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Implications of the theory of evolution in an information society

Milagros Pérez Oliva
Press Ombudswoman of *El País*, Barcelona, Spain

Resum. Quan es compleixen dos-cents anys del naixement de Darwin, la biologia viu una de les etapes més fructíferes. Malgrat que la teoria de l'evolució està plenament acceptada en la comunitat científica, hi ha corrents d'opinió que intenten adaptar les velles teories del creacionisme a les noves exigències de la cultura científica, presentant-les a la societat amb la vestimenta del disseny intel·ligent. És un bon exemple de com l'adaptació és un valor universal, però l'adaptació comporta canvis i mutacions. Abusant un cop més de les teories darwinianes, pot ser interessant observar quins canvis i mutacions s'estan produint en el procés de socialització del coneixement. La manera com la societat metabolitza la revolució de la biologia n'és un exemple paradigmàtic. Els extraordinaris progressos assolits en l'àmbit de la biologia molecular o la genètica estan obrint portes en el coneixement dels mecanismes bàsics de la vida que fa pocs anys semblaven ciència-ficció. Clonació, reprogramació cel·lular, enginyaria de teixits són conceptes nous que han passat a formar part del vocabulari habitual dels mitjans de comunicació. La producció de coneixement s'està accelerant de tal manera que la societat té dificultats per a assimilar i adaptar-se a les conseqüències de les noves troballes; però no es pot aturar. Els mitjans de comunicació s'han convertit en el principal transmissor de nou coneixement. En la societat mediàtica, el coneixement va directament del laboratori a la població en el moment mateix en què es produeix. En els darrers anys, Internet ha multiplicat exponencialment la quantitat total d'informació en circulació. A la xarxa, però, veritat i mentida viatgen de vegades en igualtat de condicions. Quan l'evidència científica afecta interessos econòmics, el soroll mediàtic pot convertir-se en una nova eina de defensa.

Paraules clau: teoria de l'evolució · Charles Darwin · biomedicina · societat de la informació · mitjans de comunicació · sociabilització del coneixement

Summary. As we celebrate the Darwin bicentennial, biology is in the midst of one of its most fruitful stages. At the same time, although the theory of evolution is fully accepted by the scientific community, there is a movement to adapt traditional creationism to the new demands of scientific culture, presenting it to society in the form of intelligent design. This is a good example of adaptation as a universal value, but adaptation also entails changes and mutations. Aside from the current atmosphere of abuse of Darwinian theories, it is interesting to note the changes and mutations as knowledge becomes socialized. The way in which society processes the revolution in biology is paradigmatic. The extraordinary breakthroughs achieved in the areas of molecular biology and genetics are opening doors to an understanding of the basic mechanisms of life, a goal that a few years ago seemed more appropriate to science fiction. Cloning, cellular reprogramming, and tissue engineering are new concepts that have quickly become a part of the media's everyday vocabulary. However, the production of new knowledge is accelerating at a rate that society has difficulty to keep pace with and thus to adapt itself to the implications of these new findings; but progress cannot be stopped. As the mass media has become the main transmitter of new knowledge and society has in response become increasingly "medialized," knowledge seems to flow instantaneously from the laboratory to the public. In the last several years, use of the internet has multiplied exponentially and thus so has the total quantity of information in circulation. On the World Wide Web, however, truth cannot be readily discerned from fiction or even from outright lies. Moreover, when scientific evidence conflicts with economic interests, the media can be abused, serving as a weapon against the unwanted truth.

Keywords: theory of evolution · Charles Darwin · biomedicine · information society · media · socialization of knowledge

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Correspondence: Milagros Pérez Oliva, *El País*, Zona Franca, Sector B, Carrer D. 08024 Barcelona, Spain. Tel. +34-934010500. Fax +34-933353925. E-mail: mperezo@elpais.es

Introduction

The 150th anniversary of the publication of Charles Darwin's *On the Origin of Species* was celebrated on 24 November 2009. Against all predictions, given the cultural context of the time, the book can be considered to have been a bestseller. The 1250 copies of its first edition sold out on the first day of print, despite the long, and rather dull, title: *On the Origin of Species by Means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life*. The second edition, of 3000 copies, sold out in just a few days, clearly reflecting the public's interest in and great expectations of the book's subject matter. Since then, without a doubt, *On the Origin of Species* has become one of the most read, most cited, and I venture to say, most intellectually enjoyed books in the history of science.

It was a revolutionary book, not just for the theories it expounded but also in the way that it communicated science. It offered one of the most groundbreaking theories of its time, and did so in a style that broke many of the established and canonic patterns of communication among scientists. Darwin was perfectly aware that how he chose to convey his revolutionary and dangerous theory would determine whether it was accepted and understood not only by fellow scientists, but by the general public as well. He recognized the importance of explaining his theory properly, in the greatest detail and with all possible examples, and to appeal to reason in the exposition of his ideas, which dared to enter into what Darwin himself defines in the book's introduction as the "mystery of mysteries." He knew that his theory on the origin of the species represented a definitive blow to theology's interpretation of the natural sciences. He understood the transcendence of what he was proposing, and therefore the importance of explaining it well. If he failed to do this, his theory would most likely be rejected.

After returning from his long voyage as a naturalist aboard the *HMS Beagle*, in 1837, Darwin began his conceptual construction in what would fill several notebooks, in which he meticulously annotated all the observations and useful examples needed to support his theory. But given the nature of the subject of his work, a hypothesis that directly threatened the basis of religious thought regarding the natural world, he did it with great care. At the same time, he knew that another scientist, Alfred Russell Wallace, was arriving at the same conclusions; hence he was under pressure to accelerate his decision to formulate his theory in writing, and to publish it quickly. Nonetheless, Darwin adopts a modest tone, admitting that he is finally presenting a theory he had been working on for many years and that, at last, its publication was the result of the urgent encouragement of his colleagues, Lyell and Hooke.

It is worth saying that Darwin, due to his career trajectory as well as his social status, already enjoyed the respect of the scientific community. But as stated before, his goal was not limited to exclusively addressing the scientific circles in which he moved. And as Martí Dominguez explains in the prologue of the recently published *L'Origen de les species* (Catalan version of Darwin's book, Edicions 62), Darwin was not only a great scientist who transformed our view of the world, but a modern thinker as well. His approach to science was from a perspective that remains absolutely valid today but which contrasted with the elitism and aristocratic views that characterized his time. His method of reasoning was very much like that which is required of scientists today, and one which every science journal reader would recognize.

Darwin is considered the first, or one of the first, and certainly among the best science communicators of all times for several reasons:

- He used a direct style, aimed at reaching a wide audience. Although obviously respecting the scientific community, he sought to broaden the audience for his theories.
- He spoke directly to the reader, thus challenging his or her own capacity of reasoning, an approach that was not common at the time. He wrote in an easily understandable and likeable way, taking his readers along with him to the end of this intellectual journey. He thus placed great value on the way in which he presented each component of his theory.
- He argued and counter-argued his own reasoning, setting himself in the role of an opponent. He searched for opposing arguments, the holes in his own reasoning, and confronted them directly.
- Rather than expounding, Darwin talks to the reader, an approach that has since been highly regarded, for e.g., by the great science communicator Jorge Wagensberg, who wrote, "science must be communicated as a conversation with the person receiving the information." Throughout his book, Darwin converses with his readers, persuading them and not by imposing his theories, using the readers' own reality, with small examples of domestic life, as he explains the natural selection of species. And that is what good scientific communication is all about.

In this way, Darwin was able to present the most revolutionary idea of his time, a truly groundbreaking idea, in a simple and highly understandable manner.

Now, on the 200th anniversary of Darwin's birth and the 150th anniversary of the publication of his work, biology is enjoying one of its most fruitful stages. And yet, despite its complete acceptance by the scientific community, the theory of evolution still has its detractors. Today, there are those who, by choosing the name "intelligent design," seek to adapt the old theories of creationism to the new demands of science. This is in itself is a good example of how adaptation is a universal value, also in the world of ideas. To confront the ideas of evolution dogmatically can only lead to failure, whereas re-interpretation of the theory in the modern idiom provides a new opportunity to those who wish to promote the idea of first cause and of the divine origin of life.

Our acceptance of the theory of evolution has not only allowed us to understand the sequence of events that have controlled life on Earth, but also humanity's place in these events. Moreover, expanded upon by the current biotechnological revolution it has been the driving force in an explosion of scientific knowledge. Ginés Morata, recipient of the Prince of Asturias Award for Scientific Research, told me in an interview: "See it

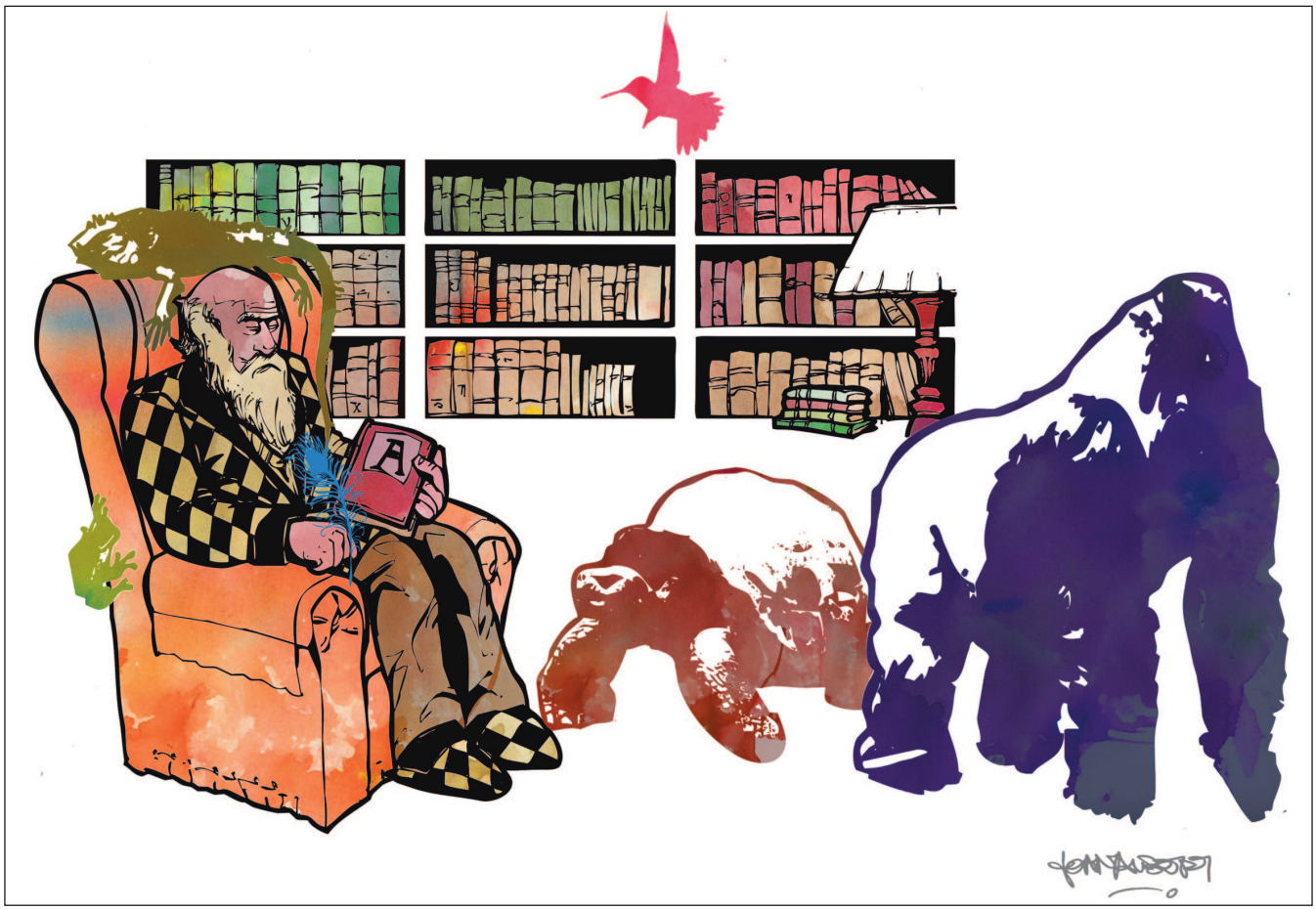

Fig.1. "Darwin dreams of biodiversity," drawing by Joan-Albert Ros.

from a temporal perspective: if 200 years of industrial revolution, and the technology that has been developed throughout this industrial revolution, have given us all that they have, imagine what 200 years of genetics and research could give us in the field of biology."

Indeed, 200 years ago it was difficult to image that we could cross the ocean in just a few hours, communicate and broadcast live images instantaneously from any part of the planet, or receive high-quality images from Mars. If the force of scientific creativity, applied to understanding life and its most basic mechanisms, allows us to draw fundamental conclusions, how, in 200 more years, will what we know change who we are? Will we have "mutated" in any sense? And in which sense?

Throughout my years as a journalist, I have reported on scientific news events that previously would have been considered of the stuff of science fiction. For example, in the field of medicine, I never imagined that I would author a story with the headline, "A grandmother gives birth to her granddaughter,"—an event unthinkable 30 years. In one of my last interviews, a scientist in Barcelona (jokingly) warned me to be careful not to leave a single hair on his desk, because I had no idea what he could do with that hair. He was referring to the ability to use a single hair to isolate a differentiated cell, and, in the laboratory, to undermine its differentiation by modifying just five genes, resulting in an undifferentiated, essentially embryonic cell that could be reprogrammed to differentiate into a heart cell , a bone cell, etc.

Similarly, I never imagined that I would see, lying in a Petri dish, cells that after a few days of cultivation would differentiate into cardioblasts, which through some still poorly understood internal program, would begin to rhythmically beat.

The extraordinary progress achieved in the fields of molecular biology and genetic engineering is opening new doors to understanding life, and thus profoundly changing our view of its most basic mechanisms. Just a few years ago, who would have thought that the terms cloning, cellular reprogramming, tissue engineering, and test-tube babies, among others, would become part of the everyday language of the media? And indeed, it is fascinating to be able to communicate all of this. But new technologies demand new ways of proceeding, new paradigms. The production of knowledge is accelerating so rapidly that society has difficulties to assimilate and adapt to its consequences. Nevertheless, scientific research, as a reflection of human curiosity, cannot be stopped; thus, in order for society to adapt itself to the new challenges posed by progress in the fields of science, we need to better comprehend the nature of these challenges.

The information society and the role of the media

We live in an information society in which the production, storage, and distribution of information is an integral component.

This means that, in the emerging social model, the media plays an essential role, and that today, more than ever, science communication is vital to society's ability to assimilate the changes that are so rapidly occurring. What are these changes?

Globalized society. Globalization has been facilitated by a revolution in communication technologies. Without this revolution, it would be impossible to live in the globalized society of today. It demands maximum real-time connectivity, an unlimited territory of information, and a planetary scope for all types of content. It is characterized by the following factors:

- **Networked, multi-connected, and interactive.** These characteristics are of great importance in the world of science. The World Wide Web allows us to overcome the limitations of the human brain, making it possible to talk about a "brain of all brains" (a global brain, a collective brain, a scientific brain), a concept that Darwin would have probably readily accepted.
- **Immediacy.** Instantaneousness is a new and critical element in the production process. Previously, time was often the liming factor. The Web greatly reduces, or even destroys, the time factor, since interaction is immediate.
- **Polycentric.** Many referents of reality, such as territoriality, have become less important. In this sense, the concept of center and periphery disappear. Anywhere can be the center, or the periphery, at a given time because the concept of center, or periphery, is now a qualitative one. The same happens for the distinction between near and far, thereby changing society's perception of reality. For example, when bird flu appeared in a hospital in Indonesia, it was no longer seen as a remote event, but rapidly as a planetary threat. The same happened in 2009 in the case of the H1N1 virus.
- **Blurred borders between reality and fiction.** The mass media often uses elements of fiction (drama) to communicate reality, and elements of reality (documentaries) are frequently used to make fiction more credible.
- **Interaction between information and reality.** The media not only informs us of reality, it influences events and allows people to experience a more wide-ranging reality.
- **Anticipation.** We could say that one of the perversions of the scientific method in its application to everyday life is society's need to anticipate events, which is linked to the desire to simulate but also to prevent what will happen. This leads to maximum reactivity, hyperactivity, and compulsive decision-making (as we recently saw with the H1N1 virus and the WHO's declaration of a pandemic). In fact, a great number of political decisions are motivated by anticipation. As the philosopher Daniel Innerarity said, what identifies humans before anything else is the fact that we know the future exists, and we can imagine our future, something that is known as "the futures of today." A combination of foreseeing and anticipating also gives rise to the "futures of science," as is clearly observable in the field of medicine.

Profound changes in the socialization of knowledge

The media as the main source of scientific information. For the first time, the media has become the primary transmitter of new knowledge. Before, society received new knowledge from official institutions, whose mission was to validate, order, contextualize, and disseminate it. Therefore, within the normal parameters of uncertainty, the reliability of this knowledge was largely unquestioned. Today, new knowledge arrives to society mainly through a single channel, the media, whose mission is not to validate scientific knowledge but to transmit it. Newspaper coverage implies a hierarchy of reality, in which we, as journalists, tell society what we have decided to be the most important events of the day, among the seemingly infinite number events that took place on that day. In this sense, knowledge that arrives directly from the media to society lacks validation, and therefore certainty, but exactly at a time when people want and need this reassurance.

The information explosion. In the last few years, the Internet has multiplied exponentially the quantity of circulating information. Here we could say that one of Darwin's rules applies, "the increase of all organisms tends to be geometrical, and in a vast majority of cases at an enormous ratio". At the beginning of the 1990s, the number of Web pages was perhaps a few hundred. Today we have hundreds of millions of pages that can be accessed with just a click. In writing *On the Origin of Species,* Darwin was greatly inspired by Malthus' theory: when geometrical growth is produced, it results in a struggle for existence between the members of a population. Nowadays, an important task of a journalist is not to go looking for news, but instead to fill his or her laptop's trash can with the news that won't be published, as not all news is judged to be truly "news." The implication of this decision for the public is that the validation of news today has become a much more difficult task than it was just a few years ago.

The "survival of the fittest" in the media. As alluded to above, while every day there are hundreds of news items, there is not nearly enough space, even on the Web, to publish them. Which items survive? Through which rules or selection criteria? Of course, the spectacular is clearly favored. An attention-grabbing news item will have a much greater chance at dissemination than news that is equally important but is not of a dramatic or controversial nature. However, this form of natural selection exercised by the media is the antithesis of scientific rigor and often distorts the content of the information being transmitted.

Equal opportunities for truth and lies. On the Web, unfortunately, truth cannot be readily discerned from fiction (or even from outright lies), and both are equally likely to thrive. Furthermore, fiction masquerading as truth, if put forward convincingly, may have a better chance of survival than the truth itself. This makes it very difficult for the media to choose between scientific truths and apparent scientific "truths" designed to shield the public from disquieting information. Moreover, when scientific evidence butts up against economic interests, the media can, perhaps at times inadvertently, become a weapon in the distortion of reality. The

best example of this concerns Intergovernmental Panel on Climate Change (IPCC), made up of over 1500 scientists who have joined together in an international panel to study and publicize climate change and its worldwide implications. During the early years of the IPCC's existence, but perhaps even more so today, the media has frequently become an accomplice aimed at distorting the IPCC's work, as reality conflicts with so many of the powerful interests behind our fossil-fuel-based economy.

Information sources. Via the media, scientific knowledge travels directly and seemingly instantaneously from the laboratory to the population. It is thus more difficult for the scientific community to control the quality of what is being published. Often, and especially with controversial topics, informed sources are not adequately consulted, and the consulted sources are poorly informed. Still, for the media, the only decision is whether to publish or not.

Visibility in the media. To paraphrase the communication theorist Marshall McLuhan, those who do not appear, do not exist. This is absolutely true today. To appear in the media is to exist, and, by extension, to be a part of the political agenda, you must first be part of the information agenda. This has catapulted the media onto the stage upon which all social conflicts take place. Their presence influences what is being said and thus the framework in which it appears and is understood.

The problem of information validation

In the framework referred to above, the importance of scientific journals is no longer measured simply by their impact within the scientific community, but also by the repercussions of their topics in the media. This was shown in a study by the Observatory for Scientific Communication (Pompeu Fabra University), which analyzed the press releases sent by scientific journals to the media.

The problem also lies in the fact that the mechanisms by which the scientific community carries out quality control are inadequate, especially in the field of biomedicine. Besides ongoing criticism of the peer-review system, the main problem today is conflict of interest, which has reduced the credibility of scientists and at the same time, of the media. In the light of a number of serious incidents in the past few years (Lipobay, Biox, substitutive hormonal therapy, etc.), and because their own validation procedures have likewise been questioned, the credibility of the pharmaceutical industry as a source of information has become highly suspect.

In September 2001, 13 of the most prestigious research journals published a joint editorial in which they expressed their concern regarding current trends in clinical research. They demanded more transparency to avoid conflicts of interest and advocated greater independence and respect for scientists. Such reforms would be of obvious benefit for the media, as controlled clinical research from transparent public institutions offers more confidence in the publicized results than that carried out by the, often opaque, structures of the private sector.

In this context, and taking into account Darwin's theories, credibility is the most important capital of communication, and the validation of information, one of the most important challenges of scientific communication. The Darwinian revolution, if applied to our times and to today's world of communication, shows us that much work lies ahead of us.

About the author

Milagros Pérez Oliva obtained her degree in Information Sciences from the Autonomous University of Barcelona and has studies in Law from the University of Barcelona. As a journalist, she has focused on the specialties of biomedicine and health. Since February 2009 she has been the press ombudswoman of *El País*. She serves regularly as an analyst of television and radio shows such as *Hora 25* and *El Balcó* from *Cadena SER*, *El Matí* from *Catalunya Ràdio* and *59 segons* from *Televisión Española*. She teaches in the Masters in Journalism program of the Journalism School UAM/El País and in the Journalism Studies department of Pompeu Fabra University. She has been editor-in-chief of the biomedical and the health sections of *El País* since 2004, editor-in-chief of the Catalan office's of the paper's "Society," "Local," "Economy," and "Politics" sections since 1996, and president of the Barcelona division of the Catalan Journalilsts' Association. She is a member of the Bioethics Committee of Catalonia, the Social Council of Pompeu Fabra University, and the Science Committee of the Barcelona City Council. Throughout her professional career, she has received numerous awards and citations, such as the 1987 UNICEF award for her informational work on child welfare; the 1994 award from the Spanish Society of Cardiology; the 1996 Social Welfare Award, from the Barcelona City Council; the 2006 National Journalism Award, from the Department of Culture of the Autonomous Government of Catalonia; the 2007 Grífols Bioethics Award; the 2008 award of the Spanish Pharmaceutical Law Association (ASEDEF); and the 2008 award from the Spanish Society of General Medicine.