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VIRALITY: NOTES ON A CONCEPT CROSSING DISCIPLINES

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ABSTRACT

Virus and virus-related terms were much-abused concepts before the COVID pandemic, and they have become even more so during the pandemic. Such concepts stemming from microbiology are now used in a wide range of areas, such as the media, and even in computing language. In this paper, I map out how these concepts have spread across disciplines.

INTRODUCTION

Virality is a concept that is strictly linked to biological viruses; however, the term spreads over different activities linked to human communication and information such as marketing (viral marketing), computer science (computer viruses), and social media (viral news and viral media). How did the biological concept of "virality" shift from biology to information and communication technologies? To which extent the biological concept has colonized computer field terminology? Which characteristics of the biological virus have colonized the computer and social media terminology?

1. VIRUSES IN BIOLOGY

While infectious diseases were known since 2500 B.C.[1], the first instance of the word "virus" is found in Latin and it means "poison" (as produced by a poisonous animal), "slime" or "venom". One of the first occurrence of the

[1] Chinese had identified small-pox and knew that it was transmissible. Aristotle was aware of the fact that rabies was transmitted by the bite of dogs.

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word "virus" appeared in A.D. 50, when Cornelius Aulus Celsus, indeed, produced this remarkable sentence: "Rabies is caused by a virus." However, the ideas of Celsus about viruses, considered in the light of our present knowledge, were probably rather primitive (Lwoff 1957).

A paper presented to the St. Petersburg Academy of Science in 1892 by Russian botanist Dimitri Ivanowsky found that the agent for the mosaic disease of the tobacco plant was much smaller than a bacterium. He suggested that could be a poison (Russo & Cove 1998) and concluded that the agent can replicate and multiply in living plants. Six years later, Dutch microbiologist Martinus Beijerinck – the father founder of virology – demonstrated that this agent was similar to a living organism. Beijerinck then (re-) coined the name "virus" in virological sense to indicate its non-bacterial nature. However, the word had been previously used for pathogens, although not for viruses in the modern sense. Furthermore, Beijerinck asserted that the virus was somewhat liquid in nature, calling it "contagium vivum fluidum" (contagious living fluid) (Sankaran 2018).

Therefore, "contagium vivum fluidum" would be the first attempt to defining biological viruses; as virology developed further, other definitions took place, also because virologists questioned for a quite long time the very nature of viruses, whether they are organisms or molecules and even their taxonomy, that is whether they were "inframicrobes" or "ultraviruses" (Lwoff 1957).[2] The nature of viruses was a problem as they were not visible through the optical microscope. French microbiologist Louis Pasteur had no difficulty in proving that rabies was a specific infectious disease yet he was unable to identify the exact nature of the pathogenic agent.

Roughly, a virus is an infectious agent of small size and simple composition that can multiply only in living cells of animals, plants, or bacteria (Russo & Cove 1998, 53). Indeed, viruses cannot live alone, they are parasites. The smallest virus is the poliovirus (28 nanometers), the biggest is the cowpox virus which is ten times bigger than polio. Viruses are the simplest form of life. As is well known, many of them are pathogenic and cause infections. The chemical nature of their genome is made of DNA or RNA, but compared with even simplest cellular genomes, viruses contain a very limited number of genes, i.e. 4 in the mosaic tobacco virus to less than 22 in reoviruses (Chieffi and others, 2000, 277). DNAs or RNAs are packed into a wrapping (called capsid or envelope) consisting of proteins which has a dou-

[2] Ironically, this would probably explain the litigious nature of virologists and their difficulties to agree around the main COVID-19 characteristics. Nobel laureate A. Lwoff (1957), quite sarcastically, claims that "The man in the street generally considers viruses as the dangerous agents of infectious diseases. If one has to lecture before an assembly of microbiologists, one becomes aware of the fact that the real danger lies with the virologists."

ble feature: to protect the nucleic acid when the virus is in an external environment and to interact with the infected host organism. Famously, the COVID-19 coronavirus has a crown-shaped capsid (spikes) which allows a virus to hook with a target organism.

More importantly, there are positive uses of viruses in modern biology, as they are used as carriers of genetically engineered DNA in host cells. As they are parasites, viruses use independent organisms, including bacteria as hosts, hijacking some of their genetic machinery to reproduce (Moody 2004, 62) and also they are largely made of nucleic acid (DNA or RNA) and a small external packing (capsid);

> for this reason, viruses are remarkably similar to the computer viruses: compact code whose only function is to reproduce by subverting the host. By inserting themselves into the organism, they are able to use the cell's "hardware" to run the parasitic program to produce new copies of the virus, which can then spread to other bacteria in the vicinity. (Moody 2004, 62-63)

U.S. Molecular biologist Medicine Nobel Prize Hamilton Smith found that

> some bacteria have developed an interesting defense against this digital attack. Since the problem was that parasitic DNA was running on their hardware, the optimal solution would be for the bacteria to render the digital code defective so that it would not run. Just as dividing up a computer program arbitrarily into two or more pieces is generally sufficient to render it useless (because key structural elements are missing in each part), so literally cutting up the viral DNA would stop it from subverting the bacterium's genetic processes. This is precisely what size-specific restriction enzymes do – they restrict the operation of the virus in the bacterium. They work on the viral DNA by carrying out the equivalent of a text search: each restriction enzyme is able to recognize a unique string of chemical letters that might be found in the virus but is not part of the bacterium's own DNA sequence. When the enzyme locates such a string – the specific site – it cuts the DNA in a particular way, thus rendering the programming code around it useless. (Moody 2004, 63)

Modern molecular biology through the massive use of computers[3] have highlighted a strict analogy between viruses' code and computer code, since

[3] H. Smith's research in computer programming eventually led to a radical change with which human genomics was approached during the "genome wars." That is a shift from traditional methods (such as BAC to BAC) to computer-centered methods in sequencing by using the so-called Whole Shotgun Approach (see Marturano 2009).

biological viruses and computer viruses share a universal concept of the underlying digital code, which displays itself in a different way in the biosphere and in the noosphere.[4] Using a well known Kantian dichotomy, the concept of underlying digital code is *noumenon*, so to speak, while DNA and computer code are *phenomena*.

2. COMPUTER VIRUSES

The first field in which the metaphor of virus has attached is thus computer science. Since the '80s, indeed, computer viruses *et similia* started to spread around PCs, through floppy disks, then through the Web once the network was not just available for the academic elite. While computer viruses were known in the '70s as technical games or in science fiction novels[5] and movies[6]; according to UK pioneer computer scientist Neil Barrett

> Since this first appearance of what was then simply thought of as a rogue "program," the number of viruses has escalated dramatically – passing 2000 in 1992, and now [in 1997] at some 9000 – the basis of a huge, protection industry and one of the greatest concerns for security specialists (Barrett 1997, 55).[7]

U.S. computer scientist pioneer Frederick B. Cohen while describing self-replicating computer programs uses the phrase "computer virus" (suggested by his teacher Leonard Adleman) to describe the operation of such programs

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[4] Noosphere, according to French Jesuit, Paleontologist and Philosopher Pierre Teilhard De Chardin, is the sphere of thought encircling the earth that has emerged through evolution as a consequence of this growth in complexity/consciousness. The noosphere is therefore as much part of nature. As a result, Teilhard claims the "social phenomenon is the culmination and not the attenuation of the biological phenomenon" (Teilhard De Chardin 1959: 171). Teilhard describes the noosphere as a kind of human beings "collective consciousness" that arises from the interaction between human minds. For this reason, many scholars compared the noosphere to the Internet and, more generally, to social networks (Werbos 2019).

[5] One of the first uses of the term "virus" to describe a program that infects another computer in a science fiction novel can be found in D. Gerrold, *When HARLIE was One* (1972).

[6] Michael Chrichton's *Westworld* made an early mention of the concept of a computer virus, being a central plot theme that causes androids to run amok. The movie's main character states that "...there's a clear pattern here which suggests an analogy to an infectious disease process, spreading from one... area to the next», and «Perhaps there are superficial similarities to disease." Chrichton's earlier work *The Andromeda Strain* (1969) was about an extraterrestrial biological virus-like disease that threatened the human race.

[7] Today, in 2020, the number of known computer viruses increased to 100.000. However, more than 317 million new pieces of malware, that is computer viruses and other malicious software, were created in 2014 (Harrison & Pagliery 2015).

eventually in terms of "infection". He defines a virus as "a program that can 'infect' other programs by modifying them to include a possibly evolved copy of itself" (Cohen 1984).

3. VIRAL MARKETING

Viral marketing or viral advertising is a business strategy that exploits existing social networks to promote a product by the application of traditional word-of-mouth (WOM) marketing to encourage both online and peer-to-peer communication about a brand, product or service (Golan & Zaidner 2008)[8]. Its name refers to how consumers *spread* information about a product with other people, much in the same way that a virus spreads from one person to another. In this sense, viral marketing adopts the contagion effect in order to be most effective.

Virtual marketing includes, but is not limited to, viral videos, email messages, use of online social networks and online forums, text messaging, interactive microsites and online games, blogs, podcasts, and so on (Eckler & Rodgers 2010). Viral advertising, on the other hand, is a subset of this larger umbrella and is defined as unpaid peer-to-peer communication of provocative content originating from an identified sponsor using the Internet to persuade or influence an audience to pass along the content to others (Porter & Golan 2006).

Very importantly, unique to viral marketing is its focus on the message, not the product. Thus, the brand is often secondary in viral videos, as they aim to look more like entertainment pieces and less like branded commercials. The success of a viral campaign can be attributed to its emotional or entertainment value rather than information about the brand or product (MindComet 2006).

The most important feature of viral marketing is its *contagion* effect. Effective viral marketing, indeed, depends on consumers' forwarding behavior; that is, the viral package should be integrated to consumers' needs, norms and values, as much in the same way a viral DNA becomes integrated into the bacterial DNA where it lies, apparently quiescent, being replicated by the bacterium along with its own DNA for many generations. But, the alien DNA, in this integrated form, is risky. It is a bomb that can explode at any time. It just needs exposure to some ultra-violet light to make the bomb ex-

[8] According to some scholars, viral content is another extension of word-of-mouth (Phelps et al. 2004). This analogy seems reminiscent of the way rumours and gossips virally spread in certain times and contexts. Other scholars call this phenomenon "word-of-Mouse" (Mills 2012, 162).

plode then causing the death of the host cell or bacterium (Russo & Cove 1998, 66-67).

4. VIRAL NEWS AND MEDIA

Viral news is defined as networked news stories that spread online mostly through social media in a much faster and wider manner than other news stories (Al Rawi 2019). They are a subset of viral phenomena, which are, generally, objects or patterns that are able to replicate themselves or convert other objects into copies of themselves.

Once again, viral news and media are examples of how the viral metaphor has colonized online phenomena. In particular, they get their name from the way that viruses propagate. For this reason, they focus on metaphors of "infection" and "contamination," which means that audiences play as passive carriers rather than an active role to "spread" contents (Jenkins et al. 2013). This has become a common way to describe how thoughts, information (such as in Twitter), and trends (such as in YouTube or Influencers' blogs) move into and through human society.

5. THE COMMON ORIGINS OF MOLECULAR BIOLOGY AND COMPUTER SCIENCE

The idea of genetic information, or better, of a code script into the cell is ascribed to Schrödinger (1944); the code script would be "a sort of cellular amanuensis, set to record the gross and microscopic features of the parental cell and pass the information thus obtained to the cell's descendant." The idea of genetic information implies the idea of code (that is a nucleic acid) which is shared by molecules, genes, and even viruses.

As we have seen, viruses fold internally a nucleic acid, either DNA or RNA. Watson and Crick's second paper of 1953, which discussed the genetic implications of their recently discovered double-helical structure of DNA (Watson and Crick 1953a), used both "code" and "information": "... it, therefore, seems likely that the precise sequence of the bases is the code which carries the genetic information…" (Watson and Crick 1953b: 244).[9]

It was not until 1977 that robust and generally applicable sequencing methods were developed, and even then the modern bioinformatics techniques of gene discovery were still years away. Although the development of information/processing by computers proceeded contemporaneously with

[9] In other words, "specificity" and "information" had become synonymous terms in biological literature. This because they were both based on the concept of uniqueness of the sequence as a condition for an organism's self-replication at the molecular level.

progress in research into biological and biochemical information processing, the trajectories of these two initiatives were never unified even if they sometimes overlapped at various points (Marturano 2008).

According to Castells (2001: 164), modern science relies largely on computer simulations, computational models, and computational analyses of large data sets. Although genetics is considered to be a process that is entirely independent of microelectronics, *it is not really so independent*. Castells argues that bioinformatics and computer technologies are convergent. Genetics technologies are obviously information technologies because they are focused on the decoding and eventually the reprogramming of DNA (the information code of biological matter).

6. CONCLUSIONS

Viruses and viral phenomena share a large number of metaphors. Along with this paper we have found a few: they are *code-like*, they are *opportunists* or *parasites*, they are *infectious* agents, they are *contagious*.

Other virus metaphors depict them as enemies-like, from outside, or *invaders*. Writer and philosopher Susan Sontag (1990, 103 and foll.) famously explains that "this is the language of political paranoia, with its characteristic distrust of a pluralistic world." She later in the book claims that "descriptions of how the virus does it work continue to echo the way illness is perceived as infiltrating the society" (Sontag 1990, 105). The virological metaphor (how viruses work in bacteria or in human organisms) thus does not directly colonize the digital world, but they first *spillover* from viruses to society. Another, indeed, quite abused metaphor (during viruses – computer or biological – pandemics) is that of war: *bellum contra morbum* (war against disease) (Sontag 1990, 96). Such a military metaphor is used for mass ideological mobilization whose goals are cast as the defeat of the enemy. Not very oddly, Sontag claims, such military metaphors may be inevitable in a capitalistic society.

Discussions on Covid-19 seems to have focused just on the concept of "contagion" (Peralta 2020). This is indeed a crucial concept in Agamben (2020) who notoriously claims that the Covid-19 contagion has caused a disproportionate measures individual isolation by the majority of world governments to the detriment of one of the pillar rights of modern western society: individual freedom. Agamben's critique to the government's response to Covid-19 has overturned Hardt & Negri (2000) position in connection with HIV. Hardt and Negri, indeed, suggest that the age of globalization is synonymous with the age of "contagion," as one can read in the following quote:

> The dark side of the consciousness of globalization is the fear of contagion. If we break down global boundaries and open universal contact in our global village, how will we prevent the spread of disease and corruption? This anxiety is most clearly revealed with respect to the AIDS pandemic. The lightning speed of the spread of AIDS in the Americas, Europe, Africa, and Asia demonstrated the new dangers of global contagion. As AIDS has been recognized first as a disease and then a global pandemic, there have developed maps of its sources and spread that often focus on central Africa and Haiti, in terms reminiscent of the colonialist imaginary: unrestrained sexuality, moral corruption and lack of hygiene. Indeed, the dominant discourses on AIDS prevention have been all about hygiene. We must avoid contact and use protection" (Hardt & Negri 2000, 138).

The idea of contagion has shifted on networks as it refresh consuming model of wealth creation founded on a clearer understanding of how money can follow knowledge and then social influence as it spreads across a network (Lyotard 1979).

> Indeed, the link between an ever-expanding form of network capitalism and the self-propagation of network virality is explicitly made through a heady concoction of business enterprise, network science, and neo-Darwinian-related literature. It is via these various contagion models that financial crisis, social influence, innovation, fashion and fads, and even human emotions are understood to spread universally like viruses across networks. (Simpson 2011, 2)

However, the main characteristic of biological viruses is their being "venomous" – which is also at the (Latin) root of "virus" meaning. Unsurprisingly, this characteristic is not found in the viruses metaphors used by media and in connection with the web. Computer viruses, viral marketing and viral news and media (such as the fake news), indeed, are devoid of moral elements. Deep capitalism has developed computer viruses as one of the most important fields of IT industries. Viral media, especially through fake news, cannot incorporate whatsoever moral values, as their horizon provides just for global business or political manipulation. The social and economical climate that led to the Covid-19 pandemic is paradoxically embodied in viruses' metaphors and in the way social media were constructed.

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