

The Artificial Human

A Tragical History

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Wherever one comes across examples of the artificial human, one can be sure that they are not the first of their kind. They were always there, moving and sleeping amongst us. Take the Japanese robots developed by Honda, or by Waseda University – they are already there in principle (albeit with considerably more primitive technology) in the mechanical dolls of the 18th century French engineer Vaucanson, which could move their limbs at least to the degree needed to play a musical instrument. Earlier still, in the 16th century, they appear in the guise of the twelve apostles circling a Christ-figure in the astronomical clock of Strasbourg cathedral. The biological variety, too, the test-tube babies produced by in vitro fertilization, have a long and distinguished lineage stretching from the “Creature” of Mary Shelley’s *Frankenstein*, a patchwork of electrically galvanized organs from the charnel house, to the homunculus of the 16th century philosopher-medic Paracelsus, which was born of male seed kept in a sealed glass vessel for forty days in a midden of warm horse manure – certainly the earliest example of in vitro fertilization. The homunculus motif is also central to the Faust legend resurrected three hundred years later by Goethe.

All these artificial constructs, whether mechanical or biological, sooner or later claim (or are claimed) to be Promethean. Mary Shelley at the beginning of the 19th century described her Victor Frankenstein – a doctor of medicine from the long ago closed University of Ingolstadt in Germany – as a “Modern Prometheus”. And with some justification, if one observes that Frankenstein’s monster, like its many types and antitypes, was born not of a woman but of leading-edge technology in the laboratory of a savant of the day. Looking back through the long series of artificially constructed men and women one cannot but conclude that their history is as old as that of the race itself.¹ Mankind seems never to have been entirely satisfied with natural generation as a means of reproducing the species; with astonishing regularity the desire has surfaced to take matters into one’s own hands, to go the whole way, even to go one better without the inconvenience of sharing the procreative process with womankind.

¹

See Horst Albert Glaser: “Prometheus als Erfinder des Menschen”. In: *Erfindung des Menschen. Schöpfungsträume und Körperbilder*. Ed. R. van Dülmen. Vienna 1998.

In terms of mastery of nature the artificial human was (and remains) the ultimate proof of man's supremacy.²

With little short of blasphemy the ancient and medieval craftsmen of the human artifact took pleasure in the title 'secundi dei': they saw their labors as a replication of biblical and Hesiodic myth, whose deities fashioned man (and a fortiori woman) from water and clay. And if the received myths of creation cast them in the role of constructs, why should men and women not be entitled to repeat their own creation, above all if they could improve on it? For no one could deny that Yahweh and Zeus had been guilty of imperfect workmanship.

The most detailed account of human creation that has come down to us from antiquity is not that of the Bible but of Hesiod, who in his *Works and Days* (c. 700 BCE) relates the story of Pandora, the first woman, made to the order of Zeus, the supreme Olympian, by the blacksmith-god Hephaestus – or, according to other sources, by the potter-god Prometheus, who in an image from the Athenian Academy is in any case depicted to be the elder of the two deities. Prometheus was at all events the patron of the *kerameikos*, the potters' quarter of Athens – and his association with their craft would explain why potters have sometimes been nicknamed 'little Prometheuses'. That it was Prometheus who (with the help of other gods) made Pandora is more likely in view of the fact that not only Hesiod but also Aeschylus and Plato credit him with having endowed mankind with technology and culture, for both of which fire was essential. Without fire there could be no cooking, no metalwork, and no pottery (*terra-cotta*, after all, means 'baked earth'). And it was Prometheus who stole the fire of the gods, Prometheus, therefore, who stands at the head of human civilization.

The pre- and post-history of that theft amount to a myth of the fall and redemption of the race. Without fire, man is like the animals, with the decisive difference that his nature requires him to advance; and in Hesiod's version of the tale, the gods prevented this, depriving humankind of the fire that was "useful" (*Theogony* 563) to them, or was, as *Works and Days* puts it, their "means of sustenance" (42) – an attitude on the part of Zeus that closely parallels that of the Mosaic God, who laid down the limits of human advancement in terms of knowledge (rather than technology) that Adam and Eve were not to cross. To our forefathers the gods were indeed jealous gods. Hesiod goes one better in the cycle of blame by grounding that jealousy in an earlier misdemeanor of the Titan Prometheus, who had tricked Zeus into taking the less desirable portions of a sacrifice. It might seem rather unfair that "dwellers on the ground" (*Works and Days* 47, *Theogony* 564) should have to suffer for the quarrels of the Olympians with their predecessor divinities. However, the mythical fault is redressed when

² See *Maschinenmenschen*. Ed. Horst Albert Glaser. Frankfurt am Main, Bern, New York, Paris 1988.

the work of redemption also falls to Prometheus, and this appropriately consists in restoring to man the fire he needed to establish and sustain his earthbound cultural hegemony. Hesiod's *Works and Days* provides not only a convincing myth but also some hints at the deconstruction of that myth when it speaks of the "Lord of lightning and storm" (52f.) in connection with the discovery and domestication of fire. Here, as in other traditions, it is the story of forest-dwellers first mastered by, and then gradually themselves gaining, losing and regaining mastery of the precious but volatile element ignited by the storm.

Hesiod's tale is the oldest written account of these events that we possess. Archaeological evidence dates the control of fire – and with it the birth of human culture – to the period of *homo erectus* some 400,000 years ago. The earliest definitive evidence of human control of fire has been found in South Africa, where burned deposits date from 200,000 to 700,000 BCE – i.e. the Middle Palaeolithic period. The Prometheus cult, which is found only in the Mediterranean, must be younger: the pottery production of which he was the patron is not found in Greece before 1100–800 BCE, though its roots can be traced back 4000 years, or even further, in Mesopotamian cultures, and a pottery vessel found in China has been dated to around 16,000 BCE.

Prometheus was also the god of metalworkers, an art somewhat older than pottery. The Aegean Bronze Age, notably in Cyprus, began around 3000 BCE, but had its origins, historians suggest, around a thousand years earlier in the bronze alloys of the Maykop culture in the North Caucasus – that same Scythian region where the mythical Prometheus was chained to a rock in punishment for his insubordination. Iron smelting and the Iron Age only started in central Europe around 500 BCE, some 200 years after Hesiod, so the smithy of Hephaestus that plays such a central role in the Prometheus myth would have made tools and weapons of bronze. These were only gradually replaced with iron; and the earliest iron tools, like fire itself, were a gift from the heavens, for they were made with the metal found in meteorites.

The Prometheus myth, therefore, is intimately bound up with the development of the *téchne* that enabled the human race, through the exploitation of fire as a source of energy, to control, use and enjoy the fruits of its environment. In his tragedy *Prometheus Bound* (c. 460 BCE) Aeschylus allows the immortal Titan to tell his own story, culminating in the retribution wrought by Zeus when he commanded Hephaestus to nail Prometheus to the rock. There, for many thousands of years, an eagle fed daily on his liver, which was restored to health each night. But that is not the end of the story, for although it might seem that their hero – at the cost of his own suffering – had won them an important battle, mankind had not yet won the age-old war against the gods. As Hesiod tells it, the gift of fire is turned against them in the form of a *kalòn kakón*, the 'beautiful evil' of the fateful Pandora, fashioned by Hephaestus (or was it

after all Prometheus?) out of oven-fired clay. She and her entire sex³ were meant by Zeus on the race of men as a trick. In their headlong search for fulfillment in the arms of women, men would from this moment onward eternally “embrace their woe” (*Works and Days* 57).

Aeschylus says nothing in his tragedy about punishment for humankind, whether male or female; indeed he omits the whole episode of the theft of fire. For him Prometheus is the giver of the arts of culture and technology, and it was for this that he earned the wrath of the Olympians. Verses 442-506 are a catalog of his gifts: men and women, who had lived hitherto “like a swarm of ants immured within the earth” were now “possessed of mind and consciousness”; they who had pulled the plow themselves now had animals to bear the yoke; and Prometheus, too, had given them the “linen-wingéd chariot of the sea”:

Treasures hidden in the womb of earth
helpers in so many of men’s works
iron and ores, gold, silver – who will dare
to claim these for his own invention or
assert their common use before I came? [...]
To put it in a single word – from me,
Prometheus, are all the arts man has.

Aeschylus’ tragedy is the only document of antiquity that concerns itself in detail with how the technology and handicrafts of the time (5th century BCE) came into being. The civilizing cultural process he describes includes the invention of writing and numbers, and it is taken for granted that this needed a far longer time than the Bible’s seven symbolic days. Unlike the Bible, too, Aeschylus ignores the creation of the human race, and Hesiod is only interested in the origins of the ur-woman Pandora, who was, he asserts, made at the forge of Hephaestus; but, as already noted, it seems not unlikely that her true (mythological) maker was Prometheus, the earlier god of metalworkers. Hesiod’s reasons for denying Prometheus the honor belong to the logic of his narrative: he could scarcely ascribe to the hero of the race the creation of its most intimate tormentor and femme fatale. There was, moreover, the inconvenient detail that Prometheus was already pinned to the cliff-face by the time Pandora came upon the scene.

Where the male portion of the race originated remains unclear. The *Theogony* (535f.) remarks cryptically that the gods had already “separated from the mortal race” at some earlier date in Mekone (the place of Zeus’ famous cheating of the spoils), which suggests a common life and origin before that time. But nothing further is said, and the matter remains in the dark. Only on the

³ See the chapter on ‘Artificial Women’ below.

subject of the gods is Hesiod more revealing, relating the rank and order of their families and those of the Titans who preceded – and perhaps, the *Iliad* suggests (xiv, 201), even procreated – them. For the ancients humanity as such was evidently a brute fact whose genealogy required no further explanation. Not for them the Darwinian descent from the apes – a revolution in thought that had, incidentally, been anticipated by Goethe’s discovery some decades before the voyage of the Beagle that the intermaxillary bone in apes and humans is identical.

Plato’s account in the *Protagoras* (c. 388 BCE) of the origins of the race approximates that of the Bible:

There was a time when the gods lived, but no race of mortals yet existed. When the appointed time came for their creation, the gods formed them within the Earth – formed them out of earth and fire, mingling with those elements all that is mingled out of earth and fire. (320d – Stephanus)

The choice of elements here is surprising: Hesiod’s Pandora was made of earth and water. The substitution of fire for water suggests that it was Prometheus, the pre-Olympian divinity of forge and furnace, who lurks in this account as a demiurge behind Zeus, the supreme creator. He and his brother Epimetheus were tasked to equip mankind with the skills and powers that would distinguish them from the animals; for in this respect the gods had left man incomplete. But what powers and skills were suitable for a horde of “naked, unshod, unclad, unarmed” (321c) women and men? The brothers were at a loss to know, and to the gods on Mt. Olympus it was a matter of sublime indifference. It was at this point that Prometheus, ever the crafty operator, stole the fire from Hephaestus’ smithy, along with the latter’s *téchne*, his wisdom and skill: “And after he had thus stolen Hephaestus’ fiery art [...] he bestowed it on men, who from that point on enjoyed the comforts of life” (321e). If we see Hephaestus as Prometheus in other garb, we must conclude that Prometheus stole from himself – that he alone was the source and provider not only of the art of pottery but of all the other métiers that depended on fire, above all those concerned with the smelting and working of metal.

According to Plato there was, however, one art Prometheus did not grant humankind, that of political wisdom (*politikè sophia*). And without it the race, for all its skills and talents, would fail to attain happiness. “Houses, clothes, shoes, bed-coverings and food” – all this they could now produce; they had learnt to assemble in cities for protection against the “beasts of the wild”; but once there, they inevitably began to quarrel, insulting and arguing with each other until the danger of reverting to their former state (or worse) was very real. So Zeus sent Hermes, his messenger, to save them, revealing to them the arts of political wisdom without which “there could be no state”. Plato, however, was

realist enough to concede that the latent aggression of the race would impose on the virtuous a never-ending task of regulation and negotiation if the state and civil life were to survive.

Plato had drawn the creation of humanity by Zeus and its equipment with *téchne* and intelligence by Prometheus into close proximity, as if the latter process were merely the logical extension of the former. It was left, however, to the following century and the philosopher and astronomer Heraclides Ponticus, a pupil and follower of Plato, to take the step of uniting the two acts and attributing to Prometheus the entire work of creation without appealing to any superior divine principle of authorship. How exactly the work proceeded is left unsaid, but the story is taken up by Philemon and Menander in the New Attic Comedy of the 4th-3rd centuries BCE, in which man was made by Prometheus from clay. In contrast with Genesis (as with Plato) there was in these comedies no longer a properly divine creative principle at work at all. As a Titan, Prometheus possessed skills superior to those of any mortal potter, but he was definitively on man's side.

In the course of the following centuries the balance of power was to shift still more in favor of humanity. For Ovid (first century BCE) man was "formed in the image of the gods who control all things" (*Metamorphoses* I, 83); moreover, the clay Prometheus used to cast that image must have contained ethereal particles, because Earth and Heaven had been separated only in latter times. Humanity, therefore, bore within it a spark of divinity – an early glimmer of the concept of *secundus deus*, of man as godlike in form, his body inseminated with quasi-divine particles, upright of gait and with a "countenance turned toward the heavenly stars". What more was needed for a truly anthropomorphic god who would see it as his task to give the Earth "new form", liberating it through human culture from its "raw and unmolded" condition?

Aesop's *Fables* (c. 600 BCE) take the secularization of the myth still further. Here Prometheus is again the potter who shapes the human race, but his supply of clay runs out: he has used too much on the beasts and is obliged (an early economic cutback) to form men from some of these. The result is a sorry compromise in which the human form is inhabited by "the soul of an animal" (383). The *secundus deus* of later philosophy was left with base instincts but a countenance still turned heavenward – the same creature, in fact, we know with all its shortcomings today.

To return briefly to Ovid – he too had his version of the Pandora myth. This time, however, it is neither the god of potters nor of smiths but a Cypriot sculptor who creates the archetypal woman, carving her out of ivory. And the motive of the tale has also changed – from divine revenge to human dissatisfaction. Ovid's Pygmalion appears in Book X of the *Metamorphoses* in place of Hephaestus/Prometheus; his artificial woman was to be the perfect exemplar of

her sex, in contradistinction to the real and spoilt women he had found on Cyprus. In its Latin guise the moral tenor of the Greek legend has become noticeably aesthetic – a transformation that will be seen to run back and forth through the many variants of the Prometheus-Pygmalion story that appear through the succeeding centuries.

Like the biblical myth of Genesis, the Greek myth of human creation expresses in a few paragraphs a process which in historical terms took more than 250,000 years. Comparing the two accounts one is struck by the stronger focus in Hesiod, and even more so in Aeschylus, on the cultural development of the race. Both Hebrew accounts, that of the Priestly Code (Gen. 1, 26-2, 3) and the Yahwist story (Gen. 2, 4-3, 24), are silent on this score, their focus being respectively on man's position at the summit of the cosmic order and his fall and expulsion from Paradise. The most recent finds in Ethiopia – documented in the *National Geographic Magazine* (July 2010) articles "Evolutionary Road" and "Birth of Bipedalism"⁴ – indicate that *homo erectus* has a history of more than four million years. *Ardipithecus ramidus* had a small brain and was scarcely more than a meter tall, but her body structure (the bones were female) already diverged significantly from that of the apes. This was millions of years before the age of metalworking or pottery; indeed, the control of fire itself is probably only a few thousand years old. Recent help in dating that key cultural achievement has been provided by the so-called Tyrolese Iceman (nicknamed Ötzi) found in 1991 in the Italian Alps. Preserved in glacial ice, his remains have been reliably dated back some 5300 years. That he carried copper weapons and material for fire-lighting, and was clad in a variety of garments, establishes a new terminus a quo for the fire-based history mythologized in ancient Greece and Rome.

If Prometheus already transmutes in Ovid's hands into the artist-king Pygmalion, one would expect the advent of Christianity to either absorb or abolish him altogether. In fact Christianity initially took both routes: the 4th century Fathers of the Church Lactantius and Fulgentius adopted Prometheus as an allegorical type of Christ, whilst at the same time fulminating against the pagan myth as a pastiche of the biblical account of creation. But it was only a thousand years later, as the Middle Ages passed into the early Renaissance, that the Prometheus myth, along with the entire cultural heritage of Greece and Rome, regained respectability, and the mythical Titan could be drawn into ever closer proximity to the Christian Creator. In the 14th century Boccaccio goes so far as to give them the same name: in his *Genealogia deorum gentilium* (1350-1367) he calls the Greek artisan-god the "second Prometheus" to the biblical Godhead's "first Prometheus": a logical progression from Plato's ordering of the

⁴ *National Geographic Magazine* 218, 1 (2010).

two divinities involved in the act of creation, and at the same time a further significant step in their anthropomorphic assimilation. For the creator of natural man (Prometheus I) was now, in name at least, one being with the creator of intellectual and cultural man (Prometheus II) – one being with two aspects, just as man himself possessed two faculties, the material and the spiritual. But if the maker was so reflected in his artifact, it was a small step to elevate the human artifact to the role of maker, and in a neat logical inversion Boccaccio's "homo duplex" quietly assumed to himself the role of both Prometheuses. This sublime usurpation was made all the easier by the fact that, as Boccaccio makes unmistakably clear, the intellectual faculties were paramount. It is they that enabled the race to establish a cultural order analogous (and in a sense superior) to the order of nature within which it was itself constituted. Following Aeschylus, however, the intellectual-cultural order was for the early Renaissance the work of Prometheus II, and thus ascribed to man himself.⁵ But if Prometheus II was an aspect of man, the reduction applied a fortiori to the lowlier work of Prometheus I.

Man, for the 15th century Ficino (*Theologia platonica*, 1482), was a "Deus in terris", a God on Earth, using his creativity to exploit the forces and resources of nature, and in that sense vying with nature and its traditional Creator in productivity. That this interpretation of Plato's *Protagoras* goes further than its author intended would not have disturbed a writer of the Italian Renaissance: Ficino considered himself called to draw the Platonic doctrine "out of the darkness of past centuries into the light". And the light in question was that of the Platonic Academy of Florence, where the classical myth was destined to shine forth in all its truth, demonstrating to an enlightened age that the arts of men were as creative as those of nature, and that humanity, far from being the slave of the material universe, was now to an ever increasing extent its master.

The new pathos of the Renaissance entailed the dissolution of the myth: the world was not the work of gods, but of men as earthly gods. As the Renaissance gathered scope and momentum, the divine creation degenerated to little more than a storehouse of materials for the experiments of the cognoscenti and the enjoyment of whoever managed to gain and retain power over them. It was Francis Bacon who around 1600 gave the signal for the untrammelled empirical investigation of nature, on the premise that nature's purpose could only be to alleviate the ardors of human existence. As philosopher, scientist, and Lord Chancellor of England he did much to promote and realize his own thesis, specifically rebutting the argument that the divine order of creation might

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See A. Buck: "Über einige Deutungen des Prometheus-Mythos in der Literatur der Renaissance". In: *Romanica*, Halle 1958, 86-96.

prohibit, or at least restrict, such researches. Empirical science was the sole appropriate tool for understanding the nature and laws of creation, and if those laws could then be applied to the good of humanity, this could only be seen as furthering the divine salvific plan. By laboring on and in creation man developed it and established his own mastery in accordance with God's law. That this mastery might itself become a problem, that the development of nature might lead to its exhaustion and destruction, lay beyond the mental horizon of the English (or any other) Renaissance. Bacon's warnings, inasmuch as he gave any, were aimed in a different direction: at the "forbidden arts" that created "instruments of lust and death", specifically the "powerful poison, arms and similar military equipment" encompassed by contemporary industrial production, whose power might "exceed the ferocity of Minotaur" (*Sapientia Veterum: Myth of Daedalus*, 1609).⁶ Scientists were warned not to "impose their will upon nature" or otherwise abuse it; this would only result in "monstrosities and unfit works". Bacon's prescience in this respect was especially apt as regards what he called "chemical products". Four centuries later we would probably extend his list to nuclear and genetic engineering, and indeed to many fields of natural exploitation. But perhaps Bacon was prescient here, too, when he counseled his contemporaries not "to battle with nature" but rather to "search her embrace with devotion and adoration" (*Sapientia Veterum: Myth of Erichthonius*).

But the advocate of empirical science was realist enough to admit that nature does not readily give up her secrets. Bacon, who read myths much as we do, saw in the Prometheus legend a parable of the inventive spirit of man whose cultural development depended on breaking the blind dictates of nature. Only by an act of rebellion could primitive humanity free itself from the oppression of natural forces and harness these, as Prometheus harnessed fire – "helper of all helpers and [...] power of all powers" (*Sapientia Veterum: Myth of Prometheus*) – to its own purposes. In *The Advancement of Learning* (1605) Bacon conceded that nature would not be persuaded by embraces alone to subject her powers to human purposes:

Like as a man's disposition is never well known till he be crossed, nor Proteus ever changed shapes till he was straitened and held fast; so the passages and variations of nature cannot appear so fully in the liberty of nature, as in the trials and vexations of art. (178)

Without "vexation" there can be no knowledge and certainly no subjection of nature. Bacon cites the "inhumanity of anatomia vivorum" (human vivisection)

⁶ Francis Bacon: *The Major Works*. Ed. with an introduction and notes by B. Vickers. Oxford 1996.

as an example, but grants in the same breath that the “great use” of vivisection for knowledge of anatomy and physiology can, despite the “dissimilitude of their parts”, also be had by the “dissection of beasts alive” (*Advancement of Learning*, 212). It was left to the school of Descartes some years later to establish theoretical credentials for this position. The puzzling thesis that animal vivisection and organ transplantation were morally unobjectionable was based on the assertion that animals have no soul: they are little more than a “bête machine”, so the question of their suffering does not arise. A creature that cannot think cannot grasp what is being done to it. Mere sense perception, for Descartes, was reducible to the physiological reactions of nerves and muscles, which were analogous to the reactions of a machine. And does one ask what a machine feels when one of its parts is broken?⁷ The cries of the tormented laboratory animals in H. G. Wells’ *Island of Doctor Moreau* (1896) suggest the sea-change in attitude brought about by empirical science and global exploration in the two-and-a-half centuries that separated the Victorians from Descartes and Bacon.

This is not to say that Bacon himself would have condoned the type of experiments conducted on Dr. Moreau’s island; research of that sort would, in his opinion, have lacked adequate purpose. It might produce isolated results of questionable interest, but Wells’ mad scientist was inevitably brought down by his bizarre attempt to create a human being through surgical transplantation of animal organs. True science and technological development cannot be subjected in this way to the whim of the individual researcher. Bacon was a great believer in method and system; his *Advancement of Learning* sought to survey and classify the entire knowledge of the age, and such a unified body of learning could only be based on consistent social organization. “Contemplation and action”, he wrote, “may be more nearly and straitly conjoined and united together than they have been”. Only in this way would “natural philosophy [i.e. empirical science] be operative to the endowment and benefit of man’s life” (*Advancement of Learning*, 178). To achieve this end Bacon urged his contemporaries – whether scientists or officers of state remains unclear – to compile a so-called Calendar, an “inventory of the estate of man” recording all the inventions made throughout history and listing those that still remained to be made, including what seemed impossible at the time, so that science might be set clear tasks. These should not be principally concerned with things of “immediate and present use”, but with those that would have “most universal consequences” (202). For science was not a “shop for profit and sale”; the sole aim that would “indeed dignify” its pursuit was “the relief of man’s estate” (148).

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See Leonora Cohen Rosenfield: *From Beast-Machine to Man-Machine. Animal Soul in French Letters from Descartes to La Mettrie*. New York 1968.

The implementation of such a program is sketched out in Bacon's utopian *New Atlantis* (1627), which describes a college of natural philosophy set on an imaginary island in the Pacific and dedicated to the systematic collective study of the "works and creatures of God". In deference to the Bible Bacon calls his institute "Solomon's House" or the "College of the Six Days Work". The scholars who inhabit it form a scientific aristocracy that is well aware of its importance for the island's inhabitants, as well as for its occasional visitors. Thus it is said of the scientist deputed to meet the visitors – a singularly haughty person – that "he had an aspect as if he pitied men" (*New Atlantis*, 478). The impression of a privileged community is confirmed when the scientist appears on the scene like a worldly prince with an entourage.

The scientists work on the entire range of subjects regarded by Bacon and his time as relevant. The Utopian vision was never completed; it was published after the author's death by William Rawley, Bacon's "chaplain and literary executor", who added at the end of the work the note: "The rest was not perfected", followed by an appendix titled *Magnalia Naturae, Praecipue Quoad Usus Humanos*, which the editor of Bacon's *Major Works*, Brian Vickers, translates as: "The wonderful works of Nature, chiefly such as benefit mankind". The appendix comprises a list of discoveries not yet made but deemed "desirable" – an astonishing compilation of research and technological achievement, much of which had to wait centuries for its realization and some of which only became possible in our own day. Here is Rawley's list:

- The prolongation of life.
- The restitution of youth in some degree.
- The retardation of age.
- The curing of diseases counted incurable.
- The mitigation of pain.
- More easy and less loathsome purgings [evacuations of the bowels].
- The increasing of strength and activity.
- The increasing of the ability to suffer torture or pain.
- The altering of complexions and fatness and leanness.
- The altering of statures.
- The altering of features.
- The increasing and exalting of the intellectual parts.
- Versions [transformations] of bodies into other bodies.
- Making of new species.
- Transplanting of one species into another.
- Instruments of destruction, as of war and poison.
- Exhilaration of the spirits, and putting them in good disposition.
- Force of the imagination, either upon another body, or upon the body itself.
- Acceleration of time in maturations [chemical processes].
- Acceleration of time in clarifications [freeing from impurities].
- Acceleration of putrefaction.

Acceleration of decoction [preparation of a mineral or ore by heat].
Acceleration of germination.
Making rich composts for the earth.
Impressions [pressures] of the air, and raising of tempests.
Great alteration; as in induration, emollition [making soft] etc.
Turning crude and watery substances into oily and unctuous substances.
Drawing of new foods out substances not now in use.
Making new threads for apparel and new stuffs such as paper, glass, etc.
Natural divinations.
Deceptions of the senses.
Artificial minerals and cement (*New Atlantis*, 488f.)

Many of these desiderata have been achieved, for example “The prolongation of life [...] Making of new species [...] Deceptions of the senses” (e.g. in film), to name only three. But many others would still feature on the to-do list of 21st century science.

The catalog does not include the production of an artificial human: in the early 1600s Bacon would not have thought of such a thing, although he comes quite close with his “Transplanting of one species into another”. This work does, however, continue apace both in the Department of Artificial Intelligence at M.I.T. (Cambridge, MA) and in the synthetic cell laboratories of the J. Craig Venter Institute (Rockville, MD). Bacon touches upon a central concern of these and other areas of current research when he expressly entitles his scientific aristocracy to withhold certain results of their labor from the public and the state, namely whatever will constitute a major danger if it is misused. In his *Sylva Sylvarum* he mentions two such discoveries:

a white gunpowder that explodes noiselessly, and a method of rendering the flesh of beasts, fowl, or fish poisonous, by feeding them with certain substances.

Bacon’s misgivings foreshadow those of J. Robert Oppenheimer who, after the development of the American atomic bomb refused to work on the hydrogen bomb project. To Heinar Kipphardt, the German author of the play *In the Matter of J. Robert Oppenheimer* (1964), he justified the dropping of the bombs on Hiroshima and Nagasaki with the need to end the Second World War, and Kipphardt could hardly accuse the leader of the Manhattan Project, himself the descendant of a German Jewish family, of having worked on the perfection of a super-weapon intended to prevent the murder of further millions of his own people. As far as the development of the hydrogen bomb was concerned, however, Oppenheimer argued that a new weapon more than six hundred times as devastating as the atomic bomb was morally questionable because it could no longer be used against purely military targets: its whole purpose was to destroy vast numbers of civilians. What followed was Oppenheimer’s denunciation as a

Soviet spy – it was the time of the Cold War – and dismissal from his academic and administrative positions. He had gone further than Bacon demanded, refusing to participate in projects whose results could in any case no longer be withheld for the simple reason that the immense funding they required – leaving aside their overt political purpose – was only available from the state. Modern large-scale research facilities differ in kind from anything prior centuries could conceive of, and moral responses, Oppenheimer shows, must differ accordingly.

That research involving the collaboration of large numbers of scientists cannot be pursued in secrecy was, less than half a century after Bacon's *New Atlantis*, one of the assumptions behind the founding of the Royal Society of London as a new type of centralized "research and teaching institute". Although explicitly calling on Solomon's House as a model,⁸ this was to be an open association of men of learning, not one of initiates who would decide in secret whether and in what circumstances to pass on their knowledge to their fellows. The group of scholars and followers of Francis Bacon involved in the establishment of the Royal Society in 1662 were confident that it would promote "the Empire of Man over Nature", as Glanville put it in his 1665 dedication of *Scepsis Scientifica* to the Society. Like Bacon himself, these men of the English Renaissance looked to the future and its yet undiscovered secrets to accomplish the "relief and remedy of human needs". As such they were worthy embodiments of Prometheus, whose name in Greek means, albeit at a more general level, "forethought". Thanks to his intelligence and skill man, Bacon had argued, will become the "centre of the universe". For the "creation and ability of man [is the] peculiar work of providence", and without him the universe has "neither purpose nor intent". This providence, Bacon added, was "clearly and obviously" what the ancients meant by the figure of Prometheus himself. To the demythologizing mind of the Renaissance the Greek myth "represents" the potential of the human race to master its environment (*Sapientia Veterum*: Myth of Prometheus). In its various chapters the present book will trace the unfolding of this potential with particular reference to the Promethean art (or artifice) of making man since the Jacobean age.

Science, art and the so-called mechanical arts developed apace in the first hundred years of the Royal Society's life, and by the mid 18th century it seemed appropriate to the learned Society of France to take stock of humanity's cultural and scholarly achievements. In 1751 d'Alembert and Diderot issued the first volume of an *Encyclopédie des sciences, des arts et des métiers* which aspired to nothing less than a complete review of all that the human race had achieved in terms of knowledge, skills and products since its inception. Initially conceived in terms of a half dozen or so books, the enterprise grew to a massive 35 volume

⁸ See Vickers' commentary on *New Atlantis*, 789.

series indicative of the range of current scholarship in both subject matter and the human resources available to address it. Dozens of authors were commissioned by the editors, and the turnover in scholars became itself a feature of the undertaking, which developed into one of the greatest publishing and bookselling ventures of a burgeoning mercantile age.

Inasmuch as the editors aimed not only to inform the interested public about the state of play in science, technology and the arts, but to subject this to critical scrutiny, denouncing blind alleys, renewing, redirecting, and opening up new approaches, the *Encyclopédie* established itself – especially in the areas of national administration and politics, economics, and literature – as the universal intellectual platform of the French Enlightenment. It was virtually inevitable, therefore, that Diderot and a number of his collaborators, including such illustrious names as Voltaire and Rousseau, should fall foul of the ancien régime’s censorship. Some, like d’Alembert, reduced their commitments or left the project; others, like Rousseau and Voltaire fled the country; Diderot himself spent several months incarcerated in Vincennes. Although the royal imprimatur was withdrawn in 1759, largely under pressure from the Catholic Church, which complained about the latent atheism of the *encyclopédistes*, the undertaking continued – partly under the tacit protection of Madame de Pompadour, partly by having the volumes ostensibly printed abroad. In this respect the Encyclopedia was from its very inception a cornerstone not only of cultural development but of political and intellectual emancipation. That this was the intention of its editors is made clear in the *Discours préliminaire* appended by d’Alembert and Diderot to the first volume,⁹ a declaration of policy that has been seen by subsequent centuries as outlining the philosophical program of the French Enlightenment.

Far from having recourse to revealed religion or the concept of divine creation, the authors of this manifesto were intent on surveying the length and breadth of human knowledge, summarizing the general principles and central details of every branch of endeavor from what we would nowadays call the arts, through the social and natural sciences to engineering. The order and context of each subject was to be demonstrated by describing its origins and development in the countries most closely connected with it; and in this way the Encyclopedia was to resemble a “mappemonde” in which one could immediately see the path taken by the sciences, arts, and crafts over the centuries – a path the editors did not think of as a straight line, but one that had suffered setbacks, taken false turnings and for lengthy periods of time disappeared from view altogether (“Discours préliminaire”, XV).

9

M. Diderot et M. D’Alembert (ed.s): “Discours préliminaire”. In: *Encyclopédie, ou dictionnaire raisonné des sciences, des arts et des métiers*. Vol. 1, Paris 1751.