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An Epistemological Approach to French Syllabi on Human Origins during the 19th and 20th Centuries

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Abstract This study focuses on how human origins were taught in the French Natural Sciences syllabuses of the 19th and 20th centuries. We evaluate the interval between the publication of scientific concepts and their emergence in syllabuses, i.e., didactic transposition delay (DTD), to determine how long it took for scientific findings pertaining to our topic to be introduced in teaching. Conceptions were categorised into four successive periods, each of which lasted approximately half a century. We showed that the DTD on human origins was influenced in each period by the conceptions of the curriculum developers, by the educational system and, more generally, by the socio-political context.

Key words: history of science, human origins, French secondary school syllabuses of the 19th and 20th centuries, epitemological obstacle, conceptions, didactic transposition delay

1. Introduction

The topic of evolution and the origins of humankind is a characteristic example of knowledge development and education in the biological sciences, due to the complexity of the concepts involved, to interactions among numerous disciplines, to connections with values and socio-cultural issues, and to the affective dimensions in learning. How has the teaching of this topic evolved during the 19th and 20th centuries? What were the main driving forces behind these changes? Our hypothesis is that the changes in the teaching of human origins are not linked solely to the progress of knowledge, but are also strongly linked to social and political considerations and to the values system of each period.

2. Theoretical Background

The theoretical background of our approach combines the following notions:

2.1. EPISTEMOLOGICAL OBSTACLE

There is an ''epistemological obstacle'', as defined by Bachelard (1938), when the everyday life is in opposition to a new scientific concept. *''When one examines the psychological constraints on scientific progress, we come to the conclusion that the development of scientific knowledge is a matter of overcoming obstacles. And it is not so much a matter of external obstacles, such as the complex or transient nature of phenomena, nor the limitations of the human mind, but rather it is within the act of knowing itself that we encounter necessary functional difficulties, demonstrated by hesitation, doubt, and slowness in accepting new knowledge. It is at this level that we identify causes of this stagnation or even regression, i.e., causes of inertia we call epistemological obstacles*''(Bachelard 1938, translated by us). For example, seeing the sun rise to the east and set in the west was an obstacle to understanding that it is the earth that orbits around the sun. In this study, the belief that God created all living species is an epistemological obstacle to the development of evolutionist ideas. Scientific knowledge can only be established by breaking with initial experience and commonly held beliefs. Several kinds of obstacles, such as anthropocentrism, animism, spiritualism, etc., have been identified by researchers in biology education (Clément 1998). In Science Education, this concept is useful for analysing the difficulties students encounter when they learn new scientific concepts (Astolfi et al. 1997). This concept is also very useful to understand the resistance of the scientific community to accepting new scientific findings. Historical analysis of the main epistemological obstacles related to a particular scientific topic, and of arguments or means used to overcome these obstacles, is a fruitful methodology in science education.

2.2. CONCEPTIONS

Much of the science education literature analyses learners' conceptions and conceptual changes after a teaching/learning sequence. Far fewer works have analysed teachers' and students' conceptions (Duit 1994; Giordan et al. 1994) or conceptions underlying the biology syllabi (Mathy 1997; Clément & Fisseux 1999; Forissier & Clément 2003). The importance of values in the educational system is being more and more taken into account (Mathy 1997; Clément 1998; Allchin 1999). The present work analyses scientists' conceptions and the conceptions underlying French

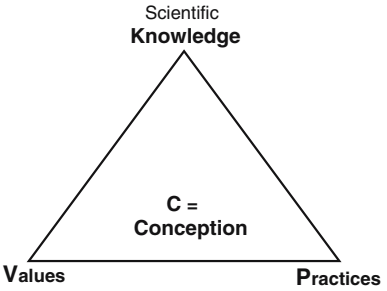

Figure 1. A model to analyse the conceptions as the interaction between the 3 poles K, V and P (K = scientific knowledge; V = systems of values; P = social practices).

secondary school syllabi, using the KVP model (Figure 1; K = scientific knowledge, V = values and P = social practices, Clément 1998).

2.3. DIDACTIC TRANSPOSITION

This notion was first defined by a sociologist (Verret 1975) and was then developed in an anthropological approach to the field of mathematics education (Chevallard 1985): "*The scientific study of the process of didactic transposition (may be) represented by the following schema: item known → item to be taught → item taught*" (Figure 2).

The first stage relates to external transposition, while the second stage relates to internal transposition. The type of external didactic transposition most pertinent to our study is controlled by what Chevallard calls the *noosphère* : the sphere of those who develop teaching content, including not only academics interested in problems related to teaching, but also textbook authors, inspectors, specialist associations, innovators and didacticians. Martinand (1986, 2001) then showed that the references also

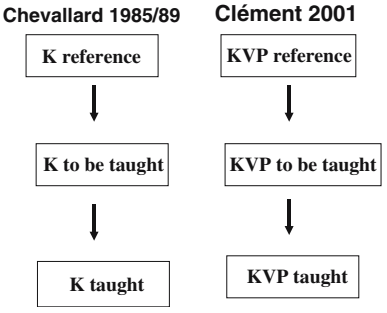

Figure 2. The didactic transposition. K = scientific knowledge; V = systems of values; P = social practices.

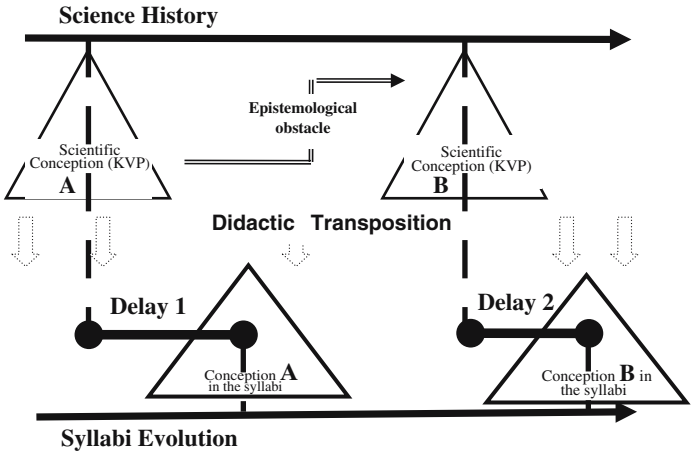

Figure 3. The didactic transposition delay (DTD) = delay 1 for the scientific concept A, and delay 2 for the scientific concept B. An epistemological obstacle has been overcome for the change of concept A to the concept B in the scientific community.

included social practices and, more recently, Clément (1998, 2001) added systems of values, using the KVP model (Figure 1) to analyse the processes of the didactic transposition (Figure 2).

2.4. THE DIDACTIC TRANSPOSITION DELAY

In this work, we are proposing a new model: the didactic transposition delay (DTD). The DTD is the interval between the emergence of a scientific concept and its appearance in syllabuses (Figure 3).

The emergence of a scientific concept is indicated by the year (or date) of its first publication. So the DTD is integrating several processes:

- The delay of acceptance of a new scientific finding by the scientific community. There is a period of latency between the initial publication of a hypothesis and the moment of its acceptance by the majority of the scientific community. The length of this latency varies depending of the respective strength of the scientific arguments and the epistemological obtacles, but also on stakes and the context (inside and outside the scientific community).
- The delay taken by the education system to decide to introduce new scientific conceptions in the syllabus, at a precise level of the curriculum. Often this would be when the conception has reached a fairly stable recognised definition among the scientific community. But sometimes it can be before, or even well after that. This information is interesting to analyse the meaning of the DTD.

For example, the same epistemological obstacle (as creationism) can explain the delay of some ideas about evolution first in the scientific community, then in the education system. The DTD can be short or long, depending on the scientific importance of a new finding, but also on pedagogical or didactical parameters, and possibly for several other reasons (social, political, philosophical, ...).

The strength and the possible limitations of the DTD model can be underlined a priori. Its utility lies in highlighting other factors involved in didactic transposition besides the simple evolution of knowledge. If solely the advancement of knowledge is involved, the DTD should be constant regardless of the era, the concepts in play, and the discipline. We will demonstrate that this is not the case.

The greatest limitation of the DTD model lies in the precise dating of the emergence of a scientific concept. Based on what criteria do we define the first publication? A scientific idea may have been developed for more or less time before its initial publication (as in Darwin's case, some 20 years). Isn't there always some, albeit less developed, preliminary work? However, opting to start the DTD from the date when the new concept is accepted by the majority of the scientific community seems intuitively even more difficult. These questions, which can lead to uncertainty in the evaluation of the DTD, will be discussed one by one.

In this paper, we try to measure the successive DTDs during the 19th and 20th centuries, concerning the precise topic of the origins of humankind. We then propose some hypotheses to interpret DTD length for each historical period identified.

3. Methodology

We compared the changes in scientific knowledge on human origins with the changes in French secondary school syllabi contents concerning this same topic during the 19th and 20th centuries. From this comparison, we identified the delay it took to introduce scientific findings or hypotheses into syllabuses. Here we propose hypotheses to explain the different delays we observed.

3.1. HISTORICAL EPISTEMOLOGY OF SCIENTIFIC KNOWLEDGE ON HUMAN ORIGINS

The corpus used for our historical epistemological approach comprised 40 scientific articles, treatises or syntheses written by scientists (including Linnaeus 1735; Cuvier 1817; Darwin 1871; Teilhard de Chardin 1956; Brunet 2002; Picq 2002; Coppens 2003; Mirazon Lahr & Foley 2004) or science historians (including Gould 1977; Leakey 1994; Tort 1996; Cohen 1999; Duris 2006). The goal of the analysis was to identify the main changes in the conceptions

of human origins and then to identify the major epistemological obstacles to these changes for successive periods since the 18th century. We categorised researchers' conceptions of human origins over 250 years. We identified seven epistemological obstacles that slowed the development of scientific understanding of the origins of humankind since Linnaeus (1707–1778): separation between animals and humans, biblical timing, refusal of common origins with monkeys, belief in the superior nobility of man, racism, finalism, and over-simplification. Every time one of these obstacles was overcome, scientific conceptions of the subject progressed considerably. These results are not presented separately below, but included in the presentation of the four periods. It can be noted that, during the period analysed, science and religion were closely linked initially, but then science became increasingly distant from religion. Also, knowledge of human evolution has developed more and more rapidly in the last few decades.

3.2. A STUDY OF THE FRENCH SECONDARY SCHOOL SYLLABUSES

Fifty official texts were selected from the French secondary programmes from 1814 to 2005. Syllabus topics analysed included: taxonomy, comparative anatomy, palaeontology, population genetics and molecular phylogeny, particularly when concerning humankind. The conceptions of human origins as they appeared in the syllabuses were differentiated using the categories of conceptions previously defined in the historical–epistemological study of scientific knowledge on our subject.

3.3. AN EVALUATION OF THE DTD

By comparing the changes in scientific knowledge of human origins with the changes in conceptions on the same topic in French secondary school syllabuses, we evaluated the delay (DTD) it took for scientific findings to be introduced in the syllabuses. These DTD were determined for different periods from 1814 to 2005. Other historical texts of the corpus (Buisson 1882, 1911; Belhoste 1995) were analysed to formulate hypotheses to explain these delays.

4. Results

Results of these analyses are summarised below for four successive periods.

4.1. THE FIRST PERIOD (1814–1850): FROM A BIBLICAL CONCEPTION OF MAN TO A ZOOLOGICAL CONCEPTION

In the teaching programmes of the early 19th century, there is a great separation between animals and humankind (Figure 4).

In the 1819 syllabi

Elements of zoology and botany

- Animals

…

- Humankind and the particular nature of humans. Clearly distinguished from animals. Influence of this nature on the physical and intellectual development of humankind. Differences between races. The influence of humankind in the works of the creation.

Figure 4. Translation of the French 1819 syllabus (Circular of the 30th November 1919 concerning the programmes of physical sciences courses in royal secondary schools, first year); from Beloste, pp. 91–92.

MAMMALIA. PRIMATES. Homo.

I. PRIMATES.

Dentes Primores inciſores: ſuperiores IV, paralleli.
Mammæ Pectorales II.

1. HOMO. Noſce te ipſum. (*)

Sapiens. 1. H. diurnus; *variant cultura, loco.*
Ferus. Tetradus. inutus. hirſutus.

Figure 5. From Linnaeus ***Systema naturae*** (Electronic Document BNF: Reprod. de l'éd. de, Holmiae: impensis Laurentii Salvii, 1766, p. 18) (original text, in Latine).

This creationist conception of human specificity dominated the western world until the middle of the 18th century. This conception was based on the Bible, according to which the mankind originated from a particular creation, separate form other living species.

However, as early as 1735, Linnaeus overcame the obstacle separating mankind from other animals by situating man among quadruped anthropomorphous (Duris, 2006). Hence Linnaeus introduced a zoological conception of Homo sapiens. In 1866, he situated Homo sapiens among mammal primates, closely related to another Homo, Homo nocturnus (the Orang-utan) (Figure 5).

However, it took nearly 100 years for this zoological conception to first appear in French secondary school syllabuses, in 1833 (Figure 6), changing the conceptions which were dominant until 1833 (as in the syllabus of 1819: Figure 4).

This DTD was very long: 98 years to integrate a zoological conception of man! How can such a slow transfer of the zoological conception be explained? An important element of explanation can be found in the classification chosen for the 1833 syllabus. Man was indeed presented in a zoological classification, but isolated from monkeys in a separate "Bimanes" order, following Cuvier's classification (1817). The DTD for this particular concept is 16 years (from 1817 to 1833). This "Bimane" order conformed to the posi-

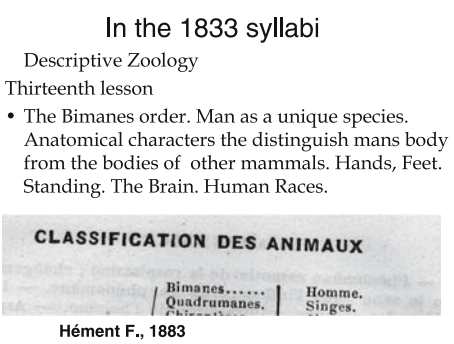

Figure 6. Translation of the 1833 French Syllabus (Circular of the 5th November 1833, Programme of Natural History in secondary schools. Belhoste pp. 135–139).

tion of the Catholic church, and was in continuity with the creationist conception separating men and animals in the 1819 syllabus. This probably resulted from the influence of Georges Cuvier (1773–1838), a famous anatomist and palaeontologist, who took a strongly anti-evolutionist position on human origins. For Cuvier, Man could not be classified in the same group as a Monkey! Cuvier also had great influence on the school system, as inspector of Public Schools and then at the Royal Council of Public Education. In particular, he was directly involved in preparing syllabuses. During this period, the Ministry of Public Schooling was influenced by natural theology. In short, the mission of "Natural History" was to demonstrate "Divine Providence".

4.2. THE SECOND PERIOD (1850–1912): A HISTORICAL CONCEPTION OF HUMAN ORIGINS

In the syllabuses of the last part of the 19th century, the continuity of geological time, and the existence of prehistoric men before the biblical period

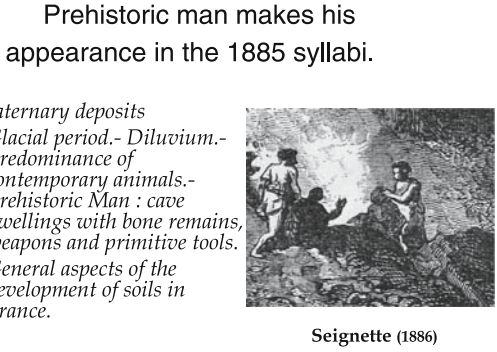

Figure 7. Translation of the 1885 syllabus (Circular 22th January 1885 in Belhoste, pp. 503–504).

of Adam and Eve were admitted (Figure 7). A highly romanced account of human origins was still given, in which mankind had first to strive to survive and then progressively developed higher and higher levels of civilisation. The difference between prehistoric man and contemporary man was still seen to be purely cultural. Thus the biological evolution of humans was not yet clearly taken into account in the French syllabuses. This secular mythical account of human origins replaces the biblical creationist version.

This historical conception emerged in different steps, from successive works. In the early part of the 19th century, the discoveries of flint by Marcel de Serres and Paul Tournal, from Montpellier, France, as early as 1827, and then those of Boucher de Perthes in the sand pits of Abbeville, in 1838, introduced the idea of pre-diluvian man. But biblical timing was an obstacle to any historical conception of man. It was only in 1856, when a cranium fragment and a long bone clearly of human origin were discovered in the Neander valley, that Neanderthal man provided the first undebatable fossil evidence of the existence of prehistoric man. In 1860, the French Academy of Sciences and the British Royal Society finally recognised the existence of prehistoric man (Cohen 1999). The epistemological obstacle of the biblical timing, with the diluvium and ante-diluvian periods, was finally overcome in the scientific community. Prehistoric man was introduced in the French school syllabus in 1885, only 25 years later (Figure 7). This DTD is much shorter than the delays observed during the first part of the 19th century.

However in precisely measuring the DTD we are confronted by the same difficulty previously discussed in the presentation of the theoretical framework: do we measure the DTD from the date of the findings of Paul Tournal (1827) and Marcel de Serres (1838), the development of the theory of anti-diluvian man by Boucher de Perthes (1838), the discovery of Neanderthal man (1856) or the conceptualization of prehistoric man (1860)?

Regardless, the introduction of the idea of prehistoric humans was probably linked to the political decision to secularise republican schools. In effect, Jules Ferry, Minister of Public schooling, declared (1880): "*it Gentlemen, the Government believes that the religious neutrality of schools is a necessary principle whose time has arisen, and the application of which can wait no longer*". Meanwhile, Edmond Perrier, zoologist and evolutionist (1882) wrote : "*Natural history ... has fought in close combat with ancient philosophies, doing away with old legends one by one, and is now preparing for its toughest battle yet, the most profound revolution ever achieved in the philosophical, political and religious orders*". These two citations are exemplary of the context and the role of Natural History in the secularisation of schools in France during the late 19th century.

In conclusion, during this second period (1850–1912), it is mostly for political reasons that the DTD introducing prehistoric man in French syllabuses was relatively short assuming a rupture with the biblical creation of man.

4.3. THE THIRD PERIOD (1912–1960): A TOTAL ABSENCE OF HUMAN ORIGINS IN THE SYLLABUSES

During the third period (1912–1960), the teaching of evolution was introduced in French syllabuses, but only for non-human beings. References to human origins were totally absent from the French secondary school syllabi through this period (1912–1960).

In contrast, among scientists during the second part of the 19th century, the idea of prehistoric man was accepted, but the idea that the human species may be of simian origin was an obstacle not only to the cultural origins of mankind, but also to its biological origin. The puritan society of the late 19th century had very hostile reactions to such ideas, epitomised by the famous debate on June 30th, 1860, between Archbishop Wilberforce and Huxley (Lecourt 1992). In his book "The Descent of Man" (1871), Charles Darwin described particular aspects of man's evolution: becoming biped, use of technology, and increased brain capacity, that for Darwin developed simultaneously, suggesting an honourable lineage of intelligent bipeds having mastered the use of tools (Leakey 1994). The shift from divine creation to biological development was sudden and brutal. The idea of a biological evolution of the human species was admitted, with monkey-like ancestors, but doted with conscience and intelligence compatible with the divine nature of the humankind. With the work of Darwin, the refusal of common origins with monkeys was weakened. During the first part of the 20th century, this evolutionary conception was accepted by the scientific community, even if the place of prehistoric discoveries remained the subject of debate regarding their classification among primates.

However, following this rapid transposition regarding prehistoric man during the latter part of the 19th century, the early part of the 20th century was characterised in France by a regression and then the complete disappearance of the notion of evolution of the human species in French syllabuses. Why was there no didactic transposition of human evolution during the period? One hypothesis is that the data on prehistoric humans were discordant and thus could not be taught in the positivist context of this period. Louis Liard, vice rector of the Academy of Paris and Secretary of the Superior Council of Public Schooling, in a conference on science in secondary education in January 1904, defined the sciences as being "*positive*" referring to the positivist philosophy of Auguste Comte. Pertaining to natural sciences, he stated that "*one is not teaching when one transforms*

into disciplinary doctrine what should be above all the teaching of facts'' (Liard 1904). Another hypothesis is that the Catholic religion influenced education policy, limiting the teaching of evolution to non-human beings during the religious reaction following the secularisation of schooling.

4.4. THE FOURTH PERIOD (1960–2005): THE HUMAN EVOLUTION IS TAUGHT

During this period, human evolution appears in the French syllabuses. Initially a linear, finalist conception of human origins was proposed, which corresponded to scientific conceptions of the 1950s (Teilhard de Chardin 1956). This conception has been progressively transformed into a contingent and ''bush-like'' conception of human origins with many branches, corresponding to the scientific conceptions of the 1990s (Figure 8).

The syllabuses closely followed the major changes in views in paleoanthropological research. In this regard, Picq (2002) qualified the 1990s as *''the decade of apocalypse for all the conceptions on the evolution of primates, monkeys and man. In only a few years time, the diversity of our lineage has emerged to a very surprised modern man, unique survivor of a past far more complex than we had suspected''*. These fast changes in the syllabuses demonstrate a considerable acceleration in the DTD of recent scientific knowledge pertaining to the subject of human evolution.

Since the 1994 syllabuses, the origins of modern man developed in conjunction with arguments from population genetics, indicating that modern man is composed of a single common species. These arguments serve to demonstrate that the notion of human race has no biological basis. In the most recent 2001 syllabuses, the hypothesis regarding the origins of this unique species is that we are all the descendants of a small population originating from Africa. Thus only the monocentrist conception of human origins is proposed in the latest French syllabuses, attesting a clear choice to not transpose the polycentric hypothesis.

In this period, the DTD became very short (less than 10 years). Several hypotheses can be advanced to explain this:

In the 2001 syllabi

The **humain lineation**

- The bushy aspect of hominid species evolution
- The origins of modern man, *Homo sapiens*.

Figure 8. Translation of the 2001 syllabus (Circular 30 August 2001 – BO n°5 – Programme S, senior year)

– The need to align syllabus content with available scientific knowledge, now very rapidly presented to a wide public via the media, presumably because the origins of humankind is a very popular topic.
– A great deal of scientific knowledge on this topic is now available, with convergence between several approaches (palaeontology, genetics, palaeo-ecology, human and social sciences...), so that it is now possible to teach human origins in a more affirmative way than during the first half of the 20th century.
– The Catholic Church is now admitting evolution, at least in a finalist perspective (the goal of evolution being the apparition of *Homo sapiens*). In another study (Quessada & Clément 2005), we give a precise analysis of the different images of tree-like or bush-like representations of the origins of man in French school textbooks. The initial tree with only *H. sapiens* at its top (as proposed by Teilhard de Chardin, 1956) is today replaced by a bush-like evolution where *H. sapiens* is juxtaposed to other contemporary species of Primates.
– Political strategies have introduced more citizenship into school teaching, notably the study of "*certain major problems of the contemporary world, for example in the fields of health or the environment*" but also in the fight against racism. Indeed, racist ideas have been promoted more and more in France by the extreme right since the 1980s. This issue was in particular the focus of Circular n°77.164 of 29 April 1977 stating: "*Teaching should encompass certain key points that one should think a citizen can not ignore*". In 1991, the national committee on science education declared on November 13th *"Biology is of particular importance in non-scientific curricula. For example, the theory of evolution is an essential element of general culture today"*. To stress the unity of humankind, current French syllabuses only focus on the monocentric origin of *Homo sapiens*, adopting a dogmatic approach to this issue that is in fact far from closed.

5. Conclusions

The first conclusion of our work is related to the great resistance to introduce the biological evolution of humankind in the French syllabuses. This resistance can be related to the main epistemological obstacles identified from our historical approach.

- In the country of Lamarck (beginning of the 19th century), the content of syllabuses of the first half of the 19th century was dominated by the creationist ideas of Cuvier. These anti-evolutionist views, long approved by the Catholic Church, then remained a major obstacle to introducing human evolution in the French syllabuses.

- The epistemological obstacle of the separation between men and other animals was still in effect in the 19th century. It took one whole century after Linnaeus (who proposed to classify the Man with the Orang-utan, as 2 species of the genus *Homo*, in the group of Primates), for a zoological classification of humankind to appear in French syllabuses. An even then, the classification retained was that of Cuvier, with a clear separation between Man, unique species of the Bimanes, and the other Primates.
- At the end of the 19th century/beginning of the 20th century, the epistemological obstacle of the biblical timing (focused on Adam and Eve, and then on the diluvium) was finally overcome. The secularised republican school system decided to introduce prehistoric man in the syllabuses. Nevertheless, this was more a new historical timing than a real introduction of the biological evolution of humans, as suggested just before then by Darwin. The superiority of man over animals, and the refusal of common origins with monkeys, were both persistent epistemological obstacles. These obstacles had been overcome by the scientific community (at least partly), but not by the education system.
- The greatest resistance to the introduction of human origins in the French syllabuses was during the period 1912–1960, with the total absence of this topic in the syllabuses. We proposed to interpret this absence by the conjunction of several parameters: (i) the power of the church, still resistant to the secularisation of schools, and against the idea of a biological evolution of humankind; and (ii) the positivist position of the education system, which restricted the teaching of biology to indisputable scientific knowledge. Indeed the Prehistoric discoveries were subject to debate in the scientific community at the time. In the USA as well, biology textbooks placed little emphasis on human evolution prior to the 1960s (Skoog 2005). It would be interesting to interpret this convergence more precisely.
- Although the precedent epistemological obstacles had been overcome, and human evolution had been introduced in the French syllabuses after 1960, this new teaching was still linked to other epistemological obstacles identified by our historical approach: belief in the superior nobility of man, racism, finalism, and over-simplification.

Secondly, we have shown in this work that the DTD can be an interesting indicator of socio-cultural influences on the teaching of sciences. During the period studied, DTDs varied from a decade to a century. We have shown that DTDs were clearly influenced by the conceptions of the curriculum developers (mainly their values), by the education system and, more generally, by the socio-political context in each period. Short DTDs in recent years are probably also linked to the development of modern media.

The longest DTD correspond to periods in which there were still great debates within the scientific community, and in which the influence of the Catholic Church prevailed. The shortest DTD correspond to periods where there was a socio-political project in education, such as the secularisation of the French republican school in the late 19th century, but also by introducing anti-racist positions, with the development of more citizenship education.

From this study on the teaching of human evolution in France, we conclude that it is clearly difficult to teach a topic in which scientific concepts are evolving so rapidly, and even more so when these topics are strongly tied to ideological values. We, therefore, recommend introducing epistemological reflection into teacher training and a historical approach to science in curricula, including reference to this topic in particular, as this would undoubtedly favour the ability of students to develop a critical outlook on new discoveries on this subject of never ending debate.

Outside France, the teaching of evolution, and more precisely human evolution, is currently encountering more and more difficult in several countries. This is the case in Christian countries such as the USA (Lecourt 1992, and recurrent judgements in several states since the one analysed by Lecourt), but also in Muslin countries like Algeria or even multi-confessional Lebanon (Harfouch & Clément 2001). These situations differ from the historical situations analysed above (in France during the 19th and 20th centuries) in that today, the entire scientific community has accepted the Neo-Darwinian theory of evolution. Although strong debates still oppose specialists on precise aspects of evolution processes or the interpretation of particular discoveries, all scientists are in full agreement about the general principles of evolution. In this context, the DTD essentially measures the weight of systems of values in each society. A European research project (involving 19 countries, 6 outside Europe) is starting to compare the syllabuses and school textbooks concerning this precise topic of human evolution. This collective research will use the instruments, concepts and perspectives presented in the present work.

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