Workshop 1

“New pollutants, new diseases”

This workshop was chaired by Professor Henri Joyeux, cancer specialist at the University of Medicine of Montpellier. The secretaries were Claire Bernat and Patrick Weingertner of the Rhine-Meuse water agency.

The participants were :

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Doctor Marc SÉGUINOT, European Commission, Directorate General for Health and Consumer Protection (Luxembourg)

Professor Paul HUNTER, Public Health Laboratory, specialist in the microbiology risks of drinking water (Chester, United Kingdom)

Doctor Philip W. HARVEY, National Centre for Environmental Toxicology, specialist of endocrinal disruptors in water, Water Research Centre – WRC (London, United Kingdom)

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Professor Jean-Marie PELT, President of the European Ecology Institute

Opening

Professor Henri JOYEUX
University of Medicine of Montpellier, Cancer specialist

All of the participants here are simultaneously consumers, scientists and communicators. Every day, we consume food that is good or bad for us, and we need quality information to enable us to make choices. In this workshop, we will precisely attempt to throw some light on these choices. While there is no doubt that we will conclude with questions, questions are what make it possible to move forward in the field of science.

Ecosystems and food chains

Professor Annick DELELIS
University of Lille 2, Chairwoman of the Board of Directors of the Artois-Picardy water agency

I. The components of ecosystems

The first components of living ecosystems are plants, which are producers. Some of these are valuable bio-indicators, in that they are capable of accumulating pollutants and thereby providing a clue as to the impact of pollutants on human health. The first level of producers includes autotrophic producers, that is producers who can feed themselves and sustain their metabolism with light energy. They are followed by a chain of consumers that make up "food chains". Lastly, there are the decomposers, who play an essential role but only 10% of the interactions of which are known. These are particularly waste recyclers.

There are other mini ecosystems about which very little is known and which are called rhizospheres. These are living underground environments around the roots of plants. That is why many scientists are asking for moratoria in order to determine the effect of an element or its interactions, before starting a process that may well turn out to be irreversible. All the components of an ecosystem are dependent on the air, the soil in which they are present or the water in which they live. In these three elements, there is continuous interaction from the air to the soil and water, making water an element that plays a determining role.

That simple fact gives water agencies a key part in the work of preparing diagnostics or the interventions required for regulating that environment. Also, it must be noted that one compartment of the aquatic environment is unfortunately becoming extinct, namely wetlands, which can balance an ecosystem and supply very detailed information about the condition of the environment.

II. Food chains and interactions within ecosystems

A food chain can be represented in the form of a pyramid extending from producers to the end consumer, i.e. ultimately humans, who are the final receiver of the entire ecological chain. At any level of the pyramid, the requisite quantity of the biomass on the previous level is always greater than that produced at the higher level. In short, a large number of producers are required to feed a single human being.

Besides, we know that the concentration of elements that make up the food chain increases gradually as you go up that chain, through the bio-indicators that are capable of accumulating them. Consequently, the last level of the pyramid will have the maximum concentration level. At the same times, these "inputs" interact with each other throughout the food chain. Not very much is known about that part of the issue, which must be explored in order to gain a better understanding of the phenomena that occur within an ecosystem.

New approaches to water pollution

Béatrice GRAVE
Lecturer, Hydrology Laboratory, University of Lille 2

I. Introduction

Water is indispensable for all forms of life and civilisation and is the most common element in nature. Unfortunately, a degradation of the resource can be seen over time, which naturally leads to a large number of problems, particularly in terms of health.

II. Microbiological risks

1. Overview

Microbiological risks can be the result of bacteria, viruses or parasites. In recent times, the problem of the toxins secreted by some species of algae has also come to the fore. Biological risks are a major problem for bathing water and also for drinking water. Salmonella and Legionella are prominent among the bacteria that are pathogenic agents. In industrialised countries, microbiological risks are well under control, with the exception of some problems relating to Escherichia coli and chiefly Legionella.

2. Legionella

Legionella are bacteria that develop in natural sweet water. They thrive particularly in stagnant water at a high temperature, which is rich in magnesium and calcium. These habitat preferences explain why they do so well in hot water and air-conditioning systems. People mostly get exposed to Legionella through the inhalation of infected aerosols.

Legionella are responsible for a benign disease called Pontiac fever. But Legionnaires' disease is of greater concern, as it has a fatal outcome in 15 to 20% of the cases. There are some 600 cases in France of the disease every year. However, the figure is certainly underestimated. The Pasteur Institute puts forward the figure of 3000 to 4000 cases every year. While the number of deaths due to Legionnaires' disease is small, Legionella constitute a hazard that cannot be ignored, in view of the increasing use of air-conditioning systems.

3. Other bacteria and parasites

Parasitic diseases can also be caused by the presence of viruses and parasites. Among these, the major viruses that pose a problem in this country are Giardia and cryptosporidia. The latter create cryptosporidioses that lead to gastro-enteritis, which occurs fairly frequently in our country. The largest epidemic observed due to the consumption of treated water occurred in Milwaukee, affecting

close to 400,000 people. These parasites have the particularity of persisting in the environment by withstanding conventional treatment.

4. Algal toxins

a. Algal hepatotoxins

Besides, the increasing eutrophication of water has led to an increasingly worrying proliferation of algae, some species of which secrete toxins. The most common species of alga secrete Cyanobacteria, which can live in sweet water, stagnant water, waste water or coastal water. In the presence of some conditions that occur mainly in summer or autumn, the bacteria proliferate extensively by means of algal blooms that create hepatotoxins and neurotoxins in the most common cases.

Hepatotoxin blooms chiefly contain Microcystins and Nodularins. These toxins have different chemical structures but a very comparable biological effect. They inhibit some cellular proteins, including phosphates, which are indispensable for cell metabolism. Besides, they disorganise the cytoskeleton and the connections between cells. The targets are mainly liver cells, which undergo necrosis and haemorrhage, that can be fatal. There is also the risk of chronic toxicity. Indeed, it has been shown that there is a risk of tumour commotion and carcinogenic phenomena following an exposure to hepatotoxins.

Cylindrospermopsins are also hepatotoxins and are generally found in tropical or subtropical regions. But their geographical area has extended to some temperate zones. They were detected for the first time in France some four or five years ago, to the south of Paris. They inhibit the synthesis of cellular proteins. They also target liver cells, leading to gastro-enteritis and other forms of hepatitis, or even kidney disorders in some cases.

b. Algal neurotoxins

These neurotoxins are mainly anatoxins, which affect neurological mediators by having an impact on acetylcholine and acetylcholinesterase, which is an enzyme involved in conducting nerve influx. They result in the paralysis of the skeletal or respiratory muscles and can lead to respiratory stress or even death by asphyxia. Lastly, the neurotoxins may include aphantoxins, which inhibit sodium channels and lead to an effect that is very similar to that of anatoxins, blocking nerve influx and giving rise to paralysis. However, saxitoxins – a form of aphantoxins – are more dangerous in they have an effect at a lower dose than anatoxins.

c. Health risks

Algal toxins are endotoxins, that is toxins that can build up in algal cells. Exposure can therefore occur by ingesting the algae or by the release of the toxin in the water. Such release happens when the cell dies or after treatment to make the cells burst open. The toxins released in this way persist for a variable length of time in the environment. It has also been shown that some of the toxins can accumulate in living organisms such as fish or some shellfish. Contamination through food cannot therefore be ruled out completely, even though no case has been described in the literature. Over time, these toxins degrade naturally. But that time is sufficiently long for them to have effects, some of

which include allergies and acute or chronic poisoning. Allergies in particular are fairly frequent and result from direct contact with contaminated water.

The phenomenon was particularly observed in Australia, where water from a river used to produce drinking water was contaminated by Cyanobacteria. The most serious case of acute poisoning recorded in the literature relates to a haemodialysis centre in Brazil that used water containing Microcystins. Out of the 126 people that came in contact, 60 died following damage to the liver or nervous or cardiovascular systems. The survivors were kept under close monitoring to ascertain the risk of developing liver cancer. That is because an epidemiological study conducted in China seems to suggest that there is a correlation between the consumption of water rich in Cyanobacteria and the risk of developing liver cancer. The examples in the literature are very numerous. Following these observations, the WHO (World Health Organisation) has set a guidance value of 1 µg/litre, for Microcystin-LR, which is the most frequent and the most toxic.

III. Chemical risks

1. Overview

Chemical risks relating to water are the result of many molecules such as pesticides, hydrocarbons or detergents, to name but a few. Chemical risks generally act over a longer period than microbiological risks. In particular, they can be the result of the accumulation in living organisms of toxic compounds present in the environment. There is a large number of examples of chlorine molecules, and also examples of carcinogenic phenomena. These phenomena are fairly well known. But two concerns have emerged more recently, namely endocrine disruptors, which have been mentioned in some detail this morning, and also degradation products, which will be chief focus of my paper.

Among the molecules present in the environment, some persist whilst others are fully or partly degraded at varying speeds. The result is intermediate degradation products, which sometimes have a toxicity that is comparable or even greater than that of the parent molecule. These substances are also present during the water treatment process, which does entirely eliminate organic molecules from the water.

2. Pesticides

a. Diffuse and persistent pollution

France is the second largest consumer of pesticides in the world and has to face diffuse pollution. The French Environment Institute reports that almost all the surface water is polluted, as only 3% of the rivers are said to be completely pollution free. As regards underground water, the study is more reassuring since it finds that 75% of the underground water is free from any pollution. The molecules responsible for the contamination are chiefly herbicides, including triazines (and the (in)famous atrazine), phenyl urea and organochlorine molecules (particularly insecticides). These last molecules are now forbidden, but they persist in the environment and can therefore still be found in aquatic environments.

In France, the most frequently found molecules are atrazine and one of its metabolites, desethylated atrazine, which can be found in surface water and underground water alike. The molecule is even most present in underground water, because its solubility means it quickly enters the water table from the soil. However, the studies seem to have a deficiency, in that they only address parent molecules, which means that the presence of the metabolites of the molecules in the aquatic environment cannot be identified. But a study conducted in the USA on 88 municipal catchments to find traces of five pesticides has shown that these five molecules are present, as are their degradation products, the frequency of detection of which is greater than that of the parent molecules. That fact is confirmed by the observation of the quantities of the two types of molecules present in the samples.

b. Atrazine

Atrazine, which is now only used for some crops such as maize, was used widely in our fields till a recent authoritarian measure. Atrazine is soluble in water and can be found in some surface water, at a concentration of several tens of µg/litre in the worst cases. The standard sets the maximum concentration of the molecule at 0.1µg/litre per pesticide. The International Cancer Research Centre has classified atrazine among the group of molecules suspected to be carcinogenic for humans. However, it was moved in 1999 to group 3, which includes molecules for which the carcinogenic nature cannot be established as a result of the insufficient number of studies completed or because of their conflicting nature. Besides, it has been shown that atrazine disrupts the endocrine system. That is why it has been classified among the 11 hazardous molecules that are now being studied on a priority basis.

c. 4-nonylphenol

Lastly, 4-nonylphenol is a compound used by the plastics industry, particularly as a softener, mould stripping agent and antioxidant. It also results from the degradation of some detergents present in washing agents. Because it is highly stable, traces of the compound are frequently found in watercourses. What is more, it can accumulate in food chains. Its presence was also found in water treatment plant sludge. As for its toxicity, 4-nonylphenol acts as an endocrine disruptor at doses that are equal to greater than 1 µg/litre. It has also been found that it can feminise some species of fish, both in respect of the parent molecules and the metabolites. This compound has also been classified by the European Union among the 11 hazardous molecules that are to be studied on a priority basis.

IV. Conclusion

Microbiological risks are particularly alarming because of the problems – as yet unsolved – posed by Legionella and Cryptosporidia. The phenomenon of algal toxins is just as disturbing, because of the identification of hepatotoxic blooms in several countries. Besides, other toxins that are as yet unidentified will certainly have to be added to those that are known to date.

As regards chemical risks, the carcinogenic effects are an obvious hazard for human health. But the hazard of endocrine disruptors must also be studied with care, the more so since the molecules that can lead to such disruption are many and that disruption results not only from parent molecules but also from the products of degradation. However, all the degradation products have not been identified, and much is still to be learnt about the toxicity of parent molecules, as a result of their very large number.

That is not all, as a pollutant is never isolated in the environment. There are many interactions between different pollutants, which make the studies of the subject that much more complex.

Professor Henri Joyeux

I would like to add a touch of optimism here, by reminding you that science has helped us make considerable progress in the field of health. Chlorination of water has eradicated typhoid. Also, household appliances have led to a dramatic fall in the rate of stomach cancers. For instance, when I joined the Cancer Centre in Montpellier in 1970, we used to operate one or two patients with stomach cancer every day. Today, we only have one such operation per month. Cold storage thanks to household appliances means that the transformation of nitrates present in food into nitrites can now be prevented.

Evaluation of the chemical and microbiological risk

Professor Philippe HARTEMANN
University of Medicine of Nancy

I. Introduction

I represent the authorities in charge of evaluating and limiting the risks, that is the effect the hazards presented are like to have on public health.

II. Chemical risks

The 19th century was the century of chemistry, including that of risk evaluation and standardisation in the field of health. The barriers that have been put in place already offer a certain level of safety. That is what I am going to attempt to describe.

1. Determinist effects

The substances said to produce determinist effects are those that lead to effects that are not pathological as such, but can create disorders if a certain dose is reached. The seriousness of the disorder depends on the dose, in a dose and effect relationship. For these substances, it has been decided on an international level that the risk must be eliminated. Exposure scenarios were made on that basis, including water as a possible element of contamination, by trying to estimate the part of that element in the entire risk. Safety margins, which are conventional in toxicology, are still to be defined.

After that, a maximum concentration level in water will be inferred for that element, so as to fully eliminate the risk of contamination in the conventional exposure scenarios. If that system of action is now clearly defined and under control, it may happen that scientific knowledge is not available. That is so, for instance, when new substances emerge or when it happens that the safety margins must be reviewed in order to reduce the risk further.

2. Stochastic effects

The substances that produce stochastic effects do not lead to a disorder by themselves, and the disorder can be found in unexposed subjects. These substances lead to late effects (cancers, abnormalities etc.) and the risk cannot be eliminated completely. For instance, it is known that each of us has a 50-50 chance of developing cancer and there is no way cancer can be eradicated in the short term. Conventional exposure scenarios are therefore defined here as well. Limits are set for the substances in order to make the risk acceptable to those individuals who will be exposed. For these substances, the WHO estimates that the acceptable level of risk is of 1 for 100,000 inhabitants. Within the European Union it has been established that the acceptability limit must be pushed down further to 1 for 1 million consumers.

On that basis, exposure scenarios are fixed with limit values that reflect the level of risk. The figures are conservative, mainly because the reasoning is isolated for each substance, with limited knowledge of the interaction between different substances. Now if the effects of different substances can sometimes add to each other, which hypothesis cannot be ruled out, the limit of acceptability for each molecule must be set very low for each of them. At that risk level, the effect of a substance can obviously not be identified. Special protection systems must therefore be put in place as part of a public health monitoring approach.

III. Microbiological risk

1. Historical note

If the 19th century was the century of chemistry, the 20th century was that of the negligence of the microbiological risk, and one can only hope that microbiological risks will be back on the agenda in the new century. In the UK, Mr Snow, who was knighted subsequently, was the first to demonstrate the role of faecal contamination, which led to the setting up of preventive measures to protect water, even before the discovery of micro-organisms by Corpand Pasteur in particular. That discovery made it possible to validate the role of faecal contamination. In around 1870, these scientists created the idea of a faecal contamination indicator, which would show the probability of finding pathogens in an element of life. All hygiene was then based on that indicator of faecal contamination, with remarkable success.

2. Current issues

But in industrialised countries, we have reached the limits of the effectiveness of the system, as it does not give any indication of current waterborne infectious diseases. Admittedly, the risk relating to water has been reduced considerably in relation to what it was in earlier centuries, but it continues to exist. Besides, the law has given up the faecal contamination indicator altogether, and replaced it by “test germs”, which act as the basis on which engineers have developed treatment to eliminate the said germs.

In future, we must go back to the idea of evaluation of the microbiological risk, which is taking new forms, for instance with the Legionella mentioned before. Besides, the receptive population has changed over the generations, particularly as a result of a gradual drop in immunoprevalence and seroprevalence. Above all, we have to face new hazards today, a good example of which are BSE prions. Extensive work is under way to ascertain if they can be transmitted by water. Lastly, the role of infectious agents in diseases that were thus far not believed to be infectious has also been shown, which throws the established body of knowledge into doubt. That is so, for instance, with stomach ulcers. As a result of all these findings, water is now believed to play a significant role in the transmission of diseases, some of which are serious.

One of the difficulties is due to the greater resistance of some bacteria and parasites. For example, if you test the chlorine resistance of bacteria, viruses and protozoan organisms using the conventional parameter of the product of the concentration and the time required to eliminate 99% of the test population, it appears that whereas the chlorine dose required is 1 µg/litre for bacteria, it is 10 µg/litre for viruses and 100 µg/litre for protozoan organisms. Consequently, taking disinfecting measures in some water is more of a cosmetic operation than a useful public health measure.

Likewise, in respect of the immunoprevalence of populations, we have always reasoned in terms of the minimum infecting dose for healthy populations. Today, we must think in terms of the minimum infecting dose for the most sensitive 1% of the population.

3. The limits of regulation

Given the challenges ahead, the legislation must be adapted. The Higher Public Health Committee in France is a staunch opponent of the alleged virtues of disinfecting measures to change waste water into bathing water, and refuses to classify areas irrigated with waste water as bathing areas. That decision is based on the finding mentioned earlier – while it can be established that bathing water is of very good quality in terms of faecal contamination indicators, that does not say anything about the presence or otherwise of other microbial or bacterial pathogens. This position of the authorities in France is not shared by all others on the international level.

An epidemiological study was conducted with Denis Zmirou to compare gastro-enteritis in volunteer populations in communities where the water is not treated and always compliant with faecal contamination indicators. It appeared that when water is not treated and the conformity indicators are less satisfactory, the frequency of gastro-enteritis is higher. But more surprisingly, it was found that in communities in which disinfecting treatment has been put in place, the rate of gastro-enteritis is identical to that in those with no treatment. It may therefore happen that water that meets conventional criteria contains micro-organisms that have an effect on the population.

IV. Conclusion

The French position in relation to future regulations, which will be prepared to apply the European directive, will most probably consist in requiring all those who distribute water to test the hazards and evaluate microbiological risks and put in place the necessary preventive measures. In other words, the aim will be to require not only the implementation of best efforts but also the delivery of results, within a risk evaluation approach.

Professor Henri Joyeux
Thank you very much for your account. I would like to add that our body is made up of billions of cells that make up our weight. But we also contain billions of germs in our digestive system, that do not even weigh a gram. They are in a state of balance. That is why we do not fall sick, unless if our immune system is deficient.

New infectious risks and drinking water

Professor Paul HUNTER
Laboratory of Public Health, specialist of the microbiological risk in drinking water (Chester, United Kingdom)

I. Introduction

As mentioned before, water is a resource that is indispensable for life and civilisation. Unfortunately, only 20% of the world population currently has access to clean drinking water. The World Health Organisation estimates that a child dies every eight seconds from a water-related disease. But waterborne diseases also affect the richer countries. One of the specific problems we have to face is that of the strong emergence of infectious diseases related to drinking water. In the last thirty years, a number of water-related bacteria have been associated with drinking water.

II. The factors for the emergence of new waterborne pathogens

1. Microbial evolution

Pathogens are evolving continuously and developing the capacity to become waterborne.

2. Technological changes

Technological changes, including new laboratory diagnostic methods, can explain the fact that new forms of pathogens are identified. But these can also be related to our environment, as can be seen by the example of Legionnaires' disease, which is linked to air-conditioning systems.

3. Ecological changes

Ecological changes, particularly through the construction of dams and the destruction of forests, which play a part in protecting mankind and maintaining the balance between resources.

4. Human behaviour

People travel more, particularly to tropical countries, where they are exposed to waterborne diseases that they bring back to their home country. Likewise, the increase in the world population puts great pressure on the water resources.

5. Failure of public health systems

Lastly, the breakdown of public health systems is still a risk, as was seen in the former Soviet Union, where typhoid has reappeared in some regions.

III. New waterborne diseases

Among the new waterborne infections, two agents seem particularly active and their role has become clearer in recent years.

1. E. Coli 0157

E. Coli 0157 can give rise to severe diarrhoea with a high fatality rate, and severe kidney disorders in children. This infectious agent has only given rise to one epidemic in the United Kingdom, where it was related to one small private source of water. More recently however, a much larger epidemic affected some 1300 people in Canada, 65 of which were admitted to hospital, with six deaths. The agent E. Coli 0157 is therefore a major risk in non-chlorinated water. Other pathogen agents are known today, such as that of gastritis, which is a major factor in the development of ulcers and gastric cancers.

2. Cryptosporidioses

On the other hand, the link between Cryptosporidiosis and drinking water seems less certain. An epidemic was reported in Lyon, but even though the authors of a study on the subject have claimed that the epidemic was a waterborne epidemic, the evidence is still to be found. One of the varieties of Cryptosporidiosis, which takes the form of a small protozoan, can lead to diarrhoea after an incubation period of about 7 – 10 days. The disease can last for 2 – 26 days and is associated with well-identified abdominal pain. To date, there is no treatment for the disease. Most of the cases were diagnosed in children below five. Contamination can occur by person-to-person contact, in crèches or in hospitals, through contact with animals or by consuming contaminated drinking water, particularly when it is not filtered.

But the main cause for concern with Cryptosporidiosis is related to the serious diseases they can cause in patients with AIDS. 8% of AIDS patients contaminated with Cryptosporidiosis die rapidly of a fatal form of the disease, whilst 60% of them develop a form of chronic diarrhoea that can also have a fatal outcome. The main risk factors for AIDS patients are a low rate of TC-4, hospitalisation or sexual activity, the more so with multiple partners and in the case of oral or anal contact.

In the UK, some 4500 cases of Cryptosporidiosis are reported every year. In the 90s, Cryptosporidiosis was responsible for some 26 waterborne epidemics. But a major question is raised by the great differences that can be found between the countries of the European Union in respect of the presence and number of waterborne diseases.

One explanation lies is the monitoring systems in place, which mean that many countries in the European Union are unable to detect the appearance of possible waterborne diseases. The French epidemiologist Denis Zmirou, has recently published an article showing that thanks to monitoring, an abnormally high rate of gastro-enteritis was found in some French villages in which the water shows nonconforming faecal contamination indicators prior to treatment. Another reason could be the fact that developed countries remain very dependent on risks in terms of the supply of drinking water. There is no doubt that the stupidity of men and the ingeniousness of micro-organisms will continue to create new threats for our water supply.

Dr Marc SÉGUINOT
European Commission, Directorate General for Health and Consumer Protection (Luxembourg)

I. Introduction

This meeting is in my opinion an important initiative, in that it shows that health and environment issues are occupying an ever higher position on the agenda. This conference does not just bring together a large gathering of health specialists to discuss problems we all have to face. It also provides a unique opportunity to reinforce the relations between the European Commission and the health and environment organisations in the member states. I would also like to congratulate you for your insistence on the relevance of the international dimension throughout this conference.

Today more than ever, health and the improvement of the environment must be approached in an international context. As we all know, transmissible diseases, food infections and the effects of pollution on health do not stop at national boundaries. The protection of public health from these threats therefore requires cooperation on an international scale.

II. The action of the European Community in respect of health

1. The competencies of the Community in terms of health

Only with the treaty of Maastricht in 1993 did the Community take on special competencies in the field of public health. Article 152 of the Amsterdam treaty extends its field of action further by providing that Community action in the field shall relate to the improvement of public health, the prevention of disease, human infections and the reasons for danger to human health. This is undisputedly a very wide mission, covering practically all health issues. The Treaty also emphasises the essential role to be played by each member state. That is because while pursuing the above objectives, Community action must fully respect the responsibilities of member states in terms of the organisation and provision of medical services and health care.

2. The first programmes implemented

The earliest public health programmes were prepared on the basis of the Treaty of 1993. They addressed a certain number of specific health problems and diseases such as cancer, AIDS, transmissible diseases, pollution-related diseases, rare diseases, accidents and injuries. In addition, they integrated two large transverse subjects – the promotion and monitoring of health. Following the coming into force of the new Treaty, which extended the competence of the Community in the field of public health, the Commission decided that the time had come to develop a new and more complete approach. The initiative was necessary to be able to effectively take on the challenges which we have to face.

3. New challenges

The upcoming extension of the Community is one of the challenges, as it would mean that the Community must taken on board the health and environment situation of the candidate countries, which is very different from ours. In general the health and environment standards of these countries are below those applicable in the European Union and they can only allocate limited resources to the field of health.

Another major challenge relates to the concerns and expectations of the people, both nationally and on the Community level. European citizens are concerned, and rightly so, about the way in which their health is being protected. The fears are exacerbated by the various problems that have surfaced in recent years in the fields of food and environmental safety.

Given the issues at stake, a wide debate was initiated in 1998 about the future policy of the Community in the field of public health, leading to a wide consensus. In May 2000, the European Commission adopted a proposal relating to the future policy of the Community, on the basis of that consensus. The measures presented by the Commission chiefly included two components.

III. Proposed new public health programme

The new public health programme will be spread over six years, with a budget of € 300 million. It will focus on three main points.

1. The improvement of health information

The aim is to implement a complete information system intended for the public, health professionals and the relevant governmental agencies. The system will offer reliable updated information about health and environment issues, accompanied by links to national websites. The statistical relay of the information system will be developed as part of the community statistics programmes.

The information system created in this way will have a very wide scope, with data relating to the trends of the health of the population, which can be analysed on the basis of the major categories of the population, and data on the factors affecting health. It will also propose data and analyses of health systems, for instance on the use of resources, and the effectiveness of specific interventions.

2. Intervention capacity

A rapid reaction organisation shall be set up, combining effective monitoring mechanisms and the capacity to take quick action to identify and evaluate the risks and take the measures required. The aim is to ensure that the Community has the means to take effective action against the serious threats relating to transmissible diseases and other health risks. These monitoring systems will be developed on the basis of what exists already for transmissible diseases, i.e. a European network of epidemiological monitoring and control, with the aim of the collecting data from the national monitoring networks. The network, which has already proven its effectiveness and considerably improved the cooperation between member states, must be extended to other diseases and particularly environmental diseases.

3. In-depth action to improve the health of citizens

Lastly, the programme will endeavour to influence the determining factors of health, that is the fundamental factors that affect health, with the objective of reducing the number of premature deaths and the frequency of conditions such as cancer, cardiovascular disease and respiratory diseases across Europe. The programme will also take on economic and environmental factors of the diseases. The aim will be to set up mechanisms designed to improve the effectiveness of health interventions by supplying the competent governments, the professionals and the public with information about broad trends in the Union with support from innovating projects, by evaluating new technologies and defining guidelines for good practices.

This proposed programme must receive the joint approval of the European Parliament and the Council, expected by the end of the year. The new public health programme could therefore come into force by 2002.

IV. Communication about the overall strategy of the Community in the field of health

For the first time, the Commission has defined an overall approach to health, incorporating the various community policies. The aim is to ensure that the impact of our public health programme is reinforced by a policy and action in other fields. That means that the work done, say in the fields of the interior market, social affairs, research or environment, must actively promote health and help improve it.

To that end, in 2001, each action proposed by the Commission will take account of health requirements and clearly indicate the impact of the proposal on health. Besides, the coordination mechanisms within the Commission will be reinforced. Lastly, the new public health programme will emphasise the evaluation of the impact of community policies on health, in all member states. With that in mind, one of the priorities will be to prepare and improve the methods and criteria to gain a better evaluation of the impact.

The final part of the proposal concerns the setting up of a new authority, namely the European Health Forum. The Commission is aware of the demand from all quarters for the development of Community policies that are more open, more transparent and more sensitive to the needs of citizens. The new forum, which will be an advisory mechanism, will contribute to responding to these demands. It will bring together public health representatives, volunteer organisations, health professionals, academics and associations of patients to explain the objectives of the Community strategy and discuss health issues and the priorities of the Community.

In that way, all the stakeholders will have the opportunity to make their contribution to the Community health policy. The details of the working, organisation and composition of the forum are still to be finalised. The Commission will soon initiate a consultation on the subject and we hope that you will give your opinion on these issues.

The strategy proposed by the Community in the field of health is very ambitious, because the challenges before the European Community are large and complex. But I hope that by making the

ideal materialise, we will be able to not only give you concrete assistance in your daily work, but also make a true contribution to the improvement of the health of the people of Europe.

Professor Henri Joyeux

My experience and seniority enable me to say that we must hope that these wishes will materialise, unlike what has often been seen in the past. But the youth of our contributor makes us hope that one day, these wishes will become a reality. In any case, we will work along with you to help you implement this programme and take it forward in a spirit of complete openness.

Discussion

Sophie DUMERY, Impact Médecin magazine

Ms Grave, you say that algal toxicity can persist for a long time in water. What is the duration of such persistence?

Beatrice GRAVE

The persistence in the environment varies depending on the toxins. Studies have shown that the most frequent hepatotoxins, namely Microcystins, can persist in the environment for several weeks, sometimes even six months after the algal bloom. But these values are not known for all toxins.

Céline LLORET, France Nature Environnement

Ms Grave, you told us that Cylindrospermopsins were found recently in France. How can a toxic alga have entered our country? Can climate change have anything to do with that emergence?

Béatrice GRAVE

The exact reason for the appearance of the alga is still unclear. It was first detected some four or five years ago. Then it was found once again three years ago. It is true that some climate changes that tend to increase the temperature of the environment could be favourable to the development of such algae. But in view of the proportion in which they occur, it is difficult to put forward the hypothesis that climate changes make any real contribution to the development of the algae.

Professor Henri JOYEUX

Are these toxins destroyed when heated, for instance when you cook fish?

Beatrice GRAVE

Some toxins are degraded when heated. But very little is known about the exact conditions of the change, specially since many toxins are totally ignored by such research, because there are so many of them.

Professor Henri JOYEUX

I might have an answer to that: if the food is cooked in a microwave oven, it would not be cooked evenly and it is therefore probable that the toxic substances remain at the centre. Steam cooking on the other hand is more even, and the toxic substances would probably be completely destroyed. It is important to know these cooking factors. In general, it may be said that toxic elements can appear if

the temperature exceeds 250 degrees, while toxic products in the food are not destroyed if the cooking temperature is less than 95 degrees.

Member of the audience

What about the standards for lead in citrus fruit juice for infants? Also, recent articles in agricultural publications have mentioned the risk of nitrates for human health. Could you tell us something more about it?

Professor Philippe HARTEMANN

As regards standards for lead, it must be noted that the regulations relating to water and those relating to consumer products are not the same. It is true that lead standards are lower for water. These differences are based on the exposure scenarios that are used while defining the values.

Professor Henri JOYEUX

As regards nitrates, we tend to forget that our digestive system generates nitrates in our body and that this is good for our organism. About half the nitrates in our body are made by the digestive system, and the other half are taken in with food. We need both of them. The hazard only exists if there is any excess.

But the nitrates themselves are not hazardous. The problem is the transformation of nitrates into nitrites. The intake of excessively high quantities of nitrates can be countered by consuming food that is rich in vitamin C, which slows down the transformation of nitrates into nitrites thanks to its oxidising role. But it is obvious that consuming food with a high vitamin C content does not mean that you can take in excessively high quantities of nitrates.

Professor Philippe HARTEMANN

I would like to add that the European Commission has decided to completely review its position on nitrates. The work done in the field of toxicology is therefore currently being summarised. It would appear that nitrates could in principle also act as indicators of the other chemicals that are discharged into water along with nitrates.

Bruno de BUZONNIERE, Vivendi Environnement

Is the Higher Public Health Council in France going to take a specific position on the issue of BSE prions following the work in France and Europe? Is the evaluation phase completed and what would be the next stages of the issue?

Professor Philippe HARTEMANN

I am not entitled to say anything on behalf of the French Higher Public Health Council. However, I can tell you that the scientific evaluation phase is in progress. Bu the risk is not easy to evaluate when you know neither the hazard nor the exposure scenarios.

Two attitudes are possible: either you apply the precautionary principle and try to achieve zero risk, which we are very anxious to avoid in view of its consequences, considering that the risk is not at all certain, or you apply a preventive approach, as we have been doing up till now.

Daniel DIETMANN, Chairman of the Joint Committee for the development of the Largue (Upper Rhine department)

A controversy has raged for some time about the toxicity of atrazine. In the meantime, atrazine has been continued to be used in our fields. Also, it turns out that this substance persists for a very long period of time, which may reach several years or several dozens of years.

And now we hear that atrazine is an endocrine disruptor to top it all. What more do we need to ban the substance altogether?

Doctor Marc SÉGUINOT

Endocrine disruptors are being studied by the European authorities and will lead to directives in the years to come, depending on their impact on human health. A legislative framework is being prepared on the European level to address the issue. But it will probably not be ready before about 2004.

Professor Philippe HARTEMANN

The question of banning substances is not easy, because a ban always means replacing one substance with another. Now, that sometimes means replacing a substance that is known and can be monitored by one that is not known and therefore cannot be monitored easily. Bans do not always provide binary solutions and one might believe.

Bérengère CHAMBON, Chairwoman of Gers Action Ecologie

What you say is far from reassuring. I live in Southern France, where there is a ban on drinking the "drinking" water for several years, because of atrazine. From what you say, there is no chance of a solution.

Beatrice GRAVE

The problem with atrazine, as with other pollutants, is that the substance is now present in the subsoil and it is very difficult to clean up underground water. Cleaning up is slightly easier for surface water.

In the short term, the only solution would be to use another source of water. But because the limit has been exceeded in the resources, those who make water fit for drinking are having great trouble eliminating the product sufficiently well, even with the most efficient techniques.

Professor Philippe HARTEMANN

I would like to add that the maximum limit of 0.1 µg/litre for atrazine was set by the authorities at a time when there were no sound scientific bases for determining the value. Today, the limit seems irrelevant.

The application of such limits leads to the closing of water resources because of very low values. Sometimes, that makes people rush out to get bottled water, which can sometimes contain even more of the offending products, because they are not subject to the same regulation.

Claude BERTSCH, Economic and Social Council of Lorraine

The life of these manmade substances in the environment seems very long. Is it ten years or several dozens of years? Does that not mean that we must impose a complete ban on these manmade substances which cannot be biodegraded and replace them with biodegradable substances even though these might be not as effective?

Professor Philippe HARTEMANN

The answer is not easy. That would depend on the substance. I often tell my young colleague that science only pushes back the limits of infinite ignorance. But the life expectancy in our countries has been increasing continuously. That is why we must take care not to frighten the people excessively. We are making continuous progress, even though we do not have all the answers.

Gérard BORVON, Loire-Brittany basin community

In Brittany, particularly in Finistère, at the end of winter, fields are covered with phosphates and biophosphates. These and their derivatives end up in great concentrations in rivers. Have these biophosphates been studied at all?

Professor Philippe HARTEMANN

I am afraid I have no answer to that question.

Professor Jean-Marie PELT

I would like to remind you that the success of biophosphates in the USA was derived from the biodegradability of the product. But after a trial in that country, Monsanto had to cease to use the claim in the USA. However, the claim is still made in other countries, though not in France. In this country, the word biodegradable has been replaced by the word “smart”!

The life of the substance is short, lasting a few weeks. But very little is known about the metabolites of biophosphates, because of the secret surrounding these molecules developed by industry.

Endocrine disruptors in water

Doctor Philip W. HARVEY
National Centre for Environmental Toxicology, specialist of endocrine disruptors in water, Water Research Council (London, UK)

In 1997 in Brussels, endocrine disruptors were defined as exogenous substances that lead to side effects on the health of an intact organism or its progeny as a result of changes in the endocrine function.

I. The endocrine system and effects on humans

1. Endocrine system

The endocrine system is made up of glands that release hormones into the body, which are vital for reproduction and health. For example, the thyroid gland is responsible for metabolism and the consumption of oxygen. The pituitary gland located near the brain controls the endocrine system, the thyroid and the gonads (ovaries and reproductive system in men). The endocrine system is not limited to oestrogen, contrary to what was believed earlier.

Several mechanisms can disrupt the endocrine system, particularly by modifying the hormonal metabolism, and enzymes and steroidogens can be influenced and inhibited. Further, the functioning of the gland can also be modified. But the most important mechanism for chemical exposure to the environment is the interaction between hormonal receptors and several oestrogen-like chemicals.

2. The effects on man

For several years now, malformations and breast and testicle cancers are being observed, as are problems relating to the masculine reproductive system, with a lower sperm quality.

The effect of chemicals that disrupt the endocrine system and affect human beings and diseases was suggested, without any evidence. These chemicals can have properties other than oestrogenicity, such as anti-oestrogen, anti-androgen and anti-thyroid effects. Laboratory testing has identified an increased number of chemicals with a wider range of effects.

3. The chemicals

There is a range of products relating to endocrine disruption. They include pesticides, industrial chemical effluent, PVC, phthalates_xe "phthalates"_, natural plant oestrogen and hormones secreted by livestock, the largest contributor being the residues of female contraceptive pills.

4. Examples of oestrogen compounds

Industrial chemicals include the following compounds – polychlorinated biphenyl, APE, bisphenol A, phthalate, which have two modes of action because some are oestrogenic whilst others are anti-androgen and are therefore enzyme inhibitors. Pesticides include trazine, endosulphane, idane and DTT.

These pseudo oestrogens are often chlorinated phenol compounds. It was believed earlier that pesticides had no effect other than as anti-androgens or inhibitors. Glyphosate inhibits stAR protein, which regulates the transfer of cholesterol from the outer to the inner mitochondrial membrane. These are followed by phthalate, which can be oestrogenic and anti-androgenic in PVC pipes, and also disinfecting by-products such as haloacetate and dibromoacetate, which can affect the hormones and ovaries.

5. Chemicals in water

The first evidence of the effects of these disrupting chemicals is eco-toxicological. In the United Kingdom, male fish that live downstream from waste water treatment plants produce an abnormal rate of female hormones. These effects are more due to the presence of oestrogen in the water rather than to pesticides and industrial discharge. The oestrogenic effects observed in fish have led the WRC to conduct a study to establish that several substances reduce the level of oestrogen in the water samples studied. We must continue to work in that direction to determine the impact of the chemical contaminants on the human health.

The link between the endocrine disrupting chemicals and health recently led to a study of Porto-Rican children with premature breast grown at twenty-three months. The study showed that these children had very high levels of phthalate in their blood, which should not have been there. That breast development has increased in recent years, showing that the substance comes from the PVC used in food packaging. However, we must also take account of the presence of pesticides in the area of the study and soybean infant feed. That is why tests are currently under way.

Most human data show a correlation between the effect on health and exposure to a chemical.

Scientists are in agreement about the fact that endocrine disruptors affect wildlife. That is why it is necessary to conduct more research to identify all the chemicals, their weight, limits and targets. The environment and human exposure must also be monitored on the basis of the development of foetuses and embryos, which are the most sensitive to endocrine disruptors.

Chemical and radiological toxicology of the inorganic constituents of water intended for human consumption

Doctor Florence MÉNÉTRIER
Atomic Energy Commission (CEA), Laboratory of radiological toxicology, Life Sciences Unit

I. Introduction

The aim of scientific research is to characterise and evaluate risks by means of experiments. The results are designed to guide those who are responsible for managing risks and preparing the regulations. Two broad lines of study are addressed at the Life Sciences Unit of the Atomic Energy Commission:

? radiological biology, which is focused on the effect of radiation on life at the molecular, cell, tissue levels and on the entire organism, and the study of the interactions with other types of stress such as thermal or chemical stress;

? nuclear toxicology, which addresses biological behaviour and chemical and radiological toxicity of the chemical elements used in nuclear research and industry (including uranium, cobalt, selenium, cadmium and caesium).

Risk evaluation involves answering these questions. First of all, you must identify the hazards, in this case the chemical elements that have an effect on health. The second stage involves evaluating the dose-response relationship in order to quantify the probability of producing effects on human health. At the same time, it is important to determine the variations in the concentration of the elements studied that are naturally present in water.

II. The factors to be taken into consideration while evaluating the toxicity of inorganic constituents in drinking water

If we consider water to be a source of exposure, we must take account of the major elements present in water (e.g. calcium and potassium) and elements that are present in trace form such as selenium, arsenic, lead and uranium. But each element can show wide variations in concentration depending on the geographical region. That is particularly true of uranium. Besides, some elements such as selenium are essential to the organism in variable quantities, and the margin is very narrow between the optimum intake and the toxicity limit.

The evaluation of the toxicity of a constituent that may be present in drinking water starts by examining its specific properties. The possibilities of exposure must also be taken into account. Exposure may occur by ingestion, but also by skin contact in some cases. The conditions in which the study is performed must also be considered – acute studies with single administration can lead to

results that are different from those of chronic administration over a longer period. The administered quantity can quite clearly play a role in the side effects that may be observed.

Besides, the physiological and pathological status must be taken into account – the risk of toxicity can vary if the element is administered to an infant, for a given quantity. The nutritional status also has an effect on the absorbed quantities, which are for instance much greater if the subject ingests the food on an empty stomach. Pregnancy is another very particular condition.

The chemical form of the compound can also have its effects – for example, the methylated form of mercury does not have the same toxicity as its inorganic form. Chromium offers another interesting example, because depending on the degree of oxidation at which it is studied, the toxicity varies. Toxicity is certain by inhalation if the chromium is oxidised to the 6^{th} degree. It is also classified as a carcinogen for humans by the international cancer research centre. When oxidised to the 3^{rd} degree, on the other hand, it is not toxic by inhalation and is not included in group 3 of substances classified by the same research centre.

If administered orally, the absorption takes place chiefly in the intestines, before the compound is distributed to soft tissues (liver, heart, lungs) by the blood or to the bones. Part of it will be eliminated by the kidneys.

III. Evaluation of the dose-response relationship

1. Chemical toxicity

As Professor Hartemann has told us, there are two types of effect – non genotoxic effects, where a harmfulness limit is to be found and genotoxic effects, which are of the stochastic type. However, it must be noted that the harmful effect will be different depending on the chemical involved. When a study covers several animal species at the same time, the species most sensitive to the toxicity of the element is used as the reference. For genotoxic effects, there is a probability regardless of the level of exposure.

In that case, the method consists in using a mathematical model to calculate the dose associated with an acceptable risk. For arsenic, recent observations have shown that skin cancer can be attributed to a high arsenic content in the drinking water. A dose calculation has led to the fixing of 0.2 µg/litre as the value for an additional risk of 10-5, i.e. one additional cancer for 100,000 people. But in toxicology, it is not always possible to be supported by sufficiently long studies. That is why extrapolation is often required.

2. Radiological toxicity

As with chemical toxicity, radiological toxicity has “threshold” effects and effects for which no threshold has been shown. The former, called “determinist effects” appear early and their seriousness increases in proportion with the exposure dose. For their part, stochastic effects such as cancer appear late. A hypothesis of linearity has therefore been selected, associated with heightened probability as the dose increases.

In the field of stochastic radiological risks, the International Radiological Protection Commission (IRPC) has calculated the risk of cancer for all radionuclides, estimated in Sievert units as follows: exposure to 1 Sievert (Sv) increases the risk of fatal cancer by 5%. Currently in France, the standard set under the revised regulations following the publication of European Directive 96-29 provides the exposure limit of the public by natural or medical exposure to 1mSv/year, on the basis of the recommendations of the IRPC.

As regards the radiological toxicity of natural uranium, the WHO intends to set a reference dose of 0.1 mSv/year, associated with the consumption of drinking water. That would be equivalent to a maximum natural uranium (with three isotopes, 234, 235 and 238) concentration of 114 µg/litre, for adults consuming two litres of water per day. But with isotope 238 alone, the reference concentration would be higher, inasmuch as the specific activity of this isotope is less than that of natural uranium.

While natural uranium is often mentioned as a very dangerous element from the radiological standpoint, it was first known in the late 19th century as a toxic chemical. Studies conducted in Germany had particularly shown that when it is injected in chemical form, it could lead to death, whilst it was much less hazardous when administered chronically. For several decades, studies were performed to determine the toxicity limit. Only recently, the WHO defined a minimum renal injury dose following uranium intake in water, on the basis of a study conducted over a ninety-day period. After extrapolation, the WHO has recommended a temporary guideline value of 2 µg/litre for humans for that element. Note that the guideline value for mercury is 1µg/litre, whereas those for arsenic and lead are 10 µg/litre.

IV. Conclusion

The toxicity of inorganic elements present in drinking water is the result of their chemical or radiological toxicity, which do not exclude each other. For natural uranium, we saw earlier that the limit evaluated on the basis of its chemical toxicity is much lower that that evaluated on the basis of its radiological toxicity, contrary to popular belief. However, the recommended guidance value is 2 µg/litre, whilst the natural uranium content in some regions before treatment can be as high as several dozens or even hundreds of micrograms (µg) per litre.

Monitoring of waterborne infectious diseases by the French Public Health Monitoring Institute

Pascal BEAUDEAU
French Public Health Monitoring Institute (INVS), epidemiologist

I. Introduction

The Public Health Monitoring Institute was founded in 1999. It has replaced the national public health network, with extended tasks. It is responsible for monitoring the condition of the health of the population. I work in the Health and Environment department, which is responsible for monitoring environment-related health problems in the population.

The fact that the monitoring programme is limited to infectious diseases may seem odd. That is so because our action is based on risk and not on hazards. For any given disease, we consider all the risk factors that could favour the expression of that disease. For instance, exposure to pesticides largely occurs through food and not through water.

As part of that approach, we believe that water is an indicator of general environment contamination. However, it is not be the best angle of attack when it comes to characterising the exposure of the population. On the other hand, in respect of infectious diseases, we find that it is useful to address waterborne diseases because of risk management reasons. When the treatment of water is modified to reduce the presence of one pathogen, that necessarily has an effect on the other pathogens that may be present.

However, if the reasoning is valid for filtered water, it does not apply to disinfecting processes. As has been emphasised earlier, chlorination is not very effective against viruses and is quite ineffective when it comes to parasites.

II. THE HEALTH BACKGROUND

1. Recent awareness of the population

Waterborne diseases continue to pose major problems in the Third World. In developed countries, the approach to these problems has changed noticeably in the last ten or fifteen years. A key factor for that change was the Milwaukee accident and its tragic consequences. The event heightened the awareness by showing that such a disaster could occur in a major city (population two million) with a water supply that meets applicable standards. That was what happened when the population was exposed to Cryptosporidia.

2. Development of populations at risk

The other major phenomenon in the recent developments in health issues in developed countries is the increase in populations at risk such as immune-deficient people, HIV positive people and the elderly.

3. The role of water

Recent and convergent studies by the Canadian researcher Pierre Clement have also shown that the part played by water in endemic diseases is stable. For instance, 20 – 30% of the cases of gastro-enteritis found in a population with a good (in relation to standards) water supply may be attributed to the consumption of that water.

If we consider the various pathogen agents, it appears that the epidemiological character of the diseases associated with them are highly variable. For instance, for gastro-enteritis, the probability of a fatal outcome varies greatly depending on the germ involved. Besides, the part played by water in human contamination, alongside food and direct contact, seems to be the greatest with parasites (Cryptosporidium and Giardia). There are germs that are poorly transmitted by food. But that does not necessarily mean that water plays a key part. For instance, the proportion of contaminations by direct contact is very high in rotaviruses.

A third element can be used to distinguish the germs – the proportion of endemic cases and epidemic cases. For instance, with E. coli 0157, one case out of ten is part of an epidemic. The rate is much lower with other germs. It can also be seen that regardless of the pathogen, endemic cases dominate largely, because they continue to account for 90% of the cases.

III. THE BACKGROUND OF MONITORING

The monitoring of health problems can be approached in several ways.

? **Monitoring the effects on health**
In France, 300 - 500 deaths are reported every year following enteritis infections. But there is no way of determining the part played by water in these figures. The monitoring of effects comes up against an obstacle, that of the multifactor character of the disease.

? **Monitoring exposure**
Epidemiological monitoring can also address exposure, which includes both water contamination and the visibility of the contamination, which is often forgotten. The monitoring of the contamination of the vector is often reduced to inspection by the local Health and Social Affairs authorities. They could be said to be deficient in two respects – first of all, bacterial indicators give no information about the risks of viruses and parasites and secondly, they only take spot samples, which only throw light on episodic phenomena, whilst all phenomena would be visible if continuous records were available.

IV. TWO PARTS OF THE WATERBORNE INFECTIOUS DISEASE MONITORING PROGRAMME OF THE INSTITUTE

1. The monitoring of waterborne infectious diseases and accidents in the supply of drinking water

This programme is not original and even exists already. But today, it is to be reinforced by focussing the efforts on two clear objectives:

? searching for aetiology by taking stool samples and water samples at the right time in order to identify the pathogens involved in risky situations, using the new methods of molecular biology;

? evaluating the usual indicators and possibly indicators of the risk of viruses and parasites.

The programme will probably be implemented from 2002.

2. Risk monitoring

In addition to monitoring the effects and exposure, it is also possible to monitor the relation between exposure indicators and effect indicators. For exposure indicators, the indicators to be taken into account are turbidity, as has been done in several tests. But we shall also endeavour to acquire data about water consumption in the selected areas. As for effect indicators, we will remain focused on gastro-enteritis, because it offers advantages for observation – it is highly responsive, with a short latency period and high sensitivity.

A study has provided us with relatively new data derived from continuous computerised records. Also, for the data on the effects, the health insurance authorities achieved the ability two years ago to provide data relating to the sale of drugs across France, thereby making it possible to conduct epidemiological studies in areas with a minimum population of 10,000. However, the consumption of water does not always make it possible to perform such studies. For example, in the pays de Caux, the poor quality of the water has led the local people to resort massively to other forms of supply, which means that the risk cannot be measured.

Lastly, such approaches necessarily come up against the need to multiply testing. Four studies were conducted and a fifth is under way, clearly showing that the turbidity value is an indicator of exposure. But the diversity of diet, water sources and treatment processes have led the Public Health Monitoring Institute to choose to conduct a study in a large number of different centres and situations in order to estimate the risk of exposure to waterborne disease of the populations in the various contexts concerned.

A practitioner's experience of waterborne diseases

Doctor Christian PENALBA
Corvisart hospital (Charleville-Mézières, Ardennes), Director of the department of Infectious Diseases

I. Introduction

First of all, I would like to thank the organisers for inviting a non-specialist in water such as myself to address you. Let me take this opportunity to tell you more about the vision of a physician in the field, who has to treat patients suffering from water-related diseases, in order to approach the circumstances of contamination that may be connected to such disorders.

II. Circumstances of exposure

1. Drinking water

As a former gastro-enterologist, I am particularly interested in giardiasis, which I found was significantly present in France, even though it is not easy to bring out. In the hospital in which I work, we spent two years looking for parasites in biopsies with the help of fibroscopy. That helped us to determine that 2.46% of the population was contaminated, and that the contaminated population was both non-European in origin and local. Water and food are the probable sources of the contamination.

2. Recreational activities

a. Leptospirosis

Leptospira are bacteria that include many different germs. They can be found in France in all major water basins particularly Meuse. Domestic and wild rodents have leptospira, of which large quantities are excreted in their urine. In that way, they can greatly contaminate the environment of bathing water, for instance. The contamination may occur by direct contact or by exposing the skin, mucous membranes or conjunctiva. The people most exposed are people who are likely to come in contact in the course of their jobs (farmers, drain workers, refuse collectors and in people working in abattoirs) or leisure activities, such as bathing, fishing or water sports. According to a study conducted in 1998 and 1999, the cases of leptospirosis observed during the period showed acute renal insufficiency and very varied infectious tables. The distribution of the occurrence of this disease over the year shows that it chiefly occurs between July and December.

Following these findings, work was undertaken with pharmacists. A student in pharmacy defended a thesis on leptospirosis. That work made it possible to prepare information leaflets that were distributed this year to farmers by ANSA. It happens that the major difficulty in this approach is less related to the designing or production of the leaflet than to its distribution, because ANSA refused to

distribute it to farmers who were owners of their farm. For their part, the health authorities and local doctors showed no interest in the project.

The common sense advice given to farmers in the leaflet included the following:

? always wear boots and gloves while working;
? stay away from livestock as far as possible;
? eliminate rats;
? limit stagnant water in the farm;
? do not eat while working;
? do not smoke while working, etc.

The same document has been prepared for anglers and should be issued by the national Angling Federation. The booklet also includes information about leptospirosis itself.

b. Free amoeba

A patient who came in to see me twice told me that he had to wear a mask in some parts of his workplace, the Chooz power plant, because of amoeba. I contacted the company's medical officer, who confirmed that amoeba could pullulate at some times of the year, creating a risk of meningitis. The power company then told me that some sites had stainless steel condensers and aero-refrigerants in which these free amoeba could multiply and then be discharged in the Meuse. The representatives of the French power company also told us that there was treatment to eliminate the amoeba and remove all risks for bathers.

3. Floods

In the last four consecutive years, the Meuse valley has been flooded. That has given us the opportunity to try to study the impact of the floods on the health of the population. It turns out that the population of rescue workers only suffered from some skin infections and waterborne diarrhoea. No particular germ was identified in the inhabitants of the affected areas. The interrogations of general practitioners showed that other than the back pain associated with the handling of furniture and depressive syndromes, only mild gastro-enteritis was observed. An epidemic of hepatitis A was found in a very clearly demarcated area, where the people had moved often.

In the laboratory, nothing new was seen in the pathogens isolated during the floods as compared to those that were known in other times. No disease was reported by the Peugeot-Citroen foundry in Charleville. Only one person who cleaned the plant after the floods without wearing the mandatory mask they had been given came to the hospital with pneumopathy. The period after the flooding was however followed by an increase in absenteeism in companies as a result of gastro-enteritis.

4. Legionnaires' disease

The 1998 act, which provides for regular monitoring of the water supply made us discover cut offs in some locations in the piping circuits of the hospital, which were insufficiently heated. Consequently, we were able to eliminate the problems relating to Legionnaires' disease for a low cost. Oxygen scrubbers had caused a small epidemic (of four to five cases) of the disease, because not enough

precautions were being taken while using the devices. Today, circulars are in place to explain to the personnel how to use the devices without spreading contamination from patient to patient.

The side effects of pesticides on health and the environment

Professor Jean-Marie PELT
Chairman of the European Institute of Ecology

I. Introduction

I was struck by the figure that was mentioned - 3.4 million children die every year of diarrhoea, making water the greatest vehicle of pollution. The fact is often not known, just like the two to three million deaths caused every year by malaria. As Mr Baudot told us this morning, pesticides are probably not the chief danger from water, because they get to us mainly through rain water, spreading and food.

Admittedly, pesticides have three different types of side effect – effects on the immune system, oestrogen-like effects and carcinogenic effects. However, very little is known about the field. Standards, where they exist, are purely administrative. Not much is known about the effectiveness of each substance. It is also notable that less than 1% of the substances produced in quantities of over 1000 tonnes per year are tested or experimented. What is more, the experimental protocols are rarely satisfactory and are still under preparation for oestrogen-like effects. Strong certitudes are rare in the field, unlike in other areas such as bacteriology.

I believe that this is important, as it leaves scope for disinformation campaigns on the subject. For instance, the readers of the chief French scientific periodical must have noted the presence of an article by Professor Ames, known for the test that bears his name, in which he states with surprising assurance, that pesticides have no effect on health. The same periodical is also engaged in a fierce battle against organic farming, even as our Chairman has demonstrated that organic food is of high nutritional quality as compared to conventional farming products. If we are to be reasonable, we must in my view be wary of the short and mainly long-term effects of these toxic substances, which often remain for long periods of time and which can accumulate.

In particular, they accumulate in the living beings that are at the top of the food chain like ourselves, and who have long life, like us. The danger to which we are exposed particularly, as compared to other animal and plant species, is the risk of bio-accumulation over a long time. The risk first appears with the foetus. It has been shown time and again that disruption in the natural development of the foetus, which is governed by specific hormones and thrown into disorder by the pseudo hormone role played by pesticides, leads to genetic consequences that have been demonstrated clearly. The same goes, in some cases, for the transmission of these substances through the mother's milk, which is a major risk for the infant. The problem of cancer, particularly prostate cancer, breast cancer and testicle cancer, was also rightly mentioned this morning. The incidence of these three types of cancer is indeed rising, probably because of chemicals.

Immunity problems have not been mentioned in detail, but they certainly play a part. That is because these substances also contribute to reducing immunity, making us more prone to infectious diseases. And we are not the only beings to be affected – seals are affected as well. Some of you may

remember the collective death of 18,000 seals in the North Sea, i.e. almost half their population, some ten years ago. It turned out that the animals were suffering from ordinary infections that they ought to have overcome. But they also showed extremely high pesticide contents in their adipose tissues, leading to a decrease in their immunity.

These animals have the same characteristic as us – they live to an old age and can accumulate elements because they are at the top of the food chain. That ought to make us think about the possibility of similar disasters among the human population if we do not keep up our guard. As regards oestrogen-like effects, we could add a number of other examples to those mentioned this morning. Beluga whales residing in the Gulf of St. Lawrence have collectively become hermaphrodites, having both male and female functional genital organs.

One subject was not mentioned today – that of drugs and what happens of them in the environment. Surprising figures were published in 1994 as regards the Thames. British researchers had found many cases of hermaphroditism in fish, which could only be seen downstream from the London water treatment plants. The quantities of hormones ingested as "post-menopause" drugs or as female contraceptive pills and then discharged into the Thames were suspected of being responsible for the phenomenon. The jury is still out on that question. Also, we must mention organic tin, which is used as a fungicide in marine paint, and has a powerful androgenic effect, particularly on female seabirds, which become hermaphrodite when they come in contact with it.

Lastly, a remark of another nature can be made. We have all noticed that the generations are growing taller. For instance, the son of the king of Spain is 15 centimetres taller than his father and the same may be said of Prince William of England, to take but a few illustrious examples. At the same time, it is quite noticeable that these young generations are very often slimly built and fragile from the immunity point of view. Very recently, the leader of the construction and public works union of the Lorraine region told me of the difficulty the trade is having in finding young apprentices, particularly because of their reduced resistance to physical work. The anecdote may seem amusing, but it must concern us or at least intrigue us, in that these findings raise questions that are still to be answered.

All these observations clearly raise the more general question of the type of relation we have with nature. We are submitting nature to harsh treatment, and are ending up by turning it into an enemy. Yet, the conservation and development of a quality environment would considerably increase our chances of survival and improve our quality of life. If, on the other hand, we decide to settle for a degraded environment, it will degrade us more often than not. I would therefore like to ask you all to pursue your endeavours in the field.

Discussion

Christophe MOULIN, Chief of the Industry, Water, Environment and Health Group, EDF (French power company)

We have been tracking the problem in the Chooz plant mentioned before for some twenty years. Along with the Higher Council for Public Health, we have been able to put in place the resources to evaluate the risk, find the industrial treatment that will be the most acceptable from the environmental standpoint and the methods that will ensure the rapid detection of the risk in the industrial situation. EDF rapidly adopted a responsible approach, within the limits of the knowledge available. I am at the disposal of anybody who would like to have more information about the issue.

Céline LORET, Representative of Health at France Nature Environnement

Have any studies been conducted in France or on the European level on the residues of drugs in water? Are some substances particularly present in significant quantities in the surface water in France?

Professor Jean-Marie PELT

I researched the subject to prepare my paper and my search was almost completely in vain - the only notable information is that it would appear that the question is beginning to be asked. Besides, the union of manufacturers of pharmaceuticals products has indicated that if any residues of drugs are to be found in waste water – which is probably so in this country – that would not come from manufacturing plants but from the day-to-day use of the drugs by the people, for instance when they pour unused drugs down the sink. An article by Ms Crié was published by the daily *Libération* a few months ago on that subject.

André-François BOSCHET, European Water Centre

While we are on this issue, I would like to inform you that a large number of patents are now emerging as a result of the work done fairly early in Germany, particularly in respect of the discharge of drugs in water and new germs such as BSE prions.

Member of the audience

I come from San Diego, California, where we turn to specialists when we have problems with radon in wells. It would appear that radon is not a source of concern in France, because there is no standard relating to its presence. Now the independent radiology laboratory CRIRAD says that every year, radon leads to 4000 to 5000 deaths due to lung cancer. Of course, the figure includes the gaseous form and not only the radon present in water. Could you confirm that figure?

Doctor Florence MÉNÉTRIER

Radon is a radioactive gas and is not hazardous as such. Its metabolites, on the other hand, are hazardous. Among these, alpha elements are the most dangerous, in that they are carried by dust and can be inhaled, leading to lung cancer. Experimental and epidemiological studies have demonstrated that when inhaled, the element is carcinogenic in very small doses.

In France, there is a high radon content in water in those regions in which granite is abundant, such as Auvergne, Ardennes, Corsica and Brittany. However, the studies relating to the carcinogenic effects on the exposed populations have not delivered significant results. It is true that the studies are not easy to perform, in that they mean that we must be able to track the history of the exposure of the people to radon.

As regards water, the WHO has taken no particular interest in radon, because it is a gas and can evaporate relatively easily. Above all, that makes it difficult to measure the radon content of water, considering the differences in the conditions of presence of the gas between the discharge of the treatment plant and the user's tap.

Member of the audience

But how come there is no standard in France, when there is one in other European countries and the USA?

Doctor Florence MÉNÉTRIER

In any case, measurements have been made by the Nuclear Protection and Safety Institute and methods have been developed to reduce the radon content.

Professor Philippe HARTEMANN

Under the new European legislation, reference values have been fixed even if they have not yet been included in the law in France, because the legislation is yet to be transposed into the domestic legislation. I cannot confirm or dismiss the figure put forward by CRIRAD. But monitoring is being done on the basis of a model of the radon-related risk in France. It is probable that radon leads to a certain number of deaths every year in this country, even though I have no data to say that the high figures put forward by CRIRAD are plausible.

Professor Henri JOYEUX

We must also put the risks in context, in relation to one another – as regards lung cancer, we are now beginning to operate increasingly on women, who were practically unaffected a few decades ago. Smoking is a major reason for this disease. I am sometimes surprised by the position of some politicians who appear not to dare to remind the people of public health advice, particularly the young – 60% of our high school students smoke. In this field as in others, there are inconsistencies that must be lifted.

As there are no other questions, I would like to thank the organisers for this day, which enabled us to extend our knowledge in order to make ever more enlightened choices.

Prepared by Hors Ligne on the basis of the recordings made during the sessions.