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INTERDISCIPLINARITY: IN SEARCH OF THE HUMAN WHOLE

INTERDISCIPLINARIDADE: EM BUSCA DO TODO HUMANO

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SUMMARY – This article presents a unique perspective on interdisciplinary dialogue. We delve into the interplay between various forms of knowledge, with a particular emphasis on scientific knowledge. Our objective is to illustrate that knowledge is not rigid but dynamic, a quality vital for human society's thriving. We contend, therefore, that all dogmatism within any epistemological domain is innocuous if it does not open up, interdisciplinary, to other fields, with which it must maintain a constant dialogue.

KEYWORDS – Interdisciplinarity, scientific knowledge, human sciences, photography

RESUMO – Este artigo apresenta uma perspectiva única sobre o diálogo interdisciplinar. Investigamos a interação entre diversas formas de conhecimento, com especial ênfase no conhecimento científico. Nosso objetivo é ilustrar que o conhecimento não é rígido, mas dinâmico, uma qualidade vital para a prosperidade da sociedade humana. Afirmamos, portanto, que todo dogmatismo dentro de qualquer domínio epistemológico é inócuo se não se abre, interdisciplinarmente, a outros campos, com os quais deve manter constante diálogo.

PALAVRAS-CHAVE – Interdisciplinaridade, saber científico, ciências humanas, fotografia

From binary logic to the digital age: past and present intertwine

When George Boole laid the foundation of binary logic[1] in the 19th

[1] Boole's theory can be explained as follows: suppose a person goes to a party and wants to dance without a partner. You can't do both simultaneously in a place where some people dance and others don't. The person sought must be a man or a woman. For Boole, what is at the party are

century, little did he know that he was paving the way for a revolutionary transformation far beyond his initial vision. The method of this self-taught mathematician, who in his youth had a strong inclination towards the Human Sciences, studying multiple languages, became the bedrock of the Digital Revolution that would unfold a century later. As Brandão (2008, p. 89) aptly puts it, this revolution is when 'everything around us is reduced to two digits: 0 and 1 when the human no longer mediates us, but by the non-human'.

As the 20th century drew close, humanity emerged immersed in a digital landscape that fundamentally altered our perception of the world. The advent of personal computers (from 1970 onwards), fully digital cameras (from 1988 onwards), cell phones (2G, from 1991 onwards), and smartphones (with a large capacitive touchscreen, from 2006 onwards) marked the beginning of a significant shift in the way we perceive, see, and interpret our surroundings and ourselves. Despite our incomplete understanding of these changes, their rapidity was undeniable.

These are significant for understanding how we understand the world around us, how we see and apprehend it, and how we communicate with each other, transmit and receive knowledge, or enjoy and create art. For some, so many transformations in such a short period still cause a particular concern and distrust, not clearly understood by the new generations of the 21st century – already born and accustomed to these new technologies like Generation Z or Generation Alpha – who cannot understand why certain blocks and difficulties, or even the non-acceptance, by older people, of what they consider trivial.

It is evident that, after the amazement seen in the face of so many innovations that we are going through, the next moment is the establishment of a specific **accommodation**, when the majority of society still needs to assimilate and adapt to this new moment and its consequences, even if such changes do not reach everyone in the same way.

This is because transformations took place over centuries in other periods, such as Antiquity, the Middle Ages, or even Humanism. Thus, there was an extensive period of **maturation** by society that saw the world, knowledge, and science very differently from how we see it. Therefore, to change, not only the will was needed, but something more: the audacity and

groups of people: men (M) and women (W); in addition, some people dance (D) and who want to dance (Q). The male pair had to satisfy two conditions: being a woman and wanting to dance. Boole sees the importance of the connective **and** that connects these two conditions, giving it the symbol ∩; he represents, in this way, this set of pairs as W ∩ Q. However, only some people in the room may wish to dance, but talk to someone who can be both W and M since both are in the room. Here, Boole shows us the importance of another connective **or**, in other words, giving it a symbol ∪. Thus, in Boole's algebraic logic, M ∪ W includes all men and women in the room. This way, the variables will always be two: yes/no, true/false, 1/0. (BRANDÃO, 2008, p. 89)

boldness of those who see what not everyone can; thus, this new Prometheus of every moment of humanity throws, with his impetus, the whole society, towards another future.

Boldness? Before having audacity and fearlessness, or rather, having the courage and daring to go where not everyone wanted, took the risk, or could go. Many believe, however, that to be bold, it is enough to break established rules, question pre-established models, or even say what you think to everyone without worrying about the consequences. However, as typically happens in such revolutionary outbursts, the result is the accommodation of this lack of consideration over time.

The younger generations, as always, full of hormones and fond of risk and daring, abhor lethargy and launch themselves, once again, towards the new, the unknown, the **modern**, even if this is nothing more than a mere anachronism. For older people: this is the charm of the human *continuum*, of constantly seeking new models and innovations, even if they are in those dusts of the past, against which young people of the past had also fought and relegated to **unlikely** oblivion: the mythical Lethe never he manages to fully fulfill his role, contenting himself with merely temporizing it.

Just like the wheel of time, culture and science are not, and cannot be, watertight, in the same way, that, in the past, they were not; otherwise, entire societies would be **robotized** into the same old same old and, not seeing the changes in their surroundings, would be absorbed by others that surrendered to them. To such **primitive models**, as was said until the middle of the 20th century, would not have much of an option: either they would disappear, or they would be swallowed by others who opened up to the new**, modernized**, **evolved** (even if such evolution was not for the common good).

Classical Greece, for example, although for a long time, it was considered "synonymous with proportion, stillness, balanced synthesis, both in art and in thought" (CAMBI, 1999, p. 43), was never effectively so, at least as proclaimed in the Renaissance. It was, after all, a human society made up of human beings who were also driven by outbursts of emotions, by sentimentalities, by laughter and tears; they were not **beautiful** immobile and inert statues whose beauty consisted, above all, of an idealization, whose purpose was to ecstasy, as Lessing (1998) had said: "everything that the plastic arts can encompass if it is not compatible with the beauty, must be completely discarded." (p. 91)

Even the beauty issue, crucial to classical Greek culture, was also being constructed and underwent theoretical changes over time. For Socrates, for example, the plastic arts should not be content with reproducing bodily beauty but transmitting the expression of the moral being (JAEGER, 2013) since "it is not through the expansion and satisfaction of its physical nature [...] that man can

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achieve this harmony with being, but through complete control over himself [...] in the examination of his soul" (p. 535), the moment in which happiness, well-being (*εὐδαιμονία – eudaimonia*).

For Plato, following his master's path towards the metaphysical (in a strictly etymological sense: *μετα* – beyond – and *φύσις* – nature, physical), beauty was not linked to the **sensory issue**, to the physical; this because, through the body and its sensory traces (GREUEL, 1994), it would not be possible to contemplate it, since

> A being is beautiful if its perceptible form coincides with the archetypal idea, and it is lovely to the extent that it enhances this *convenience*. The loving enthusiasm of those who contemplate earthly beauty is provoked by the reminiscence of beauty, eternal and true [**Phaedrus**], «which exists by itself, always uniform and such, that all the other beautiful things are so because they participate in its beauty, though they are all born and perish it nothing gains nor is lost nor is changed» [**The Banquet**] (PLAZAOLA, 2007, p. 28)

As an essence, beauty can only be in the world of ideas, where it manifests itself. Man, however, when finding correspondences of Beauty in art, allows himself to be carried away because the "human soul, before birth — before being imprisoned in the prison of the body — had contemplated ideas while following the procession of gods." (PLATO, 1999, p. 20) However, once "incarnated, it loses the possibility of direct contact with incorporeal archetypes" (PLATO, 1999, p. 20); but, faced with their copies, even if imperfect, they can, through glimpses, recover knowledge of these perennial and archetypal ideas. Distinguishing Beauty would, therefore, be remembering, recognizing, reminding.

Aristotle (1996), in turn, abandons the Platonic idealization about beauty, as he conceives it from the point of view of sensible reality, by explaining its primary forms and criteria: **order** (*τάξις*) – "spatial arrangement of parts" (PLAZAOLA, 2007, p. 33) of a composition –; **symmetry** (*συμμετρία*) – "proportional size of the parts between themselves and with a relationship at all" (PLAZAOLA, 2007, p. 33) –; and **finitude** (*ὡρισμένον*) – "limitation in size of the set, the extrinsic proportionality " (PLAZAOLA, 2007, p. 33); demonstrating it from the harmony, the greatness, the ordering between the various parts of the being or object:

> Beauty resides in extension and order, so an animal of extreme smallness (since vision is reduced to an almost imperceptible moment) cannot be beautiful, nor of extreme grandeur (since vision cannot encompass the whole). (ARISTOTLE, 1996, p. 38)

This sensorial vision paves the way for demonstrating the importance of beauty and the prestige that art itself will achieve. After all, for Plato, beauty could not manifest itself visibly (from a sensory point of view) – therefore, there would be no reason to honor art, considered

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"harmful because it diverts man's gaze from the true essence of things" (GREUEL, 1994, p. 148), by creating ill-fitting copies of the sensible world –; for Aristotle, what was seen was precisely the opposite: he went so far as to describe the sensible properties of some technical activities as beautiful (PLAZAOLA, 2007), in addition to showing that it is the function of art to create:

> All **art** is related to creation, and dedicating oneself to art is studying how to make something that may or may not exist and whose origin is in the person who makes it and not in the thing made[2]. (ARISTOTLE, 1996, p. 219, **emphasis added**)

One cannot forget, however, that the word **art** in English – from the Latin *ars* – corresponds to the Greek term *τέχνη* (*téchne*), whose polysemy has given us a slightly different connotation that moves between the concepts of **art** and **technique**. Such meanings were also different in both Plato and Aristotle:

> For Plato, for example, *τέχνη* had a double meaning: art and science. It is not possible, therefore, to find a systematic distinction between *επιστήμη* (*epistéme*) and *τέχνη* (as art) because they are ordered and regulated human activities [...]. The technique presupposes that its holder – *τεχνίτης* (*technítes*) –, the craftsman, holds an *επιστήμη* (*epistéme*) not based on the gifts of nature, the *φύσις* (*phýsis*), which makes its transmission possible to those who do not have this technique. This presupposes, of course, that such knowledge has not been acquired from the empirical; for epistemic knowledge, it is necessary to use *λόγος* (*lógos*). For Plato, therefore, the *είδος* (*eîdos*) not only permeates *τέχνη* but also *τέχνη* itself; after all, it is not enough for the future artist (*τεχνίτης*) to only have the concept, the idea of what he intends to do, the *είδος*, but he must retain the *τέχνη* from accomplishing it. It is evident, therefore, that what we call art will be the result of a glimpse of the work – *είδος* – in the mind of the *τεχνίτης* (craftsman) who, through *τέχνη* – the processes necessary for its execution and transmitted via *λόγος* – will achieve the desired result. (BRANDÃO, 2010)

If for Plato, art and science were correlated, Aristotle,

> distinguished the two terms, the epistemological criterion that will persist in Western culture for centuries. The Stagirite tells us that *τέχνη* [art] is similar to *επιστήμη* [epistéme] since *τέχνη* refers to a practice acquired through **empirical** [*έμπειρίας*], after all, all theoretical knowledge must be based on experience. (BRANDÃO, 2010, **emphasis added**)

The difference between the two will be, exactly, the question of empirical; for, while Plato did not value it, considering it deprived of rationality (*ἄλογος*), Aristotle thought it similar to science and art since

[2] *ἔστι δὲ **τέχνη** π ᾶσα α π ερὶ γένεσιν καὶ τὸ τεχνάζειν καὶ θεωρεῖν ὅπ ως ἂν γένητ αί τι τῶν ἐνδεχομένων καὶ εἶν αι καὶ μὴ εἶν αι, καὶ ὧν ἡ ἀρχὴ ἐν τῷ ποιοῦντι ἀλλὰ μὴ ἐν τῷ π οιουμένῳ·* (*Ηθικά Νικομάχει α,* 6 1140a).

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both "come to us *through* experience; because 'experience made art'" (ARISTÓTELES, 1969, p. 37).

Thus, for the Stagirite, the work of art tends towards concreteness, towards the sensory, but goes beyond it, as

> It does not affect man only through (aesthetic) sensations; the work is also received by intelligence (noetic). Hence, the great importance of the plot, the myth, and the work is also moved by its emotions (pathetic). It is essential to distinguish, in the work of art, on the one hand, the sensitive (aesthetic) affectation, immediate reception of the senses, and, on the other, the emotional (pathetic) affectation that can be mediated and constituted by discourse, its figures, and ordinations, as well as triggering actions. (SANTORO, 2007)

It appears, therefore, that the idealism with which Greek society sought to be represented as *sui generis* fell to the ground since, like any other, it was also subject to contestation, improvements and clashes – if we stay in the field of ideas and art, for example – in addition to "political, class, ethnic struggles" (CAMBI, 1999, p. 44), and which also opened up to other cultures that were around it, in the Mediterranean, and with which it maintained commercial, cultural and religious contacts.

The fact that Greek society was not enclosed in its dogmas made it open to new things, even though the process for such opening was long and required a lot of reflection and changes step by step, from generation to generation: used words were used to demonstrate what was wanted, empirical evidence was sought to prove a concept, and *τέχνη* was used to minimize human effort.

Einstein demonstrated that time and space are intrinsically intertwined and relative. So, while for some, time passes faster, for others, it is slower. Employing this model, without any great pretension, and parodying the idea of the great genius of the 20th century, we can say that, for us, our twenty-four hours a day – always insufficient for the entire daily marathon we have – did not correspond to the twenty-four hours of Antiquity, whose tasks, with due proportions, were very different.

Thus, if the maturation of a process, a thought, or a theory took centuries, what we see today is very different. We are not brighter or more intelligent but use our time differently.

Currently, when any new technical process emerges, its dissemination and assimilation are almost instantaneous or in an increasingly shorter period: years or, at most, decades, as was the case with the widespread use of the internet (even without knowing what it is for, everyone has heard "www" and is used to it); cell phones (not just as a mobile phone, but full of applications); of PCs (and all the facilities it provided); the CD, a replacement for vinyl records (which appeared in the late 1940s), which had already taken the place of 78 rpm shellac records (created in the 1870s); the

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proliferation of digital images, among others.

This theme, precisely that of the photographic image, can serve as an example of the disconnect between our present and a not-so-distant past. This is because "if we already lived in a sea of images in their analog form[3] and their mechanical character" (BRANDÃO, 2008, p. 89) and, in little more than a century, we sanctified photography by granting it a prominent place in our lives – scattered throughout our homes: on walls, in albums, in picture frames –; with the advent of the digital process, it became utterly trivial, breaking all the rituals that surrounded it:

> Everyone wants to show that they have long tongues, huge noses, or that they know how to show the middle finger; in these photos, anything is possible, mainly due to the ease that digital cameras and cell phones have provided to humanity, a fact that was unthinkable a few years ago when there was a whole ritual to be photographed or to photograph. (BRANDÃO, 2008, p. 319)

It is worth highlighting the fact that all the moments of transformation that humanity has gone through have been **great**, especially for its time; and, in addition, in one way or another, they took into account the knowledge raised by previous generations, without which such changes would not have been possible, even if, generally, they make a point of not remembering, this is what we can call the **arrogance of the present time**. This presupposes that the change we are going through would not be **the** change (as much as we want to believe that), despite its reach and universalization being evident; it is just another change **that** the human being has gone through and will still go.

It is possible to see this with some clarity, even limiting ourselves to just over a hundred years, when reading texts that portray the transition from the 19th to the 20th century, such as **The City and the Mountains** (Portuguese: **A Cidade e as Serras**), by Eça de Queirós (published posthumously in 1901). In the novel, even in a caricatured way, the technological achievements of the *Belle Époque* are extolled (and written in capital letters), as well as the "supreme man of the 19th century, amid all the devices that reinforce his organs" (QUEIRÓS, 1997, p. 67) that, in the service of humanity, were seen as

> completers and facilitators of life – your Telegraph, your Telephone, your Phonograph, your Radiometer, your Graphophone, your Microphone, your Typewriter, your Counting Machine, your Electric Press, the other Magnetic, all its utensils, all its tubes, all its wires... (QUEIRÓS, 1997, p. 88)

[3]Nothing more than the traditional process of obtaining a photographic image, resulting from a physical-chemical process: the light that passes through the lens and, upon reaching the photographic negative, causes the silver salts in the film to become sensitized. (BRANDÃO, 2008, p. 89)

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As usually happens in the present, we do not have complete clarity of what is happening around us; after all, this time is always limited; as Deleuze (2003) said, when talking about Aion, adds:

> The present measures the temporal effectuation of the **event** [...] its incorporation into a state of things [...], to the same extent the event itself has no present but recedes and advances in two directions at the same time" (DELEUZE, 2003 p. 65, **emphasis added**),

This means that each present is divided into past and future.

Therefore, while we have one foot in the past and the other in the future, we do not see clearly what passes beneath them, our practical present, unless we lower. When this happens, however, we cannot even discern it clearly since we will have before our eyes only one piece of the mosaic of the moment, which, taken from the other pieces, does not give us clarity of the whole in which we are immersed. We can only see today by seeing yesterday and envisioning tomorrow.

Figure 1
French soldiers at the beginning of the First World War, Paris, 1914

Just as the men of the *Belle Époque* couldn't imagine the disastrous limitations of the collective euphoria in which they found themselves, whose joy and enthusiasm would succumb with the Great War, the same one that, in light of his declaration, did not shake those young people, on the contrary, many, with a smile on their faces, rushed either to enlist or to support the imminent conflict: they would

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come out of their lethargy and have **fun** on the chessboards of history (fig. 1 and 2)[4].

How many, when immersed in their present, fully believed in all the euphoric illusion provided by that second phase of the Industrial Revolution: they also longed for their moment of glory, tired and bored as they were with their lives. Thus, despite the comfort that the technique had provided for some and spread to many, it can be said that the man at the turn of the 19th century to the 20th, despite all the achievements of that society, had, without knowing why, much of the boredom and sadness of Jacinto, a character by Eça de Queirós. The war, in turn, would release the adrenaline that the sameness of comfort (or the hardship in the midst of it) had taken away from them. However, this choice proved to be more than ghastly: the conflict, which they believed would be quick, extended beyond what was expected, leaving a result of unimaginable destruction and death.

Similarly, we can talk about our limitations, since faced with the technology we see today, we also see young people giving up everything and **escaping** the boredom of their lives through drugs or **playing** war to feel the iron smell of blood that is not possible to smell in games: how many have not abandoned all the benefits of civilization and thrown themselves against it, enlisting in warlike movements like the Islamic State that employs, for as paradoxical as it may be, the same expedients that they are running away from and that only technology can offer? What about those who went to Ukraine to enlist in that country's army, including Brazilians, to put into practice what they believed to be correct: fighting for the freedom of an unknown nation or against Russia's pseudo-communism, without even imagining that the origin of the conflict has nothing to do with what the media propagated, but was received as an indisputable truth?

There is only change with rupture or return

The so-called Information Age, a transformative era that has reshaped our world, resonates with our current reality. To fully grasp its implications, we must delve into its specificities and profound impact on various fields, including education.

If, before this period, we had needed to leave our homes to experience the outside world, other realities, and different cultures, the virtual window opened the outside world and brought it into our homes.

[4] Such collective euphoria was, in fact, brilliantly demonstrated in the German-American film **All Quiet on the Western Front** (*Im Westen nichts Neues*, 2022) when it was shown how young people were highly enthusiastic about the conflict that was announced, leading them to enlist in the German army. However, what they saw was the raw and brutal reality of war, destroying every illusion of heroism strongly propagated by the German State.

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Figure 2
Mobilization in Berlin. Reservists in a truck, 1914

Figure 3
Postcard from Grootfontein, in the former German colony in Africa, 1902

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Something similar had already occurred with the advent of the printing codex in the 16th century and with photography in the 19th century. The latter, for example, open space for the proliferation of **postcards** (fig. 3) that brought the distant, exotic, and unknown to the homes of their buyers, collectors, relatives, and friends who went to these places; after all, "collecting photographs is collecting the world." (SONTAG, 1986, p. 13)

This iconotropism (BRANDÃO, 2014) that draws us towards images, urging us to read through them in our own homes, all aspects of the world, has caused the photographic imagery inventory of everything that man (European) knew until then, as well as the most inhospitable places he had gone to, had practically been completed in 1826. However, photography improved what, in Brazil, engravers like Frans Post or Albert Eckout in the 17th century, or painters like Debret or Rugendas in the 19th century, had already done before his appearance: presenting bringing to readers the world they were unaware of.

Figure 4
Veil of Veronica, Dürer, 1513

Despite the proliferation of these images through watercolors, paintings, or photographs as a "window to the world," the world's doors had already also opened from Gutenberg. This is because, after it and the press with movable types, there

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was a cultural proliferation and universalization, also **unprecedented**, a role that not only fell to hatching (fig. 4) and its popularization for almost three centuries, but also to the action of graphed *λόγος* (*lógos*, word), it was an image carrier[5] who took and brought different worlds and placed them before the reader's eyes[6].

Thus, we can exemplify this imagery power of words, giving two examples. One is the Western imagery construction of **Christian hell**, which is mainly due to the creative genius of Dante Alighieri in his **Divine Comedy**. The poet, by collecting part of the image collection created and constructed at different times – such as the vision of Hades in Virgil (who drank from Homer) or that been built by images of demons in Romanesque churches in the High Middle Ages –, elaborates his vision, that will permeate the collective unconscious of the Christian world until the present. Another example, so as not to distance ourselves in time, was the image representation of the alleged oriental exoticism (Middle East and North Africa), created by European writers of the 19th century, but which did not correspond with reality itself, despite their alleged desire to do so It.

This construct will permeate the Western iconophotology collection for decades, where **bizarre things have been created** if read outside their original contexts when transposed to other artistic supports.

The King of Kings, 1927, produced and directed by American Cecil DeMille, will become apparent in the first scene if we watch the silent film epic today. This portrays Mary Magdalene as a luxurious courtesan who, in reality, looks more like a queen, like Cleopatra, in the middle of a large palace. In the environment, whose abundance and opulence are exaggeratedly constructed, several men can be seen, surrounded by servants, who eat and drink sitting at the table. Meanwhile, some servants play music; others shake the place, and another plays with a leopard. Although it is intended to portray Roman Judea in the 1st century, that is not what is seen in that scene, just as we see neither Romans, Jews, nor Egyptians, but an intermixture of all. What matters here is the portrayal of the exotic, the circus. It cannot be forgotten that cinema is also the child of the circus, hence the use of **exotic animals** in the scene: leopard, monkey... Madalena (courtesan or queen?) has a chariot pulled by zebras. (fig. 5)

It should be noted that, just in their mannerisms, those men **could** resemble Roman rulers, at least according to the creation and popularization constructed by cinema itself. The caricature, which uses an entire literary imagery construction, when wanting to portray a prostitute, shows us a diva, a princess, with all the pomp and power that only nobles would have; the same happens with those men represented there: submissive, exotic

[5]Something like **phanopoeia** by Pound (2006).

[6]As is *evident* Latin or *ενάργεια* (enárgeia) Greek.

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and, why not, grotesque beings with their turbans, earrings, necklaces, rings.

Therefore, in the same period in which a theory like Boole's emerged, which sought, in the field of mathematics, to employ algebraic techniques to deal with expressions of propositional logic – which would lead to a great revolution in terms of communication a century later –; in which photography emerged, whose discovery was linked, in a way, to certain painters who sought to improve their art and developed the second part of the photographic process, the chemical one – since the first part, the physical one, had already been discovered in Antiquity –; It was the moment in which, remarkably, the sciences opted for specialization, for clustering around themselves, in a frantic search for the accumulation of data. They forgot, however, that science is not enough to accumulate knowledge to develop but to transform the principles that guide them (MORIN, 2013) into others and more.

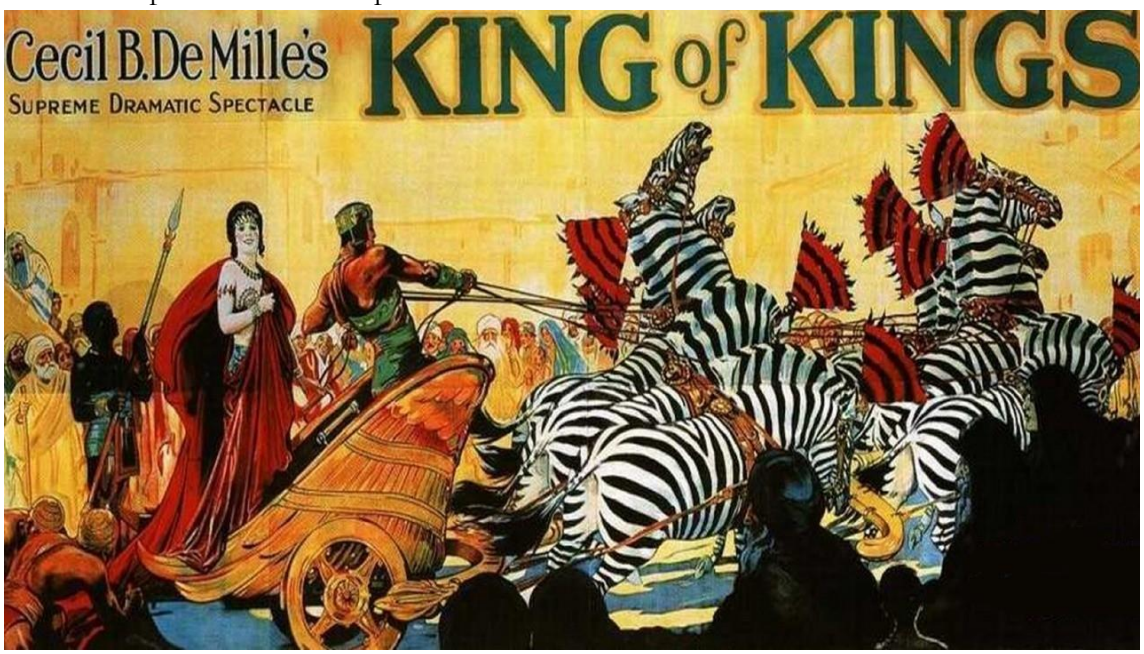

Figure 5
Poster for the film The King of Kings, by Cecil DeMille, 1927

To science is not enough to grow but to transform what is already understood and discovered into new means and jobs. Thus, when, in the 13th century, Saint Albert the Great, who is credited with discovering that silver nitrate could separate gold from silver and that the same element darkened in the presence of light, he could never have imagined that such a component would be the basis chemistry of photographic development six centuries later.

Thus, the most exciting thing about scientific discoveries is their trans-conceptual value, that is, none of them are stuck to themselves but are open to others: their primordial concept goes beyond any expectation on the part of its creators/discoverers, meddling with other ideas to have a different use from the original. Furthermore, in both cases (among several existing in science), there is always interdisciplinary participation in the process; without the interrelationship between more than one discipline in different areas of knowledge, such discoveries would not have been possible. This is evident if we think of the term **discipline**, based on the construction of the concept carried out, incipiently, from the 17th century onwards with Descartes, since before that, there was a unity in science.

An example that can demonstrate this, once again, is photography itself, the discovery of which was only possible due to centuries of knowledge and studies that came from both philosophy and physics, to arrive at chemistry finally: from knowledge of the physical principle of the camera obscura by Aristotle, Al Hassan, Bacon, Leonardo da Vinci, Athanasius Kircher; to the experiments of Angelo Sala, Johan Schulze, Niépce, Daguerre, among others. Not forgetting that, due to these continuous interrelations, we must also give part of the merit of the new photographic revolution to Boole; after all, the principle of its digital form is also non-binary.

This is the magic of science that opens up to others; after all, "science would never have been science if it had not been transdisciplinary" (MORIN, 2013, p.136), but for this, it also had to go through a long process that involved monastic contemplation in the Middle Ages, which, however, did not abstain from empiricism, mathematics, physics, philosophy, such as Robert Grosseteste (he wrote several scientific treatises, especially those dealing with light and optics), Roger Bacon (his studies of optics demonstrated the properties of lenses, essential for the manufacture of future glasses, and telescopes), William of Ockham (whose Occam's Principle sought clarity and simplification instead of sterile discussions), Jean Buridan (impetus theory – precursor of the ideas of Newton).

With the Renaissance, studies expanded, always based on the material raised by the Middle Ages, whether to reaffirm it or to refute it, increasing the scope of science that opens up to rationalism to experimentalism: Aristotle's geocentric notion was overturned by the writings of Copernicus, giving rise to the heliocentric idea, followed by Galileo and Kepler who deepened it: the latter, through mathematics, proved that the planets had an elliptical orbit; the former, through his telescope, observes the phases of Venus, the moons of Jupiter and the craters of the Moon.

In the 17th century, Descartes' rationalism took over scientific knowledge, causing it to move away from

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that contemplative, theological, and metaphysical vision that still reigns since it seeks the origin of human knowledge only in thought and reason. Therefore, what we call modern science began, which, in a certain way, broke the previous idea of grouping and sharing knowledge, as well as the relationship that existed between science and philosophy, between the thinking **self,** the *ego cogitans,* and the material thing, the *res extensa*. Therefore, the subject was dissociated from the object: the former was referred to as metaphysics, and this one was related to science. (MORIN, 2013)

If, in the Enlightenment, there was still an attempt, in some way, to maintain relations between the two fields, in the 19th century, the jettison was even greater "due to the galloping acceleration of knowledge and the growing sophistication of new technologies." (JAPIASSU, 2006, p. 21) An "exaggerated and unlimited specialization of scientific disciplines" (JAPIASSU, 1976, p. 40) was sought to the point that the specialist "has become this man who, by knowing more and more about an increasingly less extensive object, you end up knowing everything about nothing." (JAPIASSU, 1976, p. 40-41)

The search for interdisciplinarity: the rediscovery of man

On the one hand, the change in the university system, implemented by Humboldt in the 19th century, "succeeding the theological university of the Middle Ages, was beneficial for the development of science. Today it is an obstacle due to the division into departments and disciplines." (MORIN, 2007, p. 26-27)

Even worse is this limitless search for **nothing**,

> In the second half of the 20th Century, hyper-specialization emerged and quickly became imposed, causing the indefinite multiplication of disciplines and sub-disciplines to focus on reduced objects of study increasingly. [...] Disciplines became closed and stagnant, sources of jealousy, glory, arrogance, power, and dogmatic attitudes. (JAPIASSU, 2006, p. 21).

Unfortunately, when acting in this way, the essential thing is lost: the human, since the sciences exist as a product of "our understanding, of our spirit-brain" (MORIN, 2013, p. 139) and, by seeking to jettison man science ends up getting lost in its emptiness. To avoid this,

> It is necessary to root physical and equally biological knowledge in a culture, a society, a history, and humanity. From there, the possibility of communication between sciences is created, and transdisciplinary science is the one that can develop from these communications, given that the *anthropo-social* refers to the biological, which refers to the physical, which refers to the *anthropo-social*. (MORIN, 2013, p. 139)

From the 1970s onwards, this self-enclosed conception began to be questioned within academic circles, and

several movements in the academic and educational fields tended towards interdisciplinary issues.

In this way, according to Japiassu (1976),

> Interdisciplinarity presents itself to us today in the form of a triple protest:
> a) against fragmented knowledge, in crumbs, pulverized into a growing diversity of specialties, in which each one closes itself off as if to escape actual knowledge;
> b) against the growing divorce, or intellectual schizophrenia, between an increasingly compartmentalized university [...] and society in its dynamic and concrete reality, where true life is always perceived as a complex and inseparable whole [...];
> c) against the conformity of acquired situations and "received" or imposed ideas. (p. 43)

As important as being aware of the aridity caused by hyper-specialization is the search to break down the boundaries that prevent disciplines from communicating by emphasizing interdisciplinary projects. More than mere meetings of converging points between the different disciplines, these should lead to a more critical and refined look at the whole in which man is inserted, especially if we consider the significant plurality and access in which knowledge is found nowadays.

After the Second World War, there was a dizzying diversification of knowledge, combined with other social, political and economic factors (MORIN, 2013) that took the debate for interdisciplinarity beyond the borders of the university and crystallized it, according to Lenoir (2005), around three main axes: a) the questioning of the certainties of science led to specific epistemological questions, which consisted of exploring disciplinary boundaries, organizing scientific knowledge and avoiding its fractionalization; b) faced with a world in profound upheaval, a social questioning emerges that [re]places the meaning of man's presence in his environment; in this way, we seek to integrate the various disciplines not only to have a fundamental understanding of the world in which we live, but also so that we can better understand it, despite its constant mutation and extreme complexity; c) it is linked to the issue of expanding professional activities due to the new needs of industrial societies (and why not overcome them in one focused on the tertiary sector) after globalization.

Thus, more than integrating knowledge and, consequently, disciplines, what is expected from interdisciplinarity is that the individual can develop new thinking processes and manage and find new solutions to society's new challenges. Of the Information Age imposes on each of us.

Given the complexity of our society, "it is necessary to accept the adventure of complex thinking because complex thinking gives us instruments to connect knowledge." (MORIN, 2007, p. 28) Therefore, linking knowledge and complex thinking requires, from each of

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us, more than a mere desire to **be interdisciplinary**, but to **become interdisciplinary**. Still, more than goodwill, it requires boldness always to want more and go further.

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