Taking Eyeglasses Seriously

Tomás Maldonado

Contribution to the Lecture Cycle "Sapere e narrare. L'uomo e le macchine," "Centro Fiorentino di Storia e Filosofia della Scienza", Florence, 19-11-99.

There is a rather widespread notion, these days, that technology is an exogenous factor, something that impacts "the world in which we live" from the outside. It is a factor that reaches us from some distant place, surreptitiously worming its way into our society; something extraneous to us, but also (and especially) something higher, located above us.

After all, it is only natural that this emphasis on the autonomy of technology should contribute, in practice, to make it seem extraneous, and then to its sacralization. The groundwork is laid for *technological determinism*, or the belief that technology is the cause of all changes, both real or imagined, taking place in society.

In all this, a rather obvious fact is overlooked: technology is not some untamed force running wild beyond the boundaries and control of society. It is a part of society, forcefully conditioned by social, economic, and cultural dynamics. In short: what changes the world, for better or worse, is not technology, but society.

And when technology, as in the case of the environment, for example, "causes problems," in the long run, the problems are not problems of technology, but of society.

"Everything is technique," historian Fernand Braudel has stated, presumably alluding to the fact that, in any human act, there is always, to a greater or lesser extent, a moment of artifice, of prosthesis or of recourse to an instrument or device charged with the task of augmenting the operative and communicative potential of our action.

I believe that Braudel's statement is correct, from this point of view, or at least partially correct. A more accurate phrasing might "Everything is technique, because everything is society." Or, vice versa, "Everything is society, because everything is technique."

At this point, another question implicitly appears. In this total identification of technique and society, of technical action and social action, might not there be concealed a slightly subtler version of technological determinism?

In my opinion, this fear is not justified. To acknowledge the fact that, on the one hand, technology is omnipresent because society is omnipresent as well, and on the other, that society is omnipresent due to the omnipresence of technology, does not constitute an admission of the existence of an autonomy of technology. Nor can it justify any claim that technology is an indispensable

part of the governing of the world. Just the opposite. What is repudiated here is precisely the notion of the autonomy of technology, and therefore of its implicit technological determinism.

Of course, we must also reject, in the same manner, the idea of a total autonomy of society with respect to technology. And there is nothing very daring about such a rejection. After all, it is evident that the idea of such autonomy clashes blatantly with the real facts. Who could possibly doubt today, without seeming ridiculous, that technical developments are capable of strongly influencing our styles of living, our relationships with others, and our values and beliefs? Is anyone reckless enough to claim that technology is a marginal factor in our society?

The point is not so much to accept (or to deny) the importance of technology—it must be taken for granted—as to decide whether technology should be assigned a *causal* role with respect to the changes that take place in society.

Many historians and philosophers of science and technology, especially those oriented toward sociological constructivism, deny such a possibility. In their view, the cause, the main thrust behind changes in society, must be sought in society itself, not in technology. This position usually is summed up with the following slogan: society is the *cause*, and technology is the *agent* of change.

But it should be said that the tone of this assertion (although, in general, I would agree with it) deserves a bit of reflection or added explication. We should not overlook the fact that the notions of "cause" and "agent" have a long tradition in philosophical thought. Just consider Aristotle's doctrine of the "four causes," and the complex conceptual constructions of the medieval scholastics on the cause-effect relationship, not to mention the sophisticated logical-epistemological excogitations of modern philosophy of science on this argument.

Though I do not intend to dwell on the purely philosophical implications of technological determinism, it is evident that any discussion of this theme will be difficult (or even impossible) without taking them into account. This also is true when the notions of cause and effect are not utilized in an explicit manner, or when they are replaced, where necessary, by more or less ingenious metaphorical terms.

Let's take a look, for example, at the formula favored by the supporters of technological determinism, according to which technology "pushes" and society "pulls." Their opponents, naturally, believe that society does the pushing and technology does the pulling.

At this point, a doubt arises: are we really sure that these two versions are not both the result of the same error, namely that of believing that between cause and effect the relationship always must be linear, unidirectional, and irreversible? Hasn't the philosophical tradition regarding causality mentioned earlier often

invited us to reflect on the problem—a problem as yet unresolved—of *circular causality*, of *causal chains*?

In the theme we are discussing here, the question of circularity cannot be overlooked. If it is true, to go on with the same metaphor that, in a certain phase, it is technology that "pushes" and society that "pulls," it is equally true, that in an earlier phase, society was "pushing" while technology was "pulling."

On other occasions, I have defended the primary role of society in the dynamic of social changes. I am firmly convinced of the validity of this view. Nevertheless, the relationship between society and technology does not lend itself to description, as often attempted by the exponents of constructivism, as a process in which there is a point of departure—society—and a point of arrival—technology, i.e., a process in which technology is the point of destination or culmination, and, therefore, of definitive fulfillment. In the path from society to technology, there is never an *end of the road*, and never a *terminal* point, or a last stop. What "pulls" today may "push" tomorrow, and vice versa. Recently, there have been a number of attempts to document, with concrete examples, the way society, all told, with its complex range of economic, social, and cultural needs, stimulates, conditions, and guides technological innovation in every era. In short, a way to show how society "pushes," forcing technology to "pull."

With few exceptions, the cases studied belong to the sphere of technological macrosystems, as in the well-known works of T. P. Hughes on the electrification of the United States, or of F. Canon on the French railways. In the same perspective, William Pool, in his recent book with the significant title *Beyond Engineering. How Society Shapes Technology*, has selected, among many other examples, that of the development of nuclear technologies.

Naturally, technological macrosystems are simultaneously *excellent* and *very poor* examples for the support of the thesis in question.

I say they are *excellent* because their connection with society is so evident that it would be hard to infer that society, so to speak, has nothing to do with technological macrosystems, or that it plays a subordinate role to them. To look closely at the situation, it is evident that technical macrosystems are veritable macrosystems of social management (and control).

On the other hand, they are very poor examples, precisely because their probative obviousness prevents less evident, but no less important, aspects of the society-technology relationship from emerging in the overall assessment.

In order to explore the possibility of a different, less simplistic way of examining this relationship, I would like to examine the case of the birth and development of a technical object that, in spite of (or because of) its small size and lack of complexity, can be useful

to grasp those aspects which, in the case of the macrosystems, usually are overlooked.

The technical object in question is the eyeglass, or *eyeglasses*, an object that quietly, without fanfare, for over seven hundred years now, enables a large majority of the human race—afflicted by myopia, presbyopia, hyperopia, or astigmatism—to facilitate sensory-perceptive access to reality.

Of course, a "serious look" at eyeglasses might not seem like a very stimulating choice for scholars who prefer to grapple exclusively with much more complex objects. But the fact that eyeglasses apparently are banal objects (or have become banal for us) is not a good reason to imagine that they are without historical relevance, or worse, to refuse to recognize their usefulness in today's theoretical reflections on technology.

Historian Lyn White writes on this subject: "Surely no one in the bespectacled academic world could be so impolite as deny the fact that the invention of eyeglasses contributed to a general improvement in the level of education, and to favor the almost feverish activity of thought that characterized the fourteenth and fifteenth centuries."

I would begin by recalling that the history of eyeglasses, as is well known, is closely connected to that of lenses. Moreover, the invention of ophthalmic lenses undoubtedly marks a turning point in the development of optical instruments. Lenses for visual purposes opened the way for the development of the first telescopes and composite microscopes. They were the forerunners of high-precision optics, that complex of instruments and devices that, in the period from the 1300s to the 1700s, created the technical-scientific premises for the industrial revolution. In short, instruments and devices that form the basis of the formidable breakthrough that took us "from the world of the approximate to the universe of precision,"to use the apt expression of A. Koyré. This is a universe in which careful observation, accurate measurement, and precise quantification become the three sustaining elements of the structural and functional order.

But isn't it a bit excessive—although some may object—to assign such a significant role to eyeglasses in the process of constitution of the modern world? Aren't we stretching the point for interpretational effect? In my opinion, such perplexities are not justified. I suspect that they simply are a legacy of what Vasco Ronchi, on several occasions, denounced as the "conspiracy of silence" of the "learned by profession" (philosophers and historians) regarding lenses and their applications. That same "conspiracy of silence" which the brilliant Giambattista Della Porta was the first, in the sixteenth century, to attempt to violate with his books *Magia Generalis* and *De Refractione*.

Nevertheless, it is quite amazing that, in spite of the centuries that have passed and the striking progress that has been

made, in the meantime, in the field of optical instruments and related endeavor, doubts remain regarding the historical importance of the invention of eyeglasses. A historical importance that does not have to do only with the invention of the utilitarian object known by this name, but also with the scientific knowledge and technical experiences that led up to it (and in some ways prefigured it). This is not to mention the knowledge and experience that, in the wake of this invention, were acquired immediately thereafter, opening the way for unprecedented developments in the field of instruments for scientific observation. For the preinvention phase, we can mention, for example, the contributions of Alhazen, Grossatesta, and Roger Bacon; for the post-invention phase, those of Della Porta, Kepler, and Galileo.

I would like to avoid the controversial question of to whom we should attribute the invention of eyeglasses: Florentines, Pisans, or Venetians. As we know, the Florentines claim the inventor was Salvino Armando degli Armati. The Pisans insist on Alessandro Spina. The Venetians boast of an unknown craftsman of glass or crystal from Murano.

As I have already mentioned, my aim is to find the answer to two different (and antithetical) questions.

First: what is the link, perhaps even random or coincidental, between progress in the glass or crystal industry, or the capacity to supply the lenses required for optical performance, and the invention of eyeglasses?

Second: how and why, in and around 1280, did the social, economic, and cultural need emerge to correct the visual problems of the *farsighted*, i.e., those who can see things well at a distance but not up close, and later, around 1450, to correct the visual difficulties of the *nearsighted*, i.e., those who can see things well up close but not at a distance?

It can be intuited that, with these queries, we are headed right back to the question discussed earlier of what "pushes" and what "pulls" in the technology-society relationship.

I would like to concentrate on the second of the two questions. This certainly is not an easy task. The main difficulty lies in our subjective condition as modern men and women. In fact, we are so accustomed to the use of glasses today, and other refined visual prostheses, that it is hard for us to imagine the everyday life of the nearsighted and the farsighted before the invention of eyeglasses. Nevertheless, it is worth making the attempt.

It is plausible to assume that, in the late Middle Ages, the life of the nearsighted and the farsighted was, to put it mildly, anything but easy. But the farsighted must have had an easier time of it than the nearsighted, or at least those afflicted with a medium-high level of myopia.

Let's try to examine the existential conditions of the latter group. Although we know many different things today including a

wide range of aspects of the everyday life of the late Middle Ages, practices of hygiene and nutrition, clothing, jewelry, and ornaments; and courtship, celebrations, parades and processions, we have a surprisingly limited amount of documentation on subjects suffering from acute forms of myopia.

This is hard to understand, because the apparent diversity of such persons must have been constantly evident in normal interpersonal relations.

In the few documents that do exist on the subject, without excluding those from the history of medicine, the mention of myopia sufferers is indirect, with cryptic allusions and ironic or sarcastic comments. Whether due to ignorance or to poorly disguised maliciousness, the category in question often is registered, so to speak, under a false name. For example, in the records of persons who entered medieval hospices, alongside the infirm, the elderly, orphans, paupers, madmen, and, not the last on the list, the blind, there is mention only of the rather vague category of the "almost blind."

Who are they? It would seem logical to hypothesize that this category included, among others, those afflicted by myopia. In fact, it is probable that a large number of the women and men with myopia wound up in hospices. It also is probable, to be frank, that they were the lucky ones. In the worst cases, they could have been seen as undesirables, forced to live outside the walls of the fortified settlements, becoming a part of the motley rabble of the outcasts.

Naturally, all this happened only to nearsighted persons of humble origin; those of the upper classes met with different vicissitudes. In courtly culture, the ritual of the gaze was fundamental in interpersonal relations. The nearsighted, for obvious reasons, were excluded from this ritual. Therefore, they were unable to comply with the code behind the ritual, which was a code of etiquette, of good manners. In the light of this, the nearsighted person seemed indifferent, gloomy, cold, enigmatic, and disoriented or, at times, haughty and condescending.

In any case, apart from their social standing, the nearsighted provoked a general intolerance or worse. The aversion or even hostility they provoked could be transformed, in some cases, into abnormal suspicions and judgments leading to serious consequences for those unlucky enough to be nearsighted.

I am referring here to the tendency to attribute downright maleficent powers to the nearsighted and the blind. The fact that a person suffering from myopia can see things well up close and poorly (if at all) at a distance was interpreted not as an optical-physiological pathology—as is truly the case—but as proof of a presumed fundamental ambiguity. In other words, a nearsighted person was seen as an impostor who, for unspeakable motives, pretended to be blind without actually being so.

We should admit, however, that these facts supply a truthful, but also incomplete, image of the life the nearsighted in the late Middle Ages. There also was another side of the coin.

The nearsighted, precisely because of their particular visual problem, were present in all of those trades in which good close-proximity vision was required such as scribe, copyist, calligrapher, engraver, miniator, teacher, merchant, bookkeeper, notary, judge, goldsmith, spinner, weaver, embroiderer, carpenter, cabinetmaker, shoemaker, and tailor.

The farsighted, on the other hand, again due to their anomalous condition, had to work in areas in which good long-distance vision was indispensable. such as hunter, farmer, shepherd, livestock breeder, fisherman, woodsman, mason, miner, sailor, and soldier.

The former, to use the words of Lucien Febvre, were "greenhouse men," closed in limited, protected spaces, while the latter were "men of the open air," close to the land and rural life.

This division of labor sheds light on the role of both types of ametropia. It is clear that, while the farsighted appear, for the most part, connected to traditional productive areas such as the obtaining of nutritional resources, the extraction and transport of materials, and the construction of edified works, the typical fields of activity for the nearsighted were much more highly articulated and diversified.

Undoubtedly, the nearsighted were involved in traditional productive areas, especially those involving craftsmanship. But some of them, including both clergy and laymen, were also in–volved in monasteries and universities in activities such as writing, reading, translation, and the production of books.

Others (at times the same persons), due to their organizational abilities as bookkeepers or notaries, played an important role in the administrative (and also political) management of the economic affairs of the lords. In short, these nearsighted persons were able to achieve clear positions of power.

As is well known, the invention of eyeglasses took place in two phases: the first, toward the end of the thirteenth century, was based on the development of eyeglasses with convex-converging lenses, capable of correcting the problems of the farsighted; the second, in the mid-fifteenth century, involved the development of concave-diverging lenses, to correct the problem of myopia.

But why, one immediately wonders, was it necessary to wait a century and a half for the progress from eyeglasses for the farsighted to those for the nearsighted? How can this long gap between the two events be explained?

The exponents of technological determinism, of course, will support the thesis that this was due to the simple fact that the craftsmen-opticians were not capable, before 1450, of producing concave-diverging lenses. Does this argument stand up? Only in part. We

cannot deny the fact (it is blatantly evident) that the craftsmen did not make such lenses during this long period. This statement cannot be challenged but, on its own, it does not suffice.

There is a general consensus among technical historians that the knowledge required for the production of lenses for the farsighted was not, in the final analysis, very different from that required for the production of lenses to correct myopia. The craftsmen of Venice, the most highly skilled in all of Europe in the 1300s, most probably could have progressed, after a brief period of experimentation, to the production of the latter typology, without excessive difficulties. Just consider the high level of expertise they had achieved in the technologies of grinding, polishing, and smoothing of lenses.

An implicit question arises here: if, as it appears, all this was effectively possible, what prevented them from doing it? A possible answer has been supplied by some historians of science.

In their view, the invention of eyeglasses for the farsighted was the result of a rare temporal coincidence of two factors: on the one hand, the reflections of the "learned" Oxonians, Robert Grossatesta and Roger Bacon, on the optical properties of convex lenses; on the other, the construction of similar lenses on the part of the "practical" Italians.

In this context, by "learned," we mean "philosophers of nature," and, by "practical," we mean craftsmen. In a more modern definition, stretching the point just a bit, we could call the former scientists, and the latter technicians.

Moreover, we find confirmation that this temporal convergence between the learned and the practical was, on the other hand, absent for the entire fourteenth century, and that the blame for this can be assigned to the slowness, on the part of the "scientists," in supplying a theory of biconcave lenses similar to the one they had developed in the 1200s for biconvex lenses.

In logical terms, therefore, the conclusion, according to this point of view, can be summed up as follows: the development of eyeglasses for myopia became possible only when the "learned"managed to supply the "practical" with a theory of biconcave lenses.

And this takes us back to the old idea that the learned, not the practical, are the main protagonists of technological innovation. An idea that, together with its opposite, is notoriously at the center of the controversy over who is truly the inventor, for example, of the steam engine: the learned Denis Papin or the practical Thomas Newcomen; the learned Joseph Black or the learned-practical James Watt?

But it immediately should be said that while the interpretation illustrated above on the eyeglasses for myopia is, in my opinion, erroneous, its error does not lie in its implicit stance in the

learned-practical controversy, but in the lack of historical foundations for the thesis itself.

It is an undeniable fact that, as opposed to what happened in the thirteenth century, the learned did not show up for the appointment at the same time as the practical, but arrived after a long delay—one-hundred and fifty years after the technicians already had invented the new eyeglasses.

Eyeglasses for myopia first appear in approximately 1450, while the texts that completed (or nearly completed) a "general theory of lenses" by Della Porta, Kepler, and Maurolico were published in the period from 1589 to 1611.

The truth of the matter, however, is that these interpretative subtleties, necessary as they may be, have not offered much help to find an answer to the question of the basic reasons that, in a given socio-historical context, led to a greater urgency for the development of eyeglasses for the farsighted, with respect to those for the nearsighted.

In order to pursue a possible answer, I feel it is necessary, at this point, to pause for further clarification of some of the notions I am employing. Up to this point, I have spoken, for simplicity's sake, of the nearsighted and the farsighted, and excluded the important category of the emmetropic, the *normal*, or that category of persons who do not have problems of either nearsightedness or farsightedness.

While sufferers of myopia, with slight improvements (or further impairments) as they age, remain myopic for their entire life, most "normally-sighted" people, after the age of forty or fifty, become farsighted.

To go back to Fevbre's metaphor, we can say, that while the nearsighted, before the invention of eyeglasses, were always (and in any case) "greenhouse men;" for the persons with normal vision who had decided, at a young age, to work in the same areas of activity as the myopic, things became much more dramatic with the advance of old age. At the critical age of forty-five to fifty, these "greenhouse men" suddenly had to become "men of the open air." For them, the most difficult part of all this was the need to find a new means of livelihood. For example, a scrivener suddenly found himself in the position of having to learn how to hunt, or how to work in a mine. People with normal vision whose jobs were in line with the capacities of the farsighted had an easier time of it. After all, they already lived and worked as if they were farsighted, so there was nothing traumatic about the change in their visual capacities that came with aging.

But just what was the relationship, in terms of percentages, in the 1200s and 1300s, between the nearsighted and farsighted? It is impossible to know for sure, since very few statistics are available.

No reliable quantitative estimate can be made. Perhaps the only way to assess the situation is to make a purely indicative attempt to compare it to the present.

In the industrialized countries, there is no doubt that there are a great many farsighted people, and that their numbers are constantly growing. Due to the fact that presbyopia is a problem of aging, it comes as no surprise that a society such as ours in which life expectancy has risen to a level of about seventy-five years and, therefore, is a society containing many elderly people also is a society with many farsighted people. And, in proportion, it is a society with relatively few myopic individuals.

In the late Middle Ages, the situation was quite different. Although there is no precise agreement among experts of historical demographics on the life expectancy in this period, the most reliable and least pessimistic estimates range from fifty-five to sixty years.

This means that a normally-sighted person, for example, who became farsighted in the forty-five to fifty age range, would remain so for the rest of his or her life, or namely for only about one decade. Therefore, it is obvious that, with respect to the present situation, the number of farsighted people was proportionally less in relation to the number of the nearsighted individuals.

To support this thesis, let us, examine what happens in the world today. Robert N. Kleinstein, an epidemiologist of presbyopia, offers a comparison between a country such as the United States with a long life expectancy, and a country from the Third World, such as Haiti, where the life expectancy is similar to that of the late Middle Ages. The results speak for themselves: after the age of forty-five, in the United States, thirty-one percent of the population is farsighted; in Haiti, the figure amounts to just sixteen percent.

In the light of this (and other) assessments, we can clearly see certain elements of great interest for the question we are examining here. We can hypothesize that, on the threshold of the 1300s, the reigning division of labor, with its great rigidity, was beginning to be unsuitable for the emerging need for greater mobility in social relations.

An emerging need that is very often, it is worth noting, the focus of reflection of the most eminent scholars of the Medieval—from Rudolf Stadelmann to Charles Haskins, and from Marc Bloch to Georges Duby and Gioacchino Volpe to Ovidio Capitani—all if whom, each in his own way, were involved in identifying the latent factors of crisis and recomposition of the late Middle Ages. In other words, they attempted to debunk the static, immutable version of that historical period.

It is precisely in this perspective of the late Middle Ages that we can examine the relationship between the division of labor and the problems of eyesight. Everything points to the possibility that, in the 1200s and 1300s, the traditional practice of dividing up the work force in the territory according to the visual capacities of indi-

viduals to see things up close and at a distance was no longer regarded as the most suitable to deal with the changes that were slowly (but inexorably) happening in the society.

But in this new perspective the question remains: why was the invention of eyeglasses for the farsighted viewed as a priority, as opposed to the invention of eyeglasses for the nearsighted?

I am convinced that this priority was not the result of an arbitrary choice or a mere accident of progress but, instead, of the need to adapt to changes (or hopes for change) in the overall organization of the division of labor.

In the end, the objective was to permit normally-sighted subjects involved in activities in which close-up vision was important to continue, with the aid of glasses, to do their jobs, in spite of the fact that, after the age of forty-five to fifty, they tended to become farsighted.

This was, therefore, an effort to prevent the neo-farsighted from shifting into other fields of work in which close-up vision was not required. The result of this previous migration had been detrimental, leading to a lack of stability and continuity.

But behind all of this there also was a more ambitious project, that of attracting, thanks to the use of eyeglasses, many of those employed in occupations in which only long-distance vision was required. In short, to provide an incentive, so to speak, for a reverse migration of the work force from the realms of the farsighted to those of the myopic.

Naturally, at the base of this urge to reorganize, on a territorial level, the distribution map of the work force, there was the need to offer a response to new requirements that were becoming more and more urgent in the late medieval society. These requirements included the need for more "close-up" working activities, i.e., jobs involving meticulous, precise procedures.

The demand for a larger work force of "clerks" was the result of a number of developments including widespread literacy among young people and artisans, the spread of education and universities, the advent of systems of accounting, bookkeeping and notorial activities, the growth of international trade, the development of the textile industry, and progress in the areas of the manufacture of mechanical products such as timepieces and firearms.

In any case, by using this example of the invention of eyeglasses, I have tried to demonstrate how society "pushes" and technology "pulls." But I also wish to show that technology—once it is established—"pushes," while society does the "pulling."

I am aware of the fact that this process is not as linear as many would wish. But that is just the way things are. And in the case of eyeglasses, another ambiguous factor complicates the issue.

In everything that has to do with vision aided by instruments, or with any act of seeing in general, it always is difficult to identify the cause and the effect. It is a question Gaston Bachelard,

in his allusive style, has summed up as: “Utilization of a magnifying glass means paying attention; but isn’t attention already a magnifying glass in itself?”