ANNALEN VAN DE BELGISCHE VERENIGING VOOR STRALINGSBESCHERMING

GEZONDHEIDSRISICO'S VAN RADON EN TABAKSROOK

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HEALTH RISKS OF RADON AND TOBACCO SMOKE

RISQUES LIES AU RADON ET A LA FUMEE DE TABAC

Colloque organisé par la
Rijksuniversiteit Gent
en collaboration avec l'Association
belge de Radioprotection et
Société belge de Pneumologie

Gent, 13 mars 1990

ANNALES DE L'ASSOCIATION BELGE DE RADIOPROTECTION

Dit nummer bevat teksten van uiteenzettingen gedaan tijdens het colloquium georganiseerd door de Rijksuniversiteit Gent in samenwerking met de Belgische Vereniging voor Stralingsbescherming en de Belgische Vereniging van Pneumologie

Ce numéro contient les textes d'exposés présentés lors du Colloque organisé par la Rijksuniversiteit Gent en collaboration avec l'Association belge de Radioprotection et la Société belge de Pneumologie

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THE EPIDEMIOLOGY OF LUNG CANCER

J. Van Meerbeek and G. Joos°

Dienst Longziekten, UZ-Antwerpen
Wilrijkstraat 10
B-2520 Edegem (Belgium)

°Dienst Pneumologie, UZ-Gent
De Pintelaan 185
B-9000 Gent (Belgium)

March 13, 1990

Abstract

Bronchial carcinoma is the most frequent malignant tumor. In the western world it is the cause of some 28% of the total cancer mortality, while for men this figure can rise up to 35%. Epidemiological studies have demonstrated geographical differences in lung cancer incidence, probably due to differences in the prevalence of causal factors as smoking, environmental pollution, occupational exposure, diet and genetic factors. Among these factors tobacco smoke is responsable for almost 90% of all lung cancers by men and 80% by women. Benzopyrene is the best-known carcenogenic in tobacco-smoke, although other products as nitrosamines, arsenic, nickel and Po-210 may also intervene. As the cancer register constitutes the basic material for epidemiological research and as the registration in Belgium is far from perfect, some initiatives were taken to set-up a database for the study od causal factors, therapeutic interventions and the prognosis of bronchial carcinoma in Flanders.

1. EPIDEMIOLOGIE

Bronchuscarcinoom is de meest frequente fatale maligne tumor, in de Westerse landen verantwoordelijk voor ongeveer 28% van de gehele kankersterfte, bij de man zelfs voor ten minste 35%. Bij de vrouw is de longkankersterfte in enkele landen nu reeds groter dan de mortaliteit door mammacarcinoom. Het is virtueel ook de enige kanker waarvan de incidentie flink blijft stijgen en het vertegenwoordigt nu meer dan 16% van alle nieuwe kankergevallen.

Ook in ons land is de mortaliteit tijdens de laatste 25 jaar bij mannen meer dan verdubbeld; volgens raming bedroeg in 1961 het aantal sterfgevallen 2563, terwijl het nu tot bij de 6.000 per jaar is opgelopen. De voorspellingen zijn dat de incidentie naar het jaar 2000 verder zal toenemen, hoewel iets trager dan tijdens de laatste twee decennia. Bijzonder verontrustend op wereldvlak is de sterke toename in de ontwikkelingslanden, waar nu veel meer dan vroeger gerookt wordt; hierdoor zijn er nu al over gans de wereld jaarlijks meer dan 660.000 nieuwe gevallen. Men voorspelt dat in vele landen in het begin van de 21ste eeuw longkanker en AIDS de meest voorkomende doodsoorzaken zullen zijn. Beide aandoeningen hebben op dit ogenblik overigens een vergelijkbare slechte prognose met een gemiddelde overleving van ca. 15% drie jaar na het stellen van de diagnose.

Epidemiologisch onderzoek heeft verder grote geografische verschillen in de incidentie van longkanker aangetoond. Deze berusten allicht op verschillen in aanwezigheid van causale of predisponerende factoren.

2. CAUSALE FACTOREN

Van geen enkele maligne aandoening is de hoofdoorzaak - het roken van tabak - zo goed bekend. Minder zekerheid bestaat er over de rol van cancerogenen in de beroeps- of huishoudelijke atmsosfeer, of in het dieet. Verder wordt intensief gezocht naar de genetische factoren die tot het ontwikkelen van longkanker zouden predisponeren.

2.1. TABAKSROOK

Het sigarettenroken wordt verantwoordelijk gesteld voor 90% van de longkankers bij de man, voor 80% bij de vrouw. Hoe meer men rookt of hoe jonger men begint, hoe groter het risico. Er zijn aanwijzingen dat het risico iets kleiner is bij het roken van filtersigaretten of van sigaretten met een lager teergehalte. Bij echtgenoten van zware rokers wordt ook een 25 à 40% toename van het risico voor longkanker vastgesteld.

Benzo(a)pyreen is het best bekende carcinogeen in de tabaksrook, doch er zijn er wellicht nog talrijke andere zoals nitrosamines, arseen, nickel en polonium-210.

2.2. ATMOSFERISCHE POLLUTIE

Het effect hiervan is controversieel, omdat men bij epidemiologisch onderzoek slechts de invloed van het roken kan controleren. Toch blijken na controle van deze factor stadsbewoners 1,3 tot 2,3 maal meer longkanker te vertonen dan plattelandsbewoners.

2.3 BEROEPSBLOOTSTELLING

Voor volgende agentia bestaat er virtuele zekerheid dat ze longkanker veroorzaken, vaak als co-factor bij het sigarettenroken :

Asbest	Chloro-ethers
Radioactiviteit (Radon-dochters)	Mostaardgas
Nickel	Kool-teer produkten
Croom-zouten	Arseen

Factoren die nog onder verdenking staan zijn o.m. Vinylchloride, Acrylonitriel, glaswol en rockwol; voor beide laatste lijkt de kans dat ze zelf longkanker veroorzaken gering.

2.4. DIEETFACTOREN

Hierover is vrij weinig bekend. Toch wordt beweerd dat een dieet arm aan Vitamine A en beta-caroteen met een hogere incidentie zou gepaard gaan, waardoor aan deze substanties een protectief effect werd toegewezen. Cholesterol en dierlijke vetten zouden mogelijk het risico verhogen.

2.5. GENETISCHE FACTOREN

Familieleden in eerste rang van longkankerpatiënten hebben 2,4 maal meer kans zelf aan deze ziekte te lijden. Dit heeft geleid tot het zoeken naar genetische factoren. Zo werd gepostuleerd dat personen met een hoge aryl hydrocarbon hydroxylase (AHH) activiteit meer longkanker zouden vertonen omdat ze meer koolwaterstoffen, zoals benzo(a)pyreen, tot cancerogene metabolieten zouden afbreken. Verder zijn er aanwijzingen dat lonkankercellen, wellicht onder de invloed van cancerogeen, belangrijke letsels in hun oncogenen en tumor suppressor genen vertonen. De predispositie tot het optreden van dergelijke DNA beschadiging kan mogelijk genetisch bepaald zijn.

2.6 VOORBESCHIKKENDE AANDOENINGEN

Longkanker treedt vaak op ter hoogte van littekens of zones van fibrose in het longparenchym, het zg. scar carcinoom. Best bekend is het ontstaan van dergelijke perifere adenocarcinomen op oude tbc-letsels of bij longfibrose. Meestal is er echter ook een anamnese van tabakgebruik.

3. LONGKANKERREGISTRATIE IN VLAANDEREN

Ons land scoort zoals bekend doorgaans zwak op gebied van ziekteregistratie. Dit geldt ook voor longkankerregistratie. Daarom werd door een groep geneesheren van de Provincie Antwerpen sinds einde december 1987 met een dergelijke registratie gestart binnen de Integrale Kankerstichting. In de loop van 2 jaar werden bijna 700 gevallen geregistreerd, wat 40% is van het vermoedelijk aantal nieuwe gevallen in de Provincie. Vanaf dit jaar zal deze registratie dankzij de medewerking van de Vlaamse Vereniging voor Tuberculosebestrijding (V.V.T.), het Vlaams Overlegorgaan voor Kankerstichtingen (V.O.K.A.) en het Belgisch Werk tegen Kanker (B.W.K.) naar de andere Vlaamse Provincies worden uitgebreid, dit uiteraard met de nodige voorzorgen voor behoud van beroepsgeheim en 'privacy'. Gehoopt wordt aldus meer informatie te bekomen over het voorkomen van longkanker in onze regio. Deze registratie beoogt de studie van causale factoren, therapeutische ingrepen en prognose van het bronchuscarcinoma in Vlaanderen bij te staan.

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ON THE ROLE OF RADON IN THE ETIOLOGY OF LUNG CANCER

A. Poffijn

State University of Gent
Institute Nuclear Physics
Proeftuinstraat 86
B-9000 Gent (Belgium)

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Abstract

The reference value of 63 Bq/m^3 for radon in Belgium is comparable to the results obtained in neighbouring countries. There exists a significant distinction between the north of the country (average 48 Bq/m^3) and the south (average 85 Bq/m^3), where much higher concentrations are regularly found. This can be explained mainly by differences in the geology of the underlying soil. Extrapolating the uranium miner observations to the lower indoor exposure levels leads to an estimation of the etiological fraction for radon of the order of 10 to 30%. As the extrapolation technique for low doses is still a matter of controversy, an epidemiological study of the case-control type was set-up by the end of 1987. The preliminary results of this pilot study, indicate a significant increase in risk for the group of the exposed (>100 Bq/m^3) current smokers and non-smokers compared to the non-exposed reference groups (odds ratio resp. 5.3 and 8.6) while for ex-smokers no effect was observed.

Introduction

The wide-spread use of nuclear technology in our modern society gave rise to great concern about the risks related to the application of artificial radioactivity. For most of the general population however, the major part of the annual dose from ionising radiation is caused by natural radioactivity. Last years more research is conducted about radon, as it became clear that about 40% of the radiation burden (fig. 1) to the population is due to radon (1). As part of the C.E.C. research programme on radon an inventory has been made of the indoor radon situation in Belgium. Relying on the lung cancer risk estimates obtained in miner studies, some 10 to 30% of all lung cancers are expected to be caused by radon (2). However extrapolation from high mine levels to low indoor levels and from mine to residence conditions

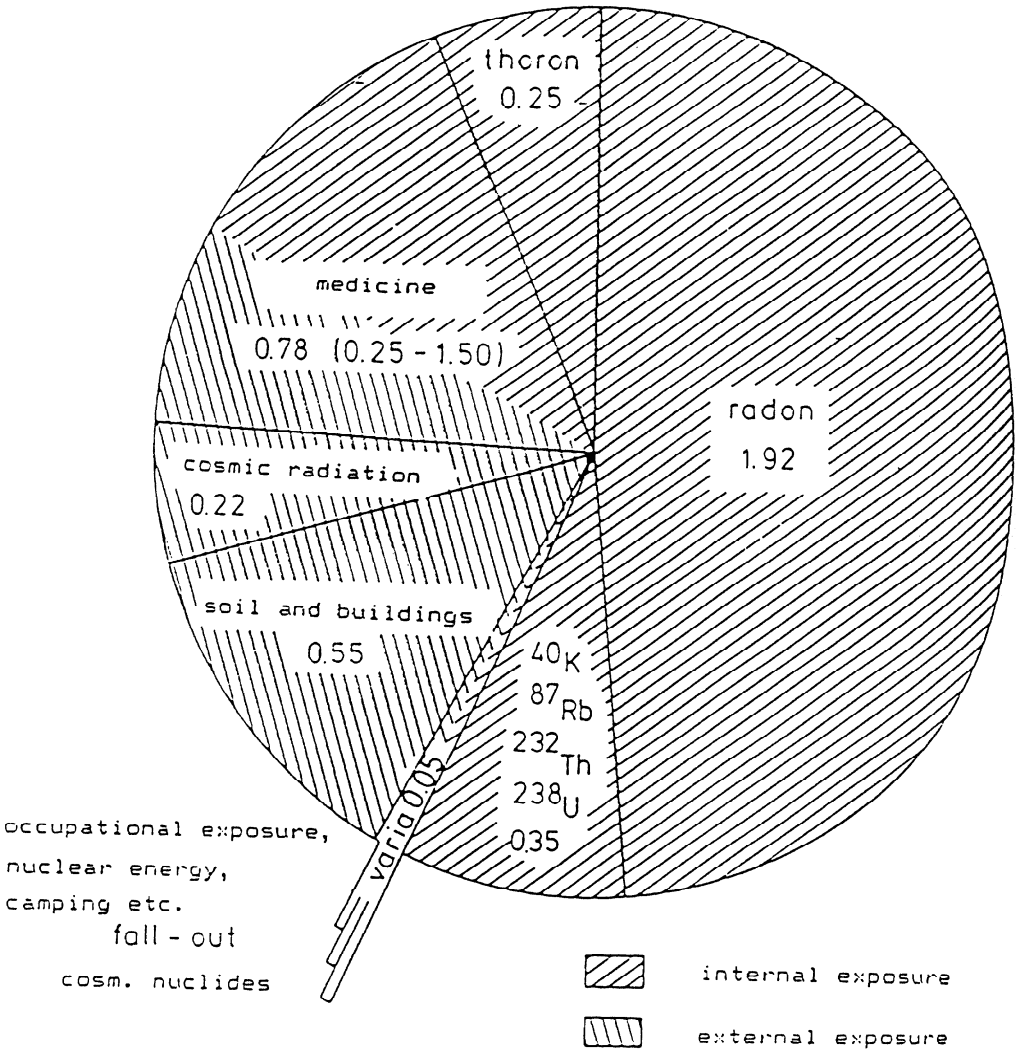

Fig. 1 : Radiation burden (mSv) of the Belgian population.

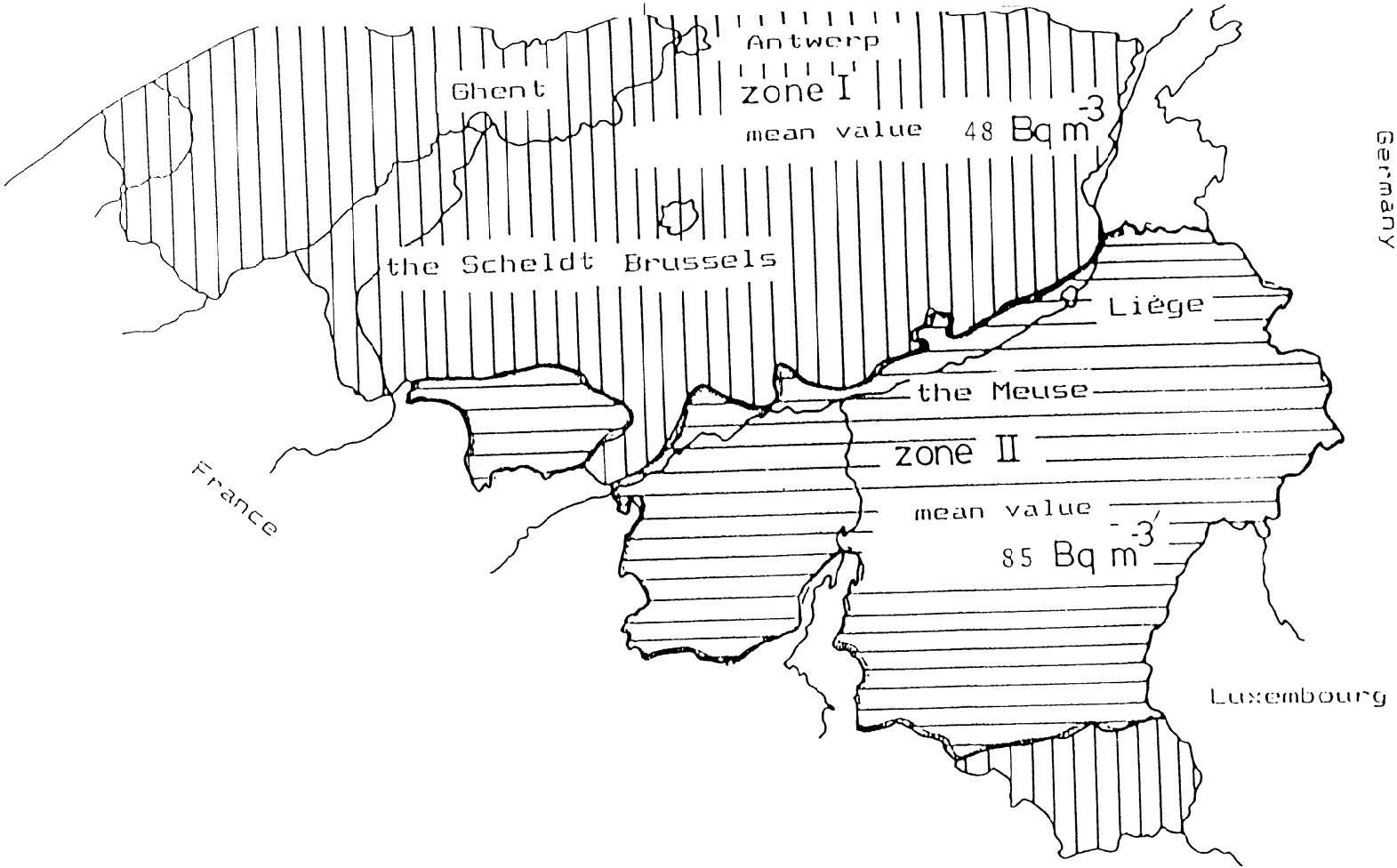

Fig. 2 : Major geological division of Belgium.

introduces great uncertainties. Some direct epidemiological evidence was gained through a hospital based case-control study. The results as they are available for the moment show a clear increase in risk for the current smokers and the non-smokers. No significant effect was observed among ex-smokers.

The Belgian radon situation

For several years the indoor radon situation is being monitored through general and local measurement campaigns. In all these surveys the exposure levels are determined by means of six-months measurements with Karlsruhe type alpha track-etch detectors (3). The results can remarkably well be divided up into two categories according to geological features. In zone I (fig. 2), corresponding to the northern part of the country, including the extreme southern region as well, the covering soil layer consists mainly of sand and loam and is rather thick, while the primary stone layers are situated at great depth. In this zone the exposure levels are in general low and no great variation is observed (Table I). The highest values are found in the valleys were the upper layers have been eroded. In zone II on the contrary, the primary rock-formations appear much closer to the surface, giving rise not only to a much higher average value, but also to a much greater variation in exposure levels (Table I). At some places were this layer pierces out, extreme high radon concentrations of the order of thousands of Bq/m^3 have been observed.

Table I : Regional radon distributions in Belgium

Geological Zone	Median (Bq/m^3)	Mean (Bq/m^3)	90%-value (Bq/m^3)
Zone I	32	48	66
Zone II	52	85	135

Radon epidemiology

Although the miner based risk estimates demonstrate clearly the non neglectable role of indoor radon in the etiology of lung cancer, there is great need for direct epidemiological evidence. Up to now only small-scale studies among the population (mainly in Sweden) have been organised (4). In preparation of the so-called "Ardennes and Eifel" study (5), a large-scale multi-center study with participants in Belgium, France, Germany, Luxemburg and the U.K. and aimed at collecting complete information about 1500 cases and 4500 controls, a pilot study was set-up in the Belgian Ardennes during 1988-1989. The main purpose was to test the feasibility of this kind of approach. The project was a hospital based study including only incident cases and controls resident for at least 25 years at their present address. Patients fulfilling this criterium were interviewed during their hospital stay by a co-worker about other lung cancer determinants as occupational exposure, active and passive smoking, diet and psycho-social factors. Shortly after the questionning an alpha track-etch detector was installed in the living/kitchen and bedroom of the patients and left in place for a period of six months. During this visit details concerning life-style and house construction were registrated and the answers to the different topics of the questionnaire were checked on their consistency and reliability. Complete information was gathered about 64 cases and 184 controls. The analysis of the yet incomplete data indicate a significant increase in lung cancer risk for the current and non smoking subgroups (Table II), while no indications could be detected for the two considered categories of ex-smokers. The major conclusions from this pilot study were the feasibility of the set-up and the restricted entry-rate (25%) caused by the residence criterium . Therefore in the further development of the European coordinated project more than one house per subject will be measured on radon.

Table II : Relation radon-lung cancer.

Smoking status	Exposure category (Bqm^{-3}) 0-100	> 100
Current Smoker (quit max. 2y)		
CA	16	8
CO	42	4
Odds Ratio	1.0	5.3
95% Conf. interval		(1.4 - 19.7)
Ex-Smoker (quit >2-9y)		
CA	8	3
CO	18	10
Odds Ratio	1.0	0.7
95% Conf. interval		(0.2 - 3.1)
Ex-Smoker (quit >9y)		
CA	7	2
CO	18	7
Odds Ratio	1.0	0.7
95% Conf. interval		(0.1 - 7.7)
Non-Smoker		
CA	2	3
CO	23	4
Odds Ratio	1.0	8.6
95% Conf. interval		(1.1 - 68.9)

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ENVIRONMENTAL TOBACCO SMOKE (ETS) AND LUNG CANCER

J. Prignot

Dept. of Pneumology,
Cliniques Universitaires de Mont Godinne, U.C.L.
B-5180 Yvoir (Belgium)

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Passive smoking is a social important issue, since not far from 2/3 of non-smokers are exposed daily to ETS, and most of us spend 80 % of their time indoor.

Most (85 %) of the ETS corresponds to the side stream smoke (SS), diffusing from the smouldering and of a tobacco product, between the puffs. Minor contributors to ETS are the smoke emerging from the burning tips during active smoking, the gaseous components diffusing through the cigarette-paper, and the fraction of the mainstream smoke (MSS) exhaled by the smoker (tertiary stream).

Differences between side stream and main stream smoke are attributed to the variations of combustion-temperature (600°C between puffs - 900°C during puffs) and to the efficiency of cigarette-filters, in selectively removing several constituents of the smoke.

In comparison with MSS, SS has a higher pH, particles of somewhat smaller size, and, when undiluted, contains higher amounts of toxic and tumorogenic agents, in the vapor as well as in the particulate phase.

ETS contains a proportional higher percentage of gas-phase components than MSS, with a tendency towards a more peripheral deposition in the respiratory tract.

Ageing of ETS alters its composition, favoring the evolution of some products from particulate to gaseous phase.

All those characteristics favor toxic and carcinogenic activities of ETS. SS smoke contains indeed 6 products with sufficient evidence of carcinogenicity in humans.

Hazards due to ETS are related to smoke production, diffusion and inhalation, and also to timing of exposure in relation to age and level of development of the inhaler.

The first approach for the evaluation of the hazards of ETS, is the study of its markers in the atmosphere and in the body fluids of passive smokers. An ideal marker for ETS is characterized by its specificity for tobacco smoke, its long half-life, its fairly constant relationship with the risk-products of the smoke, and a concentration sufficient to allow a valid titration even at low levels of ETS.

Nicotine, and especially its metabolite with long half-live, cotinine, are the most adequate markers allowing an integrated estimate of exposure over a long period of time.

Cotinine levels in non-smokers exposed to ETS are equivalent to 0.5 - 1 % only of the levels of active smokers. The epidemiological evaluation of the risk of lung cancer due to ETS is thus difficult, because of this "low dose problem", resulting in rather low relative risks and also because of the difficulties in quantifying life long cumulative exposure to ETS.

Most epidemiological studies used questionnaires in which the effects of ETS exposure, were estimated by home-contacts of life long non-smokers with smoking spouses. A recent survey (Saraci and Riboli, 1989), synthesized the results of 11 case-control and of 3 cohort studies concerning altogether

1.145 lung cancer cases in reported life long non-smokers. The combined estimates of the case-control studies show a relative risk (RR) of 1.27 in non-smokers living with a smoker versus non-smokers living with a non-smoker; for the cohort studies, the RR is 1.44, and for all studies together 1.35 (95 % confidence limits 1.20 - 1.50). Those RR appear very low in comparison with values of 10 - 20 in active smokers.

Some bias can artificially decrease the RR, other play in the other direction. It seems unlikely that this type of bias could be the sole explanation of the observed elevation of RR in passive smokers (Saracci and Riboli, 1989). The conclusions of Wald and al. (1986) seem more and more warranted, since the recently published studies : inhaling other people's smoke does cause lung cancer.

In future studies, more attention should be paid to the validation of the data concerning ETS exposure, by more precise questionnaires and by the use of markers and also to the possible role of "confounders" played by other potential indoor air pollutants like NO_X from gas stoves, formaldehyde from foam insulation, combustion products from fire places and last but not least radon daughters, whose carcinogenicity could be potentialized by ETS.

ETS is not only a major issue from a medical point of view : it plays also an important role in the evolution of the social consensus towards a smoke-free society, and for the application of governmental policies of smoking ban in public and working places.

Abstract

Environmental Tobacco Smoke (ETS) plays an important role in the evolution of the social consensus towards a smoke-free society. Most of the ETS-effect corresponds to the Side Stream (SS). Many of its characteristics favor the toxic and carcinogenic effect of ETS. The evaluation of the hazards of ETS is generally done by studying its markers (e.a. cotinine) in the atmosphere and in the body fluids of passive smokers. Because ETS is a typical low dose problem, the epidemiological evaluation of the related lung cancer risk is very difficult. The combined estimates of the case-control studies show a Relative Risk (RR) of the order of 1.3, which is very low in comparison with the RR of 10-20 for active smoking.

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MANAGEMENT OF THE RADON PROBLEM IN SWEDEN

Axelson O, Department of Occupational Medicine,
University Hospital, 582 85 Linköping, Sweden

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Abstract

High indoor concentrations of radon in many Swedish homes have been of concern since the late 70s, measurements from the 50s and the 80s suggesting a doubling or more of the levels found. Seven case-control studies on lung cancer and indoor radon have been reported from Sweden, some of a pilot character, but all indicating an increased risk. The interaction with smoking seems to be synergistic, but the results are somewhat divergent. Further studies are ongoing, and sparse funding in the past has now improved. Public attitudes to elimination have been rather conservative, younger families being concerned, however.

The potential health hazards of indoor radon are now attracting interest in many countries, since relatively high levels of this radioactive noble gas have been found in dwellings both in Europe and North America. Exposure to radon and its decay products, so called radon daughters or radon progeny, is known cause lung cancer in miners. It may therefore be argued that not only smoking but also indoor radon exposure could have played a major role for the high mortality from lung cancer occurring in this centuary, since indoor radon levels seem to have increased because of reduced thermal ventilation, when central heating, electrical cooking, etc., replaced the more or less open fires of the past.

High indoor levels of radon were noted in Sweden rather early, and comparatively many studies have also been undertaken in the country to evaluate the potential risk of lung cancer in relation to this exposure. The purpose of this paper is to briefly review some of the experiences made in these various studies and also to somewhat reflect the activities and the attitudes taken in relation to the findings made in this respect.

Measurements of indoor radon

The first measurements of indoor radon were undertaken in Sweden already in the 50s (Hultqvist 1956), but seem to have attracted little interest from the health point of view. The levels found at the time were in the range of 20 - 69 Bq/m^3. More recent measurements in Swedish homes have revealed higher levels, i.e. 122 Bq/m^3 as an average in detached houses and 85 Bq/m^3 in apartments, but there are such great variations as from 11 to 3,300 Bq/m^3 (Swedjemark 1987). The difference between these early and recently measured concentrations should probably be interpreted as suggesting a general increase of the levels over time.

Average or median concentrations of indoor radon in the range of 40 - 100 Bq/m^3 have been reported from many countries, e.g. USA (Nero et al 1986), Norway (Stranden 1987), Finland (Castren 1987), Federal Republic of Germany (Schmier and Wick 1985), etc., but the range has been rather broad, often with levels up to two or three thousand Bq/m^3 in many houses. The generally occurring differences in concentrations clearly indicate the difficulties involved in assessing individual exposures over time so as to make epidemiologic studies sensitive enough to detect an effect.

Furthermore, in addition to the scientific surveys, there have also been routine measurements undertaken since the late 70s in order to particularly identify houses with very high levels. In Sweden, such measurements have been made primarily by the local health authorities, giving priority to such houses, which for various reasons could be suspected of high indoor levels. Hence, by taking the type of building into account as well as the geological characteristics of the ground underneath the house, it is possible to identify houses, where high levels may occur and measurements therefore should be undertaken in the first place. In this latter respect, good help was obtained from the fact that earlier uranium ore prospectation from air-planes by gamma measurements had provided some knowledge about where the radiation from the

ground was particularly high, suggesting also a possibility for increased leakage of radon from the ground into the houses.

With regard to building material, it may be mentioned that some 10 per cent of the Swedish houses have been built from light-weight alum shale concrete, which is high in uranium and therefore a source of indoor radon. Similarly, certain granites and therefore also some of the gravel used in concrete, are rather radioactive, also contributing to indoor radon. The really high levels of indoor radon seem to depend on radon leakage from the ground, however, and as might be expected, especially the houses built from light weight concrete and localized on a ground with high radioactivity tend to have the highest levels of indoor radon.

Since the local authorities have the responsibility for radon measurements, the overall situation regarding the activities and results obtained in Sweden has to be evaluated from time to time through national inquiries, the last one from 1986 (SSI et al 1987). At that time about 58,000 homes had been measured, 10,000 of which were appartments. Out of these homes, 5,350 were found to have radon progeny levels exceeding 400 Bq/m^3 EER (equilibrium equivalent radon). Some homes were reported to have levels as high as between 10,000 and 18,000 Bq/m^3 EER and 238 homes had more than 2,000 Bq/m^3 EER of radon progeny. It may be mentioned in this context also, that based on a random sample of the homes existing in 1975, it has been estimated that as many as 40,000, or about one per cent of the homes in Sweden, might exceed 400 Bq/m^3 EER and 10 per cent might have levels above 100 Bq/m^3 EER radon progeny.

Exposure assessment in epidemiologic studies on indoor radon

From the experiences obtained both in routine and scientific surveys of indoor radon, as briefly reviewed above, and with regard to the various factors influencing indoor radon in a quite complex way, it is obvious that not even extensive measurements in a number of homes subsequently used by an individual would permit any particularly good estimate of his

or her cumulated exposure over many decades. There are reasons therefore to believe that any estimation of radon progeny exposure over life-time necessarily has to be quite inprecise, say, even in comparison to an estimation of background gamma radiation. Hence, exposure in this respect may be taken as mainly depending on the type of building material in the houses used by an individual (Flodin et al 1986), but not influenced by ventilation.

The exposure assessment in the studies undertaken in Sweden has been based on both assumptions about indoor radon levels and various kinds of measurements, usually by means of alpha-sensitive films. Measurements today may not particularly well reflect indoor levels decades ago, however. Therefore, estimations of exposure based on characteristics of the house and ground conditions should not be neglected for epidemiologic purposes, especially not as long as the question is just about an effect with regard to lung cancer, only requiring a crude classification in terms of high, intermediate and low exposure. When the quantitative aspects come more into focus, as is often the case in a later phase of epidemiologic research on a particular question, there will obviously be more needs for measurements, but house characteristics would still be important to consider in order to estimate the exposure over time. Then, also repair work on a house, changes in ventilation etc., need to be accounted for as far as possible.

Because of the great problem of properly assessing exposure over time in this type of environmental epidemiology, the design chosen for some of the early Swedish studies involved a restriction of the study population to be explicitly rural. The reason for such a restriction was that the subjects involved, especially the women, were likely to have spent most indoor time in their homes, whereas the situation might have been quite different for the individuals of an urban population. Furthermore, rural populations tend to be very stable and quite a few individuals may even have been born in the house, where they died. It can be argued, of course, that such restricted studies would have limited external validity,

i.e. for the extrapolation of the results to the total population of a country, and to other countries, especially when it comes to quantitative etimations of risk from indoor radon.

Some design issues in Swedish studies on indoor radon

In view of the various problems discussed above, the first pilot study on indoor radon was restricted to a totally rural population (Axelson et al 1979). The construction material of the house, where the subject had lived just prior to death, was considered in terms of wooden versus stone as indicative of indoor radon levels according to the measurements by Hultqvist (1956) as showing a difference between wooden and stone houses. However, also a mixed exposure category was used in the study to take account of houses of a less distinct or mixed character. Also the existence of a basement was considered as possibly increasing the indoor levels of radon.

In the course of time, it became more clear, however, that the contribution to indoor radon from the ground was considerable (Åkerblom and Wilson 1982). It was therefore of great interest to find an area for a new study, where geology had such distinct features as to permit due consideration. The island of Oeland in the Baltic provided such a distinct geological pattern, with an alum shale strip, leaking radon, along the western coast and with the rest of the island consisting of lime and sand stone with low radon emanation. Maps were also available indicating the zone of increased radiation corresponding to the alum shale deposits reaching the surface.

Some funding finally also became available for the study, permitting some measurements of indoor radon progeny, which turned out to be in reasonable agreement with the crude estimates based on the characteristics of the houses, when considered together with the ground conditions. It may be added that the alpa-sensitive films were exposed for one month, avoiding the summer season with a presumably better and

disturbing ventilation. Furthermore, only individuals, who had lived in the same house for 30 years or more were included in the study, a condition likely to improve the validity of the exposure ascribed to each individual but also reducing the number of individuals eligable for the study.

These same principles were also applied in a larger study that was undertaken more recently in some alum shale areas in middle south Sweden (Axelson et al 1988). In this study, a comparison was also made between the results obtained from measurements with the type of wall material of the houses. It was found that wooden walls correlated with low levels of indoor radon and that the high levels occurred together with walls of alum shale light weight concrete and mixed materials of various kinds. It is of some intrest in this context, that also another study utilized just wooden versus non-wooden houses for creating an exposure contrast and obtained an indication of an increased lung cancer risk as associated with the latter exposure category (Damber and Larsson 1986).

Some other design features may also be mentioned in this context, regarding studies from the Stockholm area (Svensson et al 1987; Svensson 1988). Hence, the exposure classification of an individual took into account whether she (women only in these studies) had lived either in a detached house or at the bottom floor of a multifamily house, i.e. under circumstances resulting in relatively higher radon progeny exposure. Measurements were also made in some 10 per cent of the houses involved in the study. Geological information regarding the potential for leakage of radon from the ground could also be taken into account for assessing exposure.

At present, no definite recommendations can be made with regard to how measured levels and various other information about house characteristics should be integrated in estimating indoor radon concentrations over time. However, assumptions about radon progeny exposure based on the type of wall material as in some of the Swedish studies would obviously be difficult in countries, where the houses are built almost entirely from either stone or wood. Under such circumstances a proper

contrast in exposure might not even be achievable on the basis of house characteristics, so that more emphasis may have to be laid on measurements alone.

A summary of the results of Swedish studies on indoor radon

The first study of of the potential lung cancer risk from indoor radon encompassed 37 cases and 178 non-cancer controls from the period 1965 - 1977 (Axelson et al 1979). These subjects came from a background population of 11,300 individuals in ages of 40 and above. Taken together, individuals with a potential for elevated radon levels were estimated to have a risk ratio of 1.8 with a 90 per cent confidence interval (CI90) of 0.99 - 3.2 in reference to those who had lived in wooden houses without a basement, i.e. the reference category. Furthermore, a significant trend in risk ratios over categories of exposure was obtained.

The study from the island of Oeland (Edling et al 1984) involved only 23 cases of lung cancer and 202 controls as derived from an average annual population of 5,456 individuals in the appropriate ages for a 19 year study period. There was a significant trend in risk ratios both with regard to estimated and measured levels of radon progeny exposure. Smoking seemed to increase the risk of radon progeny exposure.

Another study was based on two sets of 30 pairs of lung cancer cases and controls, 15 pairs smoking and 15 pairs non-smoking and drawn from the Swedish twin registry and from the cancer registry, respectively (Pershagen et al 1984). The smoking cases from the cancer registry were found to have lived in houses with significantly higher estimated radon levels than the controls, whereas no difference was seen for the twins.

After adjustment for smoking and risk occupations, another of the studies (Damber and Larsson 1986) came out with risk ratios of 1.46 (CI95: 0.91 - 2.34) and 2.01 (CI95: 1.01 - 4.03) for those who had lived for 1 - 20 years, and more than 20 years, respectively, in non-wooden houses. Interestingly also, there was a relative predominance of squamous and small cell

carcinomas among those who had lived in non-wooden houses.

In the first study from the Stockholm area (Svensson et al 1986), 292 female lung cancer cases of the oat-cell or other anaplastic types and 584 population controls were drawn from the period 1972 -1980, all having lived for at least 30 years in Stockholm. Smoking was mainly controlled by means of information from outside the study and the risk ratio obtained was 2.2 (CI95: 1.2 - 4.0).

One of the more recent Swedish studies (Axelson et al 1988) was identically designed to the earlier study from the island of Oeland (Edling et al 1984) and, as already mentioned, also located to an area with alum shale deposits in the southern part of the country. This study encompassed 177 cases and 673 controls. Measurements were possible in 143 case houses but only in a sample of 251 control houses because of lack of funding. The risk ratios obtained over the exposure categories were 1.0, 1.5 and 1.8, respectively. Upon more detailed analyses, non-smokers, passive and occasional smokers in rural areas showed the most clear trend for the risk ratio in relation to categories of exposure, reaching 2.8 (CI90: 1.4 - 5.7). In contrast, the small urban sector included in this study, showed no clear pattern for the risk ratios in relation to indoor radon. Considering wall material and the associated measurements, there was a relatively good agreement between estimated exposure and lung cancer risk, whereas for merely measured radon progeny levels, there was some slight dose-response pattern only for the rural sector of the study.

The second study from the Stockholm area (Svenson 1988) involved 210 incident female lung cancer cases and two control groups, 209 matched population controls and 191 hospital controls. Exposure was assessed by estimation along with measurements in slightly more than 10 per cent of the houses held for more than two years by the subjects. Risk ratios of 1.8 and 1.7 were obtained for the medium and high categories of cumulated exposure, respectively. The strongest effect was seen for small cell carcinomas and the weakest for the adenocarcinomas. Squamous and small cell carcinomas taken

together reached a risk ratio of 3.1 in the highest exposure category. It may be added also, that the highest risks were found to operate among the smokers, but there was also negative confounding from smoking with regard to the effect of radon progeny exposure in this study.

On-going studies in Sweden in early 1990

At least three studies on the effect of indoor radon and lung cancer seem to be going on in Sweden when this report is written. Hence, one of the aforementioned studies in the Stockholm area (Svensson 1988) is further elaborated with regard to assessments of exposure. In Gothenburg, a study including 147 cases and 230 matched controls is reported to be under way (Larsson et al, to be published). The exposure assessment is based on interview information with regard to which houses the subjects had lived in along with existing information about radioactivity of the ground and various characteristics of the houses. Hence, the exposure assessment is rather much of the some kind as in some of the other studies reviewed above.

Finally there is a large scale study that has been running for some years and which is supposed to be finished in 1992. (Pershagen et al, to be published). This study involves 1,500 cases, i.e. all female lung cancer cases and a random sample of 40 per cent of the male lung cancer cases from the period 1980 - 1984 in certain areas of Sweden, chosen so as to involve geographical regions with both high and low radioactivity in the ground. A control group of 3,000 individuals has been drawn from the same regions, half of the group being deceased individuals. Information on recidency, occupation, and smoking will be obtained through questionnare interviews of the subjects or of their next-of-kins. Information about residency will also be obtained through the authorities responsible for the census information. The houses will be inspected and measured by the local health authorities, if hold by the subjects for more than two years since 1947 (until three years

prior to diagnosis or termination of the observation period).

The measurements will be made for three months in the winter season by encapsulated alpha-sensitive films as therefore reflecting the radon levels, only radon leaking into the capsules, where it decays so that the tracks are obtained from the progeny. With the measuring principles applied, the detection limit is supposed to be 10 kBqh/m^3 with a coefficient of variation of about 7 per cent. So far, and in one season, 1,445 homes have been measured, which is about 10 - 15 per cent of all anticipated measurements. is on 1,395 measured homes, the average radon progeny level is currently 68 Bq/m^3 EER (equilibrium equivalant radon), with 89 and 43 Bq/m^3 EER for the high and low geographical regions chosen for the study and (an equilibrium factor of 0,5 was assumed).

Even if this review is concerned only with the Swedish experiences, it may be mentioned, however, that quite a number of studies seem to be going on in various countries, mainly in Europe and North America with at least 10 and 14 studies, respectively. Two or more studies may be under way in other parts of the world, and almost all these studies seem to be of a case-control design (Workshop on recidential radon, Alexandria VA, USA, July 1989).

Some studies have also been reported from other countries than Sweden, most of them indicating some, but not always a totally clear effect with regard to lung cancer. These reports involve both case-control and correlation studies, but no clear-cut cohort study (as reviewed elsewhere; Axelson 1989). One larger study of female lung cancer has been preliminary reported from New Jersey (Schoenberg and Klotz 1989) and again suggests an effect from radon progeny exposure, but, similarly to one of the Swedish studies (Axelson et al 1988), with a somewhat unclear pattern regarding the effect on the smokers.

Attitudes and efforts to eliminate indoor radon

The problem of high indoor levels of radon has been subject to quite considerable interest from the Swedish authorities since the early 80s. For a few years, a formal standard of 400 Bq/m^3 EER was observed for radon progeny but was then changed into more diffuse recommendations, however still suggesting measures of elimination to be undertaken at this level of exposure on an annual basis. Currently a radon progeny level of 200 Bq/m^3 EER is considered as a more reasonable limit. In newly built homes, the radon progeny level may not exceed 70 Bq/m^3 EER and in addition the gamma radiation is supposed not to be more than 50 uR/h. In recent years, cheap loans have become available for house-owners with radon problems and also subsidies up to 50 per cent of the costs for improving the situation have been offered, but with a maximum of SEK 15,000 (about USD 2,400).

Usually it has been relatively easy to eliminate most of the indoor radon pollution by sealing off leakage from the ground and by improving ventilation to at least about 0.5 air exchanges per hour, especially as many newer houses have a much lower ventilation rate in order to save energy. It is important, however, not only to simply increase the capacity of the kitchen fan, but also to arrange inlets for fresh air, as otherwise heavily radon contaminated air from underneath the slab or basement floor may be sucked into the house, even worsening the situation.

Sometimes it may be necessary to also install a fan, evacuating air from underneath the slab or basement floor or from "radon wells", dug out in the ground just outside the house, thus depleting the radon concentrations under the house. In new constructions, some sort of plastic sealing against the ground may become necessary if high radon emanation is occurring.

The attitudes of the population towards the radon problem have not been studied to any greater extent, but for example, based on a simple inquiry in the early 80s to 208 owners of

houses with radon progeny levels exceeding 400 Bq/m^3 EER (88 per cent responding), some steps were reported to have been taken towards elimination in 45 per cent of the houses, particularly by younger house-owners with children (Jansson et al 1989). Only 38 per cent were reasonably convinced about a risk of lung cancer, however, 36 per cent were uncertain and 26 per cent did not really believe in a risk at all.

Epilogue

Even if the interst for indoor radon in Sweden has been rather great since the late 70s, it is only recently that more convincing results have been obtained through epidemiologic studies, that there actually can be a risk in this respect. The hesitation to accept the possibility of a risk has also been reflected in the difficulties to obtain funding for this sort of studies. Hence, it may be mentioned that the Swedish Cancer Fund first totally rejected an application for money regarding one of the larger studies conducted so far (Axelson et al 1988), then in a later application provided SEK 100,000 as less than one third of the amount needed for the originally intended measurements and as applied for. Now, however, the on-going large scale study, as earlier referred to, has a budget of about a hundred times as much although the study size is only slightly more than five times as large with regard to the number of subjects involved, so funding seems to have become more generous.

However, there are also other problems besides radon with regard to the idoor environment in Swedish homes as probably in other countries as well. Moisture and moulding is one such problem, again dependent on reduced ventilation in order to save costs for heating, but to some extent also depending on various new construction techniques, which have turned out to be inadequate in some repects. Nor should the concerns about passive smoking be forgotten, especially as the environmental smoke particles seem to attract the radon progeny particles, thereby increasing the radioactivity of the air and possibly

also the risk of indoor radon in spite of a reduction of the unattached radon progeny, usually thought of as exerting most of the cancer effect. (Bergman et al 1986).

Another problem may finally also be mentioned as closely related to the radon aspect, namely the increased gamma radiation, that occurs in many homes due to stony building materials and as found to possibly be responsible for avoidable cases of acute myeloid leukemia. This is a concern at least when judging from a number of studies in this respect in Sweden (Flodin et al 1986; Flodin and Axelson 1988) and also in view of the increased risk estimates for gamma radiation now presented by the new BEIR report (1990). Hence, many aspects of the indoor environment may be worth further studies.

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POINT OF VIEW OF THE BELGIAN ASSOCIATION FOR RADIATION PROTECTION ON THE ISSUE OF RADON IN BELGIUM [1]

L. de Thibault de Boesinghe,
Service of Occupational Medicine
Ghent State University
B-9000 Gent (belgium)

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1. INTRODUCTION

Radon is a one of the decay products in the chain of natural uranium. It is a radioactive inert gas and it is present in the soil.

The major contribution to radon in buildings originates from the soil and enters the dwelling through cracks or fissures in foundations and cellars, where the higher concentrations are located. The load of radon can also be raised by exhalation from some building materials.

Radon disintegrates into radioactive, solid products, which through inhalation are partially deposited in the bronchial tree, resulting in a significant lung dose. Better thermal insulation of buildings seems to raise the indoor radon concentration.

The issue at hand is the assessment of the radon situation, the estimation of the resulting population dose and the eventual remedial actions to be taken.

2. SCOPE OF THE EXPOSURE TO RADON

The principal authoritative source concerning the evaluation of exposure to ionizing radiation is the United Nations Scientific Committee for Exposure to Ionizing Radiations (UNSCEAR). In its 1988 publication (Ref.1) it is stated that exposure to radon is the most important source of ionizing radiation for the general public. The world average exposure to radon is assesed to be from 38 % to 46 % of the total dose (effective dose equivalent) depending on the dose attributed to medical

1 Draft proposed by a task group of the Office of the Association and approved by the Office at the meeting of June 30 1989.

applications. Individual exposure to radon may vary strongly, depending on the characteristics of the soil, the type of the building and related factors.

With reference to the regulations of protection against ionizing radiation, the highest registered radon concentrations result in doses considerably exceeding the maximally permitted values for members of the public. Even the limits for professionally exposed workers at some locations are exceeded.

The available measurements indicate that the concentration of radon in Belgian dwellings is generally higher than the global mean deduced by UNSCEAR. This would imply that radon is responsible for probably more than half of the exposure of the Belgian population. Moreover, in Belgium, some buildings have been identified with indoor radon concentrations one hundred times higher than the national average. Consequently the concerned inhabitants receive three to four times the limit dose determined for workers, depending on the time spent indoors.

3. HEALTH CONSEQUENCES OF THE EXPOSURE TO RADON

The dose-effect relation for exposure to ionizing radiation is still the object of large scale research. The International Commission on Radiological Protection (ICRP) (Ref.2) established a task group to investigate the risk of lung cancer resulting from inhalation of radioactive decay products of radon.

This task group concluded that the average radon concentration in moderate climate zones, could be responsible for 10 % of the lung cancer incidence. This would mean that, for Belgium, about 600 lung cancer cases per year are attributable to radon.

The ICRP-task group also stressed the need of confirming this risk assessment or improving it by further epidemiological research.

4. CONTROVERSY CONCERNING THE RADON ISSUE

In spite of the objective data above mentioned , the radon problem is approached rather divergently. Generaly reserve is based on two major considerations. First, the exposure to radon would be unavoidable as such, as part of our natural environment. Secondly there seem to be doubts on the epidemiological basis of the radon risk.

These two conciderations will be considered hereafter.

5. CONTROL OF THE RADON EXPOSURE

The principles of radioprotection, particularly the justification of the application, the optimization of the protection measures and the fixation of dose limits, may only be applied as far as the source is controllable.

In the case of radon we see that the unavoidable load of radon can be considerably increased by a stay in buildings. It is only this incidental burden that is considered for control. It appears however that relatively simple means may limit this increase. The study of these means, their feasibility and economical implications fit in the scope of the so-called ALARA-principle (As Low as Reasonably Achievable, taking into account the social and economical consequences). It is clear that, in the transfer of this problem to the public, one has to take into account the fact that there is a residual natural risk which has to be accepted anyway.

6. THE EPIDEMIOLOGICAL BASIS OF THE RADON RISK

The uncertainty of the effect of low exposure is valid for many problems for which radiation protection standards are applied, such as routine exposure of workers and the environmental load. This does not prevent regulating this exposure within a conservative framework.

However, the relatively high inferred collective dose, as a consequence of radon, tempts to effectively demonstrate the radon risk by means of epidemiological studies. Such studies are important since they can show the potential existence of a dose threshold, under which no effects exist, or even of a hormesis-phenomenon (positive effect of low doses) and of a synergism between the exposure to radon and other pollutants (such as tobacco-smoke). The conclusions of such a study could have a drastic effect on the general principles of radioprotection. The uncertainty on the exact value of the currently used risk factors is a stimulus for further research rather than an argument to relativize the problem.

7. PRESENT KNOWLEDGE ON THE RADON SITUATION IN BELGIUM

Since some ten years the radon problem is part of the program of different research groups in our country. A central role is assumed by a task group at the State University of Ghent (RUG). It has treated various aspects in cooperation with one or more research institutions in the country and abroad:

* Fundamental research aimed at decreasing the uncertainty about the present risk assessment is conducted in the framework of a contract with the European Community (1982-1989) and is carried out in close collaboration with the National Radiological Protection Board (NRPB U.K.), and with different foreign university teams.
* Exhalation of radon by building materials has been studied in collaboration with the Scientific and Technical Center of the Building Industry (WTCB) and has been supported by the Institute for Encouragement of Scientific Research in Industry and Agriculture (IWONL) (1984-1988). From this study it became clear that the contribution from building materials in our country is only of minor influence.
* Assessement of the contribution by the soil to the radon concentration in the indoor environment is studied in collaboration with the geological service of the "Faculté Polytechnique de Mons".
* Epidemiological research is carried out in collaboration with the "Université Catholique de Louvain" (UCL), the "Commission de l'Energie Atomique" (CEA)(France), the University of Wuppertal (F.R.G.), the Imperial Cancer Research Fund (ICFR U.K.) and the Ministry of Public Health of the Grand Duchy of Luxemburg. This research is supported by the European Community and by the National Fund for Scientific Research (NFWO).

At international level, standards are already applied proposing to envisage remedial action in houses above a certain reference level. In the United States e.g. this action level is set at 150 Bq/m^3, whereas the ICRP and the World Health Organization (WHO) have proposed 400 Bq/m^3 .

This corresponds respectively with one and three times the dose limit for the population, taking into account an occupancy factor of 80% . Based on the available measurements it is expected that in Belgium some 100.000 houses exceed the American action level and some 10.000 houses the ICRP-WHO standard. A number of such buildings are already identified but only a systematic measurement campaign can reveal the problem cases. Measurements have to be done in particular in those areas where an enhanced risk exists according to the subsoil geology .

8. ADVICE FOR AN ACTION PLAN

The Belgian Association for Radioprotection recomments that also in Belgium a policy should be followed to evaluate, according to the ALARA-principle, the controllable part of the dose due to natural sources. It is therefore it is necessary :

* to increase the knowledge of radon exposure in buildings by an organized measurement campaign,
* to examine measures for the sanitation of the identified problem buildings,
* to establish standards for existing and future constructions based on the knowledge of the exposure levels and on the evaluation of the feasibility of sanitation measures.

Moreover, the Association is of the opinion that Belgium has to contribute to the international efforts aimed at a better assessment of the real risk of exposure to radon, by means of epidemiological research.

This action plan is only possible if the present expertise on radon can be maintained.

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Abstract

The Belgian Radiation Protection Association holds the view that in Belgium a policy must be conducted to manage, according to the ALARA-principle, the controllable part of the dose issued from natural sources.
Therefore is important to:

- increase the knowledge of radon situation in Belgium by organizing a national survey;
- examine measures to revamp in priority the identified problem buildings;
- set standards for the existing and new dwellings based upon the acquired knowledge of the exposure levels and the evaluation of the feasibility of mitigation techniques.

Moreover the Association is of the opinion that Belgium must provide a contribution to the international efforts for a better assessment of the risks of exposure to radon by means of epidemiological research. This action plan is only possible if the current expertise concerning the radon problem is maintained.

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THE RADON STUDY PROGRAMME OF THE CEC AND THE APPROACH BY CERTAIN COUNTRIES

Dr. M. OLAST & J. SINNAEVE
Commission of the European Communities
DG XII, D-4 Rue de la Loi, 200
B- 1049 Brussels

March 13, 1990

1. Introduction

Over the past ten years, the European Community Radiation Protection Programme stimulated and supported research dealing with the modalities and the consequences of exposure to radon and to its daughter products.

Between 1980 and 1984, most efforts were allocated to assess the extent and the distribution of exposure to radon within the Member States. This was done through national and regional surveys and yielded a reliable picture of the average exposure of the European Population, the exposure distributions at regional and national levels and an indication of regions more exposed than the average. A comprehensive idea of the present situation will be given. In the frame of the 1985-1989 research programme emphasis was given to the study of parameters and processes underlying the level of exposure to radon in order to increase our understanding of the physical and biological processes and to develop practical and cost- effective remedial actions; the main results will be presented.

In the ongoing 1990-1991 programme, priorities were given to three main lines of research involving three large international contracts; the first one deals with radon sources, modelling and remedial actions, the second one with physio-chemical studies, indoor radioactive aerosols behaviour, the base for health effects and the third one with the retrospective assessment of indoor exposure to radon, this will be presented in details. Finally an overview of the regulatory aspects will be given.

2. Indoor exposure to radon and its daughter

As mentioned before most efforts were devoted, during the 1980-1984 period to national and regional surveys of radon/radon daughters exposures carried out in in the Member States. The objective were (i) to determine the general distribution of radon concentrations and to search for correlations between concentration and some relevant parameters (ii) to determine the magnitude of individual exposures and the likely number of dwellings in which exposures might be high enough to justify remedial action. The table 1 gives reported mean or median indoor radon concentrations. These mean values do not lead to direct health concern, though the reported ranges, according to a log-normal distribution indicate a tail end of the concentration distribution that leads to rather high exposures 2000 $Bq.m^{-3}$ corresponds to an annual effective dose equivalent of 100mSv (using the most recent conversion factor).

3. The 1985-1989 research programme : main issues

During this period, emphasis was placed on the study of parameters and processes underlying the level of exposure to radon. The research priorities have been grouped in four categories :

- physico-chemical properties of the radon daughters
- processes underlying the radon ingress
- improvement of lung dosimetry and health effects
- development of remedial actions

3.1. Physico-chemical properties of the radon daughters

Studies were carried out to evaluate the charge and size of the aerosol particles and their dependence on environmental conditions. This research is done through modelling approaches supported by experimental work. The significant results obtained in this field are the following:

- the mean aerodynamic median diameter of the aerosols (AMAD) of the outdoor size distribution (AMAD 370 nm) is significantly shifted to greater diameters compared with the indoor results (AMAD 190nm) due to different plate out and coagulation rates;

- the equilibrium factor indoor is generally around 0.3 without additional sources and may increase up to 0.5 if cigarette smoke or other aerosol sources are present;

- the mean unattached fraction measured inside is significantly larger than outside (0.1 versus 0.02); as a consequence the use of the mean f_p of 0.03 used in dosimetric models for both atmosphere is no longer valid.

- it was suggested that the large spread in the values for deposition rate of the unattached fraction reported in the litterature is partly due to the assumption of a steady state situation while any disturbance (closing a door or a window e.g.) influence this deposition rate during hours.

3.2 Radon ingress

The major source of radon, exception made for some particular conditions, is the soil underlying the structure. The radon emanation from the soil was studied; diffusion model calculation showed an increase by about a factor of five for the radon concentration in the crawl space if the groundwater level is lowered from 10 cm below the surface to 50 cm (due to draining e.g.).

Radon ingress into dwellings through cracks or holes was modelled and the influence of several factors (such as pressure difference) was studied. Radon exhalation from building materials was also considered from a theoretical and practical point of view.

3.3. Improvement of lung dosimetry and health effects

Aerosol transport and deposition in the respiratory tract, with special attention to the upper one was investigated. This was done using a hollow anatomical cast and monodisperse aerosol particles in a range of 6 to 150 nanometers. It was shown that for particle diameters above 20 nanometers, only a small fraction is deposited in the nasal airways and penetration is almost complete. However below this size deposition in the upper tract increases rapidly and drastically for particle sizes below 10 nanometers. It is therefore suggested that half of the unattached fraction (size 1 to 3nm generally) is deposited in the nose.

The equilibrium factor, F, generally increased with aerosol concentration. This will lead to an increase penetration of the radon daughters and to a higher total exposure to potential alpha energy for a given concentration of gas. However, the fraction of the exposure associated with unattached progeny decreases dramatically for high equilibrium factors (f_p decreases and we must remember that the dose conversion for particles of 500 nanometers is approximately 50 times less than for the unattached daughters). The overall effect of these changes, calculated by a model developed during this period, is that the dose rate is not correlated with the equilibrium factor and on this basis a single conversion factor between radon gas and bronchial dose rate can be recommended. A value of approximately 50 microSieverts annual effective dose equivalent for 1 $Bq.m^{-3}$ radon gas concentration appears to be appropriate.

3.4 Development of remedial actions

Effectiveness of exposure and dose reduction by conventional filtration, electrofiltration and electrostatic plate out have been assessed. Usual mitigation measures such as crawl-space ventilation, sub-floor depressurisation are planned in some houses in Belgium in which indoor radon levels as high as 4.000 $Bq.m^{-3}$ were disclosed. Durability and reliability of these actions will be studied.

Two structures have been erected on a soil with high Ra-226 content, one with a concrete slab floor, used as a reference, the other one with a ring-beam foundation used as a test structure able to be fitted sequentially with a variety of floor types.

4. The 1990-1991 research programme : main priorities

The priorities given in the new programme in the field of "Exposure to natural radioactivity and evaluation of parameters influencing these risks" were well addressed by numerous proposals and in this respect three main lines of research were drawn up involving three large international contracts. The three topics are the following :

- sources, modelling and remedial actions
- physico chemical studies, radioactive aerosol behaviour, base for health effects
- retrospective assessment of indoor exposure to radon

4.1. Sources, modelling and remedial actions

These three items are interrelated and grouping them leads to a coherent and comprehensive research which aims at three goals.(1) To develop and test techniques for identifying areas with a potential for high radon concentrations in homes (and other buildings), both on large scale and for individual building sites.(2) To improve the understanding of, and to develop mathematical models for describing of the movement of radon from the ground to sub-floor spaces and into buildings.(3)To develop and test remedial actions against radon in homes using laboratory and field studies.

For this purpose appropriate geological and radiological parameters (such as mineral distributions, radionuclide contents, underground water flows, soil permeability and so on) for potential radon mapping procedures will be identified. The power of mapping procedure to identify previously unrecognised areas of high radon potential will be tested.

Mathematical models of radon movement in the soil, into buildings through subfloor spaces where present, and subsequent dilution and dispersion will be further developed. As a matter of fact the complexities associated with the radon transport of radon from soil into buildings (e.g. the importance of the soil/building interface, the driving mechanism for entry routes,...) indicated that mathematical models may assist to attain a better understanding of the effects and of the assessment and importance of the various influencing factors. These models will be compared with measurements and will be used to identify the most important parameters for measurement in assessing radon problems in homes.

4.2 Physico-chemical studies, indoor radioactive aerosols behaviour, base for heath effects.

It is already well known that the inhalation of the short-lived radon daughters (Rn-222 and Rn-220) yields the largest share of the natural radiation exposure of the population. However, the quantification of this risk is far from being exactly assessed; two of the most important parameters used in the dosimetric models and on which the uncertainty is the greatest are the particle size and distribution of the aerosol-attached activities, and the particle size and quantification of the "unattached" activities.

Recent findings in this field tend to prove that these parameters measured in the domestic indoor environment are very different to those measured in the outdoor or in the mining environment or to those proposed in the literature.

As a consequence the characteristics of the radon daughter aerosols deserve further research : the influence of trace gases and relative humidity on the particle growth and on dynamics of cluster formation, the deposition rates, and the influence of the already existing particles in the air on the cluster formation are among the most important items to be studied. In addition to experimental work, model calculation will be developed to understand the influence of these parameters on the activity concentrations.

4.3 Retrospective assessment of indoor exposure to radon

This item is very innovative and can bring interesting results of major importance for epidemiological studies. The discovery that Po-210/Pb-210 can be used as indicators for long-term indoor radon exposure levels has put potential long-term time integrating radon detectors in all houses that have any kind of glass sheets.

The experimental results obtained so far are very promising about the usefulness of the method, but future investigation are needed to assess the inherent variability in the method. The objective of this research is to study the chain of processes which in the indoor environment leads from airborne radon to embedded long-lived daughters. Variations in the radon daughter plate-out and other phenomena influencing this transfer of activity from radon in air to absorbed Po-210 in hard materials will be studied. The work will be focussed on plate-out exposures, under well controlled laboratory conditions, comparisons of the experimental results with model calculations and the development of non destructive techniques for the measurements of embedded Polonium-210.

4.4 Epidemiological study

The Ardennes and Eifel region is selected as study area for a common European project, as out of national and regional surveys it bacame clear that in this region the range of indoor exposure levels is quite large. Moreover in this region an important fraction of the population is living in high radon houses. In each of the participant countries, Belgium, France, Germany and Luxembourg cases and controls will be collected in a series of hospitals of this region. The cases will be selected in the departments of pneumology, bronchoscopy and thoraxsurgery. Only histologically confirmed cases will be included in the study.

As controls, comparable groups of hospital patients will be considered. In order to arrive at statistically significant results, some 1200 cases and 3600 controls will be considered. Other lung cancer related factors like active and passive smoking, occupational exposure, indoor and outdoor pollution and nutritional habits, will be taken into consideration through interviews.

5. Regulatory aspects

In most Member States, the issue of indoor exposure to radon and its daughters has attracted the attention of the radiation Protection Community. Policies are being discussed and recommendations are being formulated but a fully implemented regulatory framework is yet to be put into practice.

At the international level, several organizations formulated recommendations with respect to indoor radon exposure. The International Commission on Radiological Protection gradually modified its attitude towards radon exposure. In 1966, publication 9, stated that "... any dose limitations recommended by the Commission refer only to exposures resulting from technical practices that add to natural background radiation". In 1977, paragraph 89 of publication 26 states that "... there is no sharp dividing line between levels of natural radiation that can be regarded as "normal" and those that are more elevated owing to human activities or choice of environment. There will therefore be instances in which judgement will have to be exercised as to whether the component of increased natural radiation should or should not be subject to the Commission's recommended system of dose limitation.
The terms "normal" and "elevated" became subject of diverging interpretations and the need for a more precise distinction among exposure situations was felt. In 1984, in its publication 39, ICRP introduced the principle of "controllability" and made a distinction between "existing" and "future" exposure situations. For existing exposure conditions, an action level for the introduction of simple countermeasures was set at 200 $Bq.m^{-3}$ equilibrium equivalent radon or 400 $Bq.m^{-3}$ radon gas (F=0.5). For future exposure situations, an upper bound 2 times lower was thought to be reasonable.

The World Health Organization in 1985 formulated some recommendations:

- if simple means are possible, buildings with radon daughters (it is to say the EER) concentrations of more than 100 $Bq.m^{-3}$ as an annual average should be considered for remedial actions;

- prompt remedial actions should be considered for buildings with an annual average radon daughters concentration higher than 400$Bq.m^{-3}$

- building codes should be drafted to avoid exceeding 100 $Bq.m^{-3}$ EER in new buildings and should prescribe appropriate practices.

Within the Community, in 1985 the Article 31 Group of Experts created an ad hoc working group to assess the situation with respect to indoor exposure from radon. The ad hoc group reported back to the plenary Article 31 Group and at its meeting of February 1988, a set of recommendations were approved. These recommendations are now adopted and it is the Commission's intention to have them published as "Recommendation of the Commission". The following statements are made :

- an appropriate system shall be established for limiting exposure to indoor radon concentrations;

- for existing housing :

  (a) A reference level for consideration of remedial action shall be used which, where exceeded, shall be cause for consideration of simple but effective measures aimes at reducing the radon level. It should not be used for the purposes of legal regulation.

  (b) The reference level shall be an effective dose equivalent of 20 mSv per annum, which for practical purposes, may be taken as equivalent to an annual average radon gas concentration of 400 $Bq.m^{-3}$.

(c) The urgency of the remedial action shall take account of the extent to which this reference level is exceeded.

- for future housing :

  (a) A design level shall be used to aid the relevant authorities in establishing regulations, standards, or codes of constructions practices for circumstances under which the Design Level might otherwise be exceeded.

  (b) The Design Level shall be an effective dose equivalent of 10 mSv per annum, which for practical purposes, may be taken as equivalent to an annual average radon gas concentration of 200 $Bq.m^3$.

- When remedial or preventive measures are being determined, the principles of optimisation shall be applied in accordance with the Community Basic Safety Standards.

- Because of diurnal and seasonal variations of indoor radon levels, radiation protection decisions should in general be based on the annually-averaged measurements of radon gas or daughters in affected houses using time integrating techniques. The competent authorities shall ensure that the quality and reliability of measurements are adequate.

- Criteria should be developped for identifying regions, sites and housing characteristics likely to be associated with high indoor radon levels. Investigation levels for the underlying parameters (i.e. activity in soil and building materials, permeability of ground, etc.) could be used to identify such exposure circumstances.

At the national level, two Member States already took some action. In the Federal Republic of Germany, the Radiation Protection Commission (S.S.K.) recommended that the upper level of the radon gas concentration in room air should be fixed to 250 $Bq.m^{-3}$. This level should be considered as an action level for existing houses, as well as an upper bound for future housing. The commission however, put an emphasis on the fact that this level should not be considered as a legal mandatory which could have juridical implications.

In the United Kingdom, the NRPB published in 1987 an Advice standards for Protection with respect to indoor radon and proposed an action level for existing houses of 400 $Bq.m^{-3}$ and an upper bound for future housing of 100 $Bq.m^{-3}$ radon gas. Recently, early this year, NRPB published new recommendations wherein the distinction between existing and future housing was dropped, setting one single limit of 200 $Bq.m^{-3}$. It is estimated that some 75.000 dwelling will need remedial action.

Table 1

INDOOR RADON CONCENTRATIONS

COUNTRY	MEAN (Rn) $Bq.m^{-3}$		MAXIMUM $Bq.m^{-3}$
BELGIUM	50		4.000
DENMARK	50		12.000
FED.REP.GERMANY	49		6.000
FRANCE	44	*	12.000
GREECE	20		2.000
IRELAND	37	*	15.000
ITALY	25	*	5.000
LUXEMBOURG	40		78
NETHERLANDS	24	*	350
UNITED KINGDOM	22		16.000
SWEDEN	100		20.000

* Median Value

Abstract

Over the past ten years, the European Community Radiation Protection Programme stimulated and supported research dealing with the modalities and the consequences of exposure to radon and to its daughter products.
Between 1980 and 1984 most efforts were allocated to assess the extent and the distribution of exposure to radon within the State Members. In the frame of the 1985-1989 research programme emphasis was given to the study of parameters and processes underlying the level of exposure to radon in order to increase our understanding of the physical and biological processes and to develop practical and cost-effective remedial actions. In the ongoing 1990-1991 programme priorities are given to three main lines of research involving three large international contracts. The first one deals with radon sources, modeling and remedial actions, the second one with physico-chemical studies, indoor radioactive aerosols behaviour, the base for health effects and the third one with the retrospective assessment of indoor exposure to radon.
An overview of the regulatory aspects will also be given.

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EUROPE AGAINST CANCER
1987-1989 RESULTS AND 1990-1994 PERSPECTIVES

Dr.A. VANVOSSEL
Administrator -"Europe against Cancer" Program

March 13, 1990

In recommending the launch of a European Program for the fight against cancer in June 1985 at the European Council in Milan, the Heads of the State or Government of the European Community were acting as pioneers. In fact, up until that moment the involvement of the European Community had been limited to only two kinds of actions: firstly, the elaboration of standards of protection for populations against ionizing radiation, in the framework of the EURATOM Treaty, and against carcinogenic chemical substances, in the framework of the EEC Treaty, and secondly the prevention of occupational cancers, first of all in the coal and steel industries, in the framework of the ECSC Treaty, and later in all other sectors of activity, in the framework of the EEC Treaty. But it must be said that all these actions only focused on those factors implicated in less than 10 % of deaths by cancer, whilst we know that more than 75 % of cancers are linked to outside factors against which it is possible to act, as much on an individual , as on a national and international level.

From 1986 on, with the "Europe against Cancer" Program, the European Community was mobilized in areas other than those were it has a broad competence, as, for example, in the realization of a genuine Common Market. In addition, the Community has helped to strengthen cooperation between all actors, both public and private, in the fight against cancer in the 12 Member States of the European Community.

Between 1987 and 1989, during the first action plan of the Program, significant progress was made in the different action areas, these being the prevention of cancer, information and health education, training of health personnel, and medical research.

There were notable results in the area of prevention, particularly in the fight against tobacco, which is solely responsible for almost a third of deaths by cancer. Several proposals for Community texts were drawn up by the European Commission

and discussed by the European Parliament and the Council of Ministers of the European Community. Certain proposals were even adopted during this first action plan: the Council of Health Ministers adopted on 16 May 1989 a Resolution concerning the banning of smoking in public places. On 13 November 1989 it finally adopted a Community directive requiring the 12 Member States to modify, before 1 January 1993, their legislation on labelling of tobacco products, in order to make smokers more aware of the indisputable risks they are running, by printing clear medical warnings, such as "Smoking causes cancer" or "Smoking causes cardio-vascular diseases" on one of the two larger sides of cigarette packets.

As regards information and health education, the main result of the first action plan 1987-1989 was of course, the realization in 1989 of the "European Year of Information on Cancer", which mobilized all the Associations and Leagues against cancer, as well as the Ministries of Health and Education, in order to make the general public and young people in schools more aware of the European Code against cancer. This is an important step in attaining the objective of the "Europe against Cancer" Program, that of reducing the number of deaths from cancer by 15 % between now and the year 2000.

In the area of training of health personnel, representatives of all interested parties in the European Community have agreed upon a series of recommendations concerning the training of doctors, dentists and nurses in cancer. As well as this, a hundred doctors and nurses have benefited from training actions in European centers of excellence, in order to perfect their knowledge of screening and treatment of cancer.

Finally, cancer research has been "European-ised" thanks to the encouragement of exchanges of researchers (50 scholarships each year) and the coordination of clinical and fundamental research, specifically for cancer. Promising new paths of research have even been opened up in the field of improvement of radiotherapy.

Backed up by the satisfying results achieved up until now, the European Community action will continue throughout the next five years, based on a political decision which was officially adopted at the Council of Health Ministers on 13 November 1989. This decision will cover the following action areas:

In the area of prevention, the European Community will continue its legislative activity in the fight against tobacco, like restriction of tar content of cigarettes, strict reglementation on publicity, banning of oral smokeless tobacco, etc.). Particular emphesis will be given to pilot studies and actions on the links between nutrition and cancer, given the fact that nutrition could be at the root of a third of deaths by cancer. European prospective studies will allow the observation over a number of years of large population samples throughout the European Community. Due to the diverse dietary habits in our different countries, it will be possible to determine more precisely the links between certain aspects of diet and cancers of the breast or digestive organs.

The "Europe against Cancer" Program will also common progress in the field of screening, with the implementation of European pilot screening networks for breast and cervical cancer. In addition, evaluation studies on the efficiency of colon-rectal cancer screening will be completed.

Information and health education actions will continue to make the general public aware of the ten European commandments for cancer prevention.

Based on experience gained in 1988 and 1989, a great many actions on on-going training for doctors and nurses will receive financial support from the "Europe against Cancer" Program.

Furthermore, the next five years should see the first positive results of concerted actions on medical research, which have been going on since 1987 , in the form of pilot projects, notably experimental installations which will enable the treatment of patients by improved radiotherapy. Obviously efforts in coordinating medical research will be pursued and strengthened.

The Program places great emphasis on the fight against tobacco. However the issue of "passive smoking" has yet to be tackled. With its Resolution on the banning of smoking in public places, the Community tried to take a step forward, but at present the Member States are not yet convinced by pure scientific evidence. Seminars like these are therefore important and their conclusions must be made known to the public and to the decision-makers.

Because other Commission services such as DG XII and DG XI have a long tradition in radioprotection programs, the Program did not place specific emphasis on the Radon issue. Indeed, the Radon Program of the CEC provides the necessary framework for studies in this field. However, it is obvious that in the near future, the Program could be asked to undertake actions to implement the study results, as it did with its normative and legislative actions in the field of tobacco.

Even if legislative action seems premature today, the Program is ready to take the initiative, and, if necessary, to develop such actions in order to protect the European citizen. However, this means that close collaboration with scientists and the competent departments of the Member States will be necessary.

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TOESPRAAK DOOR DE HEER

ERIK DERYCKE

STAATSSECRETARIS VOOR WETENSCHAPSBELEID

EEN ONDERZOEKSPROGRAMMA INZAKE GEZONDHEIDSRISICO'S

MIJNHEER DE RECTOR,

DAMES EN HEREN PROFESSOREN,

GEACHT PUBLIEK,

ENKELE WEKEN TERUG WERD HET NATIONAAL ONDERZOEKSPROGRAMMA "GEZONDHEIDSRISICO'S" GOEDGEKEURD.
DIT PROGRAMMA IS SLECHTS EEN UITING VAN HET BELANG DAT WIJ HECHTEN AAN ONDERZOEK NAAR DE KWALITEIT VAN HET LEVEN.
ANDERE ONDERZOEKSPROGRAMMA'S DIE MET "QUALITY OF LIFE" TE MAKEN HEBBEN ZIJN, BIJVOORBEELD, "MAATSCHAPPELIJK ONDERZOEK" EN "GLOBAL CHANGE".
DE KOMENDE JAREN ZULLEN WIJ GEMIDDELD 700 MILJOEN PER JAAR SPENDEREN AAN ONDERZOEK DAT TE MAKEN HEEFT MET DE KWALITEIT VAN HET LEVEN, INCLUSIEF HET MILIEU.
DE STUDIEDAG VAN VANDAAG OVER HET ONDERZOEK DAT U VERRICHT NAAR RADON EN ROKEN, HEEFT ONDUBBELZINNIG MET DIEZELFDE KWALITEIT VAN HET LEVEN TE MAKEN.

EN PRECIES OMWILLE VAN DIE OVEREENKOMST TUSSEN UW EN MIJN BEZORGDHEID, HEB IK GRAAG AANVAARD U VANDAAG KORT TOE TE SPREKEN OVER ONS PROGRAMMA "GEZONDHEIDSRISICO'S".

WAAROM HECHT IK ZOVEEL BELANG AAN ONDERZOEK NAAR DE KWALITEIT VAN HET LEVEN ?

DE KWALITEIT VAN HET LEVEN ALS ONDERZOEKSPRIORITEIT IS GEEN REAKTIE TEGEN OF EEN AFWIJZING VAN TECHNOLOGIE OF EXACTE WETENSCHAPPEN.
WIJ LEGGEN DAT ACCENT OM DE VOLGENDE REDEN :
IN EEN SAMENLEVING DIE STEEDS STERKER STEUNT OP DE RESULTATEN VAN WETENSCHAP EN TECHNOLOGIE, OOK IN MONDIAAL-EKONOMISCH

PERSPEKTIEF, LIJKT HET ME NIET GEPERMITTEERD TE DOEN ALSOF DIE VERWETENSCHAPPELIJKING GEEN INVLOED HEEFT OP HET MAATSCHAPPELIJK GEBEUREN.

INTEGENDEEL : WETENSCHAPPELIJKE EN TECHNOLOGISCHE PRIORITEITEN ZIJN IN WEZEN MAATSCHAPPELIJKE KEUZES.
ALS U MET MIJ AKKOORD GAAT OM TE ZEGGEN DAT

1. WETENSCHAP EN TECHNOLOGIE NIET ZOMAAR GELEID WORDEN DOOR EIGEN, INTERNE WETMATIGHEDEN,
2. DAT ZIJ ZICH DUS NIET NAAST OF ONAFHANKELIJK VAN HET MENSELIJKE EN SOCIALE KUNNEN ONTWIKKELEN,
3. DAT HET DERHALVE FOUT ZOU ZIJN TECHNOLOGIE EN WETENSCHAP ALS STAND-ALONES TE STIMULEREN,

DAN IS METEEN OOK UITGELEGD WAAROM WIJ VOLGENDE TWEE BELEIDS-OPTIES ONTZETTEND BELANGRIJK VINDEN :

1. VOOREERST MEEN IK DAT ELK ONDERZOEK EEN GEINTEGREERD LUIK MOET BEVATTEN DAT SOCIALE, EKONOMISCHE, JURIDISCHE EN ANDERE GEVOLGEN VAN DATZELFDE ONDERZOEK NAGAAT.
   EEN INGEBOUWDE FEEDBACK DUS.

2. ONDERZOEK NAAR DE KWALITEIT VAN HET LEVEN MOET AN SICH WORDEN GESTIMULEERD, VANDAAR PROGRAMMA'S ALS GLOBAL CHANGE, ANTARCTICA, TRANSPORT, MAATSCHAPPELIJK ONDERZOEK EN GEZOND-HEIDSRISICO'S.

BOVENDIEN ACHT IK HET BELANGRIJK DAT BEPAALDE ONDERZOEKEN BELEIDSRELEVANT OF BELEIDSVOORBEREIDEND ZIJN, D.W.Z. DAT DE RESULTATEN VAN WETENSCHAPPELIJK ONDERZOEK DIENSTIG ZIJN VOOR DECISION-MAKERS.
TOT DAAR DE ALGEMENE FILOSOFIE WAARIN HET PROGRAMMA "GEZONDHEIDS-RISICO'S" KADERT.

NU WAT MEER OVER HET PROGRAMMA ZELF.
HET PROGRAMMA "GEZONDHEIDSRISICO'S" VERTREKT VAN EEN ZORGWEKKENDE CONSTATERING :
TERWIJL DE MODERNE LEVENSWIJZE, EN VOORAL DE INBRENG VAN WETEN-SCHAPPELIJKE EN TECHNOLOGISCHE VORDERINGEN, GELEID HEEFT TOT EEN

HOGERE LEVENSVERWACHTING EN DE UITSCHAKELING VAN EEN HELE REEKS ZIEKTEN, STELLEN WE NIETTEMIN VAST DAT DE MODERNE MENS BLOOTSTAAT AAN EEN SERIE RISICO'S DIE ZIJN GEZONDHEID DAN WEER BEDREIGEN. VEEL VAN DIE RISICO'S VLOEIEN VOORT UIT WETENSCHAPPELIJKE EN TECHNOLOGISCHE VOORUITGANG.

TOT NU TOE HEEFT MEN TE VEEL DE NEIGING VERTOOND OM DE VOORDELEN VAN DE MODERNE LEVENSWIJZE VEEL BELANGRIJKER IN TE SCHATTEN DAN DE NADELEN, DIE TOT EEN SOORT ONGEMAKKEN EN ONONTKOOMBARE BIJVERSCHIJNSELEN WERDEN GEDEGRADEERD.
HET UITGANGSPUNT VAN DE GANGBARE ZIENSWIJZE LUIDT EIGENLIJK DAT DE TECHNOLOGIE ALS PRIORITAIR EN ONONTKOOMBAAR MOET WORDEN BESCHOUWD EN DAT EVENTUELE BIJWERKINGEN ACHTERAF MOETEN WORDEN WEGGEWERKT.

DEZE ZIENSWIJZE KAN ECHTER ALLEEN DAN STANDHOUDEN WANNEER DE MATERIELE VOORDELEN VAN TECHNOLOGISCHE VOORUITGANG HOGER WORDEN AANGESLAGEN DAN DE KWALITEIT VAN HET LEVEN.
MAAR NA TSJERNOBYL, SELLAFIELD, DE EXXON-RAMP IN ALASKA, HET AMAZONEWOUD, DE ZURE REGEN, HET GAT IN DE OZONLAAG ENZ., IS MEN EEN IETSJE MINDER GERUST IN DE ALLESZALIGMAKENDE EN SACRALE WAARDEN VAN TECHNOLOGIE EN ZOGENAAMDE VOORUITGANG.
MEN KAN ZICH AMPER HET EFFECT VOORSTELLEN VAN EEN VERALGEMENING VAN ONZE LEVENSWIJZE VOOR DIE VIER MILJARD ANDERE PLANEETGENOTEN.

MEN HOEFT ECHT GEEN ANTITECHNOLOGISCHE REFLEX TE ONTWIKKELEN OM TE MOETEN TOEGEVEN DAT HET SALDO NIET ZONDER MEER BATIG IS.
VANUIT DIE OPTIEK WERD HET ONDERZOEKSPROGRAMMA "GEZONDHEIDSRISICO'S" OPGEZET.
DE KERN VAN HET ONDERZOEK DRAAIT ROND DE VOLGENDE VRAAG :
WELKE ZIJN DE MOGELIJKHEDEN EN DE GEVOLGEN VAN BESTAANDE EN NIEUWE TECHNOLOGIEEN VOOR DE GEZONDHEID ?
DIE KERNVRAAG WORDT OP DRIE SEGMENTEN VAN DE SAMENLEVING GEENT :

1. GEZONDHEIDSRISICO'S IN HET ARBEIDSMILIEU
2. GEZONDHEIDSRISICO'S IN HET MILIEU, INCLUSIEF HET THUISMILIEU.
3. GEZONDHEIDSRISICO'S IN VERBAND MET VOEDING.

HET DOEL VAN HET PROGRAMMA BESTAAT ER NIET ENKEL IN MODELLEN OP TE STELLEN DIE PREVENTIEF KUNNEN WERKEN, MAAR OOK OM DE TECHNOLOGISCHE GEZONDHEIDSRISICO'S TIJDIG TE KUNNEN INSCHATTEN IN HET MILIEU, HET ARBEIDSMILIEU EN DE VOEDING.
DE VRAAG LUIDT DUS NIET ALLEEN HOE WIJ PREVENTIEF TE WERK MOETEN GAAN OM DE GEZONDHEID TE VERBETEREN, MAAR VOORAL HOE WIJ DE TECHNOLOGIE ZELF PREVENTIEF MOETEN AANPAKKEN.
EN DIE BEZORGDHEID MOET DAN WEER VERDER GAAN DAN HET OPSTELLEN VAN STRENGERE NORMEN OF STANDAARDEN.
EIGENLIJK SPREKEN WE NU AL OVER TECHNOLOGY ASSESSMENT, DIT WIL ZEGGEN : DE GEVOLGEN - POSITIEVE OF NEGATIEVE - VAN TECHNOLOGIEEN INSCHATTEN IN EEN ZO VROEG MOGELIJK STADIUM, NAMELIJK OP EEN MOMENT DAT NOG ANDERE KEUZES GEMAAKT KUNNEN WORDEN.

HET IS DAN OOK GEEN TOEVAL DAT WIJ ONDERZOEK OVER TECHNOLOGY ASSESSMENT HEBBEN OPGENOMEN IN HET PROGRAMMA "MAATSCHAPPELIJK ONDERZOEK".
HET IS PRECIES HIERIN DAT WETENSCHAPSBELEID ZICH MOET ONDERSCHEIDEN VAN ANDERE DEPARTEMENTEN DIE MET GELIJKAARDIGE PROBLEMEN TE MAKEN HEBBEN.
VAN ANDERE DEPARTEMENTEN KUNNEN EN MOETEN WIJ VERWACHTEN DAT NORMEN WORDEN OPGESTELD, DAT BEPAALDE PRODUKTEN WORDEN VERBODEN OF VERBETERD, DAT TECHNOLOGIE WORDT INGEZET OM HET MILIEU ZUIVERDER TE HOUDEN, ENZOMEER.
IK DENK AAN NORMEN VOOR UITLAATGASSEN OF TEST- EN CONTROLEAPPARATUUR IN HET ALGEMEEN.
WETENSCHAPSBELEID GAAT ANDERS TE WERK : WIJ WERKEN OP LANGERE TERMIJN EN BEOGEN HET BELEID ONDERZOEKSRESULTATEN MEE TE GEVEN DIE PRAKTISCHE BESLISSINGEN ONDERSTEUNEN AAN DE HAND VAN WETENSCHAPPELIJKE GEGEVENS.

WIJ KUNNEN HET ONS NAMELIJK OOK ECONOMISCH EN SOCIAAL NIET LANGER PERMITTEREN EERST NIEUWE TECHNOLOGIEEN IN TE VOEREN EN DAN MET ENIGE VERTRAGING DE NEGATIEVE UITWASSEN ERVAN BINNEN DE PERKEN PROBEREN TE HOUDEN.

BIJGEVOLG WORDT HET NOODZAKELIJK DAT DE GEPLANDE INVOERING VAN NIEUWE TECHNOLOGIEEN TIJDIG EEN PRO- EN CONTRA-ONDERZOEK ONDERGAAT OM DE MOGELIJKE GEVOLGEN PRECIES IN TE SCHATTEN. DEZE "SCREENING" IS GEEN LUXE, MAAR MOET HET BOOMERANG-EFFECT ONTZENUWEN.

HET BOOMERANG-DENKEN UIT ZICH OOK IN DE ZIEKTEVERZEKERING, DIE IN FEITE EEN SCHADELOOSSTELINGSSYSTEEM IS. WIJ MOETEN ONS DURVEN AFVRAGEN OF DE TOENEMENDE INVLOED VAN TECHNOLOGIEEN NIET TOT EEN NIEUW CONCEPT MOET LEIDEN, NL. EEN SOORT VEILIGHEIDSRECHT DAT DE JURIDISCHE VERTALING IS VAN "BETER VOORKOMEN DAN GENEZEN".
ZO U WIL : EEN GEZONDHEIDSVERZEKERING IN PLAATS VAN EEN ZIEKTE-VERZEKERING.
WANNEER DE GEZONDHEIDSZORG ONBETAALBAAR DREIGT TE WORDEN, HEEFT DAT OOK TE MAKEN MET EEN VERKEERDE OF EEN GEBREKKIGE INSCHATTING VAN NIEUWE TECHNOLOGIEEN.
AANGEZIEN WIJ NOG PRIORITAIRE DOMEINEN MOETEN VASTLEGGEN EN BOVENDIEN DE GEWOONTE HEBBEN EEN OPENBARE OPROEP TOT PROJECTEN TE DOEN, KAN IK U NU NIET VERTELLEN WELKE ITEMS PRECIES ONDERZOCHT ZULLEN WORDEN.
IK HERHAAL DAT "GEZONDHEIDSRISICO'S" NIET OP ZICHZELF STAAT, MAAR DEEL UITMAAKT VAN EEN GROTERE EN SYSTEMATISCHE INSPANNING OM ONDERZOEK TE VERRICHTEN NAAR DE KWALITEIT VAN HET LEVEN.
HET IS EEN STELLING DIE WIJ TROUWENS OOK MET SUCCES HEBBEN VERDEDIGD BIJ DE PRIORITEITENVASTLEGGING VAN HET DERDE EUROPEES KADER-PROGRAMMA INZAKE ONDERZOEK.
IK TWIJFEL ER NIET AAN DAT "GEZONDHEIDSRISICO'S" BIJ ONZE VORSEN MET HET NODIGE ENTHOUSIASME ZAL WORDEN ONTHAALD.
IN DE MATE DAT DE OVERHEID HOORT IN TE STAAN VOOR DE GEZONDHEID VAN DE BURGER, LIJKT HET ME NIET MEER DAN EVIDENT DAT DIT SOORT ONDERZOEK DOOR DE OVERHEID WORDT GESTIMULEERD.
IK HOOP DAN OOK DAT "GEZONDHEIDSRISICO'S" MOGE BIJDRAGEN TOT DE ONDERZOEKSINSPANNINGEN DIE U LEVERT EN WAAROVER U ZICH VANDAAG HEBT BERADEN.

ERIK DERYCKE,
STAATSSECRETARIS VAN WETENSCHAPSBELEID