

1 Bacon's idea of science

I HERALD

When we pronounce the word *science* many things come to our minds: the theories and the experiments, the laboratories and places of research, the scientific communities and congresses, the journals and the manuals, the academies and scientific societies, the institutions and the languages of science.

Sometimes, when we speak of science in reference to Bacon or Mersenne or Galilei we are drawn to forget that that which we call science (in the form in which *we* know it) did not exist in the first half of the seventeenth century. The two great historic processes which gave life to *our* science, and which the sociologists have called *institutionalization* and *professionalization* of science, took place between the middle of the seventeenth and the middle of the nineteenth centuries. The question that the historians of philosophical and scientific thought ask themselves (must ask themselves) is the following: what idea or what image of science made those processes possible? On what terrain were they born?

In trying to answer these questions, we cannot refer to the philosophers of science. They have manifested a strong interest in scientific theories and their logical structure and in the methods (for example, in the case of Bacon, for his theory of induction), but tend to take into consideration the already constructed edifices rather than the ways and the techniques of their construction, the already realized styles rather than the emergence of new styles, the already adult individuals rather than the processes of their birth and formation.

When they emerge in history, ideas and social figures also bring with them elements of the past and anticipations of future. Bacon

dedicated to the future many of his pages; he listed with great care the rationale on the basis of which the men of his time could derive hope; he compared his undertaking to that of Columbus, and his philosophy to an adventurous voyage on the ocean:

And therefore it is fit that I publish and set forth those conjectures of mine which make hope in this matter reasonable; just as Columbus did, before that wonderful voyage of his across the Atlantic, when he gave the reasons for his conviction that new lands and continents might be discovered besides those which were known before; which reasons, though rejected at first, were afterwards made good by experience, and were the causes and beginnings of great events. (IV, 91)

Bacon assigned himself the task of trumpeter (*bucinator*), the herald, the messenger, not that of combatant: "For I am . . . one perhaps of those of whom Homer speaks: *Hail, heralds, messengers of Jove and men* and such men might go to and fro everywhere unhurt, between the fiercest and bitterest enemies" (IV, 372).

None of the great discoveries which, at the beginnings of the modern era, have modified in depth the knowledge of the natural world (for example: heliocentrism, the principle of inertia, blood circulation) can be traced to Francis Bacon. And yet (notwithstanding the assertions of some of Bacon's "fiercest enemies" of the nineteenth and twentieth centuries) he made a decisive contribution to the birth and affirmation of modern science. Not only by refusing finalism and giving force to the mechanical philosophy, not only by constructing a new encyclopedia of knowledge, but by facing certain decisive themes destined to remain at the center of modernity.

Bacon is one of the constructors – perhaps the greatest – of that which can be called a modern image of science. His discourse on this theme is ample, articulated, full of intellectual force, literarily efficacious, rich in inimitable metaphors. His discourse does not concern only the method of science (everyone knows that he made an important contribution to the discussion on induction). It concerns above all the function of science in human life, the ends and values that must characterize scientific knowledge; it concerns that which today we would call an ethics of scientific research; it concerns, finally, the ways in which this form of knowledge must present itself in comparison to the other forms of cultural life: poetry, history, religion, ethics, politics.

II WHAT SCIENCE MUST NOT BE

An image of science has, in general, descriptive and normative intents. It tells what science *is* and what it *must be*, it makes regulations and imposes prohibitions. On the basis of that image (and there are in the history many different images) boundaries can be drawn between science on the one side and the other forms of knowledge (including the so-called pseudosciences) on the other.

Men – Bacon thought – have a strong desire to know. They are pushed to know for a multiplicity of reasons: natural curiosity, the desire to distract the spirit, the search for fame, the ambition of holding primacy in discussions. Too rarely are they disposed to use the gift of reason for the good of all men

as if there were sought in knowledge a couch, whereupon to rest a searching and restless spirit; or a terrace, for a wandering and variable mind to walk up and down with a fair prospect; or a tower of state, for a proud mind to raise itself upon; or a fort or commanding ground, for strife and contention; or a shop, for profit or sale; and not a rich storehouse, for the glory of the Creator and the relief of man's estate. (III, 294)

Contemplation and action, knowing and intervening must be conjoined more than ever before: in other words, a conjunction similar to that which can occur between Jupiter, the planet of quiet and contemplation, and Saturn, the planet of civil society and action. Knowledge must resemble a bride destined to procreation and happiness. It must not be like either a courtesan in the service of pleasure or a slave who works for the utility of the master (III, 259).

In the philosophical tradition and in the learning of his time Bacon recognizes three wrong kinds of philosophy which correspond to three vices of learning and give rise to three false images of science: *phantastical* or *superstitious* learning, *contentious* or *sophistical* learning and *delicate* learning.

Bacon does not consider only the philosophies, but the entire culture of his time. He finds next to him many forms of knowledge and places them in one of three categories: (1) the *Empirics* (alchemists, magicians, chemists, dyers, artisans in general), who manipulate substances and transform them and are in general bound to forms of knowledge which have some relationships with what today we call the Hermetic tradition; (2) the *Reasoners* or *Philosophers*, who iden-

tify all knowledge with altercation and dispute; (3) finally the *Humanists* who identify knowledge with vain affectations and who present a tendency to identify knowledge with words and the beauty of oratory style (III, 282–3).

This tripartition which is present in *The Advancement of Learning* (1605), is substituted by Bacon in the *Novum organum* (1620) by a new one (IV, 63–4). There are now three kinds of false learning: the sophistical, the empirical, the superstitious. The controversy with the tradition of Humanists now appears to Bacon less important and less urgent. In all probability he does not think that all the Empirics were *necessarily* involved with the tradition of magic.

The philosophy of mediaeval Schools is the most emblematic form of the Sophistical type of philosophy which is, in general, the embodiment of a *litigiosa subtilitas* (quarrelsome subtlety) or of a contentious learning. The Schoolmen have had the temerity to incorporate the contentious philosophy of Aristotle into the body of religion; thus favoring the acceptance of consecrated traditional theories and precluding invention and discovery (III, 596).¹

Like many substances in nature, which are solid, do putrefy, and corrupt into worms, so it is the property of good and solid knowledge to putrefy and dissolve into a number of subtile, idle, unwholesome, and vermiculate questions, which have indeed a kind of quickness and life of spirit, but no soundness of matter or goodness of quality (III, 285). The Reasoners have a sharp and strong wit, abundance of leisure, and small variety of reading. Their wit was shut up in the cells of a few authors as their persons were shut up in the cells of monasteries and colleges. They knew little history either of nature or time. Out of no great quantity of matter and infinite agitation of wit, they spin out unto us those laborious webs of learning which are extant in their books (III, 285). The Scholastic method is the following: to frame objections upon every particular assertion, and solutions to these objections, which solutions are for the most part not confutations, but distinctions. On the contrary, the strength of all sciences is, as the strength of the old man's faggot, in the bond (III, 286).²

In this kind of philosophy man's mind works upon itself. The philosophy of Reasoners, who exert their brains in a vacuum, is a purely intellectual game. If the Scholastics had possessed, in addi-

tion to their inexhaustible thirst for truth and their incessant spiritual agitation, a variety and universality of reading and contemplation, they might have contributed considerably to the advancement of learning (III, 287).³

The empirical kind of philosophy gives birth to opinions more deformed or monstrous than the sophistical type. It has its foundations in the narrowness and darkness of a few experiments. To those who are daily busied with these experiments and have infected their imagination with them, such a philosophy seems probable and all but certain; to all men incredible and vain (IV, 65). The manner of making experiments which men now use – Bacon writes after few pages – is blind and stupid. Wandering and straying as they do with no settled course and taking counsel only from things as they fall out, they fetch a wide circuit and meet with many matters, but make little progress, and sometimes are full of hope, sometimes distracted (IV, 70–1).

The mechanics, being by no means interested in the investigations of truth, rise their minds and stretch out their hands only for those things which bear upon their particular work (IV, 95). Bacon's protest is twofold: against the inadequacy of the operations of Empirics and against the arbitrary character of the doctrine of the Dogmatists. The Empirics are like ants who only collect and use. The Reasoners resemble spiders who make cobwebs out of their own substance. The true *opificium* of philosophy neither relies solely or chiefly on the powers of mind, nor takes material from natural history or mechanical experiments and stores it in the memory whole, as it finds it. Like bees, the true philosophy takes a middle course: it gathers its material from the flowers of garden and the field, but transforms and digests it by a power of its own (IV, 92–3; cf. III, 616).

Bacon thinks that the twin attitudes (the Empirical and the Rational or Philosophical) have not up to now been properly mingled and combined (III, 616).⁴ The two could be joined not only by mutual hatred but in a closer and holier union.⁵ Bacon thinks that his *Instauratio* has established forever a true and lawful marriage between the empirical and rational faculty, the unkind and ill-starred divorce and separation of which has thrown into confusion all the affairs of the human family (IV, 19). What is important is to open a middle way between experience and theorizing (*via media inter*

experientiam et dogmata) and in this way to rescue the human mind from the obscurity of tradition, the giddy whirl of arguments, the waves and roundabout ways of experience (III, 573).⁶

The middle way, as a remedy to the unkind divorce and separation, is a marriage. This marriage is not a mere addition, and *sublates* the original position. Compared to ants and spiders, bees are undoubtedly something entirely new. They have the diligent industry of ants, but they do not only collect material; they produce honey. Bees have the constancy of spiders and give out a substance from their own bodies. But the honey they give out is the result of transformation and digestion.

In opposition to the opinion expressed in this century by Karl Popper and all his followers (until Peter Urbach's book published in 1987), the *digestion* of experience is a basic notion in Bacon's philosophy: experience, according to him, must be duly ordered and digested, not clumsy or erratic (I, 190; IV, 81).

The superstitious kind of philosophy gives rise to vain imaginations, that is to the pseudosciences, like astrology, natural magic, alchemy which have "better intelligence and confederacy with the imagination of man than with his reason" (III, 289). The natural magic "is as far differing in truth of nature from such a knowledge as we require, as the story of King Arthur of Britain, or Hugo of Bordeaux, and such like imaginary heroes, differs from Caesar's Commentaries in truth of story" (IV, 367). Bacon argues fiercely against the Hermetic image of the scholar as an *enlightened* man, against the Hermetic notion of learning leading to results that must be kept secret and withheld from the profanes, against a mentality that is completely dominated by what is extraordinary, astonishing, secret. When in the midst of innumerable falsities, magic does accomplish something – he writes in the *Redargutio philosophiarum* and in the *Novum organum* – then it does so not in the service of mankind, but for the sake of novelty, or to arouse admiration for the figure of the scholar.

I wrote many years ago about the condemning of magic and also about the heritage of magic in Bacon's philosophy.⁷ But I cannot agree with Frances Yates's opinion according to which Bacon presented in a more up-to-date language aims and values that had been characteristic of the Hermetic tradition.⁸ According to Bacon, magic and alchemy could never be counted as sciences precisely because of

the excessive importance they attach to the authority of individuals and their over-hasty judgments. The *rules* contained in the procedures of magic and alchemy can never reach the level of a *method* because their codifiable character can never be established. They will always remain secret rules, formulated in a symbolic language that has nothing to do with the symbolism of modern chemistry, but which refers, through a series of analogies and correspondences, to the Whole, to Universal Spirit, to God. The alchemist cannot codify his method, nor make it a *public* knowledge, available for others and to be used by others. He proceeds on the basis of few texts, that are held to be infallible. His over-large and over-ardent hopes go hand in hand with a continual state of self-accusation for he ends by blaming himself for the errors into which he is led by the texts held to be infallible (IV, 84).

III WHAT SCIENCE MUST BE

Bacon condemned magic and alchemy on ethical grounds. He accused them of imposture and of megalomania. He refuted their non-participatory method and their intentional unintelligibility, their attempt to replace human sweat by a few drops of elixir. But he borrows from the magico-alchemical tradition the idea that man can attempt to make himself the master of nature. Bacon understands knowledge not as contemplation or recognition, but as a *venatio*, a hunt, an exploration of unknown lands, a discovery of the unknown. Nature can be transformed from its foundations. Bacon's definition of man as "the servant and interpreter of Nature" (IV, 47) is the same definition we find in the magico-alchemical tradition, for instance in the texts of Cornelius Agrippa von Nettesheim.

But for all the exponents of magic and alchemistic culture, the texts of ancient wisdom take the form of sacred texts which include secrets that only a few men can decipher. The truth is hidden in the past and in the profound. Like when dealing with sacred texts, it is necessary continuously to go *beyond the letter*, in search of a message which is more and more hidden. The secret message expresses a Truth which is at the Origins and which is always the same.

In the Hermetic tradition, as in the tradition of Platonism, the natural world is conceived as the image or living manifestation of God. Understanding nature can reveal the presence in the world of

divine ideas and archetypes. Bacon's rejection of any natural philosophy founded on allegorical interpretations of Scriptures meant a withdrawal from exemplarism and symbolism, both common features of mediaeval philosophy and still flourishing in the seventeenth century. As all works – says Bacon – show the power and ability of their maker, but not his image, so God's work “do shew the omnipotency and wisdom of the maker, but not his image” (III, 350). The distinction between the will and power of God, so fully and subtly present in Baconian texts, is very important. “The heavens declare the glory of God, and the firmament showeth his handworks”: this verse from the Psalms (18,2) is quoted by Bacon several times. The image of the world, immediately after the Word, is a sign of the divine wisdom and power, and yet the Scriptures do not call the world “the image of God,” but regard it only as “the work of his hands,” neither do they speak of any image of God other than man. Theology is concerned with knowing the book of the word of God; natural philosophy studies the book of God's works. The book of Scripture reveals the will of God, the book of nature, his power. The study of nature has nothing to say about God's essence or his will (IV, 340–3).

Bacon proposed to the European culture an alternative view of science. For him science had a public, democratic, and collaborative character, individual efforts contributing to its general success. In science, as Bacon conceives it, truly effective results (not the illusory achievements of magicians and alchemists) can be attained only through collaboration among researchers, circulation of results, and clarity of language. Scientific understanding is not an individual undertaking. The extension of man's power over nature is never the work of a single investigator who keeps his results secret, but is the fruit of an organized community financed by the state or by public bodies. Every reform of learning is always a reform also of cultural institutions and universities.

Not only a new image of science, but also a new portrait of the “natural philosopher” took shape in Bacon's writings. This portrait differed both from that of the ancient philosopher or sage and from the image of the saint, the monk, the university professor, the courtier, the perfect prince, the magus. The values and the ends theorized for the composite groups of intellectuals and artisans who contributed in the early seventeenth century to the development of science were

different from the goals of individual sanctity or literary immortality and from the aims of an exceptional and "demonic" personality.

A chaste patience, a natural modesty, grave and composed manners, a smiling pity are the characteristics of the man of science in Bacon's portrait of him. In the *Redargutio philosophiarum* Bacon wrote:

Then he told me that in Paris a friend had taken him along and introduced him to a gathering, 'the sight of which', he said, 'would rejoice your eyes. It was the happiest experience of my life'. There were some fifty men there, all of mature years, not a young man among them, all bearing the stamp of dignity and probity. . . . At his entry they were chatting easily among themselves but sitting in rows as if expecting somebody. Not long after there entered to them a man of peaceful and serene air, save that his face had become habituated to the expression of pity . . . he took his seat, not on a platform or pulpit, but on level with the rest and delivered the following address . . . (III, 559)⁹

Bacon's portrait doubtless resembles Galileo or Einstein more than it does the turbulent Paracelsus or the unquiet and skittish Cornelius Agrippa. The titanic bearing of the Renaissance magus is now supplanted by a classical composure similar to that of the "conversations" of the earliest Humanists. Also in Galileo's *Dialogo* and in Descartes's *Recherche de la vérité* we find the same familiar tone and style of conversation in which (Descartes wrote) "several friends, frankly and without ceremony, disclose the best of their thoughts to each other."¹⁰ But there is besides, in Bacon, the quiet confidence that comes from knowing the new powers made available to man by technology and collaboration.

The new kind of learning, for which Bacon is searching, must get away from touches of genius, arbitrary conclusions, chance, hasty summaries. The emphasis laid by Bacon on the social factor in scientific research and in determining its ends, places his philosophy on a radically different plane from that of the followers of Hermetic tradition. Bacon's insistence on the organizational and institutional aspects of science stemmed from his own definition of learning, which is often hindered by "the nature of the society and the policies of the state":

That there is no composition of estate or society, nor order or quality of persons, which have not some points of contrariety towards true knowledge.

That monarchies incline wits to profit and pleasure, and commonwealths to glory and vanity. That the universities incline wits to sophistry and affectations, cloisters to fables and unprofitable subtilty, study at large to variety; and that it is hard to say, whether mixture of contemplations with an active life, or retiring wholly to contemplations, do disable and hinder the mind more (III, 252).

In the only piece of autobiography and self-analysis in which Bacon indulged (*De interpretatione naturae proemium*, III, 518–20), he says that the discovery of new arts for the bettering of human life is a better ambition than politics, but he allowed himself to be deflected into politics for family and patriotic reasons and because he hoped that “if I rose to any place of honour in the state, I should have a larger command of industry and ability to help me in my work” (III, 519).¹¹ Like no other philosophers of his time, Bacon vividly sees that scientific enterprise is a collective effort that concerns all society and requires institutions specific to it. The relation between science and politics, in spite of his personal psychological doubts and incertitudes, has for him a structural character. The solution he offers in the *New Atlantis* was a clear, firm *separation*. The men of science, in the *New Atlantis*, lived in solitude. Their place reminds us of a university campus cut off from the daily concerns of common mortals. But there is something else: the scientists of the *New Atlantis* held meetings to decide which of the discoveries that had been made should be communicated to the public at large and which should not. Some of the discoveries that they decided to keep secret were revealed to the state; others were kept hidden from political power. On the uses that might be made of scientific and technological discoveries he was no optimist. The wise men who decided to keep some of their dangerous discoveries to themselves did not live in the society of Elizabethan England nor in our corrupt world, but within the imaginary civilization of the *New Atlantis*, an extremely peaceful and tolerant society.

Bacon’s major claim for his science was that it would be a *scientia operativa* (IV, 22, 32) that is, productive of works. What Bacon vigorously refused and what made traditional philosophy appear to him like an infertile desert was the fact that from Socrates to Bernardino Telesio a disjunction had been introduced between knowledge and operation, theories and experiments, theory and practice, truth and

utility. One of the "topical" aspects of Bacon's philosophy is the attempt he made to show how these oppositions came about and were reinforced in the history of Western civilization.

In the *Partis instaurationis secundae delineatio* (III, 549), in the *Cogitata et visa* (III, 612), and later in the *Novum organum* (IV, 110), Bacon replies to a very foreseeable objection which could easily be raised from the viewpoint of traditional philosophy:

It will be thought, no doubt, that the goal and mark of knowledge which I myself set up (the very point which I object to in others) is not the true or the best; for that the contemplation of truth is a thing worthier and loftier than all the utility and magnitude of works; and that this long and anxious dwelling with experience and matter and the fluctuations of individual things, drags down the mind to earth, or rather sinks it to a very Tartarus of turmoil and confusion; removing and withdrawing it from the serene tranquillity of abstract wisdom, a condition far more heavenly. (IV, 110)

Those who have talked about "Baconian utilitarianism" have often based their arguments precisely on the questions to which Bacon earnestly endeavored to give a reply. The answers given by Bacon preclude even the possibility that his position could be mistaken as "utilitarian." In the *Cogitata et visa* he wrote:

It may be that there are some on whose ear my frequent and honourable mention of practical activities makes a harsh and displeasing sound because they are wholly given over in love and reverence to contemplation. Let them bethink themselves that they are the enemies of their own desires. For in nature practical results are not only the means to improve well-being but the guarantee of truth. The rule of religion, that a man should show his faith by his works, holds good in natural philosophy too. Science also must be known by works. It is by the witness of works, rather than by logic or even observation [*ex argumentatione aut etiam e sensu*], that truth is revealed and established. Whence it follows that the improvement of man's mind and the improvement of his lot are one and the same thing. (III, 612)¹²

So Bacon accepts as entirely legitimate the question about the relation between contemplation and utility. But the question does not constitute an objection because the value of theories is wholly realized into the reform of knowledge.

The aphorism 124 of the first book of the *Novum organum* is very important, and must be extensively quoted:

Now to this I readily assent; and indeed this which they point at as so much to be preferred [the contemplation of truth] is the very thing of all others which I am about. For I am building in the human understanding a true model of the world, such as it is in fact, not such as a man's own reason would have it to be; a thing which cannot be done without a very diligent dissection and anatomy of the world. But I say that those foolish and apish images of worlds which the fancies of men have created in philosophical systems, must be utterly scattered to the winds. Be it known then how vast a difference there is (as I said above) between the Idols of the human mind and the Ideas of the divine. The former are nothing more than arbitrary abstractions [*abstractiones ad placitum*]; the latter are the creator's own stamp upon creation [*vera signacula Creatoris super creaturas*], impressed and defined in matter by true and exquisite lines. Truth therefore and utility are here the very same things: and works themselves are of greater value as pledges of truth than as contributing to the comforts of life [*atque ipsissimae res sunt, in hoc genere, veritas et utilitas: atque opera ipsa pluris facienda sunt, quatenus sunt veritatis pignora, quam propter vitae commoda*]. (IV, 110)

Bacon knew Latin well enough to use *idem* correctly in place of *ipse*. The term *ipsissimus*, much used in Scholastic terminology, recurs in other passages of the *Novum organum* with a precise technical meaning. The translation "truth and utility are the very same things," broadly diffused among English and American scholars,¹³ is undoubtedly wrong, as I demonstrated in 1962.¹⁴ The "Ideas of the divine," as we can read in the *Novum organum*, are "the true signatures and marks set upon the works of creation as they are found in nature" (IV, 51). The expression *ipsissimae res* and the term *ipsissimus* were used by Bacon in reference to the "objective reality of the things" or to "things in their reality," or simply to "essence" (in the particular meaning that Bacon gives to this term). In the aphorism 20 of the second book of the *Novum organum* heat is considered not in relation to the man (*ex analogia hominis*) but in relation to the universe (*ex analogia universi*). According to Bacon's view, heat is a species of genus "motion." It is not to be thought that heat generates motion or is generated by it; rather, the very essence of heat, or the substantial self of heat, is motion and nothing else (*ipsissimus calor sive quid ipsum caloris motus et nihil aliud est*).

The meaning of that Baconian statement can be summed up as follows: things as they really are, considered not from the viewpoint

of appearance but from that of existence, not in relation to man but in relation to the universe, offer conjointly truth and utility. A literal, correct translation is: "the very things themselves are, in this kind, both truth and utility."

From this point of view, the question as to whether scientific truth depends on the procedures employed to affirm them, or on their fruitfulness in practice, is a meaningless dilemma: a scientific truth is always fruitful and this fruitfulness depends precisely and exclusively on its characteristic of full truth: "The chain of causes cannot by any force be loosed or broken, nor can nature be commanded except by being obeyed. And so those twin objects, human Knowledge and human Power, do really meet in one; and it is from ignorance of causes that operation fails" (IV, 32).

IV HOW SCIENCE GROWS

All of Bacon's work calls for a revolutionary reform which was supported by a conviction of radical changes occurring in European history and by the belief that a new epoch was about to be born. These changes *do not depend on philosophy* and do not derive from the philosophical schools or sects. They are connected with a series of material factors which have modified man's way of life. The course of history, according to Bacon, was completely changed by mechanical inventions, oceanic voyages, geographic discoveries. A new world requires a new kind of philosophy: "It would be disgraceful if, while the regions of the material globe, – that is, of the earth, of the sea, and of the stars, – have been in our times laid widely open and revealed, the intellectual globe should remain shut up within the narrow limits of old discoveries" (IV, 82). Since the conditions of time are ripe, Bacon presents his own work as a masculine child of the time (*Temporis partus masculus*) rather than of the mind of a genius.

Three great inventions, the compass, the printing press, and gunpowder, have changed the world of human space, the world of communication, the world of politics. No empire, no philosophical sect, no star has exerted greater power in human affairs. For two thousand years philosophy and the intellectual sciences "stand like statues, worshipped and celebrated, but not moved or advanced"

(IV, 14). They “did and remain almost in the same condition; receiving no noticeable increase, but on the contrary, thriving most under their first founder, and then declining” (IV, 74). “Whereas in the mechanical arts, which are founded on nature and the light of experience, we see the contrary happen, for these (as long as they are popular) are continually thriving and growing, as having in them a breath of life; at first rude, then convenient, afterwards adorned, and at all times advancing.” In the mechanical arts “many wits and industries have contributed in one,” in the liberal arts and sciences “many wits and industries have been spent about the wit of some one” (IV, 74–5).

Several typical categories of technical knowledge – collaboration, progressiveness, perfectibility, and invention – became categories to which Bacon attributed a universal value. Taking the mechanical arts as a *model for culture*, it is then possible to bring to birth a type of learning which, unlike the ancient kind, is capable of progress. The Baconian revaluation of technology and the mechanical arts entailed the rejection of that conception of science which had remained alive for centuries: an “Aristotelian” science which can be born only when the necessities of life have already been procured and which then develops into a disinterested contemplation of truth. Knowing is for Bacon a kind of making.¹⁵ Although the “baroque phrase” that Antonio Pérez-Ramos wrongfully ascribes to me (“a kind of making that involves making”)¹⁶ was written by Rodolfo Mondolfo and not by me (as clearly comes out from my own text),¹⁷ I entirely agree with Pérez-Ramos’s well-grounded and admirable portrait of Bacon as an exponent of the “Maker’s knowledge tradition: a tradition which postulates an intimate relationship between objects of cognition and objects of construction, and regards knowing as a kind of making or as a capacity to make (*verum factum*).”¹⁸

But Bacon never thought of reducing science to technology and cannot be interpreted as a philosopher of “industrial revolution.”¹⁹ The *works* and the *opera* do not mean, in Bacon’s philosophy, “artefacts or tools” or “technical achievements” like gunpowder or the printing press. Bacon’s science is directed toward *opera* not in the sense of making artefacts, but in searching for “Nature effects, phenomena such as heat, colour, or motion.”²⁰

As we have seen, the Lord Chancellor drove home a double critique, for which he fought (so to speak) “on two fronts”: against the

inadequacies of the work of *Empirics* and the arbitrariness of the doctrines of the *Rationales*. The methods, the procedures, the language of mechanics and artisans have grown outside the world of universities, in the communities of the engineers and architects and skilled artisans and makers of machines and instruments. These procedures, these operations must become subject matter of reflection and study. Natural History is conceived by Bacon not only of "nature free and at large," but much more

of nature under constraint and vexed; that is to say, when by art and the hand of man she is forced out of her natural state, and squeezed and moulded. Therefore I set down at length all experiments of the mechanical arts, of the operative part of the liberal arts, of many crafts which have not yet grown into arts properly so called. (IV, 29)

Only in this way the *experientia erratica* of the mechanics, the daily labors of those who transform nature by their hands can be rescued from chance and pure empiricism.

The so-called faith in progress (as we find it in Condorcet, Turgot, Herbert Spencer, Auguste Comte) was principally supported by three beliefs: (1) there is a law in history that tends, through gradations, or phases or steps, toward the perfection and the happiness of the human race; (2) such a process of perfecting is generally identified with the development and growth of scientific knowledge; (3) science and technology are the principal source of moral and political progress and also constitute the confirmation of such progress.

We continue to project these three convictions into the past and to attribute the nineteenth-century idea of progress to all the authors who have variously written about the growth and advancement of learning. The image of progress (and of scientific progress) present in Europe between the age of Giordano Bruno and that of Isaac Newton has characteristics quite different from those imagined by philosophers who love great "epochal" classifications. I know of no author who, between the sixteenth and early eighteenth centuries, would have been willing to subscribe to the three affirmations that I have now listed.

We can begin with the so-called exaltation of technology. Many critics of Bacon's enthusiasm for the technology and for the industrial society cannot have read his interpretation of the myth of *Daedalus sive mechanicus* in the *De sapientia veterum*. Daedalus was

an abominable man of the greatest genius (*vir ingeniosissimus sed execrabilis*).

He . . . supplied the machine which enabled Pasiphae to satisfy her passion for the bull; so that the unhappy and infamous birth of the monster Minotaurus . . . was owing to the wicked industry and pernicious genius of this man. Then to conceal the first mischief he added another, and for the security of this pest devised and constructed the Labyrinth; a work wicked in its end and destination, but in respect of art and contrivance excellent and admirable. Afterwards again, that his fame might not rest on bad arts only, and that he might be sought to for remedies as well as instruments of evil, he became the author likewise of that ingenious device of the clue, by which the mazes of the labyrinth should be retraced. . . . Certainly human life is much indebted to them [mechanical arts], for very many things which concern both the furniture of religion and the ornament of state and the culture of life in general, are drawn from their store. And yet out of the same fountain come instruments of lust, and also instruments of death. (VI, 734–5)

I think that in the whole history of philosophy it is very difficult to find a text so efficacious in underlining the “ambiguous” character of technology.

Francis Bacon, as everyone knows, firmly believed in the advancement of learning, but his belief has nothing to do with a “progressive” philosophy of history. In the *Redargutio philosophiarum* and in *The Advancement of Learning*, Bacon places the “pre-Socratic” philosophy (particularly that of Democritus) at a level superior to that of Aristotle, the destroyer of philosophical pluralism. In that very ancient philosophy, where many of his contemporaries saw only sparse fragments, Bacon saw a solidity of thought that, precisely because of its extraordinarily high quality, had sunk in the depths of time.

In the *Praefatio* to the *Novum organum* we can read the general affirmation according to which “Time is like a river, which has brought down to us things light and puffed up, while those which are weighty and solid have sunk” (IV, 15).

In the *De sapientia veterum* Bacon presented a general view on the course of history. A cyclical vision of the flourishing and decadence of states and political bodies becomes the main point of the consideration of historical events. There is present the image of the depraved conditions of man’s nature that opens, in the intervals,

ages of desolation. The theme of the vicissitudes of things, to which Bacon was to dedicate one of his essays, is also present:

But howsoever the works of wisdom are among human things the most excellent, yet they too have their period and closes. For so it is that after kingdoms and commonwealths have flourished for a time, there arise perturbations and seditions and wars; amid the uproars of which, first the laws are put to silence, and then men return to the depraved conditions of their nature, and desolation is seen in the fields and cities. And if such troubles last, it is not long before letters also and philosophy are so torn in pieces that no traces of them can be found but a few fragments, scattered here and there like planks from a shipwreck; and then a season of barbarism sets in, the waters of Helicon being sunk under the ground, until, according to the appointed vicissitude of things, they break out and issue forth again, perhaps among other nations, and not in the places where they were before. (VI, 722)

In the *Cogitata et visa* and in the *Novum organum* Bacon says that out of the five and twenty centuries over which the memory and learning of men extends

you can hardly pick out six that were fertile in sciences or favourable to their development. In times no less than in regions there are wastes and deserts. For only three revolutions and periods of learning can properly be reckoned; one among the Greeks, the second among the Romans, and the last among us, that is to say, the nations of Western Europe. (IV, 77)

As Bernard Cohen has shown, Bacon uses the term *revolution* in astronomical meaning, in every way traditional, of a motion that continually repeats itself.²¹ He does not think *revolution* as a traumatic event that generates new situations. As in many other passages, a "marine" image completely gives us the sense of Bacon's perspective: the ebb and flow of ocean, which motion is placed alongside the term *revolution*: "For wise and serious men [suppose] . . . that in the revolution of time and of the ages of the world the sciences have their ebbs and flows; that at one season they grow and flourish, at another wither and decay, yet in such sort that when they have reached a certain point and condition they can advance no further" (IV, 90).

Bacon, who attributes this thesis to "wise and serious men," does not find it acceptable. It is not true that one cannot go further. Bacon does not believe that there is no reason for hope. He knows very well

that he who reveals his hopes is immediately judged to be powerless and immature. The enthusiasm for the undertaking should not brake the severity of judgments. We must leave aside “the light winds of hope” and probe the reasons that authorize us to nourish it. To avoid sin of ingenuity, it is opportune to adopt “that political wisdom that is diffident in principle and always expect the worst in human doings.” The discourse on the reasons to hope, the so-called *ostensio spei*, is a part which is not secondary to the preparation of minds and to the Great Instauration. Hurried readers often forget this. But from the middle of aphorism 92, through aphorism 114, the text of the first book of the *Novum organum* is entirely dedicated to numbering the twenty-one reasons that authorized us to nourish “reasonable hopes” in a difficult and uncertain future. Without the *ostensio spei*, the great reform would serve only to sadden human beings, to harden them to an ever lower and more vile opinion than they at the present have (IV, 90–1).

It has always been clear to all interpreters, since the seventeenth century, that Bacon’s philosophy has something to do with the theme of advancement of learning and with the history of the idea of progress. Our times, he frequently emphasizes, have the advantage of making use of almost two thousand years of events, of experience, and of knowledge of the once unknown two-thirds of the surface of the Earth (III, 564). But, like that of many great moderns, Bacon’s philosophy cannot be easily outlined. In the thought of Bacon whom many have considered to be the advocate of technological progress, the enthusiastic apostle of industrial civilization, strong themes arise that are close to the tradition of Lucretius and Machiavelli: the wheel of time and the river of time, the “revolutions” and the ebb and flow of time, its flowering and its “desolate tracts,” the ages propitious to learning and those which are barren, the shipwrecks of cultures and the planks of the shipwrecks that have reached our shores, the possible return of barbarism. Only by referring to this context can we understand what Bacon said about the advancement of learning and about the growth of the sciences.

The Baconian idea of the *advancement* does not presuppose a “progressive” view of history, but it expresses a dimension that had become an essential trait of modern science. Forgetting the past and going beyond all that has been said in the past are positive values for scientific knowledge. Science is an exploration of unknown lands

and is like a hunt. The quarry is in the future. The light of nature lay ahead. Behind there is the darkness of the past. Scholars' interests should be turned toward the future, not to the past. What remains to be done is more important than what had been done: "*Nec refert quid factum fuerit. Illud videndum quid fieri potest*" (III, 535).

V DENIGRATIONS

During our century two different negative appraisals centered on Bacon's philosophy. According to some neopositivists and many Popperian epistemologists, Francis Bacon was a model or a champion of what science has never been and will never be: a kind of knowledge obtained by observation, a process of accumulation of data, an illusory attempt to free the human mind from theories and presuppositions. "The inductivist logic of discovery" – wrote Imre Lakatos – "is the Baconian doctrine according to which a discovery is scientific only if it is guided by facts and not misguided by theories."²²

According to Max Horkheimer, Theodor Adorno, and other representatives of the Frankfurt School, Francis Bacon was precisely the opposite – the symbol of what science has been up until now and should no longer be: the impious will to dominate nature and tyrannize mankind. The old thesis of Bacon as a "vulgarly utilitarian," proposed by reactionary nineteenth-century thought, was thus restored in this century, in much subtler form, by the proponents of the so-called critical theory of society. Taking up again the themes of Edmund Husserl's criticism of Galileo in the *Krisis*, Adorno and Horkheimer in the *Dialektik der Aufklärung* (1942) (and Herbert Marcuse about twenty years later) saw in Bacon the typical *animus* of modern science. Modern science, as Martin Heidegger theorized in the *Holzwege*, is indistinguishable from technology and Francis Bacon is the symbol of this nefarious identification. It is the scientific and technological enthusiasm of the Lord Chancellor that leads to materialism, the mercantilization of culture, to modern industrial society, which is the realm of alienation and conformism, of the standardization and destruction of all human values. "The infertile happiness of knowledge" – Horkheimer and Adorno wrote – "is lascivious according to Bacon as according to Luther. Not that kind of satisfaction that men call truth is important, but only the operation, the successful procedure."²³

According to the philosophers of our century who extolled scientific knowledge against the nonsensical propositions of metaphysicians, Bacon has nothing to do with science. According to the Continental philosophers who criticized or blamed scientific knowledge for its many sins, Bacon is the very *essence* of science. Being at disagreement over every philosophical problem, the two philosophical parties (who respectively dominate the Anglo-American and Continental philosophy) completely agree on rejecting Bacon's idea of science and Bacon's philosophy but for completely opposite reasons.

Once again, Bacon was reduced to a *symbol*. The "plumb and the weight" of the texts was avoided. "So must we likewise from experience of every kind first endeavour to discover true causes and axioms; and seek for experiments of Light, not for experiments of Fruit" (IV, 71). Bacon's precise distinction between "experiment of light" (yielding valuable information) and "experiments of fruit" (yielding immediate profit) was disregarded. So, too, were ignored the many pages Bacon wrote against the utilitarian desire of immediate results and the foolish habit of abandoning the natural course of scientific enquiry turning aside, like Atalanta, after profit and commodity (VI, 744). "Knowledge that tendeth but to satisfaction is but a courtesan, which is for pleasure and not for fruit or generation. And knowledge that tendeth to profit or profession or glory is but the golden ball thrown before Atalanta, which while she goeth aside and stoopeth to take up she hindereth the race" (III, 222).

As Mary B. Hesse pointed out, "it was a favourite pastime in the nineteenth century to criticize Bacon for not being a Galileo or a Newton."²⁴ And as Brian Vickers shows in an admirable essay,²⁵ this kind of pastime continues to be practiced in our century. After the second world war, L. C. Knights found Bacon responsible for the rise of "scientific materialism" and industrial civilization.²⁶ In more recent years Jonathan Marwil wrote about Bacon's ineptitude and his "failure as a scientist,"²⁷ Michael Hattaway presented Bacon as "essentially a conservative thinker,"²⁸ Charles Whitney denied any claim to originality in Bacon's philosophy,²⁹ Mary Slaughter³⁰ and R. E. Larsen³¹ transformed Bacon into an Aristotelian, Brian Copenhaver³² into a follower of Ficino's magic. After about thirty years Peter Urbach³³ puts an end to the imaginary Bacon which was invented by Popper and Popperian epistemologists. However, having the tendency to take the community of epistemologists for the

whole scholarly community, Urbach holds the Popperian interpretation as a *standard interpretation* ("standard" for what, we are tempted to ask) and does not care to compare this interpretation with other comments, articles, or books published outside the parochial community of English-speaking epistemologists, during the fashion of such interpretation.

General philosophers and epistemologists do not busy themselves very much with the textual analysis of the writings of the past. The "seventeenth century specialists" (as Brian Vickers pointed out, connecting the *works* of Bacon with the ancient and humanistic ideal of the *vita activa*) "all too often do not enquire what happened before 1600."³⁴

Perhaps Francis Bacon was right: it is impossible to eradicate all the idols from men's minds (IV, 27). Among the idols we have so far been unable to eradicate are undoubtedly the following: the propensity not to read the original (particularly Latin) texts; the tendency to reduce the philosophies of the past to some seemingly brilliant slogans; the construction on the basis of these of mythical philosophical portraits.

NOTES

- 1 Translation by Farrington 1964, p. 78.
- 2 Translation by Farrington 1964, p. 118.
- 3 Cf. Rossi 1968, pp. 53–63.
- 4 Translation by Farrington 1964, p. 97.
- 5 Farrington 1964, p. 98.
- 6 Farrington 1964, p. 120, revised translation.
- 7 Rossi 1968, pp. 11–35.
- 8 Yates 1984, pp. 60–6, 237. Cf. Rossi 1975.
- 9 Translation by Farrington 1964, pp. 104–5.
- 10 *Oeuvres de Descartes*, ed. Ch. Adam et P. Tannery, 11 vols. (Paris, 1897–1913), X, p. 498.
- 11 Translation by Farrington 1964, p. 31.
- 12 Translation by Farrington 1964, p. 93.
- 13 Cf. Jardine 1974a, p. 115; Webster 1975, pp. 75, 337; Hacking 1983, p. 242; Cohen 1985, pp. 85, 150; Pérez-Ramos 1988, p. 136.
- 14 Rossi 1970, pp. 157–60. Italian edition was published by Feltrinelli in 1962.
- 15 Rossi 1970, pp. 136–45.