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Victim of Intellect

ARISTOTLE, FRANCIS BACON CHARGES in *The Advancement of Learning*, behaved "as though he had been of the race of Ottomans, [and] thought he could not reign except the first thing he did he killed all his brethren" (3:365).[1] Of the many accusations he levels against Aristotle, perhaps the most ironic is fratricide. For Bacon, who has fair claim to being the first English intellectual historian, often surveys the history of ideas with an eye to demolishing rivals, ancient and modern. If he advocates a "History of *Learning* and *the Arts*" so that "the Literary Spirit of each age may be charmed as it were from the dead" (*DA*, 4:300–301), the spirits Bacon conjures up tend to sweep the stage in preparation for his own reign.

The attack on Aristotle in the *Advancement* is itself part of an odd series of tonal shifts in Bacon's critique of the state of Natural Philosophy, especially its confusion of true and false knowledges. Thus the myth of Ixion—who "designed to enjoy Juno, the goddess of power; and instead of her had copulation with a cloud, of which mixture were begotten centaurs and chimeras"—shows that "whosoever shall entertain high and vaporous imaginations instead of a laborious and sober inquiry of truth, shall beget hopes and beliefs of strange and impossible shapes" (3:362). And yet, despite this opposition, Bacon attempts to forge a relation between the possible and impossible: If we compile inventories of all inventions now extant and those "held impossible," lining up "optatives" with their nearest counterparts in reality, may we not discern a proper direction? Bacon envisions a methodical "invasion of the unknown," in John Dewey's phrase; Bacon's metaphor is of the invading army of Charles V quietly chalking up its lodgings in Naples, a procedure that contrasts with Aristotle's less civilized violence against "the diversity of sects, schools and philosophies."

This mingling of intellectual tolerance and epistemic aggression produces a peculiar wavering about the plurality and contingency of our approaches to truth:

> To those that seek truth and not magistrality, it cannot but seem a matter of great profit to see before them the several opinions touching the foundations of nature; not for any exact

truth that can be expected in those theories; for as the same phaenomena in astronomy are satisfied by the received astronomy of the diurnal motion and the proper motions of the planets with their eccentrics and epicycles, and likewise by the theory of Copernicus who supposed the earth to move; and the calculations are indifferently agreeable to both; so the ordinary face and view of experience is many times satisfied by several theories and philosophies; whereas to find the real truth requireth another manner of severity and attention. . . . In the mean time it is good to see the several glosses and opinions upon nature. (3:365)

What, given Bacon's quest for dominance, is good about it? The attempt to fuse suppleness and severity into a coherent method will lead him to a series of intellectual motions as elusive as those of the planets in his astronomical conceit.

Tracing those intellectual motions is crucial for grasping the pivotal role Bacon claims for himself and still plays in recent historiography, as the herald (or propagandist) of modern science. Bacon's work, according to a notably ambitious but representative argument, embodies a new discursive practice, one that sacrifices an integrated "exchange within" the world for a more repressive "practice upon" it. Here, the knower is no longer a part of the world of names and objects but seeks to master the world's totality, first by distancing the real as an exterior reference prior to discourse, and then by seizing it through an arbitrary grammar whose self-proclaimed adequacy freezes meaning. This "analytico-referential discourse" initially recognizes, only to hide, the perspectivism of its own representations, pretending to stand outside the world for the sake of an "imperialist" appropriation of it through supposedly objective and universal knowledge.[2] An historical narrative of this kind is appealing for its ability to draw together a wide range of specifics and generalities: Bacon's fondness for metaphors of conquest and empire; his occasional indulgence in sadomasochistic and ruthlessly inquisitorial imagery; his search for the "legibility" and commodification of nature; his yoking of knowledge and power. This view offers as well intriguing analogies between Bacon's science and his royalist politics, even suggesting the former as a species of the latter.[3] And it is also appealing because of its own elusive status *as* narrative. If it is forced to acknowledge that it, too, aspires to an "objective" historical account—thus implicated in the very discourse it criticizes—it can also claim to be only a heuristic model of differences that enables some "hope of deflecting . . . our life situation."[4]

I want, nonetheless, to offer some resistance to this approach, not because I am wholly unsympathetic to its values (or what A. O. Lovejoy might call its "metaphysical pathos") but because of the way its values are embedded in an allegory of dominant discourses proceeding along a salvational plot of original harmony, alienation, and the hope of redemption. Even as the scheme would locate the complex phenomenon of Baconian science within a broader cultural field, its dedication to a teleological, and highly moralized, narrative constrains the resourcefulness of both the texts and the culture it reads, telling through them a

singular story whose own authority is protected rather than challenged by an acknowledgment of occulted, contradictory, residual, and emergent strains of discourse.[5] Bacon, I will argue in this essay, is just the sort of writer to encourage and destabilize such narratives. His initial flexibility seems too patently a ruse: having assaulted authoritarian "magistrality," he projects a series of stages rising toward "exact" or "real" truth, a totalizing knowledge of and dominance over intellectual disciplines and over nature. And yet, as we pass through the succeeding stages, we find ourselves confronted with a series of cruxes about precisely how science is "made," recurring dilemmas about the work of human *poesis* that arise from a lateral as well as a progressive movement, a polymorphous curiosity about the world and ways of knowing it that turns repeatedly into the fields it has declared off limits.

At stake as well is an interpretation of late-Renaissance culture itself, which witnesses not only new consolidations of power but also the work of accommodating and exploiting its own volatility. Mannerism, Baroque, the Metaphysical are only the most familiar historiographical types of that volatility, and if they reveal early plurality coalescing into some singular dominance, their internal divisions also reveal the ways in which the heterogeneous culture of the Renaissance exaggerates its paradoxes as it attempts to resolve them.[6] Antinomies that earlier Renaissance writers held in contingent and unstable alignments tend toward the more starkly oppositional. Demands for method, objectivity, and disciplined naturalism confront the motions of nonfunctional excess, self-conscious idiosyncrasy, and bizarre caprice, oppositions that are, however, less rigid than their polemic implies: extremes seek their opposites, appropriating intellectual gestures that refigure their own ends.

If Bacon's "instauration" is to be viewed as a part of this culture, it should be regarded not merely as violating an original epistemic integrity (if ever that existed outside of moral admonition), nor as a culpable masking of the disjunctions of its era, but as drawing its energy from instabilities that Renaissance thought had long been heir to. Most centrally, these concern the attempt to employ yet contain the mind's active construction of its own forms of coherence. Consider the way Bacon's advice in the quotation above, to keep in play "several theories and philosophies," introduces the analogy of astronomical theory. The conceit could not have appeared at a more highly charged moment. Having divorced, then negotiated a truce between, solid science and "imaginations," Bacon raises the stakes with perhaps the oldest and most radical challenge to scientific representations of world order. Astronomers since antiquity have conceded that various, conflicting models may "save the phenomena"—that is, account for and successfully predict the appearances of things by means of figures affirmed as neither true nor false. The confession would return in the Renaissance to haunt its natural philosophers, and through them, modern philosophers of science. As Ian Hacking complains, "Much recent philosophy of

science parallels seventeenth-century epistemology. By attending only to knowledge as representation of nature, we wonder how we can ever escape from representations and hook-up with the world."[7] Is practical success ever sufficient to refute the skeptic's charge that scientific inquiry explores only its own hypotheses and metaphors?

This skeptical paradox is fundamental for Bacon, and no less so for his career-long pose of having solved it. His reliance on hypothetical figures is only partly "extrinsic," as in his use of mythic and poetic imagery to communicate with and solicit the patronage of the nonspecialist.[8] Their force is felt most immediately in the simultaneous distrust of and preoccupation with mediating constructions that mark the entire range of his thought, everywhere concerned with "that commerce between the mind of man and the nature of things, which is more precious than anything on earth" (*GI*, 4:7). The widest range of that commerce, the mind's reaching to the stars, fully dramatizes his demand for an "unbroken ascent" to the reality beyond human fables. His contempt for anything less is clear in the revised and expanded version of the astronomy passage that appears in *De Augmentis*:

> Astronomy offers to the human intellect a victim like that which Prometheus offered in deceit to Jupiter. Prometheus, in place of a real ox, brought to the altar the hide of an ox of great size and beauty, stuffed with straw and leaves and twigs. In like manner astronomy presents only the exterior of the heavenly bodies . . . as it were the hide of the heavens; beautiful indeed and arranged into systems; but the interior (namely the physical reasons) is wanting. (4:347–48)

Confined to mathematics, astronomy maintains a limited "dignity." But once it attempts to penetrate to physical actuality, "the heavenly bodies as they really are," it spawns ingenious absurdities, displays of apparent motions through "a system of machinery arbitrarily devised and arranged to produce them" (4:348–49).[9] Such artifices become synecdoches for those "beautiful . . . systems" against which he warns in the *Advancement* and elsewhere. "The shew of a total" is a coercive pleasure; its "discourse of connexion" seduces us with the coherence of our own fabrications.[10]

And yet there is something indispensable in the pleasures of mental patterning. While praising the critical rigor of "broken" knowledge and urging us to comb through the ruins for redeemable nuggets of truth, Bacon also resists dismembering old philosophies for their "some one point" of value:

> For it is the harmony of a philosophy in itself which giveth it light and credence; whereas if it be singled and broken, it will seem more foreign and dissonant. For as when I read in Tacitus the actions of Nero or Claudius, with circumstances of times, inducements, and occasions, I find them not so strange, but when I read them in Suetonius Tranquillus gathered into titles and bundles, and not in order of time, they seem more monstrous and incredible; so is it of any philosophy reported entire, and dismembered by articles. (3:365–66)

This concern for what he calls elsewhere the "apt harmony of mutually sustaining parts" (7:74) clashes with the famous dissections of the objectivizing purist. Bacon's concern is only partly to be explained in terms of a prudent traditionalism in the *Advancement*, or a strategic rehabilitation of the pre-Socratics to displace Aristotle. Throughout Bacon's works, ambitious and even bizarre speculative systematizing coexists with the famous warnings against such speculation, a double motion of rejection and recuperation that at once compromises and enables his critique of the imagination, poetry, experimentation, methodology—the great instauration itself.[11]

Bacon's Poetics

Perhaps the best known example of Bacon's doubleness is his attitude toward poetic fictions and their genesis in the imagination. His inconsistency has been an issue ever since the early seventeenth century when Henry Reynolds, in the course of defending "fictious tales [*sic*]," directed a few bitter remarks toward a "man, not unlearned," who in one treatise unfolds "much doctrine" through allegorical interpretations of ancient fables yet in another attacks the foundation upon which such interpretation rests. Quoting from the latter—"*I think they* [the fables] *were first made, and their expositions deuised afterward*"—Reynolds summarizes his exasperation:

> What shall we make of such willing contradictions, when a man to vent a few fancies of his owne shall tell vs first, they are the wisdome of the Auncients, and next, that those Auncient fables were but meere fables, and without wisdom or meaning til their expositours gaue them a meaning; & then scornefully and contemptuously (as if all Poetry were but Play-vanity) shut vp that discourse of his of Poetry with *It is not good to stay too long in the Theater*.[12]

Does allegorical interpretation, in short, uncover the truth within fable or merely compound the act of fabling? Modern assessments of Bacon's contradiction range from proposing a change of heart to discerning the opportunism of a shrewd rhetorician, a lawyer practiced in the arts of persuasion who compiled lists of opposing theses (*antitheta*).[13]

But Bacon's wavering reveals a split found throughout his work that has produced a critical tradition of two fundamentally opposed portraits: Bacon as the enthusiast of both "powers of imagination and understanding" and Bacon as the harbinger of narrow objectivism, the "dissociation of sensibility," and worse.[14] If the proponents of one view point to his wide-ranging imagery and calisthenic conceits approaching metaphysical wit, others turn to his most quotable polemic.[15] Routinely accusing rivals ancient and modern of being more imaginative than rational, he diagnoses poeticizing as the chief disease of learning. Thus, Plato is a "swelling poet" for turning the mind from the external world

toward its own idols; Aristotle invents the "fiction of four elements"; Epicurus "dream[s] up mutual imitations, correspondences, parallelisms," all conceits of his "own imagination"; and the "Greeks as a whole" present theories "like the arguments of so many stage-plays, devised to give an illusion of reality . . . a neat roundedness foreign to a narration of fact." Modern rivals, scholastics and humanists, merely reproduce different versions of the same self-referential trap—vain matter or vain words—each caught up in webs of learning or a sterile aestheticism comparable to "Pygmalion's frenzy" (*MB*; *PFB*, 64; *TC*; *PFB*, 83–86; *AL*, 3:284–85). Attacking the "Idols of the Theatre, or of Systems," Bacon famously warns that "plays of this philosophical theatre" are like "stories" in the "theatre of the poets . . . more compact and elegant, and more as one would wish them to be, than true stories out of history" (*NO*, 4:63).

Bacon often portrays the imagination as narcissistic, self-pleasuring, even criminally subversive, thus in need of traditional and institutional restraints. Faculty psychology and academic curricula promise an orderly partitioning of mental activity: Reason produces philosophy; Memory, history; and Imagination, "poesy." Safely domesticated, the imagination is harnessed for virtuous ends. "Divine grace" employs it for inspired dreams, while ethical deliberation uses it as a messenger, escorting images to the Reason for judgment before they are shuttled to the Will to stimulate action. And it is put to work rhetorically to animate teaching and persuasion (*AL*, 3:409–11; *DA*, 4:455–57).[16] Despite Bacon's warning that the partitioning of knowledge not produce "barren" fragmentation (*DA*, 4:373), protectionist segregation becomes the psychological first step toward encyclopedic wholeness.

Yet behind these blunt dichotomies and defensive mechanics lies a cluster of intellectual forces emerging, on the one hand, from an increasingly radical, late-Renaissance poetic testing its extremes and, on the other, from a scientific realism only beginning to confront its own unresolved (and only partially grasped) dilemmas.

The closest view we get of Bacon's confrontation with Renaissance poetics is his tactful yet trenchant rethinking of the most influential piece of English criticism up to his time, Philip Sidney's *An Apology for Poetry* (1595). Bacon's intellectual ambitions made inevitable some engagement with Sidney's argument, and he clearly grasps the epistemological stakes. He strategically concedes Sidney's point: the defining feature of poetry is its fictionality. "It is not rhyming and versing that maketh a poet," Sidney writes, but the "feigning of notable images" (103:26, 29).[17] Bacon concurs: "Verse is but a character of style," but "poesy" springs from imagination and is "nothing else than feigned history or fables" (*DA*, 4:292). While both are alert to the prominence of feigning within history itself, both claim the originating impulse of poetic fictions as an attempt to escape history, to move beyond what Sidney calls the "brazen world" toward "perfect pattern[s]" of heroism and morality. Poetry represents "what may be and should be," enabling

what Bacon calls the mind's movement from a "sensible world . . . inferior in dignity to the rational soul" to a world that "seems to bestow upon human nature those things which history denies to it" (4:315). Fictions thus endorse a self-conscious "argument" about the alienated mind's idealizing powers in a fallen world. For Sidney, a longing for "perfection" through the "erected wit" provides "no small argument to the incredulous of that first accursed fall of Adam" (101:21–24), and Bacon again echoes him: "A sound argument may be drawn from Poesy, to show that there is agreeable to the spirit of man a more ample greatness, a more perfect order, and a more beautiful variety than it can anywhere (since the Fall) find in nature" (4:315–16).

But for Bacon, poesy is compensatory rather than generative, "satisfy[ing] the mind with the shadows of things when the substance cannot be obtained" and feigning heroical images only because "acts and events which are the subjects of real history are not of sufficient grandeur to satisfy the human mind" (4:315–16). The goldenness of origins becomes, within his comprehensive scheme, only an originating point of departure. Sidney's "first light-giver to ignorance" reveals to Bacon the immaturity of a civilization not yet "subtle enough" for the "conclusions of human reason." Bacon's reductive, almost parodic, echoing of the *Apology* does not debate Sidney as much as expose an instability within the *Apology* itself: the conflict between its case for idealizing impulses and its oblique acknowledgment that such justification is untenable. As I argue elsewhere, Sidney understood the limits of idealism as a defense of poetic creation but sought, through a series of ingenious maneuvers, to outflank condemnation through the self-conscious playfulness evoked by a fluid and ontologically problematic world.[18]

Bacon resists such accommodations by unraveling Sidney's intricately woven paradoxes. Not that he was unappreciative, or incapable, of them. The preface to *The Wisdom of the Ancients* is a masterpiece of equivocation, doubling back on its own emphatic claims about allegory, as is the *New Atlantis*, whose darkly ambiguous but ostentatious fictionality represents what a world of scientific rigor "ought" to look like. But Bacon distrusts the way Sidney's mingling of play and earnestness takes pleasure in, and finesses, unresolved conundrums. Nor will he accept a skeptical view of poetry as a privileged, because self-conscious, instance of the pervasive fictionality of all discourse. The universality of such play is for Bacon only premature gratification; substantial truth is possible only after a regrouping of intellectual forces. Thus, in place of Sidney's cagey and, I think, ironic exploitation of the Platonic aura still clinging to the poet's "Idea," Bacon insists on the gap between mental representations and the true nature of things. For Bacon, the "abstract forms" of Platonism (themselves figures of a philosophy "fanciful and tumid and half poetical") require a broad reworking of the very notion of "form" (4:66).[19] Sidney's "high flying liberty of conceit" opens too manifest a void: "The understanding must not therefore be supplied with wings, but rather hung with weights, to keep it from leaping and flying" (4:97). Hope

depends on restraint, even submission, for the sake of a deferred but greater human power. For Bacon, the seductiveness of late-Renaissance poetics with its golden worlds and counter-realities offers not liberation but a disastrous simulation of it. It mingles the opposing extremes of idealism and skepticism, the one unmooring the mind from the confinement of the concrete and inflating claims for its power, the other morbidly fascinated by the epistemological disjunction that ensues.

Bacon's rejection of these versions of aesthetic autonomy reveals at once his antipathy to late-Renaissance poetics and his affinities with its inner tensions. He seconds Torquato Tasso's attack on Jacopo Mazzoni's central positioning of mental "idols" in poetic imitation. "An idol is nothing," Tasso objects, a complaint that could not protect him, however, from his own anxiety about the mind's "god-like" powers of conception, its ability to fashion a "little world."[20] Bacon paradoxically draws power from such concerns by conceding their greater range: not only does the limited curricular space of poetry operate along the lines suggested by its more radical theorists, but so too does most learning, driving the Baconian ever onward to take up his critical stance against them. The syllogistic method, for example, builds a world of words, using "general propositions as certain fixed poles for the argument to turn on." True discoverers, by contrast, "propose not to devise mimic and fabulous worlds of their own, but to examine and dissect the nature of this very world itself," turning to "facts themselves for everything"; "God forbid that we should give out a dream of our own imagination for a pattern of the world" (*PW*, 4:25, 28, 32–33). Our sin is greater than that of our first parents who "wished to be like God":

> For we create worlds, we direct and domineer over nature, we will have it that all things are as in our folly we think they should be. . . . We clearly impress the stamp of our own image on the creatures and works of God, instead of carefully examining and recognising in them the stamp of the Creator himself. Wherefore our dominion over creatures is a second time forfeited. (5:132)

Bacon's rhetoric on this point is well known, decisive, and misleading. Because his impersonal, objective science is posited *as* an ideal, he would be drawn to the same extremes that animate and plague other late-Renaissance ideals of intellectual power, forcing him to reconceive rather than banish the world-creating drive of Renaissance poetics: "Discoveries are as it were new creations, and imitations of God's works"; "On a given body to generate and superinduce a new nature or new natures, is the work and aim of Human Power" (*NO*, 4:113, 119). If, having transcended mere poesy, he seeks to preserve Sidney's claims for the poet who "doth grow in effect another nature, in making things . . . better than nature bringeth forth," he will also relive Tasso's dilemma, purging idolatry only to promote another form of human invention that must reconstitute even as it stakes claim to the world he would call real.

The Hypothesis Hypothesis

Bacon's sense of the real—political, moral, natural—invokes the solidity of facts, but it is no less constituted by the necessity of work. This standard also degrades "poesy" as "rather a pleasure or play of imagination, than a work or duty thereof," the imagination as that which "hardly produces sciences," and what he calls "pastoral philosophy," whose placid world would exist only if "man were removed from [it]" (*AL*, 3:382; *DA*, 4:406; *PO*, 5:490–91).[21] Crucial to "the uses of human life" is "not an opinion to be held, but a work to be done," a new "foundation . . . of human utility and power" (4:248, 21). The determined vigor of this intellectual reformation drew Immanuel Kant to this passage for the motto of his *Critique of Pure Reason*, which he dedicated to Bacon. And despite Bacon's failures as an inventor, the utilitarian emphasis of his rhetoric has helped to establish his reputation as the "philosopher of industrial science" and a leading figure in the sociology of knowledge.[22] Yet, when we turn to the work behind the work, the methodical reform that will produce new sciences, its very zeal forces into prominence the challenges that compromise even as they provoke its most decisively stated goals.

To see why this is so, we need to recall the controversy touched on at the beginning of this essay over the role of hypothesis.[23] This was in large part the legacy of classical and medieval astronomers who made both realistic and hypothetical claims for models of planetary movement. If a model's end was an accurate account of the external world, then it had to answer to the physical structure of the cosmos. But if it was a device to facilitate calculations, or a construction to "save the phenomena" (as Plato reportedly phrased it), there was no such accountability. As Proclus summarizes, "Either these circles are merely fictive and ideal; or they have a real existence." Some middle ground is possible through hypotheses progressively revised to close in on truth. Thus, in the early sixteenth century Jacques Lefèvre d'Etaples claims that even as the mind "composes within itself . . . fictive heavens and fictive motions," it "blot[s] out a little more the spots of its ignorance" until it "seizes hold of truth." But others realized that approximation does not rule out an endless series; at every stage, alternative hypotheses for saving the phenomena may be invented, as Aquinas's "fictionalist" reading of astronomical models suggests: "Although these hypotheses appear to save the phenomena, one ought not affirm that they are true, for one might conceivably be able to explain the apparent motions of the stars in some other way of which men have not as yet thought."[24] The best known literary version of the paradox appears in Raphael's astronomy lesson to Adam in *Paradise Lost* (8.66–178), which sets Ptolemaic against Copernican systems and "affirm[s]" neither in an effort to dismiss, by rendering irresolvable, Adam's questions about the earth's movement.

Renaissance epistemological debates, however, rather than teaching "be lowly wise," heightened the controversy by setting the skeptical challenge to all certainty

against the reformist demand for certainty greater than any conjecture. Nicolaus Copernicus's *On the Revolutions of the Celestial Spheres* (1543) itself enacts the conflict, representing at once a major statement of heliocentrism and, because of its textual history, an important document on the question of hypothesis. Copernicus describes himself as beginning with the "liberty to imagine all sorts of fictive circles," but he finds himself constructing a model so coherent, so tightly integrated, that it seems to compel assent.[25] Textual history ironically reverses the motion. Posthumous publication of the work included an unsigned preface introducing the treatise as one fictive construction among many, a mere aid to computation. Although Johannes Kepler revealed this meddling to be the work of Andreas Osiander, it has remained part of the critical reception of the treatise, even for modern historians.[26]

Part of the problem with hypothesis is philological: the term involves senses ranging from the best we know at a particular moment or phase of inquiry, to an assumption for the sake of demonstration or argument, to a purely mental fiction. Copernicus, for example, not only titled an earlier work on the heliocentric system an "hypothesis," but he also cast parts of the *De Revolutionibus* itself in hypothetical terms, making, in the phrase of one historian, "cinematic models."[27] Discerning precise attitudes, moreover, can be tricky. When Peter Ramus calls for a return to the purity of a Babylonian "astronomy without hypotheses," he presents himself as a hard-headed advocate of direct observation, one who would sweep away the detritus of epicycles, eccentrics, and the like. But when Isaac Newton notoriously claims, "I feign no hypotheses," his meaning proves harder to fix.[28] Indeed, one of the major controversies in late-Renaissance and Enlightenment intellectual history is over the role of hypothesis in innovation: Did it enable a breaking free of dogmatism by entertaining alternatives, or were probabilism and fictionalism themselves reactionary gestures, imported from the late Middle Ages by defenders of the status quo (such as Osiander) intent on softening the impact of Copernicus, Galileo, and other revolutionary thinkers?[29]

One of the most revealing attempts in the Renaissance to settle the issue is Kepler's *Apologia pro Tychone Contra Ursum* (1600), the work that exposed Osiander's authorship of the Copernican preface. Kepler's intent is to attack the extreme, skeptical interpretation of all hypothesis as fiction-making, a view advanced by Nicolaus Raimarus Ursus.[30] Ursus begins his treatise unequivocally: "A hypothesis or fictitious supposition is a portrayal contrived out of certain imaginary circles of an imaginary form of the world-system, designed to keep track of the celestial motions." It need not be true, or even probable, and the astronomer will think up as many hypotheses as possible, figuring and refiguring the universe at his pleasure to save the appearances. Copernicus, Ursus argues, "transposed and converted the places of the sun and earth. . . . By an act of imagination he, so to speak, transferred and relocated the sun to the place of the earth . . . and, conversely, he transferred and relocated the earth, together with the air sur-

rounding it and the moon that rides upon the air, to the place of the sun" (*Against Ursus*, 41, 43, 47). Kepler responds that hypothesis is not a license for ingenuity; Copernicus did more than juggle the spheres. Astronomers work "seriously, not in jest"; they are motivated by a "love of finding out about nature" and so "rejoice in the conformity of their hypotheses to the nature of things" (ibid., 139, 145).

Kepler's case includes a lesson in philology, which becomes at the same time a plea for epistemological stability. The first use of *hypothesis*, he notes,

> was by geometers . . . to start their teaching from some established beginning. For in architecture the builder is content to lay down foundations below the ground for the future mass of the house, and he does not worry that the ground below might shift or cave in. Just so in the business of geometry the first founders were not, like the Pyrrhonians who followed later, so obtuse as to want to doubt everything and to lay hold on nothing upon which, as a foundation, sure and acknowledged by all, they would wish to build the rest. Those things that were certain and acknowledged by all they used, therefore, to call by the special name "axioms," that is to say, opinions which had authority with all. (Ibid., 137)

The primary concern here is not a strictly realistic view of hypotheses; although their correspondence to truth is important for Kepler, he would later place hypotheses in the realm of the probable, even the conjectural. At issue is their authority in an intellectual community: legitimacy must be "acknowledged by all" and cannot be accorded to private, quirky schemes assumed on trust (181). His objection is of a piece with his later controversy with Robert Fludd, whose mystical, "poetical" patterns, Kepler charged, grasped the universe "only in your own mind, nay in your dreams." Whether founded on mysticism or skepticism, private wit too quickly assumes its mastery over the world. To Ursus's boast that daily his wit erects new and better hypotheses, Kepler mocks, "congratulations . . . on your prolific inventiveness." Ursus's boast feeds on a corrosive skepticism, a Pyrrhonian game of infinite regression that, in doubting the foundation beneath foundations, subverts the stability of any intellectual construction.[31]

Construction is one of Bacon's favorite metaphors as well, a collective rather than private building "in the human understanding a true model of the world," one that will restore a communal "authority" over "the nature of things" (4:13). But a severely critical turn of mind produces a less settled view of hypothesis. Kepler's *harmonice mundi*, a divine mathematics of beauty and simplicity upon which he sought throughout his career to base his cosmology, would have struck Bacon as yet another example of the mind's tendency to project "more order and regularity in the world than it finds" (4:55).[32] The skeptics' shifting ground appeals more to Bacon than to Kepler precisely because it forces the mind into motion, suspending assent even to the most broadly held assumptions by reminding the researcher that consensus is no guarantee of validity: "If men went mad all after the same fashion, they might agree one with another well enough" (4:51). The unleashing of skeptical demolition becomes for Bacon, as it would for Descartes, a radical first step aimed at purging the mind of preconceptions

before laying new foundations. Bacon faults merely negative skeptics for being unable to make this transition: "They ought when they had overthrown and purged the floor of the ruins to have sought to build better in place" (*VT*, 3:244). The Baconian phases of demolition and reconstruction leave unresolved, however, the role of hypothesis within this tense economy of skepticism and certainty. How do these two impulses interact? Can the skeptical be neutralized, or at least sealed off, once the act of construction begins? Does skepticism limit itself only to outmoded illusion, or does it render hypothetical all claims to knowledge, even as these are asserted? And if the latter, does this threaten Bacon's project, strengthen it through dialectical testing, or force it into unexpected contingencies?

Bacon's own method of construction seems, at first view, remarkably untroubled by such questions.[33] Beginning with the diversity of experience, Bacon would chart a "gradual and unbroken ascent" to "the most general axioms" (*NO*, 4:50). Seeking an "interpretation" of nature as opposed to rash "anticipations" (51), Bacon compiles natural and experimental histories by "slow and faithful toil" (*TC*; *PFB*, 89), then sorts this information into tables of "presence," "absence in proximity," and "comparison," and finally, by "true induction," builds a pyramidal structure of knowledge. These steps avoid the flaws of induction by simple enumeration—i.e., the projecting of insufficient, merely positive instances into vulnerable generalizations. By scrupulous observation, experimentation, and induction, Bacon proposes, the mind investigates "Forms," not as Platonic essences ("in nature nothing really exists but individual bodies") but as "laws . . . which govern and constitute any simple nature." The path of investigation thus ascends and descends, rising to new axioms and descending to the production of new works, extending human power even as it leads to the most general laws of nature. The Baconian method, at once speculative and operative, discovers a true model of the world and "new things of service to the life and state of man," a reciprocity of "light" and "fruit." A necessary condition of this action, however, is a preliminary passivity: the philosopher takes hold of nature by first withholding himself from it, his role allegorized as Echo, "which echoes most faithfully the voices of the world itself . . . being nothing else than the image and reflexion thereof, to which it adds nothing of its own, but only iterates and gives it back" (*DA*, 4:326–27). Human knowledge and power advance by conquest of a world decisively located outside the mind.

It is such pronouncements that have made Bacon a prime target in theoretical attacks on objectivist and progressive accounts of science. Over the last forty years these attacks have come from a variety of rationalist and skeptically irrationalist positions, and while they are themselves politically and epistemologically often at odds, together they have foregrounded the role of hypothesis in any engagement with the world, scientific or aesthetic.[34] Karl Popper, for example, casts Bacon as a misguided Renaissance optimist, one to whom the universe is an open book for

a cleansed mind compiling and interpreting objective "facts." In this account, Bacon joins Luther and Descartes in a tradition demanding certainty, and thus antithetical to enlightened thinkers from Xenophanes to Nicholas of Cusa to Popper himself, for whom hypothesis and conjecture are paths to knowledge.[35] Popper seizes on Bacon's effort to segregate the skeptical from the constructive moments of his thought, an effort that depends on setting "pretty and probable conjectures" against "certain and demonstrable knowledge." Let astronomers busy themselves with saving the phenomena, Bacon writes at one point, while philosophers uncover "what is found in nature herself, and is actually and really true"; "And so much for hypotheses" (*NO*, 4:42; *DI*, 5:511; *TH*, 5:557).

But the same kind of doubleness we saw in Bacon's poetics qualifies his calls for objective certainty. Advances in direct observation are purchased with a renewed acknowledgment of the beholder's share. Thus, even while natural and experimental histories are advertised as "true and severe (unencumbered by literature and book-learning)," the "simple narrative of the facts" is conspicuously theory-laden (*GI*, 4:12; *DI*, 5:511).[36] Evidence is "duly ordered and digested" (*NO*, 4:81) with screenings and sortings into tables, each with its own strategic rules of selection. Bacon may reject the age's love of far-fetched analogy, "fantastically strained . . . correspondences and parallels," but he relies on his own *discordia concors*: "instances which agree in the same nature, though in substances the most unlike." Thus the mind, scrutinizing "the Nature of Heat" can draw analogies between "the rays of the sun" and "horse-dung . . . when fresh" (*AW*, 3:370; *NO*, 4:127–28).[37] Sensory and conceptual sightlines are forever being imposed on the welter of experience to order information and sharpen distinctions. Notable is the list of twenty-seven "prerogative instances." Most seem judicious—the use of microscopes and telescopes, increased attention to likeness-in-difference and difference-in-likeness and the "Instances of the Fingerpost" that help adjudicate between competing explanations—but they can also shift the role of the observer from mere recorder to active shaper.[38] Shrewdly constructed experiments may uncover nature's secrets—the "vexations of art" and its "exquisite instruments" produce a "Designed History," "skilfully and artificially devised for the express purpose of determining the point in question" (*NO*, 4:95; *NE*, 5:136; *PW*, 4:26)—but they also reveal the mediated character of observation: "The sense decides touching the experiment only and the experiment touching the point in nature and the thing itself" (*NO*, 4:58; cf. *PW*, 4:26).[39]

Indirections appear within and following the construction of fact. Natural and experimental histories enable the researcher to investigate the forms of "simple natures," revealing the "true difference" defining a given nature. But not only does the search force Bacon to posit unobservable entities and processes, and so require hypotheses; it also requires him to concede that "we do not yet possess sound and true notions of simple natures" (*NO*, 4:149). Such notions are, in other words, presupposed by the method even as they constitute an end toward

which the method works. Bacon recognizes, of course, that if science is to be progressive, it must allow provisional assumptions and unverified data. In the *Histories*, for example, things "useful if not altogether true" are signaled at various points (*NE*, 5:136, 196, 320, 298). But it is not always clear precisely where we are along the axis of hypothesis and assertion. For example: Bacon appears for a time to endorse atomism and is sometimes regarded by historians as an important Renaissance atomist. Yet he also treats it as a metaphor or explanatory model: "The doctrine of Democritus concerning atoms is either true or useful for demonstration. For it is not easy either to grasp in thought or express in words the genuine subtlety of nature, such as it is found in things, without supposing an atom" (*TN*, 5:419). Graham Rees finds Bacon far more committed to a semi-Paracelsian "spiritual chemistry" than to atomism, which is at best a "satellite" or didactic analogue for "the only body of positive science which Bacon ever accepted." Yet even spiritual chemistry, Rees concedes, was never wholly endorsed by Bacon. Not a "genuine product of true method," pneumatic theory is at best a "good imitation" or "simulation" of how the method would work were its material "rigorous enough."[40] As for the method itself, Bacon calls it "induction," but he often uses the term the way he uses other basic terms such as "metaphysics," "magic," and the notoriously difficult "form," drawing it by analogy from past philosophies as a place holder in an evolving pattern of relations.[41] Novelty may require analogy with what is familiar, but if Mary Hesse's analysis of Bacon's "ladder of axioms" is correct, that "the conditions of [Bacon's] method can never be fulfilled," how can we ever escape the subjunctive mode of conjectural models?[42]

The Mind in Motion

When Augustus de Morgan published his famous nineteenth-century collection of paradoxes, he omitted one of his favorite authors, Giordano Bruno, because, he explained, Bruno was "all paradox." A similar point might be made about Bacon: historians and philosophers of science often have difficulty locating Bacon's use of hypothesis because his logic of discovery is, in an important sense, all hypothesis.[43] Bacon hopes for an objective certainty that will eventually overtake and complete his method, but it is method itself that makes the objective ideal possible, even as it eludes its requirements. His sense of this dynamic is more resourceful than the ingenious but futile machine James Spedding characterizes (3:171). Bacon's odd cognitive hybrids—his claim, for example, to establish "provisionally certain degrees of assurance" (*NO*, 4:32)—is at once deliberately evasive and evasively deliberate. "I am certain of my way," he writes in *Thema Coeli*, "but not certain of my position" (5:559), a concession to, yet a commitment within, a

world of flux that leaves even a certain "way" (as he admits at the end of the *New Organon*) open to revision.[44]

What abides within any revision is Bacon's enthusiasm for the drama of interpretation confronting a difficulty never-quite-overcome, his attraction to a tantalizing temporality through which the twin fruits of knowledge and power beckon from a hypothetical future. In *The Plan of the Work* for *The Great Instauration*, Bacon imagines himself as an explorer and conqueror of the intellectual globe, only to concede that his imperial epic is unfinished. All should be "subservient and ministrant" to a sixth and final part that would establish the philosophy of "legitimate, chaste and severe . . . inquiry," but that part remains "a thing beyond my strength and beyond my hopes." Instead, he offers "models" of the "process of the mind" and encourages successors by devoting a fifth part to "things as I have myself discovered, proved, or added,—*not however according to the true rules and methods of interpretation*" (4:32, 31; my emphasis). Indeed, Bacon titles this part of his Great Instauration, the last he imagines finishing in his lifetime, "The Forerunners; or, Anticipations of the New Philosophy." Not only does he highlight his furthest reach as provisional, but he names it with the very term he uses to disparage the conjectures of his predecessors: "anticipation," the opposite of true "Interpretation" (*NO*, 4:51). Modern critics properly insist on differentiating these "anticipations" from merely fanciful "anticipation," but Bacon's verbal doubling is purposeful: it forces attention to a potentially disastrous yet thrilling irony, one held at bay only by an unremitting expenditure of intellectual energy. Bacon is suspicious of fixed points, those "positions of higher generality" to which "the mind longs to spring . . . that it may find rest" (4:50). Present discoveries and proofs are for "temporary use only," "wayside inns, in which the mind may rest"; to them, he warns, "I do not at all mean to bind myself" (*PW*, 4:31–32).

Striving to rejoin the mind and nature, Bacon uses the analogy of motion to plot their a priori congruence. For both mind and nature, motion is not the illusion behind which lies the implacable rest of Greek metaphysics, but precisely the opposite. "Simple and absolute rest . . . there is none"; rest is "the effect of some hindrance, prevention, and equilibrium of motions," as when "in wrestling the stronger man holds down the weaker, so that he cannot move, yet, if the weaker still resist with all his strength, the motion of resistance is not therefore less" (*TN*, 5:429–30). Bacon's figures of domination have often been noted; but domination is itself a deferred end, making possible, and necessary, figures of continuing struggle. For once critical resistance demolishes the aesthetic elegance of traditional thought, the provisional objectivity that replaces it gives rise to a new aesthetic, one based on a sensuous, even quasi-erotic, athleticism. It is not for empirical considerations alone that Bacon takes "heat" as his central example of the investigation of form in the *New Organon*: its characteristic "motion of expan-

sion" is continuously "checked, repelled, and beaten back . . . perpetually quivering, striving and struggling, and irritated by repercussion, whence springs the fury and fire of heat" (4:153). The knower matches the mobility and dynamism of a world he would know but never wholly master.

Baconian operations upon nature are, I am suggesting, as much instances of what is sometimes called the Baroque as is the prose Morris Croll characterizes as displaying the "athletic movements of the mind by which it arrives at a sense of reality . . . twisting and turning in the act of thought."[45] The action is played out on every level of inquiry, with promises of imminent completion and final rest suspended between promises of continuing action. At times, as in "Of Truth," he mocks those who "delight in giddiness" and "count it a bondage to fix a belief," and in *The Plan of the Work* he assures us that his own "suspension of judgment" is "almost the reverse" of the skeptic's because it will lead the mind, not to an endless circling, but to a final "knowledge of causes in which it can rest" (4:32). But Bacon rejects skepticism less for its denial of rest than for its failure to sustain its initial shock of energy. Clinging to uncertainty, the skeptic is like the proverbial miser impoverished by his refusal to stake anything, canceling by hoarding his freedom of will (*DA*, 4:463).[46] The rhetoric of aphorisms gives voice to a new "provisional certainty": authoritative in tone but fragmentary in form, it "doth leave the wit of man more free to turn and toss." And such turning and tossing, despite Bacon's sober privileging of "work" and "duty" over "pleasure" and "play," is where his pleasure lies. The work of knowing never cloys the appetite but makes hungry where most it satisfies: "In all other pleasures there is satiety. . . . But of knowledge there is no satiety, but satisfaction and appetite are perpetually interchangeable" (3:317).

Interpreting nature, Bacon finds his internal, fatal Cleopatra: the dynamic subject as the center of knowing and doing. If method would legitimize the paradox of hunger and fulfillment with its inexhaustible intellectual hedonism, it must discipline the refractory individual. Bacon's vision of an international fraternity of research not only shuns the elitist solitude of the Renaissance *magus* (as does much of seventeeth-century science), but sublimates all Protagorean sentiments. "Man is the measure of all things" had its Renaissance admirers, but not Bacon; in science things are "true in relation to the universe, not man." "Man" is the "center" and "purpose" of creation only if the humanist credo is defined in terms of the species, whose intellect proceeds "by method and in order and not by desultory impulses" or individual flashes of insight. The "native and spontaneous process of the mind" must be "guided at every step; and the business be done as if by machinery" (*NO*, 4:54, 98, 40). The method "leaves but little to the acuteness and strength of wits, but places all wits and understandings nearly on a level," attributing "but little to individual excellence" (*NO*, 4:62–63,109). So important is the dispersal of individual agency into collective, mechanical, or depersonalized action that Bacon submits his own pont of origin to the general

leveling, attributing the elaborate method of the *New Organon* to "a happy accident, rather than . . . any excellence of faculty in me, a birth of Time rather than a birth of Wit" (4:77).[47] "Veritas filia temporis" becomes an antihumanist rallying cry.

But Bacon can validate his project only by invoking a powerful subject, one inferred from its very refractions and distortions of nature. Driven by a longing to close the space between the knower and the known, Bacon also thrives within such space, assuming inconsistent attitudes that forever engage him with the problem of knowledge. The mind as source of error, an "enchanted glass" or "false mirror," provokes schemes of correction, even as such schemes persist in outlining the indispensable presence of a reforming, because alienated, intelligence. Fervent claims for immediacy coexist with a subtly acknowledged perspectivism: "I . . . dwelling purely and constantly among the facts of nature, withdraw my intellect from them no further than may suffice to let the images and rays of natural objects meet in a point, as they do in the sense of vision" (preface to *GI*, 4:19). Even as Bacon scrutinizes nature (and the writings of naturalists) for experimental data, so too he ransacks his culture for images of the scrutinizing mind, comparing it to king, explorer, physician, prophet, priest, magician, architect, jurist, epic hero, and orphic poet. However many key analogies these images offer cultural historians, each case confronts us with the possibility of its being perceived as something else: *plus ultra* is the motion not only of outward inquiry, but of self-representation.

It is this sequence of images, rather than any single one, that best traces the mind's conduct, the ways in which it expands its cognitive space into those very territories against which it would define itself. Induction remains the approved method, generating "tables of discovery for anger, fear, shame . . . and again for mental operations of memory, composition and division, judgment, and the rest; not less than for heat and cold" (*NO*, 4:112). These tables may turn the subject of knowledge into an object within nature, but they defer rather than resolve questions about the compiler's self-reflexiveness. Only the sensible soul has objectifiable properties—the "softness of air to receive impressions" and the "vigour of fire to propagate its action" (*DA*, 4:398). The rational soul, which distinguishes human from brute, must ultimately be projected into the realm of faith; arising "from the breath of God," it can be known only by divine inspiration (*DA*, 4:396–98; cf. *AL*, 3:379). Such deference might be taken as Bacon's defensive reliance on his own separation of natural philosophy and theology; but, having consigned discussion of the "rational soul" to the outposts of faith, he follows closely behind, tapping that realm for his crucial paradoxes.[48] Science borrows from theology the subversion of rational complacency: even as the contemplation of God produces "wonder, which is broken knowledge," so the contemplation of nature produces a "knowledge broken" (*AL*, 3:405). Although one marks the limit of thought when facing the infinite and the other "invites men to enquire farther" into the finite,

each produces a *docta ignorantia*, a complex state of knowing and unknowing, self-consciousness and self-abnegation, fulfillment and hunger. Like the negative way of mystical theologians, which purges the mind of inadequate concepts, the Baconian way sharpens its focus through exclusion and negation. Because the mind prefers to confirm rather than deny its ideas, the student of nature must "take this as a rule,—that whatever his mind seizes and dwells upon with peculiar satisfaction is to be held in suspension" (*NO*, 4:60). Immediate knowledge is beyond human privilege; to "man . . . it is granted only to proceed at first by negatives" (4:145).

The exhilaration of conceptual free-fall is not, of course, Bacon's aim. Unlike mystical theology, which cannot "end in affirmations," science has definable goals: "a distinct and definite notion" may be "extracted out of ignorance," even as Cupid is said allegorically to have been hatched from his egg by Night (*PO*, 5:465). The distinction is shrewder and more complex than may first be apparent. Bacon does more than contrast sacred and secular; he harnesses the energy of adversaries who have become unexpected predecessors, even as he protects himself from what he deems the futility of their projects. The emergence of form out of darkness was familiar to practitioners of the negative way from Pseudo-Dionysius to Nicholas of Cusa. Despite their emphasis on mystical darkness, they well understood the necessity of an "affirmative" supplement. And none more so than Nicholas, who projects a potentially endless series of symbolic approximations of the ineffable, giving rise to an art of conjecture that embraces a surprisingly broad interest in empirical experiment.[49] Karl Popper's contrast between Bacon and Cusanus is, nonetheless, incisive on a crucial difference: Bacon's separation of natural and supernatural protects the former not only from theological speculation, but also from a view of inquiry as endlessly conjectural. When Bacon talks of "closing with nature," he seeks no asymptote of infinite representation; instead, "after the rejection and exclusion has been duly made," there remains "at the bottom, all light opinions vanishing into smoke, a Form affirmative, solid and true and well defined" (*NO*, 4:146).

The concrete specificity conjured by Bacon's chemical metaphor is, nonetheless, belied by the further indirections needed to find directions out. The very prediction of a solid precipitate, a "Form affirmative," provokes a self-conscious warning about the "winding and intricate" method of discovery. Affirmation is forced to shape itself not only through the rigors of experiment but also through the tropings of hypothesis. Without "sound and true notions" of simple natures, Bacon admits, the act of exclusion cannot be wholly "accurate." Even so, the "affirmative way" must begin before opinion is burned off, because "truth will sooner come out from error than from confusion" (*NO*, 4:149). This famous passage appears to concede the necessity of hypothesis: it is "useful" to make "a kind of essay" of interpretation (*utile putamus ut fiat permissio intellectui*), to produce a "First Vintage" by an "indulgence" or "liberty" of the understanding (*permissionem intel-*

lectus; 4:149; Latin text, 1:261). It is a potentially explosive moment when, as Karl Wallace observes, after much discipline and delay, the understanding "can no longer be held in check." This release is no generalizing inference, according to Mary Horton, but a "genuine intuitive leap," an "alogical process" whereby hypotheses are "'elicited' or 'created.'" Although Horton may press a little hard on the ambiguity of Baconian "invention," she focuses valuable attention on an activity too often hidden by Bacon's promise of a "gradual and unbroken ascent," or gingerly set aside, as in Robert Ellis's alert but embarrassed view of it in his "General Preface" as "only a parenthesis in the general method" (1:36–37).[50] Inventive liberty enables all anticipation by projecting not merely science's First Vintage but its highest end: the "summary law of nature." It is characteristic of Bacon that as soon as he pictures his ultimate affirmation, he recalls its sketchiness: the exposition breaks off, doubling back to an extended digression on "prerogative instances."

What keeps this mental shuttling between affirmation and hypothesis in motion is the stimulus of unresolved contradiction, the sustaining of opposed intellectual motions. Intellectual heat, no less than physical heat, requires a prolonged contest—"perpetually quivering, striving and struggling, and irritated by repercussion." For Bacon, as for the Milton of *Areopagitica*, singular dominance means stagnation: "Prosperity is the blessing of the Old Testament," Bacon writes in another context; "Adversity is the blessing of the New." The new organon he offers seeks out its adversary, whether it is the world of brute, unexplained "nature" or the "mimic and fabulous worlds" of theologians and poet-philosophers. If the lines of opposition are initially set by the renovating force, that force is itself contingent on and revised by successive acts of opposition.

This mutuality is nowhere clearer than in the doubleness I discussed at the start of this essay: the confrontation with poetic imagination. As in his use of religious psychology, Bacon's science sustains its *plus ultra* by recuperating energies it marginalizes: his ambiguous "liberty of the understanding" replays in a new key Sidney's "liberty of conceit." The echo is fitting, as I suggested earlier, given Bacon's conception of operative science as a "making" of "new creations" and "a new nature" (*NO*, 4:113, 119). The differences between scientific and poetic making are advertised repeatedly: rather than jettisoning the "bare *was*," science relies upon tables of fact; it seeks not the highest point of man's wit but the summary law of nature; fixed truth may not be wholly affirmed, but utility and progress offer a working justification. Yet the very need to affirm truth, and so affirm an ultimate difference, puts the opposition back into play.

Despite occasional identifications of "practical results" and "truth," Bacon cannot resist peering beyond the practical: "Works themselves are of greater value as pledges of truth than as contributing to the comforts of life" (4:110). Translating pragmatism into scientific realism opens a space that requires endless crossing. Between "use and action" and certain knowledge lies the dilemma of

the Sidneyan maker denying that he builds "castles in the air" yet, deprived of ontological fixed points, substantiating his inventions through repeated claims of practical efficacy.[51] "Sciences," Bacon warns in the *Epistle Dedicatory*, "may no longer float in air," yet the surest foundation he can offer is "the discovery of new works and active directions." The very demand for ultimate, if deferred, stability places final justification forever beyond his grasp. The science he imagines not only offers progress but enforces its necessity, inaugurating a quest for Being to be satisfied only by a potentially endless calling of absent worlds into being.

To acknowledge this condition is not to translate Baconian science into poetry. The equivalence would be injurious to both sides, not only by dismissing their own conceptions of means and ends, but also by robbing them of the dialectical opposition from which each draws inspiration. But it does uncover a self-renewing source of enabling contradictions linking scientific and aesthetic dreams of intellectual power in the late Renaissance, one that would, in turn, help reshape the ancient quarrel among the various arts and sciences into the obsessive modern opposition between scientific and poetic knowledge. Evoking the most pointed epistemological and moral condemnation from the seventeenth century to contemporary cultural theory, this contrast nonetheless draws its opposites, in the terms of a recent semiotician, into the stance of dual Narcissuses gazing in ambivalent fascination at what appear to be their inverted mirror images, "semiogenetical twins."[52] The homologies behind such rival twinning appear, as I have been suggesting, in the comparison of Bacon to Sidney. Projections of what the mind might create through and against history take shape through Bacon's "anticipation" or Sidney's "foreconceit." Each writer constructs a new relation of wit and the world by isolating, amplifying, and realigning what he takes to be the single-mindedness of his competitors. Even as Sidney exposes the abstracted philosopher and materialist historian to fuse and surpass them, so Bacon, to produce a new, transformative potency, seeks a "closer and purer league" between the rationalist and the experimentalist. The dangerous subjectivity that marks late-Renaissance poetics is contained by being reinvented. The self-abnegating trope of time giving birth to truth is balanced by its contrary: of time drowning truth, leaving mere flotsam on the surface. The universe, to cite another Baconian metaphor, would remain a "labyrinth" with "so many ambiguities of way" unless we have "a sure plan," the design of a mind that can "by [it]self" construct, master, and transmit the intellectual method (preface to *GI*, 4:18; *PN*, 4:251–52). Poised between its own opposing qualities—nimble enough to catch resemblances, steady enough to discern subtle differences—Bacon's is the least eccentric of minds, and for that very reason uniquely in position to declare "all knowledge to be my province" (letter to Lord Burghley, 8:109). He may picture his co-workers as racing with burning torches "in honour of Prometheus," and not running too strongly or swiftly for fear of "putting the torches out" (6:753), but he becomes the one honored, a "benefactor . . . of the human race" whose gift illuminates

"the circle of our present knowledge; and so spreading further and further should presently disclose . . . all that is most hidden . . . the propagator of man's empire over the universe."[53]

Sidney claimed the poet was the first light-bearer to ignorance, and Percy Shelley enthusiastically joined the two Prometheans to declare, "Lord Bacon was a poet. . . . His language has . . . a strain which distends, then bursts the circumference of the hearer's mind." These terms have value for contemporary historiography, though not as indisputable evidence for Bacon's "philanthropia" nor as an allegory of magnanimity and aesthetic transcendence to supplant those of domination: one might well argue (as I do not) that intellectual surprises and assertions of public benefit produce only further instances of domination or mystification. These terms remind us, rather, that if we would not be enclosed by our own devices as we chart discursive spaces and structures, we need to recall the versatility of the thought generated within and against its contexts. It is by such generation that Bacon could call for methodical and impersonal objectivity, and yet be perceived by his seventeenth-century admirers as a "high-flying" wit, "incomparable Author," and the possessor of "great genius."[54]

Postscript: Lord Bacon's Planet

Among the best known of Renaissance remarks on "artistic genius" is Marsilio Ficino's illustration from Greek science. According to Ficino, Archimedes' ability to construct a moving, working model of the cosmos demonstrated that "man possesses as it were almost the same genius as the Author of the heavens."[55] Bacon rarely took kindly to Neoplatonic idealizing and, as we have seen above, regarded the notion that "we create worlds" as a disastrous one. But having examined Bacon's equivocal treatment of hypotheses and the mobile mind that invents them, we are in a good position to take a final look at cosmological models—that central arena for Renaissance debate about hypothesis—and to look at one model in particular. Bacon spent a good deal of time contemplating it, going so far, he writes in the *New Organon* and elsewhere, to have a "machine made with iron wires to represent it" (4:184).[56]

Bacon's cosmology may be gleaned from several of his writings. The fullest version appears in *The Description of the Intellectual Globe* (*Descriptio Globi Intellectualis*) and in the complementary *Theory of the Heaven* (*Thema Coeli*), works whose extreme, speculative nature is at once self-indulgent and self-conscious. Not only do they contradict Bacon's habitual warnings about the vast disparity between the actual cosmos with its infinite stars and the elegant geometrical patterns we imagine (4:433), they take as a central challenge the mind's duty to make such patterns. In the *Descriptio* Bacon argues early against those who have "destroyed

and confounded system" by diffusing innumerable worlds in infinite space (5:514–16). The motive behind this quarrel emerges late in the *Thema*, where Bacon explains that he intends this "interlude" to show that his own methodological emphasis on "negative questions" is not a "vacillation of judgment or inability to affirm" (5:559). Indeed, affirmation is a repeated event in these works, especially in the *Thema*, where Bacon spells out a series of claims he pointedly "affirms" or "denies." This activity explicitly opposes the usual run of astronomical hypotheses that only "save the phenomena" and so are "useless to refute" because "they are not themselves asserted as true" (557). If there is also a sideswipe at the skeptic or poet who nothing affirms, it originates in a view of the mind, like nature, abhorring a vacuum. As Bacon explains in *The Refutation of Philosophies*, "The mind is not like a wax tablet. On a tablet you cannot write the new till you rub out the old: on the mind you cannot rub out the old except by writing in the new" (*PFB*, 103). The transition from demolition to construction refuses to linger at the Pyrrhonist abyss.

As for the claims themselves, they are an odd lot. Much of the scheme, as Graham Rees has shown, is pieced together from Alpetragius, a twelfth-century Arabic astronomer, and from Paracelsus. Furthermore, Bacon indulges a number of liberties: within a few short sentences of spurning those who erect "human wit" above nature, he grants himself a similar privilege, invoking a conjectural "anticipation" of his own (from another work concerning oceanic tides) to render an issue "settled and concluded" (5:554). Some points seem laudably modern—an assault on the incorruptibility of the heavens, for example—but others less so, including a denial of the moon's solidity in order to affirm it as "the last sediment of celestial flame," which by nature gathers into burning globes. All these motions show Bacon rounding his ideas and images into systems of coherence, a preliminary to targeting these clear-edged representations for subsequent affirmation or denial. What makes possible this conjecturalism, paradoxically, is the ceaseless hunger for fact. The *Descriptio* begins with the familiar contrasts: on the one side, "poesy," "wit," "sport," "feign[ing] what [the mind] pleases"; on the other, "philosophy," "facts," and "the truth of things, which is simple." It recommends the works of Ptolemy and Copernicus but only for the pure observation that can be "detached from the art," leaving behind "all theoretical doctrine" for "what is actually and really true" (5:503–4; 510–12). But the line between observation and theory, which Bacon is forever drawing and violating, is now crossed by another factor, a subtle historicism that links the epistemological dilemmas I have been discussing with Bacon's self-positioning within intellectual history.

Even as he champions immediacy over tradition, Bacon concedes that all innovation inevitably slips into the past: witness the history of innovation honored in the galleries of the *New Atlantis*. If this self-consciousness appears tragic, reminding us of the inevitable calcification of the living present, it also frees Bacon from the revolutionary's polemical certitude. Having historicized past phi-

losophies, Bacon includes his own work in the temporal flow. A serious play on "history" becomes a key to the *Thema*: Bacon offers to "construct a Theory of the Universe, according to the measure of the history [*pro modo historiae*] yet known to us; keeping my judgment however in all points free, for the time when history, and by means of history [*postquam historia et per historiam*] my inductive philosophy, shall have been further advanced" (5:547; Latin text, 3:769). Natural history may ideally be pictured as a "solid and eternal basis" for induction (*DI*, 5:508), but its very construction locates it within the contingencies and fluctuations of history. The distinction between science and its rivals is figured as an orientation not only toward being but also toward time: science finds in history, not a "world . . . inferior in dignity to the rational soul," but the ground of its action.[57] This action simultaneously affirms and interrogates, allowing the mind within history to make history. Thus, the doubleness of objectivity and perspectivism, of realism and pragmatism, of methodical gradualism and leaps of hypothesis, at once submits the human subject to and attempts to free it from mere historical boundedness. This doubleness becomes the final theme of the *Thema*: "These then are the things I see, standing as I do on the threshold of natural history and philosophy. . . . I repeat once more that I do not mean to bind myself to these. . . . I will preserve . . . even as the heavenly bodies themselves do (since it is of them I am discoursing) a variable constancy" (5:559).

As the concluding paradox suggests, Bacon traces the movement of his mind as well as the movement of the heavens, allowing him to image in the latter's "variable constancy" what it means to be "provisionally certain." The paradox is twice anticipated in the text through images of paired motion. One represents nature in alternating phases, "proceed[ing] a certain distance by gradations, and then suddenly by jumps. . . . Otherwise there could be no structural fabric" (5:549). The other represents two movements as balanced opposites: rotation, "which moves merely for the sake of moving and following itself and seeking its own embraces, and exciting and enjoying its own nature, and performing its own operation"; and a "contrariwise motion in a straight line [which] seems like a journey to an end, as seeking both to reach the limit where it may cease and rest, and to attain some object and then discontinue its motion" (551). It is the interdependence of such motions that best locates his work within the discourses of late-Renaissance intellectual life.

It is appropriately Baconian that, having ventured a conceit joining intellectual and cosmic motion, he would construct an experiment to put his conceit to the test. He complained elsewhere that microcosmic analogies have been "fantastically strained" by his contemporaries (3:370), and so may have felt a particular satisfaction in producing in the laboratory the rotating, flaming globes so central to his image of heavenly bodies. Placing a candle in a metal bowl and

surrounding it with spirit of wine, Bacon set both candle and wine on fire. His observation is remarkable: surrounded by the wine's curtain of flame, the candle's flame swelled to four or five times its normal size, and, rather than forming the usual pyramid, formed a globe that waved "to and fro; as if flame of his own nature . . . would roll and turn," even as the celestial bodies themselves take shape as rotating, globular spheres. The "planet-making experiment" is the way Graham Rees refers to this exercise, and he notes as well that when members of the Royal Society sought some years later to repeat it, they found the flame "was not orbicular, as it had been said it would be, nor turned round."[58] How Bacon achieved his results is not clear, but it is a good hypothesis that his quest for objective reality found indispensable the energies later personified in Wallace Stevens's Ariel, who also looked with gladness at his planet on the table.

Notes

I gratefully acknowledge the support of the John Simon Guggenheim Memorial Foundation for a study of the late Renaissance, of which a version of this chapter forms a part. I also wish to thank Paul Alpers, Stephen Greenblatt, David Quint, and especially Susan Wolfson for their helpful comments on the essay.

1. Quotations from Bacon's writings, unless otherwise indicated, are from *The Works of Francis Bacon*, ed. James Spedding, Robert Leslie Ellis, and Douglas Denon Heath, 14 vols. (London, 1857–74; reprint ed., Stuttgart, 1962–63); citations are to volume and page number. Quotations from Benjamin Farrington, *The Philosophy of Francis Bacon: An Essay on Its Development from 1603 to 1609 with New Translations of Fundamental Texts* (Chicago, 1964), are cited in text as *PFB*. Other abbreviations in the text for works or parts of works by Bacon are: *AL* for *Of the Proficience and Advancement of Learning Divine and Humane*; *DA* for *Of the Dignity and Advancement of Learning* (*De Dignitate et Augmentis Scientiarum*); *DI* for *Description of the Intellectual Globe* (*Descriptio Globi Intellectualis*); *GI* for *Great Instauration* (*Instauratio Magna*); *MB* for *The Masculine Birth of Time* (*Temporis Partus Masculus*); *NE* for *Natural and Experimental History for the Foundation of Philosophy* (*Historia Naturalis et Experimentalis*); *NO* for *New Organon* (*Novum Organum*); *PN* for *Preparative Toward a Natural and Experimental History* (*Parasceve*); *PO* for *On Principles and Origins* (*De Principiis Atque Originibus*); *PW* for *Plan of the Work* (*Distributio Operis* for the *Instauratio Magna*); *RP* for *Refutation of Philosophies* (*Redargutio Philosophiarum*); *TC* for *Thoughts and Conclusions* (*Cogitata et Visa*); *TH* for *Theory of the Heaven* (*Thema Coeli*); *TN* for *Thoughts on the Nature of Things* (*Cogitationes de Natura Rerum*); and *VT* for *Valerius Terminus of the Interpretation of Nature*.
2. I summarize the argument of Timothy J. Reiss, *The Discourse of Modernism* (Ithaca, N.Y., 1982).
3. For suggestions about the primacy of politics in Baconian experiment, see ibid., 202–3, as well as Stephen Orgel's comparison of king and scientist in *The Illusion of Power: Political Theater in the English Renaissance* (Berkeley, 1975), 55. The relevance of such analogies is clear, I think, but so copious are Bacon's own comparisons that no analogy need be granted privilege. Political analogies are themselves variously interpretable.

Contrast, for example, royalist readings to Ian Hacking's democratizing emphasis: "'The glory of God is to conceal a thing; the glory of the king is to search it out.' He taught that in the true meaning of this proverb, every inquirer is king"; *Representing and Intervening: Introductory Topics in the Philosophy of Natural Science* (Cambridge, 1983), 246.

4. Reiss, *Discourse of Modernism*, 48.
5. Reiss's treatment of cultural variety, which is indebted to Michel Foucault, Raymond Williams, and others, is adroit yet problematic. After conceding that reducing the complexity of medieval thought to a "single class of discourse" risks "flattening out . . . enormously rich diversity," he argues that this "need not prevent us from understanding [the Middle Ages] as an epistemic totality," provided we keep in mind that the "episteme" is only a "heuristic tactic" pointing to a way of knowing, not an object of knowledge. But he insists at the same time that medieval variety really does occur "under the sway of single discursive dominance." Variety, furthermore, appears to be a privilege only of the Middle Ages; "our modernity" is marked by the "accession to dominance . . . of a single discursive class" (ibid., 22–23 and note). What needs clarification is the way this use of "episteme," with its idealized periods of harmony and fragmentation, despite its theoretical subtlety and scope, avoids in practice the reductiveness of the "static . . . Weltanschauung." I am not questioning here an historian's right to raise ethical questions, only the narrative he or she would construct in order to do so.
6. For a recent approach to the late Renaissance as a "culture of exaggeration," see José Antonio Maravall, *Culture of the Baroque: Analysis of a Historical Structure*, trans. Terry Cochran (Minneapolis, 1986), chap. 8.
7. Hacking, *Representing and Intervening*, 130. For some bibliographies on the controversy concerning scientific hypotheses, see note 23 below. An earlier but still influential survey of the problem in astronomy is Pierre Duhem, *To Save the Phenomena: An Essay on the Idea of Physical Theory from Plato to Galileo*, trans. Edmund Dolan and Chaninah Maschler (1908; reprint ed., Chicago, 1969).
8. Lisa Jardine's *Francis Bacon: Discovery and the Art of Discourse* (Cambridge, 1974) properly distinguishes between imaginative eloquence and scientific method: "Only . . . scientific principles communicated by the stages of the inductive method itself will be perspicuous and unmisleading because it is open to the listener to retrace in its entirety an infallible method of discovery. . . . Otherwise . . . all presentation is misrepresentation to some specified end . . . 'rhetorical' in our modern loose sense of the word" (74–75). The distinction is, however, difficult for Bacon to maintain in practice: claims for certainty and infallibility are themselves often "rhetorical" appeals to patrons and disciples on behalf of a process of discovery itself shaped by rhetorical categories. See Walter J. Ong, *Rhetoric, Romance, and Technology: Studies in the Interaction of Expression and Culture* (Ithaca, N.Y., 1971), 102–3. Book-length studies of Bacon's eloquence include Karl Wallace, *Francis Bacon on Communication and Rhetoric* (Chapel Hill, N.C., 1943); Brian Vickers, *Francis Bacon and Renaissance Prose* (Cambridge, 1968); and James Stephens, *Francis Bacon and the Style of Science* (Chicago, 1975). For later negotiations between vividness and believability, see Steven Shapin and Simon Schaffer, *Leviathan and the Air-Pump: Hobbes, Boyle, and the Experimental Life* (Princeton, N.J., 1985), chap. 2.
9. The implication of fraud also appears in "Of Superstition," where "schoolmen" defending doctrine are compared to "astronomers, which did feign eccentrics and epicycles, and such engines of orbs, to save the phaenomena; though they knew there

were no such things" (6:416). The appeal to physics may be disputed today, but Bacon assumes traditional distinctions; see Duhem, *To Save the Phenomena*, for the contrast between mathematical and physical astronomy. For more recent treatment, see Jürgen Mittelstrass, "Methodological Aspects in Keplerian Astronomy," *Studies in History and Philosophy of Science* 3 (1972), esp. 214–25; and N. Jardine, *The Birth of History and Philosophy of Science: Kepler's "A Defence of Tycho Against Ursus" with Essays on Its Provenance and Significance* (Cambridge, 1984), chap. 7.

10. Such warnings appear in a variety of contexts, and further discussion appears below. One approach is Stanley Fish's *Self-Consuming Artifacts: The Experience of Seventeenth-Century Literature* (Berkeley, 1972), chap. 2.
11. A suggestive approach to this doubleness has appeared in a series of overlapping studies by Graham Rees. See especially "Francis Bacon's Semi-Paracelsian Cosmology and the Great Instauration," *Ambix* 22 (1975): 161–73; and "Matter Theory: A Unifying Factor in Bacon's Natural Philosophy?," *Ambix* 24 (1977): 110–25, for views of the awkward coexistence of Baconian methodology and speculation. For a fuller listing of Rees's articles, and much else, see William A. Sessions's bibliography, "Recent Studies in Francis Bacon," *English Literary Renaissance* (1987): 351–71. In a different context, Brian Vickers notes that despite Bacon's preliminary emphasis on the presystematic, he was "quite sure that systems could ultimately be devised for representing and even dominating reality (and spent most of his life designing them)"; *Bacon and Renaissance Prose*, 80. The question nonetheless remains for modern commentators whether the antinomies of Bacon's thought complement or destabilize each other. Thomas Kuhn attempts to be fair by allowing opposing elements to coexist, calling the natural histories a "morass" of "fact-collecting," but citing with approval Bacon's aphorism "Truth emerges more readily from error than from confusion" as pointing to preliminary hypotheses and larger paradigms; *The Structure of Scientific Revolutions*, 2nd ed. (Chicago, 1970), 16, 18. Peter Medawar also attacks Bacon for fact collecting, but rather than credit Bacon's opposing sensitivity to hypothesis, he cites Augustus de Morgan's revised version of Bacon's dictum (made in the course of de Morgan's own, nineteenth-century critique of Bacon): "Wrong hypotheses, rightly worked from, have produced more useful results than unguided observation"; *Art of the Soluble* (London, 1967), 150, n.1. See also Michael McCanles on Bacon's science as an "all-inclusive system" futilely attempting to suppress its "dialectical tensions" in *Dialectical Criticism and Renaissance Literature* (Berkeley, 1975).
12. Henry Reynolds, *Mythomystes, Wherein a Short Survay Is Taken of the Nature and Value of True Poesy and Depth of the Ancients Above Our Moderne Poets*, in J. E. Spingarn, ed., *Critical Essays of the Seventeenth Century*, 3 vols. (Oxford, 1908), 1:177. Reynolds quotes from *The Advancement of Learning* (3:346).
13. Bacon's *antitheta* are discussed in Wallace, *Bacon on Communication and Rhetoric*, 68–71, 205–7; L. Jardine, *Discovery and the Art of Discourse*, 219–26; and Joel Altman, *The Tudor Play of Mind: Rhetorical Inquiry and the Development of Elizabethan Drama* (Berkeley, 1978), 40–43. The standard work on Bacon's allegory is Charles W. Lemmi, *The Classic Deities in Bacon: A Study in Mythological Symbolism* (Baltimore, 1933).
14. See William Hazlitt and Thomas DeQuincey, cited in Vickers, *Bacon and Renaissance Prose*, 254. The extension of T. S. Eliot's "dissociation" to Bacon appears in L. C. Knights, *Explorations: Essays in Criticism Mainly on the Literature of the Seventeenth Century* (1947; reprint ed., New York, 1964), chap. 5. Eugene P. McCreary, "Bacon's Theory of Imagination Reconsidered," *Huntington Library Quarterly* 36 (1973): 317–26, attributes to Bacon's "deep desire to control and exert power over human experience" his

suspicion of "imagination as the source of human freedom, spontaneity, and unpredictability" (318).

15. David Hume's characterization of Bacon's writing as a mingling of stiffness and brilliance, a wit "unnatural and far-fetched," in *The History of England from the Invasion of Julius Caesar to the Revolution in 1688*, 8 vols. (London, 1802), 6:195, bears comparison to Dr. Johnson's remarks on metaphysical wit in the "Life of Cowley." Abraham Cowley means something quite different in his own praise of Bacon's "exalted wit" in "To the Royal Society," but the two are linked in terms of excess by Thomas Babington Macaulay, whose notoriously ambivalent portrait of Bacon's life and work saw Bacon's "wit" as growing increasingly self-indulgent of its "power of perceiving analogies between things which appear to have nothing in common." Bacon "never had an equal, not even Cowley. Indeed, he possessed this faculty, or rather it possessed him, to a morbid degree. . . . The feats which he performed were . . . almost shocking. . . . We marvel at him as clowns on a fair-day marvel at a juggler"; *Critical and Historical Essays*, 3 vols. (London, 1852), 2:419–20. Modern versions of this emphasis include Anne Righter's comparison of Bacon and John Donne in "Francis Bacon," *Essential Articles for the Study of Francis Bacon*, ed. Brian Vickers (Hamden, Conn., 1968), 405–6.
16. Bacon's views on the imagination are placed within the context of faculty psychology by Karl Wallace, *Francis Bacon on the Nature of Man* (Urbana, Ill., 1967), chap. 5. Moderns often pass judgment on Bacon's position; he is attacked in Murray W. Bundy, "Bacon's True Opinion of Poetry," *Studies in Philology*, 27 (1930): 244–64; defended in John L. Harrison, "Bacon's View of Rhetoric, Poetry, and the Imagination," *Huntington Library Quarterly* 20 (1957): 107–25; and both attacked and defended according to context by McCreary, "Bacon's Theory of Imagination Reconsidered." An interesting turn appears in Charles Whitney, *Francis Bacon and Modernity* (New Haven, 1986), which applauds Bacon for precisely the reasons he is usually attacked. Bacon's distrust of the imagination, argues Whitney, shows his radical engagement with the Renaissance (and modern) conflict between tradition and innovation: because the imagination draws analogies from what is already known, it must be repressed in order to break free from the past. Contrast, however, Puttenham on the imagination, through which "the inuentiue parte of the mynde is so much holpen as without it no man could deuise any new or rare thing"; *Elizabethan Critical Essays*, ed. G. Gregory Smith, 2 vols. (Oxford, 1904), 19–20. See also McCreary's remarks cited above in note 14, and note 54 below.
17. Page and line numbers for Philip Sidney's *An Apology for Poetry* refer to Geoffrey Shepherd's edition (1965; reprint ed., London, 1973). For the importance of fictionality for Sidney, see Cornell March Dowlin, "Sidney and Other Men's Thought," *Review of English Studies* 20 (1944): 257–71; and A. C. Hamilton, "Sidney's Idea of the 'Right Poet,'" *Comparative Literature* 9 (1957): 51–59.
18. Ronald Levao, *Renaissance Minds and Their Fictions: Cusanus, Sidney, Shakespeare* (Berkeley, 1985), chap. 5.
19. The precise meaning of "form" for Bacon is not entirely clear. For discussion see F. H. Anderson, *The Philosophy of Francis Bacon* (Chicago, 1948); Virgil K. Whitaker, "Bacon's Doctrine of Forms: A Study of Seventeenth-Century Eclecticism," *Huntington Library Quarterly* 33 (1970): 209–16; Mary B. Hesse, "Francis Bacon," in *A Critical History of Western Philosophy*, ed. D. J. O'Connor (1964; reprint ed., New York, 1985), 141–52; Mary Horton, "In Defense of Francis Bacon: A Criticism of the Critics of the Inductive Method," *Studies in History and Philosophy of Science* 4 (1973): 241–78; and Horton,

"Bacon and 'Broken Knowledge': An Answer to Michael Hattaway," *Journal of the History of Ideas* 43 (1982): 487–504.

20. Bundy suggests that Bacon may have followed continental disputes on the subject; "Bacon's True Opinion of Poetry." For Bacon's own suspicion about skepticism justifying verbal self-indulgence and aesthetic exhibitionism, see *AL*, 3:388.
21. For the opposition of leisure and earnest action, a "Georgics of the Mind," see *DA*, 5:5. For the congeniality of Baconianism to a Puritan work ethic, see Richard Foster Jones, *Ancients and Moderns: A Study of the Rise of the Scientific Movement in Seventeenth-Century England*, 2nd ed. (Berkeley, 1965), 105–8.
22. I allude to the title of Benjamin Farrington's general study, *Francis Bacon: Philosopher of Industrial Science* (New York, 1949). See also Charles Webster, *The Great Instauration: Science, Medicine, and Reform, 1626–1660* (London, 1975).
23. Bibliographies appear in W. H. Leatherdale, *The Role of Analogy, Model, and Metaphor in Science* (New York, 1974); Ian Hacking, ed., *Scientific Revolutions* (Oxford, 1981); and Hacking, *Representing and Intervening*.
24. Quoted in Duhem, *To Save the Phenomena*, 21, 56, 41.
25. Margaret Osler suggests that the realist claims of eighteenth-century physics stem directly from "Copernicus' insistence that astronomical theory describe reality"; "Certainty, Skepticism, and Scientific Optimism: The Roots of Eighteenth-Century Attitudes Toward Scientific Knowledge," in Paula R. Backscheider, ed., *Probability, Time, and Space in Eighteenth-Century Literature* (New York, 1979). See also Ralph M. Blake, "Theory of Hypothesis Among Renaissance Astronomers," in Edward H. Madden, ed., *Theories of Scientific Method: The Renaissance Through the Nineteenth Century* (Seattle, 1960); Edward Grant, "Hypotheses in Late Medieval and Early Modern Science," *Daedalus* 91 (1962): 599–616; and Duhem, *To Save the Phenomena*, 61–67.
26. Osiander's addition has been condemned by most but not all historians. Duhem is one of Osiander's defenders, arguing that realist claims are destructive of science in general. Giorgio de Santillana attacks Duhem's motives in *The Crime of Galileo* (Chicago, 1955), 107–8; but see also note 27 below.
27. O. Neugebauer, "On the Planetary Theory of Copernicus," in *Astronomy and History: Selected Essays* (New York, 1983), finds Osiander's reading of Copernicus "entirely plausible": "I realize that one is supposed to be disgusted with Osiander's preface which he added to the *De Revolutionibus* . . . in which he . . . speaks about mere hypotheses . . . represented by the cinematic models adopted in this work. It is hard to imagine how a careful reader could reach a different conclusion" (100).
28. For Ramus's place in the controversy, see Eric Aiton, "Johannes Kepler and the Astronomy Without Hypotheses," *Japanese Studies in the History of Science* 14 (1975): 49–71. Medawar blames Newton's remark for encouraging hostility toward hypotheses for two hundred years in *The Art of the Soluble*, but most note that Newton was only objecting to illegitimate uses of hypothesis. I. Bernard Cohen insists on the importance of Newton's "creative imagination" as a first phase of "imaginative constructs and systems," which, while not merely "false hypotheses," are striking in their flexibility and freedom; *The Newtonian Revolution* (Cambridge, 1980), chap. 3, "The Newtonian Revolution and the Newtonian Style," esp. 99–109. See also Ralph M. Blake, "Isaac Newton and the Hypothetical-Deductive Method," in Madden, *Theories of Scientific Method*; and N. R. Hanson, "Hypotheses Fingo," in Robert E. Butts and John W. Davis, eds., *The Methodological Heritage of Newton* (Toronto, 1970), 14–33.
29. For a representative of each side of the controversy, see Henry G. Van Leeuwen, *The*

Problem of Certainty in English Thought: 1630–1690 (The Hague, 1963); and Benjamin Nelson, "The Early Modern Revolution in Science and Philosophy: Fictionalism, Probabilism, Fideism, and Catholic 'Prophetism,'" *Boston Studies in the Philosophy of Science* 3 (Boston, 1968):1–40.

30. Citations hereafter will be noted in the text as *Against Ursus*. For edited texts and translations of Kepler and Ursus, together with a substantial study of the contexts and implications of the debate, see N. Jardine, *Birth of History and Philosophy of Science*.
31. Blake emphasizes Kepler's realism against Ursus, but also notes a modification toward the probable; "Theory of Hypothesis," 38–43. For the aesthetic and conjectural component in Kepler's "realism," one attributed to the influence of Cusanus, see Robert S. Westman, "Kepler's Theory of Hypothesis and the 'Realist Dilemma,'" *Studies in History and Philosophy of Science* 3 (1972): 233–64. For Kepler's attraction to symbolical "play" as well as his opposing effort to distance serious hypotheses from the merely "poetical," see respectively, Erwin Panofsky, "Artist, Scientist, Genius: Notes on the 'Renaissance-Dämmerung,'" in *The Renaissance: Six Essays* (New York, 1962), 123–82, esp. 181–82; and Robert S. Westman, "Nature, Art, and Psyche: Jung, Pauli, and the Kepler-Fludd Polemic," in Brian Vickers, ed., *Occult and Scientific Mentalities in the Renaissance* (Cambridge, 1984), 177–209, esp. 203–7.
32. Bacon's failure to appreciate the importance of mathematics has often been noted. His difference from Kepler may also be thought of less as a matter of observational purity than as a conflict between presuppositions. As Graham Rees deftly summarizes, "whereas . . . Kepler was convinced on *a priori* grounds that the harmonies of geometry were implicit in the structure of the universe, Bacon believed that nature was a mighty battleground over which raged an endless struggle between finely poised antithetical qualities. The antithesis, the dichotomising instinct, is the primary feature of Bacon's metaphysical vision"; "Matter Theory," 114.
33. Influential accounts of Bacon's method include the studies of Anderson, Hesse, and Horton cited in note 19. Still important, though now disputed in some details, are Robert Leslie Ellis's "General Preface to Bacon's Philosophical Works" and "Preface to the *Novum Organum*," *Works of Bacon*, 1:21–67 and 71–117, respectively.
34. Numerous studies concerning science appear in the bibliographies cited in note 23 above. See also George Levine, "Literary Science—Scientific Literature," *Raritan* 6 (1987): 24–41. For contrasting approaches to hypothesis in art, see E. H. Gombrich, *Art and Illusion: A Study in the Psychology of Pictorial Representation* (Princeton, N.J., 1960); and Norman Bryson, *Vision and Painting: The Logic of the Gaze* (New Haven, 1983).
35. Karl R. Popper, "Introduction," in *Conjectures and Refutations* (London, 1963). For opposition to Popper's version of Bacon, see Peter Urbach, "Francis Bacon as a Precursor to Popper," *British Journal for the Philosophy of Science* 33 (1982): 113–32; and Antonio Pérez-Ramos, *Francis Bacon's Idea of Science and the Maker's Knowledge Tradition* (Oxford, 1988), chap. 18.
36. I borrow the well-known tag lines "theory laden" (or "theory loaded") and "beholder's share" from Hanson and Gombrich, respectively.
37. Bacon's methodological reliance on analogy is discussed by L. Jardine, *Discovery and the Art of Discourse*, 144–47; and in Whitney, *Bacon and Modernity*, 70–75. For stylistic analogy, see note 15 above.
38. Praise for the soundness of these "instances" has been mixed with concern about their arbitrariness. See Curt J. Ducasse, "Francis Bacon's Philosophy of Science," in Madden, *Theories of Scientific Method*, 58. Horton concedes Duhem's similar complaint

about their arbitrariness, but defends them as "creative tools"; "In Defense of Bacon," 267, n. 34.

39. Hacking argues that experiment, because a form of intervention, escapes the dilemmas of representation: speaking of positrons and electrons, he concludes, "If you can spray them then they are real"; *Representing and Intervening*, 23. Bacon's demand for a "true model," however, does not allow him that escape. Svetlana Alpers, *The Art of Describing: Dutch Art in the Seventeenth Century* (Chicago, 1983), 99–109, emphasizes the utilitarian, observational bias of Baconian science, stressing experiment as a link to nature but also shows more generally, through examples from Dutch images and Kepler's theory of vision, that in the seventeenth century "there is no escape from representation" (35).
40. Quotations are from Graham Rees, "Atomism and 'Subtlety' in Francis Bacon's Philosophy," *Annals of Science* 37 (1980): 549, 559; and "Bacon's Semi-Paracelsian Cosmology," 171.
41. "Bacon," notes Horton, "was notoriously like Humpty-Dumpty in his use of words"; "In Defense of Bacon," 248, n. 12. See also Margaret L. Wiley, "Francis Bacon: Induction and/or Rhetoric," *Studies in the Literary Imagination* 4 (1971): 65–80.
42. Hesse, "Bacon," 148. Hesse's account also emphasizes the difficulty Bacon has at various points in gauging the extent of his own reliance on hypothesis. An important, related controversy surrounds Bacon's notion of "learned" or "literate experience" (*experientia literata*), whose meaning is strictly delimited in Anderson, *Philosophy of Bacon*, 184–88, but which has been extended by Reiss to encompass Bacon's entire project. After conceding the phrase is "mightily ambiguous," Reiss supplements it with other linguistic metaphors to expose a "ruse" typical of hegemonic, "analytico-referential" discourse seeking to establish universal dominance; *Discourse of Modernism*, 204–10. Reiss shrewdly, if somewhat unfairly, positions himself against Lisa Jardine and others who find in the *experientia literata* only a "simple recording of experience" or a practical technique for designing experiments (204, n. 6). Jardine, rather, emphasizes the "ingenious" and "imaginative" maneuvers the notion makes available for experimentation. For a good counter to Bacon's supposed objectivist ruse, see Martin Elsky, "Bacon's Hieroglyphs and the Separation of Words and Things," *Philological Quarterly* 63 (1984): 449–60. Scanning problems similar to Reiss's, but from the opposite shore, is Stephen Daniel's view of the *experientia literata* as a proto-Derridean reading of nature as a "poetic and metaphorical language" whose "referential meaning . . . must remain indeterminate"; "Myth and the Grammar of Discovery in Francis Bacon," *Philosophy and Rhetoric* 15 (1982): 219–37.
43. Augustus de Morgan, *A Budget of Paradoxes*, 2nd ed., ed. David Eugene Smith, 2 vols. (1915; reprint ed., Freeport, 1969), 1:59. De Morgan's ambivalent views of Bacon appear on 1:75–90.
44. For opposing views of Baconian certainty and probability, see L. Jonathan Cohen, "Some Historical Remarks on the Baconian Conception of Probability," *Journal of the History of Ideas* 41 (1980): 219–31; and Barbara J. Shapiro, *Probability and Certainty in Seventeenth-Century England: A Study of the Relationships Between Natural Science, Religion, History, Law, and Literature* (Princeton, N.J., 1983).
45. Quoted in Vickers, *Bacon and Renaissance Prose*, 109–10.
46. For the priority of motion, see also Morris Croll's sense of "the movements of a mind discovering truth as it goes, thinking while it writes," "The Baroque Style in Prose," in Stanley E. Fish, ed., *Seventeenth-Century Prose: Modern Essays in Criticism* (New York, 1971); Urbach, "Bacon as Precursor to Popper"; and Fish, *Self-Consuming Artifacts*,

chap. 2. The priority of rest, however, is argued by Aschah Guibbory, *The Map of Time: Seventeenth-Century English Literature and Ideas of Pattern in History* (Urbana, Ill., 1986). Reiss links rest and motion in what he calls the "process/entropy contradiction," *Discourse of Modernism*, esp. 159–62, 216, 359–60.

47. For Bacon and the elitism of magic, see Paolo Rossi, *Francis Bacon: From Magic to Science* (Chicago, 1967), 23, 30; and for the conflict between self-consciousness and self-effacement, see Farrington, *Industrial Science*. For the opposition to "radical individualism" in later seventeenth-century science, see Shapin and Schaffer, *Leviathan and the Air-Pump*. The importance of self-effacement for Bacon may be gauged by contrasting by his own dismissal elsewhere of "lucky hits": "A pig might print the letter A with its snout in the mud, but you would not on that account expect it to go on to compose a tragedy" (*MB*; *PFB*, 71).
48. A lively, if sometimes overstated, discussion of Bacon's "creative . . . leap to theory, analogous to the act of faith," appears in Michael Hattaway's "Bacon and 'Knowledge Broken': Limits for Scientific Method," *Journal of the History of Ideas* 39 (1978): 183–97. See also Charles Whitney, "Cupid Hatched by Night: The 'Mysteries of Faith' and Bacon's Art of Discovery," in Peter S. Hawkins and Anne Howland Schotter, eds., *Ineffability: Naming the Unnamable from Dante to Beckett* (New York, 1984), 51–64. For Sprat's later connection between Christian and scientific "ignorance," see Jones, *Ancients and Moderns*, 231.
49. See Ernst Cassirer, *The Individual and the Cosmos in Renaissance Philosophy*, trans. Mario Domandi (Philadelphia, 1963), 58. For a disapproving view of Cusanus's experiments, see Lynn Thorndike, *History of Magic and Experimental Science*, 8 vols. (New York, 1923–58), 4:388–94. For the generative supplement in Renaissance thinking about artifice, see Derek Attridge, *Peculiar Language: Literature as Difference from the Renaissance to James Joyce* (London, 1988), chap. 2.
50. Wallace, *Bacon on the Nature of Man*, 158–60. The ambiguous status of the First Vintage is also noted, albeit briefly, by Anderson, *Philosophy of Bacon*, 218. Horton's argument is part of a detailed response to the charges of Medawar and others ("In Defense of Francis Bacon"), but at times presses a little hard. Where Bacon advises "We are not to imagine . . . but to invent" (4:127), Spedding has "discover"; the Latin is "Neque enim fingendum . . . sed inveniendum" (1:235). Horton emphasizes that "Forms are not merely discovered, but sometimes 'invented'" (262), noting further that Bacon calls his method "the art of invention." Her point, however, is based on more than a quibble over *inventio*. Urbach follows Horton concerning Bacon's "conjectural leap" ("Bacon as Precursor to Popper," 128), as does Hattaway, who, though in very different terms, views Bacon's imaginative leaping as exposing the strain between a conservative "closed world" and "an expanding intellectual universe" ("Bacon and 'Knowledge Broken'"). Horton takes Hattaway to task for some misreadings in "Bacon and 'Broken Knowledge,'" but their essays form a valuable complement. For more "cautious" readings of the First Vintage, however, see L. Jardine, *Discovery and the Art of Discourse*, 127–28; and Whitney, *Bacon and Modernity*, 117, who follows Ellis on its relative unimportance.
51. See my discussion in Levao, *Renaissance Minds*, 143–46. Bacon's wavering on truth and utility is lucidly summarized in Reiss, *Discourse of Modernism*, 211–12, who links this wavering to a larger cultural attempt to resolve contradictions about the static or dynamic character of knowledge (cf. note 46 above).
52. Walter A. Koch, *Poetry and Science: Semiogenetical Twins* (Tübingen, Germ., 1983). Earl Miner notes the irony of early poetic attacks on science as employing the very terms

that might be used against poetry: "The Poets and Science in Seventeenth-Century England," in John G. Burke, ed. *The Uses of Science in the Age of Newton* (Berkeley, 1983), 1–19.

53. Farrington, *Industrial Science*, 54. For a more general view of this paradox, see Charles Taylor's remark in *Hegel* (Cambridge, 1975) that the seventeenth-century scientific "disenchantment" of the world, despite its claims to objectivity and humility, produces a "correlative to a self-defining subject . . . accompanied by a sense of exhilaration and power, that the subject need no longer define his perfection or vice, his equilibrium or disharmony, in relation to an external order" (8–9).
54. Percy Bysshe Shelley, "A Defence of Poetry," in *Shelley's Poetry and Prose*, ed. Donald Reiman and Sharon Powers (New York, 1977), 484–85. Seventeenth-century comments are quoted in J. Max Patrick, *Francis Bacon* (London, 1961), 15; and Vickers, *Bacon and Renaissance Prose*, 237. Attacks on or developments of Shelley's remark have been important for numerous studies, including Elizabeth Sewell, *The Orphic Voice: Poetry and Natural History* (New Haven, 1960); as well as those of Hattaway, McCanles, and Righter. It is also implied in Richard Rorty's "Solidarity or Objectivity?," in John Rajchman and Cornel West, eds., *Post-Analytic Philosophy* (New York, 1985), which advocates a pragmatism setting aside "objectivity" for a view of "human progress as making it possible for human beings to do more interesting things and be more interesting people. . . . Our self-image would employ images of *making rather than finding*, the images used by *the Romantics to praise poets* rather than the image used by the Greeks to praise mathematicians" (10; my emphasis). Rorty includes among the forerunners of this view, "the Baconian turn from science as contemplation of eternal truth to science as instrument of social progress" (15). The suggestion of Bacon as "maker" receives detailed treatment in Perez-Ramos's *Bacon and the Idea of Science*. A recent attack on "poetic" readings, however, forms part of Whitney's *Bacon and Modernity*, a discussion giving full voice to what it takes to be Bacon's "revolutionary" opposition to "the scientist's hypothesis-producing creative faculties of intellect and imagination." The attempt to link Baconian knowledge with the "creative help of human insight," according to Whitney, is an effort by "literary scholars" to make Bacon over in their own image and so "render him harmless" (121, 126–27). At such moments, the concern to score polemical points strikes me as excessive, but it engagingly restages Bacon's tough talk while placing it within a larger structure of "antithetical modern discourse" (204).
55. Ficino *Platonic Theology* 13.3, trans. Josephine L. Burroughs, *Journal of the History of Ideas* 5 (1944): 233.
56. Graham Rees, "An Unpublished Manuscript by Francis Bacon: *Sylva Sylvarum* Drafts and Other Working Notes," *Annals of Science* 38 (1981): 377–412.
57. Svetlana Alpers suggestively summarizes Bacon's goal: "Natural history displaces history—at least that history of civil life which admits human activities and time and depends on interpretation. It is . . . description, not narration"; *Art of Describing*, 109. My emphasis here, however, is on the work of shaping such description, an interpretive, human activity in time that becomes another kind of narrative. Cf. Paul Alpers's characterization of "Spenserean narrative": "confidence in locutions which are at the same time understood to be provisional"; "Narration in *The Faerie Queene*," *English Literary History* 44 (1977): 27.
58. Graham Rees, "The Fate of Bacon's Cosmology in the Seventeenth Century," *Ambix* 24 (1977): 29, 35.