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Social Sciences Department

Heritage, Communities, Sustainability

Workshop 3 (Coord H. Guetat-Bernard)
Socio anthropological approach of local knowledge in agroecology

Biodiversity for agroecology: Understanding the memory of plants and people

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PLAN

I The multiple dimensions of the agricultural biodiversity

II Strengthen the foundation knowledge

Precursors and biological basis of genetics
Darwin and the evolution by natural selection
Epigenetics and cultural epigenetics

III Rehabilitate Darwin's philosophy

The drifts of social Darwinism: Neoliberalism claim for adaptation
Darwin revisited by the pragmatist philosopher John Dewey
How Darwin-Dewey thinking applies in agrobiodiversity management?
Darwin-Dewey based philosophy ?

IV Valuing women' plant knowledge for family agriculture

Why knowledge gaps regarding women's knowledge on nature, agriculture, and, more generally, on plants?
South knowledge from rural people and women in the South under threat

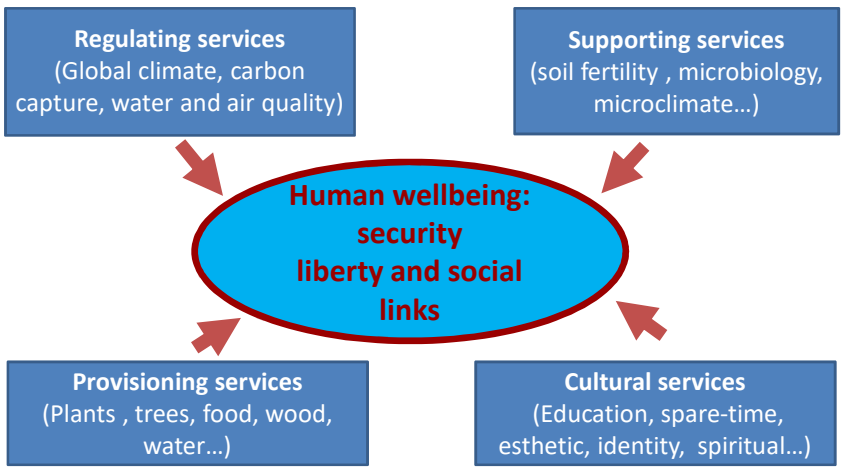
Theoretical Sources

I Agricultural biodiversity

- Agricultural biodiversity refers to the genetic diversity and evolving interactions within biological and microbiological organisms that contribute to agricultural production.
- In the historic process of renewing their seeds and livestock over centuries, farmers have bred plants and animals on their lands with a specific composition and genetic structure by maintaining a greater or lesser diversity, depending on their context, needs, uses, food habits etc.
- The seed's management is traditionally based on non-market exchange networks (self-production, inheritance, gift, barter, etc.) which operate at various levels, ranging from the farm to small natural areas.
- In Africa and South Asia, the seed management is part of women activities or related with the matrimonial systems. Hands-on learning and knowledge sharing and transmission within the community group are local specific and very often gender specific.

Agricultural biodiversity management encompasses social, cultural, economic, health and environmental dimensions.
Any loss of crop biodiversity thus reduces the options of managing agricultural and food-security and affects the social organization

The Nature's contributions to people wellbeing provided by biodiversity was conceptualized in the four pillars of Ecosystem Services (MEA, 2005)



The concept of nature's contributions to people was emphasized by the social science community considering the need to recognize its cultural and spiritual impacts **that unifies family farms, villages and regions.** In this view, **the local people culture** is the lens through which ecosystem services are perceived and valued.

For exemple, food is generally considered to be a provisioning service, but can be categorized both as a material and a non-material contribution by nature to people.
In many societies, people's identities and social cohesion are strongly linked to growing, gathering, preparing and eating food together. It is thus the cultural context that determines whether food is a material contribution by nature to people, or one that is both material (Provisioning) and non-material (Cultural Social).

Inter-governmental Platform on Biodiversity and Ecosystem Services (IPBES, 2014)

The objective of the **IPBES (created in 2014)** is to provide up-to-date available knowledge to make informed political decisions at the local, regional and international levels. Provides a critical analysis of the state of knowledge regarding the importance, status, and trends of biodiversity and nature's contributions to people.

Asia-Pacific Regional Assessment (SUMMARY FOR POLICYMAKERS FOR ASIA AND THE PACIFIC_ IPBES 2018)

- The region represent 30 % the world's agricultural land and 87% of the world's small farms, most of which support a wide range of native crops.
- Agriculture and aquaculture remain the main source of income and nutrition in the region
- Accelerated growth (Green Revolution) and urbanization **cause permanent loss of biodiversity in the ecosystems**
- **Traditional agrobiodiversity is in decline, along with its associated indigenous and local knowledge**, due to a shift towards intensification of agriculture with a small number of improved crop species and varieties.

II Necessity to strengthen foundation knowledge

The great precursors

The bases of varietal selection and modern genetics have been laid in the 19th century by **Charles Darwin** and **Gregor Mendel**, separately but in a complementary way.
Nicolai Vavilov, in the 20th century, established centers of origin and domestication of cultivated species.

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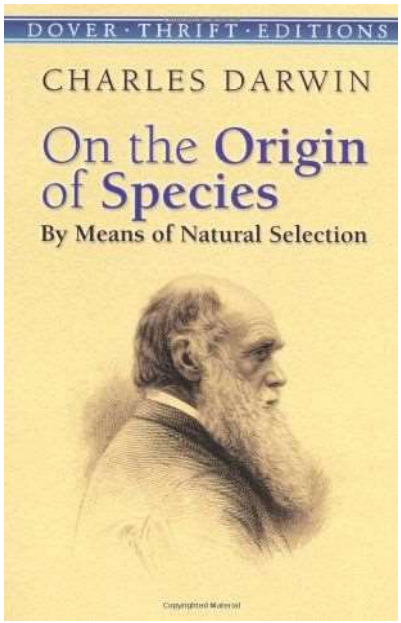

Charles Darwin's Book (1859)

Natural selection theory is still alive

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Gregor Mendel (1822-1884)

Mendel's Laws (1866) on the inheritance characters

Individuals transmit their genes from one generation to the next on a mechanical / deterministic basis (available only for simple traits)

Mendelian genetic is the basis of modern genomic was established on 'simple character' (controlled by few genes as color by ex.)
Not integrate the development and the evolution

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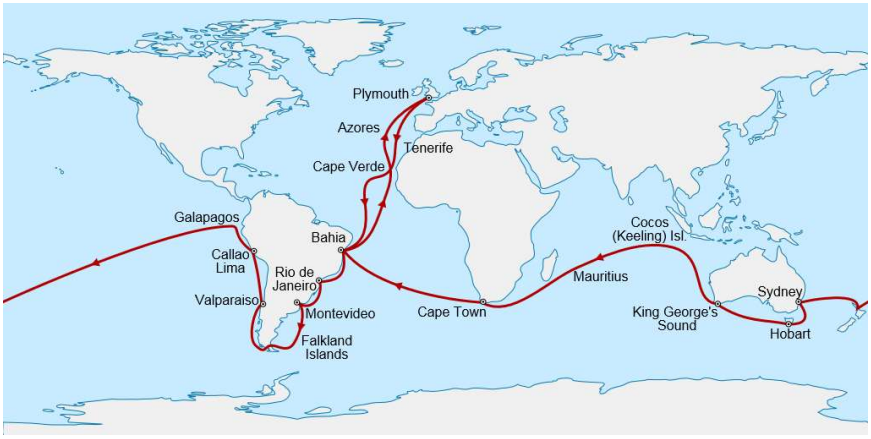
Map of the Voyage of the Beagle, a circumnavigation travel with Charles Darwin

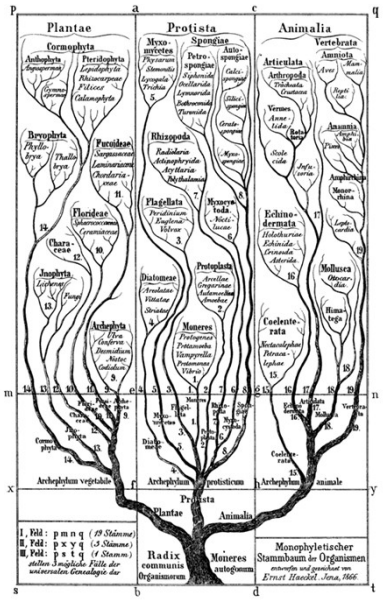


The idea of evolution by natural selection was proposed by Charles Darwin in 1859

- The key to understanding the meaning of natural selection theory is to know that Darwin conceptualized it based on observations of biological phenomena *in situ* during trips around the world .
- The maintenance of life, to feed, to heal, to reproduce, is the fruit of a constant evolution in which fortuit, chance has an important part. The result is that biological adaptation is bushy (schema).
- There is no winning adaptation, but multiple possible paths consisting of uninterrupted series of multiple bifurcations in a multiplicity of local environments.

Darwin' vision : evolution by natural selection is multidirectional and bushy

1879



Tree of Life by Ernst Haeckel (1866)

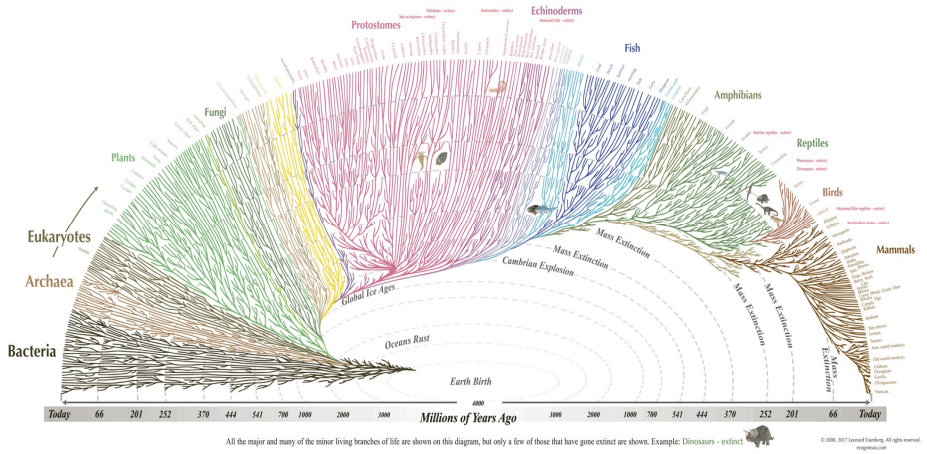
Many trees of life have been drawn since Darwin published **On the Origin of Species** (1859).

One of the first was by renowned German naturalist and embryologist Ernst Haeckel (1834-1919).

In his book **The Evolution of Man** (1879), Haeckel accepted the common ancestry of life, but differed from Darwin in favoring inheritance of acquired characteristics over natural selection as the means by which species form.

https://www.evogeneao.com/learn/tree-of-life

2010



https://www.evogeneao.com/learn/tree-of-life

Nicolaï Vavilov (1887-1943)

The works by **Nicolai Vavilov** were aimed at researching the centers of origin and the primary domestication of cultivated species.

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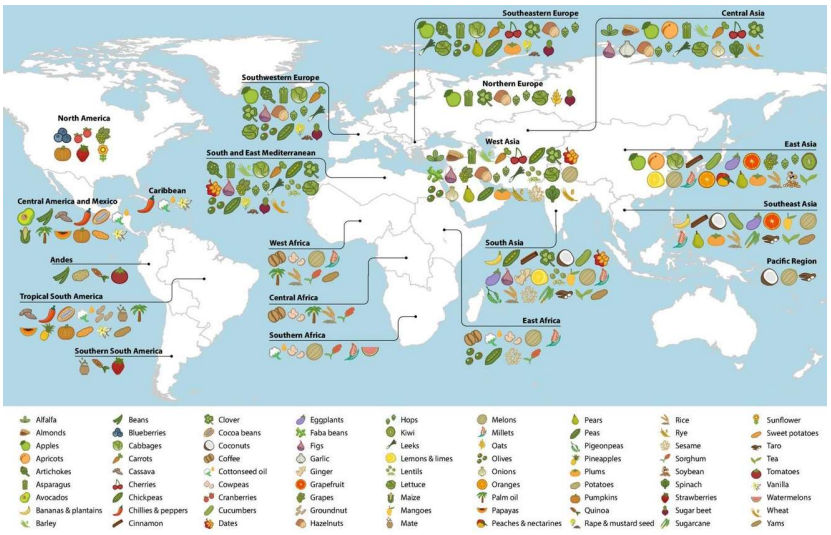

Primary regions of domestication and diversity of major agricultural crops worldwide (from Khoury et al, 2016)

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Relationship between genotype and phenotype

Previous credo ('Central Dogma' of molecular biology : one way **DNA Encodes RNA, RNA Encodes Protein**) : individuals transmit their genes (DNA) from one generation to the next on deterministic, fixed and one way basis (Crick, 1970)

Recent advances in the understanding of **gene regulation** + **epigenetics** (from the nineteen's): **gene and gene's expression can be modified by no DNA molecular phenomena**.

DNA sequence of genes + gene regulations + Epigenetics (no DNAs) shape the Biodiversity expression and this is not stable over time according to multiple factors of the environment

Properties of epigenetics marks : Observable on phenotypes, Heritable , Can skip generations to be expressed and transform DNA pattern (genotype)

Biodiversity contains a form of memory that results in phenotypes with diverse DNA profiles and epigenetics marks (expressed or not) acquired during the history of organisms (the development and evolution of their ascendants)

Cultural epigenetics

For Human, non-genetic transmission of behavioral traits were established before the biomolecular basis of epigenetics are laid

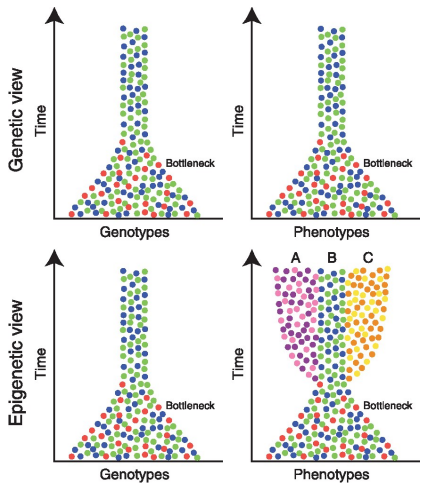
ex : education can transmit psychologic resilience , traumatic stresses of parents can have negative impact on children, post-war effects , Inuits population, Ashkenazi Jude etc.

Epigenetics marks resulting of stresses responses on plants, animals and humans are **observable in terms of evolution of allelic distribution** from a generation to other in peculiar populations (Eva Jablonka , 2016, 2017.

➡ **Epigenetics marks acts as adaptive memories that may be activated (or not) when environment is changing. This put a strong interest of local plants selected over time by farmers under strong environmental constraint, as drought for example.**

News interdisciplinary fields of research are necessary at the frontier between the biology to understand adaptive mechanisms under the environment pressure .

Genotypes and Phenotypes according to genetic perspective



Above:
From a traditional (fixist) genetic perspective:
A bottleneck occurs in genotypes and their phenotypes according to the requirements of drift and natural selection : loss of diversity at both the phenotypic and genotypic

Below :
From an epigenetic perspective:
Phenotypic diversity is increased by epigenetics mechanisms possibly mediated by genetics events (mutation, hybridization) but more frequently by extreme environmental selection or ecological change

From Ryan A. Rapp, J. Wendel, 2005. Epigenetics and plant evolution. The New phytologist

Epigenetics is of restricted use in the genetic's scientific communities

Old question of the transmission of acquired characters

We know today that gene expression are modified by a multiplicity of mechanisms of repression/ activations , mutation, genetic drifts and **also by epigenetics marks that are non DNA mechanisms : for a unique DNA pattern there are multiplicity of gene expressions among an abundance of possible other patterns**

However the fundamental enduring doctrine of modern genetics and breeding remains **determinist** (phenotypes are determined by DNA sequence variation).

Epigenetics is demanding to integrate in modern breeding research because this needs to develop new protocols that not respond to the standards and probably difficult to be repeated

Epigenetics memory is important in the evolution of biodiversity of plants and animals according to environments.
Knowledge on *in situ* biodiversity conservation and management are paramount to found adaptive responses under strong changing environment.

Effect of the cultural environment on the genomes

Recognizing that there are epigenetic inheritance systems through which non-DNA variations can be transmitted in cell and organismal lineages broadens the concept of heredity and challenges the widely accepted gene-centered genetics.

Any social-cultural-biological landscape exhibits two phenomena on : *canalization* (phenotypic uniformization) and *plasticity* (phenotypic diversification) mechanisms (Jablonka, 2017).

The observable phenotypes are **the result of reciprocal and flexible relations among multiple biological and social-cultural resources** that affect the life-trajectories of individuals (Ingold and Palsson, 2014, Biosocial Becomings, Cambridge University Press 2014, https://doi.org/10.1017/CBO9781139198394)

Communication between biology and the social sciences will be problematic as long as biology is limited to measuring differences between DNA sequences *ex situ*

Bibliography

Eva Jablonka, 2016, Cultural epigenetic, The Sociological Review Monographs, 64:1, pp. 42–60
https://www.youtube.com/watch?v=D-jyG4H3iPs , The biology of culture: the epigenetic bridge

Eva Jablonka, 2017, The evolutionary implications of epigenetic inheritance, Interface Focus 7: 20160135.

Khoury CK et al. 2016. Origins of food crops connect countries worldwide. Proc. R. Soc. B 283: 20160792.
https://royalsocietypublishing.org/doi/pdf/10.1098/rspb.2016.0792

Edith Heard, Cours au College de France (2018/2019): Epigenics underlying biodiversity within individuals and species
https://www.college-de-france.fr/site/edith-heard/course-2018-12-04-16h00

III Rehabilitate Darwin's philosophy

After Darwin, Science has proved that genetic modifications is a permanent long term processes. This process have occurred from Neolithic during the course of plant domestication

- the mechanisms is natural selection
- genes and genomes are then the expression of this evolution
- evolution is characterized by a dynamic: a temporality and the constant change of the environment constraints.

The drifts of social Darwinism

- In the neoliberal conception of adaptation, the injunction to adaptation concerns individuals who are called to more flexibility and mobility in order to benefit from a just and unpredictable economy : **neoliberalism claim for adaptation (Barbara Stiegler, 2019)**
- In the typically neo-liberal conception of democracy, experts are entrusted with fabricating consent (acceptability) in the name of a desirable future based on economic growth. (experts, in behavioral economics or personal development, must model people to make the necessary efforts to adapt.
- In this misconception of Darwinism called the '*social darwinism*', the idea of competition between individuals ('survival of the strongest-fittest') has surpassed the conception of the '*biosocial becoming*' that encompasses a multiplicity of ways to adapt.

Social Darwinism as the individual injunction of adaptation to a predefined model is a betrayal of the thought of Darwin

Misreadings of the *Darwinism*

- The pragmatist philosopher John Dewey (1859-1952) wrote '*the Influence of Darwin in philosophy*' fifty year later Darwin's theory of evolution
- In the scientific social world: misinterpreting Darwin has transformed the 'struggle for existence' into a 'law of the strongest'
- Most plant molecular biologists operated a reduction of Darwinism by transforming it into a '*Cartesian Dream*' of immutable, fixed DNA 'magic formulas'
- No species nor variety of plant is genetically unchanging for eternity. They vary in a changing environment. Fortunately.

John Dewey, a pragmatist philosopher of experience

Theories derives from actions

Educational system must respects all sources of experience

The name of the movement with which the America's philosopher John Dewey is identified is **Pragmatism**, it comes from the Greek word meaning 'action'.

Dewey was a **philosopher of change**, who consistently sought to apply Darwin's evolutionary theories to all areas of philosophy. Dewey had a profound influence on fields such as education, politics, ethical theory and aesthetics.

Dewey argued **that 'all knowledge is derived from experience'**, and that **'ideas must be referred to their consequences'** (idea of ETHICS). Philosophy of experience implies that **all experience and offering true learning situations** both orderly and dynamic.

Darwin revisited by Dewey

- Philosopher Dewey (1859-1952) takes the Darwin notion of adaptation in multiple directions in theorizing the processes of co education
- Dewey defend a radical participatory democracy
- He build strong hypothesis based on Darwin's observations: the relationship between living organisms and their environment is dialectical.
- Its definition of adaptation is based on human interest has nothing to do with the imperative neoliberal of adaptation

Dewey's conception of adaptation is based on = education + experimentation in a process of continuous education

How Darwin-Dewey thinking applies in agrobiodiversity management?

2 opposite options:

- Mainstream (still dominant) option= **productivist agriculture,** the aim is to try to modify the environment, to make it more uniform while,

  Example: introducing and marketing a new genotype with high yield, by artificializing deeply the environment.

- Alternative, defended by **family agriculture** that have developed close interactions between their environment, modes of agriculture, food, cooking, caring and socio-cultural practices.

  Example: growing a range of varieties or varieties-populations for different uses and which themselves have a potential for evolution thereby the ability to adapt.

Alternative is preferred by human populations in phase with their environment, in particular the women farmers of the Family South agricultures .

IV Valuing women' plant knowledge for family agriculture

Gender issues, and rural women, are crucial to the conservation and use of plant genetic resources worldwide

Women often have greater knowledge and a more diversified perspective on on plants resources because they are responsible for producing or procuring a large number of plant resources and for storing and transforming plants to meet household needs and for ensuring household food security and family health

'When women select varieties for their fields or gardens, they consider not only agronomic characteristics, but also those related to processing, storage and consumption needs. Even when women aren't involved in production, their criteria enter into men's varietal decision-making. Women are often responsible for seed management including selection, storage and exchange'

(From Howard and Cuijpers, 2001)

The negative effects of natural resource reduction are accented on rural women activities

Population pressure
Climate disruption
Drought
Land pressure

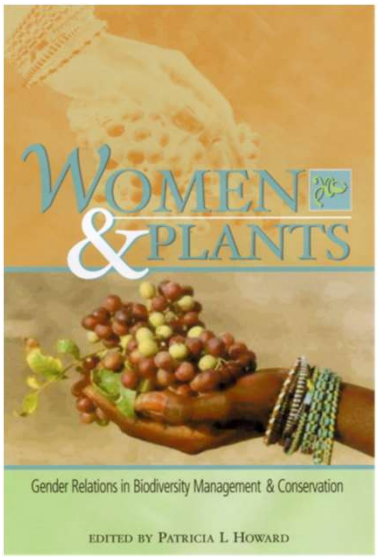
Global reduction of natural resource and biodiversity available for food and heath uses

Space near the house for gardening and rearing are limited

Diversity of wild plants is reduced

Access to irrigation water and firewood is limited

The soils are degraded (less organic matter by animals)



Experiences and knowledge of women on large diversity of cultivated wild plants and trees for food, cooking and medicinal uses

Women play a key role worldwide especially in the South to preserve the local resources knowledge and traditional practices in agriculture and for food uses.

Knowledge from rural people in the South are under threat du to under consideration of some plants of them

Social cultural knowledge of the Darwinian type, that is to say, stemming from past evolution and resulting from the struggle to ensure the continuity of life

Post colonization 'development'

has accelerated the loss of knowledge by targeting man and developing the exploitation of particular species to the detriment of the conservation of their diversity and knowledge

+ Patents, WTO agreements: the occidental liberal notion of individual benefits amplifies the phenomenon of marginalization of historically constructed knowledge on plants today called of 'neglected plants'

Southern societies

traditional knowledge is 'possessed' by no one and gendered

used and developed for the benefit of the entire community and sometime the exclusive use of knowledge for individual profit is reprehensible.

Women knowledge and choices are concealed

Women have access, have built, and transmits (sometimes exclusively) to the majority of culinary knowledge from local plants, caring practices and medicinal recipes that can be easily misappropriated from the private sphere to merchant sphere and so main benefits can escape to women

Women implication on agroecology is massive compared with the men but not valued

Seasonality of production for the period of food shortage is traditionally managed by women. In Dryland Africa : women choose their own areas and restrict their production to small gardens with access to a water source

Their technical knowledge on soil conservation, water management, preservation of local seeds, their role in community livelihoods and territory are developed outside the research or scientific spheres. Hence there are neglected and not financially valued

Theoretical References

- Joëlle Zask, Introduction à John Dewey, La Découverte, collection « Repères », 2015.
- Tim Delaney, Tim Madigan, “Beyond Sustainability: A Thriving Environment” https://philosophynow.org/issues/71/Dewey_and_Darwin
- Suzanne Cunningham , "Philosophy and the Darwin Legacy" (1996: P7) on how Darwin influenced the Pragmatist
- John Dewey , Experience and education (1938)
- Bruno Latour, Madeleine Akrich and Michel Callont, he Sociology of Translation and the Concept of Technical democracy, by B
- Brandt et al, 2013. Sustainability Science : interdisciplinary alliance which is better defined by the problemes it adresses that the disciplines it employs (Review of transdisciplinary research in Sustainability Science)
- Eva Jablonka2016, 2017, Cultural epigenetic and evolutionary implications of epigenetic inheritance
- Barbara Stiegler - « Il faut s’adapter »

https://www.franceculture.fr/emissions/avis-critique/b-stiegler-sur-linjonction-a-sadapter-m-ferraris-sur-la-post-verite