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Uranium and other alpha emitting nanoparticulates : the forgotten pollutant

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Gene – environment interaction

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55 Abstract

10 *There is a wide list of sources of contamination by alpha emitters : radon, drink- and seawater,*
11 *“NORMs” in coal, fertilizers, oil, gas, building material, ore mining, and artificial sources (atomic*
12 *test fallout, nuclear accidents...) all able to go through the food chain (esp. meat). Waste*
13 *incineration burns lots of products (eg plastics) contaminated with NORMs. Sewage also brings*
14 *alpha emitters from the food chain recycled for agriculture. The IARC Group 1 list includes all*
15 *alpha emitters in internal contamination. No study on chemicals and health ever confronted the*
16 *results with that list. The very limited effect of chemicals can be predicted from the weakness of the*
17 *chemical energy the atom can produce, approximatively one million times inferior to the energy of*
18 *a single alpha decay – 3 to 7 MeVs. This is here demonstrated through an extensive study of*
19 *epidemiological results, using the radioactivity source easiest to track, natural radioactivity.*
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25 The dangerousity of uranium has usually been associated mostly with its chemical properties [1] but
26 70 the long list of effects that have been linked to its chemical properties can be in fact explained much
27 more accurately by damage caused by alpha particles. The simple hypothesis made in this paper is
28 that the carcinogeneity, mutagenicity and teratogeneity of a contaminant is linked to the actual
29 kinetic energy it is able to produce per unit of contaminant ; it is directly verified. The chemical
30 energy of the atom is millions of times lower than the energy of alpha decay. The link between
31 radon and lung cancer has been established long ago (the link between radon and skin cancer is also
32 75 increasingly under the spotlight), as well as the capacity of uranium and its descendants to travel in
33 the body – see also [2] for a direct link between low levels of increase in radon exposure and birth
34 defects. The ability of nanoparticulates of uranium and other heavy metals such as lead (the natural
35 decay product of uranium) to accumulate in the blood and to circulate in the nerves to the brain is
36 demonstrated [3]. The carcinogenic effect of low doses of alpha particles has been verified in vitro
37 [4]. The mutagenic effect on DNA is also explained by the high relative biological efficiency of
38 80 alpha particles (see [5] for the example of a RBE of 6500, on gamets of hamster, underlining the
39 extreme sensibility of gamets and thus the already existing presumption that alpha emitting
40 nanoparticles will lead to strings of birth defects and hereditary diseases). The mutagenicity even at
41 low doses of radioactivity has also been demonstrated through a careful epidemiological review [6]
42 which is used in this article together with [7] as the basis for further demonstration of the
43 significance of the effects of alpha emitters in internal contamination together with the recognition
44 85 by the IARC. Some elements allow to quickly draw a map to a common source to hereditary
45 diseases : common genetic factors between autism and schizophrenia have been established (see for
46 instance [8]) and persons with Down Syndrome have also a more important incidence of autism and
47 of several other conditions (ADHD, Alzheimer’s, blood diseases, endocrine diseases...). The point
48 of the paper is to show the significance of the linear no threshold model through a wide ranging
49 90 interpretation of the regional epidemiology of a number of diseases, pitting it against regional
50 variations of natural radioactivity. Countries with regional variations of natural radioactivity and a
51 good hospital system have been selected and studies showing the regional epidemiology of diseases
52 in these countries have been retained. They are followed with an analysis of artificial sources of
53 contaminants.
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2 A quick comparison with natural radioactivity levels of countries where incidence and prevalence
3 100 was surveyed shows clearly a link with natural radioactivity, explained as always by either :

- 4 • direct damage in the brain, synapses, or on any other cell,... by alpha “shots” of uranium /
5 thorium / decay products nanoparticles ([9] provides good illustration of the destructive
6 effect of alpha shots), able to travel all across the body, through nerves, blood, lymph, and,
7 for cancer, subsequent proliferation due to proximity effect [4], or :
- 9 105 • Genetic change in gametes caused by alpha shots inside gonads, leading to mutations in the
10 genes of children even though healthy carriers of mutations can extend over generations the
11 emergence of illnesses (two healthy carriers with damaged genes because of alpha shots
12 giving birth to a sick child)

14
15 110 Only some physical contaminants such as wood chips or asbestos are able to create damage similar
16 to alpha decay yet the area they can contaminate is limited by their sheer size, as opposed to heavy
17 metal oxide nanoparticulates which can travel throughout the whole body.

18 The bias in these studies is non-existent because the bulk of the research used in this article (all the
19 epidemiological studies that are interpreted) did not actually ponder the possibility that alpha
20 115 emitters could have been involved in the observed variations and be causing massive amounts of
21 false positives.
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23
24 An early version of the work exposed in this article was provided to the European Commission DG
25 SANTE, which replied in a written letter that it “*will take the freedom to refer to it in future*
26 120 *discussions*”. A copy of the letter of the author to the Commission and of the European
27 Commission’s reply is included (Figure 1, Figure 2).
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31 1) Variations linked to natural levels of 32 radioactivity 33 34 35

36 125 Natural uranium, depleted uranium, and all the radioactive decay products of uranium, as well as
37 thorium and all the actinids, transuranics, present the same problem as they are mostly alpha
38 emitters (there are some major beta emitters in actinids, Pu241, and Pb-210 in the uranium decay
39 chain for instance, but these are a minority). The oxide nanoparticles from the ground, as well as
40 130 depleted uranium oxide, are all able to travel through the body. They can for instance travel to the
41 bone marrow and cause leukemia, but any cancer is likely to be caused by some alpha emitter
42 because of the vast territory that nanoparticles can invade in the body – in fact, everywhere. Many
43 other illnesses can be triggered by alpha emitters : any cell can be damaged, any function can be
44 hindered or permanently diminished.
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48 135 In France, the 2015 map of the relative risk of infantile cancer published by the French National
49 Cancer Institute [10] reproduces quite well the map of the radon potential of the grounds, especially
50 the ex-post estimation according to a Bayesian hierarchical model. Three of the departments known
51 for high natural radioactivity (*Loire, Puy de Dôme, Finistère*) have an above average relative risk
52 ([1.05 ; 1.09]) of infantile cancer (mostly blood and central nervous system). All the departments
53 140 where the relative risk is under average ([0.93 ; 0.95]) are departments with low background
54 radioactivity, according to the IRSN radioactivity map. NORMs in oil can explain why the other
55 departments where the relative risk is high are departments with dense urban areas (*Haute-Garonne*
56 (*Toulouse*), *Bas-Rhin* (*Strasbourg*), *Gard* (*Nîmes*, bordering on *Avignon*) and *Hérault*
57 (*Montpellier*), four departments which also have some high natural radioactivity areas, and Paris as
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1
2 well as the *Hauts de Seine* (a very crowded area)) – the effect of the sole high natural radioactivity
3 being equivalent it is an easy hypothesis that the carcinogenic element in urban areas far from high
4 natural radioactivity (where building material does not come from such mines...) is NORMs in
5 fumes.

6
7 150 On acute lymphoblastic leukemia in the US age-adjusted incidence is also lowest in the South, an
8 area with a typically very low natural radioactivity, and in non-Hispanic Blacks, whose populations
9 are concentrated in that area [11]. Data on leukemias also show a similar trends with rates
10 significantly lower in Blacks and Hispanics [12] which are groups concentrated in states with very
11 low or average natural radioactivity. For Blacks, the same is true of non-Hodgkin's lymphoma,
12 155 thyroid cancer, urinary bladder cancer, uterine corpus cancer, and breast cancer as well as (for
13 females, less likely to smoke) lung cancer [13]. And the overall rate of cancer incidence in
14 Hispanics is 20% lower than non-Hispanic Whites [14].
15

16
17 A direct correlation can be established between radon and cases of Down Syndrome, on the basis of
18 160 data collected in the USA [15]. It is possible to sort in ascending order of radon risk the ten US
19 states that have been tested, and to observe a direct correlation with the cases of Down Syndrome
20 (the more natural radioactivity the more frequent the syndrome), with Iowa and Utah having the
21 highest rates and Texas and Arkansas having the lowest (the level in Iowa is 131% of the level of
22 Arkansas and the level of Utah is 141% of the level in Arkansas)¹. In England, one of the least
23 165 radioactive parts of Western Europe, the rate is only 6,6 / 10 000 [16].

24
25 The higher prevalence of Down Syndrome in high natural radioactivity areas has also been
26 demonstrated already in 1976 in India [17], confirming that it is more than correlation.

27
28 There is a more important prevalence of Down Syndrome in Hispanics in the USA [15], but it is
29 extremely important to remember that the Iberic mountains (North-West of Spain) are one of the
30 170 most naturally radioactive parts of Europe, which could explain a specific genetic heritage in
31 American Hispanics having ancestors from that area. The pathway of cancer is linked to immediate
32 contamination. Given the amount of alpha emitting sources and their oversight in most research on
33 cancer, the case for a genetic origin of cancer, as for low levels of exposure to non radioactive
34 chemicals, and for a viral origin of cancer, is extremely limited and all studies must be done again
35 175 taking carefully into account alpha emitters.

36
37 Near the Iberian mountains, there also is an elevated rate of autism, according to a national study
38 undertaken in Portugal [18] on more than 332 000 children (questionnaires sent to directors of
39 schools). The Azores, known for their very elevated radon levels due to volcanism, have according
40 to this study the most elevated rate of autism, and the South of continental Portugal (which has the
41 180 lowest natural radioactivity in the country) has the lowest level. The level in Lisbon is also
42 significant but the main source of potable water of the city is in Castelo de Bode, on the Rio Zêzere,
43 an affluent of the Tage which takes its source in the naturally radioactive Iberian mountains². The
44 autism rates reported in the Iberian mountains are four times the rates in the South. Gonads are
45 more likely to accumulate heavy nanoparticulates and the higher rates of variation in genetic
46 185 mutations (as compared with cancer epidemiology) can thus be extremely easily explained by the
47 natural accumulation of nanoparticles in gonads (shown also below by the extreme gonad cancer
48 rates in areas bombed with depleted uranium – see again comments above on the extreme RBE of
49 alpha shots on gametes of hamsters found in [5]).
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56 1 Please note that the Georgia data was obtained only in Atlanta, and that the metropolis is located right upon an area
57 which has a high natural radioactivity, unlike the rest of the state, according to the available map for US levels

58 2 It is very easy to see the trace of radioactive sediments in the final part of the Tage in the LNEG radiometric map of
59 Portugal http://www.lneg.pt/download/7078/radiometric%20map%20of%20Portugal_portal.png demonstrating the
60 contamination of potable water in the city

1
2 190 In Finland, mental illnesses, including schizophrenia (see [19], and [20] for a map of mental
3 handicap in Finnish adults) are correlated very well with geological outcrops of uranium, which are
4 concentrated in the North-East of the country according to the GTK (Finnish geological service)
5 map of deposits and mines, in black schist, quartzite and not in granite [21]³ : the exploitation had
6 been planned in Sotkamo together with other ores, there is a mining project in Nuottijärvi and a
7 former mine in Paukkajanvaara, most of the other mining claims / deposits are in Lapland.
8 195
9 Natural radioactivity is higher in the South but uranium is cast into granite and dissolves thus much
10 less easily in water ; uranium mines lead to a very high contamination of the surrounding
11 environment and, in general, uranium from more porous ore is more easily drained into water.
12 Furthermore lichens, the feed of the reindeer, an important protein source in Lapland, may absorb
13 important levels of radioactive elements, for instance radon-222.
14 200

15
16 Cancers and Down Syndrome are the swifter to conclude on because of the easy diagnostic and the
17 anterior research. DNA damage may be one factor affecting meiosis, but direct impacts of alpha
18 particles from radioactive sources that have migrated into the gonads, if they are occurring during
19 205 the meiosis process are likely to be another major element involved. The Finnish results directly
20 contradicts usual claims that schizophrenia is concentrated in cities (diagnosis is certainly quicker in
21 cities because of the frequency of human contact and there are more clinicians available) and a
22 more careful survey of other countries should produce similar results. For autism the Portuguese
23 study was wide-ranging, furthermore the peak of autism cases in the Azores is again difficult to
24 associate with other types of contamination than radon (there is no big industry in the islands). All
25 210 of these results also confirm the ability of radon and its decay products as well as of uranium and
26 thorium dissolved into water to travel into the body and reach vital areas such as bone marrow,
27 gonads and the central nervous system.
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31 215 On neuromuscular diseases, in spite of the low incidence of the diseases, the epidemiological data
32 available [22] still allows to draw conclusions. One can compare for instance England, the
33 Netherlands, Denmark and Norway, Eastern China (Jiangsu...), the US "Old South" including
34 Texas, where the levels ought to be low, with the US, France, Germany, Ireland, Scotland, Italy,
35 Spain, Australia, Japan where they should be higher. For *Myasthenia gravis* the epidemiology
36 220 matches perfectly this differentiation on natural radioactivity grounds. For Guillain-Barré syndrome
37 too, the matching is absolutely perfect (it makes sense that the levels are low in Eastern China and
38 Cantabria). For amyotrophic lateral sclerosis there is a good amount of data, especially on
39 incidence, there are several matches (low level in Texas, in England, in Uruguay, higher level in
40 Ireland, Nova Scotia (high uranium potential), Scotland, France, Missouri, Italy, Sweden, Japan in
41 225 one study, Germany) but a few discording elements (Netherlands, Norway have a higher level than
42 expected), though *these are countries where the diagnosis is maybe easier thanks to the high*
43 *quality of health services* (and these are diseases for which the variations are more difficult to detect
44 due to the low incidence).
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46
47 For inclusion body myositis [22] provides data they may be partly conflicting but in [23] the levels
48 230 are low in the Netherlands, higher in Australia and highest in Minnesota (two areas of uranium
49 mining). Some other neuromuscular diseases have high levels in low radioactivity areas (e.g.
50 Duchenne, Becker). One simple explanation is an anterior contamination (before populations
51 migrated and settled down elsewhere) and mutation of maybe a single gene in a few subjects that
52 may have stayed in the genetic pool (because of the limited level of immigration in e.g. Norway and
53 235 England until the industrial revolution). It is important to understand that (as already suggested by
54 [6] in the concluding remarks) very low variations of radioactivity may lead to a strong regional
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58 3 a map of mines and mining claims is also provided by a local groups of activists against uranium mining
59 [https://pyrophor.files.wordpress.com/2017/05/uranium_industry_in_finland_2012-02_-_](https://pyrophor.files.wordpress.com/2017/05/uranium_industry_in_finland_2012-02_-_laplands_people_against_uranium_power.jpg)
60 [laplands_people_against_uranium_power.jpg](https://pyrophor.files.wordpress.com/2017/05/uranium_industry_in_finland_2012-02_-_laplands_people_against_uranium_power.jpg) confirming that extraction took place and is planned in the North East

1
2 divergence after dozens of generations (and, in some cases, even far in the past before the age of
3 coal use, events such as volcanic eruptions can change the exposure of a population to alpha
4 emitting nanoparticulates, making genealogy of the mutation harder). The idea of a “genetic
5 predisposition” is thus very difficult if not simply absolutely impossible to establish with human
6 means.
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10 **2) Confirming the effects of massive depleted** 11 **uranium bombings** 12 13 14

15 245 Alpha emitters can damage absolutely anything from the inside of the body. Nanoparticulates
16 travelling anywhere can hurt any cell and cause every kind of dysfunction. These effects can be
17 shown using mass aggregates and juxtaposing them with variations in exposure to radioactivity,
18 and, unfortunately, the vast fields of use of depleted uranium weapons have provided the biggest
19 live experiment for medical science ever known in the history of mankind. The simple study of
20 DALYs 2000-2015 provided by the World Health Organization, looking at data in Iraq, Pakistan
21 and Afghanistan allows to see it (Table 1). Pakistan has a GDP per person of 1 547 \$, Afghanistan
22 of 586 \$ and Iraq of 5 165\$ as of 2017 according to World Bank data yet a few increases are even
23 sharper in Pakistan. A rapid chi-square calculation confirms that Afghanistan, Iraq and Pakistan are
24 highly correlated (chi-square is ~91,37 for 38 degrees of freedom) and that their average evolution
25 is totally decorrelated from the average world evolution. The link ovary - testicle cancer and birth
26 defects is particularly obvious and demonstrates with force the common cause : depleted uranium
27 dust going down the body because it is a heavy metallic element and circulates with gravity down
28 the body. Testicles, for instance, seem slightly more exposed than ovaries (confirming once again
29 the effect is linked to DU dust as they are more of a receptacle than ovaries and we actually find
30 that the biggest increase in the whole dataset to be for testicular cancer in Pakistan) but they are all
31 very exposed to contamination.
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36 The effect is here also clearly confirmed for bone marrow, immune and endocrine disorders (to be
37 linked with the hypothesis of the abilities of nanoparticulates to travel anywhere and damage any
38 vital cell) as well as heart diseases and circulatory diseases, sickle cell traits (a clear case of genetic
39 effect) and disorders, haemoglobinopathies and haemolytic anaemias. Birth defects are in fact the
40 only diverging dataset which suggests either censorship from local authorities or lack of
41 transparency of local communities regarding birth defects which may be or have become a taboo in
42 the more remote places that have been the main targets of missiles and bombs in Afghanistan and
43 Pakistan (especially as the use of depleted uranium in these countries is much less known than in
44 Iraq). Yet one alternate hypothesis (on the genetic damage [7] notes that at high doses we can
45 expect sterility or fetal loss instead of e.g. a birth defect) which seems more likely is that the acute
46 contamination has produced more severe birth defects and much more miscarriages explaining why
47 the total amount of birth defects does not increase as much in Pakistan and Afghanistan while the
48 rest of the diseases increase more violently. This hypothesis is entirely confirmed by the extreme
49 rate of maternal, foetal and neonatal loss in Pakistan [24] which has for instance a stillbirth rate
50 (56,1 / 1000) more than twice as elevated as the rate found in India (27,9 for the highest) and even
51 more than in Zambia (21) and Kenya (21,2). Another table provided by the WHO Global Health
52 Observatory data repository for stillbirths [25] is also topped by Pakistan (with 43,1, Nigeria second
53 with 42,1, Afghanistan at 26,7) and another onground study collecting data on 53 524 births in
54 Kabul provides a stillbirth rate of 38 [26]. Pakistan has a GDP per person much higher than Burundi
55 (320 \$), Malawi (338 \$), Sierra Leone (499 \$) or Liberia (456 \$) and gets a much higher rate of
56 stillbirths than these countries according to the second table. The record level of stillbirths in
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Pakistan and Afghanistan matches the very high level of testicular and ovary cancer and leads directly, for a country massively bombed and as we have significant proof of the use of depleted uranium in such missiles and bunker busters, to the contamination by heavy depleted uranium dust. And it is the only common sense answer to such a common explosive trend for all illnesses recorded by the WHO in these countries.

The high increases also found in neighboring countries in WHO DALYs (Jordan, Saudi Arabia and in a lesser significance Israel) can easily be linked among other things to the winds blowing depleted uranium dust from the warfields (but also, for instance for Saudi Arabia, to air pollution linked to the increasing car use, because of rapid economic development, and to the massive use of sea water for human consumption – this particularly acute source of contamination with alpha emitters certainly contributes very much to the extreme increases for DALYs in Saudi Arabia). The fact that the DALYs increases are higher in Jordan and Saudi Arabia than in Israel also suggests that the origin of the regional variations all come from Iraqi depleted uranium dust. That depleted uranium contamination from other war fields may be one of the factors in cancers and other diseases found for instance in Gaza and must be pondered by all researchers willing to point at Israeli strikes (the data on cancers and birth defects in Gaza is sparse and contradictory).

The three tested countries follow quite clearly the same trend over all diseases : Afghanistan and Pakistan have similar increases, Iraq is behind. This is simply a proof that uranium dust tends to behave the same way in any body and that thus on aggregate on large groups of population it is possible to predict the approximate number of cases for each illnesses.

The USSR used uranium mines of the Gulag as death camps and China's Laogai uranium mines can be legitimately considered as another *ongoing* occurrence as the Huise mine has been named "Unit 731" by Chinese authorities, a transparent and cynical reference to crimes against humanity of Imperial Japan⁴. Tribunals granted compensation to the victims of radium (cancers, especially in the jaw) before World War 2. In fallout areas near Chernobyl the strong increase in cases of Down Syndrome has been documented [27]. In Fallujah in Iraq where depleted uranium weapons have been used, the observed rate of Down Syndrome [28] is 49 / 10 000 (30 cases over a sample of 6 049 births), a study which also showed very elevated rates of birth defects of all kinds in the population of the city (see also [29] for link between congenital anomalies and uranium contamination in the parents). An explosion of autism and ADHD cases has been noted in Fallujah after the bombings by Dr Samira Alaani and identical results were reported by Dr Christian Sueur in French Polynesia together with other pervasive developmental disorders and several other diseases [30]. For schizophrenia, epilepsy and mental disorders in general the rates found in Vietnam are much higher in Thanh Hoa (North, area bombed massively during the Vietnam War) than in the South (Ben Tre) [31]. There is significant proof (for instance a document on the manufacturing of depleted uranium from the Y12 plant published in 1972 which already noted that depleted uranium fires present "a radiological hazard" (as opposed to a chemical hazard) and that "adequate respiratory protection" is needed in the vicinity of uranium fires [32] – a document confirming the fact that depleted uranium was manufactured already then, another confirmation of the fact that in the Socorro range the test of depleted uranium weapons started in April 1972, one month before the

4 Historical data from authors such as Anne Applebaum, Zhores Medvedev and Nicolas Werth confirming it as well – this article presents the available evidence, including a very explicit Associated Press press release of 1986 mentioning trainloads of 4000 to 5000 Gulag prisoners every few months in a uranium mine as well as isolation rows between work alleys <https://depleteduranium.org/2018/02/26/uranium-mines-the-death-camps-of-the-soviet-gulag-les-mines-duranium-camps-de-la-mort-du-goulag-sovietique/> - the practice of using slave work in uranium mines is still widespread today in current or former communist countries and other autocratic regimes, see <https://depleteduranium.org/2018/10/24/uranium-mining-death-camps-in-mongolia-iran-and-turkey/> for proof with Google pixellization in areas where the uranium-rich geology is evident in China (one location matches the Huise mine), but also Russian Federation (at 75° North), Albania (under the direction of Turkey according to the source), Turkey itself, Iran and Mongolia (the last one being maybe under Russian and / or Chinese direction).

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2 325 last massive wave of bombings on Vietnam (Operation Linebackers), demonstrating simply that it
3 was the first occurrence of depleted uranium bombings), together with the fact that mental illnesses
4 in the country follow the same trend than in Finland and of course the massive amount of birth
5 defects in Vietnam and Cambodia, that depleted uranium was already used in the Vietnam War and
6 that dioxin is not the true responsible of the birth defects and other illnesses after the conflict. In the
7 330 Seveso accident in Italy in 1976, for instance, the actual amount of birth defects after the dioxin
8 leak was not significant [33], contradicting again the link made between Agent Orange and birth
9 defects in Vietnam. This confirms again the full validity of the claim that chemicals are very
10 unlikely to trigger in themselves birth defects or other hereditary diseases in children except in the
11 unlikely case of massive contaminations especially as the likelihood that a significant enough
12 335 amount of molecules reach gonades before killing the individual is much lower than for actinids
13 which are naturally heavy nanoparticulates able to travel through the internal barriers of the body
14 "in silence" (without causing rapid intoxication and death) and that can be easily carried down with
15 their weight.
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19 340 Thalidomide has certainly been wrongly accused of a number of evils, especially birth defects, like
20 pesticides and many other non radioactive chemicals. In addition to the high number of natural
21 sources of alpha emitters that have been listed above, the outbreak of birth defects leading to
22 accusations on that newly issued drug happened right during the most intense atmospheric nuclear
23 testing period (which of course included uranium and plutonium dust, ~90% (depending on the
24 345 efficiency) of the fissile material of a nuclear weapon does not fission) and this combined with the
25 findings in [34] also reported in [7] compels to conclude on the invalidity of research linking
26 thalidomide with birth defects until new research identifying effects separated from alpha emitters
27 is carried out (which again seems more than unlikely to succeed due to the very low chemical
28 energy of the atom, and simply very difficult to carry out due to the quasi impossibility to research
29 350 alpha emitters 60 years afterward except perhaps if good biological samples from the mothers e.g.
30 at least biopsies of ovaries are still available). The most simple explanation on cancers (exposure to
31 alpha emitting nanoparticles) should certainly be re-weighted against the supposition that a genetic
32 predisposition to cancer is involved (the pattern for cancer seems to be the proximity effect [4] and
33 nothing more and it depends on the actual amount of energy dispelled onto the cell), however this
34 355 paper also shows a large pattern of birth defects and other mutations from parental contamination
35 leading to the idea that even if the genetic predisposition thesis for cancer was proven it could
36 quasi-certainly spill from parental contamination by alpha emitters.
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40 The thesis that exposure leads to an increase in the male/female sex ratio [7] is also confirmed by
41 the extremely high proportion of boys in the birth defect cases in Fallujah Hospital (after screening
42 360 of all the cases provided by Dr Alaani over more than a year).
43
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45 The main issue with calculating the effective dose for internal contamination with alpha emitting
46 nanoparticles is the extreme diversity in organ sensibility and the impossibility to assess the actual
47 localisation of the nanoparticles. It is not possible to offer anything else than range of probabilities
48 365 based on a comparison with the existing body of human exposure cases. All factors of
49 contamination, including depleted uranium fallout pushed by winds from the Middle East (as has
50 been noted famously in Aldermaston [35]) have to be accounted, making this a very difficult work.
51 All of these factors, without exception, should be isolated from their results by researchers still
52 believing it is possible to identify any health effect of non radioactive chemicals.
53
54 370

55 In Bhopal the author emits the hypothesis that uranium was in fact manipulated together with
56 methyl isocyanate for research on uranium extraction from sea water. It is difficult to bring on
57

58 5 The depleted uranium as a forever-staying « linebacker », backing the offensive, is another implicit evidence as
59 negotiations for peace with Vietnam were already ongoing.
60

1
2 ground evidence to support the hypothesis yet cyano agents are used for uranium extraction and
3 research was done for instance on methyl isophosphonate-based uranium extraction and on a ligand
4 375 prepared by condensation of the amino-H2TPBC with commercially available diethoxyphosphinyl
5 isocyanate [36]. It is also interesting to note (in [32]) that Union Carbide was involved in the
6 manufacturing of depleted uranium since it published a document on its manufacture under a
7 contract for the US government in the Y12 plant, and thus may have also been more in an industrial
8 position to undertake activities related to nuclear fuel processing and related technologies abroad.
9 380 Secrecy obviously surrounded the manipulation of uranium in the plant for commercial and / or
10 military motives.
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3) Comments

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18 385 In the Group 1 list of the IARC, asbestos and asbestiform fibres, fluoro-edenite fibrous amphibole,
19 crystalline silica dust, wood dust and erionite are associated to an obvious physical destruction by
20 the fibres of cells that explain the triggering of cell proliferation.

21 Sun and cosmic radiations (which in fact includes neutrons which also have a high relative
22 biological efficiency, and more importantly protons that due to their positive charge will behave as
23 alpha particles and focus all of their energy in the superficial area of impact, as well as some other
24 390 atomic nuclei that can also be expected to have a very high RBE due to their mass) have to be
25 accounted as well. Their effect is hypothesized to be quite low (please note that there are particle
26 impacts explaining events such as the 993-994 spike in ¹⁴C in wood remains). Skin cancer has
27 generally a single starting point which may suggest a proximity effect from the impact of a single
28 "excess" proton or neutron (above the threshold of resistance of the body which can be significantly
29 395 elevated with consistent use of e.g. sun cream as the weakening of skin cells by UVs will clearly
30 allow for a more destructive effect of particles onto weaker cells and thus an increased likelihood
31 that a cell proliferation is triggered). It is difficult to differentiate the effect of UVs from the effect
32 of cosmic particles here. These particles may be expected to have as well a destructive effect onto
33 the genetic content of gametes and on the rest of the body (for neutrons) yet for instance high
34 400 variations of Down Syndrome were also found in Kerala depending on the natural radioactivity
35 while exposure to sun can be assessed to be quite similar (the variations of altitude are not very
36 significant and do not impact as well neutron exposure according to [37]), and the rate of Down
37 Syndrome and the cancer ratios studied in the USA and the rate of schizophrenia in Finland follow
38 in fact a trend opposite to sun exposure (they are higher in northern areas like Iowa and North
39 405 Eastern Finland than in the south coast of these countries), allowing to deduce sharply that the
40 effect of cosmic particles is not significant.

41 A quick estimation, on the basis of the rates of variation of the diseases studied in this paper linked
42 to the sole variation of natural radioactivity, and given the high importance of other sources
43 410 (NORMs for instance : the World Nuclear Association points to up to 15 millions of Bq of ²²⁶Ra,
44 up to 2,8 millions of Bq of ²²⁸Ra per kilogram of hard scale and up to 200 000 Bq of ²²²Rn per
45 cubic meter of natural gas, suggesting a more significant contamination of fuels than the ²²⁶Ra
46 already found in a study on diesel dated back 1977 [38] – the fact that oil is becoming harder to find
47 and involves more shaped charges⁶ due to the exhaustion of the easiest to extract oil fields means
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55 6 The book of the author *Depleted uranium, the invisible genocide and the seeds of terrorism* which was provided to
56 the European Commission in the email quoted at the beginning of the article and that the European Commission read
57 « with great interest » explains why « NORMs » in oil and gas are not of natural origin but linked to shaped charge
58 technology and can be substituted with deuterium without reducing the productivity of the extractive industries. Nuclear
59 weapons for mass destruction require hypercriticality (millions of critical masses, achieved through violent compression
60 and moderation with paraffin) so the first nuclear weapons only went slightly above criticality and were used for armour

1
2 415 that the numbers of the 1977 study are certainly much lower than what it is today) is that alpha
3 emitting nanoparticulates account for more than 99,5% of birth defects and de novo mutations and
4 more than 97% of cancers, in average.

5 It is the logical conclusion of the multiplication of the effects of a single source (natural
6 radioactivity studied in this paper through its variations) by all the sources that have been numbered
7 420 (they include NORMS in oil and gas, coal burning, phosphated fertilizers and the use of human
8 sewage epuration residues for agriculture which will also contaminate fields with the alpha emitters
9 passing into faeces, the fallout from atomic tests, depleted uranium bombings and their fallout,
10 accidents such as Tchernobyl, the spreading of tailings from uranium mines due to lack of care of
11 waste in the industry, as well as the contamination of meats from all sources, and the incineration of
12 425 human wastes that incorporate all these sources of alpha emitters e.g. plastics, food residues... – not
13 to mention some alpha emitters in volcanic ash). The hypothesis is that all studies on thalidomide,
14 for instance, failed to account properly of all these sources and that there have been as many false
15 positives as there have been studies on thalidomide. The same argument goes for pesticides and all
16 other chemicals (TCDD, benzene, POPs, etc), arsenic, lead, mercury and all non radioactive atoms
17 430 at low level, as well as helicobacter pylori, all the virus seen as causal for cancer, etc. Alcohol for
18 instance was produced with food stuff grown with phosphated fertilizers and / or residues of human
19 sewage – same for betel quid and tobacco and for tobacco the actual contamination with alpha
20 emitters has been already clearly demonstrated. Leather is a byproduct of the meat industry likely to
21 accumulate alpha emitters as meat does ; hence a consistent contamination with leather dust (IARC
22 435 Group 1 carcinogen) exposes to the incorporation of these alpha emitters. The glass industry, for
23 instance, and all other plants where workers are exposed to furnaces burning with coal or oil lead to
24 an exposure and glass itself when it is heated will expose the workers to more alpha emitters
25 because the glass is produced with sand likely contaminated (any soil even with low natural
26 radioactivity incorporates very low amounts of alpha emitters) and even though the uranium and its
27 440 decay products are present in an oxydated state they will oxydise even more (from UO₂ to U₃O₈)
28 and as oxyde nanoparticulates will contaminate the workers as well. The same goes for metal
29 smelting (from the contamination of ores like soils) and the manipulation of mineral sands (zircon,
30 tantalum, niobium, rare earth elements mining for instance) and building materials as well (as soils).
31 What has been accounted as side effects of pharmaceutical drugs in experimental research may be
32 445 for instance solely the result of a high radon level in the experiment room leading to a few
33 disruptions ; and the wider the set-up of the study (especially if research is undertaken on the long
34 term outside a laboratory) the harsher it is to find all sources – even if a study happens on a short
35 period of time stochastic effects cannot be eliminated because relatively high amounts of exposure
36 can be expected to have rapidly emerging effects on the body.

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43 A phenomenon that can very easily be associated with the fact that decay after decay the half lives
44 of actinids tend in average to diminish is the latency of onset of several diseases – for instance in
45 the Gulf War syndrome. The first decay of the atom can take long but be followed by decays
46 coming faster and faster (in the ²³⁸U decay chain and even more sharply in the ²³²Th decay
47 455 chain), increasing over time the rate of emission of alpha particles and the likelihood of cell
48 proliferation or significant nerve damage (etc). The same phenomenon is for instance an excellent
49 explanation for the spiking of Down Syndrome in children of older mothers together with the more

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53 piercing, they still are used everywhere and extractive industries also use it, with radium and beryllium for the neutron
54 source (a very elevated amount of radium is required, representing far more radioactivity than the small amount of
55 highly enriched uranium used, and is the actual explanation for the absence of radioactive equilibrium in the byproducts
56 of drilling ; it is clear that the choice of using radium instead of for instance tritium is explained by the need to make the
57 contamination appear natural, as the author explains in his book). A simple fusion source with deuterium (thanks to
58 compression, a few deuterium atoms will fuse and produce enough neutrons to start the blast) is much cleaner. Tritium
59 would be more efficient but would create a radioactive contamination and it is also much costlier while the gain of
60 using tritium can simply be achieved by using more deuterium.

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2 general accumulation of actinids. The delayed onset of the Gulf War syndrome has been widely
3 reported (in [39] for instance). The ageing of the body also of course contributes to the cell damage
4 yet the peculiarity of the actinid decay chains is an indispensable explanation for that delayed onset
5 460 and it does confirm once again clearly that the effects of these contaminants are linked to alpha
6 emission and nothing else.
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9 It may also be suggested quite logically that the paths for genetic changes are the same for humans,
10 465 the fauna, flora and even bacteria or virus. Virus inside humans or cattle in highly contaminated
11 areas are more likely to meet a nanoparticulate emitting an alpha shot that may affect its RNA (for
12 instance) and lead to the emergence of new forms, some more aggressive due to stochastic effect. It
13 seems that many of the most dangerous bacteria and virus have appeared in areas of high natural
14 radioactivity : for instance the “Spanish Flu” in China according to the *Institut Pasteur*, and the
15 470 1347 Black Plague in Mongolia. For the Zika mutation the first outbreak started in French
16 Polynesia and the link with artificial contamination from French nuclear tests may be suggested –
17 the virus would have absorbed defective RNA from an individual that was born with microcephaly
18 due to parental contamination with uranium and / or plutonium. The virus could have also simply
19 mutated (without any input of human genome from RNA transfer) due to alpha emitting
20 nanoparticles.
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24 The well-known protective effects of masturbation in men against prostate cancer must certainly be
25 extended to many other cancers in the urogenital apparatus and, more importantly, birth defects and
26 hereditary diseases. They are obviously explained by the ejaculation of the radioactive
27 480 nanoparticulates. Other practices such as coffee drinking can also be suspected to be beneficial for
28 digestive tract cancers. It is obvious that in general a good hygiene of life (e.g. frequent physical
29 activity) helps the body to evacuate a percentage of the nanoparticulate through e.g. kidneys by
30 increasing blood circulation. These elements have been proven by a wide amount of research.
31 Female ejaculation can also be suspected to be an important factor in the elimination of heavy metal
32 485 nanoparticulates in women. The fact that these heavy nanoparticulates concentrate in the lower part
33 of the body because of gravity leads to that simple hypothesis.
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36 Conclusion

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41 490 The linear no threshold model for alpha emitters is entirely confirmed. The same mechanism
42 explains obviously the apparition of competitive mutations, that can thrive through natural
43 selection, yet it is for the first time shown that the same mechanism that is the main responsible for
44 evolutionary processes in genetics is the main responsible for hereditary diseases, cancers, birth
45 defects. The increase in the use of depleted uranium in conflicts closer to the European continent, as
46 well as the need to extract oil from more difficult-to-tap pockets needing more shaped charges due
47 495 to resource depletion, and the increase of use of phosphated fertilizers, the increase in meat
48 consumption, industrial activity and road traffic, explains very well many informal reports about a
49 global increase of cancers and other illnesses in the European continent. Harsh measures should be
50 implemented to stop contamination : prohibiting radioactive ammunition and cleaning the already
51 existing contamination, and providing to the public world maps of natural radioactivity as well as
52 clear information on its dangers on the long term. It is absolutely possible to rely on private
53 500 businesses that have an incentive in providing these services (companies providing water treatment,
54 for instance) and this ought to be much more efficient than relying on bureaucratic work.
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58 To encourage people to drink treated water, to fight radon in dwellings, to discourage human
59 505 consumption of meats that accumulate intakes of radioactivity because for instance of the water
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2 given to animals, to reduce the use of phosphate fertilizers (including for animal feed production)
3 or, more simply, to extract alpha emitters from phosphates, coal, fuels, etc (or replace alpha sources
4 with deuterium in shaped charges), for instance, the author believes (as a PhD student in
5 economics) that market solutions, i.e. private undertakings and liberty of choice are the best way to
6 achieve not only cost-efficient solutions but also social acceptability esp. in regions of high natural
7 510 radioactivity where it may hurt the sensibility of inhabitants to forbid them for instance from
8 drinking untreated water.
9

10 11 12 **Ethics**

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15 515 No study approval was obtained.
16

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19
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21 situation in Fallujah General Hospital. The author also wishes to thank Dr Chris Busby for the very
22 interesting input.
23
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25 26 520 **Data sharing agreement**

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28 More data on the massive use of depleted uranium in conventional warheads is available at the
29 following link : <https://depleteduranium.org/2016/06/19/politically-correct-uranium-weapons/>

30
31 The ebook which was sent to the European Commission in the letter mentioned in the introduction
32 of the article can be downloaded for free : <https://depleteduranium.org/books>
33
34

35 36 525 **Funding**

37
38 No funding was obtained for this research.
39
40

41 42 **Competing interest**

43
44 None declared (the author, for instance, has no material link with the radon extraction industry or
45 the water treatment industry which is anyway embryonic, and does not draw any income from his
46 530 campaigning against depleted uranium weapons).
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49 50 **Patient consent**

51
52 Not required. No patient and no public involvement, all data was collected anonymously.
53

54 55 **Contributing statement**

56
57 The sole author did all the research and writing work for this article.
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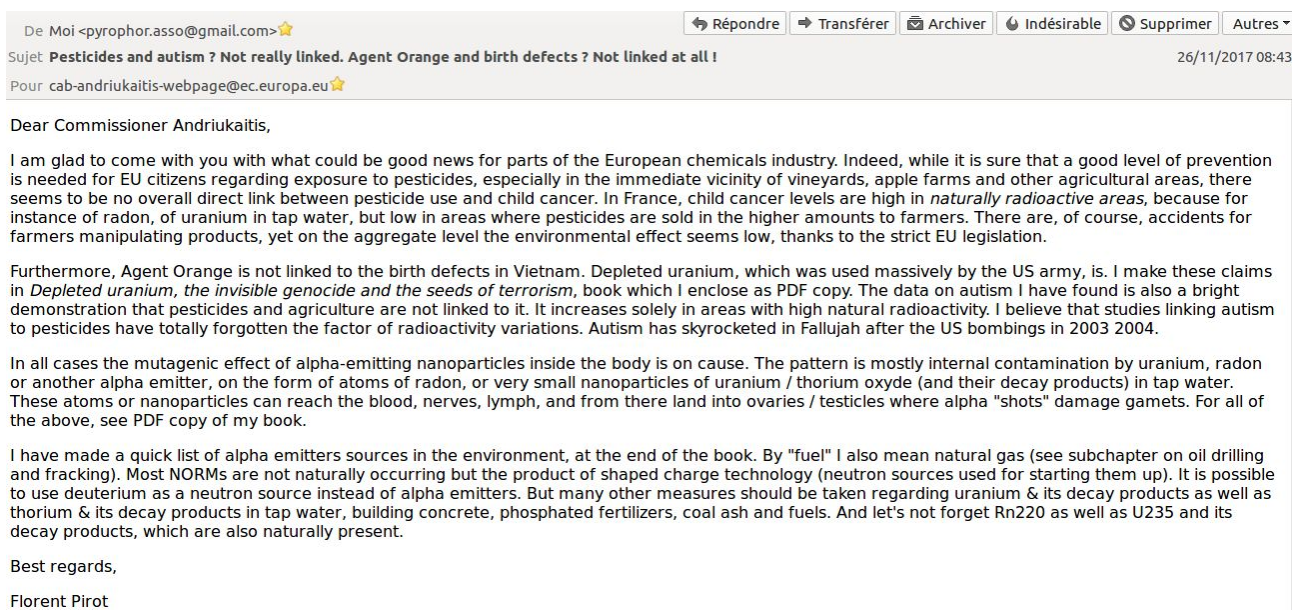
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53 Description of the documents :

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660 Image 1. Letter of the author to the European Commission dated 26/11/2017 presenting the basic outline of this paper as well as more contents related to depleted uranium weapons.



EUROPEAN COMMISSION
DIRECTORATE-GENERAL FOR HEALTH AND FOOD SAFETY

Food and feed safety, innovation
Pesticides and biocides

Brussels,
SANTE/E4/WR/gb(2017)49099

Dear Mr Pirot,

Subject: Your email dated 26 November 2017 "Pesticides and autism?"

I thank you for your mail addressed to Commissioner Andriukaitis, who asked me to reply on his behalf as my unit is responsible for the legislation concerning pesticides and for providing your publication concerning depleted uranium and its impacts on human health.

It is with a lot of interest that I took note of your findings and I will take the freedom to refer to them in further discussions on this topic with other interested parties.

Yours sincerely,

Klaus Berend
Head of Unit

665 Image 2. Reply of the European Commission saying it « will take the freedom to refer to my
work ».

670

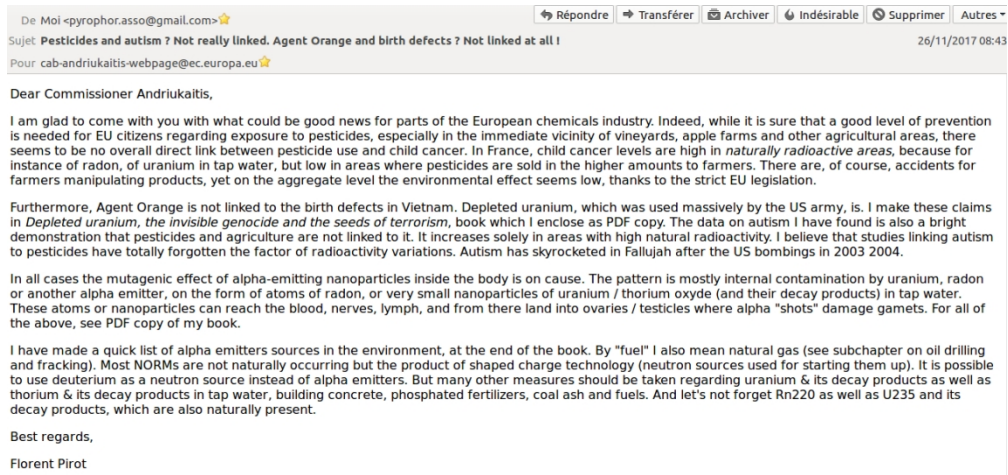
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| World increases | Depleted uranium diseases | Afghanistan | Iraq | Pakistan | |
|-----------------|---|-------------|------|----------|-------|
| 0,18 | Leukemia | | 1 | 0,42 | 0,5 |
| 0,29 | Lymphoma | | 0,55 | 0,33 | 0,41 |
| 0,27 | Brain / nervous system | | 0,78 | 0,54 | 0,58 |
| 0,36 | Other malignant neoplasms | | 0,68 | 0,34 | 0,68 |
| -0,06 | Birth defects | | 0,17 | 0,52 | 0,1 |
| 0,08 | Testicular cancer | | 0,57 | 0,51 | 2 |
| 0,3 | Ovary cancer | | 0,93 | 0,6 | 0,58 |
| 0,019 | Oesophagus cancer | | 0,58 | 0,36 | 0,37 |
| 0,02 | Stomach cancer | | 0,3 | 0,3 | 0,2 |
| 0,35 | Colon and rectum cancer | | 1,1 | 0,5 | 0,6 |
| 0,38 | Prostate cancer | | 0,81 | 0,35 | 0,62 |
| -0,105 | Thalassemia | | 0,28 | 0,2 | 0,65 |
| 0,083 | Sickle cell traits and disorders | | 0,44 | 0,3 | 0,49 |
| -0,06 | Other haemoglobinopathies and haemolytic anaemias | | 0,58 | 0,27 | 0,37 |
| 0,57 | Other endocrine, blood and immune disorders | | 1,14 | 0,7 | 1,29 |
| 0,16 | Ischaemic stroke | | 0,66 | 0,28 | 0,5 |
| 0,27 | Ischaemic heart disease | | 0,61 | 0,37 | 0,57 |
| 0,023 | Rheumatic heart disease | | 0,4 | 0,22 | 0,349 |
| 0,24 | Cardiomyopathy, myocarditis, endocarditis | | 0,84 | 0,45 | 0,75 |
| 0,22 | Other circulatory diseases | | 0,89 | 0,41 | 0,74 |

Table 1. This table shows the evolution between 2000 and 2015 for the disease-adjusted life years (World Health Organization DALYs) of several diseases for which the link with depleted uranium nanoparticles is logical.

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Letter of the author to the European Commission dated 26/11/2017 presenting the basic outline of this paper as well as more contents related to depleted uranium weapons.

454x213mm (72 x 72 DPI)

Ref. Ares(2018)58656 - 05/01/2018



EUROPEAN COMMISSION
DIRECTORATE-GENERAL FOR HEALTH AND FOOD SAFETY
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Reply of the European Commission saying it « will take the freedom to refer to my work ».

224x224mm (72 x 72 DPI)

Feuille1

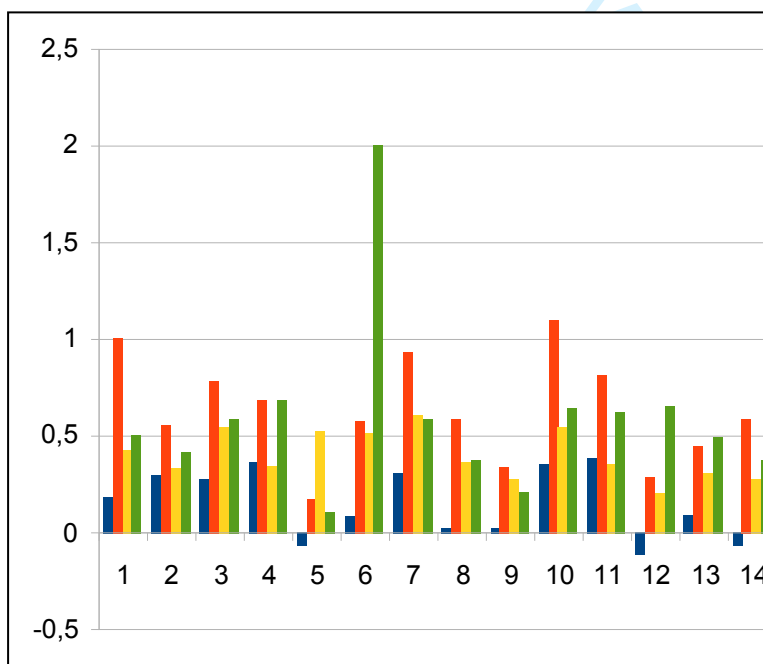
The table itself is the frame below, all the tiles from A3 to E23

World increases Depleted uranium diseases

| | |
|--------|---|
| 0,18 | Leukemia |
| 0,29 | Lymphoma |
| 0,27 | Brain / nervous system |
| 0,36 | Other malignant neoplasms |
| -0,06 | Birth defects |
| 0,08 | Testicular cancer |
| 0,3 | Ovary cancer |
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| 0,35 | Colon and rectum cancer |
| 0,38 | Prostate cancer |
| -0,105 | Thalassemia |
| 0,083 | Sickle cell traits and disorders |
| -0,06 | Other haemoglobinopathies and haemolytic anaemias |
| 0,57 | Other endocrine, blood and immune disorders |
| 0,16 | Ischaemic stroke |
| 0,27 | Ischaemic heart disease |
| 0,023 | Rheumatic heart disease |
| 0,24 | Cardiomyopathy, myocarditis, endocarditis |
| 0,22 | Other circulatory diseases |

Based on WHO data Global Burden Estimates

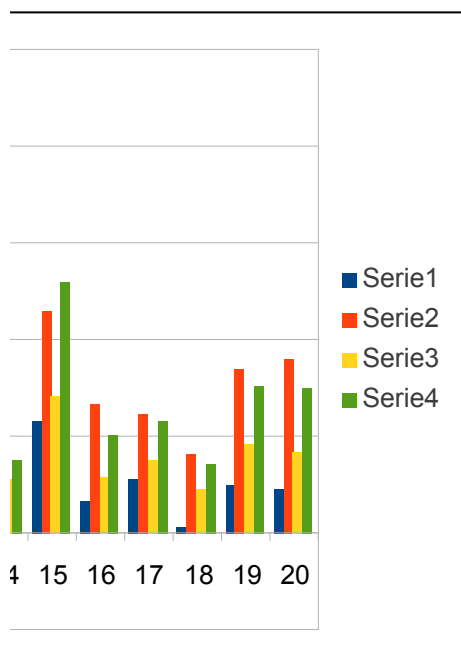
2000 to 2015 increases



Feuille1

Are the three c
Which confirm

| Afghanistan | Iraq | Pakistan | | |
|-------------|------------|------------|------------|------------|
| | 1 | 0,42 | 0,5 | 1,92 |
| | 0,55 | 0,33 | 0,41 | 1,29 |
| | 0,78 | 0,54 | 0,58 | 1,9 |
| | 0,68 | 0,34 | 0,68 | 1,7 |
| | 0,17 | 0,52 | 0,1 | 0,79 |
| | 0,57 | 0,51 | 2 | 3,08 |
| | 0,93 | 0,6 | 0,58 | 2,11 |
| | 0,58 | 0,36 | 0,37 | 1,31 |
| | 0,3 | 0,3 | 0,2 | 0,80735345 |
| | 1,1 | 0,5 | 0,6 | 2,27790532 |
| | 0,81 | 0,35 | 0,62 | 1,78 |
| | 0,28 | 0,2 | 0,65 | 1,13 |
| | 0,44 | 0,3 | 0,49 | 1,23 |
| | 0,58 | 0,27 | 0,37 | 1,22 |
| | 1,14 | 0,7 | 1,29 | 3,13 |
| | 0,66 | 0,28 | 0,5 | 1,44 |
| | 0,61 | 0,37 | 0,57 | 1,55 |
| | 0,4 | 0,22 | 0,349 | 0,969 |
| | 0,84 | 0,45 | 0,75 | 2,04 |
| | 0,89 | 0,41 | 0,74 | 2,04 |
| 13,33690955 | 7,98636181 | 12,3909874 | 133,508465 | |



Résultat des corrélations (test chi deux c

Afghanistan, Iraq and Pakistan are extreme with each other (even with a 0,1 % risk of

They of course do not follow at all the wor

The fact that several illnesses are correlated they are all linked of course with the same f

On est à 38 de

Feuille1

countries correlated ?

is depleted uranium bombings as on a big group of individuals the random effects of DU dust should be

| Effectif théorique | Afgh | Iraq | Pakistan | |
|--------------------|------------|------------|------------|------------|
| | 0,23275677 | 0,11485275 | 0,17819616 | 0,52580569 |
| | 0,12886534 | 0,07716669 | 0,11972555 | 0,32575758 |
| | 0,18980166 | 0,11365637 | 0,17633995 | 0,47979798 |
| | 0,16982254 | 0,10169254 | 0,15777785 | 0,42929293 |
| | 0,07891753 | 0,04725712 | 0,0733203 | 0,19949495 |
| | 0,30767848 | 0,18424296 | 0,28585634 | 0,77777778 |
| | 0,21077974 | 0,12621839 | 0,19583016 | 0,53282828 |
| | 0,13086325 | 0,07836308 | 0,12158176 | 0,33080808 |
| | 0,08065107 | 0,04829519 | 0,07493088 | 0,20387713 |
| | 0,22755274 | 0,13626234 | 0,21141353 | 0,57522862 |
| | 0,17781419 | 0,10647807 | 0,16520269 | 0,44949495 |
| | 0,11288204 | 0,06759563 | 0,10487587 | 0,28535354 |
| | 0,1228716 | 0,07357754 | 0,11415692 | 0,31060606 |
| | 0,12187264 | 0,07297935 | 0,11322881 | 0,30808081 |
| | 0,31267326 | 0,08797003 | 0,29049687 | 0,69114016 |
| | 0,14384968 | 0,01974032 | 0,13364712 | 0,29723712 |
| | 0,1548382 | 0,09271967 | 0,14385628 | 0,39141414 |
| | 0,09679885 | 0,05796475 | 0,08993337 | 0,24469697 |
| | 0,20378704 | 0,12203105 | 0,18933342 | 0,51515152 |
| | 0,20378704 | 0,12203105 | 0,18933342 | 0,51515152 |
| | 3,40886365 | 1,8510949 | 3,12903722 | |

Participations au chi-deux

| | Afgh | Iraq | Pakistan | |
|--------------------------|------------|------------|------------|------------|
| | 2,5290872 | 0,81073235 | 0,58114446 | |
| | 1,37627704 | 0,82839731 | 0,7037701 | |
| d'indépendance) : | 1,83525309 | 1,59928468 | 0,92401883 | |
| | 1,53266491 | 0,55845241 | 1,72848072 | |
| | 0,1051226 | 4,72914596 | 0,00970818 | |
| | 0,22365094 | 0,57596585 | 10,2788991 | |
| | 2,45411533 | 1,77841767 | 0,75364526 | |
| | 1,54148565 | 1,01220321 | 0,50757306 | |
| | 0,777746 | 1,05456244 | 0,21643034 | |
| ely correlated | 3,31292477 | 1,21045205 | 0,86767044 | |
| mistake) | 2,24762103 | 0,55694968 | 1,25204131 | |
| | 0,24741237 | 0,25934986 | 2,83344811 | |
| orld trend | 0,81850014 | 0,69677683 | 1,23740225 | |
| | 1,72213112 | 0,53189202 | 0,58228505 | |
| ord demonstrates | 2,18908881 | 4,25804883 | 3,43895798 | |
| actor, DU ! | 1,85201077 | 3,43130777 | 1,00424485 | |
| | 0,94971111 | 0,452955 | 0,74628041 | |
| | 1,98622501 | 0,88144479 | 1,66028275 | |
| | 1,98622501 | 0,88144479 | 1,66028275 | |
| | 2,31068771 | 0,67954932 | 1,60158561 | |
| | 31,9979406 | 26,7873328 | 32,5881516 | 91,3734249 |

egrés de liberté. Pour 40 DDL et une proba d'erreur de 0,1% le chi deux attendu est de 73,4020, test n

Feuille1

Is the average of the three countries correlated with the w

ad to similar levels of each disease

| Average | World | |
|------------|--------|------------|
| 0,64 | 0,18 | |
| 0,43 | 0,29 | |
| 0,63333333 | 0,27 | |
| 0,56666667 | 0,36 | |
| 0,26333333 | -0,06 | |
| 1,02666667 | 0,08 | |
| 0,70333333 | 0,3 | |
| 0,43666667 | 0,019 | |
| 0,26911782 | 0,02 | |
| 0,75930177 | 0,35 | |
| 0,59333333 | 0,38 | |
| 0,37666667 | -0,105 | |
| 0,41 | 0,083 | |
| 0,40666667 | -0,06 | |
| 1,04333333 | 0,57 | |
| 0,48 | 0,16 | |
| 0,51666667 | 0,27 | |
| 0,323 | 0,023 | |
| 0,68 | 0,24 | |
| 0,68 | 0,22 | |
| 11,2380863 | 3,59 | 14,8280863 |

Participation au chi deux

| | | |
|------------|------------|------------|
| 0,00055242 | 0,00172928 | |
| 0,0245241 | 0,07676989 | |
| 0,00384332 | 0,01203106 | |
| 0,02619909 | 0,08201328 | |
| 0,07742074 | 0,2423568 | |
| 0,04210968 | 0,13181955 | |
| 0,00428538 | 0,01341489 | |
| 0,0241481 | 0,07559288 | |
| 0,01140825 | 0,03571224 | |
| 0,00788682 | 0,02468878 | |
| 0,02824576 | 0,08842014 | |
| 0,14164241 | 0,44339543 | |
| 0,00353816 | 0,67839028 | |
| 0,07884755 | 0,24682328 | |
| 0,02632135 | 0,082396 | |
| 5,2594E-05 | 0,00016464 | |
| 0,01061184 | 0,03321917 | |
| 0,01408272 | 0,04408436 | |
| 0,00042728 | 0,00133755 | |
| 6,4819E-06 | 2,0291E-05 | |
| 0,52615404 | 2,3143798 | 2,84053384 |

Largement significatif

pas du tout significatif

réalisé avec succès

Feuille1

World average ?

Effectif théorique

| | |
|------------|------------|
| 0,62147135 | 0,19852865 |
| 0,54568216 | 0,17431784 |
| 0,684629 | 0,21870433 |
| 0,70231315 | 0,22435352 |
| 0,15410468 | 0,04922865 |
| 0,83873369 | 0,26793298 |
| 0,76041819 | 0,24291514 |
| 0,34534607 | 0,1103206 |
| 0,21912005 | 0,06999777 |
| 0,84073081 | 0,26857096 |
| 0,73768144 | 0,2356519 |
| 0,20589396 | 0,0657727 |
| 0,3736407 | 0,00823894 |
| 0,26273585 | 0,08393081 |
| 1,22273224 | 0,39060109 |
| 0,48505081 | 0,15494919 |
| 0,59620828 | 0,19045838 |
| 0,26223059 | 0,08376941 |
| 0,69726053 | 0,22273947 |
| 0,6821027 | 0,2178973 |