

Social Costs Today

Institutional analyses of the present crises

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Social Costs Today

This book deals with the causes of the present crises, but it claims that causes and policy implications cannot be properly assessed by focusing on allocative efficiency or income growth alone; it contends that a more general approach is called for, based on social costs. It does not deal with social costs according to the Pigouvian or the Coasian traditions. It draws on the work of Original Institutional Economics (OIE) such as Thorstein Veblen, Karl William Kapp and Karl Polanyi, on post-Keynesians such as Hyman Minsky and, in general, on authors who have provided insights beyond the conventional wisdom of economic thought.

The assumption underlying the book's social cost perspective is that social costs arise because the money-centered accounting of capitalist market economies is biased relative to social requirements and needs. Although social costs may sometimes have a monetary dimension, they cannot be dealt with in money terms alone. What is at issue at a more fundamental level is that (1) labor and knowledge, nature, money and finance, and problem-solving social institutions are treated as commodities, (2) our common knowledge is often distorted in order to favor vested interests, (3) whatever competition one might achieve, it cannot deal with the social dilemma between individualist profitability and societal serviceability and, finally, (4) when social costs rise and the quality of life declines, so does the ability of democratic collective action.

Social costs, in this perspective, identify the issues that need to be addressed if public policy would wish to prevent the economy from subsuming societal relations and freedom. Social costs, in this evolutionary-institutional perspective, particularly elaborated by Karl William Kapp, both precede and follow the crises, as causes and effects of the current financial, real economic, resources and food, energy and climate, social, political and moral crises. The sections in this book provide a framework that better allows us to situate the issues and to appreciate the crises.

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its recharge rate – or on its quality, as when irrigation disseminates chemicals and causes pollution. Thus, Couret Branco and Henriques conclude, the present crisis puts pressure on public finances and pushes governments to treat water as a commodity, but such a policy is going to clash with human rights, economic growth and ecological constraints.

The discussion of the commodification of water focused on the social costs that arise when a single good is subject to alternative uses. The chapter by Remi Maier-Rigaud, Michael Sauer and Frank Schulz-Nieswandt argues that problems arise also when a single good – private elderly care, in their case – has to be supplied by different actors. More specifically, the authors emphasize the social costs associated with inadequate coordination. The actors comprise families, private enterprises, public authorities and a ‘third sector’, which includes organizations such as the Red Cross or Caritas. Each actor differs in terms of its governance rationales – prices, reciprocity, legislation – and of the dominant features of the goals it may pursue: formal, informal or content. The authors believe that, owing to the complexity of the services required, interaction, cooperation and networking are better coordinating instances than competition or central planning. The absence of a coordinating body, however, may prevent the achievement of an adequate integration among these actors and may favor an ‘economic rationality’ that leads to missed opportunities, narrow optimization and substitution effects. Thus, social costs do not depend, here, on some technical ability to coordinate these different actors. The real issue is to acknowledge that the motives and rationales of each type of actor are different and that reliance on business-centered ones tends to be inadequate. Obviously, while it would be reassuring to rely on a single criterion – such as that of market efficiency – coordination of different rationales is problematic. It raises the ethical issue of the social priorities to be chosen, thereby forsaking the apparent technical neutrality of the coordinator.

Neoliberal reliance on the market tends to neglect the prevalence of oligopolistic markets in a great many industries. The most dramatic aspect of market power in these industries is less their control over prices than their control over knowledge. The chapter by Angelo Gino Levis, Valerio Gennaro and Spiridione Garbisa stresses this point by discussing how major companies carry out or finance studies in their fields. The authors provide an overview of epidemiological research that investigates the relation between exposure to electromagnetic fields – mainly those related to power lines and cell phones – and a range of diseases such as leukemias and tumors. They point out that there is a very large and statistically significant gap between the results of publicly and privately funded research: The results of the former show that EMFs significantly affect health, whereas the results of the latter tend to be much more reassuring. Drawing on the oncologist Lorenzo Tomatis, the authors contend that the method used in a great many privately funded studies is ‘to raise background noise, increasing confusion thereby making assessment of risk more difficult’. They argue that it is important to critically assess the scientific validity of these studies and they also refer to some guidelines to this end. But the main issue they point out is that

both single scientists and international journals are involved in conflicts of interest. The most likely reason is that this is the only way for them to gain information from expensive research projects that the reduction of public funds precludes. The implications are far reaching: It is not only that users of mobile phones are unaware of the risks of diseases and that inefficient scientific research cannot provide insights on potential future improvements. The most important consequence is that collective decisions concerning how these commodities should be produced and made available are precluded by the corrupted scientific knowledge that vested interests explicitly pursue.

Social costs and freedom

In his conclusive chapter, Michele Cangiani establishes a strong link between the first and the second group of chapters. His discussion is centered on how the range of social costs discussed up to now diminishes the ability of people to choose how to conduct their lives, thereby reducing their freedom.

Cangiani initially focuses on a specific case – that of the recent redefinition of contractual agreements that the automobile-producing firm Fiat has imposed on its workers. Although formally workers accepted them, the alternative they were faced with was to lose their jobs. This episode is dramatic in its own right, but what is particularly important about it is that it teaches us a great deal about the general loss of freedom that is occurring through the crises.

Fiat did not achieve its goals just because of its threats. It also managed to be convincing on ideological grounds. First, a pro-business culture prevails and presents Fiat's strategy as a necessary response to external constraints. This issue was already discussed with regard to other chapters. In Cangiani's chapter its importance emerges with all of its dramatic consequences. Second, lenders and investors constitute what Chomsky has termed a 'virtual senate', which contrasts – through capital flights and other actions – any policy that does not favor business. It is that same 'senate' that underlies the speculation on government bonds discussed by Onaran and that conventional wisdom labels with a much more appealing term: financial markets. Third, the ideology underlying dominant economic thought evaluates the economy's performance in terms of the economy's internal criteria. Its closed-system perspective prevents it from carrying out an evaluation in terms of criteria arising from the (social) system that the economy is a part of.

These circumstances allow technocratic and unaccountable institutions to prevail in the management of the economy, at the expense of all countervailing powers, thereby favoring a 'collusion between a political patronage system and private economic interests' and a 'growing connivance between neoliberal and illiberal tendencies'. Under these conditions it is no surprise that people lose interest in political issues, and that this further undermines the democratic process. The general conclusion is that Fiat and business in general are successful not only because they force their vested interests upon the rest of society. A major determinant of their power is that, in so doing, they also preclude public

11 Business bias as usual

The case of electromagnetic pollution¹

Angelo Gino Levis, Valerio Gennaro and Spiridione Garbisa

Introduction: protecting human health or protecting business? How to identify the *business bias*

About 50 years ago, Lorenzo Tomatis anticipated – with bitterness, but also with the clarity and optimism that distinguish the competent researcher – that ‘the world of research consists of a few dozen people who really matter, a small group of trusted workers, a significant number of uninformed (guilty and non guilty) ones, and a cohort of unscrupulous profiteers, true violators’ (Tomatis 1965: 139). It is not easy to identify the honest researchers, picking them out from among the violators and profiteers, whose main aims are promoting career and business. It is much simpler to actually carry out good research and identify any studies that are flawed or biased. This is, of course, a true researcher’s main goal.

Indeed, best practice in both environmental and occupational epidemiology has been well established for years (Hernberg 1981). However, the correct use of these methods is not routinely applied, a failure regrettably borne out by numerous studies on exposed workers (e.g., in oil refineries, petrochemical or steel plants), military personnel (e.g., exposure to depleted uranium) and people living in areas suffering from pollution (e.g., due to the presence of industrial plants and urban traffic congestion). Moreover, the findings of studies carried out with the benefit of corporate funding often conclude that a population exposed to some occupational or environmental risk factor, or to treatment with this or that drug, is healthier than the control population (though only until truly independent studies are carried out, these often uncovering very different results). An article published quite recently highlighted this common failure, and proposed how it might be corrected, pointing out 15 errors and biases, and so enabling epidemiologists to avoid the most serious diagnostic error that can be made: reporting a sick population as healthy (Gennaro and Tomatis 2005).²

This serious under-estimation of the epidemiological risk of disease can be produced in good or bad faith. The latter – termed *business bias* in occupational and environmental epidemiology – can be understood as an intentional study bias, specifically set up to prioritize both economic and career-related ambitions over scientific research, whose legitimate goal should be the minimization of

avoidable health damage. In later studies there is mounting evidence concerning how what is considered *health-oriented research* could in fact turn into *business- or funds-oriented research* (Egilman and Bohme 2005; Bailar 2006; Michaels 2008; Pearce 2008; Oreskes and Conway 2010). Today there are 25 points in place of the earlier 15 points, and it is increasingly clear that the business bias issue has become a new risk factor for the health of populations (Gennaro *et al.* 2009). Inconsistencies, contradictions and omissions can easily be identified by carefully reading all the sections of a scientific article. Furthermore, there is a clearly noticeable, tell-tale inconsistency in the contrast between the reassuring tone of the conclusion of a study (the part that is always read) and the alarm evident in other sections (those often disregarded: materials, methods and results).

Interest conflicts and exposure limits to non-ionizing electromagnetic fields

Discussion on the need to minimize exposure to electromagnetic fields (EMF) (frequency range: 0–300 GHz) has for over half a century been split between two irreconcilable positions. On the one hand, a ‘conservative’ stance rooted in the definition of exposure limits fixed since the mid-1950s on the assumption that the only effects of EMF dangerous to human health are the acute effects resulting from the passage of electric current or overheating (stimulation of muscles and peripheral nerves, shocks, burns, heating of surface tissues). Simple avoidance of these effects would ensure the safeness of exposure to EMF.³ This position was agreed upon at the end of the 1990s by a group of scientists which was self-constituted under the International Commission for Non-Ionizing Radiation Protection (ICNIRP). Working with so-called ‘ghosts’ (dummies reproducing the human shape and biochemical constitution of human tissue), this group identified the EMF values at which a significant thermal effect is registered, and introduced reductions of 10–50 times for workers and the general population, respectively.⁴ The ICNIRP set a single exposure limit to protect from acute and thermal effects: For the general population this limit is 100 microTesla (μT) for magnetic fields (MF) produced by the EMF at low frequencies (0–100 KHz), in particular at 50–60 Hz (ELF, extremely low frequencies: e.g., power lines), and 27–61 Volts/meter (V/m) – depending on the frequency – for electric fields produced by the EMF at high–very high frequencies (100–300 GHz; radiofrequencies or RF; e.g., radio/TV and mobile telephony emissions). For workers, the ‘safe limits’ are 500 μT for ELF/EMF and 137 V/m for RF/EMF,⁵ respectively. For the ICNIRP, the acute effects with thermal origin are the only EMF effects harmful to human health that have specifically been determined, while other effects – in particular long-term effects and biological effects of non-thermal origin – are inadequately documented or give contradictory results, for which reason they have been excluded from consideration when setting exposure limits. The position and limits defined by the ICNIRP have been accepted by the principal organizations overseeing health care, including the WHO, as well as by many national scientific committees and the European Commission (EC).⁶

On the other hand, a large part of the scientific community – especially where there is no constraint from funding by manufacturers or managers/operators of the technologies concerned – maintains a ‘cautionary’ position based on application of the Precautionary Principle and the necessity to minimize EMF exposures. This position is justified by both epidemiological and experimental data. The former data – documented after exposure of human subjects to EMF so weak as to be able to exclude any significant heating – show immediate and long-term health effects including tumors and cancers, while the latter data reveal biological effects on *in vitro* systems, animals and human volunteers, indicating molecular, cellular and functional mechanisms supporting a biological plausibility (see Box 11.1). The cautionary limits suggested for the population are lower by about two orders of magnitude than those set by the ICNIRP: 0.1–0.2 μT (rather than 100) for ELF/EMF and 0.5–0.6 V/m (rather than 27–61) for RF/EMF.⁷

Box 11.1 Non-thermal biological effects of EMF supporting the plausibility of a possible carcinogenic action of these radiations*

- 1 Alteration of the synthesis of the hormone melatonin, involved in the deactivation of peroxide radicals, which produce DNA damage triggering carcinogenesis;
- 2 stimulation of Fenton’s reaction, with consequent increase in damage due to free radicals on biological macromolecules;
- 3 modification of the permeability of the cell membrane and consequent alteration of the flow of biologically important ions, in particular calcium;
- 4 modification of the brain’s electrical activity and of the permeability of the hemato-encephalic membrane, with consequent damage to the cerebral neurons and alteration of the functioning of the cerebral neuroreceptors and neurotransmitters;
- 5 alteration of the functioning of the immune system;
- 6 inhibition of apoptosis (programmed cell death);
- 7 expression of heat shock proteins;
- 8 genetic and epigenetic effects;
- 9 synergistic interactions with other carcinogens (ionizing radiation, polycyclic aromatic hydrocarbons, benzene derivatives).

* See all the articles published in *Pathophysiology*, 16 (2009): 67–250, and in *European Journal of Oncology Library*, 5 (2010): 1–403

Residential and occupational exposure to ELF/EMF

Childhood leukemias, tumors in adults, neurodegenerative disorders and acute diseases

IARC’s monograph no. 80 on this topic is based on dozens of increasingly sophisticated studies, plus two ‘pooled analyses’ (IARC 2002). The first of these two

includes nine carefully conducted studies and shows a statistically significant doubling of the risk of contracting childhood leukemia through exposure at home to power lines, in the presence of MF equal to or greater than $0.4 \mu\text{T}$, relative to those exposed to less than $0.1 \mu\text{T}$ (OR=2.00; 95 percent CI=1.24–3.13) (Ahlbom *et al.* 2000).⁸ The second pooled analysis covers 15 studies and shows a statistically significant increase in the same type of risk for exposures above $0.3 \mu\text{T}$ (OR=1.7; 95 percent CI=1.2–2.3) (Greenland *et al.* 2000). According to IARC, the association between childhood leukemia and high levels of magnetic fields is not likely to be due to chance, but it could be affected by distortions. In particular, a distortion of the selection could explain part of the association. However, it is highly unlikely that the distortion due to unknown confounding factors can explain the entire effect observed. In addition, if the relationship observed was a result of a causal link, the risk associated with the exposure might be higher than that reported. In fact, a number of studies have shown statistically significant increases in risk of childhood leukemia exceeding those cited above, even at MF values lower than $0.3\text{--}0.4 \mu\text{T}$ (Table 11.1). The fraction of the infant population exposed at home to leukemogenic MF levels ($0.3\text{--}0.4 \mu\text{T}$) could range between 1 and 4 percent, but these MF levels represent just one average of values produced during the year by the voltage arising from power lines, and today it is still not known whether average or maximum values of MF should be correlated with the incidence of childhood leukemias. Consequently, in view of the fact (see Table 11.1) that increase in risk often far exceeds a simple doubling (up to 5–6 times) and is found even at low MF levels (up to $0.1 \mu\text{T}$) – and noting that much higher MF peaks are common ($3\text{--}5 \mu\text{T}$, and in some cases over $10 \mu\text{T}$) – this fraction could be very much higher. Furthermore, it is possible that children living close to power lines and who are exposed to MF of intensities of the order of those mentioned above are subject to an increased risk of contracting other types of cancer. Finally, a number of studies indicate that children exposed in the home to MF produced by power lines suffer from restricted growth and shorter lifespan, and have raised risk of developing some form of cancer in adult life (Fadel *et al.* 2006; Foliart *et al.* 2006; Svendsen *et al.* 2007).

Various authors have also noted statistically significant increases in various types of tumor in adults with residential and occupational exposures (Table 11.2). Much common office equipment (computers, photocopiers, fax machines, video-display units) causes simultaneous exposure to ELF/EMF and RF/EMF, and evaluation of the contribution from these various EM sources shows the need to minimize exposure to this equipment to avoid harmful health effects from using them (Seyhan *et al.* 2010).

In adults, occupational or residential exposure to ELF/EMF may also raise incidence of spontaneous abortion (Lee *et al.* 2002; Li *et al.* 2002) and cause alterations of electrical brain activity and of the muscular, cardiocirculatory, hormonal and immune systems, of the cutaneous tissue, as well as neurological disturbances (of the attention, memory, visual-motor coordination and of mental health: depression and risk of suicide). Furthermore, epidemiological data

Table 11.1 Childhood leukemias in residential exposures to ELF/EMF

Authors	Reference	Year	OR	95% CI	χ^2
Wertheimer and Leeper	<i>American Journal of Epidemiology</i> , 109: 273–284	1979	3.0	1.1–8.1	>0.30
Savitz <i>et al.</i>	<i>American Journal of Epidemiology</i> , 128: 21–38	1988	3.8	1.2–11.7	>0.30
London <i>et al.</i>	<i>American Journal of Epidemiology</i> , 134: 923–937	1991	2.2	1.1–4.3	>0.15
Olsen <i>et al.</i>	<i>British Medical Journal</i> , 307: 891–895	1993	5.6	1.6–19.0	>0.40
Feychting and Ahlbom	<i>American Journal of Epidemiology</i> , 138: 467–481	1993	3.8	1.4–9.3	>0.30
Coghill <i>et al.</i>	<i>European Journal of Cancer Prevention</i> , 5: 153–158	1996	4.7	1.2–27.8	>0.20
Michaelis <i>et al.</i>	<i>Epidemiology</i> , 9: 92–94	1997	3.8	1.2–11.9	>0.20
Linet <i>et al.</i>	<i>New England Journal of Medicine</i> , 337: 1–7	1997	3.3	1.2–9.4	>0.40
Li <i>et al.</i>	<i>Journal of Occupational and Environmental Medicine</i> , 40: 144–147	1998	2.7	1.1–5.6	<100 m
UKKCS ²	<i>Lancet</i> , 354: 1925–1931	1999	2.4	1.2–5.1	>0.1–0.2
Green <i>et al.</i>	<i>Cancer Causes Control</i> , 10: 233–243	1999	4.5	1.3–15.9	>0.14
Green <i>et al.</i>	<i>International Journal of Cancer</i> , 82: 161–170	1999	3.5	1.1–10.5	>0.15
Bianchi <i>et al.</i>	<i>Tumori</i> , 86: 195–198	2000	3.5	1.1–9.7	>0.10
Schuz <i>et al.</i>	<i>International Journal of Cancer</i> , 91: 728–735	2001	3.2	1.3–7.8	>0.20
Schuz <i>et al.</i>	<i>International Journal of Cancer</i> , 91: 728–735	2001	5.5	1.2–27.0	>0.40
Draper <i>et al.</i>	<i>British Journal of Medicine</i> , 330: 1290–1293	2005	1.7	1.1–2.5	<200 m
Draper <i>et al.</i>	<i>British Journal of Medicine</i> , 330: 1290–1293	2005	1.2	1.02–1.5	200–600 m
Kabuto <i>et al.</i>	<i>International Journal of Cancer</i> , 119: 643–650	2006	4.7	1.2–19.0	>0.40

Note

- 1 For exposures in μT or for distance in meters from the power lines;
- 2 UK Childhood Cancer Study Investigators.

Table 11.2 Tumors in adults in occupational and residential exposures to ELF/EMF

Authors	Reference	Year	Condition, sex	Tumors	OR (95% CI)
Floderus et al.	<i>Cancer Causes and Control</i> , 5: 189–194	1994	Railway workers ♂	Leukemia, brain tumors	4.3 (1.6–11.8)
Floderus et al.	<i>Cancer Causes and Control</i> , 5: 189–194	1994	Train drivers ♂	Breast tumors	4.9 (1.6–15.7)
Tynes et al.	<i>Cancer Causes and Control</i> , 7: 197–204	1996	Electricity network workers ♂	Breast tumors	1.5 (1.1–2.0)
Coogan et al.	<i>Epidemiology</i> , 7: 459–464	1996	Electricity workers ♀	Breast tumors	1.8 (1.1–3.1)
Milham	<i>American Journal of Industrial Medicine</i> , 30: 702–704	1996	Environmental exposure ♂, ♀	Leukemia and other tumors	3.9 (1.6–8.0)
Rodvall et al.	<i>European Journal of Epidemiology</i> , 14: 563–569	1998	Electricity workers ♂	Gliomas	1.9 (0.8–5.0)
Pollan et al.	<i>American Journal of Public Health</i> , 89: 875–881	1999	Electronic programmers ♀	Breast tumors	1.8 (1.2–2.7)
Pollan et al.	<i>American Journal of Public Health</i> , 89: 875–881	1999	Telegraph line operators ♀	Breast tumors	1.5 (1.1–2.0)
Pollan et al.	<i>American Journal of Public Health</i> , 89: 875–881	1999	Telephone line operators ♀	Breast tumors	1.3 (1.1–1.5)
Pollan et al.	<i>American Journal of Public Health</i> , 89: 875–881	1999	Various ELF occupations ♀	Breast tumors	from 1.3 to 1.7 (s.s.)
Villeneuve et al.	<i>Occupational and Environmental Medicine</i> , 57: 249–257	2000	Electricity workers ♂	Non-Hodgkin lymphoma	3.6 (1.3–9.8)
van Wijngaarden	<i>Occupational and Environmental Medicine</i> , 57: 258–263	2001	Electricity workers ♂	Brain tumors	1.7 (1.0–3.0)
Bethwaite et al.	<i>Cancer Causes and Control</i> , 12: 683–689	2001	Electrical welders ♂	Leukemia	2.8 (1.2–6.8)
Villeneuve et al.	<i>Journal of Epidemiology</i> , 31: 210–217	2002	Electrical welders >0.6 μT ♂	Glioblastomas	5.4 (1.2–24.8)
Hakansson et al.	<i>Occupational and Environmental Medicine</i> , 59: 481–486	2002	Electrical welders ♀	Renal tumors, leukemia	1.4 (1.0–2.0)

Hakansson <i>et al.</i>	<i>Occupational and Environmental Medicine</i> , 2002 59: 481–486	2002	Electrical welders ♀	Gliomas	3.0 (1.1–8.6)
Tynes <i>et al.</i>	<i>Occupational and Environmental Medicine</i> , 2003 60: 343–347	2003	Residents exposed to >0.2 μT ♂, ♀	Skin melanomas	1.9 (1.2–2.8)
Charles <i>et al.</i>	<i>American Journal of Epidemiology</i> , 157: 2003 683–691	2003	Electricity workers ♂	Prostate tumors	1.6 (1.1–2.4)
Weiderpass <i>et al.</i>	<i>Journal of Occupational and Environmental Health</i> , 45: 305–315	2003	Electricity workers ♀	Gastrointestinal tumors	1.5 (1.1–2.0)
Weiderpass <i>et al.</i>	<i>Journal of Occupational and Environmental Health</i> , 45: 305–315	2003	Electricity workers ♀	Pancreatic tumors	1.8 (1.2–2.8)
Fazzo <i>et al.</i>	<i>Epidemiologia & Prevenzione</i> , 29: 243–252	2005	Residential ELF exposure ♂, ♀	Peritoneal tumors, digestive system	2.2 (1.2–4.3)
Fazzo <i>et al.</i>	<i>Epidemiologia & Prevenzione</i> , 29: 243–252	2005	Residential ELF exposure ♂, ♀	Leukemia	4.5 (1.1–17.9)
Lowenthal <i>et al.</i>	<i>International Medicine Journal</i> , 37: 614–619	2007	Residential ELF exposure ♂, ♀	Lymphomas and myelomas	3.2 (1.3–8.3)
Fazzo <i>et al.</i>	<i>Journal of Occupational and Environmental Health</i> , 15: 133–142	2009	Residential ELF exposure ♂, ♀	Pancreatic tumors, leukemia	8.2 (3.1–21.8)

Notes

Negative data are given in over 50 articles published since 1998, all funded by the major electricity companies (National Grid Corporation UK, Electric Power Research Institute USA and other electricity companies), or by private bodies with interests in the development of technologies that use ELF/EMF. A few of these articles were signed by Leeka Kheifets and John Swanson, who participated in the IARC ELF/EMF monograph working group and did not declare their conflict of interests in spite of being employees of two of the world's largest electric utilities (see footnote 9).
Most of the data refer to exposures with MF values of 1–5 μT.

indicate a statistically significant increase in risk in certain cases, of neuro-degenerative diseases (Bortkiewicz *et al.* 2006): lateral amyotrophic sclerosis (Hakansson *et al.* 2003), Parkinson's disease (WHO 2007) and Alzheimer's disease (Huss *et al.* 2009), in subjects with occupational exposure to ELF/EMF. The increase in risk is found at magnetic field levels comparable with those present in some residential situations (0.2–5.0 μ T).

Finally, a number of types of tumor, pre-neoplastic effects and synergistic interactions with chemical and physical carcinogens have been observed in rodents irradiated with ELF/EMF in the laboratory, at MF levels corresponding to those in man – bearing in mind the different conditions of exposure and lifetime – to 0.3 μ T in residential exposure to power lines (Zapponi and Marcello 2004).

A number of mechanisms of biological action have also been identified that could explain the induction of short- and long-term effects of the ELF/EMF, possibly in association with predisposition through genetic factors (Box 11.1).

Criticism of the positions held by IARC, ICNIRP, the EC and WHO

The IARC monograph concludes by stating that (IARC 2002): (1) there is limited evidence in man of carcinogenicity of ELF/EMF in reference to childhood leukemia; (2) there is insufficient evidence of other forms of cancer in man and, in general, in experimental animals. For these reasons, ELF/EMF are considered 'possible carcinogenic agents for man' (Group 2B). In view of the above epidemiological and experimental data – most already available in 2001 – the conclusions of IARC cannot be justified except in the light of the new IARC 'trends' described by Tomatis, founder and scientific director of IARC (1969–1993) (Tomatis 2002), and by J. Huff, editor of IARC monographs (1977–1979) (Huff 2002).⁹

The classification of ELF/EMF (Group 2B) determined by the IARC working group in 2001 is still upheld today by the WHO/EC/ICNIRP and other international and national organizations.¹⁰

The innovative position of the Italian civil magistracy

The limits put forward by the international agencies and even those set by law should not be the only points of reference in the controversy on the possible damage to human health deriving from exposure to ELF/EMF. This was established by Sentence 9893/2000 of the Italian Supreme Court (*Corte di Cassazione*), which established that the regular judge had full power, including for determination of the danger to health on the basis of scientific knowledge acquired at the time of the ruling. This is a principle that has frequently been emphasized in the sentences of various court cases: Milan 43678/2003; Potenza 195/2003; Modena 1430/2004; Como 1490/2005; Venice 441/2008; Criminal Court (*Cassazione Penale*) 33285/2008. These hearings established that: (1) the constitutional right to health is understood in the broadest sense, including the

right to live in an environment that is healthy and that should also be protected preventively – that is, where there is the presence of merely a danger of falling ill or contracting a disease. This protection, to be effective, cannot in fact be subordinate to a state of illness or disease arising. (2) The harm, in the form of risk, should be prevented and compensated for, even if it is not known who will be struck, nor when, but it is instead known that when it does strike it will be too late, in the sense that a harmful event that could have been avoided has instead arisen. (3) Observation of the limits set by the regulations in force does not make exposures to ELF/EMF in themselves legal and compatible with the protection of the right to health. Instead, account should be taken of the constitutional relevance of the right to health (Article 32 of the Italian Constitution) and of the consequent level of protection, necessarily prevailing over freedom of enterprise, provided for by Article 41 of the Constitution, stating that: ‘Private economic endeavor is free but may not be carried out in conflict with social utility or in any way that compromises safety, freedom or human dignity’ and that: ‘The law determines the programs and appropriate controls in such a way that public and private activity can be directed toward and coordinated for social goals’. (4) The scale of values set out by the Constitution should also include the Precautionary Principle, as provided for by Article 174 of the EU Treaty, which should be considered part of the national regulations. (5) In cases of doubt as to the level of risk, the Precautionary Principle requires the adoption of the most conservative arrangement consistent with minimizing risk, where necessary opting for ‘zero risk’. (6) Where a number of epidemiological studies have shown a significant increase in risk, the emissions should be considered dangerous, even though the mechanisms of action are still not known. Here, in fact, the causality link can only be determined in terms of probability.¹¹

Mobile phones and head tumors: a representative case

The worldwide spread of the use of mobile phones (MPs: analog and digital cell-ulars, and cordless) has heightened concerns about possible adverse effects, especially head tumors. According to the International Telecommunications Union, the number of mobile phone subscriptions has reached five billion (mid-2010), with over half of all users thought to be children and young adults. There are no data for cordless users, but a figure of two billion is a reasonable assumption. Given these figures, even an established modest increase (20–30 percent) in tumor risk for MP users would result in significant social and health costs and individual suffering, while higher risks could give rise to a health crisis of dramatic proportions. While most technologies carry risks, these should be assessed accurately and responsibly.

Whether or not there is a relationship between MP use and head tumor risk is still a matter of debate. On the one hand there are researchers who recognize the validity of positive results – such as those by Hardell, who has documented a statistically significant increase (100 percent) of head tumors (brain gliomas and acoustic nerve neuromas) in people exposed to MPs for a long overall time

(more than ten years) – and who are requesting application of the Precautionary Principle, especially for children who face decades of exposure (Hardell and Carlberg 2009; Hardell *et al.* 2011). On the other hand there are researchers who form their own conclusions, largely reassuring, on the basis of the results of the Interphone project, which involved research groups from 13 countries (Interphone Study Group 2010). It is therefore vital to understand the weight of the conflict between Hardell's positive results and those from other studies considered reassuring in their failure to find any increased risk of head tumors in MP users. Progress requires a critical analysis of the methodological elements necessary for an impartial evaluation of contradictory results (Box 11.2).

Box 11.2 Main methodological elements that should be considered to ensure the reliability of epidemiological studies on the relationship between MP use and increased risk of head tumors

- 1 The compatibility of latency and/or exposure time since first use of MPs with the progression time of the examined tumors;
- 2 the inclusion among the exposed of all users of MPs, cordless included;
- 3 the laterality of the head tumor localization relative to the habitual laterality of MP use;
- 4 the percentage of actually exposed subjects, based on the frequency and duration of the MP use;
- 5 the number of subjects selected (cases and controls), and the percentage of their participation in the study;
- 6 the distribution of the relative risk values (OR) above and under 1, and the probability that such distribution might be casual;
- 7 the full and correct selection and citation of data included in the meta-analyses.

The pooled analyses of epidemiological case-control studies by Hardell produced positive results indicating a cause–effect relationship (Hardell and Carlberg 2009; Hardell *et al.* 2011): exposures for or latencies from at least ten years to MPs increase by up to 100 percent the risk of tumors on the same side of the head preferred for phone use (ipsilateral tumors) – which is the only side significantly irradiated – with statistical significance for brain gliomas and acoustic neuromas. On the contrary, studies published under the Interphone project produced ‘negative’ results and are characterized by a substantial under-estimation of the risk of tumors (Interphone Study Group). The data published a year ago by Interphone included the risk of malignant (gliomas) and benign (meningiomas) brain tumors in people using only cell phones (not cordless), and have been widely publicized as reassuring by the authors as well as by the organizations that promoted and funded the study (IARC and EU 70 percent, the cell phone companies 30 percent), by the main agencies responsible for protecting human health and by more than 100 newspapers that have made headlines around the world. This, despite the article being accompanied by a ‘commentary’ with a very telling title: ‘Call me on my mobile phone ... or better not?’ – a

look at the Interphone study results' (Saracci and Samet 2010). This commentary pointed out some major defects of the Interphone protocol and results that would have substantially 'diluted' risk estimates. In this context we consider even more important the editorial by E. Cardis – former coordinator of the Interphone project – and S. Sadetzki. The latter headed the Israeli Interphone team and his own studies – showing large increases in parotid tumor risk in regular and long-time cell phone users (Sadetzki *et al.* 2008) – were presented in September 2009 to the US Senate (Havas 2010). This editorial has a rather eloquent title: 'Indications of possible brain-tumor risk in mobile phone studies: should we be concerned?' (Cardis and Sadetzki 2011). Furthermore, the highly risk-assertive response of the two editorial authors was not based on new experimental data, but instead on a critical review of the results of the Interphone study (2010), to which they themselves contributed. It seems to us that such a stance represents a milestone in the quest for truth.¹² Additional factors contributing to 'dilution' of risk estimates, not reported by Cardis and Sadetzki in their editorial, are pointed out in our recent article (Levis *et al.* 2012a).¹³

Cardis and Sadetzki did not limit themselves to criticism, but reported that the Interphone data obtained using the essential factors for identifying a carcinogenic effect due to cell phone exposure – significant time use, continuity of use or latency of at least ten years and ipsilateral tumor detection – showed a statistically significant rise of up to 100 percent glioma risk in five studies – and the same is observed for acoustic neuromas (two studies) and parotid gland tumors (one study). As they stated: 'The overall balance of the above-mentioned arguments suggests the existence of a possible association' between cell phone use and increase in brain tumor risk.¹⁴

There are therefore many biases and flaws in the non-blind Interphone protocol, giving rise to a systematic under-estimate of the risk, whereas the double-blind protocol by Hardell producing positive results is without apparent errors, the results indicating a cause–effect relationship supported by biological plausibility (Box 11.3).

Box 11.3 Methodology errors in the Interphone negative studies on tumor risk from MP use, based on non-blind protocol. Reliability of positive Hardell studies on tumor risk from MP use, based on 'double-blind' protocol

- 1 **Interphone:** inadequate assessment of the 'regular use of cell phones' defined as 'at least 1 phone call/week, for at least 6 months': 2–5 minutes/day, often for less than five years. **Hardell:** MP use is significant: from over 16 to over 32 min/day for at least ten years.
- 2 **Interphone:** inadequate exposure or latency time in relation to the time required for diagnosing the tumors concerned: less than 5 percent of cases have latency time of at least ten years. **Hardell:** 18 percent of cases were exposed for or from 10–15 years.
- 3 **Interphone:** fails to include cordless users, even though they are exposed. **Hardell** includes them.

- 4 **Interphone:** fails to include people younger than 30, although they are exposed. **Hardell** includes them.
- 5 **Interphone:** fails to include people living in rural areas, although this group has high exposure. **Hardell** includes them.
- 6 **Interphone:** fails to include subjects who had died or were too weak to respond to the interview carried out during post-operative convalescence. **Hardell** includes them.
- 7 **Interphone:** fails to distinguish tumor laterality in relation to laterality of MP use. **Hardell:** tumor laterality is always considered in relation to laterality of MP use.
- 8 **Interphone:** fails to consider other types of malignant and benign head tumor, except for astrocytomas, neuromas, meningiomas and salivary gland tumors. **Hardell:** other types of head tumor are considered separately.
- 9, 10 **Interphone:** participation and selection bias. The participation of the controls is reduced to 60 per cent, at times less than 40 per cent, with prevalence of the exposed. **Hardell:** exposed and non-exposed controls participate in equal proportion and in high percentage (nearly 90 percent). *There is no selection or participation bias.*
- 11 **Interphone:** delayed interviews: the controls are interviewed at a later stage than the cases (up to more than nine months). Also for this reason, given the rapid spread of MPs, the control group contains more exposed than the case group. **Hardell:** case and control interviews are both conducted with no delay.
- 12 **Interphone:** data collection bias. As it is impossible to collect responses from hospitalized cases that are frail, the information is collected from a relative (up to 40 percent of cases) with consequent data uncertainty. **Hardell:** the data are always provided by the subject concerned. *There is no collection bias.*
- 13 **Interphone:** attribution bias in laterality of MP use. The patient, interviewed face-to-face when still in a confused state during the post-operative period, may report the most recent laterality of use which, owing to the disturbances brought about by the tumor, may not actually be the side habitually used before the development of the tumor. **Hardell:** the data are double-blind collected through questionnaires sent to the homes of the cases on their dismissal from hospital, when they are recovering. *There is no attribution bias.*
- 14 **Interphone:** documentation bias. In the bibliography cited to support the Interphone findings as reassuring, negative studies are widely reported and discussed; instead the positive studies of Hardell group are regularly ignored, under-evaluated or even selectively chosen. **Hardell:** negative Interphone studies are always cited and criticized, and their significant data are included in the meta-analyses. *There is no documentation bias.*
- 15 **Interphone:** funding bias: the findings from Interphone, which is co-funded by the cell phone companies, are publicized as fully reassuring – even though these at times include positive data indicative of increased carcinogenic risk, e.g., for only ipsilateral tumors, or only in the subgroup exposed for ten or more years, or only in residents in rural areas (one study). **Hardell:** all studies are funded by public bodies. *There is no funding bias.*

The discrepancy between the positive data of Hardell and the negative data from Interphone is also highlighted by other authors, who performed a meta-analysis of 24 case-control studies (Myung *et al.* 2009). These authors observed a statistically significant positive association between MP use and increased head cancer risk in ten studies using blinding ('high-quality studies', including seven studies by Hardell, just one by Interphone, and two by other groups), whereas a negative association (i.e., an apparent 'protective effect') was observed in 14 studies not using blinding ('low-quality studies', including 12 by Interphone, two by other groups, and one by Hardell). Elements in the method used to evaluate the 'quality' of the studies were: (1) blind or non-blind protocol; (2) presence or absence of participation and selection bias of cases and controls; (3) relevant or marginal MP exposures; (4) adequate or inadequate latency or overall time of MP use; (5) scrutiny of tumor laterality; (6) funding by independent sources or by cell phone companies. The authors reach the following conclusion: 'We feel the need to mention the funding sources for each research group because it is possible that these may have influenced the respective study designs and results'.¹⁵

Statistical relationships between positive or negative results and public or private funding in studies on EMF effects

Notes have already been made of the degree of conflicts of interests commonly found among researchers, scientific consultants and international organizations, and the ensuing consequences this situation has for the spread of distorted information, favoring the interests of the funding industries. According to Tomatis, the method used was 'the careful and systematic production of results, both experimental and epidemiological, whose sole purpose is to raise the background noise, increasing confusion and thereby making correct assessment of risk more difficult' (Tomatis 2007), and 'the best way to halt, or at least delay, a decision of public health issues is ... to inject doubts about the validity of data that are uncomfortably positive' (Tomatis 2008: 39).¹⁶ Conflicts of interests are particularly widespread in research on the effects of EMF. In fact, Hardell reports the following data (Hardell *et al.* 2006): (1) in 2001, out of 1,386 articles, 16 percent were funded privately; (2) by 2004 the number of articles funded privately had increased to 33 percent; (3) in 2004, 25 percent of articles published in two of the world's leading biomedical journals were signed by one or more authors with conflicts of interests. According to Hardell, these data are an underestimate owing to the accepted and now widespread custom in many journals not to indicate – or to indicate only partially – the sources of funding for the work carried out. This state of affairs means that information produced by independent research on the environmental and health risks of EMF has almost no influence.

In an interview published in July 2007 by the Association 'Liberterre', G. Carlo, author of the book *Cell Phones: Invisible Hazards in the Wireless Age*, stated that: (1) while perfectly aware of the health risks inherent in exposure to EMF, industry does not alter the present situation unless there is a drastic

intervention from governments and national and international agencies responsible for protection of health; (2) the ‘pollution’ of scientific information due to funding given by industry to researchers, agencies and governments themselves has today reached unimaginable proportions – at least 50 percent of studies on the effects of EMF are funded by sector industries; (3) many scientists funded by these industries have stated that the results of their research, where unfavorable to the interests of the commissioner of the work, have been modified by this latter or deleted in full; (4) the likelihood of finding a no-effect result is six times higher in studies funded by the industry companies than in those funded by public bodies; (5) industry also controls the dissemination of scientific information about the effects of EMF, so also influencing the way the public perceives the dangers connected with the technologies in question.

One significant item of data has been published by Huss *et al.* (2007), who selected particularly important articles about the biological and health effects of MPs. If 1 is the average probability of statistically significant results in work funded by public bodies ($p < 0.05$), the probability of at least one positive result in those funded by the cell phone companies is almost zero (OR=0.11; 95 percent CI=0.02–0.78); that is just one positive result out of 10. The probability for studies with mixed funding sources falls in an intermediate position (OR=0.56; 95 percent CI=0.07–3.80), and even studies not citing any source of funding – increasingly common as a result of the permissive approach of too many editors – are affected by some influencing (OR=0.76; 95 percent CI=0.12–4.70). Huss *et al.* (2007) concludes by recommending that ‘the interpretation of the results from existing and future studies of the health effects of RF radiation should take sponsorship into account’.

A critical review of studies on the biological and health effects of RF/EMF found that, out of 1,056 articles published in peer-reviewed journals, 44 percent reported negative results (no effect), with 93 percent being funded either by private bodies or by non-specified sources. Instead, 56 percent of the articles reviewed reported some kind of biological effect or harm to health, with 95 percent funded by public bodies (Levis *et al.* 2012b). As shown in Figure 11.1, there is massive intervention by the private funders in expensive testing and testing that is long and difficult to perform, such as experimental carcinogenesis on animals, genotoxicity testing which is predictive of possible carcinogenesis effects and epidemiological studies on head tumors in MP users, which is one of today’s most controversial debates involving a possible relevant risk for human health. The intervention of private funders is instead lower in less costly tests, such as short-term testing of biological effects in *in vitro* systems and in animals, epidemiological studies of tumors in small numbers of occupationally or residentially exposed subjects and testing on electro sensitivity, which tends to use simple and quick tests on volunteers or statistical sampling on populations of limited size. Even so, there is a constant vast prevalence of negative results in studies funded by private bodies, and of positive results in those funded by public bodies, just as there is a constant, almost-zero probability that this difference is due to chance (Fisher test: p -value < 0.0001 – 0.0004).

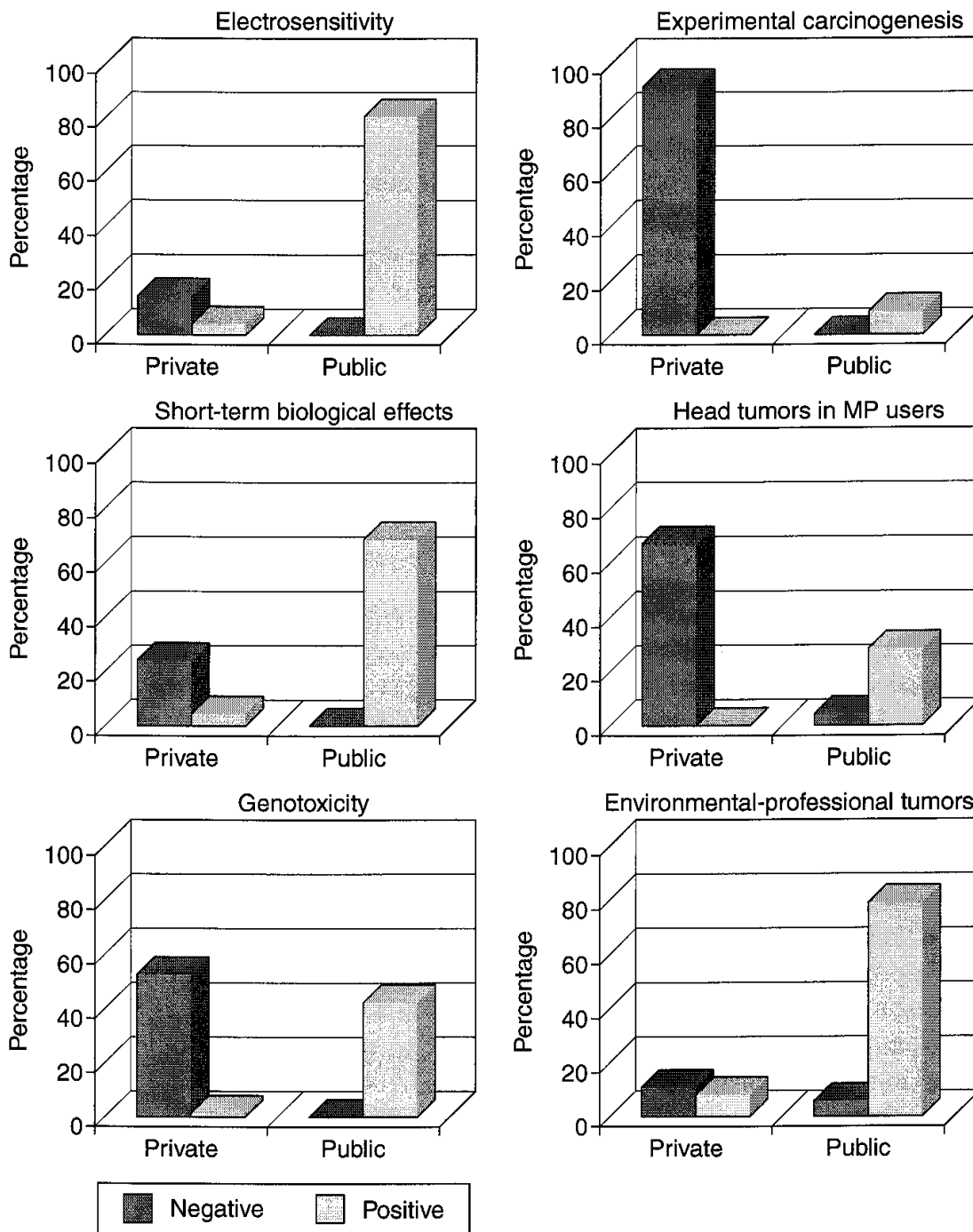


Figure 11.1 Relative percentage of results from all studies on health effects of RF/EMF of the individual topics, relative to the source of funding (public or private).

Epidemiological studies aimed at defending industrial interests: the case of EMF

Funding for EU programs on EMF effects

The EU programs on the effects of EMF (besides Interphone, these include Guard, CEMFEC, RAMP 2001, Perform A, EMF-NET, Reflex, Cefalo,

Cosmos), as the EU itself recognizes (European Commission 2005), are all co-funded by the mobile telephony industries. In fact, as that document explains:

With strong public resistance to the siting of mobile antennae masts, the mobile telecommunications industry is naturally very concerned. The roll-out of new mobile technologies has been delayed and the wider take-up of beneficial new mobile services is slower than expected. The industry is well aware of the problems of risk communication and public perceptions and therefore contributes funds to research into the health effects of RF-EMF that is guided by the research priorities of the WHO's international EMF Project's research priorities. Industry funding contributions to national and EU research projects is provided in such a way as to ensure complete scientific independence. Worldwide, industry funding for EMF health effects is comparable to public funding.

The quality of reassuring opinions on health risks due to EMF

All the major national and international agencies and commissions are compromised by conflicts of interests and, as a result, make reference only to studies with negative results, that is, that are reassuring, so confirming the complete inability of mobile telephony radiation to induce head tumors, disregarding, dismissing or even manipulating the results of Hardell's work and even those – despite their indication of increased cancer risk – reported in some of the Interphone studies (see the above section on 'Mobile phones and head tumors').¹⁷

Among the mobile telephony companies, a major role is played by the Mobile Manufacturers Forum (MMF), which co-funds the Interphone Project and the WHO's EMF Project, as well as other international and national EMF programs. MMF is an umbrella body for the 12 main mobile telephony industries (Alcatel, Ericsson, Mitsubishi Electric, Motorola, Nokia, Panasonic, Philips, Sagem, Samsung, Siemens, Sony Ericsson and TCL and Alcatel Mobile Phones). Working alongside MMF in terms of financial support provided to the Interphone Project and other EU projects is the GSM Association, another strong lobby of the mobile telephony industries. And linked to these two is the 'Wi-Fi Alliance', which brings together the many industries involved in the uptake of new technologies and wireless services: there are 309 listed on the website www.wi-fi.org/our_members.php.¹⁸

Even some international science journals are involved in conflicts of interests

A number of scientific journals are compromised by conflicts of interests leading to manipulation of data on EMF effects: for example, supplement 6 *Bioelectromagnetics* from 2003, one of the leading journals in the sector, was commissioned by the 'Radiofrequency Committee' of the Institute of Electrical and Electronic Engineers to justify maintenance of the exposure limits set by

ICNIRP. The supplement contains seven monographs, all funded by the US Air Force and Navy, and written by their employees, who maintain that RF is harmless. The monographs cover all possible effects (mutagenesis, teratogenesis, *in vitro* transformation, carcinogenesis, effects on the nervous, endocrine, immunological systems, etc.). *Radiation Research*, another major journal in the field, published 21 articles between 1997 and 2006 on the genotoxic effects of RF: 17 of these (81 percent) described negative results, and all were funded by the mobile telephony operators (Motorola: ten articles) or the US Air Force (seven articles). In 1991 J. Moulder became editor of *Radiation Research* and was promoted to senior editor in 2000: all the while he acted as consultant to the electricity and mobile telephony industries (Electric Power Research Institute and Federation of the Electronics Industry, respectively), despite at the same time being a member of the UK's Independent Expert Group on Mobile Phones. In 2001 Vijayalaxmi joined the *Radiation Research* editorial committee, funded by the US Air Force and by Motorola, for whom he published seven articles in this journal, reporting negative results for the genotoxicity of RF.

These actions allow the international scientific agencies to postpone indefinitely any review of their opinions on the presumed harmlessness of EMF. Every 3–4 years, through one of the scientific journals funded by the operators of the technologies concerned, researchers employed or funded by these private companies are given the task of reviewing the effects of EMF. Through careful choice of negative studies and particular interpretation of some of the positive work, a fully reassuring picture is produced. The following year the international agencies call on a group of scientists apparently above suspicion (Ahlbom, Feychting, Repacholi, Kheifets, van Deventer, Vecchia, etc.) to obtain – using the reviews produced as described – the support necessary to confirm their reassuring conclusions.

Recent precautionary positions on health risks of EMF exposures

Alongside the strongly cautionary stance regarding the risks due to EMF exposure put forward by D. Gee, ‘project manager of the emerging programs’ of the EEA (set out in his chapter in the *BioInitiative Report* on the applications of the Precautionary Principle (Gee 2009)), an appeal was made in September 2007 and reiterated in January 2008 by the EEA's Executive Director, J. McGlade, calling for EU governments to lower the EMF exposure limits, especially for Wi-Fi emission, mobile telephony and their radio-base stations. In McGlade's words,

There are many examples of the failure to use the Precautionary Principle in the past, which have resulted in serious and often irreversible damage to health and environments. Appropriate, precautionary and proportionate actions taken now to avoid plausible and potentially serious threats to health

from EMF are likely to be seen as prudent and wise from future perspectives. We must remember that precaution is one of the principles of EU environmental policy.

McGlade is convinced that:

Over the last two years the epidemiological evidence of possible cancer risk amongst the 10 year plus mobile phone user group, has got stronger. It is now also supported by preliminary scientific reports on the damaging effect to cells of RF and ELF EMF exposures. This is a cause for concern, given the widespread and generally rising exposure of the public to RF from mobile phone technology.... For example, the French part of the WHO coordinated International Interphone study reported that the risk of head tumors is particularly evident in those mobile phone users who have had RF exposures at and above 460 hours per year for over 15 years. This evidence is supported by several other epidemiological studies carried out in Sweden, UK, Germany, and Israel, all of which find some evidence of increased risks of head tumors in the 10 year plus exposure groups.

Furthermore, she underlines that:

The evidence, though necessarily limited at this point in time, is sufficient for health authorities to consider advising the reduction of RF exposures, where feasible. I note that such advice was issued by the German Federal Office for Radiation Protection (July 2007), and the French Ministry of Health (January 2008). It would also be prudent to reconsider the adequacy of the ICNIRP guidelines on exposure limits of 1998 to protect public health, especially of vulnerable groups.

Even stronger positions supporting the need for a cautionary approach to EMF exposure and more critical of the failure of the ICNIRP, WHO and EC to act are set out in two important documents, again from the EEA: one article by Gee (2009) and one report by the EEA (2007/2008) from 2008. These two documents re-examine the history of the errors made in science and by public health in tackling the problems arising in the past by 15 chemical and physical agents found to be harmful to human health, and underline what these 'past lessons' can teach in terms of prevention of risks from EMF, in particular RF (mobile telephony). Furthermore, they also provide vital keys for a proper understanding of the status of knowledge and criteria for assessing the risks to human health from EMF exposure, and for drawing up the consequent, pressing cautionary measures.

On 19 December 2008, the Commission on the Environment, Public Health and Food Safety of the European Parliament (EP) announced a 'Preliminary report on preoccupations concerning the effects on human health of electromagnetic fields' (www.next-up.org). Among other statements, the report:

- 1 'reiterates its demand to the Council to update its recommendation 1999/519/CE in favor of more stringent exposure limits for all devices that emit electromagnetic radiation in the frequencies between 0.1 MHz and 300 GHz, taking into account the best available technology on the market';
- 2 'asks the Commission to find a way to accelerate the enactment of the directive 2004/40/CE and thus to ensure that workers are protected effectively from EMFs';
- 3 'draws attention to the appeal for prudence made by the coordinator of the Interphone study, E. Cardis, who, on the basis of current knowledge, recommends that children should not make unreasonable use of a mobile phone and should preferably use a landline phone';
- 4 'suggests also to the Commission, prompted by concern for political and budgetary efficiency, a re-routing of the Community funding devoted to the study of EMFs towards a far-reaching campaign to educate young Europeans in the best ways to use a mobile phone, such as using a 'hands-free' kit, making only short calls and using a phone in the areas where the reception is good';
- 5 'proposes an addition to the mandate of the European group for Ethics in Science and New Technologies: the task of evaluating scientific integrity in order to help the Commission forestall possible situations of risk, conflicts of interests or even the frauds which tend to arise in a context of heightened competition among researchers';¹⁹
- 6 'condemns certain marketing campaigns by the phone operators, which are particularly strident in the year-end holiday period, such as the sale of mobile phones designed exclusively for children, or the "free minutes" deals aimed at adolescents';
- 7 'proposes that the Union includes in its policy regarding the quality of indoor air the study of wireless devices used in the home, such as Wi-Fi for internet access and cordless phones, which have multiplied these last few years in public places and in homes, exposing people to continuous microwave emission';
- 8 'calls on the Council and the Commission, in coordination with member States and the Committee for the Regions, to work towards putting in place a single standard in order to minimize the exposure of those living nearby if there is an extension to the network of high-voltage power lines';
- 9 'is very struck by the fact that the insurance companies tend to exclude cover for risks linked with EM fields from their policies of public liability, which means evidently that European insurers are already acting on the principle of precaution';²⁰
- 10 'charges the President to transmit the present resolution to the Council, to the Commission, to the governments and parliaments of member States, to the Committee for the Regions and to the WHO'.

The Commission also states that:

This is the approach chosen by the EEA which in September 2007 courageously advised the public authorities of the 27 member States to take

measures to provide better protection for the public, measures that are appropriate and in proportion in order to avoid serious dangers in the future. This represents a significant move forward on this issue, a call for action that contrasts with the *status quo* favored by the WHO. In fact the WHO seems to want to play for time, offering us an appointment in 2015 for a full estimate of the impact of electromagnetic radiation of human beings.

On 4 September 2009 the EP approved in plenary session and with wide majority the text proposed by the Commission noted above (www.europarl.europa.eu/sides/getDoc.do?type=TA&reference=P6-TA-2009-0216&language=IT&ring=A6-2009-0089), and at the same time issued a press release that, bearing the logos of the then-imminent European elections (www.elezioni2009.eu-1/3), assumed the sense of a real and proper program for the future parliamentary mandate.

In May 2011 a draft resolution adopted unanimously by the Committee on the Environment, Agriculture and Local and Regional Affairs of the EP riveted that:

- 1 'as regards standards or threshold values for emissions of electromagnetic fields of all types and frequencies, the Assembly recommends that the ALARA or "as low as reasonably achievable" principle is applied, covering both the so-called thermal effects and the athermic or biological effects of electromagnetic emissions or radiation. Moreover, the Precautionary Principle should be applicable when scientific evaluation does not allow the risk to be determined with sufficient certainty, especially given the context of growing exposure of the population, including particularly vulnerable groups such as young people and children, which could lead to extremely high human and economic costs of inaction if early warnings are neglected';
- 2 'the Assembly regrets that, despite calls for the respect of the Precautionary Principle and, despite all the recommendations, declarations and a number of statutory and legislative advances, there is still a lack of reaction to known or emerging environmental and health risks and virtually systematic delays in adopting and implementing effective preventive measures. Waiting for high levels of scientific and clinical proof before taking action to prevent well-known risks can lead to very high health and economic costs, as was the case with asbestos, leaded petrol and tobacco';
- 3 'moreover, the Assembly notes that the problem of electromagnetic fields or waves and the potential consequences for the environment and health has clear parallels with other current issues, such as the licensing of medication, chemicals, pesticides, heavy metals or genetically modified organisms. It therefore highlights that the issue of independence and credibility of scientific expertise is crucial to accomplish a transparent and balanced assessment of potential negative impacts on the environment and human health';
- 4 'in light of the above considerations, the Assembly recommends that the member states of the Council of Europe: a) take all reasonable measures to reduce exposure to electromagnetic fields, especially to radio frequencies

from mobile phones, and particularly the exposure to children and young people who seem to be most at risk from head tumors; b) reconsider the scientific basis for the present electromagnetic fields exposure standards set by the ICNIRP, which have serious limitations, and apply Precautionary and ALARA Principles, covering both thermal effects and the athermic or biological effects of electromagnetic emissions or radiation; c) put in place information and awareness-raising campaigns on the risks of potentially harmful long-term biological effects on the environment and on human health, especially targeting children, teenagers and young people of reproductive age; d) pay particular attention to “electrosensitive” persons suffering from a syndrome of intolerance to electromagnetic fields and introduce special measures to protect them, including the creation of wave-free areas not covered by the wireless network; e) in order to reduce costs, save energy, and protect the environment and human health, step up research on new types of antennas and mobile phone and DECT-type devices, and encourage research to develop telecommunication based on other technologies which are just as efficient but have less negative effects on the environment and health’;

- 5 ‘concerning the private use of mobile phones, DECT phones, Wi-Fi, WLAN and WiMAX for computers and other wireless devices such as baby phones: a) set preventive thresholds for levels of long-term exposure to microwaves in all indoor areas, in accordance with the Precautionary Principle, not exceeding 0.6 V/m, and in the medium term to reduce it to 0.2 V/m; b) undertake appropriate risk-assessment procedures for all new types of device prior to licensing; c) introduce clear labeling indicating the presence of microwaves or electromagnetic fields, the transmitting power or the specific absorption rate (SAR) of the device and any health risks connected with its use; d) raise awareness on potential health risks of DECT-type wireless telephones, baby monitors and other domestic appliances which emit continuous pulse waves, if all electrical equipment is left permanently on standby, and recommend the use of wired, fixed telephones at home or, failing that, models which do not permanently emit pulse waves’;
- 6 ‘concerning the protection of children: a) develop within different ministries (education, environment and health) targeted information campaigns aimed at teachers, parents and children to alert them to the specific risks of early, ill-considered and prolonged use of mobiles and other devices emitting microwaves; b) ban all mobile phones, DECT phones or Wi-Fi or WLAN systems from classrooms and schools, as advocated by some regional authorities, medical associations and civil society organizations’;
- 7 ‘concerning the planning of electric power lines and relay antenna base stations: a) introduce town planning measures to keep high-voltage power lines and other electric installations at a safe distance from dwellings; b) apply strict safety standards for sound electric systems in new dwellings; c) reduce threshold values for relay antennas in accordance with the ALARA principle and install systems for comprehensive and continuous monitoring of

all antennas; d) determine the sites of any new GSM, UMTS, Wi-Fi or WiMAX antennas not solely according to the operators' interests but in consultation with local and regional government officials, local residents and associations of concerned citizens';

- 8 'concerning risk assessment and precautions: a) make risk assessment more prevention oriented; b) improve risk-assessment standards and quality by creating a standard risk scale, making the indication of the risk level mandatory, commissioning several risk hypotheses and considering compatibility with real life conditions; c) pay heed to and protect "early warning" scientists; d) formulate a human rights oriented definition of the Precautionary and ALARA Principles; e) increase public funding of independent research, *inter alia* through grants from industry and taxation of products which are the subject of public research studies to evaluate health risks; f) create independent commissions for the allocation of public funds; g) make the transparency of lobby groups mandatory; h) promote pluralist and contradictory debates between all stakeholders, including civil society (Aarhus Convention)'.

This resolution is accompanied by a 'memorandum' underlining that:

- 1 'with regard to the frequently inconclusive if not contradictory findings of scientific research and studies on the possible risks of products, medicines or, in this case, electromagnetic fields, a number of comparative studies do seem to suggest a fairly strong correlation between the origin of their funding – private or public – and the findings of risk assessments, a manifestly unacceptable situation pointing to conflicts of interest which undermine the integrity, the genuine independence and the objectivity of scientific research';
- 2 'accordingly, in this field and in others, one should call for genuine independence on the part of the expert appraisal agencies and for independent, multidisciplinary and properly balanced expert input. There must no longer be situations where whistle-blowers are discriminated against and renowned scientists with critical opinions are excluded when experts are selected to sit on expert committees or no longer receive funding for their research';
- 3 'it seems obvious that the prime considerations for societies dependent on electricity, mobile telephony and telecommunication are the economic and financial parameters, hence profits and market shares. Understandably, in this context more stringent regulations and threshold values which ostensibly inhibit their business dealings are viewed with disfavor and forcefully resisted – as could be seen from the irritated and sometimes emotional statements of a representative of French mobile telephony at our committee's hearing for contrastive expert opinion';
- 4 'serious scientific and medical studies revealing biological effects of a pathological nature have existed since the 1930s concerning radio frequencies and microwaves from radar installations and harmful effects of protracted

exposure to the low or very low frequency electromagnetic fields of electrical transmission lines or computer screens were observed already in the late 1970s’.

And this resolution concludes that:

- 1 ‘after analyzing the scientific studies available to date, and also following the hearings for expert opinions organized in the context of this Committee there is sufficient evidence of potentially harmful effects of electromagnetic fields on fauna, flora and human health to react and to guard against potentially serious environmental and health hazards’;
- 2 ‘that was moreover already the case in 1999 and 2009 when the European Parliament overwhelmingly passed resolutions upholding the Precautionary Principle and efficient preventive actions vis-à-vis the harmful effects of electromagnetic fields, in particular by substantially lowering the exposure thresholds for workers and the general public according to the ALARA Principle, by restoring genuine independence of research in that field, and through a policy of enhanced information and transparency towards the anxious populations’;
- 3 ‘lastly, the Assembly could endorse the analyses and warnings issued first in September 2007, then in September 2009, by the European Environment Agency (EEA) concerning the health hazards of electromagnetic fields, mobile telephony and not least mobile phones. According to the EEA, there are sufficient signs or levels of scientific evidence of harmful biological effects to invoke the application of the Precautionary Principle and of effective, urgent preventive measures’.

The above text was adopted on 27 May 2011 by the EP Standing Committee, acting on behalf of the EP Council (<http://assembly.coe.int/Documents/Adopted-Text/tal11/eRES1815.htm>). This EP Resolution no. 1815 modified only the above point 6b, adopting a less stringent recommendation, that is: ‘For children in general, and particularly in schools and classrooms, give preference to wired internet connections, and strictly regulate the use of mobile phones by school-children on school premises.’

How to promote protection against the health effects of exposure to EMF

In view of the considerable volume of experimental data demonstrating the biological and health effects of EMF, plus possible mechanisms of action, the position held today by the WHO, EC, ICNIRP, IARC and other major national and international agencies appears unsustainable and without justification – this stance draws from guidelines drawn up at the end of the 1990s and is based on theoretical assumptions from over 50 years ago. In fact, for defining the exposure limits these guidelines are based on: (1) health effects alone, thus ignoring

the biological data that underpin them and help explain the mechanisms by which they arise; (2) only effects that have been unequivocally demonstrated and accepted by the whole scientific community, quite overlooking the Precautionary Principle; (3) thermal effects alone, while non-thermal effects, in particular effects at low intensity, are now well documented; (4) short-term effects alone, disregarding long-term effect data found in the literature, in particular genetic and carcinogenic effects.

This position – also shared by the main bodies concerned with protection of human health, is a priori rigid, refutes historical evidence, declines scientific challenge and appears to be influenced not by prudence but by conservation of clearly identifiable financial interests. Data in the scientific literature in fact clearly justify an urgent revision of national laws on EM pollution, in particular in terms of the principle of minimization through the preventive planning and programming by the regions and municipalities as regards development of EMF-emitting installations, along with information campaigns and participation of the citizen.

Quantifying the long-term risks is difficult for residential exposure to ELF/EMF because this requires conclusive data on the body of the population exposed and on the values of the magnetic fields present. As regards mobile telephony, our examination of the literature data leads us to conclude that even today the risk of head tumors resulting from MP use is very high (Levis *et al.* 2011, 2012a). Lloyd-Morgan (2009), while under-estimating by 50 percent the number of cell phone users, without considering the risk for cordless users and assuming a minimum latency time of 30 years, calculates ‘there would be about 1,900 cell phone-induced brain tumors out of about 50,000 brain tumors diagnosed in 2004, increasing to about 380,000 cell phone-induced brain tumors within 2019 in the USA alone’, which would require ‘an increase in health costs of an annual US\$9.5 billion and the need for a 7-fold increase in number of neurosurgeons’. An estimate of the incidence of head tumors must begin with the correct number of cell phone users (five billion subscriptions worldwide at mid-2010), should also consider the risk to cordless users and assume at least a doubling of the incidence of head tumors and of acoustic neuromas as documented by Hardell already after a latency of at least 10–15 years, which gives about 750,000 new cases worldwide even today.

As if this were not enough, a number of factors raise our concern still further: the latency of head tumors induced by MPs can exceed 30 years; risk is higher in those starting MP use when young and who have not yet accumulated ten years of latency; there is a continued rise in MP use by young people, attracted to new facilities from the MP companies (photography, listening to music, videophony, internet); the data by Hardell on the increase in risk of other types of malign and benign head tumor – besides brain gliomas, astrocytomas, acoustic neuromas and parotid gland tumors – are for the main part today only indicative. Therefore, there is no doubt that today we are dealing with just the tip of an iceberg, and will have to wait one or two decades before its real dimensions come to light. But it is clear that a significant increase in tumor risk is already established, so that the use

of MPs could lead to a health crisis of dramatic proportions (Lloyd Morgan *et al.* 2009).

While recognizing that mobile telephony is an extraordinary technology of inestimable value, responsible science must raise awareness of the risks involved.²¹

As also expressed by the EEA and the EP, we thus conclude that there is sufficient epidemiological evidence to warrant application of the Precautionary Principle aimed at:

- setting exposure limits that are precautionary;
- limiting the spread of wireless technology in schools and highly frequented places (libraries, offices, hospital wards);
- providing accurate information about the risks from exposure to MPs, with low-cost voluntary options ('prudent avoidance') based on caution in the use of MPs and other devices emitting MFs. A ten-point list of simple personal actions designed to substantially reduce exposure to cell phone radiation was produced by Viennese Medical Officers in 2006, adopted in the same year by the French Agency on Radiofrequencies (www.sante_radiofrequences.org), and by several international scientific committees (see note 7 and a document signed by 20 scientists: www.devradavis.com);
- awareness-raising in schools through a campaign on the use of the various wireless transmission technologies;
- discouraging the use of MPs by minors under 14 years;
- epidemiological monitoring of the possible harmful effects produced by residential and occupational ELF and RF/EMF exposures.

Given the results and considerations set out in the section on 'Mobile phones and head tumors', it is small wonder that a number of scientists have maintained that 'the long-term use of cell phones was leading to brain tumors and was more dangerous to health than smoking cigarettes' (Pawl 2008: 445), and that 'MPs could kill far more people than smoking or asbestos' (the reader is referred to Khurana – an Australian neurosurgeon who collaborated with Hardell in the meta-analyses showing increased risk of head tumors in MP users – interviewed by G. Lean for *The Independent*, 30 March 2008).

In conclusion, it is perfectly clear that an *ex ante* evaluation of the overall impacts of today's technological innovations is not only compatible with the Precautionary Principle, but actually necessary, as also borne out – as we saw above – both in some of the Italian magistracy's statements and in the recommendations of the EP and of the EEA. This evaluation is particularly vital in the case of exposure to EMF, given the state of advancement of scientific knowledge about their possible/probable harmful effects on human health. In fact, the Precautionary Principle was designed to justify actions to protect the public and the environment even in the absence of any significant knowledge, so it could be used to justify exposure reductions to EMF despite the amount of – seemingly but almost never ad-hoc produced – conflicting evidence of risks.

Should any doubt still remain, it is worth recalling the consequences of the four main scenarios facing us with EMF, especially with RF from mobile phones, underlined by Gee (2009):

The first is similar to the case studies where much avoidable harm was not prevented. The second is where precautionary actions to reduce MF exposure prevent much potential harm, whilst stimulating more sustainable innovation in the production and use of MP technologies and energy systems. The third is where such precautionary actions to reduce exposures are taken but turn out to have been unnecessary, needlessly costly, and worrisome. The fourth is that no action is taken to reduce exposure and no convincing harm emerges from EMF exposure. We do not know which scenario will unfold, but we do know that a choice over current and future EMF exposures must be made now, if the costs of possibly being wrong are to be minimized. The choice is ours. Shakespeare might have described our dilemma thus: to know or not to know, to act or not to act?

The tragedy is that the unfolding story of EMF looks set to become another case of history repeating itself – following in the tracks of ionizing radiation, asbestos, tobacco smoke and many other now-demonstrated human carcinogens where evidence of harm was officially recognized only a score or even more years after the initial warnings. In view of the evidence we already have, this time we can act early, rather than giving cause for future generations once again to regret our inaction – it is our duty and responsibility as scientists, in particular to our offspring!

Conclusions

Disguising or playing down the evidence of harm to health is not simple to do; in fact, this deception is often easy to detect. The malpractice uses a few elements that can be found almost systematically in the formal studies of many corporations and government agencies. These often show an exposed population to be at lower incidence and/or mortality risk for all diseases than the control population (at least for the few times the results are actually examined). But how is this paradoxical conclusion possible? Authors usually try to argue that exposure does not induce adverse health effects, the '*healthy worker effect*'²² being produced unintentionally. Once the source(s) of the biases in scientific studies on public health have been identified, attempts can be made to determine whether these limitations and errors are structurally inevitable, accidental or intentional. It is possible, however, that financial motives are a driver in certain research areas, for example industrial chemicals, asbestos, vinyl chloride, beryllium, alcohol, cigarette smoke, diagnostics, some pharmaceuticals, and as we see here, electromagnetic fields.

A recent communication laid the groundwork for an initial, systematic identification of the criteria needed for a fast, transparent and standard assessment of

intentional deception through the integrated evaluation of three elements: the *quantity* of errors (or biases), the *direction* of these errors/biases and the *size* of the incorrect estimates present in each epidemiological study (Gennaro and Ricci 2010). We believe that evaluation of these three elements can enable the detection of the deliberate manipulation and deviation of public health scientific studies in favor of economic and career interests. Systematic bias detection may also help counter the skepticism and mistrust surrounding most epidemiological research, and enable all but sound, socially useful, evidence-based epidemiological research to be filtered out.

Business biases as collective risks are very common. There is mounting evidence to show that cartels are very influential in the assessment of the overall effects of most scientific/technical innovations. This state of affairs matters in reality. Indeed, in many countries over the past two decades (data for Italy are available only up to 2008) the reported trend of improvement in healthy life expectancy – for many years showing an increased number of disease-free years of life (over six months) – came to an abrupt halt and reversed (Eurostat 2011). Is it possible to postulate causes of the situation described in this chapter other than the *business bias*?

Appendix: abbreviations

CI	confidence index
EC	European Commission
EEA	European Environment Agency
ELF	extremely low frequencies
EMF	electromagnetic fields
EP	European Parliament
EU	European Union
Ghz	gigahertz
Hz	hertz
IARC	International Agency for Research on Cancer
ICNIRP	International Commission for Non-Ionizing Radiation Protection
Khz	kilohertz
μ T	microTesla
MF	magnetic field
MMF	Mobile Manufacturers Forum
MPs	mobile phones
OR	odds ratio
RF	radiofrequencies
SCENIHR	Scientific Committee on Emerging and Newly Identified Health Risk (EC)
UN	United Nations
V/m	Volts/meter
WHO	World Health Organization

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Notes

- 1 *Conflict of interests*: the authors declare they do not have any conflict of interest.
- 2 There are rather well-established methods used to confuse epidemiological results and compromise their consequences. The most common biases identified are: (1) inadequate design of the epidemiological study; (2) lack of a standardized protocol; (3) incorrect reference population – wrong selection, combination and dilution of both cases and controls, e.g., inclusion of cases among the controls; (4) failure to choose the subjects most exposed and most sensitive; (5) a priori decision to study only a few and rare selected diseases, e.g., a few rare risk factors; (6) over-short follow-up for tumors with long-term latencies; (7) only high risks ($OR > 2$) are taken into account, despite the relevance of even lower risks when exposure concerns a high number of subjects; (8) undervaluation of the synergistic role of multiple risk factors (simply because law limits are respected for each single factor); (9) the epidemiological study is considered only from a simple statistical point of view; (10) experimental data supporting the plausibility of harmful biological effects are systematically ignored; (11) flawed multicenter results are given too much weight, overlooking the much more significant results produced by just one research center; (12) constant reference is made to unreliable results in order to bolster the interests of private corporations; (13) even when funding from industry is actually reported, conflicts of interests are often not declared; (14) Precautionary and Prevention Principles are both ignored; (15) there is preference to protect the economic status quo rather than public health.
- 3 Documents published since 1953 by the American Conference of Government and Industrial Hygienists (ACGIH), and by the Conferences of American Military Bodies held since 1957 by the Air Research and Development Command, USA. The ACGIH is neither a public body nor a government organization, but an industry-based private association of hygienists, despite the misleading name (Casson 2007: 23). The ACGIH's role in underlining the inadequate exposure limits for protecting human health – totally ignoring experimental and epidemiological evidence – has been widely reported. The ACGIH has very close ties with private industry and, of the over 600 threshold values set by the ACGIH, at least 100 are based exclusively on the opinion of industry experts, without any experimental support (Davis 2008: 357). As regards the interests of the American military bodies in the development of RF, we can note the report by the Naval Studies Board, Division of Engineering and Physical Sciences (2002: 2–13). In this report, the section on 'Directed-energy non lethal weapons' states that:

The first RF non-lethal weapons are based on a biophysical susceptibility known empirically for decades. The heating action of RF signals is well understood and can be the basis for several additional directed-energy weapons. Leap-ahead non-lethal weapons technologies will probably be based on more subtle human–RF interactions in which the signal information within the RF exposure causes an effect other than simply heating: for example, stun, seizure, startle and decreased spontaneous activity.

This admission by the Naval Studies Board confirms that:

1) some of these non-thermal effects can be weaponized with bioeffects that are incontrovertibly adverse to health; 2) there has been knowledge for decades about the susceptibility of human beings to non-thermal levels of RF exposure; 3) the concept that RF interacts with humans based on the RF information content (signal information) rather than heating, so it can occur at subtle energy levels, not at high levels associated with tissue heating, is well established; 4) a dedicated scientific research effort is promising enough for continued federal funding.

(Sage *et al.* 2007: §4, 11–12)

The magazine *Nexus* (no. 69, August–September 2007: ‘EM Arms and Human Rights’; www.nexusitalia.com) shows that the American military–industrial–intelligence complex has an arsenal of EM arms for use in today’s battlefields and against the citizen as a means of social control, in contravention of the convention on human rights. During the 1950s and 1960s the CIA began seeking methods for influencing cognition, emotions and human behavior. This research included the wireless use of EM energy defined as ‘informatic war’ and ‘non-lethal arms’. New technological capabilities have been developed under projects financed through slush funding over recent decades: these technologies bring about the ability to influence the human emotions, disturb thought and inflict severe pain through the manipulation of EM fields. The EM spectrum has provided a range of new weapons that have already been adopted in both private and military arenas, for example millimeter waves, pulsed energy projectiles (PEPs) and other high-power EM arms. PEPs represent a type of weapon used to paralyze a victim with pain: the expansion of the plasma acts on the nerve cells and the long-term effects are still quite unknown. The direct acoustic device ‘voice-to-skull’ is a non-lethal EM weapon that produces highly disturbing noises within the cranium. This technology has been tested by businesses including McDonald’s and Wal-Mart to direct advertising messages into the consumer’s head. The power of the US Defense Department (UDD) is hard to believe: in May 2006 the Air Force provided a total of \$24 million in contracts for ‘research and development’ (R&D) on EMF to Northrop Grumman, Voss Scientific, Lockheed Martin, Electro-Magnetic Applications and other private companies. Already in 1996 the UDD had recognized a key element in wars of the future in R&D on EM radiation. The development of non-lethal weapons has also been taken up by the universities, with millions of dollars being set aside for grants and research doctorates: the Pennsylvania State University hosts the Institute for Non-Lethal Defense Technologies, the New Jersey University of Medicine and Dentistry hosts the Institute for Stress and Motivated Behavior, the University of New Hampshire hosts the Center for Non-Lethal Technological Innovation, while many military schools fund courses on the technology of non-lethal weapons.

- 4 ICNIRP (1996). Overview of research papers limited to the biological and health effects of RF/EMF with negative results, funded mainly by managers or operators of the technologies concerned. The few papers showing positive results cited – of the many found in the literature – were labeled as ‘inadequate number of repetitions’, ‘not significant’ or ‘carried out under conditions of sizable thermal increase’, even though these criticisms were quite invalid.
- 5 ICNIRP (1998). Overview regarding all EMF frequencies (0–300 GHz), carried out using the same criteria as above. At the time, the ICNIRP members with conflicts of interests included: M. Repacholi, president until 1996; M. Grandolfo, vice-president until 1996; M. Hietanen, vice-president from 1996; R. Matthes, scientific secretary; R. Saunders, P. Vecchia and E. Vogel, ‘external experts’. At a later date, P. Vecchia became president of ICNIRP, M. Hietanen became vice-president and M. Repacholi became emeritus president.
- 6 ICNIRP: in 1974 the self-appointed working group of the International Radiation Protection Association (IRPA) set up a sub-group on Non-Ionizing Radiation (NIR). At

the Paris conference of 1977 IRPA and NIR then formed the International Non-Ionizing Radiation Committee (INIRC). In the following years, IRPA, INIRC and the WHO collaborated on developing the guideline criteria for protection of human health from EMF. Finally, at the Montreal conference of 1982, IRPA and INIRC formed ICNIRP. Since 1996 (see note 4) this body has adopted the proposal – already drawn up earlier by the WHO and IRPA – of considering only the acute effects of a thermal nature when defining the limit values of exposure to EMF, and since that date these values have remained unchanged in all subsequent revisions made by ICNIRP (1998, note 5; Ahlbom *et al.* 2004: see note 16). The particular attention given to ICNIRP by authoritative international bodies results from the close ties this body has established with the WHO (M. Repacholi was for many years president then emeritus president of ICNIRP and, at the same time, head of the WHO's EMF Project), and with the EC (see the following note).

European Commission: despite the unanimous view expressed by the EP on the basis of a report from one of its scientific committees, in conflict with adoption of the guidelines and limits proposed by ICNIRP, the EC on 12 July 1999 adopted recommendation 519/EC, which accepted in full the ICNIRP/WHO proposals. The following years saw an ever-increasing strengthening of the links between ICNIRP, the WHO and EC (through SCENIHR, the EC's scientific commission on EMF), expanding to increasing numbers of national commissions (see note below and notes 16 and 17), and also tighter relationships even with operators of the technologies using EMF, in particular MMF (see note 18). A well-documented criticism of the conflicts of interests compromising the initiatives of the ICNIRP–WHO–EC consortium – listing cases where the founding principles of these bodies are flouted – was published by D. Maisch (2006). Anyway, ICNIRP remains a private and fully autonomous body, and as sanctions cannot be applied to this association – as was recognized by the UN Secretary-General when responding to one of the many cases brought by associations, private citizens and groups of scientists – since intervening to alter the static positions of ICNIRP was not possible precisely because of its body's private nature. Instead, there are the cautionary positions held by other 'independent' committees, medical associations and even the EEA and EP, to protect human health from the short-term biological effects and the long-term effects (certainly not thermal in nature) of EMF – these positions are highly critical of the 'monopoly' formed by ICNIRP, the WHO, EC and their countless 'ramifications' (see note 7 and the main text).

WHO: the reader is referred to the 'fact sheets' published since 1998 regarding the 'EMF Project' launched by the WHO and co-funded by the electricity network operators and the mobile telephony companies. Leading the project until 2006 was M. Repacholi, also emeritus president of the ICNIRP, member of various national scientific committees and consultant to various electricity and mobile telephony companies, as he himself has admitted to the Australian Senate and in a number of interviews. In 2006 E. van Deventer took over the position. See: Valberg *et al.* (2007), review funded by the National Institute of Environmental Health Sciences and by the WHO, despite Valberg having a senior role in a private energy company for which Repacholi himself often acted as consultant (Gradient Corporation USA).

National scientific committees: the reader is referred to the reports of the Royal Society of Canada (Krewski *et al.* 2001; the Independent Expert Group on Mobile Phones (IEGMP 2000); the 'Zmirou Report' (2001); the reports of the UK National Radiological Protection Board (NRPB 2004) and the most recent reports (Swedish Radiation Protection Authority 2006; SCENIHR/EC 2007; Health Council of the Netherlands 2007; Mobile Telecommunications and Health Research Programme 2007). All set out almost only the negative data, while the few positive results quoted, among the many that exist, are considered 'inadequate' or 'inadequate number of repetitions' or sometimes are even partially processed to make them appear 'not significant'. Furthermore, many of the members of these committees have clear conflicts of

- interests even though they declare that the funding received from the companies with interests in the area concerned does not represent any conflict of interests.
- 7 From 1997 positions of caution have been presented at conferences putting forward the need to minimize exposure, with drastic reduction in the limits adopted by ICNIRP/WHO/EC: for example, Rockville ('Physical characteristics and possible biological effects of microwaves applied in wireless communication' 1997); Vienna ('Possible biological and health effects of electromagnetic fields' 1998); Salzburg ('International conference on cell tower siting' 2000: www.land-sbg.gu.at/celltower); Stockholm ('Workshop on electrosensitivity' 2001: www.Feb.se/NEWS/Program10927.pdf) In addition, the 'STOA Report' by Hyland (2001); the 'independent' International Commission for the Electro-Magnetic Safety (ICEMS) funded in Venice 2002; the influential *BioInitiative Report* 2007 (see note 3), noted by bodies including the EEA and the EP; and the extremely cautionary position of the Russian National Committee on Non-Ionizing Radiation Protection 2008. Many strongly 'cautionary' appeals have also been published by doctors from various countries: Freiburg 2002; Helsinki 2005; Brussels 2007, Holland 2009. In particular there is the well-known 'Appeal from the Viennese Doctors' 2007, with an attached 'vademecum' for voluntarily limiting the risk from EMF exposure, plus a review of initiatives of various European governments (France, Austria, Germany, Great Britain, Spain, Luxembourg) for minimizing the dissemination of new wireless technologies (Wi-Fi, WiMAX) and for reducing exposure limits to RF.
 - 8 OR ('odds ratio'): the relationship between the number of sick (cases) in exposed and non-exposed subjects. The OR is calculated on the basis of the ratio: exposed cases/non-exposed cases \times non-exposed controls (non-sick subjects)/exposed controls. A 95 percent CI (confidence interval): probability interval at 95 percent of OR. When OR is above 1 and 95 percent CI does not include 1 (i.e., the whole 95 percent CI interval lies above 1) means that in the exposed there is a statistically significant increase at 95 percent probability of falling ill. In the specific case, the values indicate that there is 95 percent probability that the risk of falling ill from leukemia (OR) in children who lived exposed to $0.4 \mu\text{T}$ lies between 1.3 and 3.1 relative to that (OR=1) of children who live exposed to below $0.1 \mu\text{T}$, and that the most probable increase in risk is a doubling (OR=2.0).
 - 9 IARC is an international scientific organization which operates under the sponsorship of the WHO. Tomatis and Huff warn that from 1994 IARC has witnessed a complete overhaul of the criteria for evaluating carcinogenicity, with a wholesale devaluation of the criteria underpinning identification of carcinogenic factors: (1) the criteria for evaluating the carcinogenicity of an agent, based on study of the mechanisms of action (biological effects, in particular genotoxic) are no longer applied; (2) the evidence of carcinogenicity deriving from animal experimentation is undervalued; (3) possible confounding factors of the scientific criteria aimed at primary prevention of carcinogens in the workplace or at home are highlighted out of all proportion; (4) consequently, epidemiological data are hardly ever conclusive; (5) there is a higher percentage (from less than 10 percent in the 1970s to over 30 percent in the 1990s) of experts predisposed to favor the industrial interests, who are being invited by IARC into the working groups (see, for instance, note 16). It follows that, according to Tomatis and Huff, the IARC monographs have lost the authority and independence they original had. This criticism can easily be leveled at the ELF/EMF monograph: in fact, the IARC working group involved in the preparation of the IARC ELF/EMF monograph (2002) included M. Repacholi, president of ICNIRP and coordinator of the WHO's EMF Project, funded by electricity network and mobile cell phone companies (see note 6: ICNIRP and WHO); L. Kheifets, employee of Electric Power Research Institute (EPRI), a private body which enjoys all US electricity company research funding; J. Juutilainen, C. Blackman, D. McCormick, C. Porter, M. Mevisen, J. Schuz – all participating also in the IARC 2011 RF/EMF panel (see note 16) –

and R.D. Saunders and B. Veyret, all members of various national committees, but all with conflicts of interests; and also representatives of major electricity companies: J. Swanson (National Grid Company, UK); W.H. Bailey (Exponent, United States); V. del Pizzo (CA EMF Program, USA).

- 10 A very important example, in view of the authority of the source, is report no. 238 of June 2007 ('Environmental health criteria 238: extremely low frequency fields'), sponsored by the WHO, ICNIRP and the World Labor Organization. The report, signed by the new head of the WHO's EMF Project, E. van Deventer, was actually put together in October 2005 by a working group whose members included scientists with conflicts of interests (M. Repacholi, L. Kheifets, A. Ahlbom, C. Johansen, J. Juutilainen, R. Matthes, E. Van Rongen, P. Vecchia). Furthermore, it was prepared – in clear conflict with WHO and ICNIRP principles – in the presence and with the contribution of 'observers' from electricity companies of the United States (APRI), United Kingdom (National Grid Transco), Canada (Hydro-Québec), France (EDF Gaz), Japan (Japan NUS Co.) and Brazil (Electric Energy Research Center). The report notes that there is no justification whatsoever for application of the Precautionary Principle to ELF/EMF: there is a lack of clear evidence of either long-term effects (even childhood leukemias) or acute non-thermal effects. Consequently, a single limit is applied of 100 μ T to give protection from 'clearly documented' effects, i.e., only short-term biological thermal effects!
- 11 It is beyond the scope of this chapter to give an overview of the workings of the magistracy of other countries. It might be useful to offer a comparison limited to the very contrasting positions of the Italian magistracy and that of the United States: reference is made to the paper by Prof. E. Al Mureden (2010). In the United States it is an absolutely unbroken rule that any manufacturer not observing the norms is responsible, while manufacturers who do observe them are never responsible. For this reason, there can never be compensation for damage arising despite full observance of the norm – including exposure limits set by law. Health protection is assured in the United States through the judgment of administrative agencies, who have been conferred powers to draw up rules and regulations. In fact, the Food and Drugs Administration (FDA) has the role both of assessing risks, costs and benefits associated with the commercialization of goods and technologies (risk management), including those products using and emitting EMF (risk assessment), and also of drawing up the regulations designed to protect users' health. The 'technical regulations' approved by the FDA at once are the absolute reference point for justifying any sanctions imposed by the FDA itself, and also give legal backing to the decisions whereby the civil judge demands the employer or insurance body to pay compensation commensurate with the level of resulting invalidity and, when appropriate, also punitive damages. However, even considering the problem of compensation, reference must necessarily be made to the prescriptions of the FDA, since otherwise application of the norms regarding civil liability would prove misguided. Concerning atmospheric pollution, too, American environmental legislation has almost always chosen to grant wide discretionary powers to the Environmental Protection Agency (EPA) for setting pollution safety levels. The EPA is required to set the national standards of environment quality at levels 'appropriate for protecting public health' – the wording here is vague, which in practice means that the EPA has broad discretionary powers in setting air-quality control levels. However, a decision of the American Appeal Court has pointed out two areas to clarify: (1) what criteria the EPA should adhere to in setting air-quality control levels; and (2) (of greater resonance) what are the best ways of monitoring the EPA's discretionary powers. In the case brought by the American Trucking Association Inc. versus United States EPA (1999 Westlaw 300618), the Court maintained that the EPA did not base its decisions on any clearly set out principles when considering the principles in terms of criteria used for setting quality levels, and that there should be clear guidelines for monitoring the EPA's powers. According to the

Court, a well-founded reasoning must be provided either by the statute drawn up by Congress, or by the EPA itself. Since the statute is set out in general terms ('appropriate for protecting public health'), the Court's view is that the EPA is best positioned to give this reasoning. This decision deserves close examination, because it highlights an important aspect of environmental law, i.e., how wide does the law allow the discretionary powers of public agencies such as the EPA to be? In fact, American law has for a long time (since 1930) accepted the principle that Congress can authorize the public agencies – through a rather generalized legislation – to take responsibility for specific issues.

The Italian legal system – as clearly seen from the cases noted above – takes the extreme opposite position: once an activity has been classified as 'dangerous', there is a tendency for the absolatory proof to be considered as never obtained, and the employer or body responsible for monitoring of harmful technologies can only try to demonstrate that all suitable means of preventing the harm have been adopted. Instead, the performer of the dangerous activity has to attempt to undermine 'upstream' the categorization as dangerous, or else demonstrate that the case in question is coincidental – this is because once a technology is included among those labeled as harmful, the responsibility for it becomes an automatic consequence of demonstration of the harm caused (see also note 14, in the reference to the sentence regarding the damage (tumor) caused by radiation emitted by MPs).

- 12 The editorial of Cardis and Sadetzki (2011) leaves little doubt about the relevance of their criticisms, which we documented in Levis *et al.* (2012a). Within the 17 Interphone studies: (1) less than 5 percent of total cases had completed at least ten years of latency or continued cell phone use, which means that over 95 percent had a totally inadequate exposure time – since in most of the tumors examined the latency is high (10–30 years), this is a factor giving rise to 'dilution' of risk. The percentage of cases or controls exposed for at least ten years within the 17 Interphone studies is 0 percent in four studies, less than 5 percent in four studies, less than 10 percent in five studies, not even given in one study; Hardell documents 18 percent of cases with exposure to MPs of at least ten years. (2) The failure to identify the ipsilateral tumors, arising on the side of the head habitually used for calls, mainly in the temporal lobe which is exposed to 97–99 percent of the radiation emitted during phone use, with consequent further 'dilution' of risk due to the detection of tumors on the whole brain mass, for the most part not exposed to radiation – within the 17 Interphone studies only 2 percent of total cases of ipsilateral tumors were actually exposed for at least ten years; Hardell reports 16 percent of his total cases with ipsilateral tumors, some of which involved exposure for an overall total time or latency of 15 years. (3) The Interphone protocol defines 'exposed' subjects as having used a cell phone 'at least once a week for at least six months' (which means almost never!). Therefore, even if a risk exists, it is 'diluted' because of the dominance, in the sample examined, of subjects exposed too little or not at all: the average daily use of cell phones in subjects considered 'exposed' by Interphone is just 2–5 minutes per day, often for less than five years. These data obviously are barely significant relative to today's intensive use of cell phones, especially by those who use them for work purposes; in Hardell's studies, MP use is reported to be over 1,000 hours for 194 cases and over 2,000 hours for 85 cases, so that the average daily use of MPs ranges from over 16 to just over 32 minutes per day for at least ten years. (4) In the Interphone studies, participation in the epidemiological study of cases or controls is low: less than 50 percent in three studies, less than 60 percent in five studies, less than 70 percent in five studies; in Hardell's studies, participation is always very high (85–90 percent) for both cases and controls. (5) The reduced participation in the study by the non-mobile users initially selected – in particular, controls who are not affected by tumors, naturally less interested in the aims of the research than regular users, especially cases affected by tumors – represents a further factor of 'dilution' of risk

estimates (see note 8). This 'selection bias' is recognized by the Interphone authors themselves, but in their view it does not cause reduction in risk estimated by more than 10 percent, which is true for the overall Interphone data, but in some studies this bias alone can result in a more significant reduction in risk assessment; more than 15 percent in two studies, more than 25 percent in three studies, and even more than 30 percent in two studies; in Hardell's studies the percentage participation is basically equivalent for the exposed and non-exposed cases and controls.

- 13 (1) The Interphone protocol considers cordless phone users as not exposed, while it is documented that the radiation emitted by cordless can even exceed the intensity of a cell phone, so much so that Hardell records significant increases in the risk of meningiomas and acoustic nerve neuromas also in people using only cordless. (2) The Interphone study fails to consider other types of malignant and benign head tumor, except gliomas, meningiomas, neuromas and parotid gland tumors; in Hardell's studies, increased risks in MP users also involve other types of head tumor, which are considered separately. (3) The risk values of head tumors in three of the Interphone studies even fall off with increased duration of exposure to cell phones and/or latency time; in Hardell's studies, the trend for risk as a function of time of MP use is statistically significant and the combined use of various types of MP raises the risk of developing head tumors. (4) In the Interphone study the combination of these factors leads to strong under-estimation of the risk, showing that the majority of risk values are below 1, often statistically significant: in the 17 Interphone studies, out of 1,084 risk values different from 1, 76 percent are below 1 and only 24 percent are above 1. The prevalence of OR values below 1 is extremely unusual in most of these studies: 100 percent in one study, more than 90 percent in two studies, more than 80 percent in five studies, more than 70 percent in three studies, and the probability of this asymmetric distribution of risk values – which seems to indicate a protective effect – being chance is very low in six of these studies, while in another six studies, as in the overall data, is practically zero; in Hardell's studies, over 90 percent of the risk values are above 1, of which 41 percent are statistically significant, and the probability of this asymmetric distribution – indicating a carcinogenic effect of MP use – being due to chance is almost zero.
- 14 The association is found and well documented in 2007 by the Italian Association of Medical Oncologists, with specific reference to Hardell's data, emphasized in his monograph *Guidelines for Brain Tumors* (www.aiom.it), which established 'a doubling of the risk of brain gliomas and acoustic neuromas among long-term (at least 10 years) users of cellular and cordless phones', recommending 'caution in the use of mobile phones'. Recently, even a judgment (614/2009) of the Appeal Court, Labor Section of Brescia, Italy recognized for the first time the association between MP use and increased risk of head tumors. The case was a neurinoma of the trigeminal nerve on the left side of the head in a subject having been exposed for more than ten years and more than 15,000 hours on analog and digital cellular and cordless phones. This subject was involved professionally in customer services for his employer; he was right-handed and, during MP calls, used his right hand for making notes and the left hand for holding the MPs. As a result, this tumor was ipsilateral as are most of those Hardell identified. This case therefore concerned a personal situation where the experts – including one of us (Angelo Gino Levis) – evaluated the pathology as a probable consequence of a causal link, even if weak, to the subject's exposure to MPs. This carried weight in the decision of the Court, which recognized that there was a link of causality, or at least of a contributing cause, in the sense that exposure in the workplace to wireless radiation from MPs contributed to the malignant pathology. This led in turn to the recognition of and compensation for the suffering of a physical impairment, which in the present case was evaluated at 80 percent. There are two particularly interesting aspects of this sentence: (1) until 2008, non-ionizing EMF was included in the 'tables of professional diseases' and for any employment involving

- possibility of exposure this covered an indemnity of unlimited duration for appearance of tumors. Certification of tumor and demonstration of there having been exposure to EMF radiation during work would therefore have been sufficient for the Istituto Nazionale per l'Assistenza sugli Infortuni Lavorativi (INAIL, national body aiding workplace incident sufferers) – or the labor tribunal in the case of a legal hearing – to confirm payment of compensation. Through decree of 9 April 2008 of the Italian Ministry of Labor and Social Welfare, non-ionizing EMF were removed from the tables of workplace diseases. However, through a deliberation of the Italian Constitutional Court (no. 179 of 18 February 1988), welfare care was extended to include pathologies that, while omitted from the tables, were traceable to exposure in the workplace; here though, the worker has responsibility for demonstrating the cause–effect relationship. The person involved in fact has to show with reasonable certainty that the pathology has arisen through workplace exposure, and that there is therefore a high probability that the pathology in question has a workplace origin – *Cassazione Penale* (penal instance) no. 11087 of 15 May 2007. The case cited here is the first in which a Labor Court has recognized this causal link for workplace exposure to EMF, despite this being omitted from the tables of workplace illnesses/diseases. (2) The literature gives wide documentation of increased risk of acoustic neuromas in long-term users of MPs (see above), while there is complete absence of cases showing correlation between exposure to MPs and increase in tumors of other cranial nerves, in particular the trigeminal. In this case, recognition of workplace disease is based on the fact, documented by consultants, that the acoustic nerve and the trigeminal nerve both originate in the same well-defined, limited area of the endocranial volume, clearly irradiated during the use of MPs. Instead, attempts have failed in the United States to have manufacturers held responsible in cases where cell phones caused tumors because of a lack of convincing demonstration of the existence of a causal link between the harm caused and the use of the cell phone (see *Motorola v. Ward*, 1996, and for a more updated overview see Capriotti 2002). In a more recent case (*Murray v. Motorola*, 2009), it is clearly stated that the cell phone conformity to the technical standards for commercialization, set by the FDA in accordance with the Federal Communications Commission, categorically excludes the possibility of recognizing such products as defective, thus refusing to recognize the responsibility of the manufacturer in the case that this is harmful to the user's health (including where the harm is severe).
- 15 The Hardell group was always supported only by grants from public bodies, whereas the Interphone-related studies received funding through the Quality of Life and Management of Living Resources program of the EU and the International Union Against Cancer, but the latter received funding for the Interphone studies from the Mobile Manufacturers Forum (MMF, see note 18) and the Global System for Mobile Communication Association (GSMA) (IARC 2010). In addition to the above funds, several authors participating in the Interphone study received further funding from their national MP companies (five studies) or other private companies (three studies), such that a substantial portion of the Interphone funding came from the cell phone industry. Furthermore, other negative studies have been supported by the cell phone industry: two studies were funded by the Cellular Industry Telecommunications Association via the Wireless Technology Research, while another was funded by TeleDanmark Mobil, Sonofon and the International Epidemiology Institute – a private company operating as a cell phone industry advisor – and one by Motorola. Nevertheless, of the 17 authors of the Interphone studies, ten do not make any declaration about conflict of interests, three state 'conflict of interests: none declared' (it is not clear whether this is from the authors or from the editor), while four declare 'conflicts of interests: none' (Levis *et al.* 2011).
- 16 This is precisely the picture found today as regards assessment of risks correlated to the use of MPs, and more generally to residential and occupational exposure to EMF,

given that the 'confusion' arising from the production of experimental and epidemiological data and their interpretation (open to scientific discussion) is fueled by the support given to this interpretation by the extraordinary web of some authors' involvement in the agencies working in these areas, who receive financial support from the mobile telephony companies. In just one example, Prof. Anders Ahlbom, a figure of leading authority in the Interphone 'team' – set up and monitored by IARC and the EU – plays major roles in ICNIRP, SCENIHR/EC, the Swedish Radiation Protection Agency and in the WHO's EMF Project. Recently (May 2011), Prof. W. Mosgoeller, past president of ICEMS (see note 7) disclosed that Ahlbom is the co-founder of 'Gunnar Ahlbom AB', a Brussels-based lobby firm aiming to assist the telecom industry on EU regulations, public affairs and corporate communications. He created the lobby firm in 2010 together with his brother and sister-in-law. His brother, Gunnar Ahlbom, has been a telecom lobbyist in Brussels for the leading Swedish mobile phone operator TeliaSonera, among others, since the early 1990s, and was already active in this field in 1998 when Prof. Ahlbom participated in the setting of the controversial ICNIRP standards on non-ionizing radiation from different sources (see note 5). Ahlbom, professor in epidemiology at the Karolinska Institute in Sweden, is one of the leading and most influential international experts on evaluation of health risks with mobile telephony. He led an important expert evaluation for the European Commission in 2007 (Possible effects of electromagnetic fields on human health) and participated in a new expert report (SCENIHR, see note 6) to the European Commission in 2009. He has chaired every single expert investigation about possible health risks with mobile telephony and electromagnetic fields carried out in Sweden during 2003–2011 for the Swedish Radiation Protection Authority and the Swedish Council for Working Life and Social Research. Ahlbom has never mentioned his brother's work as a lobbyist for the concerned industry in his declarations of interest. Neither has he mentioned his interest in the 'Gunnar Ahlbom AB' mobile phone lobby firm. Ahlbom was appointed to chair the IARC epidemiology expert evaluation about cancer risks of mobile telephony on 24–31 May 2011. The evaluation aimed to serve as a guideline on cancer risk assessment of the mobile telephony for many years ahead. The result of the review is of utmost importance to the mobile phone industry, which sent three 'invited observers' to the meeting: Mays Swicord, CTIA (the wireless association), Joe Elder, the Mobile Manufacturers Forum (MMF) and Jack Rowley, the GSMA (see note 15). The members of the IARC scientific committee had to submit a declaration of interest, and the IARC had already barred one scientist from the committee: Dr. Alexander Lerchl from the German Radiation Protection Board, who has been questioned regarding his relations to the German mobile phone industry, and was finally not accepted onto the committee as 'an IARC Monograph is an exercise that demands complete independence from all commercial interests, and from advocates who might be perceived as advancing a pre-conceived position'. On 22–23 May 2011 *Microwave News* (www.microwavenews.com) communicated that: 'IARC told Ahlbom that he could still come, but only as an invited expert'. The key difference is that invited experts cannot vote on how to categorize RF radiation – say as possible or probable carcinogen. Ahlbom decided that he did not want to attend under those restrictions; therefore, in the IARC Monograph Working Group Member list, Ahlbom was quoted as an 'invited specialist (withdrew)'. The decision taken on 31 May 2011 by the IARC expert group on the evaluation of cancer risks produced by EMF/RF – including the emissions by MPs – was to allocate these agents in the 2B group as 'possible carcinogenic agents for man' (www.thelancet.com/oncology published online 22 June 2011). This decision is the same as that taken by IARC in 2001 for the ELF/EMF, unchanged despite the greatly increased amount of evidence for short- and long-term risks for human health produced by ELF/EMF that has accumulated since then. The reasons for such an ultra-conservative position by the IARC–WHO and other international scientific organizations was pointed out back in 1994 by

Tomatis and Huff (see notes 9 and 10), and there is no doubt that the same should be applied to the evaluation of the risks produced by RF/EMF and mobile phone emissions. In fact, in addition to the five members of the IARC panel on RF who declared to have conflict of interests, more than ten others members of the 30 making up the working group had conflicts, but did not declare them. Moreover, just a few days before the IARC began its evaluation of the cancer risks associated with RF radiation, French national TV accused one member of the IARC panel of trying to suppress a study indicating a health risk from cell phone use. A minority opinion was expressed by a small group of IARC panel members (Microwave News, 3 May 2011): 'Our conclusion means that there could be some risk, and therefore we need to keep a close watch for a link between cell phone and cancer risk' noted Jonathan Samet, who served as Chairman of the IARC panel on RF. Rodolfo Saracci, who also participated in the IARC panel, concluded his critical analysis of the Interphone data (Saracci 2011), stating that the 'Interphone, like other observational studies, may conceal an elevated risk under the appearance of consistently reduced risk'. Also, the Swedish Radiation Protection Agency issued a press release announcing that it was taking the Ahlbom affair very seriously and investigating whether it might affect Ahlbom's role as chairman of its own expert group, which issues an annual review of new EMF/RF research (see notes 6 and 17). As a consequence, Ahlbom was invited to resign as chairman of the agency, since he had also been a member of the Swedish Tobacco Company's Medical Research Council for a number of years. In addition, the Chair of the EU/SCENIHR working group informed the Committee that Ahlbom declared an interest view of his affiliations (http://ec.europa.eu/health/ph_risk/committees/04_schenihr/does/schenihr_mi_014.pdf). Two other members of the SCENIHR working group, D. Mattson and L. Hillert, are at the same time members of the mobile phone company TeliaSonera's scientific council (<http://ollejohansen.adante.se/olle-andras-bra-saker-htm>), whereas J. Schuz, who was a member of the IARC ELF and RF/EMF monograph working groups and who was recently elected president of the international Bioelectromagnetic Society, received industry funding from the Electric Power Research Institute as well as from the mobile phone industry through the EC Interphone, Cefalo and Cosmos Projects and, in addition, has consulted for an Austrian mobile phone advisory group that received funding from the Telecom companies (www.microwavenews.com, 9 June 2011). There is therefore an urgent need to review and reconsider the reports on RF health effects to the EU Commission produced by the ICNIRP and SCENIHR working groups under the chairmanship of Ahlbom and other experts with conflicts of interests.

- 17 This is taken from NRPB (2004), Sienkiewicz and Kowalczyk (2005), Ahlbom *et al.* (2004), European Commission and SCENIHR (2007; 2009), Swedish Radiation Protection Authority (2006), Health Council of the Netherlands (2007), Italy's Upper Health Institute with the reports of S. Lagorio, P. Vecchia and A. Polichetti at conferences organized by the 'Consorzio Elettra 2000' and in the document on the 'Progetto Camelet', promoted and funded by the Italian Health Ministry. Other national agencies and commissions have been found to be compromised by conflicts of interests which have influenced assessment of the health risks resulting from exposure to EMF: (1) the Zmirou Commission, set up in 2001 by the French General Directorate for Health: in 2005, following the resignation of Prof. Zmirou (who, along with the other members, declared himself free from conflict of interests), successor Prof. Paillotin declared to the French Senate that the conclusions of the Commission (mobile telephony was harmless) should be considered invalid. In 2006, inquiries of the French Social Affairs and Environment General Inspectorate revealed 'inadequacies, irregularities and links between some members of the commission and the mobile telephony operators'. (2) the Royal Society of Canada produced a document held secret for a long time ('Report of the panel monitoring Ontario Hydro's electromagnetic fields risk assessment program. A panel report prepared at the request of the Royal Society

of Canada for Ontario Hydro'): this reveals that the reassuring views about EMI emissions are compromised by the interests of private companies involved in the development and management of the technologies concerned (Hydro-Quebec and Gradient Corporation). (3) There are conflicts of interests compromising WHO and ICNIRP – these are extremely serious, resulting in targeted choices of falsely reassuring data on the effects of EMF on human health. In fact, at least 50 percent of the funds for the WHO's EMF Project – which up to mid-2006 cost over \$250 million – come from electricity companies and mobile telephony operators: some of these funds (\$150,000 for mobile telephony alone) are collected by the MMF and sent to the Royal Adelaide Hospital in Australia (where Repacholi is based) and then transferred to the WHO. Since 2006 Repacholi has no longer led the WHO's EMF Project, but has remained as emeritus president of the ICNIRP, and was taken on as a consultant by several industries, including two American electricity companies (Connecticut Light and Power Co. and United Illuminating Co.) to bolster support against the Connecticut Department of Public Health's initiative to lower the ELF/EMF exposure limits. These actions all conflict with the founding principles of the two organizations: the WHO in fact 'does not allow industries to participate in either setting the standards or in assessment of risks to human health'. According to the WHO,

the working groups established to set the standards may not contain industry representatives. The WHO working groups may not include anyone who has or is subject to any influence that is favorable to a given industry, in particular when assessing the effects on human health of the products of this same industry is concerned.

According to ICNIRP,

all members of the commission are independent experts' and 'they are often reminded that they must declare any interests that could compromise the principles of the statute of ICNIRP, as an independent consultation group. ICNIRP does not accept any funding from industry.

The reader is also referred to note 10 concerning report no. 238/2007 sponsored by the WHO and ICNIRP. Even though Repacholi is no longer ICNIRP president or the WHO's EMF Project leader, the workings of these two organizations has not changed: his successors, P. Vecchia (ICNIRP) and E. van Deventer (WHO's EMF Project) continue their links with the producers and operators of electricity and wireless technologies, in particular mobile telephony.

18 The aims of the MMF are set out on the website www.mmfa.org:

The MMF is an international association of telecommunications equipment manufacturers with an interest in mobile or wireless communications. Established in 1998, the association's mission is to facilitate joint funding of key research projects and cooperation on standards, regulatory issues and communications concerning the safety of wireless technology, accessibility and environmental issues. The MMF ... is currently active in more than 30 countries, as well as supporting an extensive international research program. The MMF's goal in research is to promote the highest quality independent research that furnishes relevant data for the development of sound public policy. MMF funds research addressing important scientific questions. To achieve this, the MMF has responded to the research recommendations of the WHO's EMF Project and has coordinated its global activities to correspond with these recommendations. Only by enhancing the existing scientific database relating to RF/EMF will it be possible to perform an independent health risk assessment recognized by the scientific community as well as by government and statutory bodies.... The MMF coordinates its inputs and contributes relevant expertise within standards-setting processes. The MMF commissioner

quality research in support of standards. The MMF's regulatory activities are focused on developing and presenting the views of the mobile industry to regulatory agencies and authorities in a globally coordinated manner. The MMF also responds to requests for information, or assistance, by national and international bodies in relation to the safety of wireless technology, accessibility and environmental issues.... The MMF supports national trade associations by providing a source of information that is based on the pooled resources and networks of our member companies.

Members of the MMF include many prestigious bodies and agencies: The MMF has links with some of the major international agencies overseeing the protection of health from the effects of EMF (WHO, EU, IARC, International Union Against Cancer, Health Council of the Netherlands, Swedish Radiation Protection Authority, Norwegian Radiation Protection Authority, UK Health Protection Agency, UK Independent Expert Group on Mobile Phones). This pool of mobile telephony industries distributes a series of information leaflets to disseminate serious and targeted misinformation, supporting an absence of risk from use of MPs, the pointlessness of taking precautionary measures even for babies, the inappropriateness of modifying the exposure limits set by ICNIRP and the need to reassure public opinion.

- 19 This recommendation sits well with the scientific committees that have overseen the Interphone project (see the section 'Mobile phones and head tumors') and all the other programs on EMF launched by the EU and co-funded by the mobile telephony companies (see the section 'Funding for EU programs').
- 20 It has been known since 2004 that no insurance company in the world is prepared to insure businesses that manufacture cell phones since they refuse to take on the risk that a user or his heirs sue for damages (see *La Nazione* of 29 January 2004, which reproduces a news item published on the front page of the *Suddeutsche Zeitung*, one of Germany's most authoritative newspapers). Instead, it is little known that, from 2010, even cell phone manufacturers have begun to include warnings in their accompanying instructions about possible risks to health that these devices could cause. Consider, for instance, the easily overlooked few lines of legalese found in the safety manual for Apple's iPhone4:

When using iPhone near your body for voice calls or for wireless data transmission over a cellular network, keep iPhone at least 15 mm away from the body, and only use carrying cases, belt clips, or holders that do not have metal parts and that maintain at least 15 mm separation between iPhone and the body.

Similar warnings against carrying cell and smart phones in a tight pocket close to the body are found throughout the industry. The safety manual for Research in Motion's Blackberry 9000 phone tells users that: '[they] may violate Federal Communications Commission guidelines for radio-frequency energy exposure by carrying the phone outside a holster and within 2.5 cm of [their] body'. In addition, the safety manual of the Motorola W180 phone tells users to 'always keep the active device 2.54 cm (one full inch) away from [their] body, if not using a company-approved clip, holder, holster, case or body harness'. Clearly, cell phone manufacturers apply the Precautionary Principle in order to cover themselves legally, since they are aware that long-term use exceeding the standards could lead to serious adverse effects. Even more clear are the recommendations in the 'Safety and Product Information' of the Blackberry Curve 8520 Smartphone (www.blackberry.com/docs/smartphones). It states that

to reduce radiofrequency exposure: 1) use the BlackBerry device in areas where there is a strong wireless signal ... a reduced signal display, which might occur in areas such as an underground parking structure or if you are travelling by train or car, might indicate increased power output from your BlackBerry device as it

attempts to connect to a weak signal; 2) use hands-free operation if it is available and keep the BlackBerry device at least 25 mm from your body (including the abdomen of pregnant women and the lower abdomen of teenagers) when the BlackBerry device is turned on and connected to the wireless network; 3) reduce the amount of time spent on calls.

21 To this aim D.A. Carpenter (2010) concludes his review, stating that:

The benefits to society derived from electricity and wireless communications are significant, and certainly none of us is willing to return to the pre-electric age. However it is imperative that society at least acknowledges the disparities between current standards and current evidence of adverse health effects. Rigid and sudden imposition of the standards we propose is certainly unrealistic at the present time, but these levels are appropriate goals that could at least be approached by a combination of development of new technology and voluntary changes in behavior. Application of the Precautionary Principle is appropriate under the circumstances where there is a demonstrated elevation in rates of serious diseases in humans following elevated EMF exposure, but has many unanswered questions as to mechanisms responsible. We need additional research, of course, and much better exposure assessment. The evidence that we have at present is too convincing to be ignored. Our national and international standards are obsolete, and ignore evidence reported by many different investigations. The lack of certainty with regard to mechanisms and animal models is no reason to ignore studies of human health. Similar lack of certainty regarding mechanisms also exists for some chemicals, yet precautionary measures are commonly taken to reduce exposure. We need the electric and communications industries to be proactive in developing products that can be used with reduced exposures. We need governments and international organizations to set standards that are based on the evidence of whether there are hazards to humans, not on a hypothesis that is not credible based on the evidence from animal and cellular studies. Most importantly, we need individuals to understand that personal decisions will significantly impact the level to which they are exposed to both ELF and RF EMFs.

22 The 'healthy worker effect' is regularly produced in cohort studies when workers are wrongly compared to the unselected general population instead of a proper control group (non-exposed and healthy selected workers). Consequently, the worker population exhibits overall lower death (or morbidity) rates than those of the general population due to the fact that the severely ill and disabled are ordinarily excluded from employment.

References

- Ahlbom, A., Day, N., Feychting, M., *et al.* (2000) 'A pooled analysis of magnetic fields and childhood leukemia', *British Journal of Cancer*, 83(5): 692–698.
- Ahlbom, A., Green, A., Kheifets, L., Savitz, D. and Swerdlow, A. (2004) 'Epidemiology of health effects of radiofrequency exposure', *Environmental Health Perspectives*, 112(17): 1741–1754.
- Al Mureden, E. (2010) 'I danni da uso del cellulare tra tutela previdenziale e limiti della responsabilità del produttore', *Responsabilità Civile e Previdenza*, 6: 1392–1423.
- Bailar, J.C. (2006) 'How to distort the scientific record without actually lying: truth, and the arts of science', *European Journal of Oncology*, 11(4): 217–224.
- Bortkiewicz, A., Gadzicka, E., Zmyslony, M. and Szymczak, W. (2006) 'Neurodegenerative disturbances in workers exposed to 50 Hz electromagnetic fields', *International Journal of Occupational Medicine and Environmental Health*, 19(1): 53–60.

- Capriotti, S. (2002) 'Is there a future for cell phone litigation?', *Journal of Contemporary Health and Law Policy*, 18(2): 489–510.
- Cardis, E. and Sadetzki, S. (2011) 'Indications of possible brain-tumour risk in mobile-phone studies: should we be concerned?', *Occupational and Environmental Medicine*, 68: 169–171.
- Carpenter, D.A. (2010) 'Human health effects of EMFs: the cost of doing nothing', *Electromagnetic Phenomena and Health: A Continuing Controversy?*, doi: 10.1088/1755-1815/10/1/012004.
- Casson, F. (2007) *La Fabbrica dei Veleni*, Trento, Italy: Sperling & Kupfer.
- Davis, D. (2008) *La Storia Segreta del Cancro*, Turin, Italy: Codice.
- EEA (2007/2008) 'Radiofrequency electromagnetic fields: EEA commentary on the evaluation of the evidence'. Available at: http://report.eea.europa.eu/environment_issue_report.
- Egilman, D.S. and Bohme, S.R. (2005) 'Over a barrel: corporate corruption of science and its effects on workers and the environment', *International Journal of Occupational and Environmental Health*, 11: 331–337.
- European Commission (2005) 'Health and electromagnetic fields: EU-funded research into the impact of electromagnetic fields and mobile telephones on health'. Available at: http://ec.europa.eu/health/archive/ph_determinants/environment/emf/brochure_en.pdf.
- European Commission and SCENIHR (2007) 'Possible effects of electromagnetic fields on human health final resolution'. Available at: http://ec.europa.eu/health/ph_risk/committees/04_scenihhr/docs/scenihhr_o_007.pdf
- European Commission and SCENIHR (2009) 'Health effects of exposure to EMF'. Available at: http://ec.europa.eu/health/ph_risk/committees/04_scenihhr/docs/scenihhr_o_022.pdf
- Eurostat (2011) *Health Status Indicators*. Available at: http://ec.europa.eu/health/indicators/indicators/index_en.htm.
- Fadel, R.A., Salem, A.H., Ali, M.H. and Abu-Saif, A.N. (2006) 'Growth assessment of children exposed to low frequency electromagnetic fields at the Abu Sultan area in Ismailia (Egypt)', *Anthropologischer Anzeiger*, 64: 211–226.
- Foliart, D.E., Pollock, B.H., Mezei, G., Iriye, R., Silva, J.M., Ebi, K.L., Kheifets, L. Link, M.P. and Kavet, R. (2006) 'Magnetic field exposure and long-term survival among children with leukemia', *British Journal of Cancer*, 94: 161–164.
- Gee, D. (2009) 'Late lessons from early warnings: towards realism and precaution with EMF?', *Pathophysiology*, 16: 217–231.
- Gennaro, V. and Ricci, P. (2010) 'Conclusioni tranquillizzanti francamente sbagliate in epidemiologia; come capire?', *Epidemiologia & Prevenzione*, 34(5–6, suppl. 1): 231–232.
- Gennaro, V. and Tomatis, L. (2005) 'Business bias: how epidemiologic studies may underestimate or fail to detect increased risks of cancer and other diseases', *International Journal of Occupational and Environmental Health*, 11: 356–359.
- Gennaro, V., Ricci, P., Levis, A.G. and Czosignani, P. (2009) 'Vizi e virtù dell'epidemiologia e degli epidemiologi', *Epidemiologia & Prevenzione*, 33(4–5, suppl. 2): 49–56.
- Greenland, S., Sheppard, A.R., Kaune, W.T., Poole, C and Kelsh, M.A. (2000) 'A pooled analysis of magnetic fields, wire codes, and childhood leukemia', *Epidemiology*, 11: 624–634.
- Hakansson, N., Gustavsson, P., Johansen, C. and Floderus, B. (2003) 'Neurodegenerative

- diseases in welders and other workers exposed to high levels of magnetic fields', *Epidemiology*, 14(4): 420–426.
- Hardell, L. and Carlberg, M. (2009) 'Mobile phones, cordless phones and the risk for brain tumours', *International Journal of Oncology*, 35: 5–17.
- Hardell, L., Walker, M.J., Walhjalt, B., Friedman, L.S. and Richter, E.D. (2006) 'Secret ties to industry and conflicting interests in cancer research', *American Journal of Industrial Medicine*, 50(3): 227–233.
- Hardell, L., Carlberg, M. and Hansson Mild, K. (2011) 'Pooled analyses of case-control studies on malignant brain tumors and the use of mobile and cordless phones including living and deceased subjects', *International Journal of Oncology*, 38: 1465–1474.
- Havas, M. (2010) 'Interphone study: it's not just brain tumors!'. Available at: www.magdahas.com/2010/05/17/interphone_parotid_gland_tumors.
- Health Council of the Netherlands (2007) 'No Indications for Health Effects of UMTS and DECT'. Available at: www.healthcouncil.nl.
- Hernberg, S. (1981) 'Negative results in cohort studies: how to recognize fallacies', *Scandinavian Journal of Work, Environment & Health*, 7: 121–126.
- Huff, J. (2002) 'IARC monographs: industry influence, and upgrading, downgrading, and under-grading chemicals', *International Journal of Occupational and Environmental Health*, 8: 249–270.
- Huss, A., Egger, M., Hug, K., Huwiler-Müntener, K. and Rösli, M. (2007) 'Source of funding and results of studies of health effects of mobile phone use: systematic review of experimental studies', *Environmental Health Perspectives*, 115(1): 1–4.
- Huss, A., Spoerri, A., Egger, M. and Rösli, M. (2009) 'Residence near power lines and mortality from neurodegenerative disease: longitudinal study of the Swiss population', *American Journal of Epidemiology*, 169: 167–175.
- Hyland, G.J (2001) 'The physiological and environmental effects of non-ionizing electromagnetic radiation', Working Document for the STOA Panel, European Parliament/EU Directorate General for Research. Available at: www.europarl.eu.int/stoa/publi/pdf/00-07-03eu.pdp.
- IARC (2002) *Monographs on the Evaluation of Carcinogenic Risks to Humans: Non-Ionizing Radiation, Part 1 – Static and Extremely-low Frequency (ELF) Electric and Magnetic Fields*, Vol. 80, pp. 1–395.
- IARC (2010) 'The Interphone study'. Available at: www.iarc.fr/en/research-groups/RAD/RCAd.html.
- ICNIRP (1996) 'ICNIRP statement: on health issues related to the use of hand-held radio-telephones and base transmitters', *Health Physics*, 70(4): 587–593.
- ICNIRP (1998) 'Guidelines for limiting exposure to time-varying electric, magnetic, and electromagnetic fields (up to 300 GHz)', *Health Physics*, 74(4): 494–522.
- IEGMP (2000) *Mobile Phones and Health*. Available at: www.iegmp.org.uk/report/text.htm
- Interphone Study Group (2010) 'Brain tumour risk in relation to mobile telephone use: results of the Interphone international case-control study', *International Journal of Epidemiology*, 39: 675–694.
- Krewski, D., Glickman, B.W., Habash, R.W., Habbick, B., Lotz, W.G., Mandeville, R., Prato, F.S., Salem, T. and Weaver, D.F. (2001) 'Recent advances in research on radiofrequency fields and health 2001–2003', *Journal of Toxicology & Environmental Health*, 4(4): n.p.
- Lee, G.M., Neutra, R.R., Hristova, L., Yost, M. and Hiatt, R.A. (2002) 'A nested case-control study of residential and personal magnetic field measures and miscarriages', *Epidemiology*, 13: 21–31.

- Levis, A.G., Minicuci, N., Ricci, P., Gennaro, V. and Garbisa, S. (2011) 'Mobile phones and head tumors: the discrepancies in cause-effect relationship in the epidemiological studies – how do they arise?', *Environmental Health*, 10: 59.
- Levis, A.G., Minicuci, N., Ricci, P., Gennaro, V. and Garbisa, S. (2012a) 'Mobile phones and head tumours: a critical analysis of case-control epidemiological studies', *Open Environmental Sciences*, 6: 1–12.
- Levis, A.G., Minicuci, N. and Ricci, P. (2012b) 'Statistical relationships between positive or negative results and public or private funding, in studies on EMF effects', in preparation.
- Li, D.K., Odouli, R., Wi, S., Janevic, T., Golditch, I., Bracken, T.D., *et al.* (2002) 'A population-based prospective cohort study of personal exposure to magnetic fields during pregnancy and risk of miscarriage', *Epidemiology*, 13: 9–20.
- Lloyd-Morgan, L. (2009) 'Estimating the risk of brain tumors from cell-phone use: published case-control studies', *Pathophysiology*, 16: 137–147.
- Lloyd-Morgan, L., Barris, E., Newton, J., O'Connor, E., Philips, A., Philips, G., *et al.* (2009) 'Cellphones and brain tumors: 15 reasons for concern – science, spin and the truth behind Interphone'. Available at: www.radiationresearch.org.
- Maisch, D. (2006) 'Conflict of interest and bias in health advisory committee: a case study of the WHO's EMF task group', *JACNEM*, 21(1): 15–17.
- Michaels, D. (2008) *Doubt is their Product: How Industry's Assault on Science Threatens your Health*, Oxford: University Press.
- Myung, S.K., Ju, W., McDonnell, D.D., Yeon, J.L., Kazinets, G., Chih-Tao, C., *et al.* (2009) 'Mobile phone use and risk of tumors: a meta-analysis', *Journal of Clinical Oncology*, 27(33): 5565–5572.
- NRPB (2004) 'Review of the scientific evidence for limiting exposure to electromagnetic fields, 0–300 GHz', *NRPB*, 15(3): 1–224.
- Naval Studies Board, Division of Engineering and Physical Sciences (2002) *An Assessment of Non-lethal Weapons Science and Technology*, Washington, DC: National Academies Press.
- Oreskes, N. and Conway, E.M. (2010) *Merchants of Doubt: How a Handful of Scientists Obscured the Truth on the Issues from Tobacco Smoke to global Warming*, New York, Berlin and London: Bloomsbury Press.
- Pawl, R. (2008) 'Cellphones more dangerous than cigarettes!', *Surgical Neurology*, 70: 445–446.
- Pearce, N. (2008) 'Corporate influences on epidemiology', *International Journal of Epidemiology*, 37(1): 46–53.
- Sadetzki, S., Chetrit, A., Jarus-Hakak, A., Cardis, E., Deutch, Y., Duvdevani, S., *et al.* (2008) 'Cellular phone use and risk of benign and malignant parotid gland tumors: a nationwide case-control study', *American Journal of Epidemiology*, 167: 457–467.
- Sage, C. Carpenter, D. and the BioInitiative Working Group (2007) *BioInitiative Report: A Rationale for a Biologically Based Public Exposure Standard for Electromagnetic Fields: ELF and RF*. Available at: www.bioinitiative.org.
- Saracci, R. (2011) 'Electromagnetic fields from wireless phones declared "possibly carcinogenic"', *Epidemiologia & Prevenzione*, 35(3–4): 171–172.
- Saracci, R. and Samet, J. (2010) 'Commentary: call me on my mobile phone ... or better not? A look at the INTERPHONE study results', *International Journal of Epidemiology*, 39(3): 695–698.
- Seyhan, N., Firlarer, A., Canseven, A.G. Ozden, S. and Tepe Cam, S. (2010) 'Occupational EMF exposure measurements in different work environments', *European Journal of Oncology*, 5: 379–386.

- Sienkiewicz, Z.J. and Kowalczyk, C.I. (2005) 'A summary of recent reports on mobile phones and health: 2000–2004'. Available at: www.hpa.org.uk/webc/HPAwebFile/HPAweb_C/1194947376017
- Svendsen, A.L., Weihkopf, T., Kaatsch, P. and Schüz, J. (2007) 'Exposure to magnetic fields and survival after diagnosis of childhood leukemia: a German cohort study', *Cancer Epidemiology, Biomarkers & Prevention*, 16(6): 1167–1171.
- Swedish Radiation Protection Authority (2006) 'Recent research on EMF and health risks'. Available at: www.ssi.se.
- Tomatis, L. (1965) *Il laboratorio*, Milano: Einaudi.
- Tomatis, L. (2002) 'The IARC monograph program: changing attitudes towards public health', *International Journal of Occupational and Environmental Health*, 8: 114–152.
- Tomatis, L. (2007) 'Percorsi e difficoltà della ricerca eziologica e della ricerca in chemioterapia', *Epidemiologia & Prevenzione*, 31(4): 197–203.
- Tomatis, L. (2008) *L'Ombra del dubbio*, Milano: Sironi.
- Valberg, A., van Deventer, E. and Repacholi, M. (2007) 'Workgroup report: base stations and wireless networks – radiofrequency (rf) exposures and health consequences', *Environmental Health Perspectives*, 115: 416–424.
- WHO (2007) *ELF Health Criteria Monograph on Neurodegenerative Disorders*, pp. 1–187.
- Zapponi, G.A. and Marcello, I. (2004) 'Recent experimental data on extremely low frequency (ELF) carcinogenic risk: open questions', *Journal of Experimental & Clinical Cancer Research*, 23: 2–16.
- 'Zmirou Report' (2001) *Zmirou Report to the French Health General Directorate*. Available at: www.sante.gouv.fr/index.htm