

**The New organon, and related writings/ □
Francis Bacon; Indianapolis: The □
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INTRODUCTION

I. Some Biographical Data

Francis Bacon was born in 1561 and died in 1626. He was thus a contemporary of Galileo, almost a hundred years the junior of Copernicus, and thirty-five years older than Descartes. He was one—Descartes the other—of the two original philosophers produced in that period, germinal of science, rich in the arts, and abundant in eclectic thought, called the Renaissance. His days overlapped those of Drake, Raleigh, Spenser, Shakespeare, and he evinced the same imaginative daring which characterized these other “great Elizabethans.” Drake voyaged around the world, adventuring in strange seas, and he and Raleigh stormed the strongholds of the Spanish Main, while Bacon embarked on bold intellectual enterprises, assaulted the fortresses of learning, and in a philosophic way encompassed the whole realm of nature. Like Shakespeare in his plays, Bacon in his essays, histories, and philosophical writings probed the passions, thoughts, and faiths which motivate the actions and determine the opinions both of great and of little men.

Through the circumstances surrounding his family, and because of his plans for the support of his philosophical designs, Bacon throughout his life was involved in the affairs of royal courts of worldly magnificence and very considerable learning. He was the son of Sir Nicholas Bacon—Lord Keeper of the Great Seal and senior legal officer in the Kingdom, the nephew by marriage of Lord Burghley—Elizabeth’s Lord Treasurer and her most trusted adviser, and the cousin of Lord Salisbury, Burghley’s son—Secretary of State and Lord Treasurer under James I. Bacon’s mother, Anne Cooke, was a sister of Lady Burghley and a daughter of Sir Anthony Cooke, tutor to Edward VI. Lady Bacon, herself schooled in Greek, Latin, French, and Italian, was the demanding and

commanding person who subjected her gifted son to a rigorous discipline in ancient and modern authors. In religion a Calvinistic Puritan with "fanatical" tendencies, Lady Bacon did not hesitate to upbraid her brother-in-law, Burghley, for his part in Elizabeth's repressive measures against "nonconformists" both within and without the Established Church. To her early influence may be credited her son's segregating, in Calvinistic fashion, the principles of philosophy from the dogmas of religion given through revelation, and his pleas, in unheeded "advices," to Elizabeth and James for a liberal ecclesiastical policy in state affairs.

Francis Bacon entered Cambridge in 1573, when twelve years of age. At the University he read Aristotle and his Peripatetic commentators and some of Plato and his Augustinian interpreters. University exercises for the training and the examining of candidates consisted mainly of disputations. These were conducted according to the rules of syillogistic logic. A respondent was required to defend theses, with terms defined, against two or more opponents. The candidate's first disputations were rhetorical exercises, considered preparatory to later disputational "demonstrations of truth." "Truth" in this conjunction consisted largely of a collection of propositions traditionally taken from the physical, ethical, political, and metaphysical works of Aristotle. The contexts of these propositions in the original writings were more often than not unfamiliar to candidates and not always remembered, if ever known, by presiding officers. Against this method of testing and examination Bacon rebelled. To him it was no more than verbal gyration, elevated and refined by the Peripatetics into an art. A Peripatetic, it seemed, having assumed some "principles," could through the art of logic compose a complete system of discourse, like a playwright making a play with little, if any, foundation in fact. The Peripatetic method of proof was a bequest from the "magisterial" Aristotle, who had always, in Bacon's opinion, been disposed to lay down "first" and most general principles of demonstration on which all others were to hang, and then to escape any difficulties

encountered on the way by inventing such new definitions as might be required to resolve the questions at issue.

Bacon nevertheless regarded Aristotle as a man of great "wit." He first admired and later envied the Stagirite for his having at his disposal, while a relatively young man and tutor of Alexander at the Court of Macedon, a host of helpers in collecting data suitable for natural histories. Bacon also saw in Aristotle an investigator who began wisely with an observational and experimental study of nature and then foolishly forfeited the fruits of his early inquiries by turning aside to pursue "abstractions."

From Aristotle, and from Plato too, Bacon acquired the opinion that the tasks of politics are occupations appropriate to a philosopher. He welcomed Aristotle's contention that the fully virtuous citizen will have within his magnanimous disposal the products of husbandmen, mechanics, artists, and scientists. This opinion served to confirm Bacon in his congenitally expansive tastes, and to its influence may be partly ascribed his always living beyond what persons with natures less lavish than his considered more than adequate means.

Bacon left Cambridge at the close of 1575 with a reputation for extraordinary application to study. In 1576 he was enrolled at Gray's Inn. His legal studies were undertaken not for the purpose of pleading before the bar, but as a preparation for the future administration of affairs of state. These studies were interrupted less than a year after they were begun, when at the age of sixteen Bacon went to France as a member of the ambassadorial staff of Sir Amyas Paulet. There he had an opportunity to observe the complexities and intrigues of continental politics. On one occasion, he was entrusted with a diplomatic message to the Queen. An interest on his part in the causes of natural phenomena and inventiveness showed themselves at this time: he became curious about vibrations in the production of sounds, and constructed a cipher for diplomatic communication.

In 1579 Sir Nicholas Bacon was suddenly stricken and Francis was called home. The father's death was to determine

the future circumstances of the son. Sir Nicholas had provided for his other children and over a period of years had been setting aside funds for the purchase of land with revenue for Francis. Death having intervened suddenly, the junior son got but one fifth of his father's personal estate.

Francis Bacon faced the world at the age of eighteen with learning unusual in one of his years, large capacity of mind, skill in the use of words, a "small portion," and great ambition. The youth reared in opulent circumstances found himself comparatively poor and dependent on wealthy relatives at Court for sustaining employment. He turned with zeal to the study of law. In 1582 he became a barrister and in 1586 a bencher. He was now bent on emulating his father by attaining high legal place and a reputation for learning and justice in dispensing the law. This ambition he was to accomplish, notwithstanding his removal from office in 1621 through political causes. Bacon's father had been well informed in the law; the son was to become the greatest authority of his time on the constitutional law of England and the possessor of a legal learning far beyond that of his contemporary Coke, who in later times was to be accounted a far greater professional lawyer and to acquire wider celebrity as a jurist.

Having prepared himself by legal studies, Bacon turned to the Court in suit for office. Burghley, to whom he early appealed, was not unmindful of the son of his brother-in-law and a former Lord Keeper. But he thought he saw in his nephew an alarming precociousness, undue self-assurance, and too great an independence of mind. There was engendered in the conservative statesman a deep-set suspicion that the nephew might not have political aptitude. This suspicion was in no degree allayed by the nephew's asking for some political office or other to "carry" him, so that through its holding he might have the "commandment" of many "wits" for the implementation of a newfangled scientific enterprise. To the early suspicion of Lord Burghley there was to be added by his heir, Lord Salisbury, jealousy toward a potential political rival. Queen Elizabeth was well disposed toward the son of

a respected Lord Keeper, whom she had known from his boyhood, even if she saw cause to banish him from her "presence" for some three years because of his promoting opposition in the Commons to her Lord Treasurer's attempt to violate the "privileges" of the Lower House by consulting the Lords on a question of supply. King James and his deputy Lord Buckingham were impressed by Bacon's capacity to sift political issues and his mastery over the House of Commons and courts of law. They accepted his services and read his "advices," if they but rarely put into effect the wise measures and shrewd procedures he advocated.

In 1584 Burghley provided his nephew with a seat in the Commons. From then on Bacon continued an influential member of that House for some thirty-six years. In 1589 he was made Clerk of the Star Chamber, but only by promise in a "reversion," and a few years thereafter Queen's Counsel without formal warrant. At the beginning of James's reign, in 1603, he was knighted, and became in succeeding years King's Counsel with patent, Solicitor-General, Clerk of the Star Chamber in fact, Judge of the Court of the Verge, Attorney-General, Lord Keeper of the Great Seal, Lord Chancellor, Baron Verulam of Verulam, and Viscount St. Albans.

Bacon sought political office both for his own support and for the furtherance of large public designs. These designs included the coherent ordering of the common and statutory laws of England, the modification of harsh and "vengeful" legal penalties, and the maintenance of the "privileges" of Parliament and courts of law against arbitrary incursions by sovereigns and their ministers. Most of all, Bacon hoped that through the influence gained by the occupancy of high office great patronage and large means would be his for the collecting of the massive natural history required to inaugurate a new inductive philosophy and to establish a new regimen of science and learning.

The holding of many public offices was in fact, however, to impede his philosophical undertaking and leave its written exposition far from complete. During a period of thirty-six

years Bacon was a member of every Parliament and of nearly every important committee of the Lower House. He was the chief mediator in incessant quarrels between Commons and Lords. He held some of the most laborious political and judicial offices in government. Such writings in representation of his philosophical "instauration"—most of them incomplete, and many of them fragmentary—as he was able to set down before 1621, when he went out of political office, were prepared in brief "vacations" between sittings of Parliament and courts; those written after that year were put together in haste under apprehension that he would not have long to live.

II. *Toward a New Naturalistic Philosophy*

From the days when Bacon studied at Cambridge his mind had been occupied with a scheme of philosophy and a method of investigation which would entail a decisive break with the thinking of the past. While in early revolt against Peripatetic doctrines and practices he had turned to the dialogues of Plato and the fragments of the Pre-Platonists. In Plato's writings he discerned a "phrenetic" tendency to construct a universe out of "thoughts." But he also found examples of a rudimentary induction and a regarding of knowledge as the ascent from sensible particulars through lesser "axioms" to higher axioms, and finally to a determinate unity. He welcomed with eagerness the identification by the Pre-Platonists, especially by Democritus, of philosophy with the science of nature. In Democritus he saw a philosopher who was fortunate in being free from the doctrine of final causes and in discerning a formed and active matter, which was not the indeterminate, deprived, and inert abstraction he had met with in the writings of Plato and Aristotle.

Bacon turned also for light and guidance to the "reformers" of logic and, neglecting Platonico-Aristotelian eclectics like Pico, Pomponazzi, and Vives, looked to the professed philosophers of nature, Campanella, Cardan, Patricius, Severinus, and Telesius. He pondered the hypotheses of the new astrono-

mers, Copernicus and Galileo, and the theories of the physicist Gilbert, and brought under review the experiments of Roger Bacon, the chemists, and the alchemists.

In Roger Bacon's experiments he saw promise of fruitful inquiry, but in the claims of the chemists and the alchemists, mainly confused empiricism employed in the service of charlatanism. Lully's method, based as it was on the mechanical alignment of some letters of the alphabet and some colors, chosen as representations of various principles, Bacon regarded as the symbolical manipulation of doctrines assumed to be already known. Lully's logical machine might be made to work but no real discovery could ever come from it. Ramus' vaunted reform of Aristotle proved on close examination to be nothing more than a specious fusion of rhetoric and logic, many of whose terms were mere metaphorical figures of speech. Astronomers were promoting a "new," heliocentric "hypothesis" which was not in fact new, for it had been proposed long before by Grecian and Roman writers, in order to "save" certain phenomena which admittedly could also be salvaged by the Ptolemaic theory of cycles and epicycles, with the earth as the center of all. These "new" astronomers could still assume, like Aristotle of antiquity, that the components of celestial bodies differed in kind from the elements composing the earth. Their failure to seek and investigate the nature, composition, and motions of one matter common both to heavenly and terrestrial bodies was, in Bacon's view, the obvious evidence of their failure as naturalists. Gilbert, Telesius, and some other recent philosophers had professed a reliance on observation and experiment and had displayed considerable capacity for inquiry, but they, like their predecessors, lacked a restraining explicit method of inductive investigation and were driven by ambition to assume that axioms which pertain to but few phenomena and hold within limited areas may be elevated, through reliance on an intemperate intellect, into a complete philosophy. These ambitious thinkers were like the overeager boy who, having come upon a tholepin on the shore, supposed he had

the makings of an entire ship! Bacon's impatience with builders of whole systems out of scant materials was characteristic of his thinking from an early age. He gave it classic utterance in his *Natural and Experimental History for the Foundation of Philosophy* of 1622.

To what purpose (he asked) are these brain-creations and idle displays of power? In ancient times there were philosophical doctrines in plenty; doctrines of Pythagoras, Philolaus, Xenophanes, Heraclitus, Empedocles, Parmenides, Anaxagoras, Leucippus, Democritus, Plato, Aristotle, Zeno, and others. All these invented systems of the universe, each according to his own fancy, like so many arguments of plays; and those their inventions they recited and published; whereof some were more elegant and probable, others harsh and unlikely. Nor in our age, though by reason of the institutions of schools and colleges wits are more restrained, has the practice entirely ceased; for Patricius, Telesius, Brunus, Severinus the Dane, Gilbert the Englishman, and Campanella have come upon the stage with fresh stories, neither honored by approbation nor elegant in argument. Are we then to wonder at this, as if there would not be innumerable sects and opinions of this kind in all ages? There is not and never will be an end or limit to this; one catches at one thing, another at another; each has his favorite fancy; pure and open light there is none; everyone philosophizes out of the cells of his own imagination, as out of Plato's cave; the higher wits with more acuteness and felicity, the duller, less happily but with equal pertinacity. And now of late by the regulation of some learned and (as things now are) excellent men (the former variety and license having I suppose become wearisome), the sciences are confined to certain and prescribed authors, and thus restrained are imposed upon the old and instilled into the young; so that now (to use the sarcasm of Cicero concerning Caesar's year), the constellation of Lyra rises by edict, and authority is taken for truth, not truth for authority. Which kind of institution and discipline is excellent for the present use, but precludes all prospect of improvement. For we copy the sin of our first parents while we suffer for it. They wished to be like God, but their posterity wish to be even greater. 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, not as seems fittest to the Divine wisdom, or as they are found to be in fact; and I know not whether we more distort the facts of nature or our own wits; but we clearly impress the stamp of our own image on the creatures and works of God, instead of carefully examining and recognizing in them the stamp of the Creator himself. Wherefore our dominion over creatures is a second time forfeited, not undeservedly; and whereas after the fall of man some power over the resistance of creatures was still left to him—the power of subduing and managing them by true and solid arts—yet this too through our insolence, and because we desire to be like God and to follow the dictates of our own reason, we in great part lose. If therefore there be any humility toward the Creator, any reverence for or disposition to magnify His works, any charity for man and anxiety to relieve his sorrows and necessities, any love of truth in nature, any hatred of darkness, any desire for the purification of the understanding, we must entreat men again and again to discard, or at least set apart for a while, these volatile and preposterous philosophies, which have preferred theses to hypotheses, led experience captive, and triumphed over the works of God; and to approach with humility and veneration to unroll the volume of Creation, to linger and meditate therein, and with minds washed clean from opinions to study it in purity and integrity. For this is that sound and language which went forth into all lands, and did not incur the confusion of Babel; this should men study to be perfect in, and becoming again as little children condescend to take the alphabet of it into their hands, and spare no pains to search and unravel the interpretation thereof, but pursue it strenuously and persevere even unto death.

It was Bacon's intention to supplant the theories of past and present schools and sects—Platonic, Peripatetic, Paracelsian, Telesian, and the rest—by a thoroughly naturalistic, materialistic philosophy, fully and not partially founded on natural history, and pursued according to the requirements of a new restraining method. The axioms or principles of this new philosophy would be statements of natural causes and natural laws derived from scientific observation and experiment, directed and interpreted according to the rules of a

strict induction. This philosophy would exclude all that was transcendental and admit nothing that could be deemed a priori, unless the term transcendental could be applied to the most general of those principles confirmable, through sense observation, by data from whose examples they were derived. Its method would provide aid for the senses while controlling and purging the intellect of its overweening disposition to fly to "high priori" areas and there to remain—witness its abiding in the realm of Platonic forms dialectically sustained, and in Aristotle's Being qua Being derived through abstraction in high degree.

III. *Man and the Kingdom of Nature*

Man, the investigator of nature, is according to Bacon a natural creature with faculties by nature limited. He is also a partaker of the Divine Image. What is divine in him lies, like the will of his Maker, within the area of Divine Revelation, and beyond the purview of natural philosophy. The ethical direction of the divine part of man is to be found in the placets of revelation. As a natural creature with limited capacities befitting his nature, man cannot through his own powers attain to a knowledge of the transcendent mind and nature of God, or anything else that is divine. A metaphysics which pretends to this knowledge, like the Peripatetic ontology in which a philosophical Being qua Being and first and uncaused Cause is identified with the God of Divine Revelation or the Platonists' equation of the Divine Creator with a causal Form of the Good, is in philosophy pretension and in theology heresy. Man, according to Bacon, belongs to three kingdoms, the kingdom of God, where through divine Grace he is saved from his sins; the political kingdom in which initiative in sovereignty, justice, and law is given by God to ruling powers; and the kingdom of nature over which man at the Creation has been given dominion. For an understanding of the first and second of these kingdoms one must go to the revelation given in the Scriptures; knowledge of the third

is attainable through the exercise of human faculties. Because the three kingdoms cannot be brought under one knowledge with one derivation, Bacon's philosophy is pluralistic in character. It is with the knowledge of the third kingdom, the kingdom of nature, that the *New Organon* has to do.

The subject matter of human philosophy consists, in Bacon's view, of creatures operated by natural causes, including the part of man produced in natural generation. The structures and processes of these natural creatures are physical and material. If in a new philosophy of bodies the ancient term "form" is to be retained to represent the component elements of things—and of all the terms in use it is probably the best for the purpose—the forms of this philosophy are not to be confused with Plato's occupants of a "divine" realm nor with those causes which activate and give meaning to Aristotle's potential, indeterminate matter. Plato assumed that forms, unavailable to sense, were far removed from materiate things. In his scheme they constituted, through dialectical organization, a transcendent realm of being set apart from, indeed posed in opposition to, the changing, moving world of physical particulars. Aristotle set his forms, as activating factors in natural motions, over against an indeterminate and by itself inert, meaningless, logically indiscernible matter. Bacon will make matter, whose operations are available to sense, the actual and not merely the potential stuff of nature. Bacon's forms are materiate. Matter as such is in its inherent nature formed and furnished with active and determinate characteristics, indeed with all natural causes, motions, and structure of bodies; these are none other than formed matter's manifestations.

IV. *Some Peripatetic Doctrines*

The general character, as well as the novelty, of Bacon's philosophy becomes clear when we consider his manner of rejecting the prevailing Peripatetic principles, scheme of knowledge, and methods of scientific demonstration. This re-

jection is everywhere manifest in his *New Organon*. The Peripatetics recognize three divisions among the sciences: the theoretical, the practical, and the productive. The end of the theoretical is contemplation; of the practical, action; of the productive, the making of things through the imposition of a secondary form on what in nature has a natural form—for example, the imposing of the form of a table on the form of a tree. This division of the sciences includes metaphysics, mathematics, and physics. These three theoretical sciences show increasing degrees of abstraction. Physics deals with the forms of material things in motion; mathematics with quantity in abstraction from both the matter and motion of things; and metaphysics with being in abstraction from all else. Metaphysics, called by Aristotle "first philosophy" and "theology," is according to the Peripatetics the most abstract, most inclusive, and most certain of all the sciences. Its subject matter, Being qua Being—which is also the First Cause and the Prime Mover—is convertible with a Unity founded on and established by the Principle of Identity. These three convertibles are called Transcendentals by some Peripatetics, because, as Aristotle taught, they lie beyond what is interpretable by those categories employed in demonstration within the sciences which fall below metaphysics. "Physics" in the Aristotelian, Peripatetic—and Baconian—sense extends over the whole realm of "nature" (Greek *physis*) and includes mineralogical, biological, botanical, anatomical, physiological, chemical, and psychological data.

The practical sciences are ethics and politics, in the latter of which, according to Aristotle, the former has its end. These sciences are not demonstrable, as the theoretical sciences are, because, while the subject matter of a theoretical science cannot be other than it is, contingent factors enter into the conduct of ethical and political agents, in possession of voluntary desire and choice.

In the productive division of the sciences are to be found the varied sorts of knowledge manifest in the arts—drama, medicine, agriculture, carpentry, cooking, and so on. Those

arts which have to do with the body—its feeding, clothing, shelter, and the like—are by many of the Peripatetics called "mechanical," in opposition to those of a higher, intellectual sort, like music and drama.

Each science in each of the three major divisions is kept independent and separate from the others through its own distinctive underlying axioms. The axioms of one specific science are not deducible from those of another, nor from any more general axioms which might conceivably lie beyond the specific sciences. Axioms are intuitively discerned. To ask for proof of them would, according to Aristotle, be to invite a proof in turn of this proof, and then a proof of the proof of the original proof, and so on ad infinitum.

There is one science which Aristotle recognizes but omits from his classification, because he assumes that it is implied in all the sciences. This is analytic, called by some Stoics and later thinkers logic. Logic has three "first principles," the laws of identity, contradiction, and excluded middle. It includes two methods, deduction and induction. The instrument of the former is the syllogism. This consists of three propositions, so aligned that from two given propositions, called premises, a third, called the conclusion, necessarily follows. The syllogism contains three terms, two of which are joined in each proposition by a copula. In every valid syllogism the term common to the two premises, called the middle term, is employed in a universal sense at least once.

Of induction Aristotle recognizes two sorts. The first of these is "perfect" induction, which requires an exhaustive examination of all the particulars concerned. Since, except in a very limited number of rather obvious cases, this would impose an impossible operation, Aristotle does not stress it. The second kind of induction which he mentions depends on the determination by exclusion of negative instances of a universal term which represents a species. To exemplify: (C) Man, horse, mule (A) are long-lived; (C) man, horse, mule (B) are without gall; therefore, all animals without gall are long-lived. Here the conclusion obviously depends on the sup-

position that B is no wider than C—a supposition for which Aristotle provides no proof. Bacon observes that Aristotle as a rule arrives at his definitions of natural species through the process of excluding contrary instances and, having done so, makes these species fixed and "eternal," affirming the while that whereas particulars appear and disappear the species remains and through it nature attains her ends.

Aristotle's "universe" is composed of fifty-five concentric spheres, with the earth at the center. The outermost of these spheres is called the *primum mobile*, the first moved by the First Mover. The motion of the *primum mobile* is, in turn, transmitted to other celestial bodies, whose motions may be said to be in different degrees "imitations" of the motion of the First Mover. Celestial motion is appropriately circular, for the circular is the most perfect of all motions, uniform without break, irregularity, or end. The heavenly bodies, again, contain a quintessence or fifth element, ether, while terrestrial bodies are composed of the four elements, fire, air, earth, water—sometimes designated according to their fundamental qualities as the hot, the cold, the dry, and the wet. These elements are not to be confused with Aristotle's matter, since they are already formed "first bodies." They are not to be thought of as existing in separation one from another. Each of the four "first bodies," having a specific inherent weight of its own, tends to take up its appropriate place. Their several motions are rectilinear in character. All terrestrial motions are combinations of rectilinear motions. These motions Aristotle classifies generally in a fourfold manner, as local motion or change in place, increase and decrease, qualitative change, generation and decay.

Motion of whatever sort is for Aristotle a passing from potency to act through the agency of form. Forms activate matter, which without their agency would remain in a condition of potency, privation, indeterminateness, nonsignificance. In motion four causes are, for Aristotle, discernible: the material, that out of which whatever in a condition of becoming becomes; the formal, the determinate thing which

is actualized; the efficient, the operation which brings potency into act; and the final cause which is the end or purpose achieved through the passage from potency to act. Since the form is the cause which both activates matter and marks its determination and significance in actualization, Aristotle is able to reduce his four causes to two, the material and the formal. These causes produce substances. Nature consists of substances, each of which is a compound of matter and form.

V. Bacon's Rejection of Aristotelianism

At Bacon's hands the Peripatetic principles and arrangement of the sciences undergo a drastic reconstruction. His alternative classification of the divisions of knowledge is set forth in detail in his *Advancement of Learning* (1605) and also with some minor modifications in the Latin translation of this work, *De dignitate et augmentis scientiarum* [1623]—(*Of the Dignity and Advancement of Learning*). From his classification Bacon excludes any metaphysical ontology which has to do with a philosophical First Cause and that most abstract of all objects, a transcendental Being qua Being. The doctrine of a first, uncaused Cause Bacon considers unphilosophical for the reason that the conception first assumes the principle of cause and effect, and then—when it becomes philosophically inconvenient—deserts it. A metaphysics which takes its stand, as Aristotle's does, on a transcendental abstract unity, asserting the convertibility of this with an abstract being as such rests, in Bacon's opinion, on a circular argument which can do no more than exhibit a tautology. Aristotle himself, affirming that these transcendentals are known intuitively, significantly puts them beyond the realm of categorized things which admit of demonstration by syllogism.

Bacon identifies his metaphysics with universalized demonstrable physics. He reduces mathematics in status from an independent science to an instrument of physics. The principles of ethics, because of their having to do with the part of man which is made in the Divine Image, are placed by him under

the jurisdiction of revealed theology. Knowledge in the arts, whether "intellectual" or "manual," however elevated, however lowly and commonplace, he merges with the operative part of physics. In his view all works of art, formed as they must be through the operations of matter, are as natural as stones, trees, animals, and that part of man produced in natural generation. Bacon would have it "firmly settled within the minds of men, that the artificial does not differ from the natural either in form or in essence, but only in the efficient. . . . Nor matters it, provided things are put in the way to produce an effect, whether it be done by man or apart from man."

Bacon rejects the Peripatetic principle of abstraction as a misleading guide in the organizing of objects of scientific inquiry. "One," he says, "who philosophizes rightly and orderly should dissect nature, and not abstract her." Aristotle enfranchises the science of mathematics, assigns to it abstractions separable from materiate things in motion, and argues that quantities, the objects of this science, are not existential realities. Then he goes on to stress an even more abstract science, metaphysics, whose objects lie beyond what is amenable to treatment by such categories as space, time, quantity, quality, active and passive power. But the proper objects of science are in Bacon's view concrete, material, moving things. These, he says, are the objects which admit of "dissection."

The Peripatetic separation of the sciences by means of "axioms" Bacon regards as "unscientific." It has served to perpetuate the divisions of knowledge introduced in antiquity, when the investigation of nature was scarcely begun, and has been constantly used to thwart the introduction of new investigations. It has severed the branches of knowledge, such as astronomy, optics, medicine, from the nourishing stem of general scientific principles.

Bacon regards as an unfortunate error Aristotle's belief that earthly motions and elements are different in kind from those of the celestial spheres. This opinion, which, he says, owes its origin to a pagan regard for the supposed eternal

character of the heavens, has served to "corrupt" both astronomy and physics. Bacon rejects all of Aristotle's five elements.

As a philosophical materialist Bacon reduces Aristotle's four types of motion, local motion, increase and decrease, qualitative change, generation and decay, to one sort, local motion in space. Aristotle's account of motion as process through which deprived matter comes to have a form, an actualized final cause, involves in Bacon's opinion an untenable view of both matter and form. To hold, as the Peripatetics do, that potential, indeterminate matter is an ingredient in action is to affirm something which cannot be described in any positive manner. The explanation of process in terms of nonmateriate form, which is also deemed final cause, is merely a stating of what has been effected and not an account of factors operative within the action.

For Bacon forms are inherent in the matter of which moving objects are composed. A substance for him is not a conjunction of a single form and "appropriate" nondeterminate matter, but a conjunction of several materiate forms. "To inquire the form of a lion, or of an oak, of gold," says Bacon, "nay even of water or air would be to turn serious business into a game; but to inquire the form of dense, rare, hot, cold, heavy, light, tangible, pneumatic, volatile, fixed, and of similar things; and of schematisms as well as motions, which . . . are not many and yet make up and sustain the beings and forms of all substances; this, I say, it is which we are attempting, and it constitutes and defines the metaphysic of forms." Forms are the natures of their inner causes, the laws of their operations, the very things themselves. The terms form, nature, cause, and law are all convertible, each with the others. Even as lesser legal clauses are included within the more general law, so are lesser forms contained within the greater form. The lesser form stands in relation to the greater form, as species stands in relation to genus. The form of heat, for instance, is motion, but only of a kind, for the motion which is heat is comprehended within a more general form of motion, far more comprehensive in operation than heat. The

forms of nature, like the letters of the alphabet, are limited in number. Out of their combinations arise all things which are produced whether in natural generation or by art. In change or motion one form gives place to another form. The search for forms and demonstrations respecting their operations constitute science as theoretical; the production of works through the knowledge of them is the achievement of science as operative. Human knowledge ends in the production of works through an understanding of the materiate forms of nature.

Bacon is extremely critical of the Peripatetics' claims for their logic. They stress the unassailability of a "knowledge" derived from their "first notions," the principles of identity, contradiction, and excluded middle, and the certainty of the syllogistic demonstration which is said to follow from the acceptance of these three. Bacon, of course, as a sane man admits that what is, is—the principle of identity; that the same thing cannot both be and not be what it is—the principle of contradiction; that a thing must either be this or not this, for there is no middle alternative—the principle of excluded middle. He also acknowledges that the syllogism can play a useful role in the organizing of scientific knowledge when this has already been gained, and in the presenting of ethical, political, legal, and theological arguments—whether ill or well founded. Yet he contends vigorously that neither the "first principles" of thought nor the syllogism can furnish any new truth about nature's operations; that the syllogism demonstrates no truth not already implied in the premise which contains the universal term. Bacon condemns the promotion by the Aristotelians of the separate axioms of their several sciences to the status of primary principles. It is from these axioms as highest propositions that all lesser, "middle" scientific propositions are, in the schools, derived and attested, to the perpetuation of ancient, outmoded doctrines and divisions within knowledge and the denial of new, specific truths.

The method of scientific demonstration now taught in the

schools consists almost entirely of the syllogism. Induction is but lightly touched upon, and then forgotten. The so-called proof by syllogism, in Bacon's view, is but a relating of terms. Demonstration by syllogism is about words, not things. Its argument depends upon a universal middle term; yet for the establishment of this Aristotle and his followers provide no satisfactory direction, if indeed any direction at all. Aristotle's own middle terms are commonly vague and formed without due regard to sense and particulars. In the beginning Aristotle seems to show some respect for observation, experiment, and experience. Later on, when he comes to depend upon terms hastily defined to resolve his difficulties, he leaves experience behind, or drags her along like a captive chained to his chariot. His successors, with their elaborate definitions, have altogether deserted experience. Middle terms on which proof turns are "elected" according to every man's invention.

As means for the establishment of a middle term in a major premise Aristotle's "perfect" induction is futile. His other induction, which proceeds to definition of species by the adduction of affirmative instances to the exclusion of negative instances, does little more than exemplify what Bacon calls the "peculiar and perpetual error of the human intellect to be more moved and excited by affirmatives than by negatives." On this method Bacon makes the comment, "To conclude upon an enumeration of particulars without instances contradictory is no conclusion, but a conjecture; for who can assure . . . that there are not others on the contrary side which appear not." Aristotle's dependence on his second kind of induction, which determines species through selected affirmative instances only, is in Bacon's opinion the chief cause of his readily assuming that nature as such consists of a number of fixed types. Aristotle regards as unnatural things, as "monsters," those objects in "nature" which are not found to conform to his defined species. When making his physical demonstrations Aristotle concerns himself only with nature "at liberty," and excludes both nature as "vexed," when framed

into works by the arts, and nature as "impeded," when in digression and deflection from her common motions and generations she produces monsters. It is not surprising, then, that those of Aristotle's successors who compile natural histories tend to segregate nature's deviations in collections of marvels, treating them as intractable objects, strange addenda to nature. Yet surely, says Bacon, the things which nature herself produces are of nature, natural. The study of monsters can surely help the scientist bent on the production of new species and the artist eager to understand the manner in which nature may be made to operate in the production of new "marvels."

Bacon's own scheme of science rises, "like a triangle," from the wide base of natural history gathered and interpreted according to the requirements of a new inductive method. Its next stage is physics inductively established. At the top this physics, now made general, becomes the metaphysics of nature.

Of Natural Philosophy (writes Bacon) the basis is Natural History; the stage next the basis is Physic; the stage next the vertical point is Metaphysic. As for the vertical point, *Opus quod operatur Deus a principio usque ad finem*, [the work which God worketh from the beginning to the end], the Summary Law of Nature, we know not whether man's inquiry can attain unto it. But these three be the true *stages* of knowledge; and are to them that are depraved no better than the giants' hills, [Pelion, Ossa, and Olympus, piled upon each other] . . . but to those which refer all things to the glory of God, they are as the three acclamations, *Sancte, sancte, sancte* [Holy, Holy, Holy]; holy in the description or dilatation of his works, holy in the connection or concatenation of them, and holy in the union of them in a perpetual and uniform law. And therefore the speculation was excellent in Parmenides and Plato, although but a speculation in them. That all things by scale did ascend to unity. So then always that knowledge is worthiest, which is charged with least multiplicity; which appeareth to be Metaphysic; as that which considereth the Simple Forms or Differences of things, which are few in number, and the degrees and co-ordinations whereof make all this variety.

In Bacon's naturalistic scheme there is no place for a knowledge which has for its purpose mere contemplation—the activity assigned by Aristotle to his metaphysician. The aim of all knowledge is action in the production of works for the promotion of human happiness and the relief of man's estate. Through inductive science man is to recapture his dominion over nature long forfeited and long prevented through the efforts of erring philosophers and men of learning. Since knowledge is operative in design, and the acts of nature and art are one in kind, to physics there is to be assigned, as its operative part or counterpart, mechanics; and to metaphysics, which is generalized physics, magic—in the original sense of full and active wisdom. Physics will deal with things in relatively narrow contexts and implications. Metaphysics will contain what is "summary," will abridge the "circumlocutions and long courses of experience," command the "widest and most open field of operation," and having established a summary general law, form, cause, or nature will "enfranchise" man unto "the utmost possibility of superinducing that nature upon every sort of matter."

VI. Natural History and the Instauration of the Sciences

For the provision of help toward the collecting of natural history, the foundation on which his philosophical edifice was to rest, Bacon began suit as early as 1592 to Lord Burghley. In that year he wrote this uncle of his hope, that when a political office became his, he might "bring in industrious observations, grounded conclusions, and profitable inventions and discoveries." "I do easily see," he explained, "that place of any reasonable countenance doth bring commandment of more wits than a man's own, which is the thing I greatly affect." Three years later in a "device" or masque, presented at Gray's Inn for Elizabeth's entertainment, Bacon appealed in similar vein to the Queen herself. In 1605 he reminded James that "if Alexander made . . . liberal assignation to Aristotle of treasure for the allowance of hunters, fowlers,

fishers and the like, that he might compile an History of nature, much better do they deserve it that travail in Arts of nature." In 1608 Bacon conceived the plan of acquiring an already established "place to command wits and pens, Westminster, Eton, Winchester, specially Trinity College in Cambridge, St. John's in Cambridge, Magdalene College in Oxford, and be-speaking this betimes with the King, My Lord Archbishop, My Lord Treasurer." In 1620, in his *New Organon* he implored the King's aid in collecting a natural history, and at the same time, having by now begun to despair of obtaining from members of the Court either funds or a college, he called upon his readers generally "to come forward and take part" in the work. Five years later, a year before his death, Bacon wrote to the Venetian Fulgentius, saying, "The third part of the Instauration, that is, the Natural History, it is plainly a work for a King or a Pope, or for some college or order, and it cannot be performed by private industry as it should."

During his lifetime, Bacon got no help from any public or private person for his instauration of the sciences. A year after he died his chaplain and first biographer, Rawley, wrote in a preface to what was obviously a hastily prepared collection of examples of natural history, the *Sylva sylvarum* (*Forest of Materials*):

I have . . . heard his lordship discourse that men (no doubt) will think many of the experiments contained in this collection to be vulgar and trivial, mean and sordid, curious and fruitless. . . . I have heard his lordship speak complainingly, that his lordship (who thinketh he deserveth to be an architect in this building) should be forced to be a workman and a laborer and to dig clay and burn the brick; and more than that (according to the hard condition of the Israelites at the latter end), to gather the straw and stubble over all the fields to burn the brick withal. For he knoweth, that except he do it, nothing will be done: men are so set to despise the means of their own good.

A generation was to elapse before scientists, at home and abroad, hailing Bacon as a "new Aristotle" and "nature's sec-

retary," undertook at his bidding and according to his directions the collecting of myriad natural histories.

Bacon's Great Instauration, framed according to new principles and a new alignment of the sciences, was to contain six parts. The first of these parts was designed for the clearing away of the waste and rubble which, through battles among contending philosophical sects, had accumulated about the foundations of knowledge. The second part was to present a new method of inquiry, hitherto unused and unknown. The third would contain natural histories collected, arranged, and interpreted according to the requirements of this new method. The fourth would exhibit a "ladder" or scale of ascent in proven knowledge, from lesser to greater axioms. The fifth would consist of pieces of knowledge, experimentally derived but not as yet proved and placed within a new scientific synthesis. The sixth was to provide a naturalistic metaphysics or comprehensive philosophy of nature.

The character of each of these parts, with the exception of the first, was determined by the year 1607, when Bacon wrote his unfinished *Outline and Argument of the Second Part of the Instauration*. Two years earlier he had published his *Advancement of Learning*. In this he had given an account of certain "errors," "vanities," and "oppositions" which had retarded science. (Most of these are mentioned in the *New Organon*.) He had presented his evidence in the form of a review of the waste areas of learning, uncultivated by apt inquiry and neglected by the professors of learning. As an effort toward the furtherance of his scientific enterprise this attack on past and present learning and learned institutions had produced but little effect. The result could hardly have been a matter for surprise to any person less sanguinely dedicated to a cause than the author. Both Elizabeth and James had been educated in the classics. Elizabeth continued to read Augustine. James wrote learned treatises. Burghley and Salisbury were in turn chancellors of Cambridge. The clergy and the heads and fellows of colleges were by training and profession Platonic or Aristotelian in philosophic outlook. For-

mer attacks on traditional learning by Agrippa, Bruno, Campanella, Cardan, Telesius, and others had left learned persons and foundations unmoved.

While composing his *Advancement of Learning*, Bacon had kept a guard on his pen lest anything he wrote should prove "harsh," "out of tune," offensive to a learned sovereign and learned subjects in Court, church, and the universities. Later on when it became evident to the author that this publication was not proving an effective means for obtaining royal or other support for his instauration, Bacon pondered the wisdom of publishing a less restrained attack on traditional learning by "discouraging scornfully of the philosophy of the Grecians . . . taking a greater confidence and authority in discourses of this nature." For some years he had thought of representing the errors of past and present learning as "idols" or phantoms which perpetually beset the human mind in general and the minds of philosophers in particular. In 1620 Bacon was in his sixtieth year; nothing as yet had been accomplished either by way of exposition or exemplification of his Great Instauration. To put some of its parts, at least, "out of peril," as he said, he decided to publish his unfinished *New Organon* in representation of the second part. This would provide a new inductive method, however incomplete, a "key" to the "interpretation of nature." To the *New Organon* he would attach an introduction to the third part, a *Preparative Toward a Natural and Experimental History*. Observations and experiments recorded in the Second Book of the *New Organon* to illustrate the new method would serve also to exemplify in some degree the sort of natural history required for the third part. Since Bacon's thoughts about "idols" had at this date been set down merely in aphoristic form, and not composed as a continuous treatise, such aphorisms as were ready could be included within Book One of the *New Organon*. These aphorisms would serve to indicate what the first of the six parts of the instauration intended. As soon as the Latin version of the *Advancement of*

Learning with some deletions, modifications, and additions could be made ready, it also—since nothing better was available—would be published in representation of the first part. As soon as possible the preparation of an independent natural history would be undertaken.

By 1622 Bacon was able to produce a section of his natural history. This he published under the title *Natural and Experimental History for the Foundation of Philosophy: Or Phenomena of the Universe: Which is the Third Part of the Great Instauration*. The pressing reason for its preparation the author made clear in a "foreword." He wrote:

It has occurred to me that there are doubtless many wits scattered over Europe, capacious, open, lofty, subtle, solid, and constant. What if one of them were to enter into the plan of my Organum and try to use it? He yet knows not what to do, nor how to prepare and address himself to the work of philosophy. If indeed it were a thing that could be accomplished by the reading of philosophical books, or discussion, or meditation, he might be equal to the work, whoever he be, and discharge it well; but if I refer him to natural history and the experiments of arts (as in fact I do), it is out of his line, he has not leisure for it, he cannot afford the expense. Yet I would not ask anyone to give up what he has until he can exchange it for something better. But when a true and copious history of nature and the arts shall have been once collected and digested, and when it shall have been set forth and unfolded before men's eyes, then will there be good hope that those great wits I spoke of before, such as flourished in the old philosophers, and are even still often to be found—wits so vigorous that out of a mere plank or shell (that is out of scanty and trifling experience) they could frame certain barks of philosophy, of admirable construction as far as the work is concerned—after they have obtained proper material and provision will raise much more solid structures; and that too though they prefer to walk on in the old path, and not by the way of my Organum, which in my estimation, if not the only, is at least the best course. It comes therefore to this, that my Organum, even if it were completed, would not without the Natural History much advance the Instauration of the sci-

ences, whereas the Natural History without the Organum would advance it not a little. And therefore, I have thought it better and wiser by all means and above all things to apply myself to this work.

Shortly after the publication of the *New Organon* Bacon was out of political office. In the remaining years of his life he did what he could to leave written works in adequate representation of the parts of his philosophic scheme. According to the "Plan of the Work" contained in the *New Organon*, the Great Instauration was to consist specifically of six parts: (1) the Division of the Sciences; (2) Directions concerning the Interpretation of Nature; (3) the Phenomena of the Universe; (4) the Ladder of the Intellect; (5) the Forerunners of the New Philosophy; and (6) the New Philosophy or Active Science. Of the fifty-odd larger works and smaller philosophical pieces composed by the author the following were in his opinion representative, in some degree, of these respective divisions: Part One: *De dignitate et augmentis scientiarum* (*Of the Dignity and Advancement of Learning*). Part Two: *Novum organum sive indicia de interpretatione naturae* (*The New Organon or True Directions Concerning the Interpretation of Nature*). Part Three: *Parasceve ad historiam naturalem et experimentalem* (*Preparative toward a Natural and Experimental History*), *Historia naturalis et experimentalis ad condendam philosophiam: sive phenomena universi* (*Natural and Experimental History for the Foundation of Philosophy or Phenomena of the Universe*), *Historia ventorum* (*History of the Winds*), *Abecedarium naturae* (*The Alphabet of Nature*), *Historia vitae et mortis* (*History of Life and Death*), *Historia densi et rari; necnon coitionis et expansionis materiae per spatia* (*History of Dense and Rare: the Contraction and Expansion of Matter in Space*), *Historia gravis et levis* (*History of Heavy and Light*)—a "lost work," *Historia sympathiae et antipathiae rerum* (*History of the Sympathy and Antipathy of Things*)—preface only, *Historia sulphuris, mercurii, et salis* (*History of Sulphur, Mercury, and Salt*)—

preface only, *Sylva sylvarum* (*Forest of Materials*), *Inquisitione de magnete* (*Inquiry Concerning the Loadstone*), *Topica inquisitionis de luce et lumine* (*A Topic of Inquiry Concerning Light and Illumination*). Part Four: *Scala intellectus sive filum labyrinthi* (*Ladder of the Understanding or Thread of the Labyrinth*)—preface only. Part Five: *Prodromi sive anticipationes philosophiae secundae* (*Forerunners or Anticipations of the New Philosophy*). Part Six: nil.¹

VII. *The New Organon*

The published work of 1620, which follows the present Introduction, includes a *Proem*, an *Epistle Dedicatory*, a *Preface* to the *Great Instauration*, the *Plan of the Work*, a *Preface* to the *New Organon*, the *New Organon* proper, and a *Preparative Toward a Natural and Experimental History*. These various pieces, some brief, some lengthy, contain no statement of Bacon's classification of the sciences and only slight reference to his divorce of theological ontology from naturalistic metaphysics; yet together they may be said to contain the author's most telling statement of what is certainly a distinctive and a new philosophy. The *New Organon* represents Division Two of the Great Instauration. Of the six divisions of his instauration Bacon considered this the most important of all, and there can be no doubt that he looked upon the *New Organon* as likely to be in effect the most consequential of all the literary works produced by him in the promotion of a new learning founded on a new type of science. The method contained within it was designed to initiate the "end and termination of infinite error." Every stage of future scientific inquiry and investigation, from the collecting of natural history to the eduction of the most general metaphysical principle, was to proceed according to the requirements of this method. To the preparation of the *New*

¹ For a detailed account of these and the other philosophical works of Bacon, see the writer's *Philosophy of Francis Bacon* (Chicago, 1948), Chap. III.

Organon Bacon devoted parts of seventeen politically busy years. Rawley said that he had seen "at least twelve copies" of the work "revised year by year, one after another, and every year altered and amended in the frame thereof, till at last it came to that Model in which it was committed to the press; as many living creatures do lick their young ones till they bring them to their strength of limbs." Some of Bacon's earlier and incomplete attempts at its writing and composition remain under such titles as *Valerius Terminus of the Interpretation of Nature: with the annotations of Hermes Stella*; *Partis instaurationis secundae delineatio et argumentum* (*Outline and Argument of the Second Part of the Instauration*); *Filum labyrinthi, sive formula inquisitionis* (*Thread of the Labyrinth or Rule of Inquiry*); *Cogitata et visa de interpretatione naturae, sive de scientia operativa* (*Thoughts and Impressions: Concerning the Interpretation of Nature, or Concerning Operative Science*); *Aphorismi et consilia, de auxiliis mentis et accensione luminis naturalis* (*Aphorisms and Counsels Concerning the Mind's Aids and the Kindling of Natural Light*).

The introductory parts of the *New Organon* provide reasons for undertaking a new sort of inquiry and indicate the general character of the new induction. The First Book expounds the doctrine of Idols and advances reasons for the lack of advance in scientific knowledge. The Second Book exhibits by examples the new interpretation of nature in operation. In this the author names eleven directions for the "true interpretation of nature." These directions are designed to show "how to educe . . . axioms from experience" and in turn, "how to deduce and derive new experiments from axioms." The beginning will lie in the observations and experiments recorded in natural history. Investigation will then proceed to the discovery of the least general principles, and from this to the discovery of the more general. At each level of inquiry the axiom, whether less or more general, will, in addition to explaining the phenomena brought under ob-

ervation, suggest other and more general axioms which as hypotheses—Bacon on occasion uses this term—will be tested by sense-observation in the light of particulars. The most general principles will be established last of all. They, too, like all the others, will be demonstrated by operations available to sense.

The new method of induction will help the senses, infirm and given to error as they are; it will also aid and control the intellect, ever prone to fly to first principles and there to remain, forgetful of phenomena and facts. The new organon or method will govern the knowing faculties, and will implement a "commerce between the mind and things" by promoting "forever a true and lawful marriage between the empirical and the rational faculty, the unkind and ill-starred divorce and separation of which has thrown into confusion all the affairs of the human family."

Of the eleven directions contained within Book Two of the *New Organon* Bacon calls the first "the Presentation of Instances to the Understanding" and the second "the Indulgence of the Understanding." The interpretation of nature really begins with the latter of these, which becomes the "First Vintage," so to speak, from the new vineyard of science tilled by a new kind of philosopher. Bacon illustrates his first and second directions with a search for the form or nature of heat. For the Presentation of Instances three sorts of table are to be prepared. The first of these tables will contain examples in which the nature under investigation is present, for instance, rays of the sun, flames, quicklime sprinkled with water, and substances rubbed violently together—Bacon instances some twenty-seven cases. A second table will contain instances lacking the nature under investigation, for example, the rays of the moon, and mixtures of oil and quicklime—Bacon lists some thirty-two. To these tables, one of Presence and one of Absence, a third, that of Deviation or Absence in Proximity will be added. This table will contain records of the increase and decrease of heat in the same objects. Here Bacon lists

some forty-one examples, including the increase of heat in animals through exercise and in anvils through repeated blows upon their surfaces.

After making a protracted examination of the three tables of instances, Bacon offers, as the First Vintage produced through the toil of workers in the vineyard, the following definition of heat. "Heat," he says, "*is a motion, expansive, restrained, and acting in its strife upon the smaller particles of bodies.* But the expansion is thus modified: *while it expands all ways, it has at the same time an inclination upward.* And the struggle in the particles is modified also; *it is not sluggish, but hurried and with violence.*" Having in mind, now as always, his doctrine that science is in end operative, Bacon gives instructions for the production of heat. "If," he says, "*in any natural body you can excite a dilating and expanding motion, and can so repress this motion and turn it back upon itself, that the dilation shall not proceed equally, but have its way in one part and be counteracted in another, you will undoubtedly generate heat; without taking into account whether the body be elementary (as it is called) or subject to celestial influence; whether it be luminous or opaque; rare or dense; locally expanded or confined within the bounds of its first dimension; verging to dissolution or remaining in its original state; animal, vegetable, or mineral, water, oil, or air, or any other substance whatever susceptible of the above-mentioned motion.*"

The two directions so far illustrated are but the preliminary stages of induction. Nine other directions remain for consideration: those of Prerogative Instances—which excel "common" instances in the aiding of the senses and intellect and in the furtherance of "operation"; the Supports of Induction; the Rectification of Induction; the Variation of Inquiry according to the Nature of the Subject; Nature's Prerogative with respect to Investigation—what should be investigated first and what afterwards; the Limits of Investigation or the Synopsis of All Natures in the Universe; the Bringing Down

to Practice; the Preparations for Investigation; and the Ascending and Descending Scale of Axioms.

Of Prerogative Instances, Bacon names and provides examples of twenty-seven kinds. These he separates into two groups, one having to do with the "informative," the other with the "operative" part of science. The former of these groups he subdivides into two according to their functions, the aiding of the senses and of the intellect respectively. Those Prerogative Instances which bring aid to the senses Bacon calls Instances of the Lamp—for their shedding of light. They are of five kinds: Instances of the Door or Gate, which serve to "strengthen, enlarge, and rectify" the senses; Summoning or Evoking Instances—to borrow a term from courts of law—which serve to make available to sense factors that lie concealed through circumstances; Instances of the Road or Traveling Instances, which stress especially the continuity of motion in natural objects; Supplementary Instances or Instances of Refuge which bring aid where the senses are unable to perceive objects directly; and Dissecting or Awakening Instances which are especially helpful in arousing the understanding.

As for Prerogative Instances which aid the understanding: Solitary Instances help in the exclusion of the form under investigation; Migratory, Striking, Companionship, and Subjunctive Instances indicate relatively more determinately the affirmation of the form; Clandestine, Singular, Constitutive, Conformable, Alliance, and Bordering Instances "exalt" the intellect toward the discernment of common natures and genera; Deviating Instances guide the intellect when it would be led astray through mere habit; and Instances of the Fingerpost and of Divorce warn the intellect when it might proceed in the direction of false causes.

Prerogative Instances which have to do with the operative part of science include three kinds: first, those which serve to indicate especially the aim of operation in producing "works," and the most economical means of accomplishing this—In-

timating Instances and Instances of Power; secondly, those which illustrate the measure of operation—Mathematical Instances; and thirdly those which facilitate practical operation generally—Polychrest and Magical Instances.

Having illustrated Prerogative Instances in great detail and indicated which of them should be employed initially, which later on, and having then announced that he will proceed immediately to consider the remaining eight of his eleven directions, the author brings his *New Organon* to a sudden close.

Whether it was Bacon's expectation in 1620 that he would be able to continue the exposition of his inductive method at some later date is questionable. Certainly never during the remaining six years of his life, when he was working feverishly to leave works in representation of the third part of his Great Instauration, did he find time to return to this task. The *New Organon* was to remain incomplete. Thus, the reader inherits much less than half of what Bacon for years hoped and intended to bequeath to future generations.

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