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**Daedalus sive mechanicus: Humankind and machines**

At the roots of the great scientific revolution of the 17<sup>th</sup> century is the union between technology and science that has marked, for the good and the not so, the entire Western civilization. This union, that became marked in the 17<sup>th</sup> and 18<sup>th</sup> centuries and which perpetrated all over the world, was, however, absent in ancient and medieval civilisations. The Greek term *banausia* means mechanical art or manual labour. In Plato's *Gorgia*, Callicle states that a machine manufacturer ought to be despised; insulted, by being called a *banausos*; and that no one would consent to the marriage of their daughter to him. Aristotle had excluded the mechanical workers from the citizens' society and had said that they differed from slaves only due to the fact that they care for many individuals' needs whilst a slave only cares for one. The divide between slaves and free individuals tended to be made manifest by the division between technics and science, the division between practically-orientated knowledge and knowledge dedicated to the contemplation of truth. The disdain with which the slaves were treated was equally transferred to their areas of work. The seven liberal arts of the *trivium* (grammar, rhetoric and dialectic) and of the *quadrivium* (arithmetic, geometry, music and astronomy) are so named liberal due to their belonging to free individuals, and not to the non free individuals, or to the slaves who practised mechanical or manual arts. Knowledge not directed towards a specific end but collected for its own intrinsic value is the only key to discovering the true nature of humankind. The practise of *sophia* requires wealth and the presence of life's fundamentalities. Philosophy needs the mechanical arts upon which it is based, however, they are inferior forms of knowledge that are immersed between the material and the sensible and which are linked to manual and practical labour. The wise and learned individuals' ideal tends to coincide (as it does in Stoic and Epicurean philosophy and later in Tommaso d'Aquino's thoughts) with the image of one who dedicates his life to contemplation while waiting for (like the Christian thinkers) the bliss of contemplating God. The exaltation of active life, which is displayed by many fifteenth century authors; the eulogy of hands, which is present in Giordano Bruno's writings; the appreciation of mechanical arts which appears in many sixteenth century engineers' and machine manufacturers' manuals, gains, in the light of these considerations, an important meaning. Forty four years ago, in my published book *I filosofi e le macchine* (Feltrinelli, 1962), I discussed the birth of a new point of view on technics within European culture in the years between 1400 and the

beginning of the 18<sup>th</sup> century. The book, titled 'Philosophy, Technology and the Arts in the Early Modern Era' was published in the United States in 1970 by Harper Torchbooks. It is worth remembering that the headword 'mecanique' in Richelets's *Dictionnaire Francais* (1680) reads "this term, speaking of particular arts, signifies that which is opposite of liberal and honourable; it has the connotation of baseness and of being little worthy of an honest person". Callicle's theses were still relevant in the 17<sup>th</sup> century. As it is known by the readers Cyrano de Bergerac and Alessandro Manzoni, "vile mechanic" is an insult that, when directed at a gentleman, causes him to draw his sword.

Some important themes of European culture are linked to the discussions on mechanical arts, which reached an extraordinary intensity between the middle of the 16<sup>th</sup> century and the middle of the 18<sup>th</sup> century. New outlooks on work involving technical expertise, on uses of technical knowledge and on the significance of artificial processes which alter and transform nature emerged in artists' and inventors' works and in engineers' and technicians' dealings. A very different outlook on the value of the arts slowly emerged in the philosophical sphere as well: some procedures used by technicians and artisans to modify nature enhanced the knowledge of the natural world, and can be used to demonstrate (as will be said explicitly in opposition to traditional philosophy) that nature is in movement. Both Bacon and Descartes are firmly convinced that the previous inherent distinction between products of nature and products arts is forever fallen.

Art is no longer, as was written in the *Chanson de Roland* "on its knees in front of nature", it is no longer *simian naturae* or a mimic of nature which tries in vain to imitate it.

Only this context is capable of revealing to us the greatness of Galilei. In 1609, he pointed his telescope towards the sky. This deed marks a revolution, it is the Galilean *trust* in an instrument born in the sphere of mechanics, developed only through practice, partially welcomed in the military spheres, but ignored, if not neglected, by official science. The telescope was born in the environment of Dutch craftsmen. Galileo had constructed it and presented it in Venice in August, 1609 in order to make it a gift to the Government of the Lordship. For Galileo, the telescope is not one of the many particular instruments constructed for the enjoyment of the men of the court or for the immediate use of men of arms. He employs it and turns it towards the sky with methodic and scientific attitude, and turns it into a scientific instrument.

Our instinctive and little philosophical attachment to the obvious truths of the present renders the past banal. However, what is obvious for us became thus: often at the cost of great labour. In order

to give faith to what is seen with the telescope requires the belief that this instrument is not used to deform, but to enhance sight. We need to consider the instruments as a source of knowledge, abandon the old, deep-rooted anthropocentric point of view which views the natural observation of the human eyes which considers the natural vision as an absolute criterion of knowledge. Bringing the instruments into science, conceiving them as a source of truth was not an easy feat. *Seeing*, from the point of view of current-day science, means interpreting almost exclusively signs generated by instruments. An incredible number of instruments is interposed between the eyes of the contemporary astronomer using the Hubble telescope and one of those far-off galaxies which inspire astrophysics and spark the fantasies of all human beings. These instruments are, for instance, a satellite, a system of mirrors, a telescopic lens, a photographic system, a scanning device which digitizes images, various computers controlling the camera footage and image scanning and memorizing processes, a device for broadcasting the images as radio waves, a land-based device which re-transforms radio pulses into computer language, the software which reconstructs the images, providing them with the necessary colours, the video, a colour printer and so on (Pickering, 1992). At the origins of what we see today in the skies remains this initial, solitary act of intellectual courage made by Galilei.

The defence of the mechanical arts from the accusation of unworthiness, the refusal to match the boundaries of culture with the boundaries of liberal arts and the refusal to match the practical tasks with servile labour, implied the abandoning of a thousand-year old image of science, implied the end of an essential distinction between knowing and doing.

## **2. The equality of human wits**

In the time of the wars of religion, men and women who belonged to the first communities of people defining themselves as “natural philosophers” built within the larger, bloody society in which they live, of the smaller and more tolerant societies. Those people come together in the first academies aimed at building places of knowledge which can develop. One of the most popular books of Francis Bacon entitled “Advancement of Learning”, but those places no longer coincide with the convents and the universities. He who plans an Academy or associates himself therein, aims to protect himself above all from two things: politics and the intrusiveness of the theologies. The members of the Lincei Academy “have, by constitution of the Academy, outlawed from their studies, all controversies with the exception of issues on nature and mathematics, and distance themselves from political issues.” To all members of the society – according to a text issued by the

Royal Society – “is requested to speak discreetly, openly, naturally, with clear meanings, favouring the language of craftsmen and merchants instead of that of philosophers”.

The Academies and Scientific Societies strongly advocate certain approaches: the existence of forums with scholars, the existence of particular rules of conduct for these forums, the adoption of a critical attitude towards the declarations of anybody as a main rule of conduct. Anyone can contest any topic and has, in order to do this, freedom of speech. There are no sacred people, nor are there any sacred books. The truth is not tied to the authoritativeness of the person who utters it, but only to the evidence of the experiments and the force of the demonstrations.

I believe that the historians of the idea of tolerance should deign some sort of consideration also to the world, totally unknown to them, of the history of science. In this history, long before the appearance of the writings of John Locke, it was indeed theorised that everyone who can be qualified as a member of the scientific community has the right to speak, that it is legitimate to discuss everything, and that the inevitable variety of opinions is a right to defend and not an evil to extirpate. In the History of the Royal Society by Thomas Sprat, we find the following: «As for what belongs to the *Members* themselves, that are to constitute the *Society*: It should be noted, that they have freely admitted Men of different Religions, Countries, and Professions of Life [...]. For they openly profess, not to lay the Foundation of an English, Scotch, Irish, Popish or Protestant Philosophy; but a Philosophy of Mankind (...) They have try'd, to put it into a condition of perpetual increasing; by settling an inviolable correspondence between the hand, and the brain. They have studi'd, to make it, not only an Enterprise of one season, or of some lucky opportunity; but a business of time; a steady, a lasting, a popular, an interrupted Work. They have attempted, to free it from the Artifice, and Humours, and Passions of Sects; to render it an Instrument, whereby Mankind may obtain a Dominion over *Things*, and not only over each other's Judgements» (Sprat, 1662, pp. 62-63)

Looking back, contextualizing their time and thinking of the slow, relentless work of butchery which in Europe were the wars of religion, these words take on a miraculous sound.

Even the distinction of principle between the simple and the scholars comes, on this basis, into discussion. The truths that are called common notions (*notiones communes*) Descartes wrote in his *Principia Philosophiae*, are the ones that many people are capable of perceiving clearly and distinctly. Nevertheless, to some people, these truths are not sufficiently self-evident. It was not because “one man's faculty of knowledge extends more widely than another's” Inability to perceive truth was caused by prejudices acquired in childhood that were extremely difficult to shake off. I

hardly need recall the famous beginning of the *Discourse sur la méthode*, which affirms that “common sense is the best distributed thing in the world”. The power of judging well and the faculty of distinguishing truth from falsehood “is by nature equal in all men”. Reason or good sense which distinguishes us from animals, “is complete in each one of us”. The diversity of our opinions did not arise “because some of us are more reasonable than others” but “because we direct our thoughts along different paths and do not attend to the same things”.

Francis Bacon was pushed so much ahead to speak of the equality of human wits. Hobbes writes that “philosophy, the child of the world and your own mind, is within yourself”. The method he had constructed could be used by all: “If it like you, you may use the same. That knowledge which he undertook to consider the comparison of the greatness, the numbers, the times, the movements and their reciprocal relations – Hobbes has affirmed – is what renders us really different from the present-day American natives and what has made us different from what we Europeans were a long time ago. This knowledge is founded on a process which moves “from simple and modest principles, evident also in the poorest capacity”, and then proceeds slowly with an “extremely scrupulous” reasoning. The method of science – Leibniz will say – is more important than the ingeniousness of the individuals given that the end of philosophy is not one of improvement of one’s own intellect, but one of all men. Marine Mersenne, the tireless “secretary of cultivated Europe”, put the radical anti-magic and anti-occult idea of equality of intelligence into a striking maxime: «One man can do nothing that another man cannot also do, and each man contains within himself all that is needed to philosophize and reason on all things».

On the theme of the connections between the origins of tolerance and the origins of modern science, there exists a particularly poor bibliography. This does not depend solely on the provincialism of the community of historians. It depends above all on the fact that, until half a century ago, the gravity which this had all over Europe was greatly underestimated, after the mid-1400s and up until Newton, the so-called hermetic tradition.

Magical techniques are, together, a way to operate on the world and a process of religious regeneration. Magic is also salvation. The domination of nature presupposes the achievement of individual perfection, and the process which permits the achievement of perfection coincides with that which leads to the domination of nature (Eliade 1956: 170). Not all men can achieve perfection. Consequently, not all men can know the world and can operate on it. The ascetic discipline,

withdrawal from the world, the capacity to raise oneself to a level unattainable by other men, are some of the elements which constitute a magical type of knowledge.

This train of thought gives rise to several closely bound themes which reappear in innumerable texts, which are taken up and repeated by several authors, which taken form of constants. These are: 1) the secret and reserved character of knowledge whose revelation would have ill-omened consequences; 2) the extreme difficulty and complication of procedures and rituals which permit the approach to the truth; 3) the distinction between the narrow group of sages or “wise men” and the *promiscuum hominum genus* or the mass of the profane; 4) the extraordinary character of the personality of the magician who can accomplish impressive feats and who has reached a level of knowledge which sets him apart.

There is a passage of the Gospel of Matthew (7, 6) in which Jesus affirms:

*Nolite dare sanctum canibus neque mittatis margaritas vestras ante porcos ne forte conculcent eas pedibus suis et conversi dirumpant vos* (Do not give what is sacred to dogs, and do not throw your pearls in front of pigs since they will not walk on them with their trotters, and in turning around they will not attack you). What is precious is not for everyone, the truth is kept secret, its divulgence is dangerous: in this way, the passage of the Gospel was read for many centuries and by many authors.

Even though historians of political thought have not always realized it, the thesis on equality of intelligence in the face of scientific truth had strong political implications. The distinction between masters and servants is, according to Hobbes, completely artificial and does not derive from a difference in intelligence. Many philosophers have transformed a factual difference into an ontological one: «The inequality that now is, has been introduced by the civil laws. I know that Aristotle... maketh men by nature, some more worthy to command, meaning the wiser sort, such as he thought he himself was for his philosophy; others to serve, meaning those that had strong bodies, but were not philosophers as he; as if master and servant were not introduced by consent of men, but by difference of wit: which is not only against reason; but also against experience» All human beings, Samuel Pufendorf said, have within them a principle for self-government, and all men are intelligent beings in their susceptibility to obligations: «I cannot be persuaded that the mere face of natural excellence is sufficient to give one being the right to impose any obligations on other beings, who have, just as he does, an internal principle for governing themselves».

The notion of equality of men before the truth implied a renunciation of the image of a clear separation between philosophers and vulgar people, like beasts, for whom tales of miracles, angels and devils were appropriate. Such people required fables, as Pietro Pomponazzi, wrote, “to induce

them to good and preserve from evil, as one does with children with the hope of rewards and the fear of punishment”.

After the age of Bacon and Descartes, Hobbes, Mersenne and Galileo, all forms of knowledge that theorized secrecy in the name of inaccessibility, that envisaged “superhuman difficulties” on the path to knowledge, or that stated that only initiates could know the truth and only the few could reach the *episteme*, became irrevocably and structurally connected with the political notion that the laymen were unable to govern themselves unaided and, like children, needed fables that kept them from the truths.

### **3. Antiscience**

The complex series of behaviours, ideas, emotions which sociologists call “hostility towards science” or also “scepticism towards science” and that the philosophers designate with the most ennobling term of “criticism of science”, has accompanied right from the origins the growth of modern science and the processes of modernization. It is a sort of counterpoint which at times lies in the background and which emerges, in other periods, with particular intensity. Within this age-old story, doubts, suspicions, distrust and fears are intertwined, at times inextricably, to refined analyses and of great theoretical view. The range of behaviours is immense: sharp condemnations, proclamations of the superiority of philosophy over every other form of knowledge possible, declarations of the failure of science and of its bankruptcy, theorizations of the inferiority of science in relation to literary and humanistic culture, claims of the subjectivity as a place of salvation, gloomy prophecies on the end of civilisation and on the inevitable holocaust provoked by science, tirades against the industrial and urban civilisation, global refusals of modernity, regrets over the Medieval Age as a “community” and “well-rounded period”, exaltations of the agricultural and pastoral civilisation, primitive reminiscences with relative re-proposals of the theme of “good barbarian”, exaltations of the magic world and the alchemistic and occult knowledge as being superior to intellectual knowledge, eulogies of the folly as an entrance to another world, superior to the one of the abstractions of intellect.

Within a variegated and complicated story, we can find the great philosophers (Rousseau, Nietzsche, Heidegger), minor philosophers (Gentile, Horkheimer, Marcuse, Foucault etc.), numerous schools and trains of thought (romantic, spiritualist, existential, exponents of the School of Frankfurt etc.), as well as the many divulggers and propagandists and journalists who have spread and circulated the ideas in a public which is much wider than that of the philosophers and literary men. In many cases, this intertwining or accumulation of ideas has solidly connected itself with a declared and open hostility towards science, and it has spread (with varying intensity into the

different countries) between the political parties and unions, and has penetrated into the large mass-movements, as in the case of the movement of 1968, or, in China within the cultural revolution, or in the one which inspired the motives of the ecologists, the Greens and the No-Globals.

Within a society, how much space do they all have, the supporters of anomalous science, the magicians, the astrologers, the scoundrels, the peddlers of hopes and illusions. This depends, in layman's terms, on what the politicians and the public ministers think science is and what it must be, but it also depends, in the final analysis, on what the people think science is and must be. The ethic of science is characterised by a systematic scepticism: it trusts no one, if not on the basis of demonstrable theories and repeatable and verifiable experiments.

This scepticism (which is strongly linked to the capacity for self-irony) and the community participation (which requires common rules as well as an availability to listen and compare) are what has enabled and what enables science (at times with great difficulty and also with much squandering of public money) to ease the enormous quantity of pseudo-theories or delirious theories which have always accompanied its growth.

Beyond the illusions of followers of Enlightenment positivists, historical materialists and dialectics, the magic world continues to live and proliferate, even in the age of the "explained reason" and the progresses of science and technique. On the Internet, occult sects are omnipresent. In our world, astrological beliefs are still very widespread, and we have around us every day hundreds of people who not only read their daily horoscope, but consult books on dreams and make their choices on the basis of these consultations, still attributing cognitive powers to the dream. Looking into this in greater detail, the affirmation that the golden age of magic is neither the Medieval period nor the Renaissance period is not at all paradoxical. Indeed, it is true that there are more scientists living today in the world than there ever were from the time of Euclides to the present day, but it is likewise true that the belief in reincarnation has never been as widespread in the West as it has in the last twenty years (ranging from 25% in Italy to 31% in Canada), just as it is true that laboratory alchemy is practised today by a much greater number of people than in the Medieval Period. Throughout history, there have never been so many magic societies and movements as there are in the contemporary world. And it should finally be noted that magic is not at all restricted, as once happened, to the world of peasants or to the poor and miserable outskirts of the great metropolises. The so-called "new magicians" and their corresponding new clients do not live at all on the edges of the technological society.

At the beginning of May 1991, at the MIT, the first of a series of conferences organized jointly by the Russians and the Americans was dedicated to tackling the anti-scientific tendencies in the united States and the Soviet Union. The following year, in the first issue of "Public



Understanding of Science” Gerald Holton, physicist and historian of physics, professor of Harvard, published a 35-page paper entitled *How to think about the Anti-science Phenomenon*. One of Holton’s affirmations seems particularly worthy of being highlighted: the so-called alternative sciences can be considered quite harmless and seen as one of many ways of distributing opium to the masses. However, when they are incorporated into political movements (as, in Holton’s opinion, is happening in the USA with the fundamentalist creationism), they can become something similar to a time-bomb ready to explode.

#### **4. Daedalus and the Labyrinth**

Since I have become old, the world seems to me to be increasingly populated by characters who say old and well-known things with the air of saying new and completely unusual things. For which, fully aware of running the risk of repeating myself, I cannot resist the temptation to close this story with a myth which I have made public of many times in the course of my life. It is precisely here where many philosophers have seen a naïve and full-blooded trust in the ideology of the dominion, the issue of essential ambiguity of technology seems to be highlighted with extraordinary strength. Daedalus, who in Francis Bacon’s *De sapientia veterum* is the symbol of technique, is a clever but detestable man, best known for illicit inventions such as the machine that allowed Parsiphae to mate with a bull and give birth to a minotaur who devoured youth, and the Labyrinth he designed in which to hide the Minotaur and “protect evil with evil”. The Labyrinth is an amazing feat from the technical point of view, however aimed at an evil purpose. It has in fact the purpose of hiding and protecting. In order not to be remembered solely for his dark arts, Daedalus was however also the inventor of the resource of the thread, capable of showing the way out to whoever found themselves lost in the nooks and crannies of the Labyrinth.

Mechanical inventions are, in the eyes of Bacon, like Daedalus: they can improve the quality of human life whilst at the same time being “instruments of vice and death”. Poisons and machines of war exceed the cruelty of even the Minotaur. At the same time and in the same person, Daedalus provides men with the roads to perdition and to salvation: the same person built the Labyrinth and designed the thread used by Arianna to escape from the Labyrinth. Mechanical arts are indeed of ambiguous purpose and simultaneously produce evil and its remedy.

Four hundred years have elapsed since these thoughts were conceived. We have achieved many amazing things. We are building the Labyrinth and at the same time we are trying to design Arianna’s Thread which will not come free-of-charge. It can only be the result of a more refined technology. We can trust solely in Daedalus, which means that on this issue we are no further forward.