School on integrated environmental and health impact assessment (IEHIA)
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Climate change, both a risk and a biomarker of human self-inflicted sickness

2d part
Emerging risks and diseases

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The new medical landscape

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- **Emerging risks**
  1. **Age**
  2. **Sun**
  3. **Air pollutions: surface ozone , particles, allergens, pollens, spores**
  4. **Toxics (endocrine disruptors, chemicals, pesticides, herbicides…)**
  5. **The new infections**
  6. **The immune risk**
  7. **The metabolic risk**

- **Emerging diseases**
  1. **Chronic non transmissible age-related diseases (cardiovascular, cancers, diabetes, neurodegenerative)**
  2. **Auto-immune & allergic diseases**
  3. **The new infectious diseases**
  4. **Metabolic diseases (diabetes, obesity)**
  5. **Diseases caused or aggravated by new polluants : cancers, Alzheimer, Parkinson, autism**

Ageing, an emerging risk and a new group of diseases

- **Normal ageing means progressive changes in anatomical, physiological, and psychological changes without any real disease. Pathological ageing is associated with one or several chronic non transmissible disease**

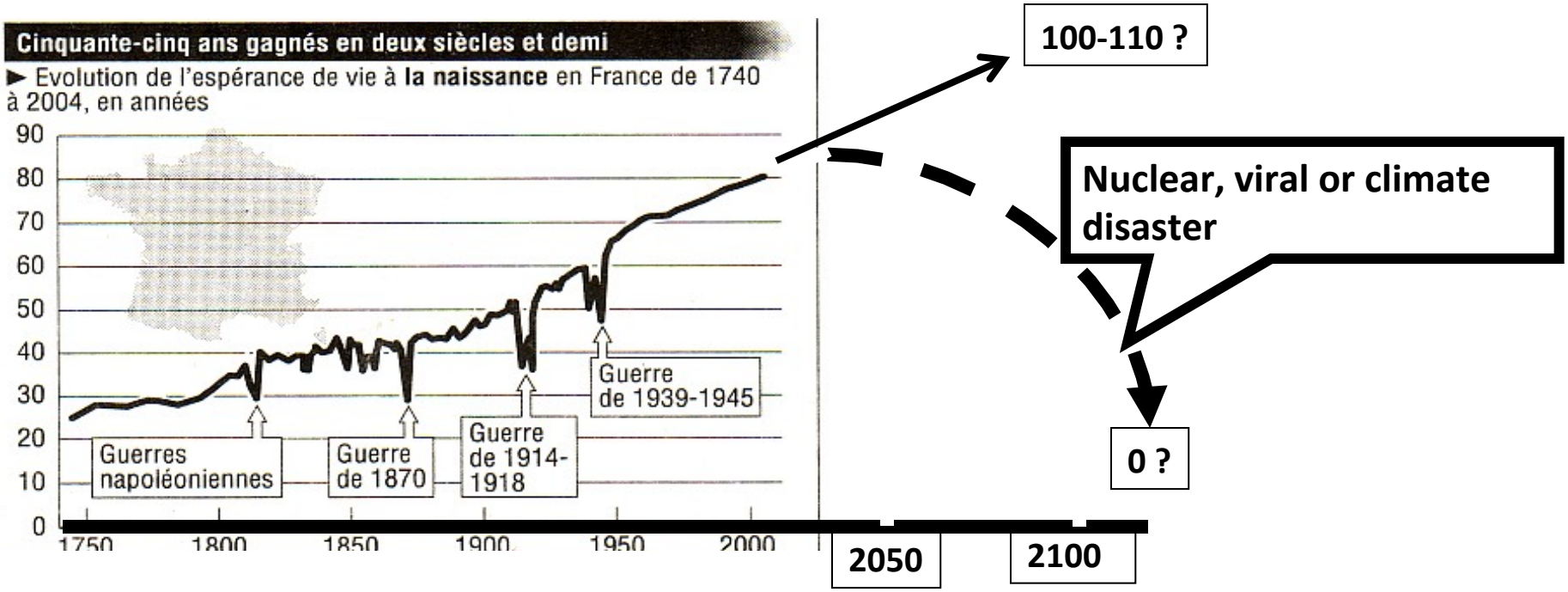
- **Mean longevity is mean lifespan. The maximum longevity is the maximum lifespan that a given species is able to live (from 10 minutes in some bacteria up to several hundred of years in sequoia or some sharks). The human maximum longevity is around 120 years.**

- **Longevity is specific for a given living species, it cannot be modified without modifications of the genome itself**

- **The improvement of lifespan which is observed in humans since one century is only shown before the age of 100 years, and is caused by the human activity. The human maximum longevity is unchanged.**

Contemporary ageing

A unique phenomena in world history entirely caused by human activity

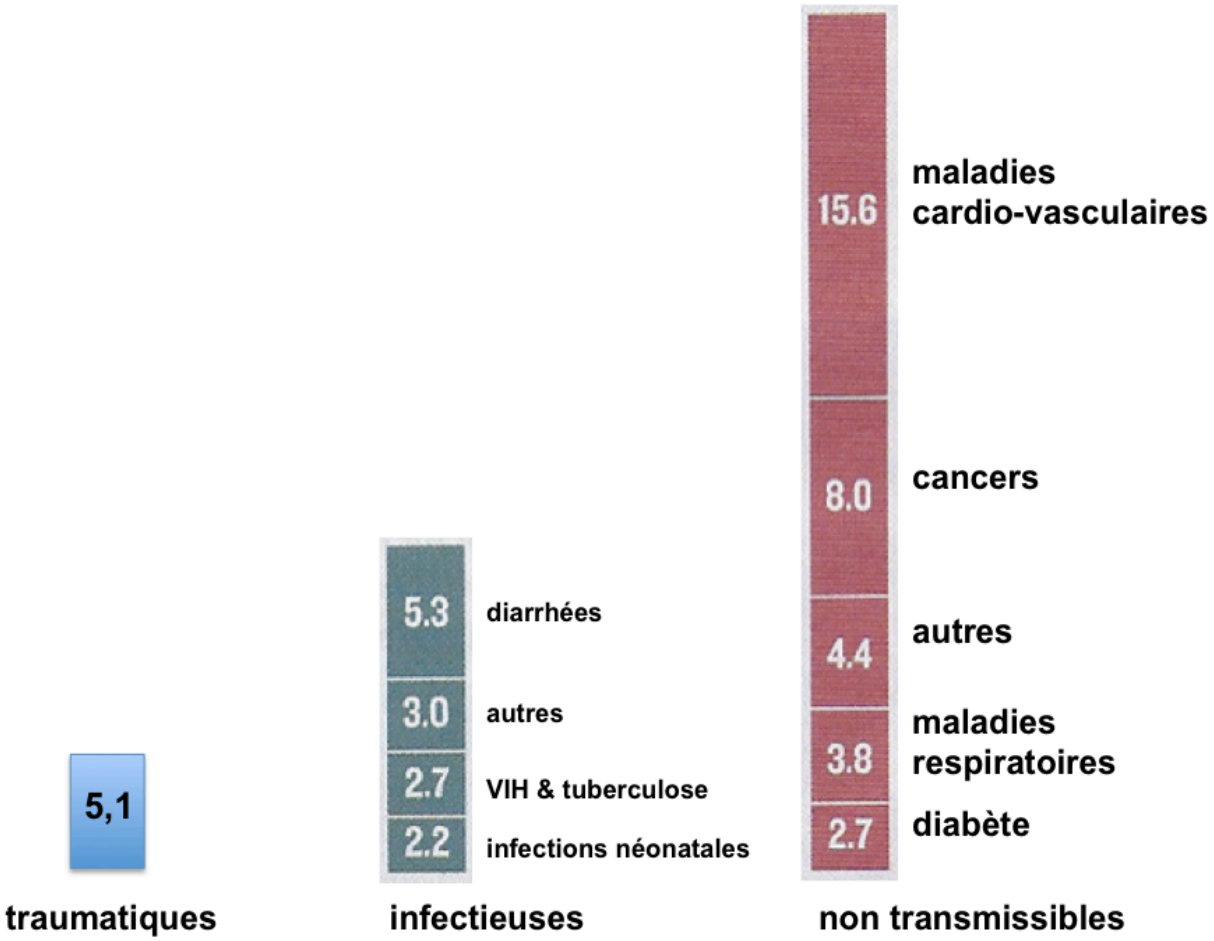


The increased lifespan and healthy ageing does not correlate with climate, but it represents the background of any approach concerning health and is now the major problem for physicians

- Human ageing is unique in the evolutionary story of life
- It concerns mainly the developed countries.
- and has major economic consequences.
- Ageing in good health, a problem of prevention.
- Chronic age-related non transmissible diseases are biological consequences of cellular senescence
- Three groups of chronic multifactorial non transmissibles diseases : cancers, some of the cardiovascular and respiratory diseases, neuro-degeneratives diseases. They represent the major causes of morbi-mortality all over the world (see *The Global Burden of Disease Study. Lancet 2016).*

The new epidemiologic transition.
In the world, there are twice more death by non-transmissibles diseases than by transmissibles diseases

[Global Burden of Disease Study, Lozano et al. Lancet 2012, 380, 2095]



The infectious risk

Germs, too much or not enough

Too much

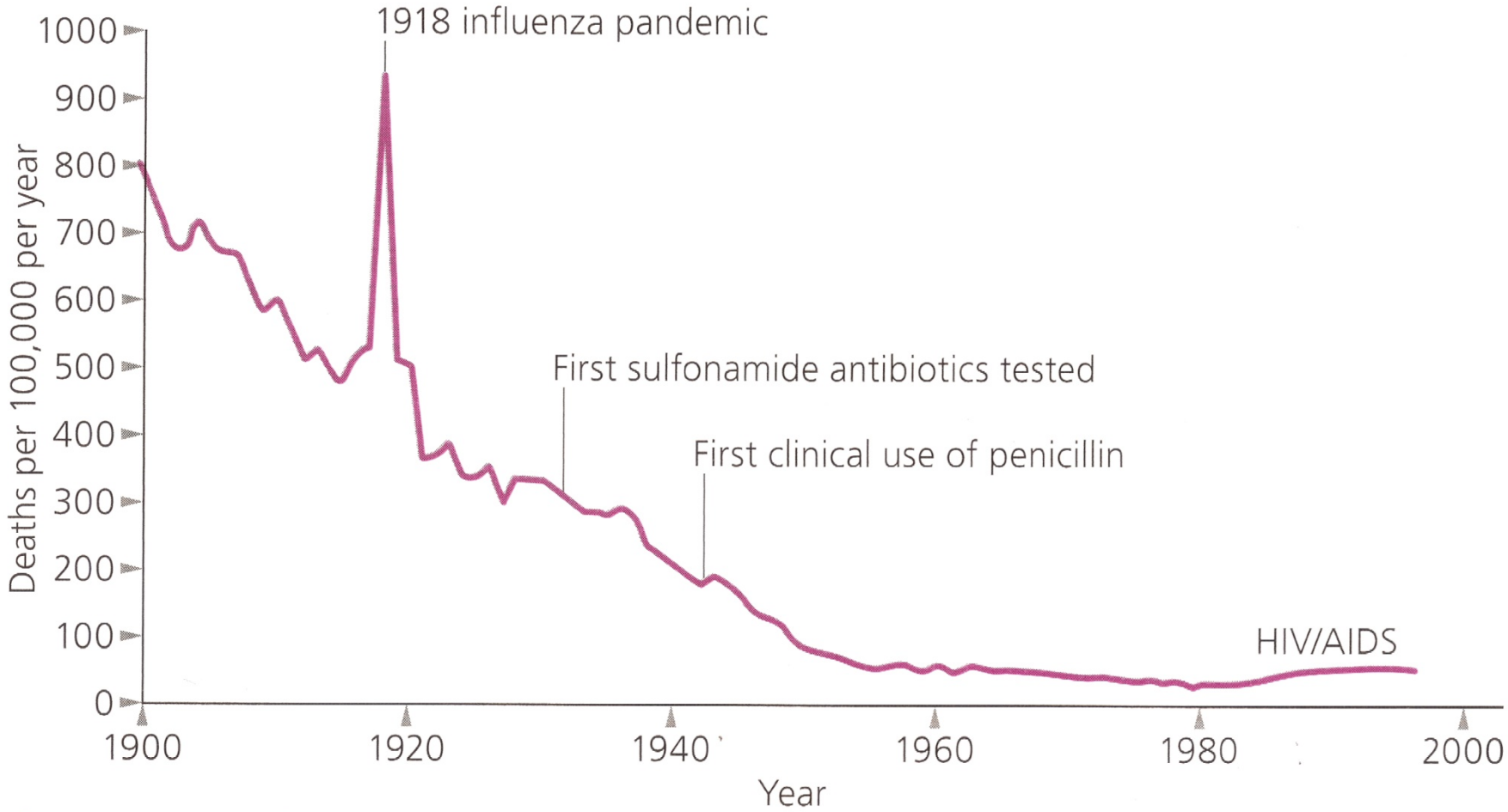


Figure 13.10 The death rate from infectious diseases dropped dramatically in the United States over the twentieth century. It began to decline thanks to better hygiene, clean drinking water, and better food. The invention of antibiotics in the mid-1900s helped push the death rate even lower. The HIV epidemic that began in the late 1980s raised the death rate, although it remained far lower than at the beginning of the century. (Adapted from Koella and Stearns, 2008)

Main categories of drivers associated with emergence and reemergence of human pathogens ranked by the number of pathogens species associated with them, most to least

[Woolhouse et Gowtage-Sequeira 2005]

1. Changes in land use or agricultural practice
2. Changes in humaan demographics and society
3. Poor population health
4. Hospitals aand medical procedures
5. Pathogen evolution (resistances…)
6. Contamination of food sources or water supply
7. International travel
8. Failure of public health programs
9. International trade
10. Climate change

Pathogenic infections, anti-biotic, anti-viral, anti-helmintic, anti-pesticides… resistance are mainly caused by multiple genetic mutations

Germs, not enough, the hygiene hypothesis

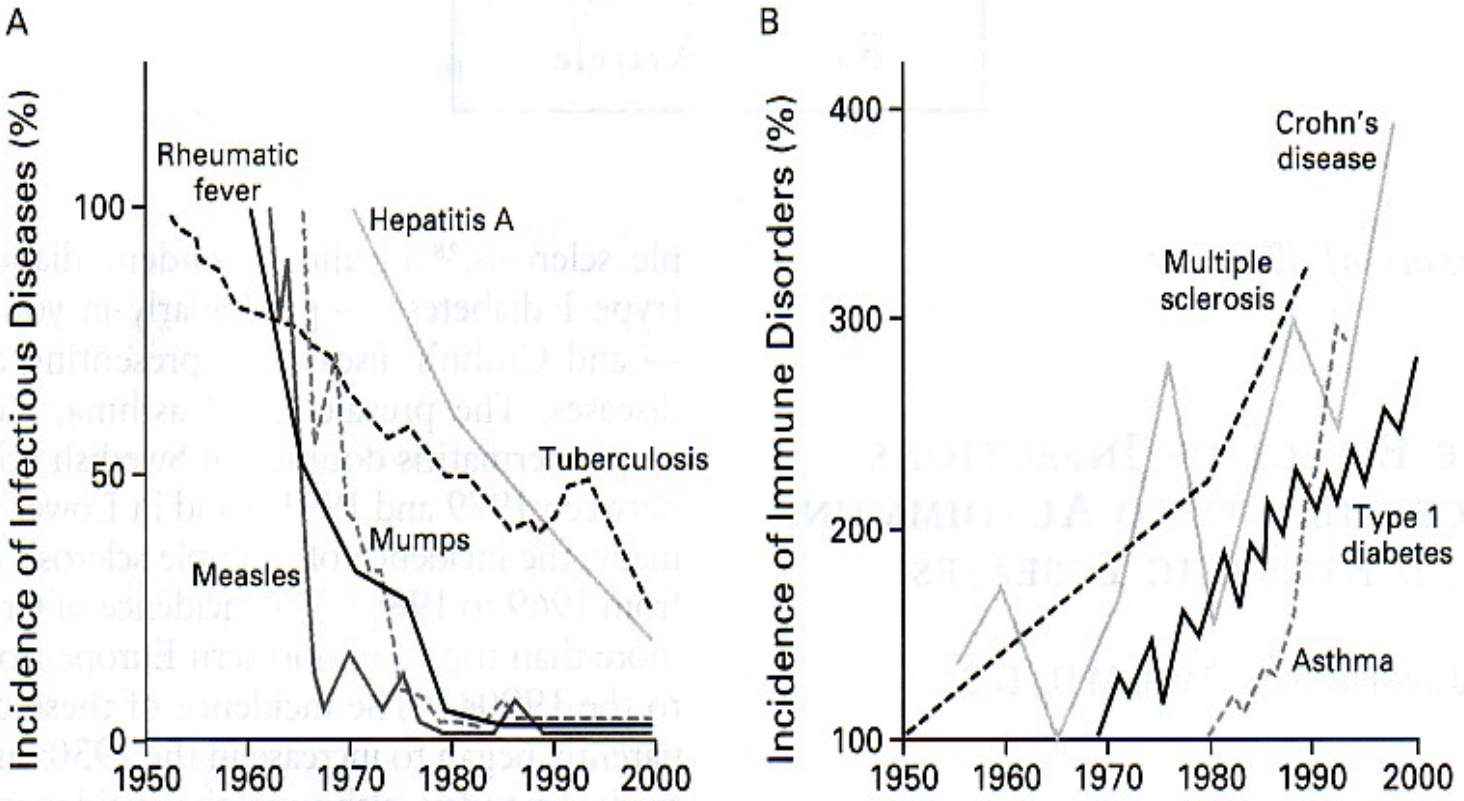


Figure 1. Inverse Relation between the Incidence of Prototypical Infectious Diseases (Panel A) and the Incidence of Immune Disorders (Panel B) from 1950 to 2000.

In Panel A, data concerning infectious diseases are derived from reports of the Centers for Disease Control and Prevention, except for the data on hepatitis A, which are derived from Joussemet et al.[12] In Panel B, data on immune disorders are derived from Swarbrick et al.,[10] Dubois et al.,[13] Tuomilehto et al.,[14] and Pugliatti et al.[15]

(From JF Bach NEJM 2002)

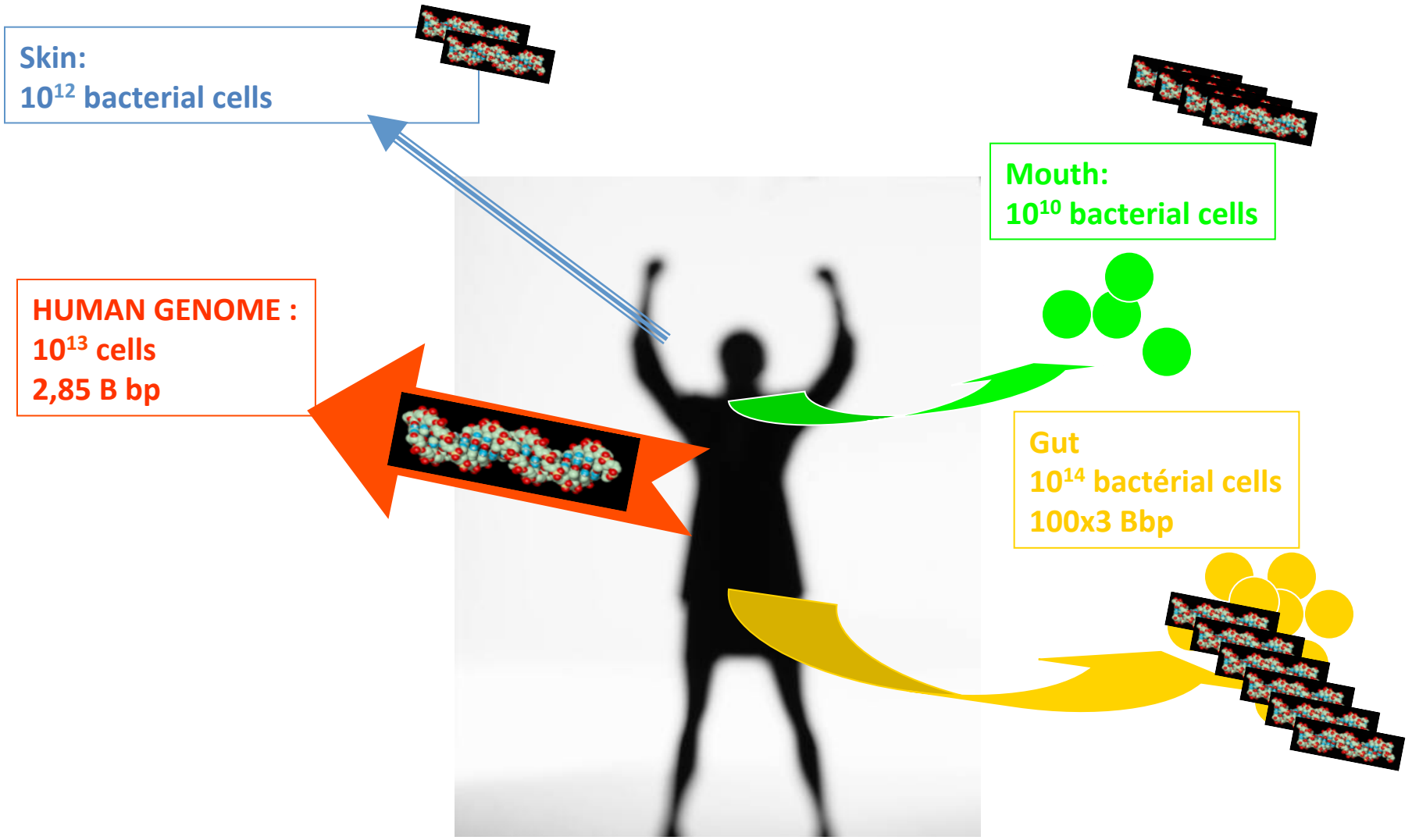
The main problem is likely to be the reduction or the relocation of the biodiversity of our gut (bacteria, toenia, archae, virus…) that modifies our immun system (as for asthma [Blaser 2009], obesity [Million 2011], atherosclerosis [Tang 2007]…). Remember that stomach ulcer is now an infectious disease, perhaps also Parkinson disease.

This is likely to be the main determinant of the increased incidence of auto-immun/allergic and metabolic diseases in our countries. This is why changes in biodiversity have consequences on public health.

The biodiversity changes in the procaryotes kingdom at the level of the biotic or abiotic microbiote and its consequences

a burning topics

The biotic microbiote, a model of co-evolution



In human, as in every living species the microbiote is a metabolic constituant of an ecosystem with a major role in the genesis of the immun system.

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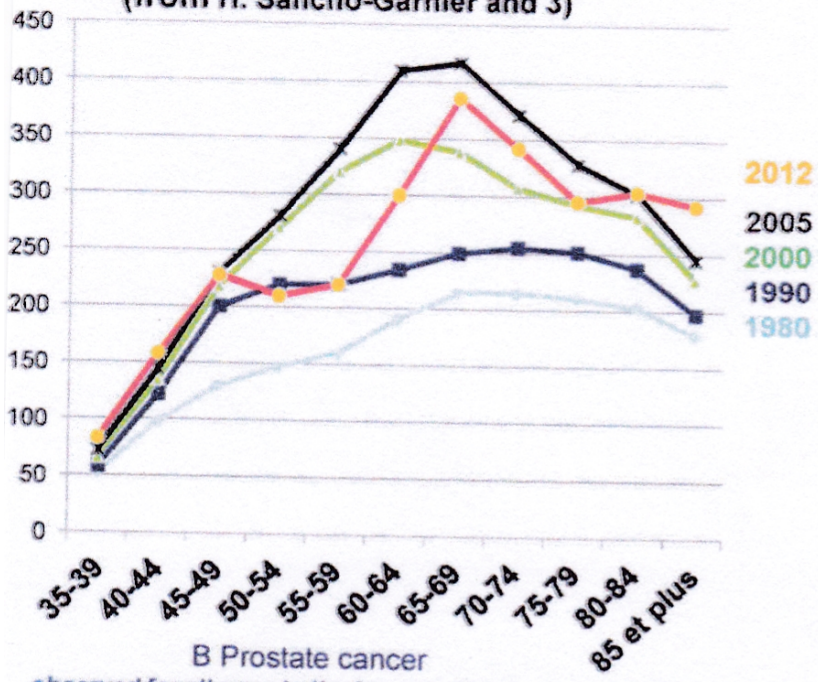
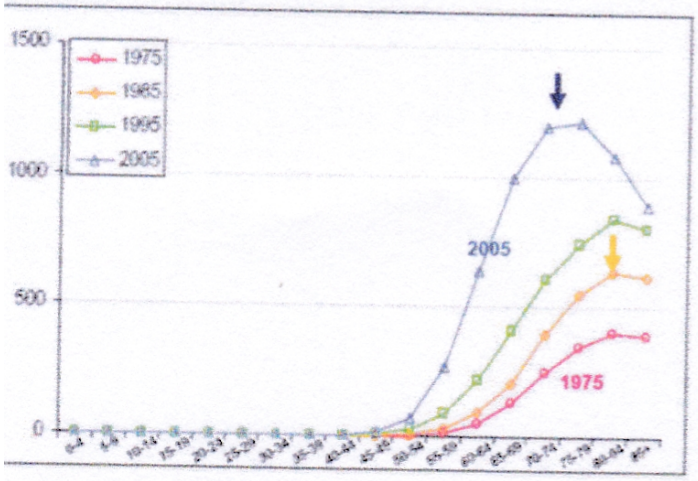
Figure 1 | Data mining. The abundant microorganisms in Earth's soils perform myriad ecosystem services, many of which are still poorly understood or remain unrecognized. The best ways of identifying and studying these processes is a topic of debate in the ecology community.

The toxic risk and pollutions

A/ Breast cancer incidence in France
(from H. Sancho-Garnier and 3)



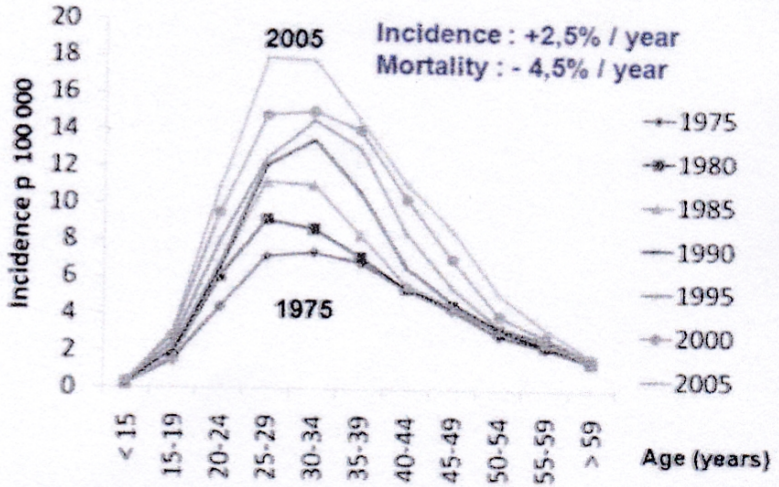
B Prostate cancer
observed for all ages (+displacement to younger men)



The increased incidence of new cancer cases In France was not only due to aging since it was observed for all ages

C Testicular cancer

A man born in 1970 has a 2 fold higher risk than if born in 1939 (R Slama, *Rev Epid Santé Pub*, 2004 and P Jouannet).

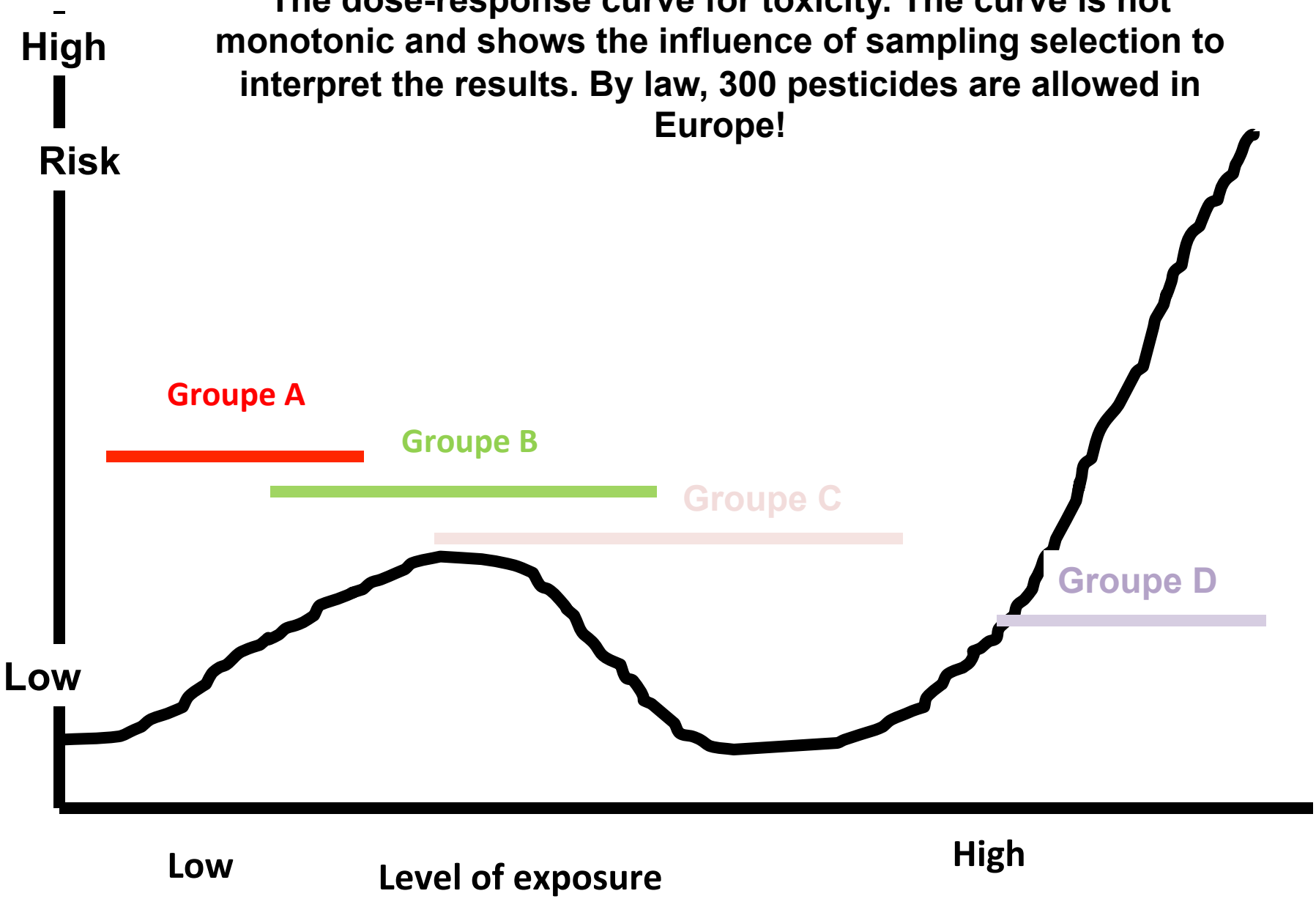


Increased incidence cannot be explained by aging or screening

Evolution of cancer incidence in France, from the 'Institut national de veille sanitaire'. February 2008. www.invs..fr

Age-independent increase in the incidence of three hormone-dependent cancers in France from 1980 to 2005. Evolution of epidemiological cancer 1980–2005, "Institut national de veille sanitaire", février 2008. http://www.invs.fr.

The dose-response curve for toxicity. The curve is not monotonic and shows the influence of sampling selection to interpret the results. By law, 300 pesticides are allowed in Europe!



[Vandenberg et al. Endocrine Rev 2012]

Pollutions related to climate events

[National Institute for Environmental Health Sciences. A human health perspective on climate changes. 2010]

- Diffusion of cancerogenic substances caused by heat (lung cancer and diesel) …

-Flood-related diffusion of endocrine polluants (hormone cancers), antibio-resistant bacteria…

-Hurricane-induced dispersion of pesticides…

The relation between atmospheric pollution and respiratory and cardiovascular diseases

- Prolonged exposure to particles PM<2.5µm*, is a major risk factor. Every increase of 10µg/m^3 is associated with a global increase in mortality of 6% . The cardiovascular mortality risk is augmented by 11% (coronary disease and stroke) ** and mortality caused by infectious pulmonary diseases 3% [Laden 2000, Miller 2007, Hoek 2013, Faustin 2014, Atkinson 2016, Bourdrel 2017]. To live near a highway increase the cardiovascular risk [Hart 2014].
- It is possible to reduce such a risk by reducing diesel utilisation (a compariso between Tokyo and Osaka [Yorifuji 2016])
- Atmospheric pollution acts as tobacco pollution [Bourdrel 2017]. It enhances the endothelial dysfunction and has a proinflammatory and pro-oxydative effect.

* It exists other markers of atmospheric pollution PM<10µm, PM<100nm), NO and NO_2, carbon and more specific markers of road traffic.

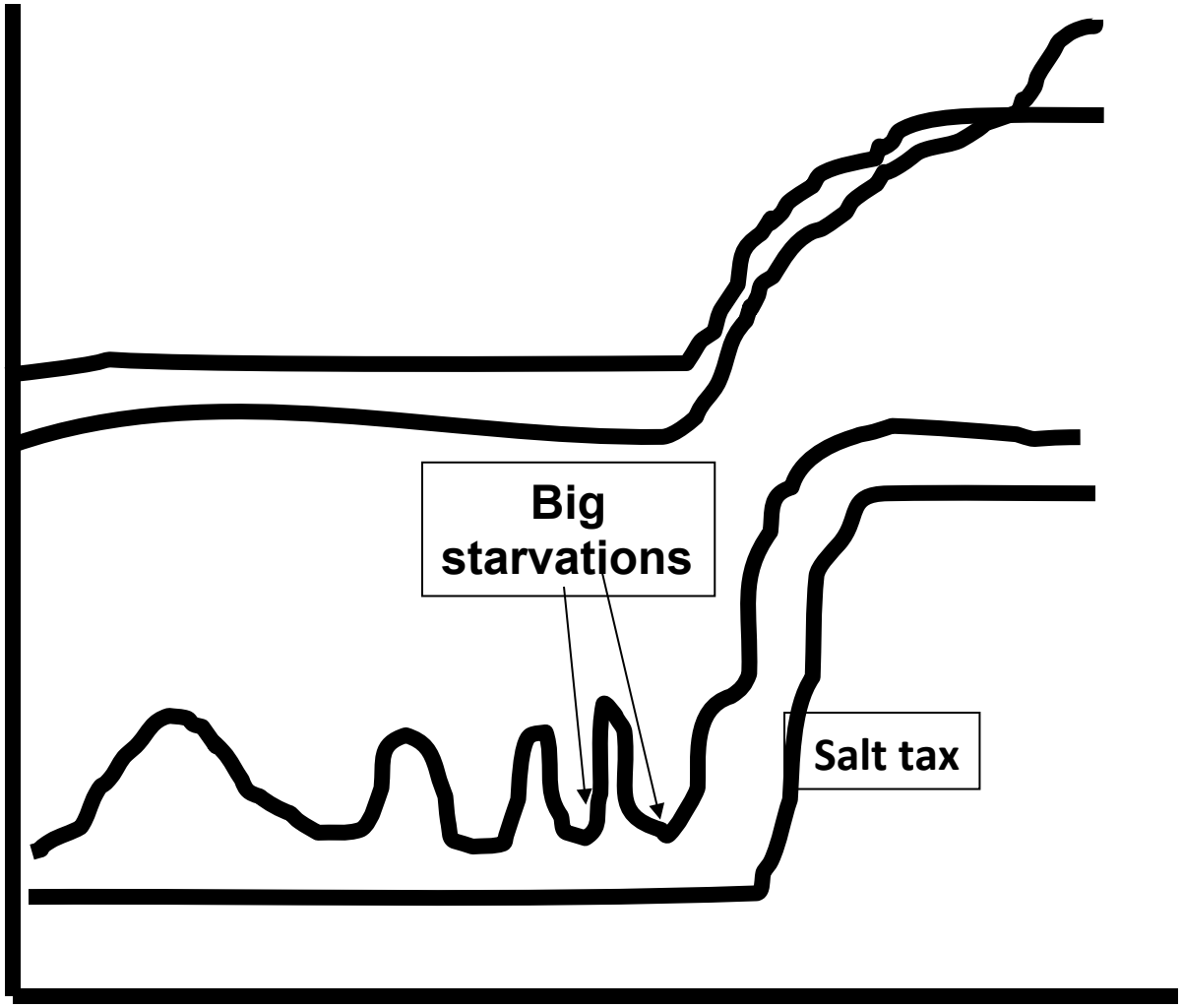
**The relative risk for environmental tobacco smoke is 1,22 [Steenland 1996, Law 1997, Pitsavos 2002],it is between 2,2 and 10,7 in active smokers [Kannel 1981, Wilson 1998]). Same for stroke [Howard 1998, Diez-Roux 1995].

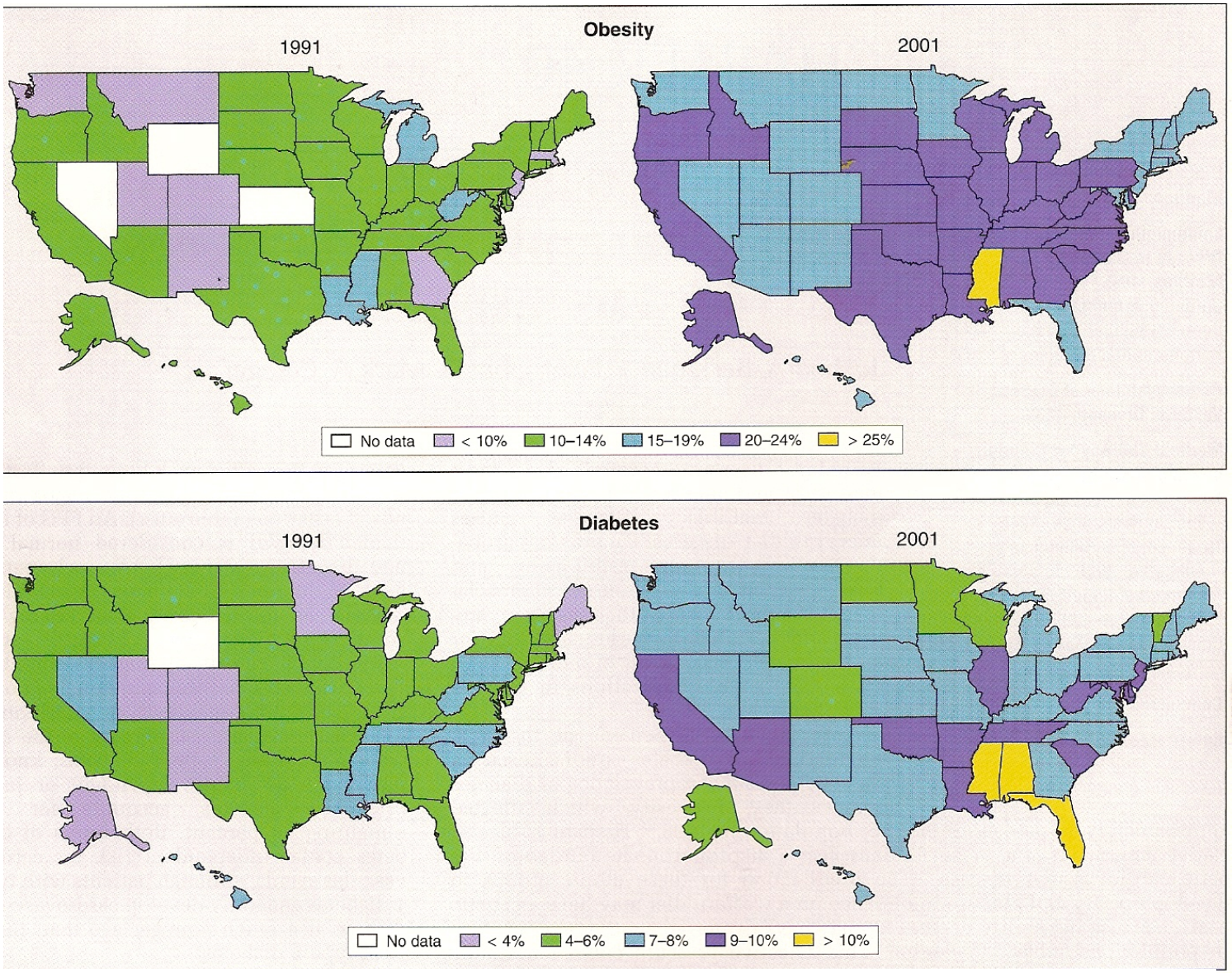
An exemple

The association between some pesticides and Parkinson disease [Elbaz A 2009] is strong, mainly for organochlorines

The metabolic risk

OBESITY, SEDENTARITY, SALT





Incidence in % of obesity and diabetes in US in 1991 and in 2001 [Braunwald 2008]

A few exemples of unresolved public health problems

- **In epidémiology: a free access to morbidity (not only mortality) registers**
- **Independent and detailed analysis of the toxicity of every compound available on the market (mainly pesticides, herbicides, but also endocrine disruptors). The simple lethal doses is unknown for most of the chemicals available and their toxicity *on the ground* is generally unknown.**
- **To create and promote regional procedure in every european country indicating geographic diffusion of bacteria, virus and emerging mutants, organic and non organic polluants (endocrine end pharmaceutic).**
- **To bring to justice the various crooks, gurus, charlatans, quacks, paranoids who are responsible, thanks to Internet ,of doubt basesd on pseudoscientific « data » .**
- **Finally, the basal questionis: « is our brain made to understand ans select some information more than others?? » [JP Krivine. Pourquoi l'information scientifique ne parvient-elle pas toujours à convaincre? JIM 3/12/2016].**

Several priorities

- **To attenuate or reduce social inequities and to control the nuclear power ???.**

- **In 2018 health politics requires an ecologic approach and a global view of health and to consider the entire ecosystem in which we are living [Rayner G, Lang T. Ecological public health. Reshaping the conditions for good health. Earthscan/Roufledge 2012]**

- **To subsidise in priority some elementary problems as: the access to clean water, the building of sanitation facilities to eliminate open defecation , to organize migrations, to develop aquaculture of herbivore species, to develop agricultural productions using CO2-dependant bacteria , to severely augment taxes for sectors that are , for the moment protected (drug and flight companies)**

- **To favor public investments in prévention (tobacco, alcohol, vaccins) and health organisatio (ex Ebola) more than in a medicine or a surgery *de luxe* which benefit mainly to rich patients**

The true question is finally IS THE HUMAN ABLE TO CONTINUE TO ADAPT TO HIMSELF?

This question is clearly beyond the simple medical practice

|Jean-Pierre Dupuy. Pour un catastrophisme éclairé. Quand l'impossible devient certain. Essai Ed Seuil 2002]

L'auteur

Bernard Swynghedauw est docteur en médecine, docteur-ès-sciences, directeur de recherches émérite à l'Institut national de la santé et de la recherche médicale (Inserm). Il a présidé un groupe de travail de l'Académie de médecine sur « les conséquences médicales du changement climatique » et est actuellement membre du groupe « adaptation et prospective » du Haut Conseil de la Santé publique (HCSP).

Il n'y a pas que le climat qui change !

Face aux nouvelles menaces, il devient urgent de protéger notre santé

Les activités humaines bouleversent notre environnement à l'échelle de la planète. Elles modifient aussi profondément notre santé. Réchauffement climatique, accroissement et vieillissement de la population, destruction de la biodiversité, pollutions multiples, usage abusif des antibiotiques... sont autant de facteurs qui influent de manière préoccupante sur la santé humaine.

Quelques chiffres en témoignent. En 60 ans, 300 maladies infectieuses nouvelles sont apparues chez l'Homme, à l'exemple du sida. Dans la même période, l'incidence de maladies allergiques comme l'asthme ou celle de maladies auto-immunes comme le diabète de type 1 ont pratiquement doublé, voire triplé. Quant à la liste des polluants divers, elle ne cesse d'augmenter, et avec eux un cortège de maladies qui leur sont peut-être liées.
Dans ce livre, l'auteur montre, exemples à l'appui, l'impact de l'Homme sur sa propre santé. Il accorde une place particulière aux bactéries de nos intestins, qui sont indispensables à notre survie et dont l'écologie est elle aussi perturbée par nos modes de vie. Comment comprendre l'émergence de nouvelles maladies et peut-on s'en prémunir ? L'espèce humaine peut-elle s'adapter aux changements qu'elle a elle-même provoqués ? C'est à ces questions et bien d'autres que répond l'auteur. Il dessine dans ce livre une discipline naissante, celle d'une approche écologique de la santé prise dans sa globalité.

Belin
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