GENERATING REBELLIONS IN SCIENCE
or: $e = mc^2$ with mass rebellious and energy generational*

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The title, Einstein and the Generations of Science, is a conscious double entendre. In this book Lewis S. Feuer is concerned with the social and psychological origins of key discoveries in modern physics: hence with the factors extrinsic to science which generate scientific concepts. His primary explanatory thesis centers on generational rebellion as the creative force appropriately channelled by the "reformist, intergenerational, constitutional republic" which is the international scientific community. The problem is important, for it has the potential to clarify our notions of how people’s ideas relate to their activities and environment. In its pursuit Feuer has gathered some valuable material and charted a course not frequently attempted. Unfortunately his thesis illuminates his subject less than it exposes his own political stance. The title’s pun veils a disproportion between intention and accomplishment resulting from a political bias no less obtrusive for being disclaimed. (Sociologists who still insist that their approach is value-free require sharp watching.)

There is an increasing recognition that factors extrinsic to science may be decisive in shaping the hypotheses and concepts with which scientists work. As usual, academic teaching of the subject lags behind. However, few philosophers or historians of science would argue any longer that the concepts that scientists use to organize so-called “raw data” derive directly and immediately from those data. As a poetic passage in a recent textbook in anthropological theory points out:

One has merely to observe birds flying, smoke rising, clouds drifting, feathers floating and stones plummeting to realize that Galileo’s formula-

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tion of the laws of motion could not possibly have resulted from the mere collection of facts.

... The normal mode of scientific procedure is ... something quite different from what Bacon supposed.¹

Of equal interest is that scientists themselves, at least some of the most creative, have recognized this all along.

Galileo himself, in an oft-quoted and pungent remark, expressed his admiration for Aristarchus' and Copernicus' ability to reject their unmediated empirical perceptions and instead enable "reason ... to commit such a rape upon their senses as, in despite thereof, to make herself mistress of their belief."² As to his own work, he wrote that his conclusions did not derive from his experiments, since he did the latter only to persuade others of what he had already figured out. "To satisfy his own mind alone he had never felt it necessary to make any."³ It seems likely, if the story is not wholly apocryphal, that the famous experiment of dropping objects of differing physical characteristics off the tower of Pisa was performed not by Galileo but by an opponent. Given that special conditions not regularly occurring in the atmosphere of Pisa are necessary completely to confirm Galileo's mind-experiment, this forgotten scientist, depending on the physical qualities on which he focused, probably went home either confused or triumphantly beguiled by the evidence of his senses.

Ernst Mach, an important influence on Einstein, explicitly adhered to a modern nominalism in which concepts are means of organizing experience rather than eternal verities about an underlying objective reality. He also had followers among some of the Bolsheviks, who read him as saying that the tools for organizing scientific experience are social products and thus that major scientific breakthroughs would require a social revolution. His influence was such that Lenin took a year off to study Machian physics and compose a critique, which has been an embarrassment to Marxist philosophy ever since.⁴

Both Einstein and Niels Bohr thought extensively about epistemology. Neither was able to recognize the prevailing inductive model as conforming to their own creative experience. Both were great physicists precisely insofar as they were philosophers. Indeed, as Feuer tells, the repudiation of Baconian methodology was for each of them an important contribution to their physical theories. For Einstein, the conviction that scientific concepts are not responsive exclusively to sensory observations and purely rational considerations was itself a recognition of relativist premises. Likewise Bohr's musings