eloquence is thus formulaic, runs a new risk: that his audiences' attention, once caught and held, may prove less than kind. Cross-comparisons of papers recently authored or co-authored by Collins, even interviews, turn up repeated replication not merely of phrases that define and explore new ideas, but of entire paragraphs presented as *de novo* that in reality have been exhumed and recycled word for word. GP reading a single Collins article may neglect redundancy amounting to self-plagiarism; few academics will. Having constructed a tough crowd, Collins seems determined to goad it into becoming even tougher. Is Collins communicating with his peers or simply thumbing his nose at them?

The centre portions of *Rethinking Expertise* are more technical than the Introduction and chapters 1-2. While still accessible to a lay audience with time and determination, chapters 3-5 appear mostly or wholly aimed at STS academics. Topics covered include putative ability to learn effective language with or without various degrees of learners' corporeal form, and use of colorblindness or perfect pitch to model generally the acquisition of interactional expertise (30).

In the book's Conclusion and Appendix, Collins again bring his GP audience to the fore. These two short sections are admirably democratic, not only in their linguistic accessibility but also in their insistence that STS must emerge from its theoretical isolation to engage the wider world. Nonetheless, Collins's expectation that GP will rush to inform themselves of STS theory seems wildly

unrealistic. An audience that lacks all but the most basic scientific expertise has little likelihood of seeking even more esoteric knowledge in how technoscience is socially performed.

VII. *IL PRINCIPE*: STEVE FULLER

I have reserved to last an examination of Steve Fuller's book *The Intellectual* because his audience comprises, *inter alia*, the other six authors I have adduced. Fuller has no meta-audience: he writes entirely for those described in his title. Further, his characterization of real, self-styled, and 'wannabe' intellectuals is witty, piquant, and dead-on accurate.

Fuller reveals and extols the prescriptive elements in the successful intellectual, from paranoia (useful in intellectuals, as it creates an eagerness to detect and reveal the hidden conspiracies that fatten the few and starve the many) to abrasiveness (the courting and enjoyment of no-holds-barred debate) and, perhaps most importantly, intense skepticism -- extending, in the ideal intellectual, to an internal reflexivity that closely and continually reappraises her own motives and knowledge.

I use the term *prescriptive* because Fuller is not content to describe how intellectuals operate in the real world. Instead he has constructed an audience eager to discover truth, no matter how uncomfortable -- an audience that hungers and thirsts after righteousness (31). Unfortunately many, perhaps most, of those who see themselves as intellectuals, and who wish to be so seen, fall far below this lofty bar. Fuller's type for this failed intellectual, the anti-ideal who chooses to seem and not be, is the overcomfortable academic who uses tenure not as a base to seek and speak the truth to all (and especially to power), but as a royal road to sloth. For such an audience Fuller, the voice of conscience, is not easy reading. To afflict these comfortable *soi-disant* intellectuals is Fuller's main aim in this little book. He achieves it spectacularly.

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NOTES

(1) Exceptions include internally reflexive (self-communicative) forms such as diaries and poetry.

(1a) *Iff*, a mathematical abbreviation for *if and only if*, indicates a logical biconditional.

(1b) 'The medium is the message.' First said by MacLuhan in *Understanding Media: The Extensions of Man* (1964).

(2) I am indebted to a 1960s article on linguistic complexity for this illustrative analogy. I have been unable to relocate this article and have reconstructed its parallel sample texts from memory.

(3) Within the set of practicing technoscientists it is also an implicit convention that the research reported should be original and not replicative-confirmatory. Standard Style also favours reporting only success (positive results) and not failure (negative results). *See* pp.5f.

(4) I use 'STS-naïve' to mean 'ignorant of, or operating as if ignorant of, any insights that represent normal science as anything but positivistic, weak-realistic, republican, and influenced solely by replicable demonstrations of objective fact.' I believe the term is my neologism.

(5) In, among other publications, *Rethinking Expertise* (*see* Bibliography, p.26f).

(6) A variant of Orwell's coda in *Animal Farm*, with scientists standing in for animals.

(7) An apparent exception to the rule of 'print=formal / oral=informal', *viz*. a paper read in person to a live audience at a conference, is best understood as an audio self-transliteration by a scientific author of her original print monograph. Its oral-yet-formal style is thus a special case.

(7a) One example of meta-audience construction in nonscientific text would be publication in a major public, objective newsjournal, *e.g.* the *New York Times*, of an interview with a senior U.S. government official. Explicit audience is GP; meta-audiences would be foreign governments.

(8) Publishers of popular-science books correlate this set of characteristics with high book sales.

(9) Christian Bible, Apocrypha & Book of Esdras. The urge to share one's intellectual discoveries -- *Look what I've found!* -- appears across a surprising breadth of eras and cultures. "Every cubic inch of space is a miracle," said Walt Whitman in *Leaves of Grass* ('Miracles'). Two millennia ago Virgil wrote: "Happy the person who has been able to comprehend the causes of things" (*Felix qui potuit rerum cognoscere causas*, supposedly said of Lucretius).

(10) H.G. Wells, *The War of the Worlds*, 1898. This is Wells's fictional characterization of Martians.

(11) *E.g.* Richard Dawkins describes moths as "nectar junkies" (*The Greatest Show on Earth* p.52). Later, after quoting a Victorian writer's sentimental effusion on how a merciful Providence lets animals "fulfill with joy the functions for which they were created" even as they are eaten alive, Dawkins sneers: "Well, isn't that nice for them!" (*ibid* p.396)

(11a) Christian Bible, King James Version (1611), Matthew 16:9. The call is also depicted, spoken comic-book style by an Amerind, on an early flag of New England.

(12) William Butler Yeats, *The Circus Animals' Desertion* (1939).

(12a) Interestingly, Dawkins dismisses Gould's book, holding that science and religion *inevitably* run afoul of each other at innumerable points, *e.g.* on the existence of miracles -- defined as temporary Heaven-directed suspensions of otherwise immutable natural law.

(12b) More accurately perhaps given his recent retirement, *Senex audax.*

(13) John Dryden, *Absalom and Achitophel* (1680).

(14) Article 'From Chicken Little to Dr Pangloss: William Nierenberg, Global Warming, and the Social Deconstruction of Scientific Knowledge' (HSNS 38 no. 1: 109-[1]52).

(15) Article 'Science and public policy: What's proof got to do with it?' (ESP 7, no. 5: 369-[3]83

(16) As well as, it must be said, their income from residuals.

(17) 'The agreeable vulgarity that occurs when many Americans are instructed at the same time.' Norman Mailer, article 'The Prisoner of Sex' (*Harper's* magazine, July 1973)

(18) Making Oreskes and Conway's constructed audience one of intellectuals, at least if we accept Fuller's conflation of intellectualism with paranoia (*see* VII *supra*).

(19) Confirmation bias is the established human tendency to give excessive weight to information that supports preconceived attitudes and ideas. Other things being equal (or even unequal), we use new data to reinforce what we already think we know.

(19a) In his book *Cool It* (2002).

(20) In a larger sense, surely this is old hat. Oreskes and Conway might easily have added the auto industry's stonewalling in the face of Ralph Nader's exposé *Unsafe at Any Speed*, or the video game industry's current use of the U.S. Constitution's First Amendment to justify ultraviolent games that have been unequivocally demonstrated to increase adolescent aggression (*see* Bibliography p.27).

(21) Distinguished Research Professor of Sociology and Director of the Centre for Study of Knowledge, Expertise, and Science, Cardiff University, U.K. His colleague and co-author Evans is a lecturer in sociology at the Cardiff University School of Social Sciences.

(22) *e.g.* 'Interactional Expertise as a Third Kind of Knowledge' [in *Phenomenology and the Cognitive Sciences 3 (2)* pp 125-143]

(23) Said by Thomas Hardy when he permanently forsook fiction for poetry.

(24) Expressible via a variety of metrics, the most accurate of which may be long-term acceptance of one's arguments by a majority of readers. A publisher's metric would be net sales.

(24a) One thinks of Moliere's *bourgeois gentilhomme*, "delighted to learn that he is speaking prose."

(24b) 'Periodic table' seems a misnomer, as the model on whose coattails it rides (*viz*. Mendeleev's original) admits orders of magnitude less transmutation than Collins's and Evans's whimsical chart. Hydrogen cannot become helium through self-study.

(25) Collins & Evans, *Rethinking Expertise*, p.16.

(26) The Thomistic scholasticists had a maxim: *Posse peccare magna est libertas non posse peccare maxima est.* ("The ability to err is a great freedom; the *in*ability to err is the greatest freedom.")

(27) Collins & Evans, *op.cit*., no pagination (immediately before p.1)

(28) Time to set aside the fiction that Evans plays anything but second fiddle: this book seems Collins *pur et complet*

(29) "the time is noon: / When the Spirit must practice his scales of rejoicing / Without even a hostile audience" (W.H. Auden, *Christmas*)

(30) Collins discusses his self-styled acquisition of interactive expertise in gravitational-wave physics to such a degree that at times he presents himself as a GW physicist *manqué*. This ploy seems designed to annoy Collins's core sub-audiences -- friend, foe, or neutral. It succeeds.

(31) The Hebraic term that the King James Version of the Christian Bible translates as 'righteous' may be understood as 'being or doing as one ought.' 'Blessed are they which do hunger and thirst after righteousness' is a Beatitude from Ieshua-bar-Iussef's Sermon on the Mount (KJV, Matthew 5:6)

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