

THE SOKAL HOAX: AT WHOM ARE WE LAUGHING?

The hoax perpetrated by New York University theoretical physicist Alan Sokal in 1996 on the editors of the journal *Social Text* quickly became widely known and hotly debated. (See PHYSICS TODAY January 1997, page 61, and March 1997, page 73.) "Transgressing the Boundaries—Toward a Transformative Hermeneutics of Quantum Gravity," was the title of the parody he slipped past the unsuspecting editors.¹ (See figure 1.)

Many readers of Sokal's article characterized it as an ingenious exposure of the decline of intellectual standards in contemporary academia, and as a brilliant parody of the postmodern nonsense rampant among the cultural studies of science. Sokal's paper is variously, so we read, "a hilarious compilation of pomo gibberish," "an imitation of academic babble" and even "a transformative hermeneutics of total bullshit."² Many scientists reported having "great fun" and "a great laugh" reading Sokal's article. Yet whom, exactly, are we laughing at?

As telling examples of the sort of views Sokal satirized, one might quote some other statements. Consider the following extrapolation of Heisenberg's uncertainty and Bohr's complementarity into the political realm:

The thesis "light consists of particles" and the antithesis "light consists of waves" fought with one another until they were united in the synthesis of quantum mechanics. . . . Only why not apply it to the thesis Liberalism (or Capitalism), the antithesis Communism, and expect a synthesis, instead of a complete and permanent victory for the antithesis? There seems to be some inconsistency. But the idea of complementarity goes deeper. In fact, this thesis and antithesis represent two psychological motives and economic forces, both justified in themselves, but, in their extremes, mutually exclusive. . . . There must exist a relation between the latitudes of freedom Δf and of regulation Δr , of the type $\Delta f \cdot \Delta r \approx p$ But what is the "political constant" p ? I must leave this to a future quantum theory of human affairs.

Before you burst out laughing at such "absurdities," let me disclose the author: Max Born, one of the venerated

The philosophical pronouncements of Bohr, Born, Heisenberg and Pauli deserve some of the blame for the excesses of the postmodernist critique of science.

Mara Beller

founding fathers of quantum theory.³ Born's words were not written tongue in cheek; he soberly declared that "epistemological lessons [from physics] may help towards a deeper understanding of social and political relations." Such was Born's enthusiasm to infer

from the scientific to the political realm that he devoted a whole book to the subject, unequivocally titled *Physics and Politics*.³

Science and religion

Born's words are not an exception. One might be even more bewildered to read Wolfgang Pauli's philosophical publications and his unpublished scientific correspondence:

Science and religion must have something to do with each other. (I do not mean "religion within physics," nor do I mean "physics inside religion," since either one would certainly be one-sided, but rather I mean the placing of both of them within a whole.) I would like to make an attempt to give a name to that which the new idea of reality brings to my mind: the idea of reality of the symbol. . . . It contains something of the old concept of God as well as the old concept of matter (an example from physics: the atom. The primary qualities of filling space have been lost. If it were not a symbol, how could it be "both wave and particle?"). The symbol is symmetrical with respect to "this side" and "beyond" . . . the symbol is like a god that exerts an influence on man.⁴

One of the more absurd examples in Sokal's satire, according to the author himself, involves the inference from quantum physics to Jacques Lacan's psychoanalytic ideas. "Even non-scientist readers might well wonder what in heaven's name quantum field theory has to do with psychoanalysis"—exclaimed Sokal in the *Lingua Franca* article in which he promptly revealed his hoax.¹ Nonetheless, a "deep" connection between quantum theory and psychology was extensively discussed in the writings of Pauli, Niels Bohr and Pascual Jordan. Jordan explored the "formal" parallels between quantum physics and Freudian psychoanalysis, and even parapsychology. Pauli, in all seriousness, proceeded from quantum concepts to the idea of the unconscious, to Jungian archetypes and even to extrasensory perception.

The following words of Bohr are among the more sober statements of these founding fathers with regard to the connection between the quantum and psychological domains:

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Transgressing the Boundaries

TOWARD A TRANSFORMATIVE HERMENEUTICS

OF QUANTUM GRAVITY

Transgressing disciplinary boundaries . . . [is] a subversive undertaking since it is likely to violate the sanctuaries of accepted ways of perceiving. Among the most fortified boundaries have been those between the natural sciences and the humanities.

—Valerie Greenberg, *Transgressive Readings*

The struggle for the transformation of ideology into critical science . . . proceeds on the foundation that the critique of all presuppositions of science and ideology must be the only absolute principle of science.

—Stanley Aronowitz, *Science as Power*

There are many natural scientists, and especially physicists, who continue to reject the notion that the disciplines concerned with social and cultural criticism can have anything to contribute, except perhaps peripherally, to their research. Still less are they receptive to the idea that the very foundations of their worldview must be revised or rebuilt in the light of such criticism. Rather, they cling to the dogma imposed by the long post-Enlightenment hegemony over the Western intellectual outlook, which can be summarized briefly as follows: that there exists an external world, whose properties are independent of any individual human being and indeed of humanity as a whole; that these properties are encoded in “eternal” physical laws; and that human beings can obtain reliable, albeit imperfect and tentative, knowledge of these laws by hewing to the “objective” procedures and epistemological strictures prescribed by the (so-called) scientific method.

But deep conceptual shifts within twentieth-century science have undermined this Cartesian-Newtonian metaphysics (Heisenberg 1958; Bohr 1963); revisionist studies in the history and philosophy of science have cast further doubt on its credibility (Kuhn 1970; Feyerabend 1975; Latour 1987; Aronowitz 1988b; Bloor 1991); and, most recently, feminist and poststructuralist critiques have demystified the substantive content of mainstream Western scientific practice, revealing the ideology of domination concealed behind the facade of “objectivity” (Merchant 1980; Keller 1985; Harding 1986, 1991; Haraway 1989, 1991; Best 1991). It has thus become increasingly apparent that physical “reality,” no less than social “reality,” is at bottom a social and linguistic construct; that scientific “knowledge,” far from being objective, reflects and encodes the domi-

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This domain [psychology] is distinguished by reciprocal relationships which depend on the unity of our consciousness and which exhibit a striking similarity with the physical consequences of the quantum of action. We are thinking here of well-known characteristics of emotion and volition which are quite incapable of being represented by visualizable pictures. In particular, the apparent contrast between the continuous onward flow of associative thinking and the preservation of the unity of the personality exhibit . . . analogy with the relation between the wave description of the motions of material particles, . . . and their indestructible individuality.⁵

The rarely noticed mistake

Like the deconstructionist Jacques Derrida, whom Steven Weinberg attacked in his 1996 *New York Review of Books* article on Sokal's hoax,² Bohr was notorious for the obscurity of his writing. Yet physicists relate to Derrida's

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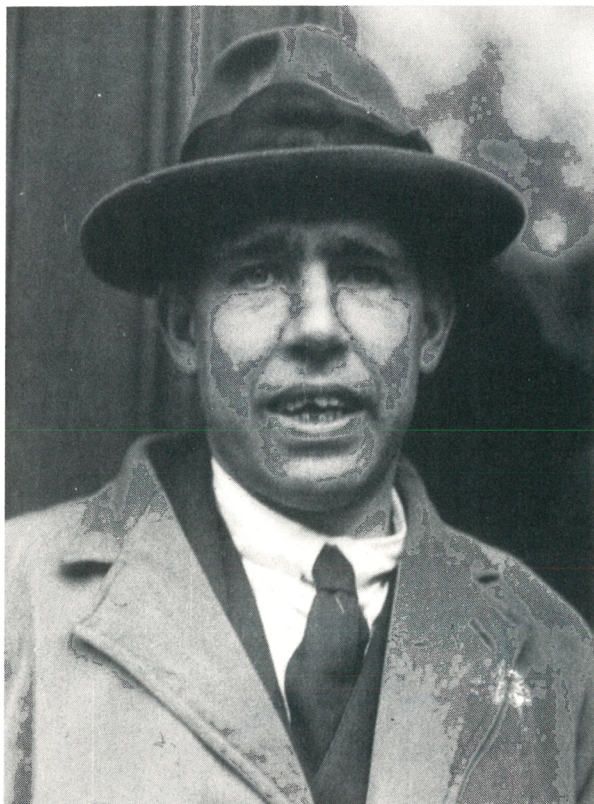
FIGURE 1. FIRST PAGE of Sokal's hoax article, unwittingly published by the editors of *Social Text* in their Spring/Summer 1996 issue.¹

and Bohr's obscurities in fundamentally different ways: to Derrida's with contempt, to Bohr's with awe. Bohr's obscurity is attributed, time and again, to a “depth and subtlety” that mere mortals are not equipped to comprehend.

Perhaps disclosure of another editorial oversight will demonstrate my point. In a widely used compendium of papers on quantum theory, edited by John Wheeler and Wojciech Zurek,⁶ the pages of Bohr's reprinted article are out of order. That paper (Bohr's response to the famous 1935 Einstein-Podolsky-Rosen critique of the standard Copenhagen interpretation) is widely cited in contemporary literature by physicists and philosophers of science. Yet I have never heard anybody complain that something is wrong with Bohr's text in this volume. The mistake, it seems, is rarely noticed, even though it occurs in both the hard- and soft-cover editions.

When physicists failed to find meaning in Bohr's writings, no matter how hard they tried, they blamed themselves, not Bohr. (Einstein and Schrödinger were among the rare exceptions.) Carl von Weizsäcker's testimony is a striking example of the overpowering, almost disabling, impact of Bohr's authority. After meeting with Bohr on one occasion, von Weizsäcker asked himself, “What had Bohr meant? What must I understand to be able to tell what he meant and why was he right? I tortured myself on endless solitary walks.”⁷ Note that von Weizsäcker did not ask, “Was Bohr right?” or “To what extent, or on what issue, was he right?” but, quite incredibly, he wondered what must one assume and in what way must one argue in order to render Bohr right?

Astonishing statements, hardly distinguishable from those satirized by Sokal, abound in the writings of Bohr, Heisenberg, Pauli, Born and Jordan. And they are not just casual, incidental remarks. Bohr intended his philosophy of complementarity to be an overarching episte-



AIP EMILIO SEGRE ARCHIVE

FIGURE 2. BOHR AND HEISENBERG IN 1927.

mological principle—applicable to physics, biology, psychology and anthropology. He expected complementarity to be a substitute for the lost religion. He believed that complementarity should be taught to children in elementary schools. Pauli argued that “the most important task of our time” was the elaboration of a new quantum concept of reality that would unify science and religion. Born stated that quantum philosophy would help humanity cope with the political reality of the era after World War II. Heisenberg expressed the hope that the results of quantum physics “will exert their influence upon the wider fields of the world of ideas [just as] the changes at the end of the Renaissance transformed the cultural life of the succeeding epochs.”

So much confidence did these architects of the quantum theory repose in its far-reaching implications for the cultural realm that they corresponded about establishing an “Institute for Complementarity” in the US. The aim of such an institute, to be headed by Bohr, would be to promote Bohrian philosophy. The aging Max Born begged Bohr not to leave him out of this enterprise.⁸

Postmodernist babble

Sokal’s hoax was ingeniously contrived. The gradual slide from the Bohr and Heisenberg quotes at the beginning of his article into postmodernist babble about the connection between science and politics is all too natural. When feminists like Donna Wilshire, or intellectuals of the left like Stanley Aronowitz, connect quantum physics with politics and wider social issues, they’re treading a well-worn path legitimized by the scientific authority of the great quantum physicists, in whose writings we find the roots of the postmodernist excesses of today. When Sokal,

in his *Social Text* article, wrote that Bohr’s “foreshadowing of postmodernist epistemology is by no means coincidental,” he was more correct than he intended to be.

We find ourselves in a peculiar predicament. On the one hand, either the whole enterprise of inferring from the scientific to the cultural and political is misconceived, unfounded and far-fetched—in which case some of our greatest physicists are no less guilty than our postmodernist critics. Or, on the other hand, drawing inferences from the scientific to the wider cultural domain is indeed a meaningful and profound activity—in which case we must judge the undertaking of the postmodernist cultural analysts to be respectable, commendable and important, even though we may regret, and perhaps even condemn, the scientific illiteracy of some of them.

The focal point of the controversy is the issue of reality. Sokal and Weinberg repeatedly express, in an emotionally charged way, their ardent belief in scientific reality as something objective and independent of the observer. Weinberg disapprovingly quoted Thomas Kuhn’s words: “I am not suggesting, let me emphasize, that there is a reality which science fails to get at. My point is rather that no sense can be made of the notion of reality as it has ordinarily functioned in philosophy of science.”⁹

Kuhn’s words can be supported by the following, stronger ones:

“The physical world is real. . . .” [That] statement appears to me, however, to be, in itself, meaningless, as if one said: “The physical world is cock-a-doodle-do.” It appears to me that the “real” is an intrinsically empty, meaningless category (pigeon hole). . . .¹⁰

This quote is not from Derrida or Kuhn, and not even



FIGURE 3. CARICATURES BY GEORGE GAMOW, drawn at Bohr's Copenhagen institute in the early 1930s. **Left:** Bohr, who did not tolerate dissent easily, in 1931 haranguing the bound and gagged Lev Landau, who had written a paper about the uncertainty relations in relativistic quantum theory with which Bohr did not agree. **Below:** Pauli as Mephisto in a parody of *Faust* performed at Bohr's institute in 1932. In later years, Pauli was given to unrestrained metaphysical speculation.

from Bohr or Heisenberg. The words belong to Albert Einstein—a staunch believer in observer-independent reality. Similar statements appear many times in Einstein's published and unpublished writings. The idea of a physical theory as a mirror of reality was completely foreign to Einstein: "[The physicist] will never be able to compare his picture with the real mechanism, and he cannot even imagine the possibility or the meaning of such a comparison."¹⁰

While Einstein's belief in an objective reality is similar to that of Weinberg and Sokal, his arguments for his conception of reality are not. In fact, Einstein was no "naïve realist," despite such caricaturing of his stand by the Copenhagen orthodoxy. He ridiculed the "correspondence" view of reality that many scientists accept uncritically. Einstein fully realized that the world is not presented to us twice—first as it is, and second, as it is theoretically described—so we can compare our theoretical "copy" with the "real thing." The world is given to us only once—through our best scientific theories. So Einstein deemed it necessary to ground his concept of objective reality in the invariant characteristics of our best scientific theories.

The founders of quantum physics—Bohr, Born, Pauli and Heisenberg—misrepresented and ridiculed Einstein's "naïve" belief in an objective, observer-independent reality. Bohr's complementarity principle, they claimed, inevitably implies that one can no longer construct a unified, objective, observer-independent description in physics. (The relevant quotations are conveniently available at the beginning of Sokal's article.)

In the quantum domain, one can have only partial, equally correct, yet mutually incompatible perspectives, disclosed in mutually exclusive experimental arrangements. In some of these arrangements, an electron behaves as a wave, in others as a particle. It is not possible to combine the partial pictures into a unified picture, and it is not meaningful to talk about physical reality as existing independently of the act of observation. Inspired by Bohr's far-reaching "revision of our concept of reality," some physicists, interpreting John Bell's theoretical re-



sults and Alain Aspect's experiments, contend that "the moon is demonstrably not there when nobody looks".¹¹ (See also *PHYSICS TODAY* April 1985, page 38.)

John Wheeler's description of an imaginary dialogue between a physicist and the universe about their respective "realities" is a telling example: The universe says to a physicist, "I supply the space and time for your existence. There was no before, before I came into being, and there will be no after [after] I cease to exist. You are an unimportant bit of matter located in an unimportant galaxy." "How shall we reply?" asks Wheeler. Shall we say, "Yes, OK universe, without you I would not have been able to come into being. Yet you, great system, are made of phenomena; and every phenomenon rests on an act of observation. You could not even exist without an elementary act of registration such as mine."¹²

A female way

If physical reality is nothing but a scientist's act of registration, then perhaps—some social scientists have argued—historical and social reality is nothing but an act of interpretation. The following lines by the sociologist Don Handelman are typical:

No longer may we assume with ease that nature (and culture) exist "out there," to be mapped and discovered without evaluating our own roles and operations at one and the same time. The particle physicist, Werner Heisenberg . . . put it this

way: "When we speak of a picture of nature provided by contemporary exact science, we do not actually mean any longer a picture of nature, but rather a picture of our relation to nature. . . ." As we now understand "forces of nature" (and culture) to be accessible to us through ourselves, so these have become our "subject." These views have some prominence in postmodern science.¹³

Donna Wilshire draws more far-reaching (many would say far-fetched) inferences from the writings of Heisenberg, Bohr and Pauli. She concludes that quantum mechanical description is "wildly illogical," and that there is, in fact, no substantive difference between science and art: "Werner Heisenberg and Niels Bohr have written that what happened in the discovery of quantum physics *united the methods of science and art* [italics in the original]. . . . Science, literature and art must value one another and incorporate and share one another's methods and forms. In [quantum mechanics], emotion, passion, and wild speculation become essential to science."¹⁴

Wilshire must have been inspired, or at least reassured, by something like the following quote from Bohr: Such considerations involve no lack of appreciation of the inspiration which the great creations of art offer us by pointing to features of harmonious wholeness in our position. Indeed, in renouncing logical analysis to an increased degree and in turn allowing the interplay of all strings of emotion, poetry, painting and music to contain possibilities of bridging between extreme modes as those characterized as pragmatic and mystic. . . . The aim of our argumentation is to emphasize that all experience, whether in science, philosophy or art, which may be helpful to mankind, must be capable of being communicated by human means of expression.¹⁴

Inspired by Bohr's union of the pragmatic and mystic way of knowing, Wilshire presents her vision of a female way of doing science—a vision that Sokal's satire could have quoted verbatim:

I anticipate the day when all discussions of ideas and science will include poetry, oral history, literary and emotional allusions. I am eager to read the astronomer-mathematician who gives as much attention to the rhythms, music, and dance she experiences in her body while she is observing as she gives to the observed: the cosmic dance, flow, and energy she is reducing to formula or speculating about.¹⁴

When Einstein warned Bohr about the irresponsible, "shaky game with reality" that Bohr was playing, could he have had this kind of argumentation in mind? Could Einstein have foreseen the state of affairs satirized by Sokal?

The rhetoric of inevitability

When Bohr speculated about parallels between wave-particle duality in physics and the "complementarity" of reason and emotion, or complementarity between different cultures, he asserted that the comparisons were not just vague analogies; they flowed necessarily from "the very analysis of the logical use of our concepts." Bohr and his supporters presented his dualistic philosophy of complementarity in physics not as one feasible way of interpreting the quantum formalism, but rather as the only logically possible way.

This rhetoric of inevitability implied the logical impossibility of any alternative to the Copenhagen philosophy, thus concealing the fruitful interpretive freedom of the quantum mechanical formalism. In this way, the

philosophy of complementarity, while certainly legitimate as one of the many possible interpretive options, was turned into a rigid ideology, misleading both scientists and educated nonscientists.

By using only simple analogies and intuitively appealing, yet misleading, metaphorical images, Bohr established supposedly necessary connections between acausality, wave-particle duality and the impossibility of an objective unified description in the quantum domain. One needed no technical knowledge of quantum mechanics to read Bohr's operational analysis of mutually exclusive experimental arrangements consisting of bolts, springs, rods and diaphragms.

While publicly abstaining from criticizing Bohr, many of his contemporaries did not share his peculiar insistence on the impossibility of devising new nonclassical concepts—an insistence that put rigid strictures on the freedom to theorize. It is on this issue that the silence of other physicists had the most far-reaching consequences. This silence created and sustained the illusion that one needed no technical knowledge of quantum mechanics to fully comprehend its revolutionary epistemological lessons. Many postmodernist critics of science have fallen prey to this strategy of argumentation and freely proclaimed that physics itself irrevocably banished the notion of objective reality

'We know better now'

In an exchange several months after his *New York Review of Books* article, Weinberg admitted that the founders of quantum theory had been wrong in their "apparent subjectivism," and declared that "we know better now."¹⁵ What exactly do we know better now? Do we know better that one should not infer from the physical to the political realm—and if yes, why? Or do we know better that the "orthodox" interpretation of quantum physics—the one that confidently announced the final overthrow of causality and the ordinary conception of reality—is not the only possible interpretation, and that, ultimately, it might not even be the surviving one?

The philosophical pronouncements of Bohr and other founders of quantum physics are not just an anachronistic curiosity. A flood of popular writings by physicists and science writers continues to proclaim the victory of Bohr's conception of reality over Einstein's, especially since Bell's seminal theoretical results and their confirmation by Aspect's experiments in the early 1980s. These writers do not mention that the most prominent feature of Bell's results, nonlocality, is, in fact, naturally contained in David Bohm's causal, observer-independent alternative to the standard quantum theory. (See the article by Sheldon Goldstein in *PHYSICS TODAY*, March, page 42 and April, page 38.) Bohm's nonlocal theory and recent variants of it incorporate the essence of Bell's results in an immediate way, without recourse to Bohr's philosophy.¹⁶

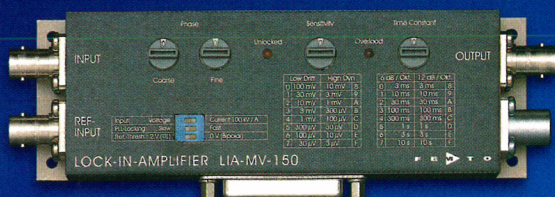
Paul Gross and Norman Levitt, whose book *Higher Superstition* inspired Sokal's undertaking, ridicule Aronowitz when he "naively echoes . . . the view that the causal and deterministic view of things implicit in classical physics has been irrevocably banished." To this end, Gross and Levitt cite the work of Goldstein, Detlef Dürr and Nino Zanghi along Bohmian lines.¹⁷ But Aronowitz had been relying on the assertions of the inevitable and final overthrow of determinism, endlessly repeated by the most honored heroes of 20th-century physics. How can Aronowitz or other nonphysicists resist the authority of such past eminences, unless the physicists of our time publicly declare that the Copenhagen orthodoxy is no longer obligatory? Such a public declaration could have diminished greatly the explosive proliferation of the post-

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modernist academic nonsense so appalling to Sokal and Weinberg.

The opponents of the postmodernist cultural studies of science conclude confidently from the Sokal affair that "the emperors . . . have no clothes."¹⁸ But who, exactly, are all those naked emperors? At whom should we be laughing?

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