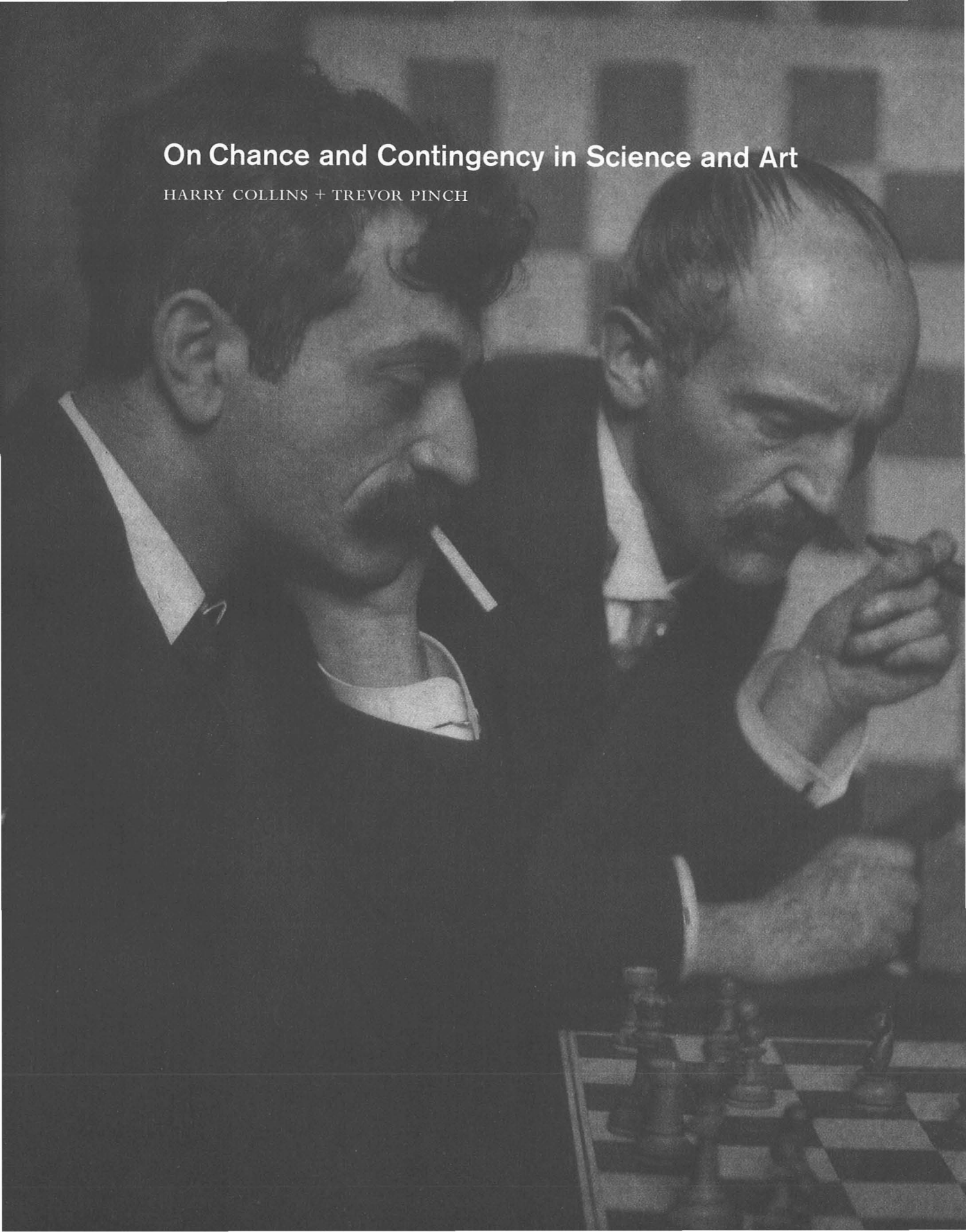


On Chance and Contingency in Science and Art

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The textbook description of many famous experiments is quite at variance with what actually happened. For example, the Michelson-Morley experiment performed in 1887, one of the most famous experiments in science, is said to have shown that the speed of light is a constant. This caused a problem for Nineteenth Century physics that went unresolved until Einstein developed the special theory of relativity in the first decade of the Twentieth Century. Actually the experiment showed only that the speed of light does not vary as might be expected were it affected by the speed of the Earth in its orbit. As late as the 1930s the experiment's results were being hotly disputed and even today one can find theories that turn on there being a small but positive variation in the speed of light in these supposedly definitive null experiments. The Michelson-Morley experiment is a paradigm of pure science. When we come to technology we find space shuttles exploding, nobody being sure whether the Patriot missiles shot down most or none of the Scuds fired during the first Gulf War, and an apparently clear, public demonstration of the failure of a safer fuel for airplanes actually being an outstanding success when things are examined more closely. In the case of medicine, we are all still dying and the very gold standard of experimental testing—the double-blind randomised control trial—is itself a testament to how little we know about the relationship between the mind and the body (all drugs are tested against the placebo effect). We have woken from the dream of a perfectly controllable world—it was really a nightmare—in which the artistic expression of the irrational has no place.

Nevertheless, it would be a big mistake to think that there remains no deep distinction between art and science. Rather, the only thing that is similar about them is that both have contingency at their heart. They are deeply different because of what they do with contingency. In a word, art celebrates contingency, science tries to wall it in.

Contingency in discovery is as big a motif in science as it is in art. A recent Nobel Prize was awarded for the discovery of the cosmic background radiation, now packaged in our newspapers as an oval figure with coloured blotches said to represent the inhomogeneities that show how the universe first separated itself into lumps that we now call galaxies and stars. Scientists love to point out that Penzias and Wilson, the discoverers, first thought they had found an unexplained noise in their antenna which they worked hard to remove. Among other things, they thought that what some ill-advised scientists now call “the face of God” was pigeon droppings. What is celebrated by scientists is not the noise but the fact that that this obstinate intrusion of the outside world was eventually recognized for what it was. We do not need to ask how true today's multi-coloured representations and associated inferences are, we need only note that scientists are constantly working to make them fully understood, and constantly apologizing for the remaining mismatches between claim and reality.

When chance cannot be scrubbed away, not even in theory, science corrals it with statistics. Some of the dreariest and most controlling of sciences take the

averaging of chance events as their method. What could be closer to the antithesis of art than the social survey, representing all difference in a mean? Still more fundamental, with the discovery of the quantum it has been a scientific heresy to deny that, at root, nature is an irredeemable gambler. So much has she been tamed, however, that the analysis of the bookmaker's odds or outcomes of experiments in the quantum realm has led to some of the most accurate predictions that have ever been made.

Where contingency hits us in the face on the macroscopic scale, science and technology know only one way to react: they blame humans. According to the scientific way of looking at things, the space shuttles failed not because sitting people on top of hundreds of tons of explosive and setting fire to it is inherently dangerous but because management overruled the engineers. Human error is always the favourite candidate in the blame game after technological accidents. And so it goes. We may have discovered that science and technology are not perfectible but this has not changed their ambition one jot. If it had, we would no longer have science and technology.

The nature of a cultural endeavour is set, not by what it can achieve, but what it tries to achieve. That science tries to eliminate or control chance and art should celebrate it is no coincidence; science and art are different. One can see this quite easily if one examines the institutions that surround them. If one draws a simple diagram showing author and public with a few intermediate stopping points (figure 1) it invites a question about “the locus of legitimate interpretation.”

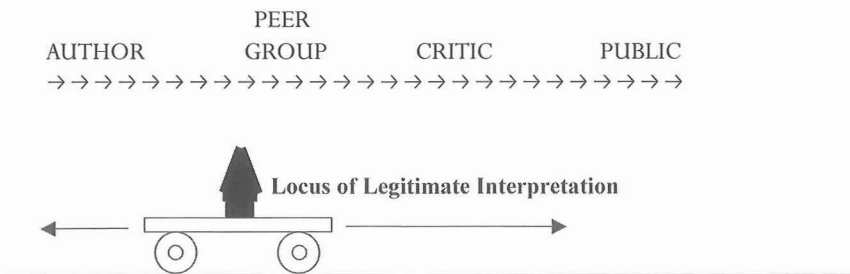


FIGURE 1 The moving locus of legitimate interpretation

In the case of science, the locus of legitimate interpretation is always well to the left. The author of a work is granted the right to interpret it—if anyone to the left disagrees with the author's interpretation, then someone has made a mistake.¹ In art, interpretative rights lie to the right with the author often having remarkably few compared to the critic—who represents the public rather than the producer.

This difference is a reflection of, or more properly, a part and parcel of, the difference in the meaning of contingency. In science and technology, interpretation is more homogeneous—the interpretation of the author is paramount—so chance must be controlled; in art interpretation can be heterogeneous—it is in the hands of the public. For some kinds of art, the more varied the range of interpretations the better and contingency is quite properly celebrated. That there is contingency everywhere means that the nightmare of a fully rational world will never be realized but it does not mean that the boundaries between science and art are blurred.

This tension between art and science is played out in fascinating ways when the two meet. One such case recently written about by one of us (Trevor Pinch and Frank Trocco, *Analog Days: The Invention and Impact of the Moog Synthesizer*) is the history of the electronic music synthesizer. Totally new musical instruments are very rare. Indeed one has to go back to 1842 and Alois Saxe's invention of the saxophone to find an instrument of similar significance to the synthesizer. The synthesizer was born out of collaborations between artists (musicians) and scientists (or more precisely engineers). Contingency, as always, was present, especially in the early days. The first analog synthesizers used transistors and were very imprecise. They were notoriously difficult to control. Musicians would talk about getting an incredible sound at night in the studio only to return to the instrument the next morning to find they couldn't reproduce it. This imprecision was a source of constant delight for some musicians. Famously the legendary space jazz performer Sun Ra took one of Moog's first synthesizers and he broke every module on the instrument, but the sound it made was "fabulous." The instrument worked better "broken"! This drove the poor engineers to distraction as they struggled to make the instrument more precise and reliable.

And then there was Don Buchla. He is a little known figure but deserves more recognition in the history of synthesizers. Buchla, an artist with an engineering background, designed synthesizers in the middle of the sixties in his studio in the middle of Haight Ashbury. Buchla was the sixties personified. He made synthesizers for the Grateful Dead and was a huge fan of John Cage. The white noise source on his synthesizer (the module that produces the sound of air hissing from a radiator) he named "The Source of Uncertainty." Buchla refused to call his synthesizers machines—for him they were instruments and what characterized a good musical instrument was all the unexpected resonances, the things that produced the sounds between the notes as it were. Buchla famously rejected the conventional keyboard. With a new source of sound—electronics—why control it in an old way? He favoured strange arrays of plates which responded in different ways to touch. Rather than keyboards he called these devices "kinesthetic input ports."

It turned out Buchla's artistic vision for the synthesizer was too radical and it is the more stable, controllable form of keyboard synthesizer, developed by engineer Robert Moog, which captured the public's imagination. The history of the synthesizer can be seen as battle ground between the engineers' desire for control

and repeatability and the artists' desire for contingency. The engineer stands at the left of the continuum of legitimate interpretation. The engineer wants the machine to be reliable, for the sounds to be available at the push of a button, for the synthesizer to work properly when switched on, and for the machine to play its pre-programmed prepackaged sounds to order, just as intended. The artists sit at the right-hand end. They want an instrument not a machine—something that will play something unique, something which, although subject to control, is capable of pushing them beyond their own preconceptions—something that can surprise them. Today's digital instruments are the most precise ever invented—"no more tuning as you play"—as 70s rocker Keith Emerson used to do in the heyday of his Monster Moog played in ELP. But some artists reject these digital synthesizers. Their search for contingency brings them back to the old analog instruments. "Creativity comes from mistakes" is their mantra. But the digital devices are devilishly clever. They can emulate the old analog instruments. What they cannot emulate yet are all the contingencies. Randomness (easy to program) does not get at it, neither does clicking a mouse on the image of a patch wire or knob. The sort of contingencies that come from analog modules breaking down or the stray capacitance of the operators' hands on the wires are the hardest to model in the digital world. At least thus far.

The positions outlined above are, of course, the extremes. Life is compromise and artists sometimes long for control just as scientists dream of the serendipitous discovery that will bring them the Nobel prize. But art and science as collective enterprises are systematically different in what they do with contingency. Sometimes the boundaries are blurred as when noise and music merge. Sometimes the boundaries are firm—we want some machines (cars, aeroplanes) to be reliable just as we want musical performance to come alive with that elusive spontaneity. Boring repetitive music can be as deadly as a car careening out of control.

NOTE

1 We refer here to norms of interpretation, not what actually happens.