When considering the numerous discoveries that have punctuated the successive decades of the twentieth century, the scientific richness of the century is indisputable. Further, there is no doubt that these discoveries have brought considerable technological progress in many and varied fields. Among them is radioactivity, which deserves to be paid special attention. It was discovered by Henri Becquerel in 1896, whose centenary was recently celebrated. Since its discovery, thanks to the research conducted by Pierre and Marie Curie among others, this field of study has undergone considerable development. In the exploitation of radioactivity there have been significant and beneficial developments in energy production and radiotherapy fields, but it has also given rise to worries about the terrifying consequences of the uncontrolled release of energy. Disasters like the bombing of Hiroshima and Nagasaki or the destruction at Chernobyl are among the more significant events.

Perhaps, surprisingly, even with a century of knowledge, most of the general public and even the people working in this field of study usually have a very limited knowledge of the levels of their exposure to the different classes of irradiation and of the potential effects of induced radiation. It is rare for the media to deal with this topic unless the opportunity arises to report on spectacular events like those at Three-Mile-Island or Chernobyl, or more recently the disposal of nuclear waste into the Channel from the processing plant of La Hague (France) or the contamination of containers or wagons from this centre. One is forced to note that everything related to such incidents is scrutinised minutely in numerous debates between experts, lawyers and the media following the event. They argue in a free-for-all, which never reaches any sensible or logical conclusions. Thus, one should not be surprised by the reactions of the general public who, more and more, are subjected to a flow of generally imprecise information, the result of which is to raise further questions and instill groundless fears.

Proximity to disasters aside, we are all exposed to low levels of radiation. The problem arises, therefore, of whether there are any associated effects of this exposure of human beings to this low level of radiation. The question has puzzled both the scientific community and the general public for a long time. From conception to death, human beings are exposed to low levels of radiation and receive a continuous low-level dose of ionising radiation. This is regardless of their lifestyle or their occupational environment and may result from either unavoidable teluric and cosmic exposures or voluntary exposures in the course of medical check-ups or radiotherapy-based treatments.
Natural irradiation constitutes the most significant part of individual exposure. It comes mainly from isotopes of natural radioactive elements such as $^{235}$U, $^{238}$U and $^{232}$Th. These are found in varying amounts in the Earth’s crust and have their origins in the formation of our planet. Simply, one can regard this irradiation as having two main contributors: on the one hand, there is the telluric contribution caused by gamma radiation from the radionuclides contained in soils and building materials, and on the other hand there is the radiation received through inhalation of the short-lived daughters of radon, a natural radioactive gas derived from the decay of radium, which is ubiquitous in the environment. In recent years, radon has been singled out as a problem by several governments because of the high concentration measured in some houses. This has produced a disproportionate response from the media who cannot accept a mere percentage and have to add an overblown adjective to their description. Levels of several thousand becquerels per cubic metre have been recorded in some houses in areas where radon release from the ground is high, which can be compared to the few hundred becquerels per cubic metre measured in ventilated uranium mines and the few tens of becquerels per cubic metre found in most indoor environments. From a scientific point of view, radon is considered to account for 30–50% of the yearly radiation dose received by individuals. In spite of the well-known harmful effects of radiation on the body, throughout the general population there is still no conclusive evidence for any effects on health from radon exposure. The various epidemiological surveys that have been conducted worldwide in recent years, together with animal experiments and dosimetric evaluations from the medical follow-up of uranium miners have allowed us to assess risk factors. However, there is no convergence from the disparate studies so far although it is likely that this complex problem will be solved in the next few years.

There is another component of the natural radiation to which we are exposed: the cosmic radiation of galactic and solar origin and the consequential secondary radiation produced in the atmosphere. At ground level, this component accounts for 5–10% of the annual received dose. The contribution increases with altitude and results in high exposures for the crews of long-range airliners and travellers who often fly. Due to the increasing level of air traffic, an increase in this contribution for a greater number of people can be foreseen in the future.

Over time one would expect very little change in the natural radioactive background on Earth to which we are exposed. However, changes in lifestyle over recent years have increased somewhat the level of exposure for a part of the population. Tightening of buildings has allowed radon to accumulate in certain buildings in some areas and air transport has developed to be an increased occupational source for a few. There cannot be many people who fly at altitude for recreation! On the other hand, as we near the end of this century, the increasing use of radiotherapy and radiodiagnosis has greatly changed the distribution of exposure sources, so much so that nowadays medical irradiation accounts for more than one third of the yearly total dose (40% in France). There are several reasons for this: an increase in the use of external radiotherapy in cancer treatment, more widespread breast screening and, above all, medical imaging whose technological development has led to more and more frequent requests for its use. Today, medical use of radiation is such that specialists are close to agreeing that efforts should be made to reduce doses without reducing efficiency while still applying the principles of justification and optimisation expressed in the European instruction EURATOM 97/43.

In recent years the general public and the media have found another topic of concern, which is exposure to non-ionising radiation. This consequence of our modern electromagnetic environment is raising more and more questions about possible biological effects particularly those on our health. Exposure to non-ionising radiation results from proximity to low-frequency electromagnetic fields, which have a variety of sources from high voltage lines to cellular phones and the use of the latter is expanding day by day. In addition, electromagnetic fields are induced by other common electrical and electronic appliances from microwave ovens to computers. In the range of the frequencies of concern, a distinction can be made between the low frequencies used for electricity transport (50–60 Hz) and those corresponding to microwave oven radiation (2.45 GHz), those of mobile communication (900–1,800 Hz) and radars and telecommunication applications (3–19 GHz). There is an intermediate range of frequencies (300 Hz–10 MHz), which are produced by an increasing number of devices such as security gates or induction cookers. As the electromagnetic environment becomes more and more congested, it generates even greater fear in the general public about potential effects. Many epidemiological studies and other research work in laboratories have been conducted in an attempt to demonstrate, for example, a correlation between cancer (leukaemia) and exposure to magnetic fields. Most of the studies have been inconclusive and do not allow convincing conclusions to be drawn about demonstrable effects.
Nowadays, there is a call for more research work boosted by the development of mobile communication and particularly radiotelephony: soon, there will be 200 million cellular phones in Europe. Public opinion and the media are worried about the potential health risks induced by this new environmental factor because of the closeness between the radiofrequency source and the head (specifically the brain). At the present time, although some effects have been reported, nothing concerned with health has been substantiated. Investigations are still being carried out to determine both the possibility of interactions between the waves emitted by these devices and the tissues of the head, and any biological effects that could eventually be induced.

So, at the dawn of the new millennium, numerous questions about ionising and non-ionising radiation and their effects on human beings are still unanswered. From the progress to date it seems likely that the present debate on low doses will continue for a long time. For years to come the impact on public health of nuclear power plants, the effect of nuclear waste storage areas on the environment, the transportation of radioactive materials, the transfer of radionuclides within ecosystems, the restoration of sites contaminated by radionuclides will continue to be among the many live topics concerned with radioactivity. All these subjects, no doubt, will generate passionate debates among the general public, media, experts and responsible organisations. The respective behaviours of these parties when faced with technological and health risks are not always in phase and the differences will keep the debate alive. Generally, it seems, people are split into two groups: by far the largest group are those who consider that without any clear evidence of potential effects the protection limits adopted by the responsible organisations (United Nations Scientific Committee on the Effects of Atomic Radiation, UNSCEAR; International Commission on Radiation Protection, ICRP) are sufficiently low to warrant that the residual exposure levels are harmless. On the other hand, the smaller yet more vocal group state that any radiation is harmful whatever the level of exposure, and that exposures must therefore be reduced to the lowest possible level. It is obvious that the thing which would appease both groups would be to better understand the fundamentals and limits of radioprotection in living things and what really are the risks linked to radiology.

This illustrates the need to educate the general population to make them more familiar with radioactivity. Indeed the abstract character of the risks resulting from exposure to ionising radiation is one of the most tricky things to make people understand. Perhaps this highlights a lack of communication between experts and the general public to whom a message, quite often simplified and reassuring, is delivered. It is no good if its only result is to introduce doubt in the community. I think we may conclude that a comprehensive educational approach is necessary which includes not only schools but also the general population and particularly the media. Such an approach should clearly explain some fundamental notions in relation to risk management. These should aim to give an understanding of a dose-effect relationship, explain the threshold effect, the determinism effect, the stochastic effect, the cautionary principle and the ALARA (As Low As Reasonably Achievable) principle. Only when this educational background has been met will it be possible to institute relevant and open communication about a subject where science is not yet able to give the final answer about the potential consequences on health of the physical phenomena involved.