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INSTITUTE OF GEOGRAPHY AND SPATIAL ORGANIZATION

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64

POPULATION AND ENVIRONMENT IN INDUSTRIALIZED REGIONS

EDITED BY
ALINA POTRYKOWSKA & JOHN I. CLARKE

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INTERNATIONAL UNION
FOR THE SCIENTIFIC STUDY OF POPULATION
COMMITTEE ON POPULATION AND ENVIRONMENT

CONFERENCE ON

POPULATION AND ENVIRONMENT IN INDUSTRIALIZED REGIONS

WARSAW AND CRACOW, POLAND, 27-30 JUNE 1994

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FOREWORD

Environmental pollution has been a steadily growing problem since the Industrial Revolution began two centuries ago. Rapid industrialization, burgeoning cities, and greater dependence on fossil fuels have brought in their wake increased production of harmful pollutants, making life in many cities and regions more and more unpleasant and unhealthy.

Among the most common and most virulent of air pollutants are sulphur dioxide (SO_2), suspended particulate matter (SPM), nitrogen oxides (NO_x), carbon monoxide (CO) and lead. In addition, there is evidence of a growing threat to human health from indoor pollutants such as radon, formaldehyde, asbestos, mercury and organic substances.

Since the 1950s, knowledge about the causes and effects of air pollution has grown, as have public demands for control measures. As we better understand the interaction between the environmental systems and population, it has become clear that these interactions are extremely complex, and that they cannot be dealt with effectively simply as a local problem near major emission sources.

Today, many air pollutants originate in industrial processes, such as smelting. The most common pollutants are known to have a range of effects on human health, including respiratory illness and aggravation of heart problems, blood changes leading to reduced oxygen-carrying capacity, hyperactivity and neurobehavioural effects.

Thanks to growing public demand — and increasingly certain evidence of a link between pollution and threats to health and environmental damage — many industrialized countries have controlled and reduced the most toxic pollutants. But in others — particularly in the former Soviet Union, Central Europe (including former East Germany, Poland, Hungary) and less industrialized Western countries — the problems continue and are particularly worrying.

The release of toxic substances into the atmosphere as a result of major industrial accidents, such as Bophal and Chernobyl, has renewed calls for stricter preventive controls of industrial plants that pose a potential pollution threat.

Economic and technological developments since World War II have brought considerable and positive changes to the quality of human life. At the same time, these changes have often caused a deterioration in environmental quality, especially in industrialized regions. Regulation itself poses difficult questions about who should bear the costs of pollution control — pollution industries, the government, or society? For many environmentalists, it has become clear that a holistic and preventive approach to pollution control is essential. Only by seeing pollution problems in the long term, and as part of wide-ranging industrial development, can the overall costs of pollution control be adequately assessed. Ecological neglect could well have contributed to the downfall of communism.

Poland, a country confronted with ecological disaster, faces the very difficult task of reshaping its environmental policy during a time of radical change in the national economic system. This new policy moves from what was once a narrow understanding of environmental protection to a broader goal of sustainable development, i.e. the attainment of a balance between social, economic, technical and environmental conditions in the process of development. This kind of understanding for the idea of sustainable development should be beneficial to addressing society's social and economic needs. Comprehensive environmental policies must be developed, and effective methods for implementing them must be established as soon as possible. Many Western and Polish organizations as well as scientific institutions and academic bodies are actively involved in this process.

The Institute of Geography and Spatial Organization, Polish Academy of Sciences and other scientific centres have a strong interest in carrying out research on Population and Environment in Poland.

A conference addressing "Population and Environment in Industrialized Regions" was held in Warsaw and Cracow, Poland, 27 to 30 June 1994. It was organized jointly by the International Union for the Scientific Study of Population (IUSSP), Committee on Population and Environment, the Institute of Geography and Spatial Organization of the Polish Academy of Sciences, Warsaw, and the Institute of Geography of the Jagellonian University, Cracow.

The local organizers were Dr Alina Potrykowska, Institute of Geography and Spatial Organization, Polish Academy of Sciences, and Dr Andrzej Zborowski, Institute of Geography, Jagellonian University.

The meeting took place under the patronage of the Ministry of Environmental Protection, Natural Resources and Forestry of Poland and the President of the City of Warsaw. The conference has been sponsored by the International Union for the Scientific Study of Population, National Fund for Environmental Protection and Water Economy in Warsaw, the Regional Fund for Environmental Protection in Cracow, the Warsaw City Hall, and the Warsaw Stock Exchange.

Conference activities occurred over the course of two days and were held at both the Polish Academy of Sciences in Warsaw and the Institute of Geography of the Jagellonian University in Cracow. Conference participants also participated in field trips to industrialized areas of Warsaw and Cracow.

The meeting brought together about 40 participants, including geographers, demographers, sociologists. Invited participants and IUSSP Committee members from Poland as well as Australia, Belgium, Brazil, Estonia, Germany, Hungary, India, Italy, the United Kingdom, and the United States presented papers.

Papers presented addressed specific subtopics which included: Changing Residential Patterns in Industrialized Countries, Deindustrialization and Unemployment, Industrial Pollution in Relation to Morbidity and Mortality, and the Demographic Consequences of Industrial Disasters.

The present volume contains revised versions of papers presented at the conference and is published with the financial support of the National Fund for Environmental Protection and Water Economy.

The organizers of the Conference and the editors of this volume acknowledge the financial support and assistance of Prof.dr Allan Hill, the Secretary General and Treasurer, and Mr Marc Lebrun, Assistant Executive Secretary of the International Union for the Scientific Study of Population; Mr Jorghansen Dahl and Mrs Graciella Duce (Chief) Interregional and NGO Programmes Branch, Technical and Evaluation Division, United Nations Population Fund; Dr Michal Wilczyński, Vice-Minister of the Polish Ministry of Environmental Protection, Natural Resources and Forestry; National Fund for Environmental Protection and Water Economy in Warsaw; Dr Olgierd Roman Dziekoński, Vice-President of Warsaw; Dr Wieslaw Rozlucki, President of the Warsaw Stock Exchange; Prof. dr Piotr Korcelli and Prof. dr Marcin Rościszewski, Directors of the Institute of Geography and Spatial Organization, Polish Academy of Sciences; Prof. dr Aleksander Kaszowski (Director), Prof. dr Adam Jelonek, Ass. Prof. dr Zygmunt Górka and dr Andrzej Zborowski from Institute of Geography, Jagellonian University; as well as other persons and institutions.

Alina Potrykowska
John I. Clarke

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I. *Introduction*

ACTIVITIES OF THE IUSSP COMMITTEE ON POPULATION AND ENVIRONMENT AND GENERAL REMARKS ON POPULATION AND ENVIRONMENT IN INDUSTRIALIZED REGIONS

JOHN I. CLARKE

Chairman, Committee on Population and Environment, International Union for the Scientific Study of Population and North Durham Health Authority, Appleton House, Lanchester Road, Durham DH1 5XZ, United Kingdom

As Chairman on the IUSSP Committee on Population and Environment, I am very happy to welcome you to this conference. I also wish to thank Alina Potrykowska, one of the members of this Committee, for all her efforts to make the conference a great success, and to thank the Polish government, the City of Warsaw and the Polish Academy of Sciences for their generous support.

This is one of a series of meetings arranged by the IUSSP Committee on Population and Environment since its formation in 1991, often in collaboration with other organizations. Initially, we held two meetings with the British Society of Population Studies (BSPS) in London (1991) and Oxford (1992) which were mainly concerned with theoretical and methodological issues. As a result some of the London papers were published as a special number of the European Journal of Population Studies (vol. 8, no. 2, 1992), and most of the Oxford papers have just been published in a volume entitled Environment and Population Change (Zaba and Clarke 1994).

The Committee has also collaborated with the Committee for International Cooperation in National Research in Demography (CICRED) in holding two special meetings about research on population and environment. The meeting at the University of Louvain-la-Neuve in Belgium (1991) led to a monograph on Population and Environment (CICRED 1992), and the meeting at the International Institute for Applied Systems Analysis (IIASA) at Laxenburg in Austria (1993) will result in a large volume of papers entitled Population--Environment-Development Interactions edited by John Clarke and Leon Tabah (CICRED 1995).

Our Committee has cooperated with the International Social Science Council (ISSC) in producing a report on Population Data and Global Environmental Change (Clarke and Rhind 1992), and has assisted the IUSSP Committee on Gender and Population at two of its conferences: on "Women and Demographic Change in Sub-Saharan Africa" at Dakar, Senegal (1993), and on "Women, Poverty and Demographic Change" at Oaxaca, Mexico held in November 1994.

At the IUSSP General Conference at Montreal, Canada in 1993 the Committee's special session on "Population Pressures and the Environment" was well attended and successful. Elsewhere its meetings are focusing on what we regard as crisis issues: deforestation, desertification, heavily industrialized regions and mega-cities. Hence we held a conference on "Population and Deforestation" at Campinas, Brazil in 1992 with the support of the Brazilian Association of Population Studies (Daniel Hogan and Richard Bilsborrow are editing a volume on this topic). Apart from this conference in Poland, in October 1994 there was a joint conference with UNESCO and the IGU Commission on Population Geography at the University of Jordan in Amman which had considered "Population and Environment in Arid Regions".

In addition to all these activities, the IUSSP Committee has had a research programme in Africa, organized by Hyacinth Ajaegbu from Jos, Nigeria. It has a number of different strands including an annotated bibliography on population and environment in Africa, a mapping project, an environmental information project, and a pilot community/neighbourhood environmental management project.

All in all, this is a heavy programme for an IUSSP Committee, but one which enables detailed international comparative studies of the immense diversity of population-environment interrelationships.

Our topic of population and environment in industrialized regions is dear to my heart, not only because I come from the country held to be responsible for the Industrial Revolution, but also because I have lived in an old industrialized region for nearly 40 years first as a university teacher and latterly as Chairman of the North Durham Health Authority.

Industrialized regions are extremely diverse around the world, and have gone through a series of evolutionary phases. Initially in the West, and more recently in the East, industrialization was associated with great concentrations of industries and populations based upon local resources, especially coal and iron ore. The coalfield concentrations have become less important with the decline of coal and rise of other forms of energy, greater technical efficiency (e.g. engines, electronics), improvements in transport, reduced need for infrastructural developments, dematerialization in which heavy raw materials are replaced by lighter and cheaper materials (e.g. plastics), and the development of new materials (e.g. fibres, ceramics). Light consumer industries tend to be attracted to the major markets where purchasing power and labour supply are abundant — thus large cities, particularly of developing countries, are assembling numerous industries.

Many older industrialized areas have suffered from deindustrialization, heavy industries being replaced by service industries and high unemployment. My own county of Durham exemplifies this multi-phased evolution. Over the last two centuries it saw the rise and fall of coal mining, iron and steel and shipbuilding. When I first went there in 1955 there were 112,000 coal miners; the last major pit has closed and only a few remain. Most of the pit heaps have disappeared, and over 70% of the workforce are now employed in the service sector, large numbers of them women. Unemployment is now rife in the more deprived areas.

We are interested in the two-way interrelationships between population and environment; not only with the impact of populations upon the physical environment of industrial areas — their geology, topography, soils, climate, plants, water supply, drainage, etc. — but also how populations have been affected by industrialization in a wide variety of ways: their employment, health, housing, communities, social and recreational amenities, etc.

Population-environment interrelationships may be viewed at different geographical levels from the locality to the globe. Heavily industrialized regions have had considerable long-distance effects on the global commons, directly causing river and coastal pollution, acid rain and stratospheric ozone depletion, and indirectly causing heavy use of remote resources such as minerals and forests.

At the regional level, people and industries are in close proximity in conditions frequently aggravated by poor:

— environmental situations (e.g. narrow valleys);
— housing;
— water supply, caused by industrial effluents, sewage and rapid run-off;
— sewerage;
— atmospheric states, affected by industrial emissions, burning of fuel and waste, and motor exhausts;
— refuse collection and waste disposal;
— sanitation and health; and
— standards of living.

Populations of industrialized regions have been greatly affected by their locations: their morbidity and mortality have been high, and often raised by poverty. Among the poor, children are a special high risk group, though in analyzing environmental causes of ill-health it is important to examine appropriate population groups, remembering that it is never easy to isolate the effects of the physical environment from those of the social environment (life-style, health care, occupation, etc.) and heredity. Often the wealthy have been able to escape from the worst environmental conditions — in 19th century Britain to a house at the top of the hill on the edge of the countryside. With deindustrialization, there has been some reversal of the process through reoccupation of central cities by "gentrification".

The evolutionary process has generally gone further and led to greater improvement of environmental and human conditions in the West than in

the East or in many developing countries, where higher population growth rates cause additional difficulties.

Government policies and attitudes to the competing claims of economic production, environmental conservation and social progress have undoubtedly played a part. We are conscious that many East European countries suffered environmentally during recent decades from policies based on giving priority in economic development to high energy-intensive and raw material-intensive industrial production, with relatively low efficiency in the use of natural resources leading to ecological disasters, and environmental degradation becoming endemic to the system. Some of the new democratic governments have established environment ministries and pollution payments, and are making positive efforts towards environmental management. Obviously, this is an area where collaboration is possible between countries, between scientists and governments, and between East and West, in order to create new societal dispositions which are more ecologically balanced and more sensitively attuned to the health needs of people.

In the course of this conference we shall be hearing about some of these various population-environment interactions from many parts of the world, and we look forward to exploring the possibilities for progress.

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LES ACTIVITES DE L'INSTITUT DE GEOGRAPHIE ET D'AMENAGEMENT DU TERRITOIRE DE L'ACADEMIE POLONAISE DES SCIENCES CONCERNANT LES RELATIONS ENTRE LA POPULATION ET L'ENVIRONNEMENT

MARCIN ROŚCISZEWSKI

Institut de Géographie et d'Aménagement du Territoire de l'Académie Polonaise des Sciences, Krakowskie Przedmieście 30, 00-927 Warszawa, Pologne

L'Institut de Géographie et d'Aménagement du Territoire de l'Académie Polonaise des Sciences a, dès sa fondation en 1953, accordé une grande importance aux recherches sur les problèmes d'environnement et de son aménagement, tant dans ses aspects biotiques qu'abiotiques. Les recherches ont été menées à des échelles différentes; à titre d'exemple on peut mentioner ici l'initiative dans les années cinquante d'élaborer la carte géomorphologique, la carte hydrologique et la carte d'utilisation du sol de Pologne, l'initiative d'études sur les petites et moyennes villes de Pologne, les recherches sur les régions industrialisées etc.

Il n'est pas possible dans une si courte notice, de mentionner d'une façon détaillée, tout l'éventail des activités scientifiques de l'Institut. Les recherches dans le domaine de la géomorphologie et de l'hydrologie, occupent toujours une place importante. On doit souligner également les recherches climatologiques qui s'orientent d'une part sur le problèmes de bioclimatologie et d'autre part sur les problèmes de topoclimatologie.

La publication de l'Atlas d'environnement géographique de la Pologne (1994) constitue une réussite d'échelle internationale.

Indiquons également la participation des chercheurs de l'Institut aux travaux des programmes "Global Change" ainsi que "Man and Biosphere". Ils ont également assuré, dans le cadre de ces programmes, la coordination de certains thèmes, à une échelle internationale.

Dans le domaine de la géographie humaine, antropogéographie, on doit souligner les études et les recherches (à l'échelle internationale aussi) qui embrassent les problèmes démographiques, des migrations, d'urbanisation. Les études sur les systèmes urbains, sur la géographie agraire et rurale, et sur leurs transformations y occupent une place importante. On doit mentionner également une importance particulière accordée aux recherches

sur l'aménagement du territoire. On se penche ici sur les problèmes du développement démographique, de l'urbanisation, de l'industrialisation, des systèmes de communication, des services, enfin sur les problèmes des divisions administratives et régionales du pays. Les recherches sur le développement actuel des zones frontalières dans une coopération bi- et multinationale constituent un domaine à part. Cette recherche a également un caractère interdisciplinaire. On doit souligner aussi le développement de la recherche sur les problèmes de géographie politique et de géopolitique concernant surtout la place de la Pologne dans l'Europe Centrale.

Les études qui sont entreprises par l'Institut ont un caractère de recherche fondamentale. Tout de même, beaucoup d'entre elles sont recherchées par différentes organisations et organismes comme bases de décisions.

On doit souligner un grand effort de l'Institut en ce qui concerne une large diffusion des résultats de ses recherches. Un des exemples est entre autres la publication des résultats de ce colloque dans le cadre de *Geographia Polonica*.

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II. Industrialized regions of Poland

ENVIRONMENTAL CONDITIONING OF THE DEMOGRAPHIC SITUATION IN POLAND

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ABSTRACT: As a result of commmunist policy of central planning in the period following the second world war a number of areas in Poland became environmentally contaminated. In 1980 there were 27 ecologically endangered areas inhabited by 1/3 of Poland's population. Currently, it is estimated that 4 million people are living in endangered zones, mainly in Upper Silesia, to the detriment of their health and lorgevity. The dangers are very serious, as they are referred to damages to the genetic code amongst children. The effects of this damage include a number of health problems and the slowing down of the psychological development of children. The number of children requiring psychiatric treatment is growing.

In Poland, as in many other countries we are witnessing the reduction in the length of life-expectancy, especially amongst men. This, amongst other reasons, is why the Polish Parliament, in 1991, decided to adopt national policy for environmental protection. As a result environmental protection legislation is being amended, environmental economic management is being reformed, and a preventative programme of health care combatting heart diseases is being implemented. These activities constitute a response to the resolutions of the Global Action Programme — Agenda 21, adopted in Rio de Janeiro in 1992.

KEY WORDS: Areas of ecological hazard, genetic code defects, ecological stress, ecodevelopment.

Poland belongs to the group of countries in which environmental conditions have essential importance for the demographic situation. The totalitarian model of the society and economy, enforced for some 45 years, resulted in the emergence of numerous urban and industrial agglomerations, which soon became areas of ecological hazard (Fig. 1).

During the 1980s, approximately 10 million people lived within 27 areas

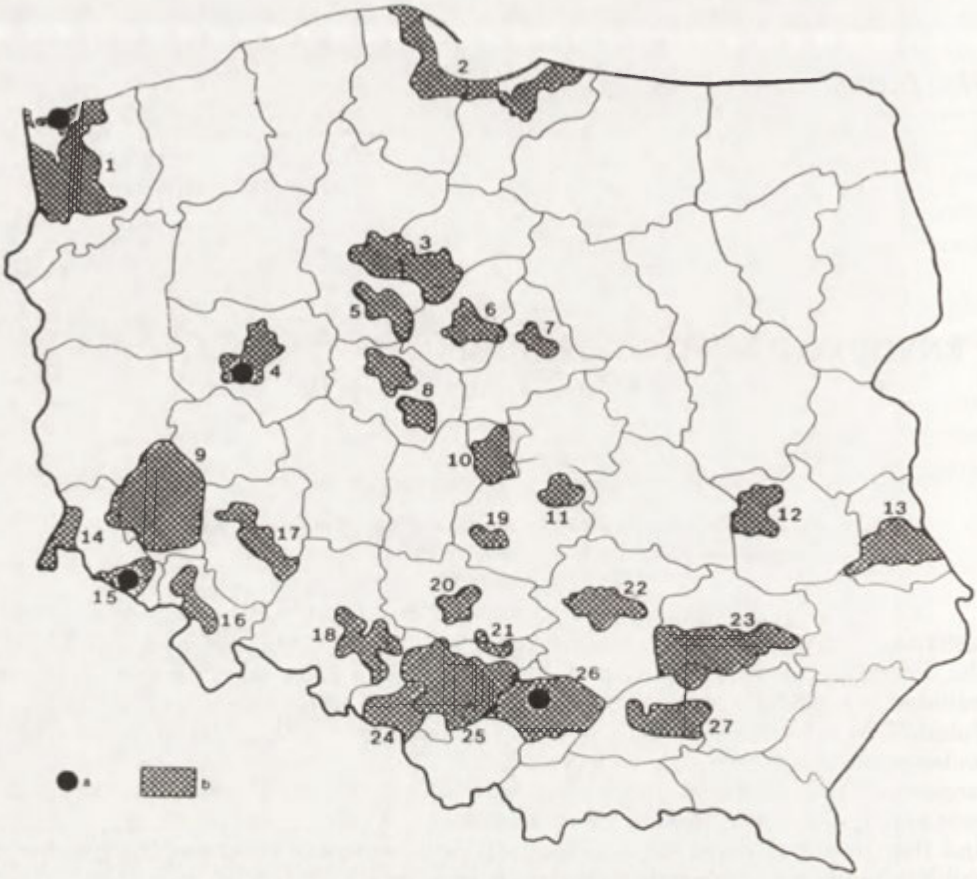

Fig. 1. Areas of ecological hazard in Poland
a — National Parks located within the areas of ecological hazard, b — areas of ecological hazard, named mostly after their main urban centres: 1 — Szczecin, 2 — Gdańsk, 3 — Bydgoszcz-Toruń, 4 — Poznań, 5 — Inowrocław, 6 — Włocławek, 7 — Płock, 8 — Konin, 9 — Legnica-Głogów, 10 — Łódź, 11 — Tomaszów, 12 — Puławy, 13 — Chełm, 14 — Turoszów, 15 — Jelenia Góra, 16 — Wałbrzych, 17 — Wrocław, 18 — Opole, 19 — Bełchatów, 20 — Częstochowa, 21 — Myszków-Zawiercie, 22 — Kielce, 23 — Tarnobrzeg, 24 — Rybnik, 25 — Upper Silesia, 26 — Kraków, 27 — Tarnów
Source: GUS, 1983

of ecological threat (that is, the areas where acceptable pollution levels — especially with respect to air pollution — were being constantly exceeded). At least 4 million people currently live within the areas of the highest environmental risk (the regions of Upper Silesia and Turoszów). These areas are undergoing a drastic worsening of health conditions (see Norska-Borówko et al. 1992, or Gumińska 1993).

Pollutants in the air, water, soil, and food contribute to the poor health of the population. Other factors undermining health include: the quality of the diet, lack of appropriate hygienic behaviour, heavy smoking, excessive

alcohol drinking, genetic heritage, and low physical activity level. This problem is outlined in a report of the Governmental Demographic Commission of the Central Statistical Office (GUS), (The demographic situation of Poland, 1992). It indicates very alarming phenomena, such as an increase in the number of cases of such diseases as:

— malignant tumours,
— food poisoning,
— viral hepatitis, and
— occupational diseases.

The factors, which have to be mentioned in this context are: living conditions, low level of health care culture, smoking, alcohol drinking and drug abuse. More than half of the deaths in 1991 were caused by the diseases of the cardio-vascular system, most often by the acute heart attacks, usually affecting men.

Men die from cancers more frequently then women, especially within the southern, western, and northern voivodships and agglomerations of the country. Poland is one of few countries in Europe where life expectancy has been decreasing for several years. Life expectancy for men in Poland is 66.1 years, and for women 75.3 years; in Western Europe, these measures are, respectively, more than 70 years and almost 80 years (see Fig. 2).

The rate of infant mortality due to birth defects is in Poland much higher than in the countries of Western Europe (male infants in Poland: 383.9 deaths per 100 thousand live births, while in France 53.3 deaths). Within Upper Silesia, health and life hazards concern 4 million people, including 1.5 million children. Half of all pregnancies and deliveries in the Katowice voivodship proceed abnormally. Urban areas of Upper Silesia with the highest risk factors are Bytom, Chorzów, and Zabrze. In this region there has been a rapid increase in the numbers of handicapped children with cerebral palsy and epilepsy, as well as various kinds of mental retardation and psychiatric syndromes. It was demonstrated that the environment polluted with heavy and other metals (lead, zinc, iron, copper) exerts a negative influence upon mental development. Long exposure to these metals, even if present in low quantities, may bring about dangerous consequences, especially in children. These consequences concern the functioning of the centres of nervous system and appear, for instance, in the form of a slowdown of psychomotoric development, as well as anxieties, excessive excitement, or disturbances in visual perception. Along with the increase of heavy metal content in children's blood (as in the area of Miasteczko Śląskie) the IQ of those children decreases. Studies indicate that within the territories polluted by industry, the proportion of mentally retarded children is three times greater than elsewhere. In the intensively industrialized areas, 10.4% of children experience school failures, with 33.7% being described as excessively excitable and nervous: within rural and urbanized areas, it reaches only 8.8%.

In the areas of ecological hazard, an increase in the occurrence of diseases of the nervous system is observed as well. It is estimated that within the

intensively industrialized areas, there are twice as many persons having undergone psychiatric treatment (Biela 1984).

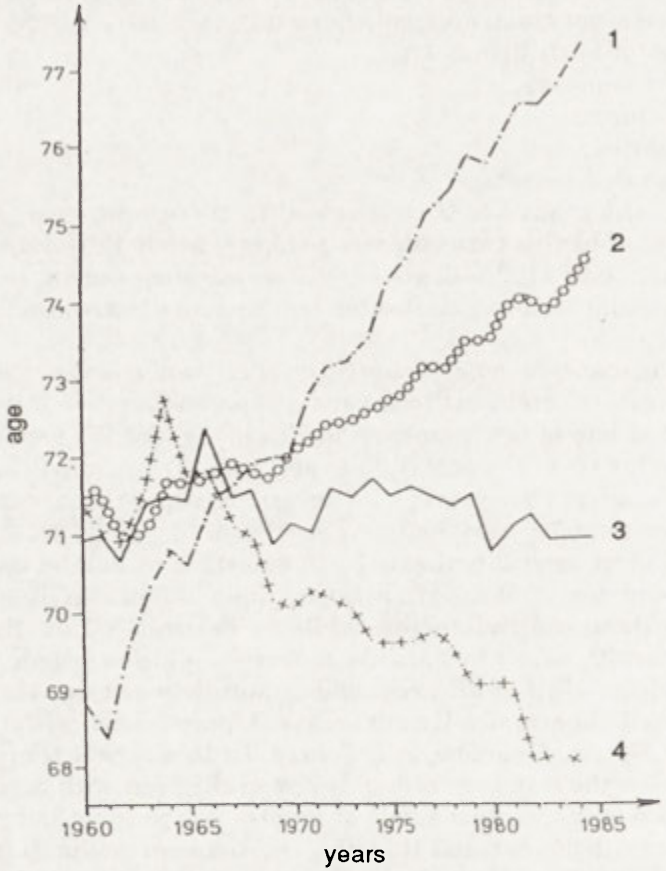

Fig. 2. Average life expectancy (of men and women jointly) at one year of age in four economically developed regions of the world in the years 1960-1985; 1 — Japan, 2 — industrialized countries of the West, 3 — Eastern European countries, 4 — Soviet Union
Source: Committee of Demographic Sciences, 1988

The data presented indicate that the younger generation living in the areas of ecological hazard, and especially in Upper Silesia, are distinctly handicapped in comparison with those living in the rest of the country. This does not make a good basis for positive forecasts concerning future social progress, particularly if we account for the fact that these areas are to a large extent the cultural and educational centres. This is presumably one of the reasons behind the steady decrease in the proportion of students in high schools to the advantage of the proportion of young people educated in vocational schools.

The study carried out by M. Chorąży (1990) indicated that extracts from

the microparticulate air pollutants show high mutagenetic activity, which is higher in the winter heating season. Air pollution extracts contain the sub- stances which damage the structures of chromatine and the chromosomes. Genetic material (DNA) gathered from the blood lymphocytes of the inhabitants of Zabrze shows several times more of the so-called adducts, i.e. chemical compounds alien to the home organism, adjoined to the DNA. Damages to genetic material are manifested through, for instance, various kinds of injuries of chromosomes and the increased number of micronuclei. These phenomena lead to pathological processes and to damages of the structure and functions of chromosomes (genes) in the cells. We observe, therefore, a decrease of the biological qualities of future generations of Poles. This is the most dramatic consequence of pollution of the human living enviroment.

According to the assessment forwarded by J. A. Indulski (1993) the present health situation of Polish society should be considered as very serious and giving rise to definite apprehensions. This assessment results from a number of simultaneously appearing negative phenomena characterizing the health state of population of Poland, including, first of all, the following ones:

— distinct shortening of life expectancy with growing excess mortality of men, as well as further increase of mortality rates over the last two years, observed in both sexes;

— high infant mortality levels persisting for many years already;

— high increase in rates accidents and poisonings, and the increase of some infectious diseases;

— disadvantageous situation in the domain of psychiatric illnesses and disorders;

— increasing numbers of disabled persons.

It is especially dangerous that Poland is one of the lowest ranked countries in Europe as to the health state of its population and that until now no preventive actions have been undertaken, which in the economically developed countries had entailed stopping or even reversing of the previously growing mortality trends related to cardiovascular diseases and cancers, constituting the main causes of deaths. In spite of lack of direct proofs, it can be presumed that the state of natural environment and the presence of health-damaging factors polluting food, drinking water, and air, side by side with such factors as health care standard of living, and way of living, do presently and will continue to shape the state of health of Polish population. The negative influence exerted upon this state of health by enviromental pollution and degradation factors will constitute an important problem for at least 10 years from now, while serious health-related consequences, mainly in the form of cancerous diseases, developmental disturbances in children, and fertility defects, will be yet observed far beyond the end of the 20th century.

The problems commented upon above were considered in more detail in the recent analytic report of the Scientific Committee of the Polish Academy of Sciences entitled "*Man and Environment*". The warning forecast of changes in the environmental conditions of human life at the beginning of the 21st

century" (Ekspertyza... 1994). Thus, the following directions of activity should be considered necessary in order to overcome the intensifying health crisis in Poland:

(1) *Carrying out the reform of the educational system.* The Ecological Council affiliated with the President of the Republic of Poland urged the introduction of a separate course on "*Man and natural environment*" into the primary and high school curricula. The respective problems should also become the subject of teaching in the curricula of medical schools and faculties;

(2) *Health promotion programmes should be put into action.* The first programme of this kind has been recently started by the Institute of Cardiology in Anin near Warsaw. A very positive public reception of this programme, entitled "*A week for your heart*", indicates the necessity of continuing and developing this particular promotion programme.

The deployment of ecological and health education was very clearly presented and emphasized in Agenda 21, the programme of deeper-reaching activities, adopted by the conference on the environment and development held in Rio de Janeiro in 1992. Poland is seriously engaged in implementation of the postulates agreed upon in Rio. The full text of Agenda 21 was proposals translated and published in Poland, followed by two popular commentaries. All the communal authorities in Poland obtained the brochure entitled *Eco-development in a commune*, forwarding the idea of self-governmental activities conforming with the concepts outlined here and proposed in Rio.

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RESTRUCTURALIZATION, DEINDUSTRIALIZATION AND UNEMPLOYMENT IN POLAND. CASE STUDY OF WARSAW

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ABSTRACT: The transition towards the market economy in Poland has already influenced the development of Warsaw capital city and its region. In the present phase of the development, the restructuralization of the economy and deindustrialization processes are very important. This paper focuses on social, demographic, economic changes, and environment in the city and the urban region of Warsaw.

KEY WORDS: Restructuralization, deindustrialization, unemployment, environmental pollution, Warsaw, Poland.

INTRODUCTION

The transition from the centrally-planned system to a market economy in Poland has already exerted some impact upon the development of Warsaw capital city and its agglomeration. Their growth potential seems to be quite substantial although the costs of transformation look substantial too.

In the present phase of development it is the restructuralization and the privatization of economic activities in the city that are the processes having the most decisive effect on efficiency. The degree of advancement is different in different economic sectors of the city and is relatively limited in industry. In contrast, it is developing rapidly in construction and some of the material services (and has almost reached 100% in the trade sector). The anticipated increase in the role of the tertiary sector will undoubtedly manifest the essential transformations. The economic transformation beginning in 1990 put into effect the economic mechanisms of the market and thus changed the situation on the Warsaw's labour market in a fundamental way.

Specific topics to be dealt with include socio-economic changes, de-industrialization, unemployment, and labour market, population structure as well as environmental question. In addition to the city of Warsaw, the urban region, here identified with the capital voivodship, includes 27 towns (ranging in size from 5 to 55 thousand inhabitants), and 31 rural communities.

The city consists of seven districts, namely: Śródmieście (the central district), Praga Północ (North Praga), Praga Południe (South Praga), Mokotów, Wola, Ochota, and Żoliborz.

THE PROCESS OF DEINDUSTRIALIZATION IN WARSAW

Historically, the manufacturing sector which was the economic basis of the Warsaw. The centrally-planned economy provided a number of stimuli to the expansion of large cities, including the capital city and its region. In 1950s the very heavy emphasis was put on industrial development in Warsaw, for example the location of steelworks (Huta Warszawa). Today, Warsaw constitutes a strong industrial centre. Being big in numerical terms, its industry constitutes about a quater of the total employment in Poland. However, this may not be ignored in spite of the critical evaluation of the fact that extensive industrialization in the capital city has been forced by the economic policy of the communist system. Industrial plants located in Warsaw manufacture over 8% of the total value of production of national industry. Warsaw industry demonstrates the very same weaknesses as elswhere in the country, and other postcommunist countries: it is not too effective, and above all non-competitive in conditions of market economy. It requires the same therapy: restructuralization and modernization. It should undergo processes of intensification which will bring to light its potential possibilities in accordance with interests of the city. Mostly, the industrial sector is traditionally located in Wola and Praga Północ districts, and some towns of the suburban zone (Ursus, Pruszków, Piastów, Piaseczno, Grodzisk Maz.) (see Fig 1). Employment in the industrial sector varied up to 30% of total employment, with 352,000 being employed there in 1988. However, by 1992, this figure had been reduced to 234,000 — indicating a fall of 34%. Estimates concerning employment in the future suggest that even the most favourable conditions will not bring about an increase in industrial employment in Warsaw within the next 5 years, and that a continued fall is in fact more likely (Table 1).

TABLE 1. Employment structure of the public sector in Warsaw and its region, 1990-1992

Employment (in thousands)	1990	1991	1992
	Capital voivodship of Warsaw		
Total employment	716.4	671.6	670.9
Employment in industry	191.0	171.0	168.0
Employment in trade	67.8	67.1	69.9
	Warsaw City		
Total employment	670.1	558.7	544.3
Employment in industry	167.4	134.8	124.7
Employment in trade	70.2	60.4	59.3

Source: Statistical Yearbooks of Warsaw capital voivodship,1992,1993, GUS, Warszawa; Warszawa XXI, 1994.

In terms of sold production, the dominant industries are the electric machines industry (38%, employing 100,000), the food industry (21% and 18,000), and the fuel and energy industry (15% and 12,000). Together these give rise to 74% of sold production, and employ 130,000. The remaining branches of industry contribute about 26% to the value of sold production and employ 60,000 workers. In total, Warsaw industry therefore employs about 190,000 people. Some branches of industry, like light industry, metallurgy and the chemical industry, were no match for the difficulties of the period of transformation and therefore went into decline. At the same time, new factories emerged with shares of foreign capital, e.g. those of Coca Cola Bottlers, Procter & Gamble and Pepsico Foods.

Consideration of declining industrial activity and employment allow it to be estimated that unused space in industrial buildings has risen to more than 40% of the total floor space occupied by industry. The majority of the unused space is in Warsaw, with an estimated 7,500,000 m^2 of industrial floor space being either unused, or serving other purposes. In suburban areas, about 60% of industrial floor space is currently used for industrial activities (Dowall, Sadowy, Zalewski 1994).

The massive decline in the area used in industry constitutes a serious challenge to both the city and the region. How can such abandoned industrial areas be used? And what is the nature of the threats to the natural environment in these areas which may make re-use difficult? Ecological reasons are among to the most important ones from the viewpoint of inhabitants and municipal authorities in the industrial question.

Today, what are still very modest investment programmes are being introduced with a view to the gradual correction of the situation resulting from years of underinvestment in the economic infrastructure of the city and its institutional, technical and economic aspects. While revising the principles of spatial economy, the attitude to areas delimited up to now for purposes of industry should be defined: those reserved for the future, those already passed over to investors, and those which should be developed for other use despite the existing industrial facilities. It should be emphasized that small-scale industry requires optimum developmental conditions.

Investment trends have also been concerned with reducing the effects of the long-term delay in the building of a contemporary centre in the city and the easing of the deficit in offices and trade services. The expansion of the tertiary sector is desired and, anyway, trends of market economy are oriented in that direction.

The beginning of a difficult but positive breakthrough was noted in Warsaw in the years between 1991 and 1993. Within a process of systemic transformation unfavourable to development and a faulty system of managing the capital, the city authorities made successful efforts to make up for the long-term negligence of the previous period. There has been an increase in the space occupied by office buildings of the highest standards, e.g. those in the Marriott LIM Center, the IPC Center, the Warsaw Corporate Center,

Kolmex and the FIM Tower. The significant effects of prestige investment will be noted in the years 1995/96.

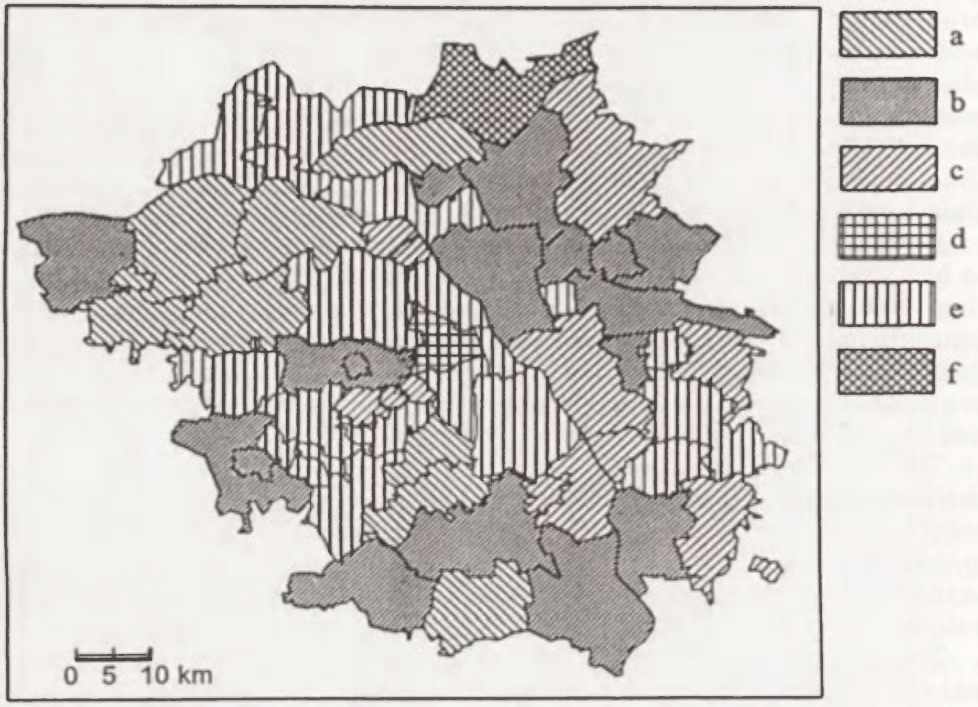

Fig.1. The employment structure in Warsaw capital voivodship,1991
Dominance of employees in: a — agriculture; b — industry (above 45%); c — industry (35-45%); d — industry and services; e — services; f — agriculture and industry
Source: Chmielewski 1993, p.23.

THE DEVELOPMENT OF PRIVATIZATION IN WARSAW AND ITS REGION

The process of ownership change in the national economy is occurring in several forms in which private capital, including foreign capital, enters the region's economy: through the privatization of existing state enterprises, as well as through emergence and development of private firms with legal personality (in the form of companies under commercial law) and those created by indivudual persons. One of those forms are direct capital investments in the existing enterprises, either by purchasing shares or by establishing joint-ventures. For example, 40% shares of the chocolate factory Wedel were purchased by the Pepsico; 51% of shares of the huge Polcolor TV factory in Piaseczno acquired by Thomson. These include the Polmo automobile works (a pending joint-venture contract with General Motors Europe, and

the Warsaw Steelworks, which has being partly taken over by the Italian industrial group of Lucchini Siderurgica. The other major enterprises are advanced in entering the restructuring process. However, the progress of the privatization of state enterprises is slow, on account of the unregulated legal situation in relation to the property of enterprises, as well as the lack of a decision concerning the establishment of the methods, scope and scale of more universal (mass) privatization.

In the years 1991-92, there was in principle no change to the number of state enterprises in Warsaw, which stood at 1000 at the end of 1992. As a result of transformations, the number of municipal enterprises rose from 48 to 123, while the number of State Treasury companies rose from 43 to 181. Although the number of state enterprises did not change much (a 20% increase in the number), the results of such transformations as restructuring and liquidation led to a decline of about 20% in the level of employment (in the case of Warsaw voivodship from 624,000 in 1990 to 496,000 at the end of 1992).

Rapid development of the private sector has been observed. In the period 1991-92, the number of registered partnerships in this sector in Warsaw increased four-fold from 14,886 to 57,220. The highest rate of increase numbers characterized joint-venture companies (on account the fact that they are associated with tax exemptions), as well as civil law partnerships and legal persons carrying on economic activities. In the latter case, the number rose from 10,600 at the end of 1990 to 44,500 in 1992. The number of private companies grew at a rather slower rate (from 2355 to 7803) in the aforementioned years.

In the economy of the voivodship, a dominant role in the spatial distribution of economic activity is played by Warsaw itself. Of the 40,100 natural persons carrying on economic activity, some 76% are active in Warsaw, with 16% in other towns in the region and only 8% in rural communities. A similar distribution is noted for registered personal companies, and a still-higher concentration in Warsaw for private limited liability companies (88% in the city, 8% in other towns and 4% in rural communities).

The Śródmieście and Mokotów districts of Warsaw are dominant from the point of view of the numbers of registered private firms (accounting for 21% of the total). Such firms are less well-represented in Wola (which has 16%), Praga Północ with 13%, Żoliborz (11%), Ochota (10%) and Praga Południe 8%.

Trade is the main activity of Warsaw's private-sector firms, with more than half of the firms in each district falling within the category. The right-bank districts stand out in having a somewhat higher proportion of industrial firms (19-20%), while the Śródmieście district has a greater proportion of firms providing services (15%).

Beyond Warsaw, the areas with the greatest numbers of registered firms are Pruszków, Piaseczno and Otwock. Industrial activities stand out within the rural communities (which have 35% of firms), on account of the fact

that land is cheaper to rent. A similar statement applies to the other towns of Warsaw voivodship (which have a further 30% of the firms in this category). This is also an expression of the new processes locating small private enterprises outside Warsaw, on account of land prices and the promotional policies pursued by local authorities.

THE SITUATION ON THE WARSAW LABOUR MARKET

The structural reforms continuing in both the national and local economies led to far-reaching changes on the labour market. Rapidly-developing sectors like trade, finance and insurance have joined services as sources of strong demand for highly-qualified employees in the fields of administration, business, accountancy, marketing, management, finance and logistics. The 1990s saw a decided improvement in the quality of the Warsaw labour market. High qualifications and education ensured the finding and keeping of a job.

The years 1988-1992 saw the supply of workers change in relation to the demand resulting from the fundamental restructuring of the Polish economy. There was a 19.4% decrease in the supply of workers (including those employed full-time), but an increased supply of those working part-time. Thus, only 6% of workers (60,000) were employed part-time in 1980, while 11,5% (84,300) were employed in this way in 1992.

The hitherto-dominant job-seeker's market made way for the kind of employer's market typical of the economics of market competition. In practice this led in Warsaw voivodship to a changeover from the 1989 situation of full employment and 32,000 vacancies unfilled (26,000 blue-collar posts and 6000 white-collar), to a situation in which the number looking for work is always greater than the number of jobs on offer.

UNEMPLOYMENT AND UNEMPLOYED

Dominant in the first period of the introduction of the market economy was unemployment deriving from so-called mass layoffs of those employed in large production plants hit by recession (examples in this category include the FSO Car Factory, Huta Warszawa (the Warsaw Steelworks), the Kasprzak Radio Factory and others). A second group made redundant included those employed in the administration, which had for years been characterized by excess ("hidden") unemployment.

In comparison with the country as a whole, Warsaw is characterized by a low, if rising, level of unemployment (5%). The lowest level of all is noted in Mokotów district (2,8% of those of working age) and the highest within the city is Praga Północ (at 4,1%) — the industrial district most affected by the process of deindustrialization. Among the unemployed, some 43% are workers made redundant as a result of transformations in the state industrial

sector, as well as those with limited work experience (31%) and those aged 35-44 (33%); 35% of unemployed people are still without work after one year. There is a steadily-rising proportion of unemployment from the private sector (currently the figure is 43% of the total). Many unemployed people are available for each opening and the "outflow" of unemployed off the registers is low. Analyses of Warsaw's unemployed by age and education allow it to be stated that the threat of unemployment is lower where the level of education is higher. Most threatened by rising unemployment are those with primary or incomplete primary education only and aged 35-44, as well as those with vocational education aged 18-34. The employment of men declined by 20% (Gawryszewski 1994).

The highest levels of unemployment are noted in communities whose populations were employed in nearby industrial centres (Pruszków and Piaseczno) or in Warsaw plants. Out-of-town employees have been particularly vulnerable to dismissal. The size of the areas with higher levels of unemployment continued to expand to June 1993, taking in the majority of the communities around industrial centres affected by the process of de-industrialization like Pruszków, Piaseczno and Nowy Dwór.

NEW DEVELOPMENTS AND SOCIAL PROBLEMS

The process of the adaptation of society to the new and difficult socio-economic conditions is continuing in a conflict-generating atmosphere which results from — among other things — the lack of a sense of stabilization in employ- ment, limited motivation to raise or adapt qualifications, new economic relations or principles of social welfare and changes in the stratification of society, which are all taking place against the background of the development of a new middle class and financial elite. Conflicts and strains in social relations result from, among other things, the stratification of the economic position and the impoverishment of at least 1/3 of the population, the appearance of the phenomenon of the spatial segregation of society by "gentrification" and the isolation of areas of decrepit construction inhabited by groups unable to adapt to the new conditions. The number of criminal offences rose and the state of public safety became worse.

The most valuable potential in society is the great ability of the younger generation to adapt to the new and unstable conditions of the market economy. On the other hand, a barrier to the increased potential of society is the rising proportion of the elderly population.

POPULATION STRUCTURE AND DEMOGRAPHIC PROBLEMS

The demographic situation of Warsaw results from a number of factors. First is the disadvantageous age structure of population, meaning the increasing share of the elderly, which is especially well seen in the downtown areas. Second is the increase of the average age of marrying during the last dozen years, and, simultaneously, the fact that the model of family with a low number of children is taking over in towns, leading to incapacity to maintain even simple reproduction. Third, migrations to towns underwent significant limitation. Initially this fact was to a large extent due to crisis in housing construction. Nowadays, apartments become a good as any other and in view of prices on the market they are virtually unattainable for the young, so that the function of housing as a migration factor ceased. Fourth, finding a job, which is the main factor attracting migrants, is a difficult thing, given the present high numbers of unemployment and the low demand for labour.

The actual decrease in the population numbers in Warsaw and its region (Table 2) results from the fact that there are more deaths than births (natural decrease) and that the net positive migration balance is very low, and therefore does not compensate for the natural decrease (see Fig.2). The latter takes on growing dimensions — first of all in the downtown (central district of Śródmieście) — due to the particularly disadvantageous age structure of population, while the migration balance is on the decrease (excepting 1992) and is also very unevenly distributed.

TABLE 2. Population change in Warsaw and its region, 1990- 1992

	Population size in thousands		Rate of population growth in per cent	
Year	Warsaw	Region of Warsaw	Warsaw	Region of Warsaw
1990	1655.7	2421.6		
1991	1653.3	2419.6	-0.7	- 0.5
1992	1644.5	2409.0		

Source: Statistical Yearbooks of Warsaw capital voivodship, 1992, 1993, GUS, Warszawa; Warszawa XXI, 1994.

The greatest natural decreases were observed, besides the centre, in the districts of Praga Południe, where it was compensated by highly positive net migration balance, and in Praga Północ.

The tendencies here outlined indicate that the growth — or even stabilization — of the population numbers in Warsaw depends on the magnitude of migration. The contribution to the net migration balance of Warsaw (in 1991 — 3,432 persons) is made in 15% by the Warsaw voivodship, in 55% by the neighbouring voivodships, and in 30% by other voivodships. In this sense Warsaw is closely connected with its region.

Side by side with Warsaw, several other areas around it feature natural decrease as well. They are: the town of Pruszków, for some time already,

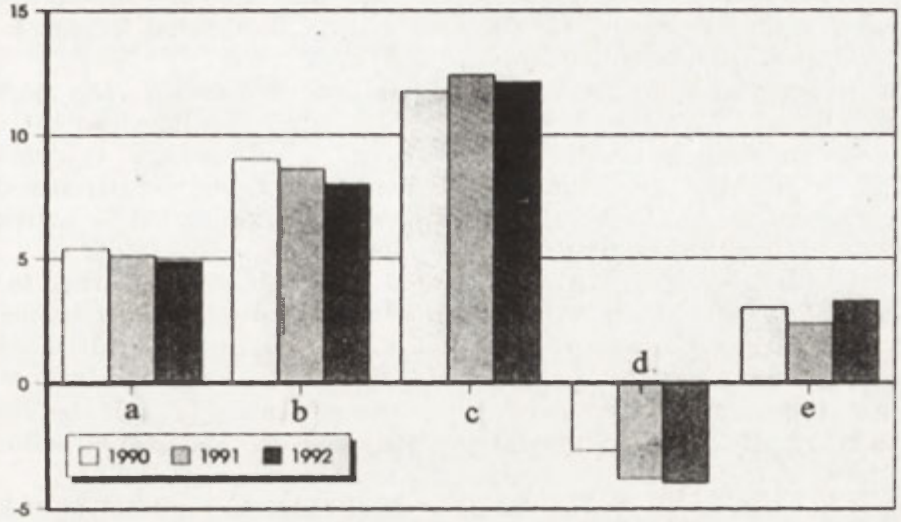

Fig.2. Population change in Warsaw, 1990-1992
a — marriages; b — live births; c — deaths; d — natural increase; e — net migration
Source: Warszawa XXI, 1994, p.76

and. during the three years studied in more detail, 1990-1992, the town of Góra Kalwaria, the town and commune of Konstancin-Jeziorna, the town of Łomianki, the town of Otwock, the commune of Józefów and the town of Radzymin. This is in relation with the process of deindustrialization, and its negative effects e.g.the unemployment. The positive net migration balance appears — besides Warsaw — also in the areas of Piaseczno and Pruszków, but in the 38 towns and communes taken together the majority of units feature migrational decrease, while only 21 units display a positive net migration balance. The latter include areas which are more attractive in terms of natural environment, have better developed infrastructure, and are sufficiently well connected with Warsaw by transport so that they can become — and do become — the local centres of development of small and medium private businesses.

THE URBANIZATION PROCESSES IN THE WARSAW URBAN REGION. NEW PROBLEMS OF SPATIAL DEVELOPMENT

The use of land in Warsaw was controlled strictly until 1990. The main instrument of control was the general plan which defined the ways in which land could be used. The huge amounts of free land have not prevented the proportion designated for development from being restricted to about 5000 ha.

If the development of Warsaw is to be promoted, and more investment drawn in, it is certainly necessary for the area of land designated for use to be increased, particularly in the central areas[1].

The new general plan for Warsaw is more oriented towards the market. It is now based on considerably more flexible control over development, and it sets out six areas in which the city is to develop. These are: 1) a central area; 2) a residential and service sector; 3) a technical and industrial sector; 4) services and stores; 5) green space; and 6) areas designated for activities which do not pollute the natural environment (Fig.3)

It might be ascertained that the present role of the plan returned to the regulating function, putting into order the basically unplanned construction movement. However, the more complicated functioning of a modern urban organism requires a much larger scope of coordinating activities connected with general urban technical facilities as well as related to such significant problems of urban environmental protection against excessive pollution (Cierpiński et al. 1993).

A further barrier to the development of Warsaw is the problem of land ownership. Land in the central parts of Warsaw — including the parts of the city most urbanized before the War — was nationalized and remains in the public sector. Similarly, almost all land in the Śródmieście and Zoliborz districts is publicly-owned. In contrast, the majority of the land surrounding the city is in private hands.

Land in private hands is designated for use, but the small areas involved ensure that investors ignore Warsaw proper and look for areas to develop in the suburbs. This trend may give rise to the artificial decentralization of the city and to a limitation to the ability of the Warsaw economy to stimulate the agglomeration economically. If this trend is to be counteracted, the city must try to attract more projects by making available a greater number of plots with unambiguous ownership titles and clear definitions of the ways in which the given plots may be used.

In the view of society as a whole, the development of housing construction in some areas has brought about the gentrification of many and the pauperization of the rest. The differentiation is clearly marked in the distribution of house prices in Warsaw and its environs. The investment activities of the private sector are of great significance, but the small amounts of capital at its disposal ensure that it remains associated with small undertakings bringing quick profits, or with the profitable location of cash.

[1] A significant element in shaping the functional and spatial structure of the town were plan directives in the scope of transport systems, determining the accessibility of various town areas, and in the scope of natural environment problems, connected with preserving proper relations between developed and open spaces. Such problems are still of extreme significance in the plan of 1992, where efforts were made at creating a new approach to the difficult problem of reserving in land for future construction of routes and for preserving the open areas system in a way allowing for the new legal regulations which are currently being prepared. Those regulations should ensure conditions for solving conflicting situations occurring between interests of land owners and future requirements of the city.

Particularly active here are areas of the construction of one-family housing which change the architectural face and functional character of areas; and areas of farmstead construction in which inhabitants leave agriculture and are interested in the exclusion from agricultural use of land with a view to

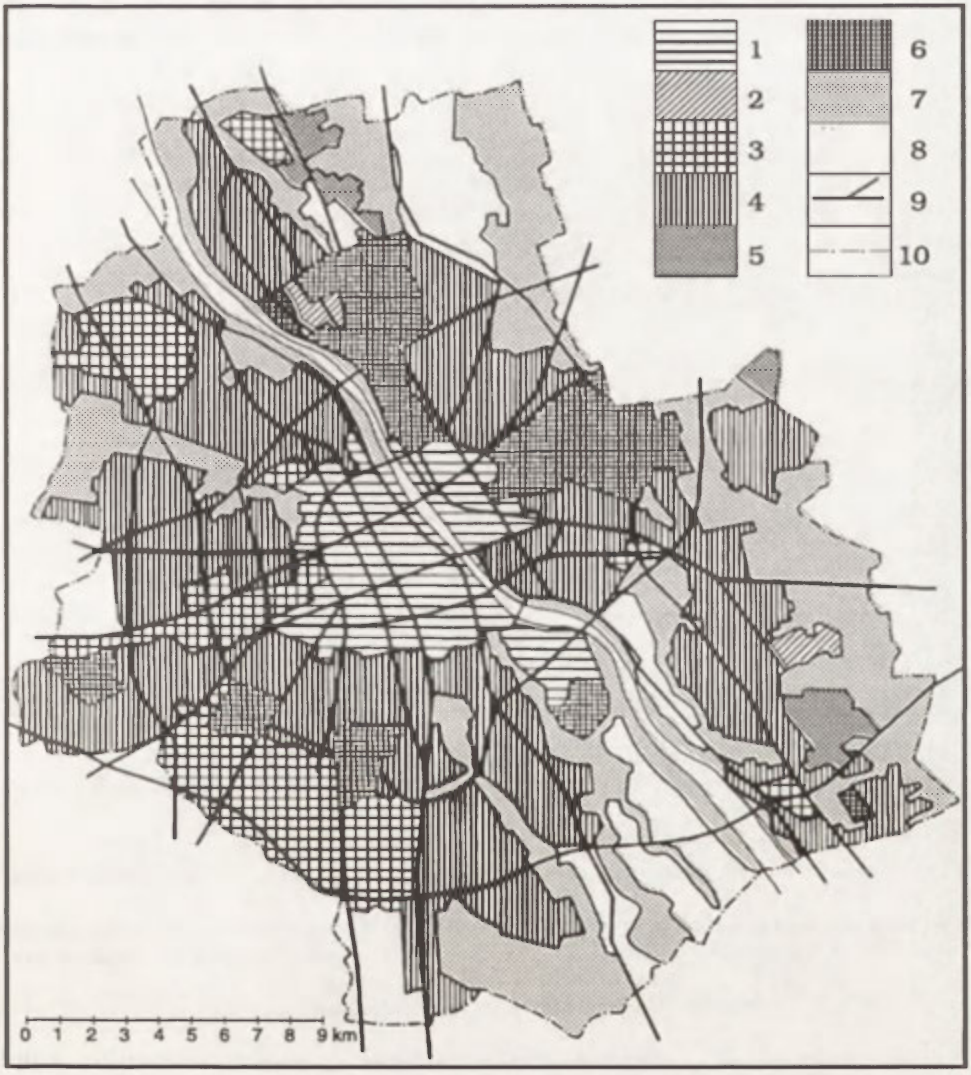

Fig.3. Warsaw's Master Plan, 1992
Functional zones: 1 — central; 2 — central zone with residential functions; 3 — services and technical functions; 4 — residential zone and services; 5 — services and residential zone in wooded areas; 6 — industrial zone; 7 — ecological zone; 8 — areas of potential urbanization; 9 — main roads and streets; 10 — boundary of the Warsaw city
Source: Cierpiński at al. 1993, p.38

its division and sale. In this process, a Statute on the Protection of Agricultural Land is the only brake to the spontaneous parcelling and development of agricultural areas.

The urbanizing villages in the immediate vicinity of Warsaw are most highly susceptible to functional and social changes. Reference may be made in the first case to the coming into prominence of what were previously secondary functions, as well as to the pressure to raise the standard of

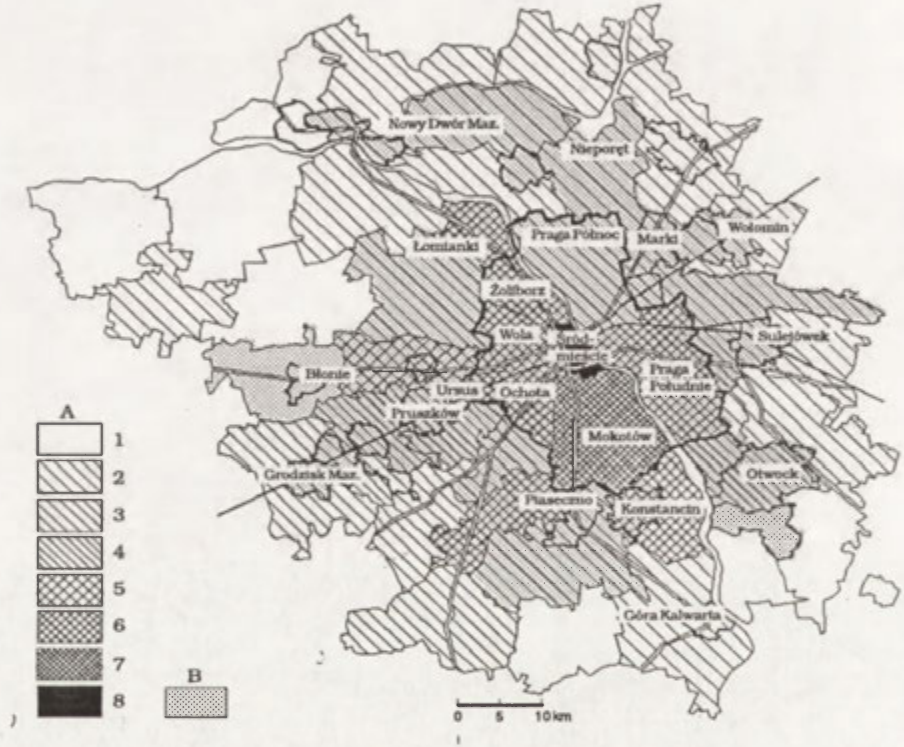

Fig.4. Technical equipment of housing units and prices of land in the Warsaw capital voivodship, 1992

A — Prices of construction plots in US $: 1 — 1-5; 2 — 5-10; 3 — 10-15; 4 — 15-20; 5 — 20-25; 6 — 25-50; 7 — 50-100; 8 — 100- 530; B — Areas with 60% of well equipped dwellings in: gas, water supply networks, and bathrooms

Sources: Chmielewski 1994, p.42; Węcławowicz 1994

residence through the development of electricity, road, gas and water supply networks. Areas furnished with gas and water supplies are characterized by housing corresponding to contemporary requirements (a bathroom, central heating, running water) as well as by distinctly higher land prices in relation to those for land in which such networks are either lacking or sparser (Fig.4).

Settlement in areas that were traditionally agricultural is only partially equipped with technical infrastructure. Sewer systems are usually lacking,

as are basic services. In consequence these areas increasingly pose a real threat to the environment. The excessive exploitation and pollution of waters is accompanied by the uncontrolled dumping of wastes, free-for-all construction and production without proper checks on sanitation. All these aspects may give rise to future problems whose solutions are likely to be difficult and costly (Fig.5).

The Warsaw agglomeration is largely covered by gas supply and water

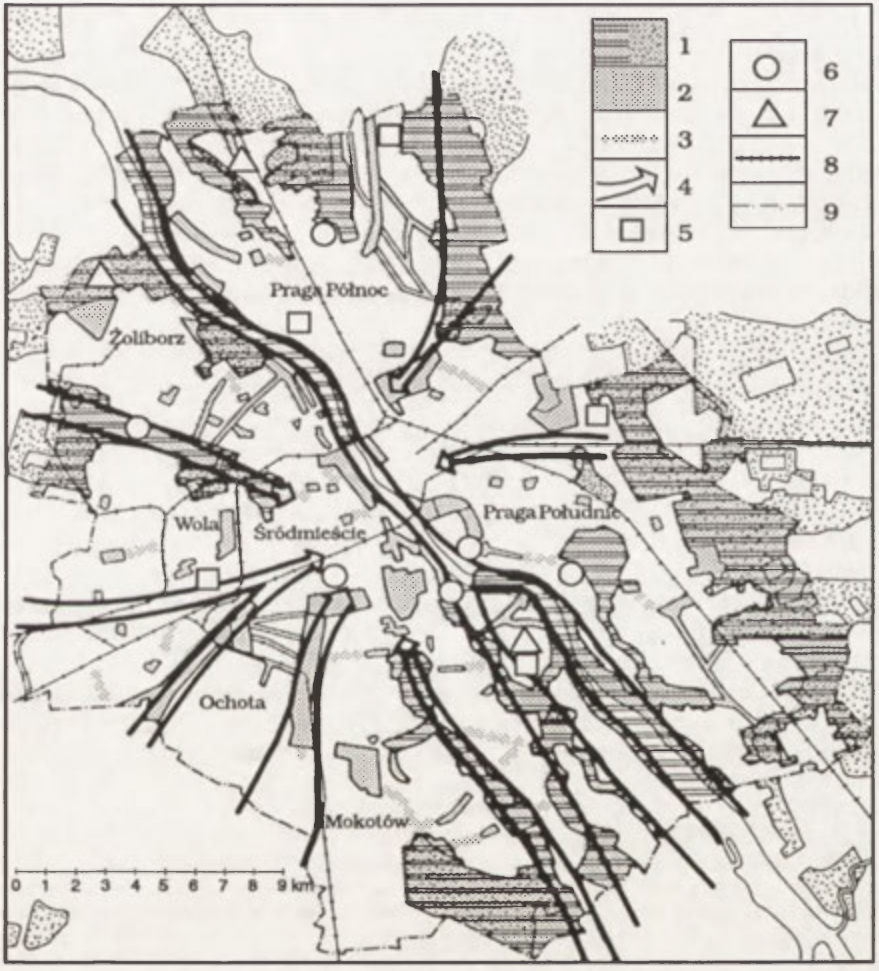

Fig.5. Warsaw's Master Plan, 1992. Environment protection
1 — Ecological zone — primary system; 2 — public green area - secondary system; 3 — green area links; 4 — air exchange and regeneration system; 5 — central heating plants; 6 — water works, water supply networks, and reservoirs; 7 — municipal sewage purification stations; 8 — railways; 9 — boundary of Warsaw city
Source: Cierpiński et al. 1993

supply networks and this fact combines with the fact that the discharge of sewage to the ground is permitted to ensure that most of the suburban zone is vulnerable to development and the associated further degradation of environment. The sewage discharge from the extensively built-up suburban areas may in future come to constitute a serious technical problem. There is even now an urgent need for sewage treatment plants for the existing sewer network, particularly for those areas on the right bank of the Vistula. The organization of catchments for liquid wastes produced in areas deprived of sewer networks is another necessity.

In answering a question as to whether the proximity of Warsaw speeds up or delays the development of the suburban zone, it is necessary to say that the development of the zone is occurring in the shadows of a capital, a great market and a multifunctional centre. The proximity strengthens the processes of urbanization in the zone, but these largely have a "wild" character or else result from local plans implemented under local pressure. In principle, planned development is limited to the construction of technical, and often also social, infrastructure. However, the scale of the development is often strictly limited, and this leads to the appearance of many developmental tensions, particularly those harmful to the natural environment.

DEINDUSTRALIZATION AND ENVIRONMENTAL QUESTIONS

The natural environment of Warsaw would create great potential if it were possible to remove harmful burdens and pollution resulting from: the poor quality of drinking water taken from Vistula river; the lack of treatment plants for right-bank Warsaw; the fact that 65% of Warsaw's area remains without a sewer network; the unecological management of wastes — with no use of deactivation; the burdensome and out- of-date industry and transport which pollute the air; noise; the pollution of soils and the increasingly-dense construction in existing housing estate.

The emission of air pollution in the Warsaw agglomeration is a direct result of the considerable concentration of people and industrial production[2]. This concentration results in:

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[2]The following types of pollution may be distinguished:

1. Pollution deriving from processes involving the combustion of solid fuels, mainly coal:
— in heat-and-power plants, large urban heat plants and large industrial boilerhouses. Indicative of this type of pollution are sulphur dioxide, oxides of nitrogen and particulates. The latter are to a great extent removed by dust-removal equipment, while objects of the kind mentioned are mostly characterized by good conditions for the dispersion of pollutants, having tall chimneys and significant thermals lifting pollutants to high altitudes;
— in small boilerhouses and groups of furnaces. Indicator pollutants here are particulates, as well as sulphur dioxide, and these objects are not usually furnished with equipment to remove them.
2. Pollution deriving from traffic. Indicators of this type of pollution are carbon monoxide, oxides of nitrogen, formaldehyde (methanol), particulates (including lead dust) and ozone. Conditions are not generally favourable for the spread of these pollutants, and depend mainly on the density of urban construction and traffic conditions.
3. Pollution deriving from technological processes in industry.
4. So-called "secondary" pollution derived by the wind-blowing of pollution already deposited, or being derived from the substrate, the dust of soils, dumps, unswept streets etc. The indicator of pollution here is dustfall.

— a great demand for energy, which is mainly obtained through the combustion of coal,

— a high degree of mobility leading to the continued rise in motor vehicle traffic,

— a diversity of technological process in industry.

On the scale of the agglomeration, most pollution is emitted from Warsaw itself (93% of particulates and 85% of gases). Particulates, oxides of nitrogen and solvents are dominant. The range of substances emitted by industry in Warsaw and capital voivodship is very great particularly in the following areas with elevated pollutant concentration in:

— a belt stretching from the centre of the city through Wola, Ursus, and Piastów to Pruszków (see also Biernacki's paper in this volume, Fig. 2). This belt has industrial plants, power plants and local boilerhouses, and is characterized by elevated levels of sulphur dioxide, nitrogen dioxide and particulates. The fall noted in pollution has been a consequence of recession, rather than of modernization and new technology;

— the northern parts of Warsaw within the sphere of influence of the Żerań heat-and-power plant an the steelworks (Huta Warszawa, Lucchini); the Piaseczno area within the sphere of influence of a group of electronics and television factories (Thomson) and the garden combine in Mysiadło; and some areas in Grodzisk Mazowiecki and Nowy Dwór.

Levels of sulphur dioxide and particulates are enhanced in these areas, as are those of other pollutants more locally. However, most industrial plants apply, or have the possibility of applying, equipment to reduce pollution. Permitted norms are not however exceeded and the modernization or replacement of production technologies (e.g at the steelworks) should lead to more limited pollution in the future. In contrast, a great threat is posed by the so-called "non-organized" emissions from these plants, which result mainly from the lack of proper closed cycling in production.

A high degree of centralization ensures that the supply of heat energy dominates emissions from the different energy sources, which are responsible for 88% of the emission of sulphur dioxide determined for Warsaw.

A summary indicator of pollution is the deposition of particulates emitted by sources large and small, non-organized and in transport. It is also a secondary pollution. A reliable evaluation is given by the results of measurement[3]. Fig. 6 shows that the greatest dust fall (120-125 g/m^2/year) occurs in the centre of the city — in the most densely populated districts of Śródmieście, Ochota and Wola. Values for the fall of particulates in most of the remaining area are within the range 40-100 g/m^2/year. This concentration

[3] The mean dustfall in Warsaw in 1992 amounted to 38 g/m^2/year (while the norm for this measure was 200 g/m^2/year). This represented a fall of 24% in relation to the situation in 1990: a phenomenon which mainly resulted from the use of coal of higher quality in heat-and-power plants, as well as from the modernization of dust-removal equipment. The recession and successive liquidation of local boilers were also factors.

of pollutants of the air in the densely populated areas of the city is very harmful for human health (see Biernacki's paper in this volume).

Along with that for dustfall, the figure for suspended particulates is another summary indicator of the pollution derived from all sources. The level of particulate pollution in Warsaw is high, although a slight fall has been noticed recently. The mean concentration of particulates was estimated at 42.7 g/m^2/year in 1992 (or more than 85% of the maximum permissible concentration of 50 g/m^2/year). This represented a fall of 14.6% in relation to the figure for 1990 of 51 g/m^2/year. The maximum permitted concentration is still exceeded in the central parts of Warsaw.

The greatest pollution problem in Warsaw is posed by transport (as an effect of the rapidly developing motorization). The participation of pollution from transport in the urban pollution balance has been estimated at 70%, and continues to show an upward trend[4]. The central area is highly polluted, with systematic and repeated non-compliance with the maximum permitted norms for concentrations of carbon monoxide, heavy metals, formaldehyde (methanol) and ozone. There is also local non-compliance along some streets in relation to concentration of oxides of nitrogen[5].

The level of transport-related pollution continues to show an upward trend, while levels of pollution from industry and power supply have fallen. This is a result of the use of coal of higher quality and the modernization of factories, as well as of the recession in industry. Away from the central area, there has been a continued decline in the spatial range and level of pollution.

CONCLUSIONS

In the symbiosis of the city and industry in Warsaw, due to the economic policy of the communist system the city has been placed on a service position in relation to industry. Particularly, the key industries (metallurgical, chemical) had numerous privileges; they required a lot but their input to the municipal economy was negligible. It is still doubtless that industry in Warsaw took advantage, and does not pay for its privileges, especially for the costs of the environmental pollution, very hazardous for the health of

[4] The emission of pollution from transport is defined as very high, and considerably higher than in places in more highly-developed countries where the intensity of traffic is comparable. This results from the high unit emissions from Warsaw vehicles which is in turn a consequence of the lack of catalytic converters, imperfect engine tuning, the poor technical state of vehicles, the great use of low-quality fuel and poor traffic conditions. In June 1993, as many as 60% of the motor vehicles were found to be in non-compliance with even the liberal Polish norms for the emission of carbon monoxide in exhaust gases.

[5] Pollution by heavy metals is characteristic of contamination due to transport. The level of pollution by lead is very varied. In the unaired centre it is very high, at 0.4 and 1.5 μg/m^3/year in 1991 and 1992 respectively — as compared with a norm of 0.2 μg/m^3/year. The distribution of cadmium was of a similar kind (at 0.161 and 0.166 μg/m^3/year in 1991 and 1992 respectively — as compared with a norm of 0.01 μg/m^3/year).

the inhabitants. Conveniences provided by the city, burdening the municipal economy, are not appropriately charged for.

However, the spatial pattern should be transformed from its present extensive character into an intensive one — taking into consideration requirements of environmental protection in the Warsaw city and its agglomeration. The restructuralized industry should recompensate the city and its population for profits achieved by the fact of its functioning and its negative impact on the environment of the city.

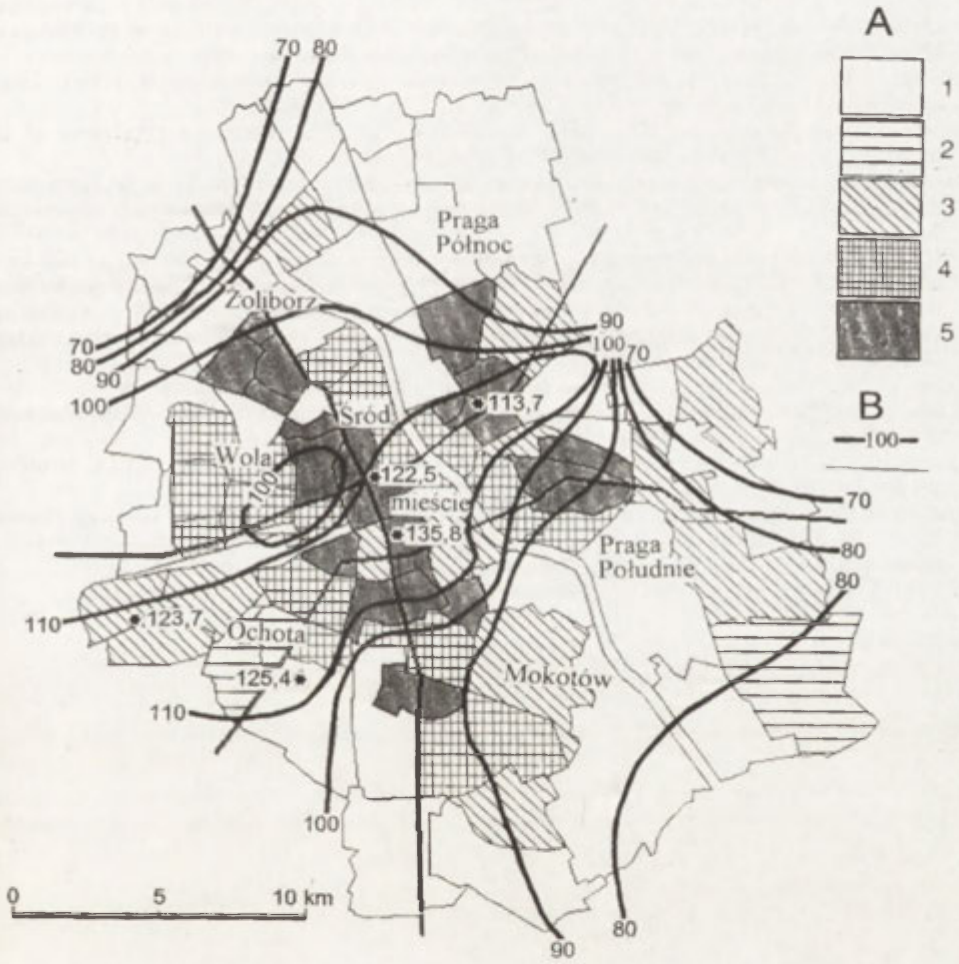

Fig.6. Density of population and dustfall in Warsaw, 1992
A — Population density in persons/ha: 1 — 0-5; 2 — 5-10; 3 — 10-50; 4 — 50-100; 5 — 100-298;
B — Dustfall: isolines presenting values of dustfall in g/mm^2/year
Sources: Ostaszewska 1994; Węcławowicz 1994.

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ENVIRONMENTAL POLLUTION AND THE HEALTH STATUS OF THE POPULATION IN WARSAW

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ABSTRACT: The paper presents an attempt at defining the factors which cause a high death rate in Warsaw as a result of civilizational diseases. It has been stated that the reason for this in the city area as a whole may be environmental pollution, namely air, drinking water and field crop pollution. In the city centre of Warsaw the higher death rate for civilizational diseases may be caused by too high concentration of transport-generated air pollution.

KEY WORDS: Mortality, health status, environmental pollution.

INTRODUCTION

The reports of the WHO indicate that Poland belongs to the group of European countries with the highest environmental pollution levels. These pollutants are considered to be one of the factors causing intensification of the number of cases of civilizational diseases and deaths due to these diseases especially those of the cardiovascular system and malignant cancers. Additional causal factors for these diseases, existing in Poland are Europe's highest consumption of alcohol and cigarettes, as well as the traditional diet, harmful for health, rich in animal fats and pork, with a low share of sea fish, vegetables and fruit. The indices of deaths due to civilizational diseases in Poland culminate in Warsaw.

MORTALITY DUE TO CIVILIZATIONAL DISEASES

During the first post-war period until the end of 1940s, the main cause of deaths in Warsaw was constituted by infectious and parasitic diseases (some 200 deaths per 100,000 population), and then by the diseases of the cardiovascular system (170 per 100,000), malignant cancers (100 per 100,000), and by accidents, traumas and poisonings (80 per 100,000).

Civilizational diseases intensified in Warsaw since the end of 1960s, while

death rates due to other causes were effectively limited. Thus, for instance, the death rate due to infectious and parasitic diseases decreased during the post-war period almost twenty times (down to 9.2 per 100,000 in 1992).

On the other hand, the death rates due to civilizational diseases increased in the years 1947-1992 many times:

— for the cardiovascular diseases: by 256%, from 167 per 100,000 in 1947 to 595 in 1992,

— for the malignant cancers: by 151%, from 100 to 251 per 100,000.

Since the middle of 1970s the death rates mentioned above have been higher than both the national averages and the urban averages in Poland (until 1970s their value had been lower). Civilizational diseases are now responsible for approximately three quarters of all deaths in Warsaw (with cardiovascular diseases responsible for some half of the deaths).

The intensity of cases of illness and of deaths due to civilizational diseases in Warsaw has endemic features.

With the high and still increasing general rate of mortality (12.4 per 1,000 people), the annual toll of the cardiovascular diseases and malignant cancers in Warsaw is 15 thousand, and approximately 2.5 thousand (16%) of these cases concern people at the age of the highest professional activity (20-59 years). Besides this, the civilizational diseases shorten the lives of 3,500 persons between 60-69 years of age (24%), and of 9,000 persons (60%) of more than 69 years of age (the average age of death).

Among Polish towns having more than 300,000 inhabitants, Warsaw ranks third as to its joint death rate due to civilizational diseases (behind Łódź and Poznań, but ahead of Katowice and Cracow), while the central district Warszawa-Śródmieście has the highest death rates due to these diseases of all the large and medium towns in Poland (Fig. 1). The joint death rate due to cardiovascular diseases and malignant cancers observed in the district Warszawa-Śródmieście (the centre of Warsaw) is some 56% higher than the rate for the whole of Warsaw (Table 1). It is higher by 20% than in Chorzów (Fig. 1), the town which has the highest joint death rate due to civilizational diseases among the towns with a population of over 100,000.

It must be emphasized that high death rates in district Warszawa-Śródmieście result partly from the specific age structure of the inhabitants of this district, namely the share of population in post-productive age is higher there than in Warsaw as a whole (Warsaw — 168.6/1000 population, district Warszawa-Śródmieście 277.0/1000 population). Still, such an age structure can by no means satisfactorily explain the fact the infant death rate in the district Warszawa-Śródmieście is higher by 24.5% than in the whole city.

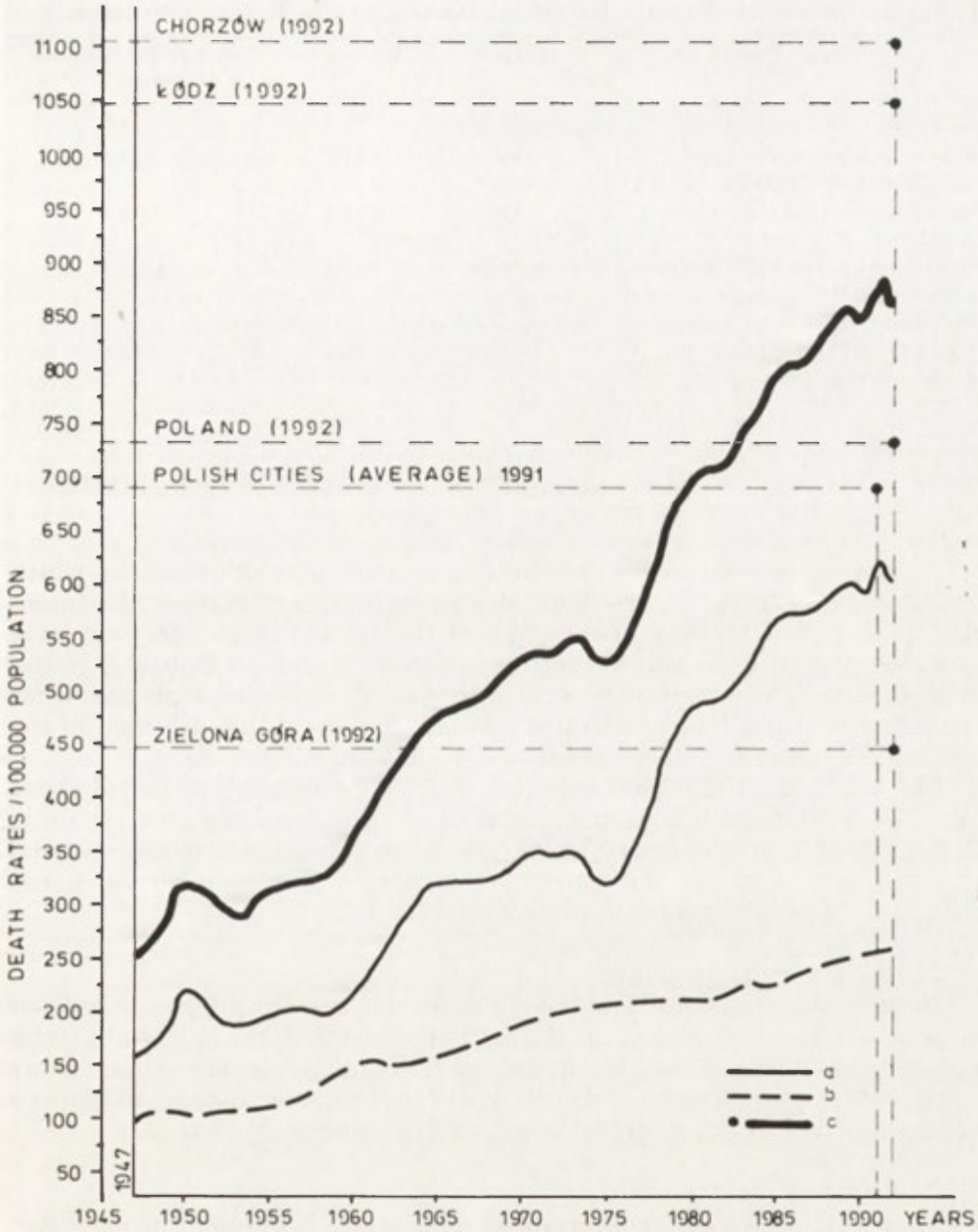

Fig. 1. Death rates due to civilizational diseases in Warsaw, 1947-1992
a — circulatory system diseases; b — malignant neoplasms; c — total: circulatory system diseases, malignant neoplasms

TABLE 1. Comparison of death rates: Poland, Warsaw, district Warszawa-Śródmieście

Causes of death	Poland	Warsaw	Warszawa-Śródmieście district
All causes /1 000 population 1992	10.2	12.1	18.2
Circulatory system diseases / 100,000 population 1992	537.4	594.7	947.8
Malignant neoplasms /100,000 population 1992	192.5	251.1	373.5
Total: circulatory system diseases and malignant neoplasms /100,000 population 1992	729.9	845.8	1321.3
Infant deaths /1 000 live births, annual average 1990-1992	15.1	13.4	16.7

CAUSAL FACTORS FOR INTENSIFICATION OF ILLNESSES AND DEATHS DUE TO CIVILIZATIONAL DISEASES IN WARSAW

In contrast to poisoning, infectious diseases and parasitic diseases, which are conditioned by the bad hygienic and sanitary state of Warsaw, the intensification of cases and deaths related to civilizational diseases does not have unambiguous, strictly defined (both quantitatively and qualitatively) causal relationships. The potential causal factors usually cited are: high quantities of alcohol consumed and cigarettes smoked, improper diet, pollution of the natural environment, stress, noise and socio-economic factors.

The assessment of the influence exerted by the factors mentioned above upon the level of the joint death rate due to civilizational diseases, resulting in the excess of 16% observed in Warsaw when compared with the national average, and by 56% in the district Warszawa-Śródmieście when compared with the whole of Warsaw, is presented below.

1. *Alcohol, cigarettes, diet*

Neither the quantities of alcohol drank, nor the cigarettes smoked per person, nor the diet of the inhabitants of Warsaw differ essentially from national standards. Thus, it can be inferred that there are other factors which entail intensification of deaths due to civilizational diseases in Warsaw as a whole and in the district Warszawa-Śródmieście in particular.

2. *Environmental pollution*

There exist in Warsaw concentrations of pollutants of the air, drinking water, soil and crops (especially of vegetables and berries), harmful for human health.

(a) *Air pollution*

According to the estimates the main cause of air pollution in Warsaw (some 70%) transport-related, followed by the energy-production-related

pollution, by the secondary pollution (dust particles from the earth's surface blown into the air, by the wind and by the cars), and by industrial pollution (Fig. 2).

Transport-related air pollution. The air in Warsaw is being polluted by approximately 700 thousand automobiles. In 1992 there were 629 thousand cars registered in Warsaw (including 541.5 thousand passenger cars). The remaining cars are connected with the inward commuting and transit traffic. Emissions of transport-related pollutants are very high indeed, much higher than in Western countries, given comparable numbers of cars. Such a situation is caused by, in particular, very high unit emission of pollutants from automobiles due to low mileage of home produced cars, not fit for lead free petrol (as of 1992) and not equipped with catalysing devices, as well as acceptance of two-stroke engine propelled cars, and generally of cars with old and worn-out engines, which emit increased amounts of pollutants. "Raw" car exhausts emitted contain gaseous and dust substances in concentrations noxious for the human body (carbon oxide, nitrogen oxides, carbohydrates, ozone, dust containing particles of lead and of other heavy metals).

Energy-related air pollution. The most important sources of energy-related air pollutants, resulting from coal burning (i.e. primarily of sulphur dioxide, nitrogen oxides and dust), are 3 co-generation power plants, 2 heating plants, a dozen power plants belonging to industrial factories, as well as some 200 smaller local and industrial heating plants. In 1990 emissions of air pollution amounted to 39 thousand tons of dust and 85 thousand tons of gases.

Industrial pollution. Within the local areas of the town industrial plants emit polluting substances in concentrations noxious for human health, including heavy metals, xylen, fenol and others.

Areas, kinds and scale of air pollution. The highest concentrations of air pollution, mainly generated by transport, appear in some 30 sq. kms of the central part of town (Fig. 2). This area encompasses, on the left bank of the river Vistula, the whole of the district Warszawa-Śródmieście. Approximately 1 million persons stay during daytime within the area in question (300 thousand inhabitants, and commuters: 300 thousand from other districts and 400 thousand from outside of Warsaw). Thus, there are on average approximately 35 thousand persons per sq. km in this area during the day.

High population concentration, lowered oxygen balance (due to reduction of oxygen producing greenery), as well as weakened insolation stimulate together intensive development of harmful bacteria and viruses in the air of the area. According to the observations of the monitoring station of the Environmental Protection Institute the annual average carbon concentration in the central area exceeded in 1992 eleven times the admissible level of

120 µg/cu.m/year. It was also stated that the admissible daily average of carbon oxide concentration, namely 1,000 µg/cu.m/day have been systematically exceeded by the factor of one up to 6. The above mentioned monitoring station is located outside of the direct reach of influence of emissions from

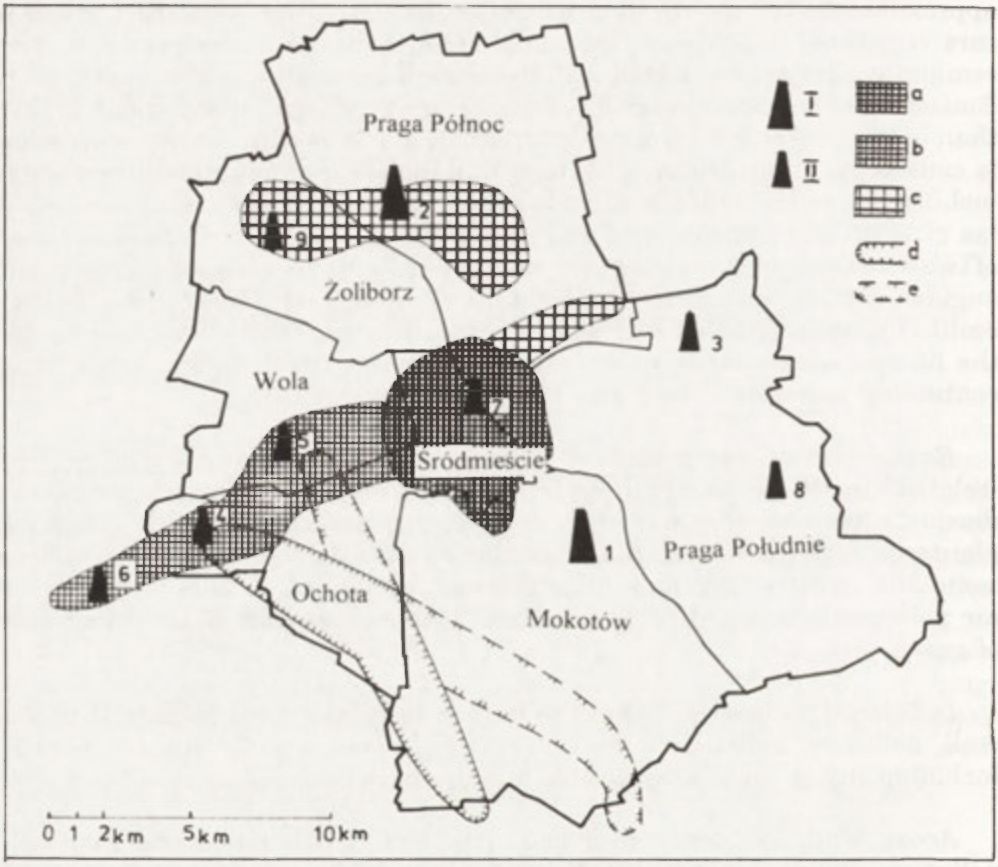

Fig. 2. Air pollution in Warsaw
The greatest emitters of air pollution: 1 — EC Siekierki, 2 — EC Żerań, 3 — EC Kawęczyn, 4 — ZM Ursus, 5 — C Wola, 6 — EC Pruszków, 7 — C Powiśle, 8 — C ZWAR Międzylesie, 9 — HLW Lucchini
Emission of dust and gases: I — over 10 000 t/year; II — from 1000 to 10 000 t/year
Areas of excessive air pollution: a — area where the concentration of carbon oxide and heavy metals exceeds many times the admissible level and periodical concentration of nitrogen oxides, carbohydrates, ozone, and suspended dust exceeds admissible level; b — area where the concentration of sulphur dioxide, nitrogen oxides and suspended dust borders on the admissive level; c — areas with a heightened level of industrial and energy-related air pollution but still below the admissible level; Areas affected by noise caused by air traffic: d — during 90% days of the year; e — during 10% days of the year.
Districts of Warsaw: Mokotów, Ochota, Praga Północ, Praga Południe, Śródmieście, Wola, Żoliborz
Source: Ostaszewska 1991.

the streets of district Warszawa-Śródmieście. It notes pollution at the height of 10 mts above ground. Thus, concentrations of carbon oxide in the air of surface-adjacent zone of central Warsaw street canyons and of the neighbouring housing estates are much higher. Over the whole intensively invested area in the city the average annual concentration of carbon dioxide significantly exceeds the admissible levels.

Further noxious air pollutants present in the central area include various dusts, carbohydrates, nitrogen dioxide and ozone. The average annual concentration of suspended dust exceeds significantly the admissible level of 50 µg/cu.m/year. For the whole built-up area of town the concentrations are close to or twice as high as the admissible level. In 1991 the average annual concentration of suspended dust, averaging for the whole of the city, was 51 µg/cu.m.

Similarly, the daily average exceeds the admissible level of 120 µg/cu.m/day, attaining some 500 µg/cu.m. The content of heavy metals in suspended dust also exceeds admissible levels — in 1992 the admissible average annual level of cadmium concentrations (0.01 µg/cu.m/year) was exceeded seventeen times, while that of lead (0.2 µg/cu.m/year) seven times. Moreover carbohydrates do not make an exception as to the exceeding of admissible levels in the centre of the city, and during the warmer season 30-minute and daily admissible levels of ozone are also being exceeded.

The above mentioned pollutants, together with sulphur dioxide and large-particle dust (the latter not recently exceeding — due to recession in industry — half of the admissible levels) act in synergy, amplifying jointly the noxious influence of air pollutants on human health.

Outside of the central and built-up urban area, where admissible annual average levels of carbon oxide and suspended dust are being exceeded, an increased level of pollution, mainly of industrial origin, is noted within the urbanized western belt. Then, in the northern part of Warsaw, located within the reach of joint influence of pollution emissions from Żerań co-generation plant and Lucchini metalworks increased concentrations of energy-related and industrial pollutants are observed. Yet another area of increased pollution exists in the eastern urbanized belt (see Fig. 2).

Lowered air exchange intensity in town. Along the main direction of winds (from the West) the urbanized area stretches over 23 kms from Pruszków through the centre of Warsaw to Targówek, thus weakening the horizontal air exchange intensity during 87% of the year (i.e. during weak winds and atmospheric stills). It is primarily then that there occur higher concentrations and stagnations of air pollution. Further weakening of horizontal exchange of air and strengthening of the disadvantageous phenomena mentioned takes place within the small, dark countryards of the downtown area, and also behind the uninterrupted walls of the new housing estates of Chomiczówka, Bemowo and Gocław, of 30-40 mts of height and some 1 km of length, located perpendicularly to the dominating directions of the winds.

(b) Pollution of drinking water

The Central Water System, composed of the central duct taking water from Vistula river, Praga duct — taking water from river sands below the riverbed of Vistula, and northern duct taking water from the Zegrze resorvoir, supplies water to approximately 94% of population in Warsaw. In 1992 this system provided 640 thousand cu. m of water. Some 5% of the population, mainly living in the external zone of town, are supplied with water from the underground wells of low depth, contaminated by the wastewaters infiltrating from various sources.

In view of considerable pollution of the Vistula river and Zegrze reservoir the water provided by the Warsaw water supply system periodically does not conform to quality standards. Substances harmful to human health occur in this water periodically and in varying quantities, including natural organic micropollutants, pesticides and excessive salinization. The compounds resulting from disinfection of water with gaseous chlorine, include trihalomethanes, chlorofenols and chloro-derivatives of benzene which display teratogenic, mutagenic and carcinogenic features.

The shortage of absorbable magnesium in the river waters of Zegrze reservoir ca 10 mg Mg/dm^3 as well as considerable salinization of the Vistula may entail intensification of cardiovascular diseases. The use of ozone for disinfection of drinking water, undertaken in 1994 in the northern water duct, should improve its quality.

The only source of (relatively) pure water, harmless for human health, available within the area of Warsaw, is constituted by the oligocene aquifers of 200-250 mts of depth. The reserves of this aquifer allow exploitation with intensity of 20-25 thousand cu.mts per day. A dozen out of some 150 existing oligocene wells were made accessible to the population. They make it possible for the inhabitants of Warsaw to avail themselves with adequate quantities of water for drinking and food preparation. Transport difficulties, however, limit the possibility of using these all-accessible wells.

(c) Pollution of soil and crops

An important part of the area of soil in Warsaw and in the suburban zone, taken up for cultivation of vegetables and berries sold on the Warsaw market, features chemical pollution of a scale harmful for the human body. These soils and crops are excessively fertilized, also treated with cesspool wastewaters, dung, manure and other kinds of waste.

Locally, soils and crops are contaminated by pathogenic microorganisms, parasites, and carcinogenic fungi.

The most important role in chemical pollution of soil is played by heavy metals. They cause damages to immunological barriers in man as well as hormonal disturbances, and stimulate the prevalence of cancer. Within the 200 meter belts adjacent to the streets with heavy traffic there exist concentrations of lead exceeding admissible levels for cultivable soils. In the areas adjacent to streetcar lines and to some industrial plants there exist

high concentrations of copper. Thus, for instance, street dust in the vicinity of Lucchini steelworks contains 155 times more copper than is admitted for cultivable soils.

Besides the above mentioned direct anthropogenic pollution there are also indirect, natural processes of leaching and geochemical cascade, leading to secondarily increased local concentrations of heavy metals and other important pollutants. In addition, due to poor chemical composition of fluvial sandy soils of terraces along the Vistula, the joint effect on the health-related qualities of crops produced in many areas around Warsaw is very disadvantageous.

Furthermore, not all of the producers of vegetables and other crops brought to the Warsaw market observe the required periods of deficiency of crops with respect to nitrogen. The process of transformation of nitrogen compounds from fertilizers into plant protein lasts approximately 3 weeks. Harvesting of crops too soon after application entails the hazard of contamination with nitrates, which may then get transformed during cold storage into carcinogenic nitrogen compounds.

(3) Urban stress

Stress-like psychological and emotional states are mainly caused by the overlapping action of the following factors:

— concentration of a large number of people in buildings and technical structures composed of elements alien to the natural environment of man,

— conflict situations, connected with numerous interpersonal contacts,

— shortage and bad quality of service,

— general lack of kindness making it difficult to go through everyday affairs,

— significant reduction (especially in the central zone) of green areas, constituting the component of natural environment of man,

— constant feeling of a threat to life and health, connected with the high crime rate in Warsaw.

The action of stress, harmful for health, indicates that it can be one of the factors contributing to intensification of civilizational diseases and deaths due to these diseases in Warsaw.

(4) Noise

The influence of noise also harmful for human health, appears at the level of sound exceeding 60 dB. This level is exceeded over 30% of the area due to trarsport (car, streetcar and railway traffic). Over a further 10% of the area of Warsaw it is air traffic that causes the noise threshold to be exceeded (Fig. 2).

Besides, inadequate acoustic insulation features of construction materials used in housing mean that the majority of apartments in housing units are subject to permeating external and neighbourhood noise exceeding the admissible level of 40 dB.

Hence, traffic and neighbourhood noise can be one of the factors contributing to intensification of illnesses and deaths due to civilizational diseases in Warsaw.

(5) Socio-economic factors

The WHO cites among others the following factors determining the health status of a population:

— food supply and diet,
— clothing,
— leisure and regeneration of forces,
— possibility of saving up and use of social service facilities,
— use made of civil rights and freedoms.

During the post-war period the influence exerted by these factors, as well as the level of medical care have not been displaying in Warsaw disadvantageous divergences from the national standards. Thus these factors were not significant for the intensification of civilizational diseases in Warsaw.

(6) Lack of awareness of threat resulting from civilizational diseases among the inhabitants of Warsaw

The inhabitants of Warsaw are not aware of the intensifying endemics of civilizational diseases within the town. Some 40 persons die of these diseases daily (1991), including 16 persons of less than 69 years of age and 7 persons between 20 up to 59 years. In contrast to historical epidemics (the plague, cholera), civilizational diseases does not entail in Warsaw mass simultaneous death, nor are they reflected in separate cemeteries for their victims (like the old cholera cemeteries). Thus, they do not cause terror and are not easily perceived by the inhabitants of Warsaw. Society is not informed of the dimensions, causes, consequences and constantly increasing trend of the endemics, nor of the individual and instiutional undertakings which might lead to limitation of the effects of the endemics on health.

Within the contiguous zone of the street canyons in the central area of Warsaw, where pollution levels due to traffic are the highest, no monitoring is conducted concerning concentration of carbon oxide or suspended dust, and carbohydrates, causing the greatest health hazard. The lack of information acts in conjunction with the causal factors of intensification of cases and deaths due to civilizational diseases in Warsaw. It impedes mobilization of public opinion and actions to rescue the situation.

CONCLUSIONS

The analysis presented in the paper indicates that the main causal factors for the intensification of the incidence of illnesses and deaths due to civilizational diseases in Warsaw may be the following:

— pollution of the natural environment,
— urban stress, and
— noise,

with pollution playing the leading part.

By analogy to other large towns noise and stress should be considered

as secondary factors, acting jointly with environmental pollution. Thus, Paris and Tokyo, metropolises much larger than Warsaw, give rise to higher levels of stress and generate higher levels of noise, the rates of deaths due to civilizational diseases are lower than in Warsaw. Such a situation is the result, in particular, of lower consumption of alcohol and cigarettes, more rational diet with higher proportions of sea fish and other sea products, as well as lower levels of enviromental pollution.

The analysis carried out does not provide an adequate base for determining quantitative contributions of particular components of environmental pollution in the intensification of civilizational diseases in Warsaw. This analysis indicates only that the main determining factor of deaths due to civilizational diseases in the district Warszawa-Śródmieście (excess of 56% in comparison with the average for Warsaw) is caused by transport generated air pollution.

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CRACOW'S SPATIAL STRUCTURE AND ENVIRONMENTAL QUALITY

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ABSTRACT: Since its founding in 1257, Cracow has developed in an evolutionary way. Post-war development has been dominated by the steel works and the associated Nowa Huta district which was included into the city in 1951. The industrial function has dominated all others with all the positive and negative consequences that might be expected. Over time, the negative factors have come to prevail over the positive ones contributing to unbalanced urban development. The impact of industrial activities has overwhelmed city infrastructure, as well as causing serious environmental degradation.

KEY WORDS: Spatial pattern, social changes, environmental quality, Cracow.

INTRODUCTION

From a social structure point of view, a city, especially one such as Cracow, can be considered a long lasting structure. Cracow shows a specific spatial and social pattern that creates non-material values for society at large as opposed to individuals or distinct interests. With over a thousand years of history, the city serves to define the cultural identity of the Polish nation in both material and symbolic terms.

Since its founding in 1257, Cracow has developed in an evolutionary way. Its history has been punctuated, however, by important influences that have added distinct additional functions, such as scientific, cultural, military, economic. The most important to mention include: (1) the creation of the Jagellonian University in 1364; (2) transfer of the nation's capital to Warsaw in 1609; (3) construction of the "Cracow Fortress" in the mid-nineteenth century; and (4) construction of the steel works and new settlement of Nowa Huta which began in 1949.

Post-war development has been dominated by the steel works and the associated Nowa Huta district which was included into the city in 1951. Having been one of the pre-war centres for white collar employment, Cracow became the fourth largest industrial area in Poland after Upper Silesia, Warsaw and Łódź. The industrial function has dominated all others with

all the positive and negative consequences that might be expected. Over time, the negative factors have come to prevail over the positive ones contributing to unbalanced urban development. The impact of industrial production activities has overwhelmed city infrastructure, as well as causing serious environmental degradation.

SPATIAL PATTERN OF CITY DEVELOPMENT

Over the seven centuries following its incorporation as a city, Cracow has grown in an orderly way by building up a concentric urban pattern in a narrow section of the Vistula river valley between the Małopolska Upland to the north and the Carpathian foothills to the south. The main residential and service area was located in the city centre 2-3 km from the historic centre which has now mushroomed out into suburban districts. Industrial zones were associated with railway lines. The most extensive green space is to be found in the west. The 1949 decision to locate the steel works close to Cracow was taken by the Communist Government to achieve the ideological goal of bringing about an "improvement" to the city's social structure, rather than to attain economic goals. This influence dramatically changed Cracow's historic pattern and interfered with the factors that had guided development historically.

The steel works, known initially as the Lenin Steel Works (now Sendzimir Steel Works), along with its residential district were located 12-15 km to the east of Cracow on the higher Vistula terraces covered by fertile soils. By 1951, these areas had been included in Cracow City on account of the expansion of the steel works. The city covers today approx. 111 km^2 of which 20 km^2 fall to the Sendzimir Steel Works. The works makes up about one-third of Cracow's area after two significant periods of expansion, notably the period 1949-1986, enlarging the area covered from 165 km^2 to 327 km^2 (Fig. 1).

Cracow's unbalanced growth has generated some interesting features in land use structure, especially with regard to specific activities. In western cities the structure is recognized, planned for and harmoniously managed. The structure differs from that of western cities. The lower share of residential and service areas is associated with the domination of multifamily housing, along with underdevelopment of the service sector. In contrast, there is an unusually high proportion of industrial areas, although they continue to be expansive (Table 1).

DEMOGRAPHIC AND SOCIAL CHANGES IN URBAN AREA

In the period 1950 to 1990, Cracow's population more than doubled from 344,000 to 751,000. The most rapid growth took place in the Nowa Huta district which grew from 19,000 to 225,000, thereby increasing its share in the overall Cracow population from 5 to 31% (Table 2). Population growth has been irregular. The period of most rapid growth in 1950-1959 (14,000

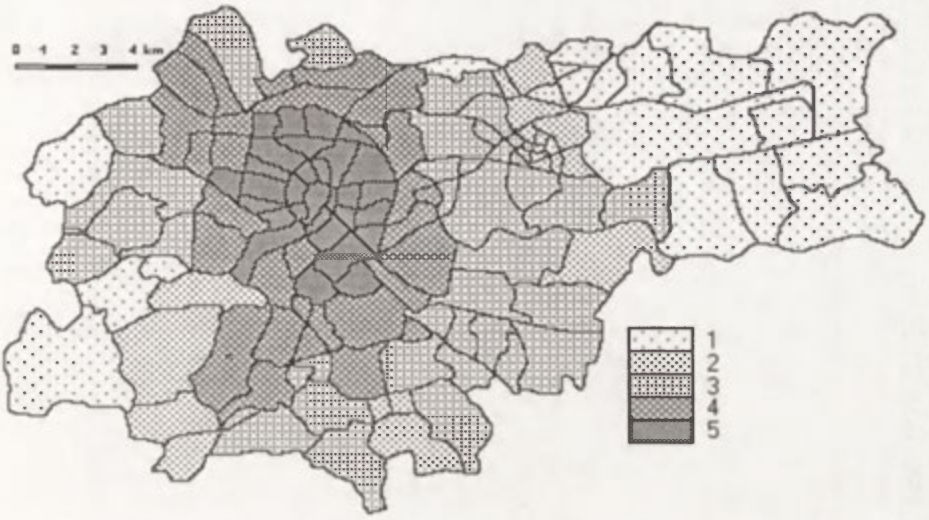

Fig.1. Density of the population of Cracow, 1950
Inhabitants per sq km: 1 — < 160, 2 — 161–200, 3 — 201–500, 4 — 501–2000, 5 — > 2000
Source: Bromek 1964

per year) was associated with the first stage of steel works and residential development. In the period 1946-1970 migration accounted for 61.3% of growth (Jelonek 1975) with a maximum observed in the first half of the 1950's. In the years 1950-1960, there were over 211,000 migrants to Nowa Huta from other voivodships (Soja 1989). In later years the contribution of migration to population growth and its spatial extent declined, but even in 1970 over two-thirds of Nowa Huta residents were born outside of Cracow. A characteristic feature was the declining share of worker hostel residents in the Nowa Huta population from 55% in 1951 to 33% in 1955 to 11% in 1978 (Soja 1989).

TABLE 1. Land use in selected cities (in %)

Main use	West European cities	Cracow City	
		Total	Nowa Huta
Residential	40 – 43	18	10
Services/business	10 - 14	8	4
Industrial	11 – 15	35	55
Transport	18 – 21	26	21
Infrastructure	3.5 – 4.0	·	·
Green space	10 – 15	·	·

Source: Luchter 1990 — data for Cracow; Ziobrowski 1992 — data for cities of Bonn, Munich, Nurnberg, Stockholm, The Hague and Zurich.

Basic changes in Cracow's spatial development were also linked to a trans- formation of the socio-demographic structure of the city's population. In the early 1950s, an earlier spatial pattern was discernible (Bromek 1964) comprising concentric ringed zones from city centre to periphery (Fig. 2).

TABLE 2. Populations of Nowa Huta and Cracow, 1950-1988

Specification	Nowa Huta					Cracow				
	1950	1960	1970	1978	1988	1950	1960	1970	1978	1988
Population (in thousand)	19	102	160	206	233	344	481	585	694	744
Proportion of Nowa Huta population in that of Cracow (in %)	5.5	21.0	27.3	29.7	29.8	100	100	100	100	100
Age structure (in %)										
people aged 15 and below	.	34.5	26.7	26.7	21.4[a]	.	26.2	19.7	21.9	20.9[a]
16-59	.	62.2	68.7	67.7	68.5[b]	.	64.2	67.8	65.3	64.2[b]
60 and over	.	3.3	4.6	5.6	10.1	.	9.6	12.5	12.8	14.9
Percentage of women	24.0	46.3	47.0	48.5	49.2	54.6	52.7	52.3	52.5	52.4
Natural movement (in ‰)										
birth rate	6.5	20.7	15.9	16.2	15.3	19.6	16.4	12.9	15.5	12.7
death rate	3.5	4.4	3.4	4.3	5.9	9.3	7.1	7.6	8.4	9.9
natural increase	3.0	16.3	12.5	11.9	9.4	10.3	9.3	5.3	6.9	2.8
Population by the sectors of the national economy (in %)										
primary	.	4.0	2.8	2.4	3.9	.	3.1	2.9	2.6	3.7
secondary	.	70.7	70.4	67.1	56.8	.	47.6	47.9	44.8	45.2
tertiary	.	21.0	28.3	26.6	39.3	.	35.6	35.5	35.8	51.1
Population by education (in %)										
university level	.	.	5.1	6.8	9.6	.	8.9	9.7	12.7	16.0
secondary	.	.	20.1	28.8	32.3	.	28.7	29.5	34.7	36.7
vocational	.	.	23.7	28.7	27.6	.	8.2	18.7	19.3	20.8
primary	.	.	44.7	33.3	29.2	.	37.3	35.0	29.4	24.8

[a] aged 0-14
[b] aged 15-59
Source: Data based on National Censuses.

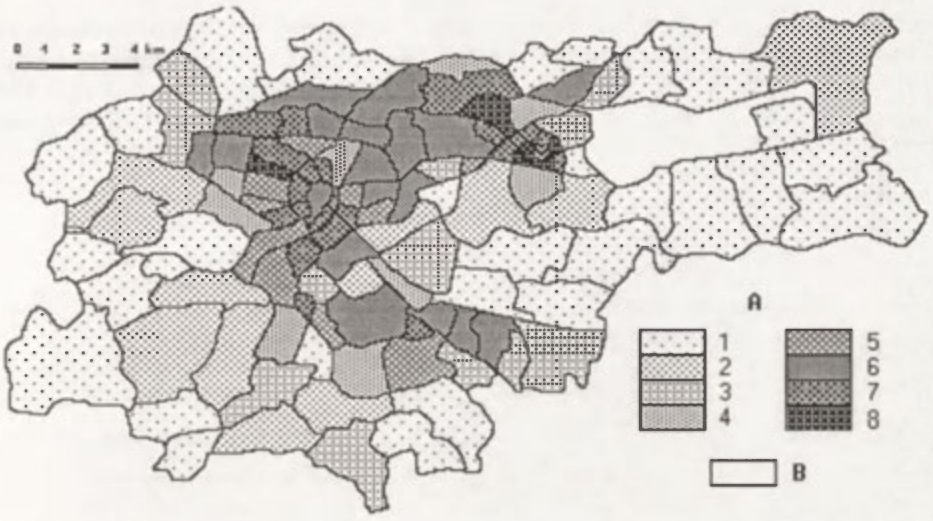

Fig. 2. Density of the population of Cracow, 1988
A. Inhabitants per sq km: 1 — < 300, 2 — 301–650, 3 — 651-1250, 4 — 1251-2500, 5 — 2501-5000, 6 — 5001-10000, 7 — 10001-25000, 8 — >25000; B. industry
Source: Zborowski 1992

Another important feature was the spatial distribution of population growth that favoured central over peripheral areas. This was the first stage of development of the Cracow Agglomeration — the urbanization stage (*Urban Europe...* 1981).

As a result of rapid construction of huge housing estates in the Nowa Huta district, the previous spatial structure of the city became less visible. An unbalanced growth of two parts of the city — the historic old city core and the new Nowa Huta district — have given Cracow a bipolar urban structure (Fig. 3), (Zborowski, in press). Currently, old Cracow is showing signs of the second stage of urban growth, namely the "suburbanization" stage. With respect to socio-demographic structure, this stage is characterized by a significant share of an aging population in the city centre with a relatively higher social status (over 21% are university graduates) and a significant proportion employed in science, education and culture (20% of the total) (Fig. 4). The population of the Nowa Huta residential districts is quite different (Górka 1989). This is still a youthful district with a high proportion of children and young people, along with a significant proportion of people of productive age working mostly as blue collar employees (55% of Nowa Huta's active population) (Fig. 5). Another distinctive feature of the Nowa Huta population that has been observed in some mining centres is the predomination of men over women.

The persistence of Cracow's socio-demographic pattern within one urban area contradicts the slogans of an egalitarian society that characterized the socialist epoch. The reality proved quite different — the social segregation and spatial polarization of urban society. The process has led to the creation

of exclusive areas, as well as areas associated with low social status which are now the poorest districts of the city. These are the first steps to various social pathologies which are now being observed in the oldest Nowa Huta residential estates, such as the Ogrodowe or Willowe estates (Prawelska-Skrzypek 1989).

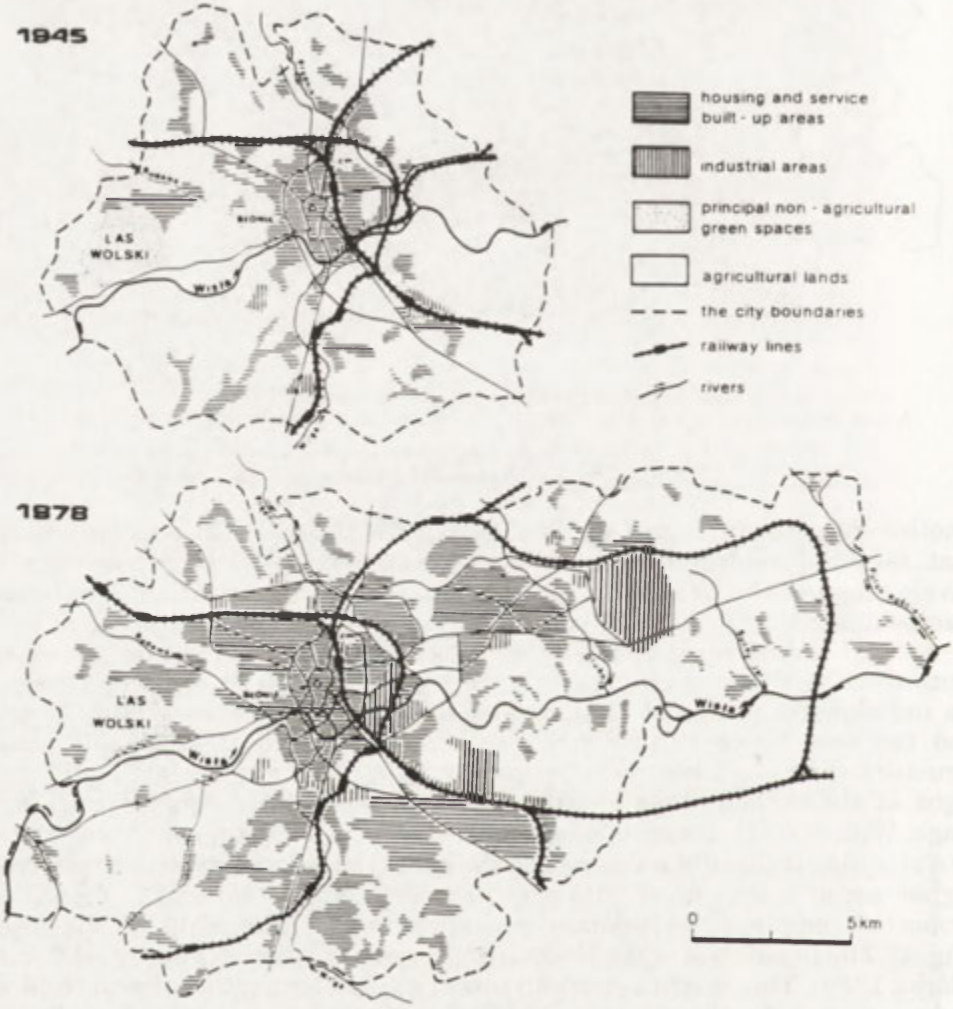

Fig. 3. Spatial pattern of the city of Cracow in 1945 and 1978
Source: Soja 1989, after Atlas Województwa Miejskiego Krakowskiego, 1979 (Atlas of the Cracow Voivodship), Kraków

CRACOW'S ENVIRONMENTAL SITUATION

The Cracow Agglomeration covers 1% of Poland's surface area with over 2% of the national population. Nearly 4% of industrial output is focused here, responsible for 17% of national gaseous air pollution emissions and

7% particulate emissions. The Sendzimir Steel Works (HTS) is dominant in this regard, although other industrial plants contribute to environmental pollution in Cracow (Kassenberg, Rolewicz 1985).

Other important pollution sources are Cracow's chemical plants in the southern part of the city (Bonarka, Solvay), the Polfa pharmaceutical plant, the Leg power station, as well as the polluting aluminum smelting plant

Fig.4. Per cent of blue-collar workers in the total of active population of Cracow in 1988
1 — <31.9, 2 — 32.0-37.9, 3 — 38.0-43.9, 4 — 44.0-49.9, 5 — >50.0

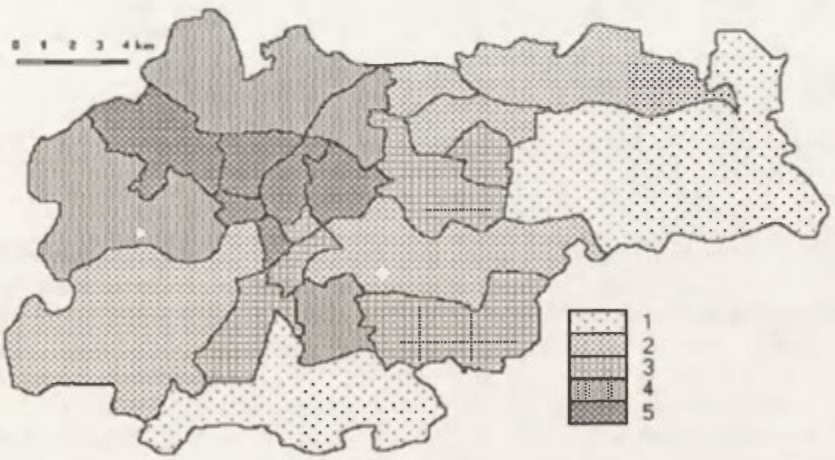

Fig. 5. Per cent of population with university level education in 1988
1 — <4.9, 2 — 5.0-9.9, 3 — 10.0-14.9, 4 — 15.0-19.9, 5 — >20.0

that operated in Skawina until 1981. Another important source are more than 100,000 domestic coal ovens located largely in the central core, 1000 coal-fired boiler houses, as well as heavy road traffic that is especially intensive along key transportation corridors.

In the 1980s Cracow was officially designated an area of environmental disaster, recognized as one of the worst in Poland. Air pollution levels exceeded prevailing standards, impacting on public health as well as many recently renovated historic buildings (*Klęska ekologiczna...* 1990).

Environmentally-related investments in past years have served to reduce particulate emissions. At the same time, the decline in industrial production has contributed to a significant fall in the quantities of particulate fall-out and atmospheric aerosol concentrations (Fig. 6). In 1993, annual standards for particulate concentrations were not exceeded in the city as a whole nor in any of its four districts for the first time in ten years (*Informacja...* 1994).

TABLE 3. Particulate and gaseous emissions from polluting industrial plant in the Cracow Agglomeration, 1993

Cracow districts and suburban localities	Fine particulates	Gases			
		Total	SO_2	NO_2	CO
		Cracow 's districts			
Nowa Huta	80.2	89.0	65.5	81.4	99.5
inc. HTS [a]	49.2	75.9	29.8	33.0	98.2
Podgórze	1.4	0.4	1.0	1.0	0.1
Krowodrza	2.3	0.3	0.9	0.8	0.0
Śródmieście	0.1	0.0	0.0	0.0	0.0
Cracow in total	84.0	90.6	67.4	83.2	99.6
		Suburban localities			
Czatkowice	0.2	0.0	0.1	0.0	0.0
Wieliczka	4.8	0.3	0.9	0.8	0.1
Alwernia	1.2	0.2	0.9	0.1	0.0
Skawina	9.8	8.9	30.7	15.9	0.3
Cracow Agglomeration	100.0	100.0	100.0	100.0	100.0

a — The Sendzimir Steel Works
Source: *Informacja...* 1994.

The main source of particulate fall-out remains the Sendzimir Steel Works (HTS) (Table 3), although its contribution has declined since 1987 to 59% in the Nowa Huta district and standards are exceeded only within the vicinity of the works themselves. With regard to gaseous pollutants, fluorine concentrations still exceed 48 hour and annual standards in the Cracow voivodship as a whole, including protected areas. The same can be said for sulphur dioxide concentrations in Cracow and in nearby Ojców National Park. Although sulphur dioxide concentrations have been significantly reduced in recent times, they still exceed permissible levels throughout the city. The most important source is low emissions resulting from domestic coal stoves and cars that increase during the winter months.

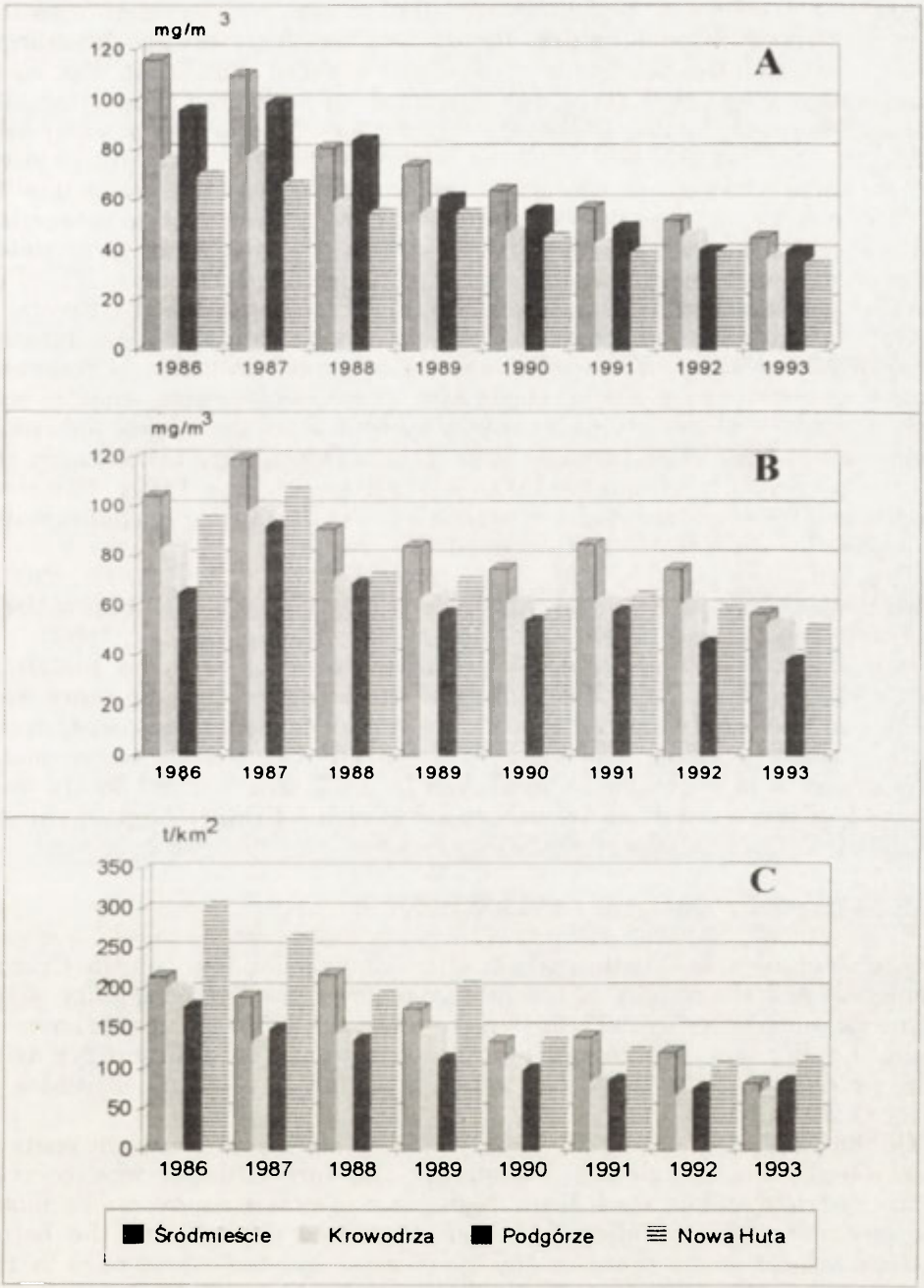

Fig. 6. Average annual concentration: A) of fine particulates, B) of SO_2, C) of heavy particulates fall-out in Cracow over the 1986-1993 period
Source: *Informacja...* 1994

Another problem is Vistula river pollution resulting in large measure from the Upper Silesian mines, though impacts from sewage discharges from Cracow and the Sendzimir Steel Works are also significant. The small rivers and streams that serve as Cracow's drinking water supply are also polluted (Rudawa, Sanka, Dlubnia). Only 3.9% of Cracow's river water falls within the highest category of water quality (defined in terms of physical and chemical criteria). In terms of biological criteria of the water quality, 98.7% of river water does not fall within the quality classification categories, and only 1.3% is classified as third class. The poor quality of river water, however, does not impact Cracow directly as the city meets over 58% of its drinking water needs from the Dobczyce Reservoir (on the Raba River).

Water resources management is ineffective in the Cracow region, in terms of inefficiencies in water consumption and continued pollution of river and ground waters. Industry uses about 80% of available water supplies and takes about 28% of the city water supply system. Even the largest industrial plants do not have closed water cycles. Increasing salinity problems in the Vistula have also been observed during the course of the 1980s. The river constitutes 80% of water resources available to the Cracow region, but remains unclassified from a water quality point of view.

The soil is so polluted with heavy metals (Cd, Cr, Fe, Ni, Pb, Zn) in Nowa Huta's horticultural areas, vegetable production should not be practised. The same can be said for Cracow's allotment gardens (*Klęska...* 1990).

It is important to add that the great concentration of heavy metals in the Cracow conurbation is also linked to the inflow of air pollutants from the Upper Silesian Industrial Region, as well as from the Karvina-Ostrava in the Czech Republic. The view is based on research on heavy metal concentrations in vegetables undertaken in 1993. The highest levels were observed in the western and southern parts of the Cracow Agglomeration.

STANDARD OF LIVING AND ENVIRONMENT

The disastrous environmental situation impacts decidedly on the Cracow population and the quality of life in a given area. Studies on quality of life in Cracow undertaken in 1992 (Prawelska-Skrzypek 1993) considered environmental quality (air pollution, drinking water quality, noise intensity), aside from residents' needs, the social context, welfare levels and attitudes to safety (Fig. 7).

Of the 18 districts studied, those in the western and southern parts of Cracow had the best environmental quality. The worst situation was observed in core districts and in Nowa Huta (high gaseous emissions, excessive noise). The environmental situation has been expressed spatially as the better districts appear to be those in the south-west and the worst ones in the central and eastern districts. The latter includes Nowa Huta.

CONCLUSION

The poor state of Cracow's environment has long been a focus for awareness, even though official statistics were not published. The Polish Ecological Club — founded in Cracow in 1980 — as well as other green organizations have

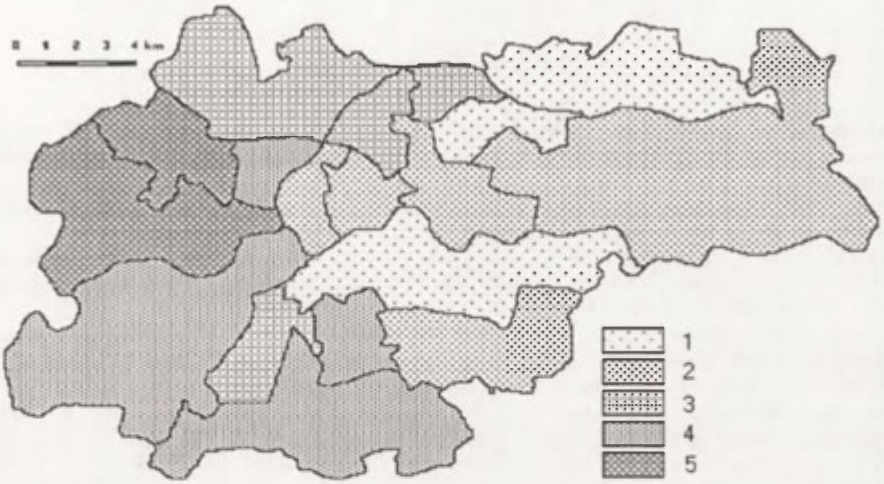

Fig. 7. Living standards of Cracow
1 — very low, 2 — low, 3 — medium, 4 — high, 5 — very high
Source: Prawelska-Skrzypek 1992

persistently been pressuring for action to improve environmental quality. In large measure due to their influence, Cracow was declared in 1989 as an area deserving special attention in which stricter regulations and standards apply. Serious discussions concerning the future of Nowa Huta also began. With the new political situation in 1989, more positive changes were hoped for.

Improvement in Cracow's environmental quality is now being observed as the levels of key air pollutant indicators decline, although standards continue to be exceeded (especially in protected areas). The improvement is not so much due to industrial modernization (which is little in evidence), but rather to economic crisis which has led to declining production and, therefore, also to a decline in air pollution. The Sendzimir Steel Works' output has fallen to 2.5 million tonnes. The obsolete Martin stoves have been removed, whereas a modern coking plant and waste water treatment plant have now been opened. The Skawina Aluminum Foundry and the Solvay Chemical Plant have both been closed. Deeper reform of Cracow industry is still needed, especially that of the Sendzimir Steel Works, in order to bring about environmental improvements. Car traffic in the city-centre has also been limited. The city heating system is now being modernized with coal being replaced by gas and electricity.

The unfavourable environmental image of Cracow persists. This remains

a barrier to the development of modern high technology industry and blocks the development of service activities by discouraging the arrival of innovators and business people (Kortus at al. 1992-1993). Last but not least, there is also the question of limited funds and poor access to up-to-date technology in the field of environmental protection. Thanks to American help an environmental monitoring system was installed in 1991.

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DEGRADATION OF THE CLIMATE IN THE INDUSTRIAL AREAS

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ABSTRACT: The changes in the climate of Cracow agglomeration during last forty years are discussed as example of the effects of urbanization in Poland. The alteration of climate was influenced mostly by industry. The human impact is shown by longterm variability of the climatic elements and phenomena. The study also concerns the changes in the industrial production and the effects of the formation of free market and economic recession.

KEY WORDS: Urbanization, human impact, air pollution, local climate change, urban climate.

INTRODUCTION

Urbanization leads to dramatic changes of the climate on different scales. These changes in the urban climate depend on meteorological conditions, the site and size of the city, the land-use pattern, the structure and density of built-up areas, as well as on the industry, traffic and other urban functions. The environmental effects of the growth of a town may be considered:

(1) locally, as the change in the nature of the substratum which forms the active surface;

(2) regionally, as the generation of large amounts of artificial heat and the changes in the chemical composition of the air;

(3) globally — through the urban contribution to the budget of sulphur and carbon dioxide, that is to the greenhouse effect and global warming.

The aim of the present paper is to show the multiannual changes in the climate of the Cracow agglomeration which is used as an example of the stages in the urbanization in Poland. The effects of the urbanization in relation to the climate are often described as an ecological disaster.

Cracow is situated in the Vistula river valley in the Subcarpathian Basin (ca 200 m a.s.l.), running from west to east. To the south, the Vistula valley

is bordered by the Carpathian Foothills with culminations attaining 350-600 m a.s.l., to the north, by the Minor Polish Uplands rising up to 500 m a. s. l. The natural features of the climate depend mainly on the influence of the topography of the Cracow region. There exist significant contrasts in the input of the solar direct radiation reaching the slopes with southern and northern aspects, an increased frequency of the conditions of stability in the boundary layer, as well as the temperature inversions due to cooling and connected with the development of radiation fog and the prevalence of the winds along the west-east axis combined with a significant share of calms and weak winds during the year.

The paper summarizes the results of numerous investigations carried out in Cracow after 1950 which concerned the alteration of climate influenced by industry. The human impact is shown by analysis of the tendencies in the long-term variability of the climatic elements and the phenomena such as sunshine duration, air temperature, frequency of fog and others. They allow us to reveal the character of the exchange of energy and matter cycling in the town where the physical features of the atmosphere are formed by dusts and gaseous particles emitted by industry, traffic, etc.

The most significant effect of the urbanization is the growth of the heat island which acts as a trap for the atmospheric pollutants. The heat island expands and intensifies as the town develops. In this paper, also, the main factors influencing the urban climate and their role during the last 50 years in Cracow in the formation of the local climate are discussed. The study concerns the changes in the industrial production and the effects of the formation of the free market, as well as the economic recession.

AIR CIRCULATION AND WIND CONDITIONS

On an annual scale, during 19% of days, geostrophic flows bring on to Cracow air masses from the west; during 10% of days from north-west, and with similar frequency from the south and the east (9% each). The air from the north-east is observed most rarely (6%) (Niedźwiedź 1981). The low winds blowing in the area of Cracow mark the increase of the share of north-eastern and eastern winds, which originate as a consequence of the local circulation in the Vistula valley (Hess 1967). Mean velocities of the wind in the town centre differ by 0.9 $m\ s^{-1}$ in summer and 1.4 $m\ s^{-1}$ in winter (Hess et al. 1989) from those outside of town.

Decreasing coefficients of roughness and a lesser role of the topography influence the change of wind directions in the boundary layer over Cracow. At the height of 600 m above the ground the western wind is the most frequent (Morawska-Horawska 1978). Next are south-western and eastern ones. These winds of greater speed are responsible for the remote transport of contaminants from high sources of emission in the Silesian and Ostrava

industrial regions. The greatest inflow of pollutants to the centre of town is from the local sources of emission which are situated on the peripheries of the agglomeration (Fig. 1), like Nowa Huta steelworks (eastern quarter), chemical plants of Podgórze and electric power station in Skawina (southern quarter). This is illustrated by the pictures taken from the LANDSAT-satellite at the time of the north-western wind occurrence (May 29, 1977), the south-western wind (October 24, 1978) and during calm (May 27, 1979) (Trafas 1981).

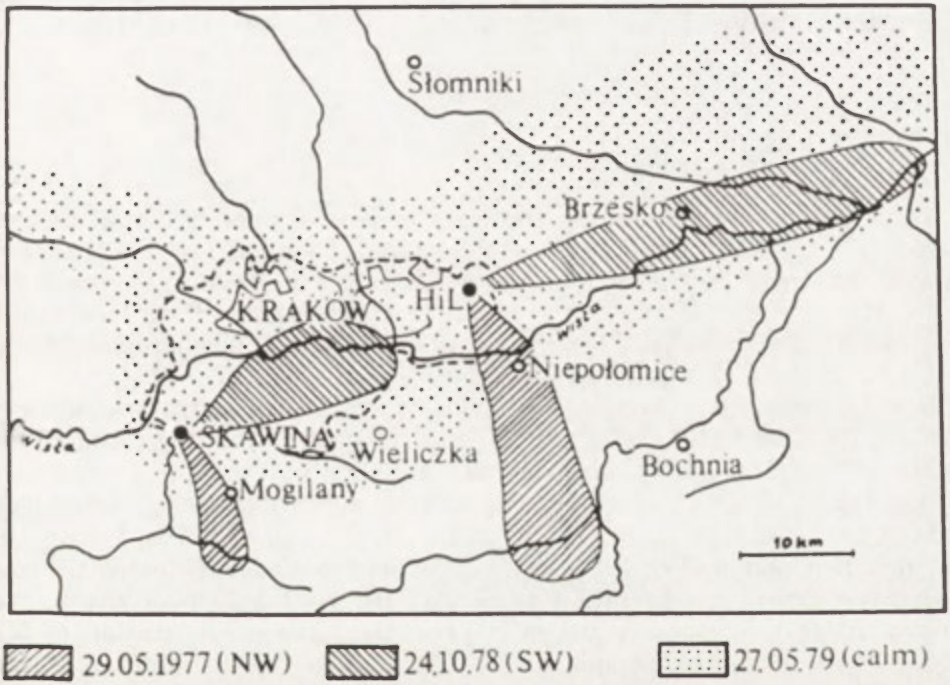

Fig. 1. Range of industrial plumes visible on the photograph taken by LANDSAT satellite under the conditions of calm and NW and SW winds over the Cracow agglomeration (after Trafas 1981)

THERMAL STRUCTURE OF THE LOWER ATMOSPHERE AS THE BACKGROUND TO THE CONCENTRATION OF AIR POLLUTANTS

The inversions of air temperature in lower layers are often observed in the Vistula valley. The research done by Walczewski since 1979 by means of acoustic sounding revealed that stable conditions of air stratification prevail in Cracow (86% of cases per year). This has a bearing on the daily course of air pollution in Cracow. At night its concentration is smaller than during the day because a considerable part of pollutants is emitted from high sources, which are isolated from the above-ground air layer at night by the inversion or isothermal layers. During the day the conditions are more diverse. In

73% of days in a year there appear layers of various duration. Namely, for 52% of days they persist for longer than 12 hours, and for 10% of days even longer than 18 hours. Cracow — in comparison with other regions in Poland — is marked by more lasting stable conditions of the air layers (Walczewski 1984).

The thermal inversion most often begins at the ground and reaches up to 150-300 m. This development is above all characteristic for the winter half-year. In summer the inversion layer may appear at the height of 800 m above the ground, situated over the strongly developed convection in the mixing zone within boundary layer (Obrębska-Starklowa et al. 1984).

AIR POLLUTION

The status of air pollution in the town is decided upon by Cracow's high sources of emission (metallurgy, energetics and chemistry) by the transport of pollutants from the Upper Silesian and Ostrava's major sources (energetics and metallurgy), as well as by the low sources of emission from local stoves and traffic. The emission from the communal sources forms about 10% of that derived from energy and industrial sources.

In the 1980s (Fig. 2) the spatial distribution of SO_2 concentration indicated that the greatest values occur in the central part of the town and in the district of Nowa Huta. It was the pattern inherited after the rapid development of industry in Cracow, when the emission of pollutants was progressively growing from the turn of 1950s and 1960s till the end of 1970s. Decreasing gas emissions occurred in 1981 and with short breaks it has lasted till now. Now the greatest concentration of SO_2 is observed only over the city of Cracow. In spite of these signs of improvement the concentration of SO_2 surpasses the permitted standards (Fig. 3). The spatial distribution of dust suspended in the air approached that of SO_2 (Fig. 2) and the greatest concentration occurred in the 1970s in the centre of town. Since 1987 systematic decrease in dust concentration has been noticed. At the present time the centre of Cracow is still the most polluted area in this respect. Second place belongs to Podgórze district (southern part of the agglomeration). In Nowa Huta there is an evident improvement of air conditions (Fig. 4).

Besides SO_2 among the toxic gaseous substances in Cracow's air there are the unusually aggressive hydrogen fluoride, carbon and nitric oxides and ammonia. Among the toxic substances found in the dusts and expanded in the form of aerosols penetrating soil and water belong the soluble fluorides, cancerogenic aromatic hydrocarbons, compounds of zinc, cadmium and lead, as well as cyanide.

Summarizing, since the second half of 1985 air quality has gradually improved. Especially, the mean concentration of suspended particulate matter in the year 1992 is about 50% of the value recorded in 1987 (Walczewski

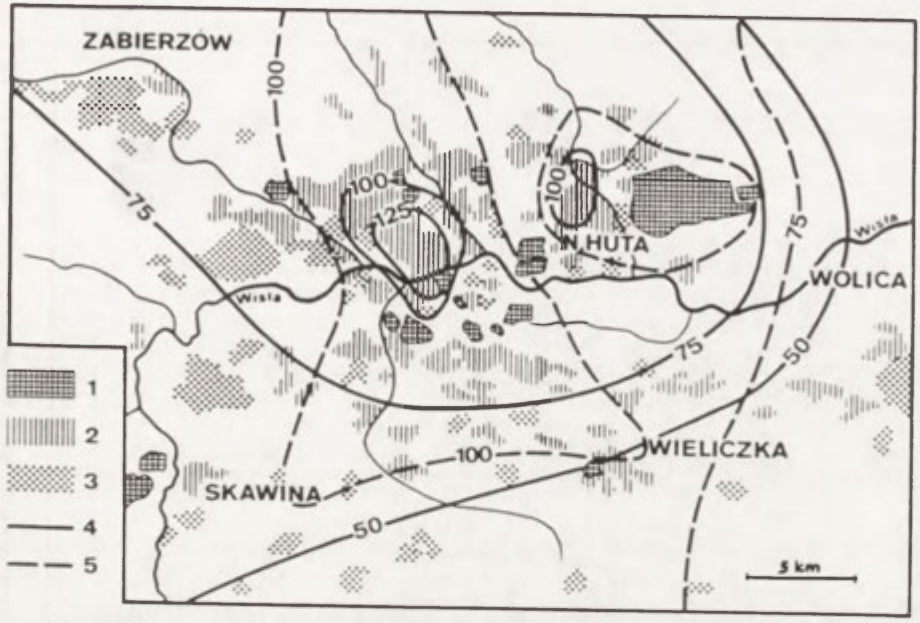

Fig. 2. Mean concentrations of SO_2 and dust (μgm^{-3}) in the cool half-year in the Cracow Agglomeration. Period of investigations: October 1975 — September 1978
1 — industrial areas, 2 — housing areas, 3 — forested areas and parks, 4 — mean concentrations of SO_2 μgm^{-3}, 5 — concentrations of dust μgm^{-3} (after Lewińska et al. 1982)

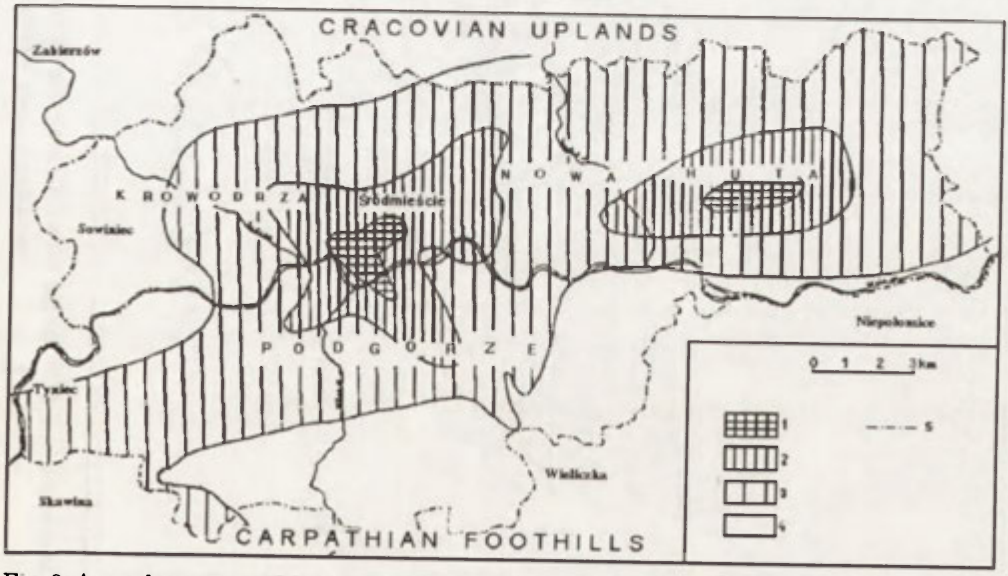

Fig. 3. Annual average of SO_2 concentration in Cracow in 1990 (μgm^{-3}) .Standards for preserved areas 64 μgm^{-3}, for specially preserved areas 11 μgm^{-3}
1 — 90$\mu g/m^3$, 2 — 2-70 $\mu g/m^3$, 3 — 50 $\mu g/m^3$, 4 — 30 $\mu g/m^3$, 5 — city boundaries
(according to Lach, Morawska-Horawska, Ziętara, in press)

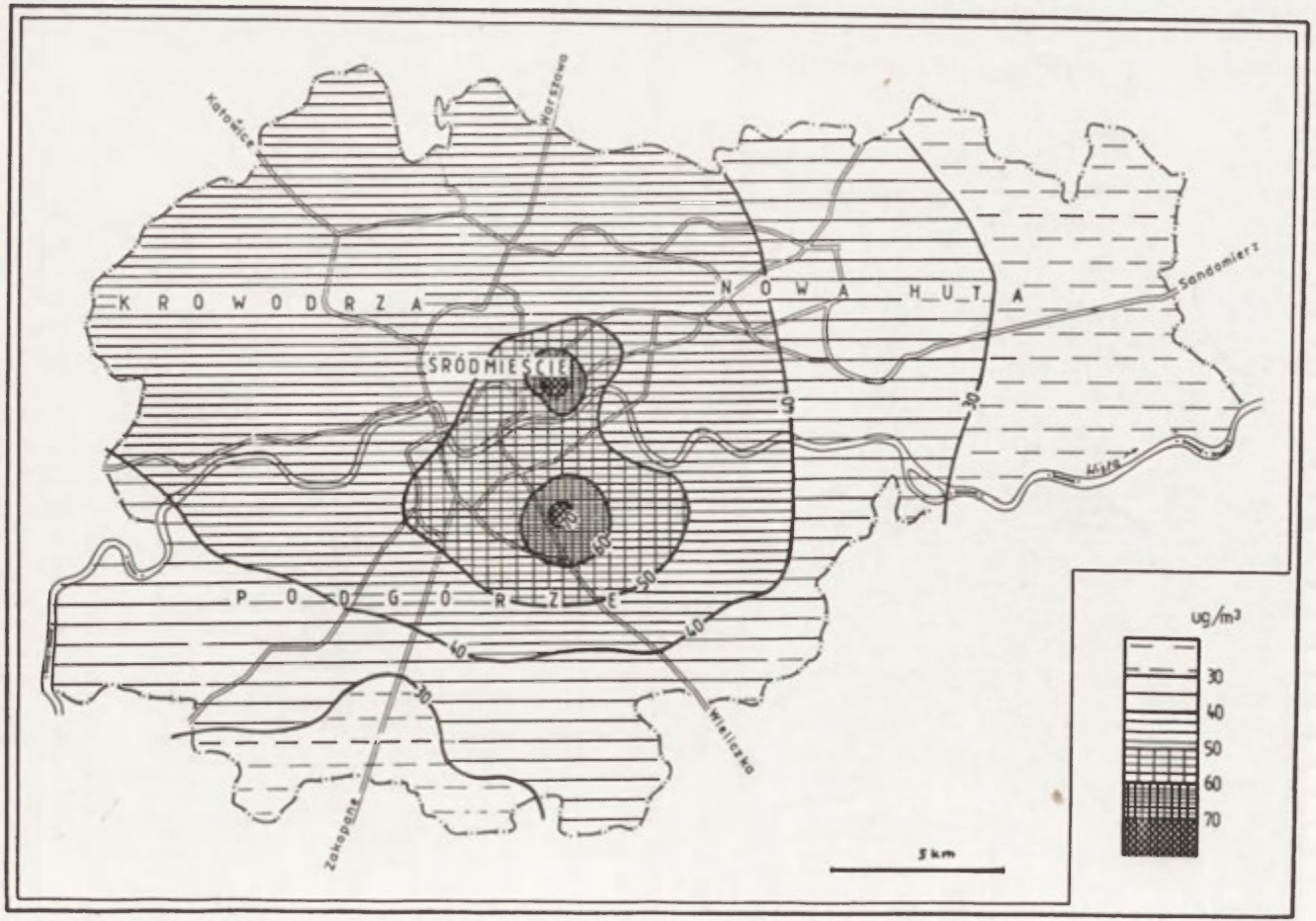

Fig. 4 Annual averages of dust concentration in Cracow, 1992. Standards for preserved areas 22 μgm^{-3}, for specially preserved areas 11 μgm^{-3} (according to Lach, Morawska-Horawska, Ziętara, in press)

et al. in press). In the agglomeration an automatic continuous monitoring system is installed which is combined with the air-pollution warning system.

URBAN HEAT ISLAND AND ITS EFFECTS

In Cracow a rise of air temperature in the town was established in relation to the temperature in the surrounding open areas and in those less densely built over. According to Lewińska et al. (1984, 1990) the frequency of occurrence of the urban heat island (determined on the basis of the deviations of minimum temperature) is very great. In the centre of Cracow it amounts to 92% (for the thermal threshold exceeding 0.5°C) and decreases to the value of about 70% in the loosely locally built-up area. When high-pressure weather occurs with slight cloud, weak wind and a strong temperature fall at night, both in summer and winter, the intensity of urban heat island is high. The maximum intensity occurs before sunrise and in winter attains 4°C; it is twice as great in summer. The height of the heat island amounts to ca 100 m at night and 200 m at daytime in the cool half-year, as well as from 100 to 200 m at night and over 200 m at daytime in the warm half-year. Under the conditions of the Cracow agglomeration the large industrial works are found mainly on its southern and eastern peripheries. The urban breeze (a weak air stream up to 2 m s^{-1}) brings industrial pollution to the centre of town creating an excessive concentration of pollutants. Maximum concentration exists also influenced by the pollution of numerous low sources of emission in the centre of the town. This concerns antycyclonic weather situations with general weak air movement or its absence.

The impact of Cracow agglomeration upon the radiation conditions results from the existence of the heat island and air pollution (Olecki 1975). If compared with the out-of-town areas, air transparency in Cracow (0.60-0.65) is less than in Gaik-Brzezowa (0.70-0.74). The intensity of direct solar radiation (on a perpendicular surface) is in Cracow throughout the year 15% lower than in the environs. The smallest differences in summer amount to 10-15%, while in winter they rise over 30%. The diffuse solar radiation in Cracow is, on average, 15% greater throughout the year; in summer it attains 20-25%, in winter 7-15%. The global solar radiation in the town it is smaller by 10-25% in comparison with the surroundings. Under cloudy conditions, the share of diffuse radiation in the global solar radiation oscillates, on average, from 70-75% in winter to about 50% in summer. In some years in January its share exceeds 80% in Cracow.

The occurrence of the urban heat island over the centre of town is manifested by the average difference of air temperature in relation to the surrounds attaining 1.3°C. The average minimum temperatures rises by 0.7°C in autumn and 0.8°C in other seasons. The centre of Cracow has fewer days with frost (t max 0°C) by 7% and 4-6% more days with slight frost

(t max > 0°C, t min < 0°C) in autumn and in spring. The growing season, with a mean daily air temperature higher than 5°C, inside the town is longer by about 25 days than in the surrounds. The winter is shortened by 23 days. During the warm half-year there appear 3-10 more hot days than outside of the town (Lewińska et al. 1984). The thermal feelings of the human body — according to the data on the enthalpy — are milder in the city. The "frosty" interval is less frequent by 6%, while there occur the intervals "cold" and "moderately cold".

The analysis of the long-term series of observations facilitates determination of the influence of the town on the particular climatic elements. The variability of the mean annual air temperature since 1826 shows in Cracow a progressive increase by about 1.1-1.3°C (Trepińska 1988). The impact of urbanization on the change of temperature was estimated as 0.5°C. Morawska-Horawska (1984) examined the changes in the inflow of direct solar radiation in the period 1950-1980. She is of the opinion that air pollution, growing in the town, reduced the mean annual total of sunshine duration by about 330 hours. The last elaborations of the sunshine duration series in Central Europe turned the attention to the increasing tendency in the multiannual course of this element in the last twenty years (Ustrnul 1993). It coincides with the changes in the functioning of the industry and with general changes of the basic town functions in Cracow (such as reduced production, economic recession and technological advance), but it is also influenced — to a significant degree — by the factor of circulation in the atmosphere.

The most characteristic feature in the long-term variability of cloudiness and sunshine duration appeared in the winter half-year in the period 1951--1990. The mean daily values of cloud cover decreased with the mean totals of sunshine duration because of the higher turbulence of the atmosphere. The air over the Cracow agglomeration was augmented by the pollutants emitted by the rapidly developing industry (Morawska-Horawska and Olecki, in press).

The changes in the distribution of precipitation are of a local character and depend on the quantity of the condensation nuclei delivered to the atmosphere. The increase of the annual total of precipitation caused only by the town may be estimated for Cracow at 8% in relation to the surrounds. A far greater differentiation of precipitation is induced by the impact of the relief (Hess et al. 1989).

FINAL REMARKS

The development of industry in Cracow has led to the violent increase of air pollution, which in turn, caused many different unfavourable effects in the natural environment and the health of the inhabitants, as well as

the destruction of numerous monuments of Polish culture. In the 1980s the emission of the pollutants into the air began to diminish, and the volume of dust and gaseous matter became reduced. Such were the effects of the lowered industrial production and some efforts connected with air protection. In spite of these tendencies to reduce air pollution, the mean annual concentrations of gases and some heavy metals in the atmosphere still exceed the standards provided for protected areas.

In general, the problems of forming the climate and bioclimate of Cracow in the latest half-century, which are presented in this paper, indicate how fast people are changing the natural environment and its quality. It is also important that pro-ecological operations backed with appropriate economic operations start creating an improved model of the city ecosystem, free from many threats to life and health of its inhabitants. Deindustrialization, which began in 1988, the decrease in the number of industrial workers and increase of the workers in services (education, culture, science, health care, etc.), and improvements in the structure of industry, are of great importance to the improvement of climatic conditions in Cracow.

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QUALITY OF THE ENVIRONMENT AS A DETERMINANT OF MORTALITY IN LARGE CITIES OF POLAND

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ABSTRACT: The paper presents selected conclusions regarding mortality from the study on "Demographic consequences of environmental degradation" carried out in Poland from 1986 to 1990, and also attempts to update it. Cities over 100,000 inhabitants differing by level of pollution (12 within the zones of ecological hazard and 10 located outside) were taken as survey units. The study confirmed the thesis of the hazardous impact of environmental degradation on mortality and other demographic processes. The most important conclusion is a decline of natural increase in endangered cities where qualitative and quantitative aspects of demographic development are affected.

KEY WORDS: Environment, degradation, mortality, infant mortality.

INTRODUCTION

Population development, as well as structural and qualitative transformations in human communities, proceeds in close connection with social and economic development. At the same time, the history of humanity is a story of the struggle against nature, a story of its gradual subordination to the needs and aims of man, usually by breaking fundamental natural laws and violating ecosystem equilibria. Effects of these processes have been growing for years, rapidly reaching the point when not only the existence of untouched nature but humanity itself is menaced.

Unfortunately, Poland has long been a good example of a country with serious ecological problems. An unreasonable economic policy in the 1970s, the persistent socio-economic crisis in the 1980s, and the insufficient coordination of the transition processes, usually without the parallel activities to protect the environment, caused the present state of near-catastrophe. The quality of the environment has been steadily worsening since the mid-seventies; for example: the emission and transgression of sulphur and nitric gases moved Poland to the top European position, and the large quantities of communal and industrial affluent discharged into waterways without proper

treatment has seriously limited their self-cleaning capacity. The result was a delimitation of 27 Polish zones of ecological hazard (Decree of the Ministry Council in 1983).

The interrelationship between the quality of environment and the welfare of society is of a specific nature. On the one hand, almost all human activities are aimed at the transformation of the environment, but on the other hand, the consequences of these transformations can focus in human organisms and weaken them both physically and psychologically. The degree of threat is crucial, and may manifest itself in various forms, usually the first step is the worsening of the state of health of the population. From the medical viewpoint, mortality is the equivalent of total lack of health. Independently of the biological inevitability, the rate and structure of mortality depend on multifarious direct and indirect factors, among which the quality of natural environment is more and more frequently mentioned (Okólski 1990).

Studies on the interrelationship between the quality of environment and human life and health are undertaken by ecologists, physicians, and recently by demographers who have started to examine the demographic consequences of pollution. This is a revision of the standard approach to the relationship between population, development, and resources, where environmental degradation is thought to be a function of population growth (e.g. Holdren and Ehrlich 1974; *Declaration...* 1991; Polluted Environment... 1992; Poulain 1993). However, since most previous studies were limited in spatially or in scope, the empirical recognition of the problem was inadequate. Research on "Demographic consequences of environmental degeneration" carried out in Poland from 1986 to 1990 as a study project of Central Research Programme, is the only national study referring to all basic demographic processes (Witkowski 1990).

The wide range of research problems required a very precise description of population under study. Cities over 100,000 inhabitants were taken as a survey units, due to their large population density and the significant accumulation of unfavourable environmental conditions. At the time of the study, there were 40 such cities in Poland including 29 located in regions of ecological hazard. Using the criteria of degree and type of pollution together with general demographic characteristics, the authors selected and examined 22 of these cities (12 within the zones of ecological hazard and 10 located outside, Fig. 1). The question of mortality and its relationship with the quality of environment was of great significance for studies carried out (Kowalska, Witkowski 1987, 1988). The analysis employs the traditional tools of mortality evaluation, life tables and methods of multiple regression. The comparative studies create the framework for that research.

Map

The paper presents the main conclusions of the study (referring to the 1980s) and also attempts to update it. The fact that Poland is presently undergoing the deep transition to the market economy is well known all

Fig.1. Location of survey units
Endangered cities: Bydgoszcz, Chorzów, Gdańsk, Jastrzębie Zdrój, Kielce, Kraków, Łodź, Płock, Ruda Śląska, Szczecin, Tarnów, Wałbrzych
Remaining cities: Białystok, Bielsko-Biała, Gorzów Wielkopolski, Kalisz, Koszalin, Lublin, Olsztyn, Radom. Rzeszów, Zielona Góra

over the world. But the process affects not only economic aspects of human life and activity; the important changes in Polish demographic configuration are observed as well. Partly these are consequences of long-term population trends but partly they are caused by changes in the determinants of demographic processes. It is a paradox that the observed decrease of gaseous emissions is not a result of the improvement of environment protection but of the economic recession.

ECOLOGICAL DEGENERATION AND DEMOGRAPHIC PROCESSES UPON MORTALITY

As many researches prove, environmental degradation contributes to the worsening of human health (e.g. Dubos 1970; Kirschner 1976; Zagrożenia...1987; Sroczyński 1989; Muszyński 1990). Examples of problems include: greater

cancer morbidity, heart diseases, sicknesses of respiratory, digestive and urinary systems, the delay of female sexual maturity. Consequently, all demographic processes determined by the health state must be recognized as susceptible to environmental influence.

The quality of environment has only recently been added to the factors determining the demographic processes (Romaniuk 1987). The consequences of living in a polluted environment can be expected in changes of intensity and pattern of mortality, affecting pathology of pregnancy and delivery and decreasing the quality of births. The state of environment may be also a factor attracting or repelling migrants, but this paper examines health and mortality impacts only.

It should be stressed that apart from the biological inevitability of death, the intensity and structure of mortality are determined by different coexisting factors. There are many classifications of mortality determinants but the task of defining a complete and universal list of them is still ahead of us (see Okólski 1990). The significance of each separate factor differs by sex, age, place of residence, and social group. Some importance should be also attached to the individual reactions, delayed reactions, beneficial or unhealthy habits, and transmission to subsequent generations. In order to describe the role of quality of the environment as a mortality determinant we need to classify its position among other factors. Generally on the basis of various classifications of mortality factors there are three large groups of determinants: genetic factors, factors describing living conditions (e.g. housing, working conditions, technical and social infrastructure, nutrition quality), and factors combining the behaviour habits and of healthy way of life. The quality of environment belongs to the second group (Witkowski, Kowalska 1991). Ecological collapse worsens living and working conditions, and limits the possibilities of relaxation and regeneration of human organisms. In this way, environmental degeneration may evoke an increase in risk of death and shorten life expectancy. An increase of infant mortality is possible too. Mortality is only one side of demographic reproduction processes; the significance of environmental quality goes beyond individual human beings and current generations. Mechanisms of the relationships under study have not been yet sufficiently recognized, but on the basis of realized surveys, cannot be excluded.

RESULTS OF THE STUDY: 1986-1990

Infant mortality

In studies of the relationship between environmental quality and mortality, the problem of infant mortality cannot be ignored. The contact of newborns with pollution begins in uterus when the mother's organism is an intermediary. In order to support the hypothesis concerning the impact of environmental degradation on infant mortality, the general — age — and cause-specific

mortality rates were analysed. The results demonstrate that ecologically endangered cities (treated as a group) are indeed characterized by higher infant mortality rates than the remaining cities. A greater life hazard occurs to both sexes, but it is considerably higher for boys as manifested in their higher mortality in endangered cities. Even if the infant mortality is higher independently of the age at death, the impact of pollution is more evident with regard to the post-neonatal mortality. It means that ecologically determined increase in mortality concerns infants who from the biological viewpoint have already survived the most hazardous period of the first four weeks.

Various facts support the hypothesis concerning the cause-specific death structure. Generally endogenous deaths prevail in all studied units, but in the cities ecologically endangered exogenous deaths have a relatively high proportion and intensity. It is especially evident in the Upper Silesia cities located in the zone of ecological disaster. The correlation coefficient for the exogenous infant mortality has reached 0.72, proving significant relationship.

One of the most important features of newborns is birthweight. As it is crucial for the probability of survival during infancy, it is important to say that the excessive mortality in the ecologically endangered cities concerns only infants of a standard weight (Table 1).

As mentioned, 12 cities belong to the category of ecologically endangered, but not all of them are characterized by equally high death risks. In some of them, the level of infant mortality is relatively low, lower than in units of more favourable environment conditions. However, the hypothesis about the disadvantageous impact of pollutions on infant mortality is undoubtedly supported by cities lying in the zones of ecological disaster (Chorzów, Ruda Śląska, Wałbrzych) and the largest urban agglomerations (Łódź, Szczecin). During the period under study, the role of the environmental conditions grew.

The quality of environment is only one of many factors determining the infant mortality but it seems particularly important for male infant mortality. It is confirmed by the correlation analysis, where the coefficient for a male infant mortality is 0.584.

General mortality

As far as the general mortality was studied, the main hypothesis concerned the existence of different mortality patterns correlated with the different ecological conditions. The analysis consisted of evaluating mortality tendencies and structures of death by causes by applying the life tables parameters.

During the period under study (1970-1986), the increase of mortality rates was one of the general characteristics of the Polish demographic situation but the intensity of deaths was higher in the endangered cities treated as a group. In addition, during the last part of the studied period the gap between endangered cities and the remainder ones increased (Table 2).

TABLE 1. Infant mortality rates in ecologically endangered and remaining cities of Poland in 1985-1987

Characteristics	Endangered cities	Remaining cities	Excess mortality endangered cities in %
	Age at death		
0-27 days	14.6	12.9	113.2
28 days and more	4.4	4.1	107.3
	Cause of death		
endogenous	15.1	14.3	105.6
exogenous	3.9	2.8	139.3
	Birthweight		
3001 gram and more	6.0	5.7	105.3
3000 - 2501	12.8	10.5	125.9
2500 - 2001	45.0	52.8	85.2
2000 - 1501	159.3	167.0	95.4
1500 and less	477.5	548.3	87.1
	Birth order		
first	16.1	14.5	111.0
second	17.1	15.0	114.0
third	24.6	23.0	107.0
fourth	31.2	25.8	120.9
fifth and next	52.5	40.0	131.3
	Age of mother		
19 and less	14.0	15.0	93.3
20 - 24	14.5	13.0	111.5
25 - 29	16.6	16.1	103.1
30 - 34	23.8	20.1	118.4
35 and more	33.3	27.8	119.8

Source: J. Witkowski 1993.

TABLE 2. Standardized mean death rates[a] of ecologically endangered and remaining cities of Poland in 1974-1986

Years	Endangered cities [b]			Remaining cities			Excess mortality endangered cities in %		
	Total	Males	Females	Total	Males	Females	Total	Males	Females
1974	7.3	8.1	6.7	6.8	7.4	6.1	107.4	109.5	109.8
1978	8.3	9.4	7.4	7.1	8.1	6.3	116.9	116.0	117.5
1980	8.5	9.7	7.5	7.2	8.3	6.3	118.0	116.9	119.0
1982	7.6	8.7	7.1	7.0	7.6	6.4	108.6	114.5	110.9
1984	8.0	9.2	7.5	7.2	8.0	6.4	111.1	115.0	117.2
1986	8.2	9.4	7.6	7.0	7.7	6.3	117.1	122.1	120.6

[a] population death rates of individual cities were standardized by age structure from 1971
[b] Jastrzębie Zdrój excluded
Source: J. Witkowski, A. Kowalska, 1992, and own calculations.

Pollution and mortality are phenomena determined by various factors. The existence of unfavourable relationships between those phenomena on the level of average mortality rates for two groups of survey units does not mean that each subpopulation living in a polluted environment must be endangered at the same level. In addition, cities under study differed according to the type and level of pollution. The impacts of various pollutants on human health and mortality might be different as well.

The main results of the survey suggest that the greatest differences in mortality rates between endangered and remaining cities are observed in the younger and middle age groups. Male mortality was higher than that of females. The structure of deaths by the most frequent causes was similar in both studied groups of cities, showing as in Poland generally a dominant position of circulatory diseases and neoplasms. More apparent differences were observed with regard to the intensity of deaths which was higher in the endangered cities. Significant surplus mortality was observed in the case of deaths from respiratory system diseases, neoplasms and diseases of the circulatory system (Table 3).

TABLE 3. Death rates in the endangered and remaining cities of Poland by major causes and sex in 1981-1985[a]

Units	Causes of deaths[b]					
	I	II	III	IV	V	VI
			Males			
Endangered	1.22	20.76	43.69	5.37	4.18	9.53
Remaining	1.19	17.70	37.49	3.96	3.55	8.77
			Females			
Endangered	0.64	16.52	43.08	3.07	3.37	3.94
Remaining	0.74	13.77	37.16	2.22	2.63	3.17
			Excess of mortality in endangered cities			
Males	102.5	117.3	116.5	135.6	117.7	108.7
Females	86.5	120.0	115.9	138.3	128.1	124.3

[a] annual average rates for the period under study, per 10,000 population
[b] I — infectious and parasitic diseases; II — neoplasms; III — circulatory system diseases; IV — respiratory system diseases; V — digestive system diseases; VI — injuries/intoxication
Source: J. Witkowski, A. Kowalska 1992, and own calculations.

A disadvantageous impact of pollution on mortality was also confirmed by the analysis of life table parameters. People living in the endangered cities were characterized by an unfavourable death order, suffered from a higher risk of death (especially for respiratory system diseases, neoplasms, injuries, and congenital defects) and consequently their average life expectancy at birth was lower (by about one year for the whole group). Degeneration of environment affects female mortality more than male mortality.

The relation between the quality of environment and mortality was very distinct in the cross-section of the two groups of survey units but was not straightforward with regard to individual cities. Some units of relatively

favourable ecological conditions were characterized by higher mortality parameters than units located in endangered zones. The reverse relationship was observed too. It is worth stressing that the interrelationship between environmental degradation and mortality in cities located in zones of ecological disaster remains beyond all doubt.

Since cities under study differ according to the degree of pollution as well as other features affecting the structure and level of mortality, it was necessary to analyse the role of the ecological factor. The list of potential mortality determinants was very extensive but the multiple regression analysis was restricted to 16 variables describing the quality of environment, availability of health services and facilities, living conditions, demographic features, working conditions and the general level of socio-economic development of the city (Witkowski, Kowalska 1992). The first conclusion coming from the analysis was that the quality of the environment was not a significant factor of mortality in the cities under study (all 40 cities over 100,000 people were included to that part of the survey). Male mortality turned out to be largely determined by character of employment, living conditions, commuting, and population density, whereas the most significant factors in female mortality were education level, living conditions, and duration of residence in a large city. Then it was concluded that the ecological factor could have been dominated by other, more important mortality determinants. The example of the highly polluted cities suggested that mortality could be affected by environmental degeneration just after crossing a threshold of pollution concentration.

THE PERIOD OF TRANSITION

The fact that Poland is presently undergoing the deep transition to the market economy is well known. Neglecting the regional differentiation of Central and Eastern Europe, a similar transformation is observed in all former socialist countries. The most important changes concern economy: creating the markets of capital, labour, services, goods and properties, but the new economic conditions exert some influence to the ecological situation.

When comparing the Polish environmental situation in the mid-eighties with the present one, some sighs of improvement can be noticed: the total amount of liquid wastes and the percentage of untreated wastes have decreased, and emissions of dust and gas have also dropped. The expenditures on environmental protection are growing (in fixed prices) however the results of investments are still insufficient. In 1992, about 29% of sewage remained untreated, and the same was true for 79% of gas emission, while almost the total amount of solid wastes was stored. Moreover, some local urban (14%) and rural (18%) water supplies did not meet quality standards.

Similar conclusions can be drawn with regard to both groups of survey units. Decreasing amounts of sewage or dust and gas emissions are the best

proof of improvement. Unfortunately, this is not necessarily a result of effective environmental protection but rather of declining production. Moreover, those symptoms of improvement, which may be only temporary, do not mean that the ecological situation is really good in all survey units. In Zielona Góra, Łódź, Kalisz and Białystok almost the total amount of sewage remained untreated (1992). The comparison of dust and gas emission is more difficult because of changes in methodology of collecting data. Although in the 1990s the decrease of emission per km^2 was observed in the majority of cities under study, some cities are still extremely highly polluted (Chorzów, Kraków, Płock, Tarnów). In spite of those changes in the ecological conditions, the distance between two groups of survey units is still adequate to the comparison. Generally the amount of untreated sewage as well as the dust and gas emission in the remaining cities do not exceed 30% respectively for the endangered ones (Table 4).

TABLE 4. Main features of ecological situation in endangered and remaining cities of Poland in 1985 and 1992

Units	Total amount of sewage	Amount of untreated sewage	Emission	
			Dust	Gas
	in hektom3[b]		in thousand tons	
Endangered				
1985	1641.0	840.2	503.6	1711.2
1992	546.5	244.1	555.1	452.1
Remaining				
1985	653.9	512.6	150.7	207.2
1992	211.6	67.8	111.2	78.5
Change in the period in % (1985 = 100):				
endangered	33.3	29.1		[a]
remaining	32.4	13.2		[a]
Remaining/Endangered in %: (endangered = 100)				
1985	39.8	61.0	29.8	12.1
1992	38.7	27.8	20.0	17.4

[a] A direct comparison between the dust and gas emission in 1985 and 1992 is impossible because of a change in the methodology of collecting data.
[b] hundred in thousand metric tons
Source: Ochrona Środowiska i Gospodarka Wodna 1986, 1993, CSO and own calculations.

One of the conclusions coming from the study carried out in the 1980s was a deep conviction of complexity of relationships between the quality of environment and mortality. It should be remembered that the demographic consequences of current degeneration may manifest themselves with an undefined delay. The human capability to adapt itself to the changing environment is of some importance here. The demographic situation of the 1990s can be still affected by the earlier pollution, independently of the current symptoms of improvement.

As a period of transition the years of 1989-1992 are taken under study. In comparison to the previous period, a remarkable increase in mortality rates is evident for both groups, but the total, male, female and infant mortality remains higher in endangered cities. The excess mortality is manifest mainly in the severely polluted cities of Upper Silesia and also Wałbrzych and Łódź. The difference between those cities and the others of lowest mortality level (Rzeszów) has reached 42%.

The studied cities differ by level of mortality and by ecological conditions. Both phenomena turn out to be correlated. As before, each type of pollution affects mortality in a different way. While gas emission seems to be insignificant (r = 0.121), dust emission must be treated more seriously (r = 0.505). The sewage discharges are of medium significance. The correlation coefficient is different for male and female mortality; male mortality shows a generally stronger correlation with pollution, independently of the type.

A separate question is an intensity of infant mortality, which is generally higher in endangered cities but only slightly correlated with the level of pollution (Table 5).

TABLE 5. Mortality [a] in endangered and remaining cities of Poland in 1989-1992

Year	Endangered cities	Remaining cities	Excess of mortality endangered cities in %
		Total	
1989	10.28	9.53	107.7
1990	10.16	9.70	104.7
1991	10.54	9.74	108.2
1992	10.32	9.13	113.0
		Male	
1989	11.13	10.29	108.2
1990	10.99	10.52	104.5
1991	11.54	10.71	107.7
1992	11.22	9.81	114.4
		Female	
1989	9.48	8.84	107.2
1990	9.40	8.95	105.0
1991	9.61	8.86	108.5
1992	9.47	8.51	111.3
		Infant[b]	
1989	15.86	13.00	122.0
1990	16.74	15.67	106.8
1991	14.49	15.74	92.1
1992	16.71	14.11	118.4

[a] average for the group based on standardized mortality rates
[b] per 1000 live births
Source: Own calculations based on data from Demographic Yearbooks, CSO, Warsaw.

CONCLUSION

The survey conducted in the eighties was one of the first attempts to study the demographic consequences of environmental degeneration in a complex way. Although unfavourable ecological conditions were not the most important determinant of mortality and other demographic processes, the main thesis of the hazardous impact of environment degradation on population was confirmed. When the survey dealt with mortality and fertility, the most important conclusion was a substantial decline in natural increase of the population. In this way, both aspects of demographic development, qualitative and quantitative, were affected by ecological conditions. In the paper, only changes of mortality were discussed. In spite of the signs of environmental improvement, the intensity of mortality remains higher in the endangered cities. In addition, the process of mortality turned out to be still correlated with the intensity of pollution. Therefore, the question of demographic consequences of environmental degradation cannot be ignored. A simple comparison of the natural increase rates for the survey units reveals the inferior position of endangered cities. In 1992, among 12 cities from the "endangered group", four had a negative demographic growth (Łódź, Chorzów, Wałbrzych, Ruda Śląska), and three others were characterized by a natural increase rate less than 1 per 1000. Cities from the "remaining group" did not manifest such problems.

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WATER RESOURCE MANAGEMENT CHALLENGES FACING INDUSTRIAL SOCIETIES: THE POLISH CASE

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ABSTRACT: The costly task of maintaining a safe public drinking water supply in an industrial society is explored, and both technical and social aspects of the challenge are considered. Advances in testing and treatment techniques have positive health benefits but make the provision of safe drinking water increasingly expensive. These costs are differentially higher for residents of smaller cities and towns. The Polish case is presented; stresses on the resource are discussed; the approach to ensuring drinking water quality is outlined; and new institutions for water resource management are reviewed.

KEY WORDS: Water supply-Poland; urbanization-environmental issues; water supply management; drinking water regulation.

INTRODUCTION

More than any other resource, water has traditionally set the outside limits on areas suitable for human habitation. In modern times, sophisticated technologies for water treatment and conveyance appear to have minimized such concerns. However, such technologies can be extremely expensive and have undesirable side-effects. Furthermore, water reserves are under increasing stress internationally, and each year, more is learned about the extent of risk associated with hazardous materials in drinking water.

This paper examines issues in maintaining good quality drinking water, focussing on Poland. It considers both technical and social aspects of the challenge, examining how resources are stressed, the approach to ensuring drinking water quality, and reviews new institutions for water resource management. As an East European country, Poland is not wealthy, and is facing a legacy of under-investment in water management infrastructure. Although specific factors shape its situation, Poland's challenges reflect more general problems facing all industrial societies seeking to implement good water management policies.

WATER RESOURCES IN POLAND

Data reveal that Poland's endowment of water resources is not large. Water deficiencies have been suffered mainly in areas where industrial and domestic use are high, including Łódź, Lublin, Cracow, Upper Silesia, Radom, and Kielce. The Swedish hydrologist Malin Falkenmark recently examined renewable fresh water resources internationally, and Poland was unique among European countries in being in a "water stress" condition. In order to compare countries, she defined a level of 1000 cubic metres per person per year as the "water scarcity" level: when available resources fall below this level, economic development and human health are jeopardized (Engelman, Le Roy 1993). She also identified a "water stress" level of 1667 cubic metres per person, and countries with at least this amount of water should be in fairly good shape, suffering only occasional or local water problems. With a 1990 value of 1467 cubic metres per person, and projected 2025 value of 1279 cubic metres, Poland is already in the water stress category. As detailed below, a number of new national policies seek to protect existing water resources, in order to avoid the prospect of "water scarcity."

Are current water deficiencies the result of population growth and concentration? During the post-war period, urbanization and industrialization

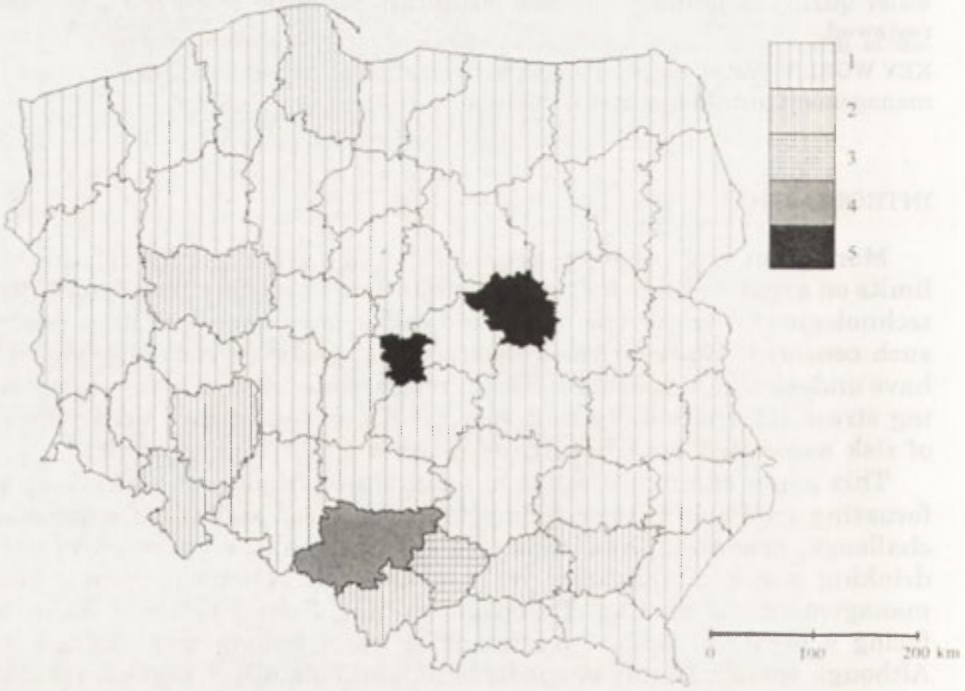

Fig. 1. Population density, by voivodship, per km^2
1 — 0.0 – 149.9; 2 — 150.0 – 299.9; 3 — 300.0 – 449.9; 4 — 450.0 – 599.9; 5 — 600.0 and more

proceeded rapidly in Poland, as in many other bloc nations. Total water consumption grew tremendously during this period: as of 1989, it was six times higher than it was in 1950. Some of the increase in water use stems from increases in domestic use which often accompany an increase in standard of living. In Europe generally, per capita water use hovers around 200 liters per day; Poland's average of 203 litres per day is thus typical. This represents a more than 40% increase since 1975, when levels of 143 litres per day were average. Today, average consumption rates vary around the country, from lows of 150 litres per day in Zamość and Leszno, to highs of 260 litres per day in the urban areas of Katowice and Warsaw. In some cases, consumption varies as a function of the type of housing structure: the per capita consumption was as high as 288 litres per person per day in large buildings where water payments were irrespective of actual use, and as low as 132 litres per person per day in luxurious single-family homes (Gutry-Korycka 1990). One of the factors at work here is the incentive created by the metering more typically found in single-family homes, but the newer fixtures of these homes would probably have less leakage, and may include more conserving devices such as low flush toilets. Estimates of losses in water systems and in flats vary from official estimates of 10-14% to unofficial estimates of 30%.

However, rather than simple population growth or the increased standard of living, it is industrialization which accounts for the great increase in water use since 1950. A map of population density by voivodship shows where the population is concentrated (Fig. 1)[1]. By comparing it with Fig. 2, depicting the level of water use per square kilometer, we can see that the areas of most concentrated population are not always the same as the areas of most concentrated water use. In fact, some of the areas of most concentrated water use actually show as having the lowest population density. Nationally, municipal use of water is dwarfed by industrial, with a ratio of 1 to 3, as of 1992 (*Ochrona...* 1993). In other industrial countries, including France, Spain, and Hungary, the ratio is the reverse, with municipal to industrial ratios of 7:3. This disparity is usually explained by the water-intensiveness of industrial plants in Poland.

Drinking water supply is challenged by poor quality sources in many areas. A very small portion of the rivers meets the first class standard, and groundwater problems have been identified in many areas. The major sources of contamination of surface water include untreated sewage, industrial discharge, mining wastes, and agricultural wastes. Many towns and cities have sewer pipes but no wastewater treatment plant; in other cases, a plant exists but is broken or burdened beyond its capacity. Unfortunately, the construction of sewage treatment plants hasn't kept up with the installation of water supply systems, and this has exacerbated sewage problems in many areas, both urban and rural. Approximately 40% of the country's municipal

[1] The author thanks Jacek Majewski and GRID-Warszawa for assistance with maps.

sewage is discharged without treatment, and the following map shows the volumes of wastewater by voivodship, getting treated and not (Fig. 3).

Both surface and groundwater are polluted, but surface water typically requires more processing in order to be considered good quality municipal water. Surface water provides 83% of Poland's overall water needs (*Ochrona...* 1993). This varies by application: surface water supplies 91% of industrial

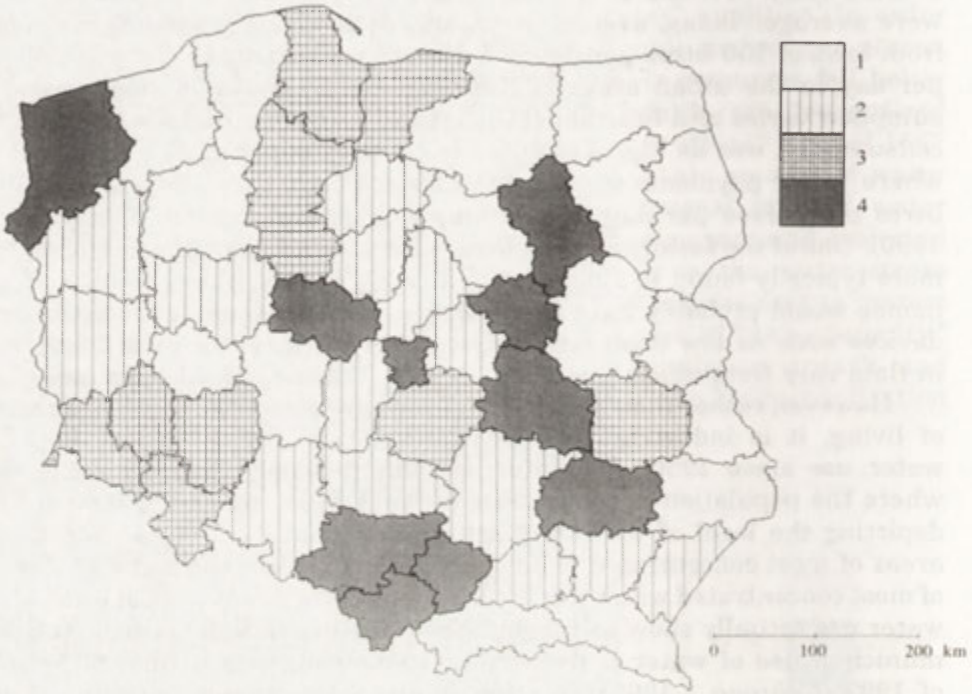

Fig. 2. Water use, by voivodship, in dam^3/km^2
1 — 0.0 – 9.9; 2 — 10.0 – 19.9; 3 — 20.0 – 49.9; 4 — 50.0 and more

needs, and only 52% of municipal needs. Many other European countries are able to use more groundwater. In Belgium, France, Germany, and the Netherlands, groundwater makes up more than 60% of the total supply; in Hungary and Denmark, groundwater provides more than 85% of the municipal supply (Water Services Association 1993). Because of its greater reliance on groundwater, Poland's challenge is even greater than that of its neighbour's.

Poor quality raw water makes problems for drinking water. According to state regulators, drinking water quality is generally rated as safe in cities, but often unsafe in villages. Governmental data states that 48% of public wells, and 66% of privately-owned wells provide water which is not suitable for consumption due to contamination by organics, bacteria, pesticides, nitrates, and other substances (*Ochrona...* 1993). However, some officials believe that these figures paint a more dramatic picture than is

warranted, and that often the violation of standards is only from the iron level — unpalatable but not a dangerous threat to human health.

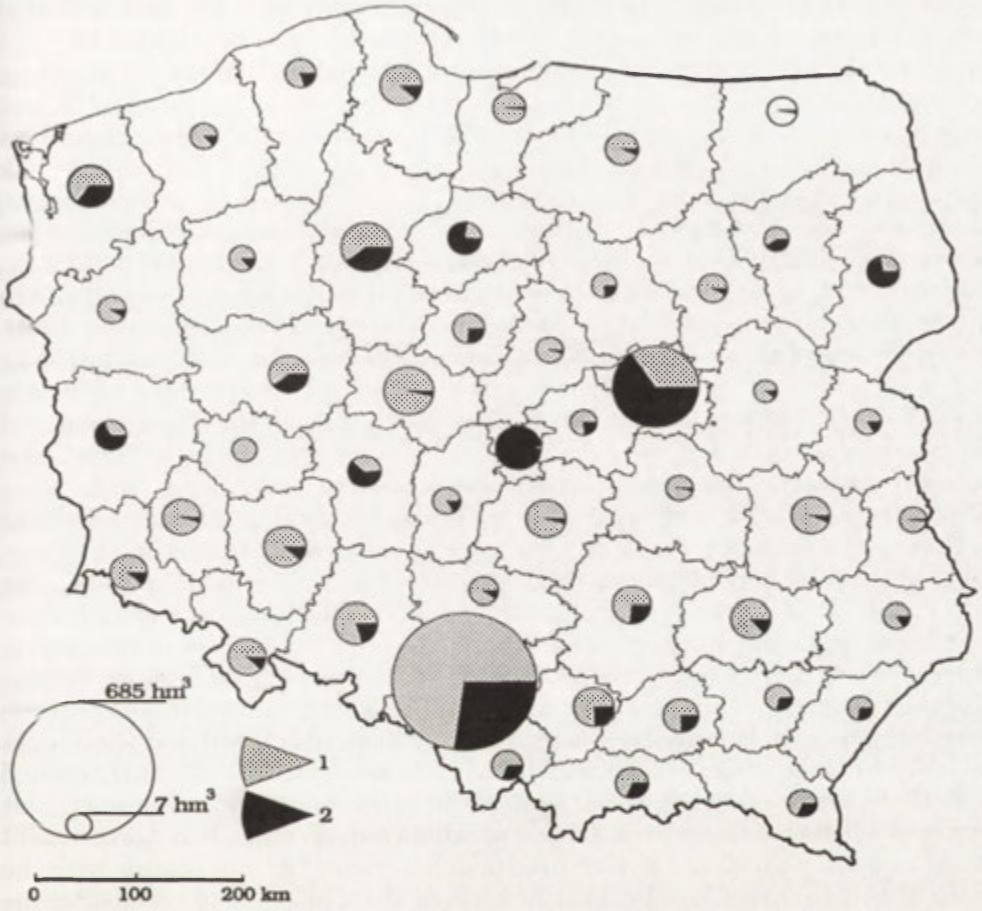

Fig. 3. Portion of wastewater treated and not treated
1 — treated, 2 — not treated
Source: UNEP, GRID, Warszawa

MAINTAINING GOOD DRINKING WATER QUALITY

In all countries, drinking water quality regulation is costly and becoming more so. Sampling and testing are expensive, and since raw water supplies often vary in quality, even from day to day, tests must be repeated frequently. Industrial societies use lots of chemicals, and not surprisingly, they find their way into the water supply. Science is developing better tests to analyse

for the presence of these substances, and we are also learning more about the complexity of their toxic effects.

The U.S. programme for ensuring drinking water quality is considered to be one of the leaders globally, in terms of completeness and technical sophistication. It can be used to illustrate some of the tensions which are increasingly plaguing water systems internationally. The goal of drinking water quality regulation in the U.S. is the protection of human health, and with an adequate margin of safety. Since 1986, approximately 78 contaminants have been regulated. These include chemicals associated with cancer risk (e.g., vinyl chloride, ethylene dibromide), organ damage (such as endrin, chromium, styrene), and nervous system effects (for example, chlorobenzene, selenium). Quantifying the benefits of controlling these chemicals is difficult, due first of all to lack of good data on occurrence, and second, to uncertainties in the mechanism of toxicity, including synergistic effects (Auerbach 1994).

The costs of these regulations to consumers have been significant: over the past ten years, average water rates in the U.S. have risen at double the level of inflation (Rubin 1994). The total cost of the monitoring and control required by the new regulations is estimated to be at least $1.4 billion annually (Auerbach 1994). The costs of complying with these regulations are high, and the costs are spread evenly; the differential effects of these regulations on small and large cities are expected to be quite strong, and this will be in addition to the costs already in place (Rubin 1994). The size range of the water systems varies tremendously, and there are far more small systems than large systems: there are only thirteen systems serving one million or more people, while there are more than 17,000 systems serving 25 to 50 people. Assuming these costs are passed on to households through rate increases, it is predicted that small system users will see their costs increase by an average of 55%, and large system users, only 2%. It is stressed that these are merely averages: systems needing to control some particular problem will be hit harder than those which do not. A recent U.S. Government study showed that small towns are having serious trouble coping with the costs of the new regulations, and has asked the Congress to reconsider the laws on drinking water quality, because of the costs associated with it (U.S. Government 1994).

In sum, drinking water quality regulations in the U.S. are costly and getting more so, to the point where there is considerable interest in adjusting the programme at the national level. The regulations may be well-intended from a human health perspective but the cost implications and the differential effects have caused many people to begin asking about just how necessary and cost-effective these regulations are. Internationally, similar developments are taking place. Both the World Health Organization and the European Community have issued guidelines and directives for drinking water quality (Falwell 1994), and these standards have shown the same general trend as the U.S. standards: requiring more monitoring, of more substances, and more controls (Polish regulations have generally although not completely

kept up with these; see Rozporządzenie...1990). However, most countries have trouble meeting these standards, and most have not even sampled in the proscribed manner. In Poland, as elsewhere, the major question is: how can we possibly pay for all this? Aren't there any less expensive technologies for ensuring drinking water safety?

NEW INSTITUTIONS FOR MANAGING WATER RESOURCES

As societies learn more about water quality and quantity problems, and their causes, it is necessary to revise various water management practices. Polish hydrologist Janusz Niemczynowicz (1992) has noted, "the water related infrastructure and water treatment facilities that exist at present are, in fact, based on the philosophy of dilution which has proved wrong over the long term." Not only technology can be maladapted; new situations may even require new institutions to ensure that resources are properly allotted. In Poland, for example, since 1989, there have been three major changes in law and policy which affect water source management. The National Environmental Policy of 1990 clarifies goals and techniques; the Local Governmental Act delegates responsibility for water supply closer to the users; and the River Basin Authorities will serve as hydrographically-oriented water managers. Together, these new policies and institutions create new opportunities for better results. They will be discussed in turn.

The National Environmental Policy of 1990 stated that management of water resources would be based on: decentralization of management into river basin authorities (more below on that); reducing allowable levels of pollutants discharged to water; strengthening economic instruments to make more efficient use and to avoid waste; encouraging water reuse and recirculation in industry; and controlling industrial use of high quality groundwater, except for food or pharmaceutical purposes (*National...* 1990).

The Ministry of Environment, Natural Resources, and Forestry has helped create a new administrative unit to facilitate the integrated management of river basins. The seven units will stretch across administrative boundaries, coordinate the activities of both central and various local branches of government, involve local residents, and draw 90% of their finances from fees and fines within the region. Each of the seven will be governed by a council with members representing national and local officials and also water users. These regional water development authorities generally follow the French model, and funding for the pilot council on the upper Vistula was provided by the International Bank for Reconstruction and Development and from the U.S. Government. A number of Polish water management officials have travelled to France and Britain to see similar water management schemes in action. Until a new water law is passed, however, these regional boards do not have strong legal backing. It also appears that when it comes to levying fees and fines, a number of different institutions may be competing for the right to do so, and political battles are the likely result.

The Local Government Act of 1990 defined water supply and other tasks as duties of the local government, and transferred the ownership of voivodship enterprises into the hands of gminas and other local units. Around 900 such companies were created, and 240 of them have responsibility for water and sewage systems. These companies can be wholly owned by the local government, or have external shareholders. Local governments are supposed to decide exactly how they plan to manage them, but according to a World Bank survey, most localities have merely delayed this decision making process, and in the meantime have created temporary local budget enterprises, to realize tax benefits, or else they have simply done nothing. In the meantime, many small water systems which once enjoyed technical assistance and other help from the voivodship office are now left on their own. In some cases, the old relationships continue on an informal basis, as the water engineers in major systems take pity on their colleagues in smaller cities and villages. Local governments have hesitated to make decisions about how to proceed, due to lack of information, fear of change, and also the complexity of the situation: in some cases, a system may have three or four owners.

Clearly, local governments have a great need for assistance in implementing and coordinating their new responsibilities, particularly in the case of water management. Perhaps the regional water management boards, with their regional orientation and separation from local politics, can help deliver these services. But the possibility also exists that the uncertainties in who charges whom for water withdrawals could set the stage future battles.

CONCLUSION

The high cost of ensuring a quality drinking water supply is already burdensome for one of the world's richest countries, and it promises to be even more so for the less wealthy nations. Again, because of the impact of poor wastewater treatment on raw water supplies, this aspect of the water management must also be considered when examining water resource management. However, traditional wastewater treatment technology often involves expensive, energy-intensive end-of-pipe treatment plants that ultimately waste the useful nutrients and phosphorous found in wastewater. Approaches drawn from an emerging field known as ecological engineering would utilize a more preventative strategy, employing source controls, recycling resources from wastewater, small-scale technologies, biological systems, and other techniques which are designed to reconstruct selected aspects of the landscape for better water management. These approaches are evolving, and it is important to remember that technologies don't just get invented by themselves — someone has to imagine them, and then develop them (Winner 1977).

Poland's water resources pose challenges for the country in maintaining a quality drinking water supply. Even though many good policies are now in place, implementation, coordination, and financial issues still remain to

be resolved. The high costs and complexity of state-of-the-art drinking water quality standards means that they are not likely to be affordable any time soon for Poland. Because of differential impacts on small and large systems, regulators must be careful not to overburden small communities, who already have a whole range of new responsibilities. The lack of readily-available alternative technologies for safeguarding water quality puts Poland — and just about every other industrial society — between a rock and a hard place.

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III. Older industrialized regions

POPULATION ET ENVIRONNEMENT EN MILIEU URBAIN ET INDUSTRIALISE: LE CAS DE LA WALLONIE

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RESUME: La Wallonie est caractérisée par un axe central qui, orienté d'ouest en est selon les vallées de la Haine, Sambre, Meuse et Vesdre, est essentiellement urbanisé et industrialisé. C'est dans ce cadre que cette communication propose une première approche de l'interaction entre population et environnement. Cette interaction est envisagée dans les deux sens et peut se résumer par les questions suivantes. En quoi l'urbanisation, la présence de fortes densités de peuplement et, par ailleurs, la présence d'industries est-elle synonyme de la dégradation de l'environnement? A l'inverse, l'environnement spécifique des milieux urbains et industrialisés a-t-il un impact sur le comportement démographique de ceux qui y vivent?

MOTS-CLES: Population, environnement, mortalité, migration, milieu urbain et industrialisé.

A PROPOS DES INTERACTIONS ENTRE POPULATION ET ENVIRONNEMENT

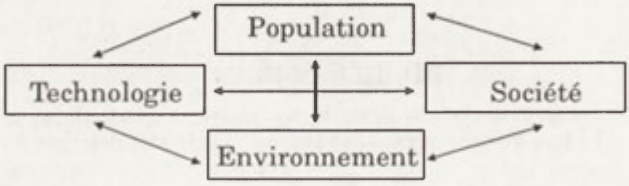
Dans le cas particulier des interactions entre population et environnement en milieu urbain et industrialisé, il est bon de rappeler que la relation est rarement directe et que le mécanisme est souvent complexe.

La communauté scientifique s'est penchée ces dernières années sur le problème des interrelations entre population et environnement, mais, à quelques exceptions près, il a été envisagé soit globalement à l'échelle planétaire, soit dans des cas spécifiques émanant des pays en développement[1]. Dans

[1] Voyez à ce sujet les travaux de la Commission "Population et Environnement" de l'Union pour l'Etude Scientifique de la Population (UIESP, Liège) et du Comité International des Centres de Recherche en Démographie (CICRED, Paris) ainsi que les recherches en cours de publication de Wolfgang Lutz (IIASA, Autriche) sur l'île Maurice.

le cadre belge et plus spécifiquement wallon[2], hormis l'analyse de l'impact de certaines pollutions sur la santé, il y a peu d'études qui aient tenté de prendre en compte la variable population, au sens démographique du terme, afin d'analyser ses interrelations avec l'environnement[3].

On comprendra par conséquent que la plupart des cadres conceptuels déployés dans ces approches ne soient pas nécessairement les plus appropriés pour ce qui regarde notre problématique, celle de l'examen des interrelations "population-environnement" dans le cadre des cités industrielles wallonnes. Nous proposons ci-dessous, en accord avec les travaux de Dominique Tabutin (1993) sur les pays du Sud, un schéma conceptuel simple, construit de façon tout à fait générale, et qui peut très bien s'appliquer à la réalité de notre région.



Ainsi, l'interaction entre la population et l'environnement est complexe. Elle s'établit rarement de façon directe, comme ce fut le cas à Tchernobyl ou à Bhopal. Le plus souvent, les composantes de l'interaction sont multiples et diverses et nous choisirons un exemple très simple pour le montrer. L'accroissement du nombre d'individus sur un territoire donné se traduira, à comportement humain constant, par un accroissement relativement identique des déplacements de cette population. Celui-ci donnera lieu à une augmentation du trafic routier qui devrait induire, à technologie également constante, une élévation du niveau de la pollution atmosphérique. Parallèlement, l'apparition de technologies nouvelles pourra se traduire par une diminution de la pollution *per capita* et compenser en quelque sorte, tout ou en partie, l'augmentation due à l'accroissement démographique. En outre, la société et ses décideurs politiques pourront faire le choix d'un type de consommation plus propre et tenter de modifier, par le biais d'une législation appropriée, le comportement des individus en favorisant le recours à ces technologies nouvelles. Ainsi, l'impact de l'accroissement du nombre d'individus sur la pollution atmosphérique ne sera pas direct, mais devra prendre en compte à la fois le rôle des technologies nouvelles et le choix de société visant à favoriser le recours à celles-ci. Enfin, cette même pollution atmosphérique, si elle est croissante, risque d'avoir un impact sur la population, soit au

[2] La Belgique est depuis 1993 un état fédéral dont le territoire est découpé en trois régions. : au nord, la Flandre abrite une communauté néerlandophone, au sud, la Wallonie est majoritairement francophone, tandis qu'au centre, la région de Bruxelles-Capitale est bilingue.

[3] Un essai d'écologie industrielle proposé sous le titre "L'écosystème Belgique" aux éditions du CRISP, en 1983, se base sur une approche systémique au niveau de la Belgique. Néanmoins, à aucun moment, la variable démographique n'y est considérée en tant que telle, dans sa relation avec l'environnement (Billen et al. 1983).

niveau de la santé, soit en induisant des comportements migratoires dont le but serait de quitter ces lieux de plus forte pollution atmosphérique.

De fait, il ne faut pas perdre de vue que la relation entre population et environnement est une relation à double sens. L'environnement exerce une influence sur les variables démographiques et ce, de manières diverses. Ainsi, certaines composantes de l'environnement perturbé à la suite des activités humaines exercent à leur tour une pression sur les populations humaines. Les différentes variables démographiques en seront à leur tour affectées: taille, composantes du mouvement de la population et structures démographiques. Il existe, tout d'abord, un effet lié aux catastrophes naturelles et aux variations extrêmes du climat (sécheresses, inondations, tornades...) dont nous ne parlerons pas ici (voir Veyret et Pech 1993). En ce qui nous concerne, cet impact touche aussi bien la morbidité-mortalité que la mobilité spatiale.

La pression de l'environnement sur les populations laisse transparaître le rôle prépondérant du concept de *qualité de vie* comme médiateur entre environnement et population (Poelmans-Kirschen et al. 1973). On constate bien souvent que les besoins de l'homme sont mis en concurrence: plus il accapare son milieu pour assouvir ses besoins, plus il le détruit et plus sa propre qualité de vie se détériore. Cette chaîne de conséquences arrive même à modifier les comportements responsables de la dynamique démographique. Quand l'espace de vie ne répond plus à l'image que l'homme en attend, il va occuper d'autres espaces plus conformes à ses désirs ou à ses besoins, par le biais de la migration. Par ailleurs, même si l'environnement est rarement une cause spécifique de mortalité, on ne peut nier son impact sur la morbidité, notamment par un affaiblissement physiologique qui peut être un facteur déterminant de morbidité et donc devenir un élément indirect de mortalité.

L'IMPACT CONJOINT DE L'URBANISATION ET DE L'INDUSTRIALISATION SUR L'ENVIRONNEMENT

Tour d'abord, il convient de constater que dans la majorité des situations, l'industrialisation est synonyme d'urbanisation. C'est notamment le cas en Wallonie où la révolution industrielle, qui s'est entamée peu après 1820, a lancé un processus d'urbanisation sans précédent. Des petits villages emportés dans la tourmente de l'industrialisation ont vu leur population décupler en occupant un territoire de façon anarchique, à l'exemple des métropoles du Tiers Monde. La croissance des cités industrielles wallonnes dans les bassins liégeois et hennuyers a souvent dépassé un facteur 10 en moins d'un siècle, jusqu'à la veille de la Grande Guerre. Les trois éléments à la base de ce développement industriel sont la présence du charbon, celle du minerai de fer et enfin, la présence de rivières et canaux, de la Haine à la Meuse, pour

acheminer les produits métallurgiques qui firent la renommée de la Wallonie et de son bassin industriel, généralement dénommé le sillon Sambre-et-Meuse.

Au XIXe siècle, l'indispensable proximité des industries et de la main d'oeuvre s'est traduite par le développement d'un habitat industriel et l'émergence de cités industrielles. A la différence des villes, ces cités urbaines ne possédaient pas la plupart des fonctions propres aux villes issues du Moyen Age. La principale caractéristique de ces lieux n'était autre que la densité de peuplement élevée, forte densité qui, sur le plan sociologique, se doublait par une homogénéité assez forte au niveau des classes sociales et du type de logement (fig. 1).

La plupart des grandes villes wallonnes actuelles on été marquées par cette industrialisation qui leur a donné un poids démographique largement su- périeur. C'est le cas à Liège et dans les communes voisines d'Herstal, Seraing et Saint-Nicolas, à Charleroi avec Châtelet, Fontaine, Farcienne et Sam- breville, à La Louvière et Manage, à Mons et dans le Borinage. En outre, leur paysage urbain a été marqué par une industrialisation lourde qui laissera longtemps encore des traces malgré la fermeture de tous les charbonnages wallons, entre 1960 et 1982. Le réaménagement des friches industrielles laissées par le processus de désindustrialisation n'est pas sans impact sur l'environnement des villes en Wallonie.

Il est donc très malaisé de dissocier dans notre démarche la problématique de l'industrialisation de celle de l'urbanisation, car ces deux processus sont, dans le cas wallon, étroitement corrélés. Seule une ville comme Namur, actuelle capitale de la Wallonie, a été quelque peu épargnée par le processus de l'industrialisation et nous permettra, dès lors, dans la mesure du possible, de tenter de dissocier dans notre raisonnement l'effet conjugué de l'urbanisation et de l'industrialisation du simple effet de l'urbanisation.

A ce stade, il nous paraît utile de s'interroger sur le fait de savoir si la *densité de peuplement* a une influence sur l'environnement? Et si l'on considère que les fortes densités ont une influence négative, cette question laisse place à la suivante: *l'environnement urbain est-il plus sensible à la dégradation que celui des campagnes*? La figure 1 présente cette densité avec des maxima sur l'axe qui, du Borinage à Liège, suit le sillon Sambre-et-Meuse. Dans la perspective historique, la qualité de vie urbaine a toujours connu des difficultés, même si elle s'est considérablement améliorée au cours du dernier siècle. Une forte densité de peuplement humain induit *ipso facto* la présence d'industries de production énergétique, mais également d'autres industries productives situées traditionnellement à proximité des grands centres de peuplement, pourvoyeurs de main-d'oeuvre. Ainsi, la pollution industrielle est-elle indissociable de la pression sur l'environnement, pression susceptible d'être attribuée aux hautes densités de peuplement?

Mais, dans ce contexte urbain et industriel, la relation population--environnement n'est pas simple, les activités urbaines et industrielles ne sont pas statiques. Au fil des années, pour différentes raisons, elles changent et sur le long terme, on peut constater des changements structurels majeurs liés à l'extension de certaines industries et au déclin d'autres. Dans ce domaine,

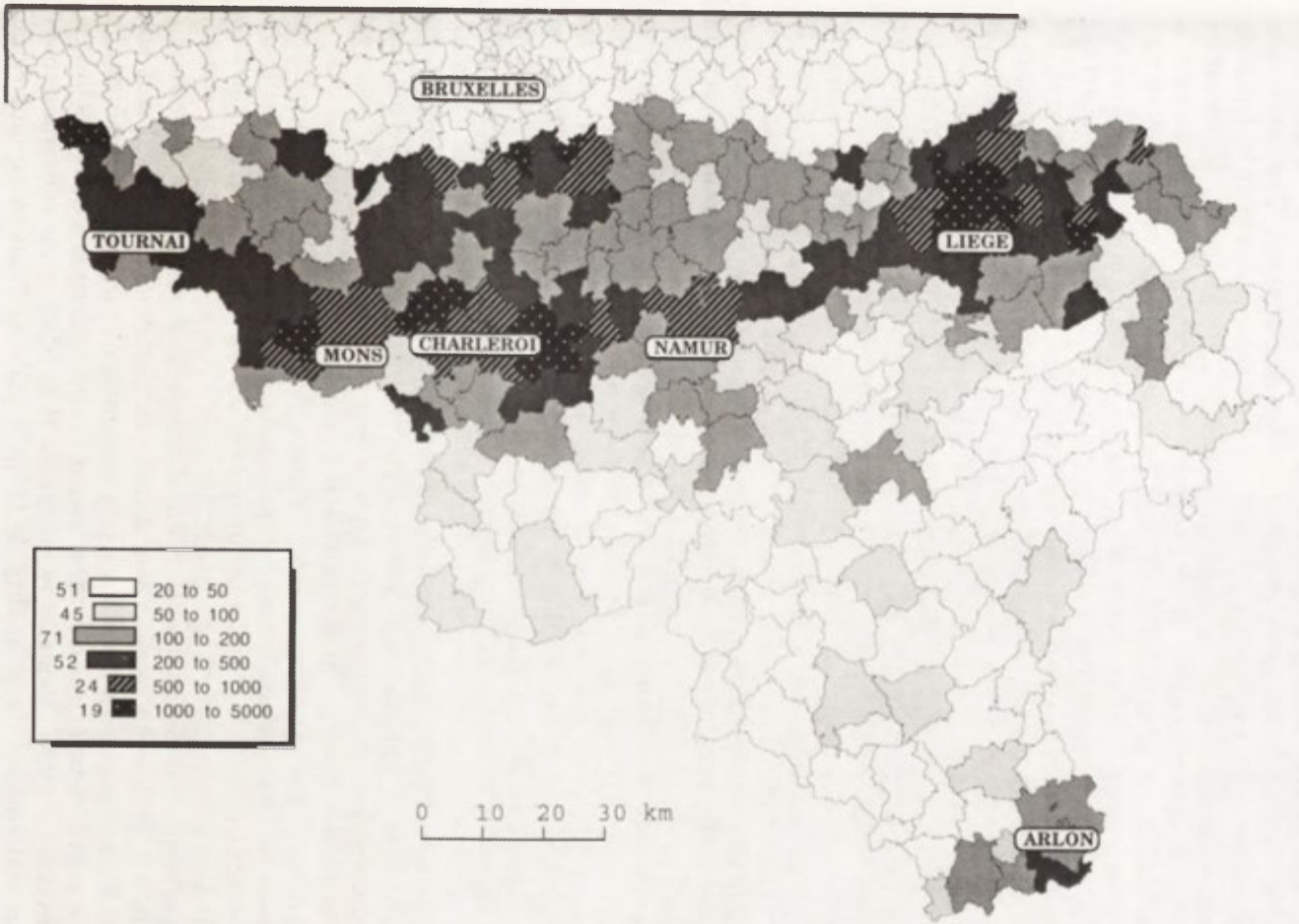


Fig. 1. Densité de la population en 1991 (Nombre d'habitants par km²)

c'est principalement la disparition de l'extraction houillère et le déclin de la grosse industrie métallurgique qui caractérisent les cités industrielles wallonnes. Tous ces changements affectent l'environnement. C'est ainsi que l'augmentation de la production peut conduire à un accroissement de la demande en matières premières et de terrains à bâtir, à l'épuisement de certaines ressources, à l'augmentation de la production de déchets et des émissions, à l'intensification de la circulation. A leur tour, ces phénomènes exercent une pression croissante sur l'environnement et risquent de favoriser les pollutions. Par ailleurs, l'amélioration de l'activité économique peut permettre de rentabiliser un investissement qui serait fait dans les technologies de l'environnement. De cette manière, des niveaux réduits d'activité écono- mique peuvent conduire à des améliorations environnementales, grâce à la diminution des émissions et des niveaux de pollution. A l'inverse, ils peuvent exacerber les problèmes écologiques en décourageant l'investissement dans l'introduction de méthodes de lutte plus efficaces contre la pollution ou de technologies plus propres, en favorisant l'abandon de zones urbaines ou industrielles.

Plus spécifiquement, quel est l'impact d'une forte densité d'êtres humains, de par leur activités domestiques et leur vie de tous les jours? C'est la pollution atmosphérique par le chauffage domestique et le gaz d'échappement des véhicules automobiles qui, la première, vient à l'esprit. Actuellement, la pollution de l'air due au trafic routier dépasse largement celle provenant du chauffage domestique et constitue la première cause de la concentration de la pollution en milieu urbain. L'environnement urbain souffre également de la pollution des eaux des ruisseaux traversant les villes et devant accueillir un volume d'eaux usées en relation avec le chiffre de la population. De même, l'élimination des déchets ménagers est une têche dont l'ampleur s'accroît avec la densité de peuplement, au même titre que les risques de pollution qui en résultent. Par ailleurs, le bruit constitue également une pollution urbaine qui affecte la qualité de la vie et indirectement la santé. Globalement et indépendamment de l'existence d'une pollution industrielle que l'on ne peut ignorer, nous pouvons supposer, *en toute première analyse*, que l'intensité de l'ensemble de ces pollutions dont nous avons fait état est en relation directe avec la densité de peuplement.

Bien que ce point se trouve à la marge de notre approche, on ne peut perdre de vue qu'il existe, dans les centres urbains, beaucoup plus qu'ailleurs, des besoins urgents de réaménagement de friches abandonnées, de quartiers délabrés, en vue de promouvoir une certaine esthétique urbaine indispensable à la qualité de l'environnement urbain. Ce type de dégradation de l'environnement est également associé à la densité de peuplement, mais il doit être rattaché, plus encore que les autres, à un ensemble de comportements humains qui peuvent être favorisés ou enfreints par les incitations des pouvoirs locaux.

L'hypothèse selon laquelle le risque de dégradation de l'environnement urbain, notamment de la qualité de l'air, de celle de l'eau et de tout ce qui touche à la gestion des déchets, serait proportionnelle à la densité de peuplement est faite en l'absence de recours à des techniques plus appropriées à

de fortes densités de population et de consommateurs. Or, il ne fait aucun doute que les investissements technologiques tels que les transports en commun basés sur l'énergie électrique, les murs antibruit, les systèmes de contrôle de la qualité de l'air etc. sont généralement orientés, de façon prioritaire, vers les zones critiques à haute densité de peuplement. En outre, la préoccupation des gestionnaires locaux en milieu urbain est vraisemblablement plus sensible aux problèmes d'environnement. De la sorte, l'action politique en la matière pourrait très bien effacer, tout ou en partie, cet impact négatif de la densité de peuplement sur l'état de l'environnement urbain.

Qui plus est, la façon dont l'être humain perçoit le respect de l'environnement varie selon l'âge et le sexe des intéressés, mais également selon le milieu urbain ou rural (Collomb et Guérin-Pace 1994). Il pourrait en résulter une prise de conscience de la population plus forte en milieu de haute densité, avec, pour conséquence, l'apparition de courants d'opinions et de comportements plus favorables au respect de l'environnement. Somme toute, dans la plupart des pays occidentaux, on masque partiellement ce que nous supposions être, dans un premier temps, une proportionnalité entre densité de peuplement et risque de dégradation de l'environnement. Même si l'on pressent qu'une intensité du peuplement plus élevée peut se traduire par une pression plus forte sur l'environnement, la densité de population ne constitue qu'un indicateur assez imparfait pour quantifier cet impact: la variable "population" n'est qu'une variable parmi tant d'autres à prendre en compte pour analyser ce système complexe qui caractérise l'environnement urbain.

LES EFFETS DE L'ENVIRONNEMENT EN MILIEU URBAIN ET INDUSTRIALISÈ SUR LE COMPORTEMENT DEMOGRAPHIQUE

Lorsque l'on souhaite aborder les effets de l'environnement sur le comportement humain et plus précisément sur le comportement démographique, c'est son impact sur la morbidité et la mortalité qui vient tout d'abord à l'esprit. L'environnement urbain a-t-il un effet sur la santé publique? Fort malheureusement, comme nous allons le voir, les données dont on dispose peuvent difficilement répondre à cette question.

Il est tout d'abord possible de produire une cartographie du niveau global de mortalité à travers une estimation de l'espérance de vie à la naissance se basant sur le rapport entre le nombre de décès réellement observés et celui qui serait attendu sur la base d'un schéma type de mortalité, en l'occurrence le schéma moyen pour l'ensemble de la population belge (Poulain 1988). La variabilité spatiale de la mortalité ressortant de la figure 2 ne permet pas de distinguer d'un premier abord les cités urbaines et industrielles du sillon Sambre-et-Meuse. Force est donc de constater qu'au niveau désagrégé des communes, la mortalité des cités urbaines et industrielles n'est pas significativement supérieure à celle des autres communes.

Une analyse plus précise de la mortalité peut être réalisée par arrondis-

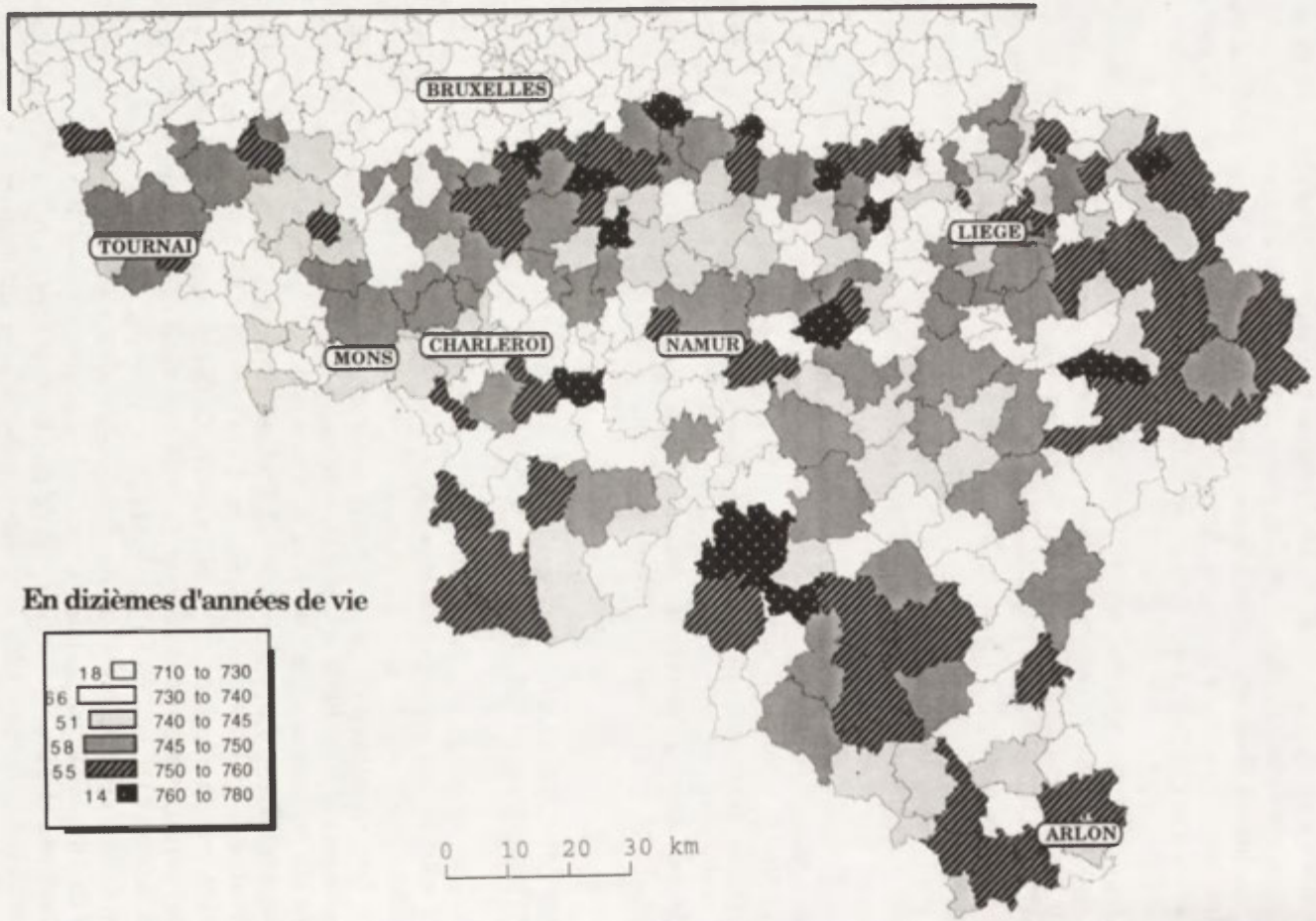


Fig.2. Espérance de vie à la naissance (sexes réunis)

sement administratif, au nombre de 20 en Wallonie. Parmi ceux-ci, on sera attentif à ceux de Liège, Charleroi et Mons qui regroupent la majorité des cités à la fois urbaines et industrielles. Les figures 3, 4, 5 et 6 proposent l'espérance de vie à 15 et 40 ans pour les hommes et les femmes, séparément. Même si on y décèle que les arrondissements précités sont plus souvent dans le peloton de tête, caractérisés par une plus forte mortalité, la situation et la hiérarchie sont loin d'être nettes. En outre, nous proposons les figures 7 et 8 spécifiques à la mortalité par cancer du poumon et par maladies ischémiques, chez les hommes, l'une et l'autre cause pouvant être en relation directe avec des problèmes d'environnement. Mais dans ces répartitions spatiales, plus encore que dans celles relatives à l'espérance de vie, les arrondissements urbains et industriels ne ressortent en rien. Ainsi, en toute première analyse, force est de constater que la détérioration relative de l'environnement industriel et urbain est rarement une cause spécifique de mortalité. Toutefois, ce constat ne signifie pas, comme nous l'avons affirmé précédemment, qu'il n'y ait pas d'impact sur la morbidité, notamment par un affaiblissement physiologique qui peut être un facteur déterminant de morbidité et donc devenir un élément indirect de mortalité. Malheureusement, les données de morbidité manquent de façon sévère pour pouvoir affirmer cet impact potentiel.

Dans le domaine de la mobilité spatiale, l'effet de l'environnement pourrait paraître plus clair. Ainsi, en excluant les causes d'ordre économique et plus particulièrement celles liées à la recherche d'un emploi, la *migration* est souvent liée à la recherche d'une qualité de vie supérieure. Les jeunes ménages urbains qui décident de s'installer en région périurbaine, le font généralement pour un ensemble de motifs parmi lesquels on retrouve la facilité d'accès au lieu de travail, le coût de l'immobilier ou du terrain à bâtir... mais également le fait d'avoir plus d'espace et un environnement plus "vert". Ils recherchent un cadre de vie qu'ils jugent de meilleure qualité par rapport à celui de la ville ou des régions industrielles peu attrayantes. De même, certains pensionnés résidant dans ces mêmes régions profiteront de leur liberté vis-à-vis d'une attache professionnelle pour s'installer dans des lieux de villégiature dont la tranquillité et le cadre de vie sont plus près de leurs aspirations. L'intensité et la direction des mouvements de migration sont donc loin d'être étrangères à qualité de l'environnement.

Sur la figure 9 le bilan migratoire détaillé de la commune de Charleroi permet, à titre d'exemple, d'identifier les âges pour lesquels cette métropole essentiellement industrielle constitue un pôle répulsif. Les jeunes enfants sont parmi les premiers concernés, mais il est clair que leur comportement est dicté par celui de leur parents. Par ailleurs, le déficit majeur se situe entre 24 et 42 ans, avec un maximum entre 25 et 28 ans. C'est évidemment le résultat de l'émigration des jeunes ménages urbains dont nous venons d'aborder les motifs. Enfin, bien que le bilan reste généralement toujours faiblement négatif, par la suite, les différences se renforcent après 75 ans, sans que cela se traduise bien évidemment dans les chiffres absolus par un déficit conséquent.

La cartographie des mouvements migratoires par commune (Figs. 10 à

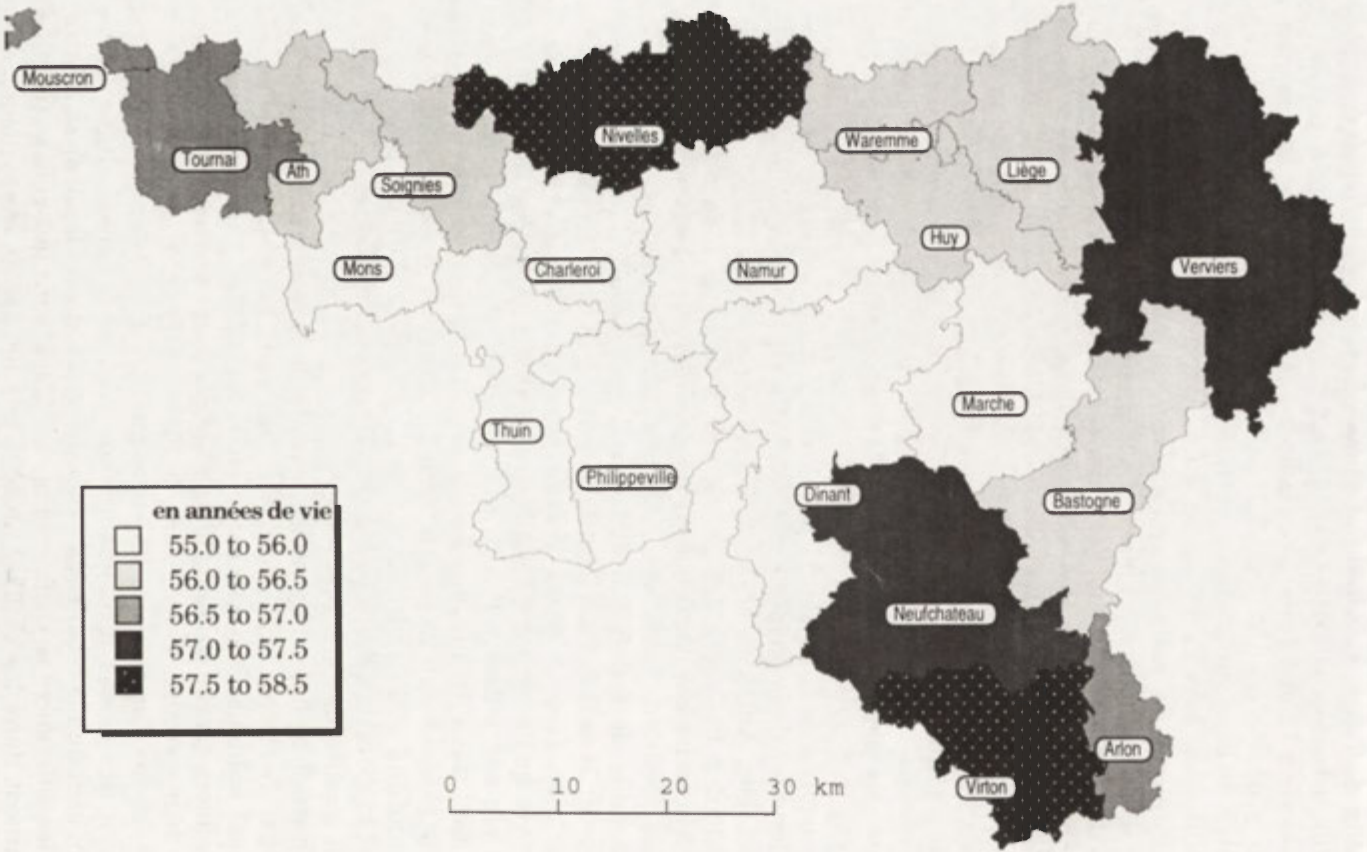


Fig.3. Espérance de vie à 15 ans. Hommes

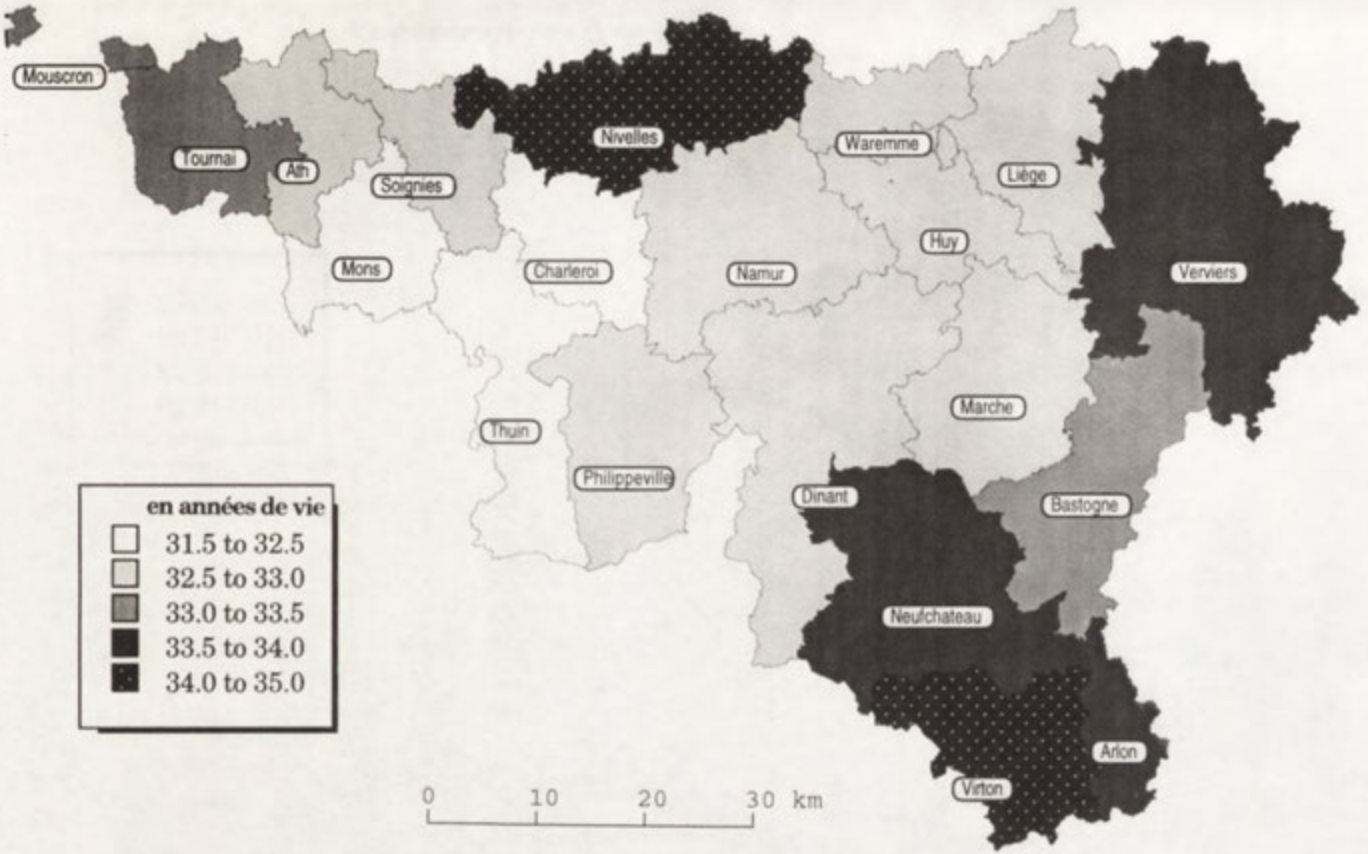


Fig.5. Espérance de vie à 15 ans. Femmes

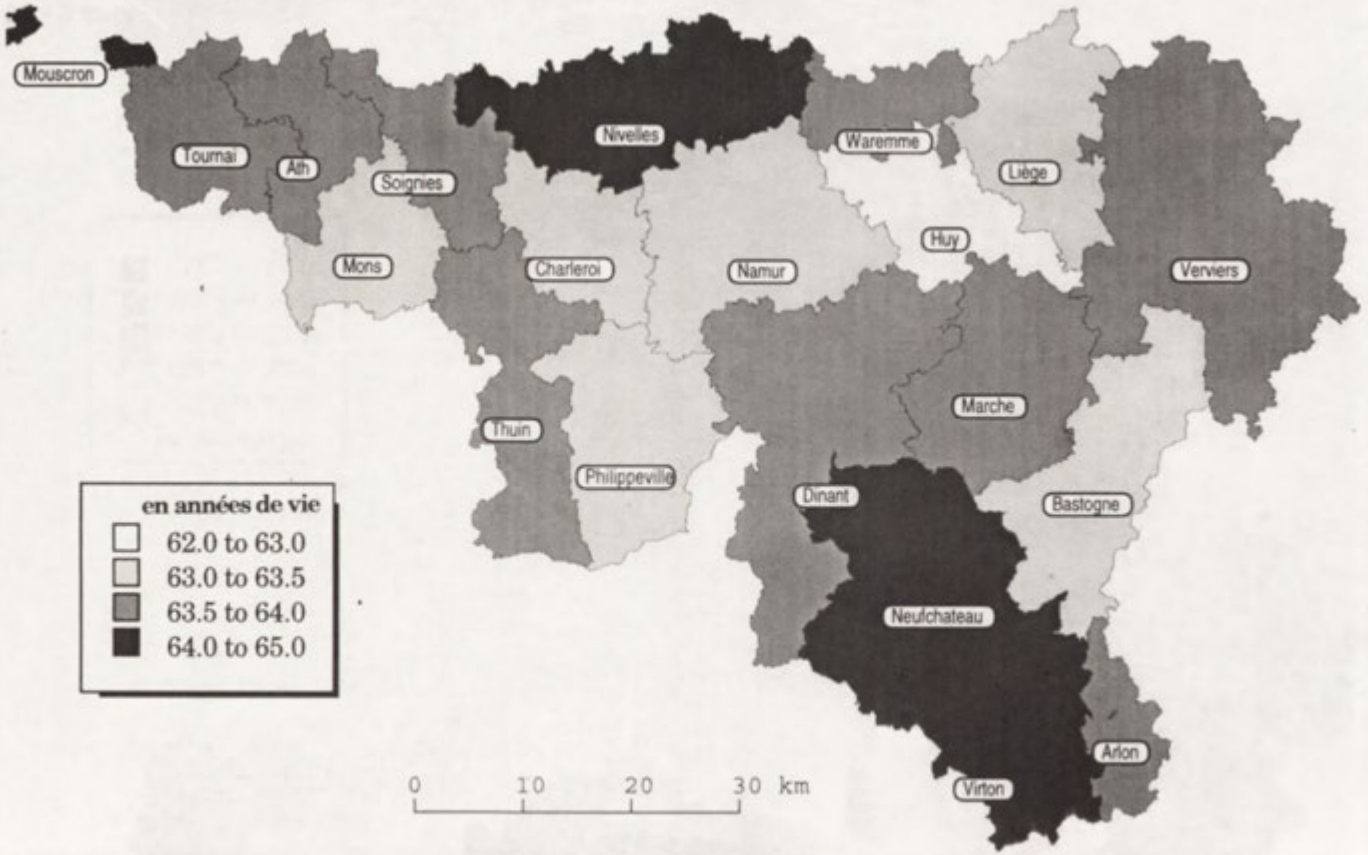


Fig.4. Espérance de vie à 40 ans. Hommes

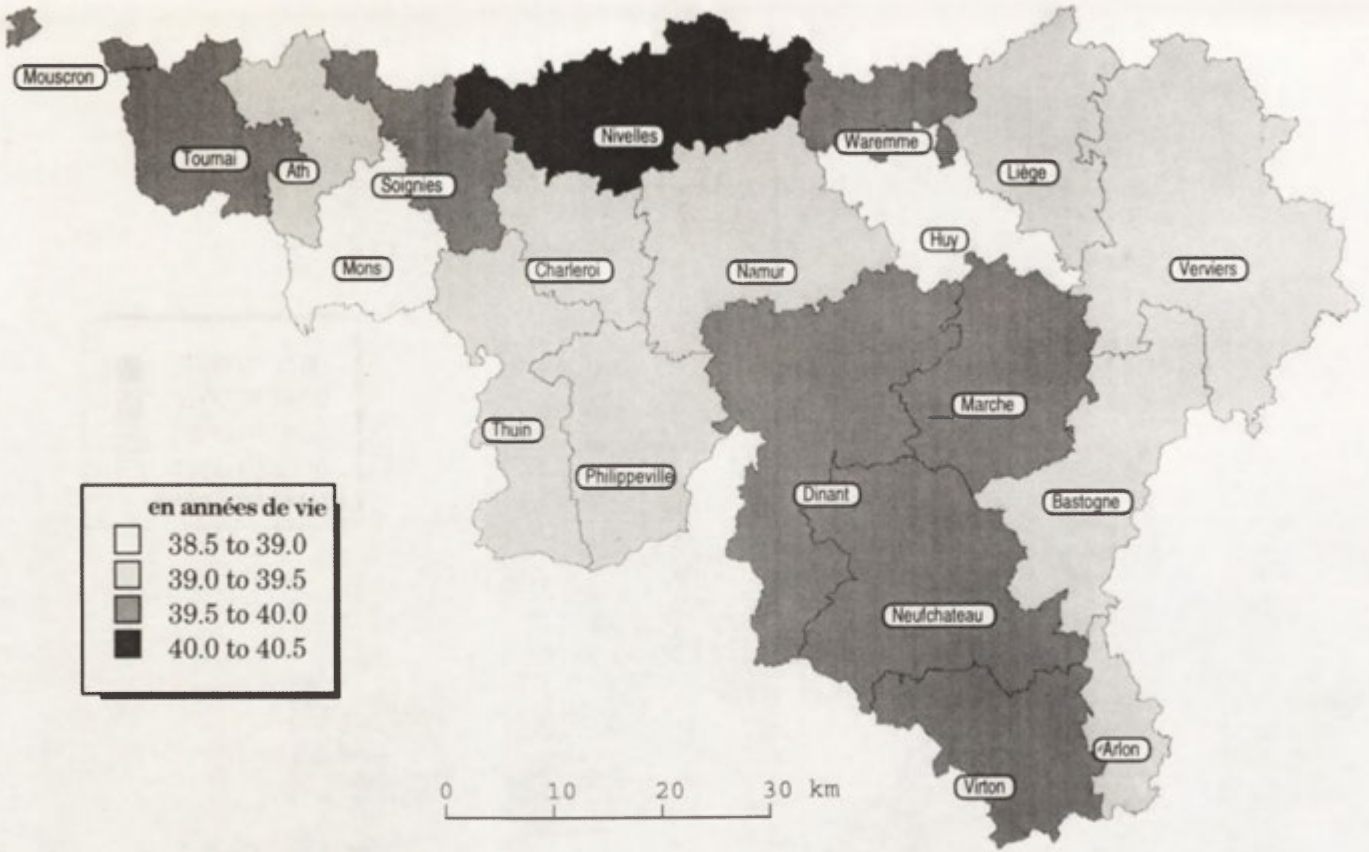


Fig.6. Espérance de vie à 40 ans. Femmes

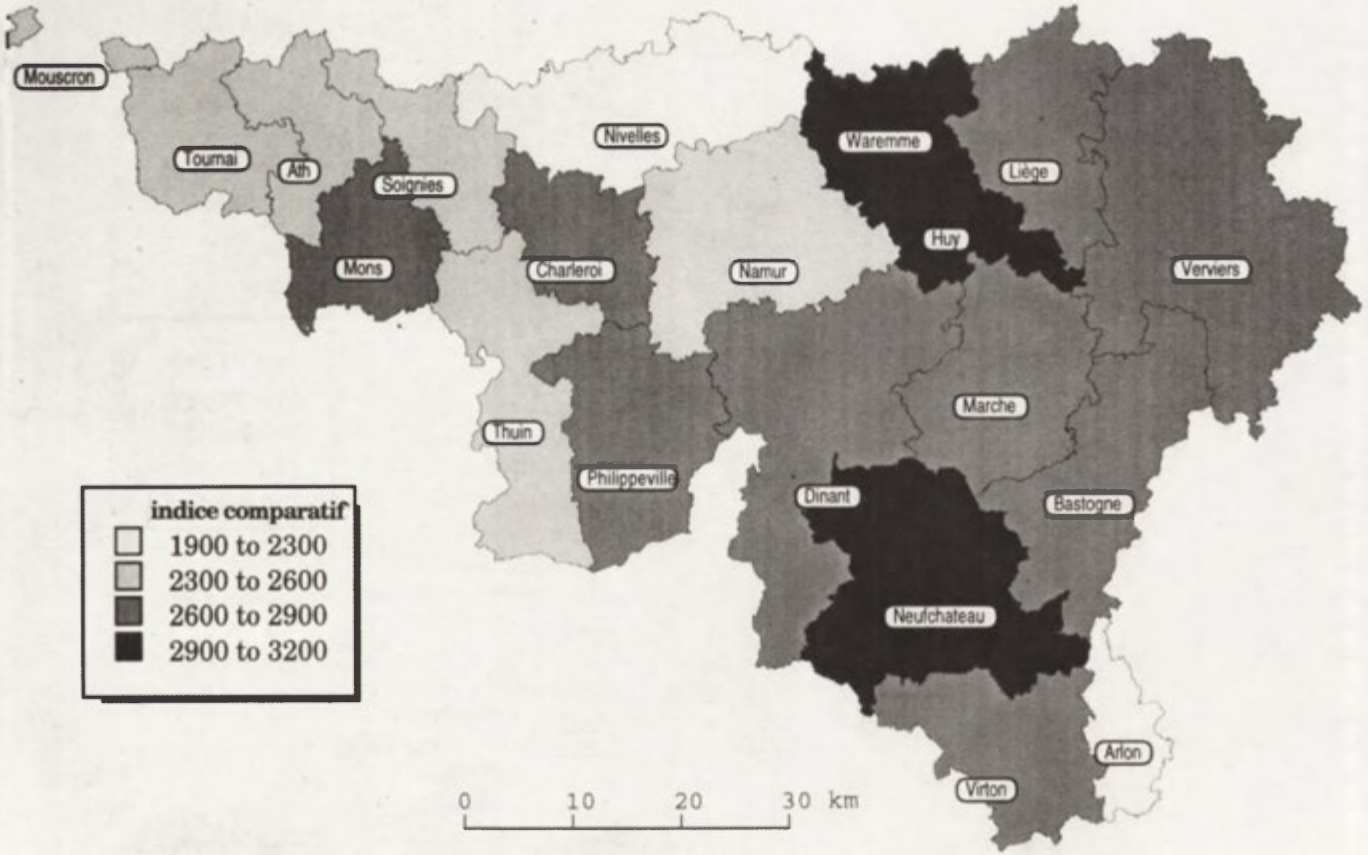


Fig.7. Mortalité par cancer du poumon. Hommes

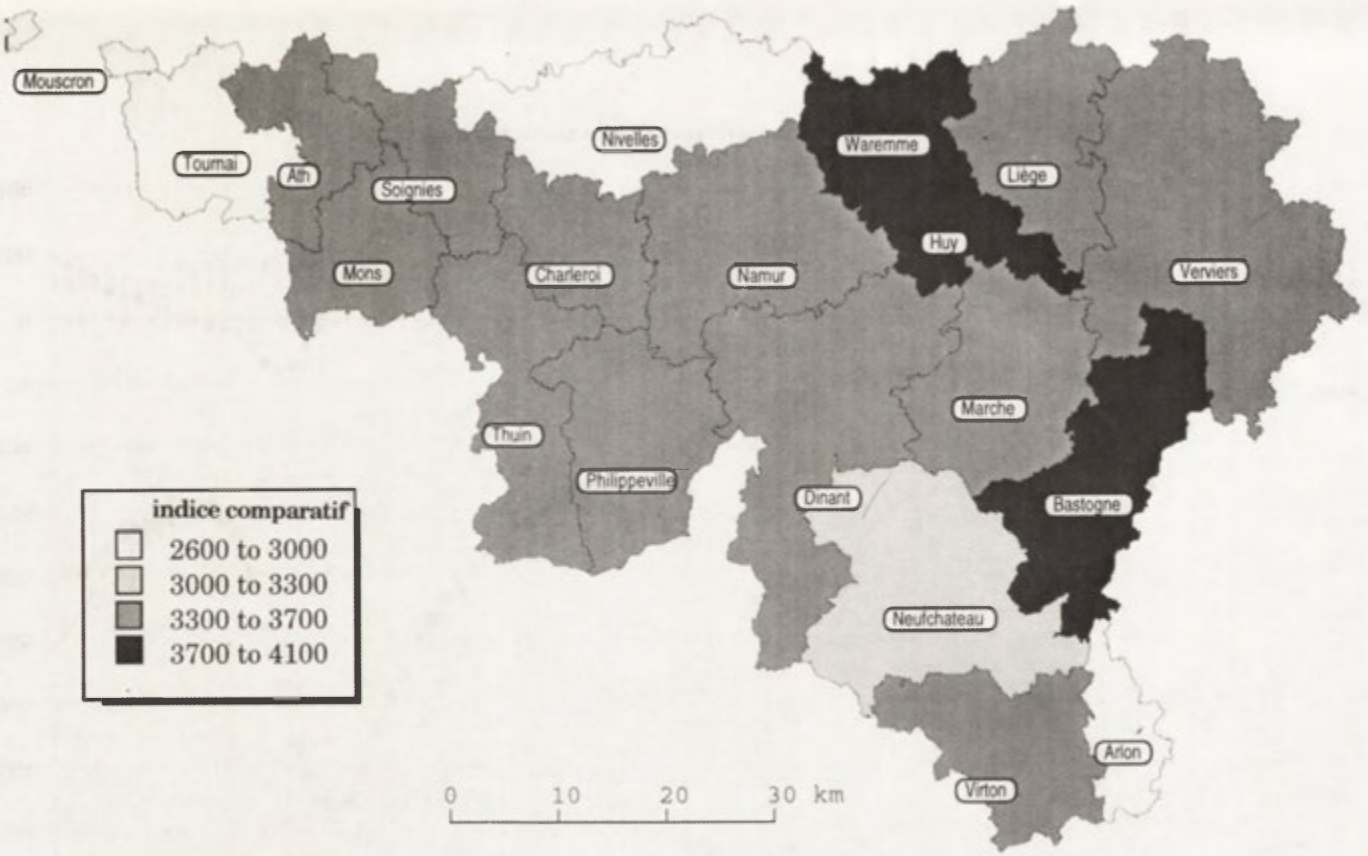


Fig.8. Mortalité par maladies ischémiques. Hommes

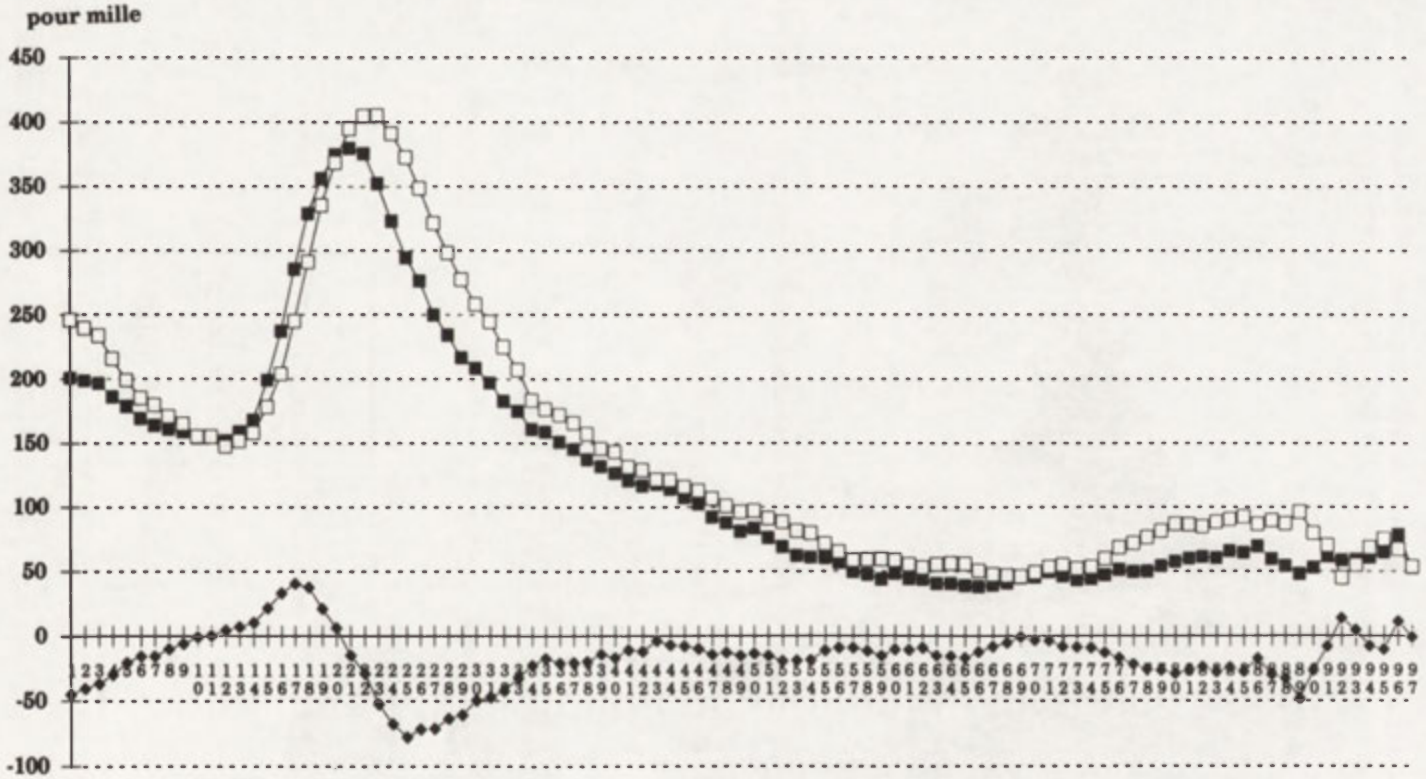


Fig.9. Bilan migratoire annuel de la ville de Charleroi, 1988-1992

14), en distinguant les différentes tranches d'âges, met clairement en évidence le rôle spécifique des grosses métropoles et régions urbaines et industrialisées, depuis Verviers et Liège, à l'est, jusque Tournai, à l'ouest, en passant par Huy, Namur, Charleroi, La Louvière et Mons. Les taux d'émigration, en rapportant le nombre d'émigrations à la population des communes de départ, donne une excellente visualisation de la force répulsive des villes pour certains groupes d'âges. Le bilan migratoire, lui-même également rapporté à l'effectif de population de chaque commune, permet de faire le point sur l'impact réel de ces mouvements de migration et de considérer leur effet sur la redistribution de la population au sein de la Wallonie.

Globalement, pour comprendre l'évolution récente plus particulière de la population des sites industrialisés, des éléments plus qualitatifs doivent être pris en compte afin de juger le pour et le contre, face à la décision de changer son lieu de résidence, soit en quittant les sites désindustrialisés, soit en venant s'y établir. C'est ainsi qu'on ne peut ignorer tout d'abord le problème lié à la qualité du logement. A bien des égards sur ce point, l'étroitesse et la vétusté des logements disponibles dans les cités industrielles font pâle figure face à la potentialité d'une villa neuve construite en zone périurbaine. Ceci n'est pas indépendant de la qualité de l'environnement au sens plus large. Le souci d'occuper un espace plus vaste, espace au sein duquel la nature trouve désormais une place que la révolution industrielle avait bouté en dehors des murs des cités laborieuses, sont des éléments qui favorisent largement le mécanisme de rurbanisation. Ce retour à la nature, ce souhait de s'entourer du calme bucolique de la campagne émergent dans la foulée des mouvements écologiques des années 1970. Toutefois, il ne faut pas perdre de vue que l'objectif majeur de ce processus de rurbanisation consiste à transposer les avantages de la ville, qui restent certains, dans un espace rural à proximité de celle-ci.

Un autre mécanisme va renforcer ce processus d'exode urbain qui touche de plein fouet les cités industrielles. Les logements de qualité médiocre libérés par les départs vers les zones périurbaines seront occupés de plus en plus par des ressortissants étrangers. Ceci aura pour effet d'accroître plus encore la part des populations étrangères dans ces cités et, indirectement, en introduisant une ségrégation spatiale de plus en plus marquée, de renforcer les arguments favorables à l'émigration potentielle de ceux que nous appellerons les natifs.

Les années 1980 moduleront quelque peu ces tendances très nettes constatées pendant les années 1970. Quelques modifications viendront freiner un mécanisme qui prenait, il est vrai, une ampleur considérable. Tout d'abord, la hausse du coût de pétrole renchérira le coût de la navette et rendra celle-ci moins attractive. Ensuite, et parallèlement à l'évolution du coût de l'énergie, le loyer de l'argent sera plus cher et freinera également les élans vers la campagne, surtout si l'on prend en considération la hausse généralisée du coût d'accès au logement en zone périurbaine. Dans ce contexte, les villes ayant développé une politique qui peut se résumer sous le slogan "revivre

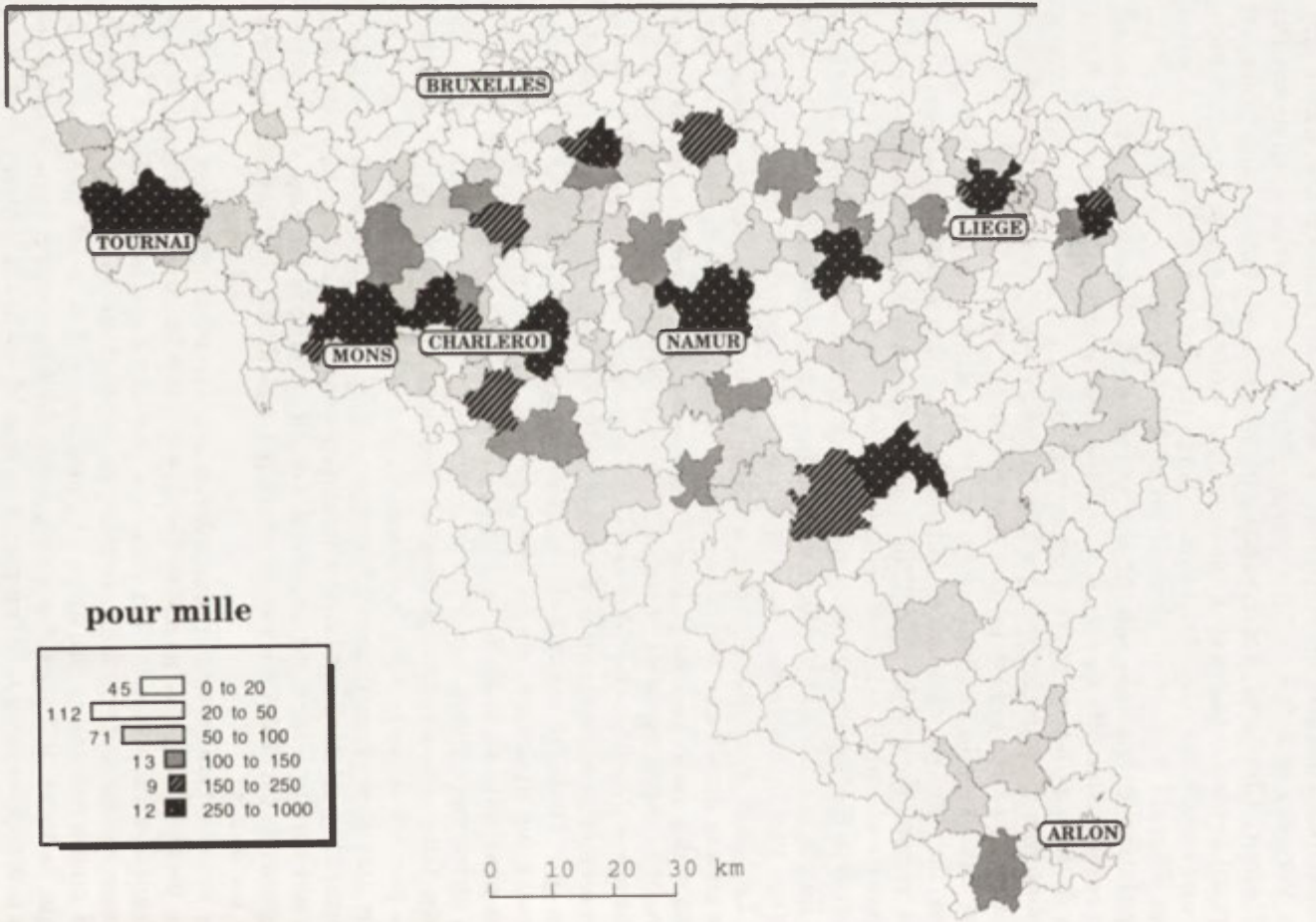


Fig. 10. Taux d'émigration des 0-14 ans

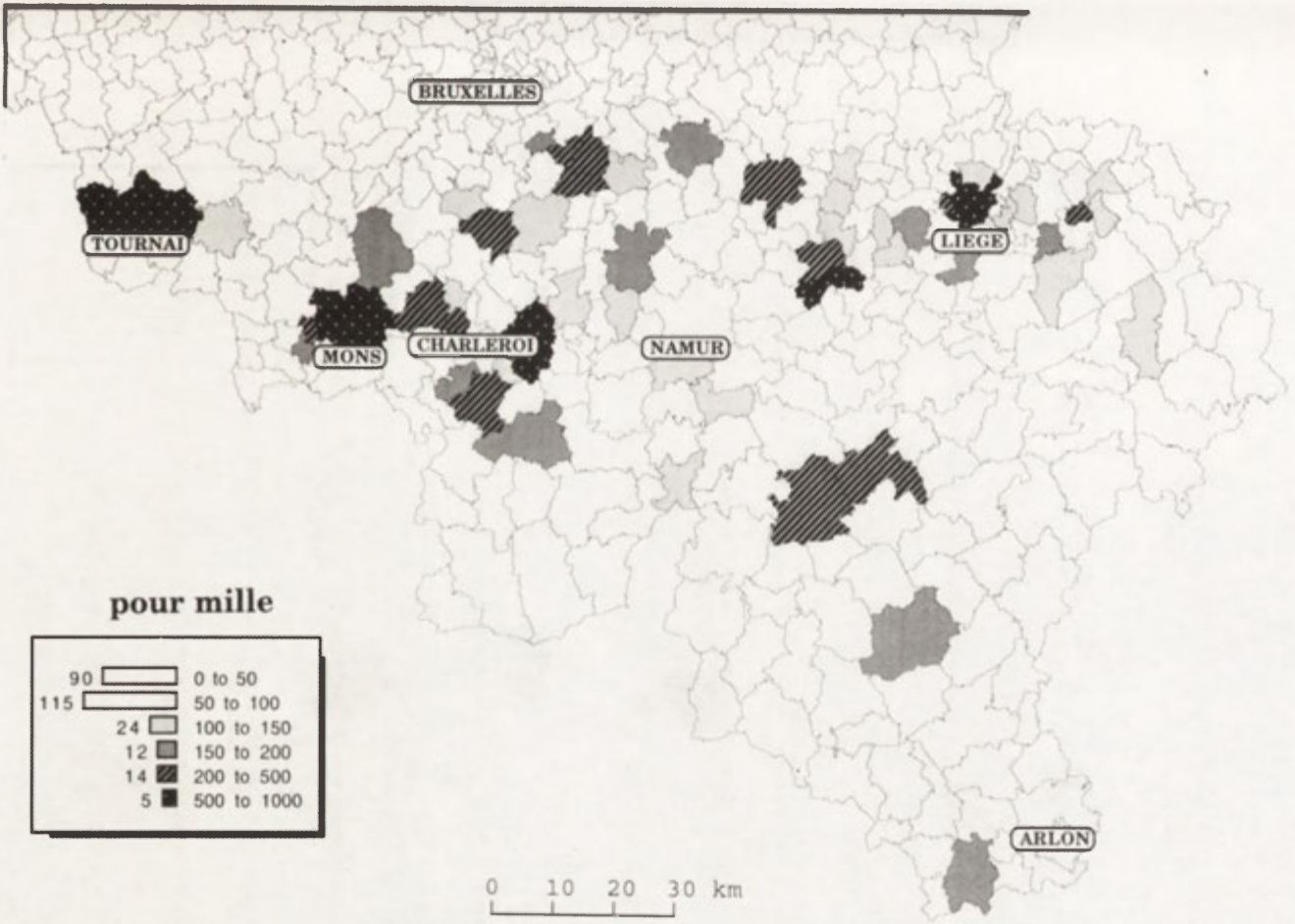


Fig.11. Taux d'émigration des 25-39 ans

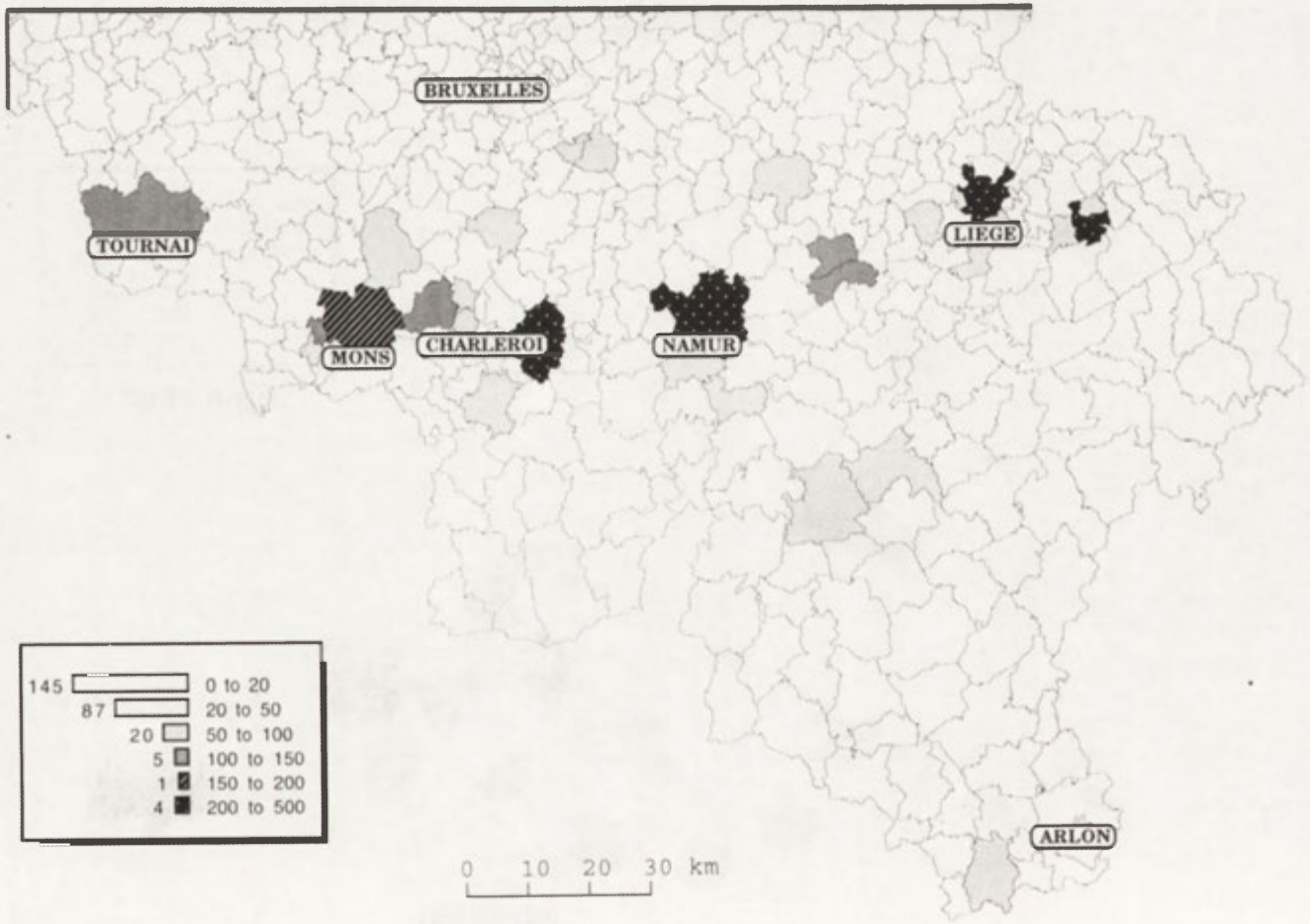


Fig.12. Taux d'émigration des 70 ans et plus.(Pour mille)

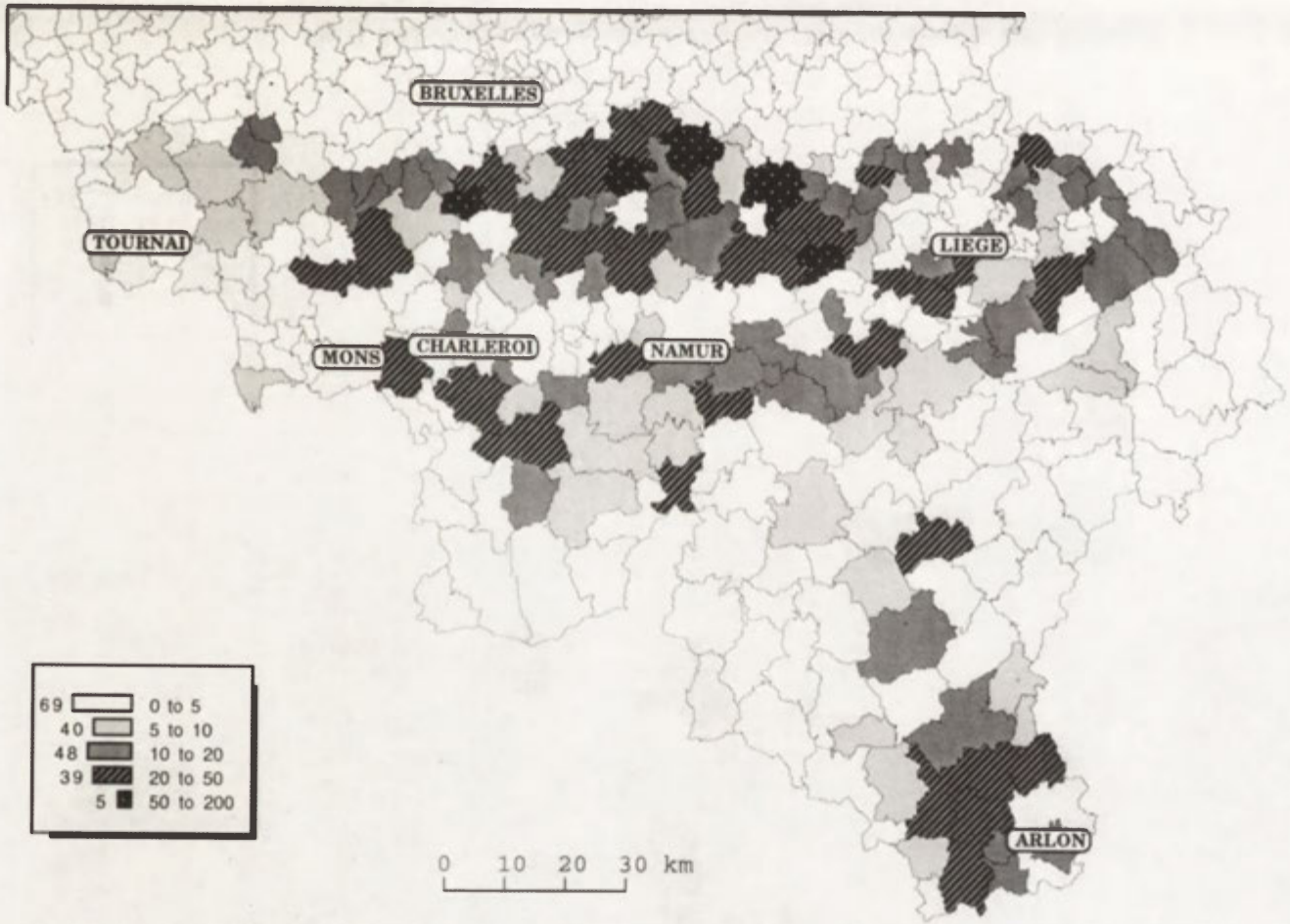


Fig.13. Soldes migratoires positifs des 25-39 ans (Taux exprimés pour mille habitants)

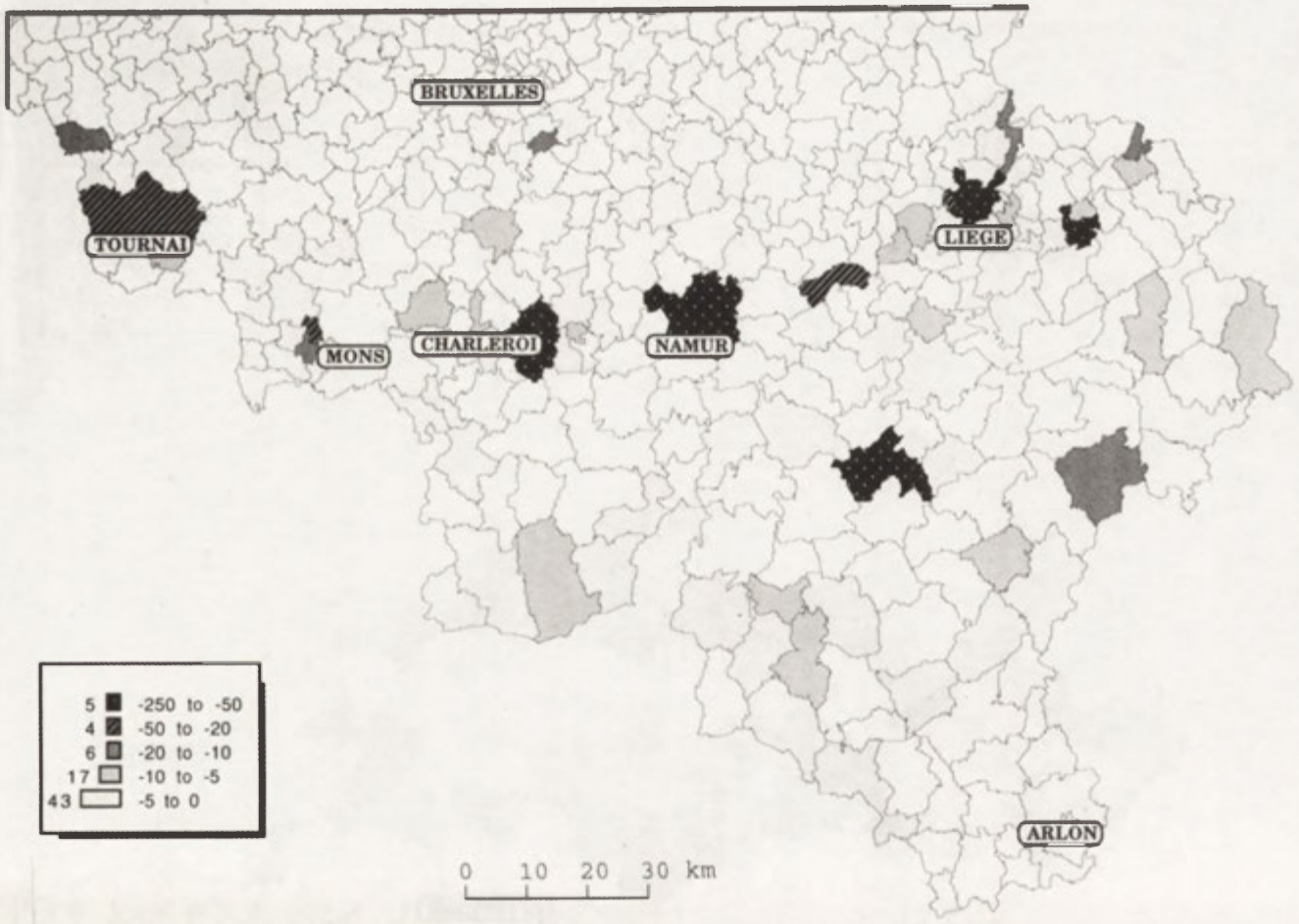


Fig.14. Soldes migratoires négatifs des 25-39 ans. (Taux exprimés pour mille habitants)

en ville", politique visant, par des actions de rénovation urbaine, à mettre en valeur les charmes historiques et à accroître la convivialité des villes, sont sorties gagnantes en induisant un tarissement de ce qui constituait un véritable exode urbain. Sous cet angle, rares sont les cités industrielles qui ont pu s'engager dans cette voie, faute d'atouts face à l'énormité de la tâche consistant à réhabiliter de vastes étendues de friches industrielles, pour une bonne part, à l'abandon. Qui plus est, aucune de ces cités industrielles ne dispose des infrastructures fonctionnelles lui assurant de statut de ville à part entière. Ainsi, dans la plupart des cas, l'exode urbain a perduré dans ces cités et continue encore actuellement. C'est dans ce contexte qu'au même titre que l'industrialisation, la désindustrialisation marque tout autant l'évolution démographique des cités industrielles.

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THE IMPACT OF DEINDUSTRIALIZATION AND UNEMPLOYMENT ON FAMILY FORMATION AND FERTILITY IN EAST GERMANY

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ABSTRACT: The paper analyses the demographic situation in East Germany which has changed fundamentally since 1989. Trends towards deindustrialization and a high level of unemployment especially among women are basic features of demographic development in East Germany. The dismantling of industrial capacities accompanying the economic transformation process in East Germany was not only the result of differences in productivity between East and West Germany, but also of regional strains on the environment. It has been proved that the one-sided economic policy in the GDR and the resulting environmental damages in East Germany have not lead to major changes in birth and mortality rates.

KEY WORDS: Deindustrialization, environment, unemployment, family formation, fertility in East Germany.

DEINDUSTRIALIZATION AND THE ENVIRONMENT

Since late 1989 there has been a wide ranging economic, ecological, social and cultural transformation of East German society. This process of transformation from a centrally planned economy to a market economy was initiated on 9 November 1989 with the fall of the Berlin Wall. Only by taking into account the political, economic, social and ecological situation in the GDR shortly before its breakdown can one judge the depth and intensity, but also the consequences of this transformation, one of which has been a fundamental change in demographic habits. The number of marriages as well as the number of births has declined by 65% since 1989 and 1.3 million people have left their homes and workplaces in East Germany to migrate west — mostly to the western parts of Germany. At the same time 0.36 million have migrated from West to East Germany. The life of those that stayed behind has been marked by a complete discontinuation of old habits, changes towards a new economic, political and social order and the attempt to adapt to the new lifestyle.

It is argued that these changes were the result of the dramatic upheavals in every aspect of life. Use of the term "transformation of the social environment", implies radical changes in the lives of East Germans. The confrontation with economic and social conditions of the new society — completely new experiences with a market economy, finding new jobs and homes, the general transformation of values and institutions, and the individualist tendencies — were a shock for East Germans.

The shock was not incited by the introduction of the West German deutschmark in East Germany in July 1990, which halved bank savings. Qualitative surveys show that most East Germans even accepted the fact that their wages lay below those of West Germans. The people asked were of the opinion that the differences in productivity between East and West did not justify equal wages at the beginning.

Much more important, instead, were the changes in living circumstances such as the unprecedented loss of jobs. For the first time East Germans experienced not only through the media the unwanted interruption to their professional lives and the transition to short-time work and unemployment, but cuts in the standard of living also had general consequences, such as far-reaching psychological and mental problems. The jobless showed signs of hopelessness, depression and fear of the future; but also those still holding a job felt insecure. Such was the picture in the former industrial and agrarian regions. Trends towards deindustrialization — meaning the shut-down of uncompetitive production units — dominated the scene in the first years of the new system.

The drastic decline in industrial production and deindustrialization in East Germany were not only a consequence of the 50% lower productivity or the run-down machinery in industry and agriculture. These production units were also closed down after 1989 because of the health risks to the people living nearby. Thus, deindustrialization was also a consequence of the economic policy of the former GDR. For years it had refused any innovation concerning the linkage of the economic and ecological aspects of production. On the contrary: such links were completely ignored. Only the progress of the economy was allowed to play a role. There was no room for the acceptance of the fact that continuing economic growth has ecological consequences. The Honecker-government would have lost face had it officially admitted that it was forcing economic development and a rise in the standard of living by exploiting the ecological environment.

It had been one goal of the state-oriented socialist government to guarantee a qualitative rise in living standards through economic growth. The term "rise in individual living standards" meant the steadily increasing government funds towards this goal. In the 1970s and 1980s, the economic policy activities of the GDR-government concentrated on the expansion of the social system. Government subsidies allowed the freezing of prices for basic foods, childrens' clothes, rents and public transport.

Besides financial aid, social policy was also used to level out the conflict

between society and the family. It was one of the main goals of such aid programmes to reduce the multiple conflicts between working women and their willingness to have children. Since most of the women worked and were expected to work outside the home, the government made it a point to guarantee conditions facilitating the decision to have one or more children. The social network, which included special financial benefits for mothers and children, was meant to guarantee reproduction long-term. Among these measures were ever-increasing child benefits, one year of paid leave from work after the birth of a child and job security if the mother wished to return to work. These measures were, however, only possible through yearly increases in the national product.

But since the beginning of the 1980s, the economic basis for such a social policy has changed fundamentally. The explosion of world market prices for raw materials and energy as well as the rise in interest rates were the start of the GDR's most pronounced economic crisis. In order to keep the economy going, raw materials had to be imported on a continuing basis, and to keep up with the expanding social programmes and in spite of the merely minor increase in the national product, politicians were forced to save where investment activity was concerned. At the same time, an "export offensive" was launched to finance the imports. In spite of these changes in the outer and inner economic situation, the government continued its subsidy policy. This led to waste and carelessness concerning subsidized foods, transport prices and rents, and large increases in government spending. In order to finance this, nothing was left undone in order to increase economic output. The expansion of energy production, a rise in brown coal mining and an increase in agricultural output through intensive use of fertilizers played a key role. The environmental consequences of this policy were increasingly ignored. After the political and economic breakdown of the GDR, the statistical safes were opened. This for the first time allowed an insight into the data and the analysis thereof, which brought to light the whole dimension of the environmental problems. Especially in the former industrial regions, in which brown coal had been the primary source of energy, the emission of sulphur dioxide by far surpassed the international as well as the national norms. In the neighbouring countries of Poland, Hungary and Czechoslovakia, the average emission of sulphur dioxide was 100 kilogrammes per inhabitant, while it amounted to more than three times as much in the GDR. In agriculture, the use of nitrogen had risen by about 50% and that of herbicides by 58% during the 1980s, when twice the amount of fertilizers per acre used in the FRG were used in the GDR (Winkler 1990a, p. 175).

This key role of the economy and the dimensions of government ignorance towards dealing responsibly with the environment became absolutely clear in the final GDR-figures. The studies of replenishable resources such as water, air and soil show the persistent damage and exploitation. For example more than 40% of the water areas in the former GDR could not be used anymore for water purification. Because of the aggressive economic policy,

the use of primary energy had risen sharply and laid at a per capita base just below that of the USA and Canada. The high per capita rate of energy consumption was no proof of a high level of industrial production, but instead of archaic industrial complexes and unrestrained waste in industry and private households.

At least the heavy pollution of the environment did not directly lead to a shorter life span for the GDR citizens. Medium life expectancy in the former chemical triangle of Bitterfeld-Halle-Merseburg was higher than that of men and women in the rural areas of northern East Germany. Even now, four years after the upheavals, it is not clear whether this is due to a better developed system of preventive medicine or to differences in life styles — especially the consumption of basic foods and alcohol. All available studies show that there is no direct connection between the environmental problems and the regional differences concerning of birth and mortality rates. The decline in the number of marriages, divorces, births and abortions is much more due to the above-mentioned transformation problems than to the ecological deficits.

THE DEMOGRAPHIC IMAGE OF THE UNITED GERMANY

There have been dramatic changes in East Germany since the fall of the Wall. Since 3 October 1990, the demographic transition has been a part of the developments in Germany as a whole. At the end of 1993 there were almost 81 million people living in Germany. Thus, the population had grown by one million. It is above all ethnic Germans from Eastern Europe and Central Asia and foreigners that represent most of the increase since 1990. In 1994 there will hardly be any change in the number of inhabitants. The reasons are the low fertility rate especially in East Germany and the decline in the number of asylum seekers. After the immigration law for asylum seekers was modified in June 1993, the number of applicants fell to less than 50% of what it was in the last six months of 1992.

The increase in the total population between 1990 and 1993 by one million is paired by an excess of deaths over births. One must, however, be precise when talking about surplus mortality in the politically united Germany of the nineties. For Germany as a whole, the mortality surplus increased fivefold between 1990 and 1992. During these three years, the balance was positive in the western parts of Germany, while it continued to be negative in the eastern parts after 1990. That year, surplus mortality amounted to 29,600 and increased to a peak of 101,900 in 1992. This is a result of the demographic changes that have been taking place in East Germany since the late 1980s. In 1988 and 1989 the figure was also negative.

But while there were no significant changes in the mortality rate, the number of births and marriages changed dramatically with the decline of the old system. In 1989, when the economic and political deficits of the former GDR had already become rather apparent and the cry "Let's get rid

of the Wall" went around the world, the number of births decreased by 16,000. Between 1988 and 1989, the birth rate sank by 0.9 to 12 per thousand. With the beginning of the transformation process in East Germany, i.e. the change from the centrally planned to a free market economy, there was a qualitative cut in birth rates. While there had been 20,000 births fewer than the previous year in 1990, the number decreased much more in 1991. Only 107,000 children were born, bringing the birth rate down from 11.1 to 6.8 per thousand. Even if this decline slowed down in 1992/93, it did continue. In 1993, even fewer children (app. 79,926) were born than in 1992. The number of births has decreased by 65% since 1989. In contrast, the number has been almost stable since 1988 in West Germany. Since then, the birth rate has been over 11 per thousand.

The pattern of mortality figures is also different in East and West Germany. The crude death rate in the old Lander was 10.7 in 1992, while it amounted to 12.1 in the former GDR. Another difference between East and West could be found in average life expectancy. In 1989 female newborns in West Germany could expect to reach the age of 78.98, male newborns 72.55. The figures for the GDR were two to three years below this average. The reasons for these differences are not totally clear. It seems that environmental strains in the East were only a marginal factor, since mortality in the industrial zones was lower than in the north of the country. More likely it was the different eating habits and a larger consumption of alcohol and nicotine that were responsible for lower life expectancy.

The size of the East German population is, as is normally the case, also determined by factors such as the ageing of the population, medium life span and decline in birth rates. The medium life span of men and women during the last years of the existence of the GDR lay at 70.0 and 76.23, respectively. This life expectancy — rather high when compared with other East European countries — was the result of intense efforts to improve the medical and social care for the population. As late as 1952, the medium life span for women was 67.96, for men 63.9 years. Contrary to life expectancy, birth rates did not grow rapidly. During the 1950s and the first few years of the 1960s, the number of births rose slowly. Hereafter, birth rates declined from 16.5 per thousand to 10.8 per thousand in 1975. Due to aggressive political measures, birth rates had risen short-term to 14.6 per thousand by 1980. Hereafter, the number of births declined steadily. In 1981, the registered number of births was 237,000; by 1988 it had fallen to 215,000. Due to the rise in life expectancy for both sexes and the irregular development of birth rates, the proportion of aged persons (65 years and above) among the total population rose steadily between 1950 and 1979. In 1950, this proportion had been 10.6%. By 1979 it had risen by 5.5%. Due to the rise in birth rates after the middle of the 1970s, this proportion sank by almost 3%. These ageing tendencies continued after 1989. Nevertheless, the ageing process before 1989 is different than that of the four following years.

The specific ageing of the East German population is a constituent part

of the demographic development of the past few years, and it is characterized by a series of crisis-like aspects. The unification of both German states and the subsequent economic, social, legal and institutional process of transformation was accompanied by uncertainty, problems of adaptation and changes in the conduct of the East German population. The result was a drastic change in the number of marriages, decline in the birth rate and migration.

THE SOCIAL AND ECONOMIC TRANSFORMATION PROCESS IN EAST GERMANY

The problem of the demographic transition process, i.e. the decline in the number of marriages, births, divorces and abortions in East Germany, cannot be explained simply by the decay of former values, customs and traditions and their substitution by those of the former FRG. The demographic process of adaptation receives specific dynamics by the lack of impulses in the economic development of East Germany over the last four years. For everyone involved, the economic and social changes are a special experiment. The task was not simply to forget experienced customs and behaviour, but to quickly acquire the patterns of socialization which were developed during the 40 years of existence of the FRG. This phase of learning was accompanied by a large economic and social breakdown in East Germany.

The living conditions of the individuals changed thoroughly with the economic and social transformation. Daily life is marked by fear of losing one's job, mental collapses and extreme uncertainty of whether or not one will be able to live up to the new demands. The fear of losing one's job and of social descent influences the conduct of the East Germans. The lack of flexibility and mobility in the former GDR has lead to a significant desire to work in the acquired profession until the age when one reaches retirement. Even if the circumstances — e.g. shut-down or bankruptcy of a company — force the individual to orientate him or herself anew, there can be no job guarantee. In general, the many attempts at retraining and further education during the first years of unification could not necessarily secure the person a job.

The process of economic and social restructuring of the East German society also initiated a tangible improvement of environmental conditions. The closure of chemical plants, reduced brown coal production and declining industrial and private consumption led to a strong decrease in environmental pollution. Controls in the former chemical triangle showed a high level of contaminated areas. Approximately 18% of the areas near chemical plants contained a high risk for the health of the inhabitants; 2300 of the areas proved to be less of a health risk. However, the necessary ecological measures were hardly different from those for the more hazardous areas. Only in 48% of the 3152 areas controlled, contamination of the soil was registered as

minor (Plassmann 1992 p. 79). Output of sulphur dioxide declined by 46% between 1989 and 1992, particularly because of the fall in the production and use of brown coal as a source of primary energy. This decrease in the emission of SO_2 was accompanied by only a slight decrease in the emission of carbon monoxide and nitrogen oxide. Mainly because of the increase in traffic density in East Germany, the emission of CO and NO_x fell only insignificantly by 4% (Horbach et al. 1994, p. 138). The process of economic and ecological transformation initiated in 1990 is marked by a series of counter--trends: the closure of production plants and the elimination of agricultural and industrial workplaces went hand in hand with a reduction in environmental pollution.

The changes in all aspects of life for the former East Germans influenced their demographic behaviour. One example of this is the rapid decline in the number of marriages. This is a result of the social and economic changes, but also of adaptation to West German behaviour. During the transformation phase of society, East German women prefer not to marry.

The introduction of the DM exerted pressure particularly on East German women, as for them, working out of the house was necessary and a part of their daily life even if this also caused disadvantages in their public and private lives. A large number of enterprises went bankrupt, and women especially were pushed out of their jobs. Recent publications by the German Federal Labour Administration indicate that around 1.2 million people in East Germany are without a job: 65% of those unemployed persons are women. This massive intervention in the labour market concerned all age-groups of women, as well as unmarried, married, divorced, single and re-married women.

A possibility to find work at least temporarily were job-creation measures (ABM), and advanced education or re-education courses offered when enterprises were shut down. Women as well as men used these opportunities. The political instruments to take the strain off the labour market were gender-specific. While ABM jobs were offered to men, women were in many cases ready to re-educate or further educate themselves. On average, 41% of the 288,100 employees at ABM jobs were female. Although the percentage of ABM jobs filled by women has increased by 5%, female ABM employees still represent a minority. The preference for women when ABM jobs were alloted cannot be seen as a result of the deliberate marginalization of women; it is instead due to the character of these jobs. Almost half of the ABM employees worked in the field of protection of the environment, in the improvement of the infrastructure and in the restoration of buildings. One did not expect women to do such physically demanding work.

In contrast to the ABM jobs, women dominated in further education and re-education. In 1992, almost 66% of the total number of persons in re-education were women. This development can be seen as an indicator of the unchanged necessity for women to continue working even under completely new circumstances. Patterns of behaviour, which had been lived and experienced before, were changed by the cut in the economic activity of

women, the experience of not being able to use qualifications as before, and the fact of having to orientate oneself anew on the labour market. Working below one's qualifications did not only mean earning less money, but also losing social prestige. Female skilled workers now became office assistants or secretaries, and fellow workers in medium or higher positions became office employees. Apprenticeships and diplomas from schools that did not exist anymore could even have a bad effect on one's career, as they were not always acknowledged, but instead represented a step back in one's further professional development. The social prestige of working women declined, but the majority of women still aimed at an adequate profession.

In this ambivalent situation of the isolation of working women and the unchanged requirement to continue working, women decided not to establish families. The pursuit of their jobs won priority in the list of individual wishes over the establishment of a family. There are studies proving the high importance of job and family for women, whereas the development of the past three years shows that during the present economic recession and the decline of social security — that is to say, the reduction of social efforts — the number of marriages has decreased dramatically. Most East German women renounced family-making for the right and the need to work outside the home. Women wanted to remain economically and socially independent — even under completely new circumstances.

The conduct of East German women in the process of transformation is marked by the multiple experiences they had absorbed in the years of the existence of the GDR, when motherhood and work had been combined. In addition to the fact that women are required to integrate or re-integrate themselves in the labour market in order to keep up their economic independence, their efforts are influenced by the continuing economic recession. The insecure living conditions will certainly mark the lives of East Germans during the next few years. As a consequence of the new orientation on the labour market, we can expect that young women and men will continue to put off marriage. Job security comes first. This requires the minimization of obligations outside economic activity. In times of economic recession, men and women give up their readiness to have a permanent partnership. Weighing the consequences and the risks, young East German women and men tend to consolidate their professional development and postpone marriage. The professional orientation with the purpose of at least halfway secure conditions of living and working, as well as the large number of East-West migrants of young age lets one expect that the rate of marriages will stay low.

THE DECLINE OF FAMILY FORMATION IN EAST GERMANY

Establishing a family in the GDR had followed pre-determined patterns, but at the same time it offered the possibility of change for a short or long

period of time without any substantial economic loss. During the past three years, this picture has changed fundamentally. The decision to establish a family in East Germany was influenced by the processes of family formation in the former FRG, as well as by old patterns of conduct which have not been substituted by new ones. The refusal by East German women to marry in times of growing social differences is no specific phenomenon of the process of change in the 1990s.

The GDR vanished from the world map within a couple of months, and the unification developments not only put an end to the centrally planned economy, but also sparked off a deep transformation crisis. A direct quantitative comparison shows that the decrease in marriages in East Germany since 1990 is much greater than during the years of the Weimar Republic, and it is not solely due to the social and economic situation. All studies depict a higher living standard for the majority of the East German population after unification. When asked whether they are satisfied with the new work and living conditions, people give answers similar to those given by "problem groups" in the West (i.e. unemployed, unmarried, older and lonely, and handicapped people). They are not entirely optimistic nor pessimistic. The uncertainties and risks involved in living with the new economic and social order, but also the new consumption and travel habits, along with a more individualist lifestyle, and also the adoption of West German divorce laws lets people postpone or abstain from marriage.

The number of marriages which took place in the last year of the GDR's existence is similar to that of 1932. It was 7.9 in 1932 and 7.1 per thousand in the GDR in 1989 (Marschalck 1984, p. 79). While the number of marriages decreased by 13.3% in the years of economic recession, the decrease in the five new Länder was much higher during the past three years: 63.2%. In 1992, the statistics of the new Länder registered three marriages per thousand inhabitants. This picture hardly changed in 1993. Compared to the previous year, the number of marriages increased by 2.5% to a total of 49,149. The rate dropped from 7.9 in 1985 to 3.1 per thousand in 1993.

In contrast to the decline in marriages in the eastern parts, the development in the old Länder was stable during the same time period. In the year of unification, there were more than 400,000 marriages, just as in the following years. Obviously, the economic development in 1990 and 1991 caused an increase in the number of marriages. However, marriage figures in East Germany are not only the result of the difficult transformation process, but also a sign of adaptation to western behaviour. The differences in the age of marriage between East and West were significant until 1989. That year, it was 25.7 years for West German women and 28.2 for men. Figures in the East were lower by 1.9 and 2.9 years, respectively. Periods of education and job training, and the years of establishing oneself were more prolonged in the West. Only after this process was completed was one possibly ready to have a family. The process was a lot shorter in the GDR, and it was easier to make use of the multiple privileges for families. Apartments were

alloted to families first, loans or tax concessions were given in a national economy with low wages. All this ended after unification (Figs 1 and 2).

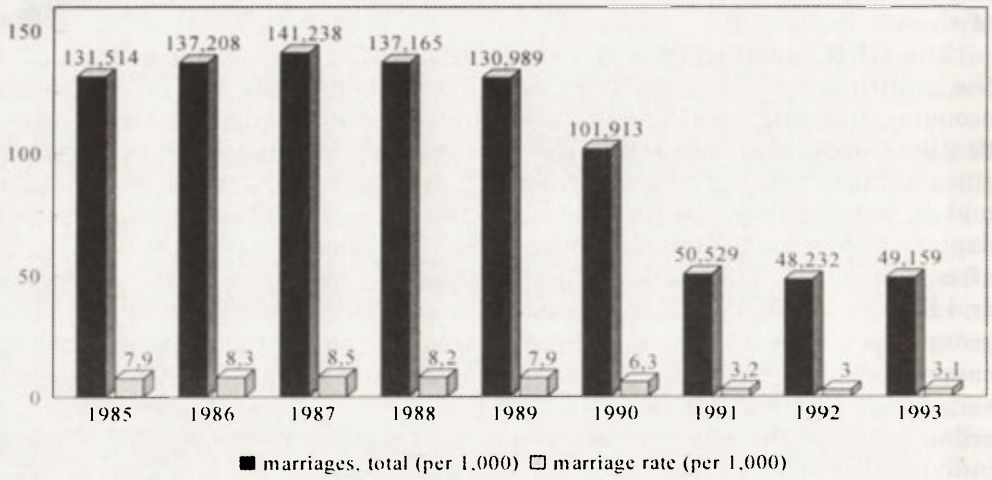

Fig. 1. Marriages in East Germany 1985-1993
Source: Zur wirtschaftlichen und sozialen Lage in den neuen Bundesländern, Sonderausgabe April 1993, Wiesbaden 1993, p.7, and Wirtschaft und Statistik 12/93

Fig. 2. Marriages in West Germany 1985-1993
Source: Zur wirtschaftlichen und sozialen Lage in den neuen Bundesländern, Sonderausgabe April 1993, Wiesbaden 1993, p.7, and Wirtschaft und Statistik 12/93

A DRASTIC DECLINE IN BIRTHS IN EAST GERMANY

So not only did the number of marriages decline significantly, but so did the number of births to a dramatic extent (Fig. 3).

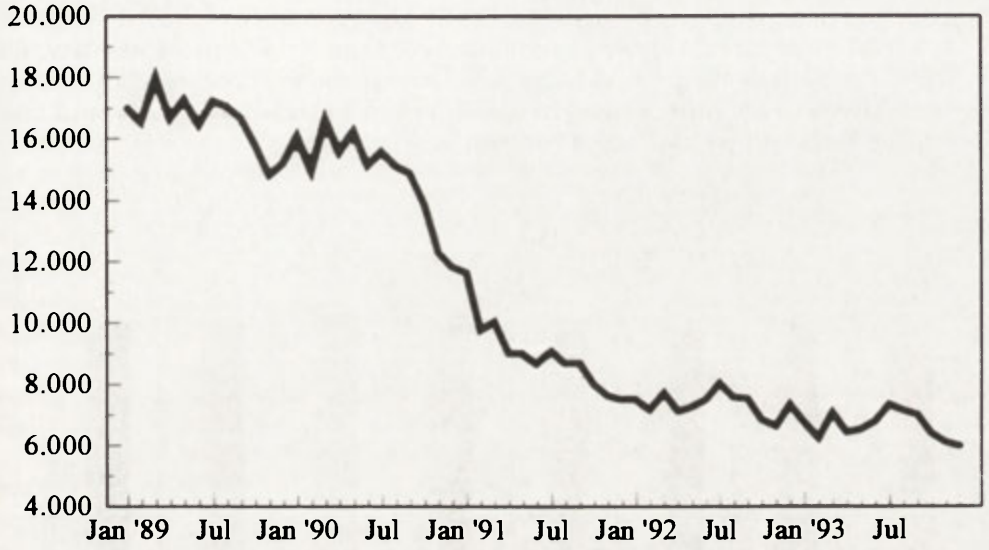

Fig. 3. Monthly development of the absolute number of births in East-Germany between January 1989 and December 1993
Source: Statistisches Bundesamt Wiesbaden

Indicators of the deep contemporary economic and social crisis are 1.1 million unemployed and the lowest rate of births in German history. Between 1989 and 1990, that is the downfall of the GDR and the establishment of the five new Lander, the birth rate decreased by 10.3%. This decline of births also continued in the following year, the first year of German unification. In 1990/91 the number of children born declined further. With a 40% decrease, the birth deficit was equal to a demographic crisis. This change of conduct is even supported by the age structure of the East German population. The years of low birth rates, caused, among others, by the law on induced abortion in 1972, were the reason for the decline in the number of people of marriageable age and, in consequence, also for the decline in the number of marriages and births. This trend of a decreasing birth rate continued in 1991/92. The number of births declined by 19.2%, and there was no hint of a change in 1993.

The transformation process after 1990 and adjustment to West German habits led to a demographic crisis. The development of periodic fertility during the last few years in East and West Germany is completely different. While the number of births sank by 50% in East Germany, the demographic situation became stable in the other part of the country. Between 1985 and 1990 the Total Fertility Rate in West Germany rose from 1.28 to 1.39. In

the last years of existence of the GDR the Total Fertility Rate declined from 1.73 to 1.57. After the unification between East and West Germany the Total Fertility Rate declined from 1.46 to 0.76 (Fig. 4). But these disparities will not determine the future development in Germany. The demographic upheaval in East Germany is usually seen to be short-term and transitional. There is consensus in viewing the deficit of births as a consequence of the break-down of all social structures, a great economic crisis, and the loss of identity, as well as of the system of values. A huge social and economic process of alteration began with German unification. It was marked by mental breaks and the search for new values and ways of conduct.

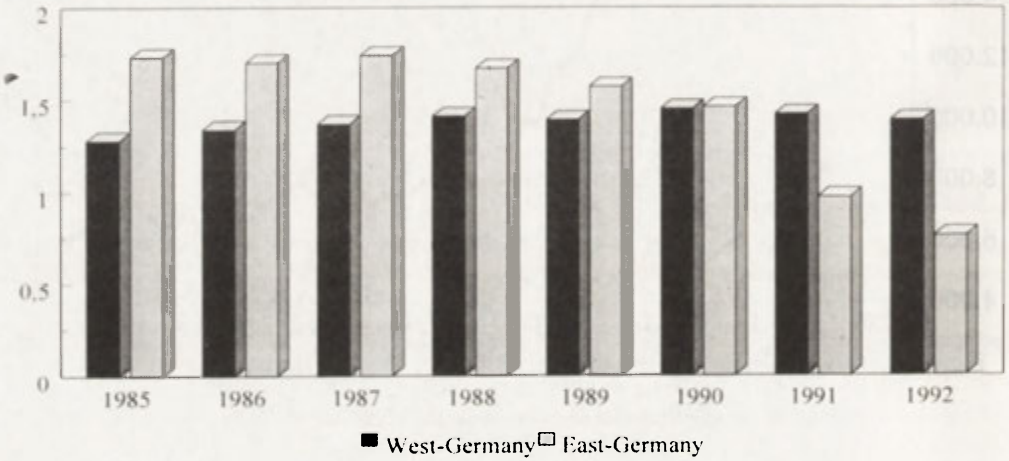

Fig. 4. Total Fertility Rates in East and West Germany 1985-1992
Source: Statistisches Bundesamt, Statistical Yearbooks of the GDR, own calculations

EMPLOYMENT RATE WANTED BY WOMEN VERSUS THE ACTUAL EMPLOYMENT RATE

To find explanations for the East German birth deficit, we should analyse the living circumstances of women with children which changed dramatically in the process of the transformation. The high rate of female occupation in the former GDR was economically necessary for increasing the family income, and it was wanted by women as a form of emancipation. The drastic reduction of the female workforce caused a radical change of conduct in other respects. The indicators are the decline of marriages and divorces, as well as the conscious and unconscious renunciation of having children in the face of the continuing economic and social crisis. Moreover, the institutional, legal, social and cultural changes caused an abrupt turnabout of behaviour among the East German population. The whole system of social-political measures and

of tremendous efforts to support working women and mothers in the former GDR were substituted over night by the political rules of the old FRG.

Women reacted to this change with a renunciation of old ways of conduct and with the search for the habits of West German women. The system of public assistance that made possible the combination of economic activity of women and motherhood was substituted by a system of self-help and self-organization of women. Women in East Germany felt deeply the loss of social regulations and financial help by the state that they were used to. More than before, they were confronted with new social conditions, with their working life which they did not want to interrupt voluntarily, and with the new demands on families and the upbringing of children. Even after the social upheavals in 1989 and 1990 the motivation to work and earn money still remained high for East German women. For them, economic activity with all the privations and the dual pressure of motherhood and job were natural. This normality was characterised by an underdeveloped system of services and a rarely mentioned but often practised attitude hostile to part-time work. But even with the manifold individual, domestic and social disadvantages a working mother had to accept, the majority of East German women did not see a reason to quit non-domestic economic activity.

Studies on working women in East Germany show the high level of social acceptance even in the period of basic economic and political change. In a study by the International Institute for Empirical Social Economy, the question whether economic activity for women is recommended is answered with "yes" by 95% of all persons asked in East Germany. In the face of this acceptance of working women and their multiple efforts to reintegrate themselves into the labour market, the decision to continue or start working again becomes especially interesting. The decision to have a first or further child is made by East German women dependent on their economic and social situation. On the basis of prognoses of the development of fertility we can expect an adaptation to the level of the old Länder in the long term. For the time being, however, East German fertility will remain far below that of West Germany.

A deep gap has arisen where the effort to arrange motherhood with work outside the home is concerned. Young women and men were confronted with a complete change in demands if they wished to continue or to begin their professional lives after the year 1989. They were influenced by the formal and practical emancipation of women that they had known. In the official understanding as well as in the individual reflection emancipation was a synonym for economic activity. Equality between men and women was needed because of the permanent lack of workers and, compared with other industrial countries, an extremely low productivity. For women, economic activity made economic and legal independence possible. Quite often, it had many disadvantages. Women had slightly shorter working hours than men, but this only underlined the traditional dual role as a working mother and housewife. Similar to this regulation, all other family-related and demographic measures

hit the women hardest. It seemed to be fairly important to combine female economic activity with the reproductive function of women. Emancipation was the compatibility of work and child-education and upbringing.

The differences between the sexes took on new forms after the implementation of the market economy. The formal equality of men and women and the adaptation of female patterns of life to the professional biography was substituted by a male-dominant labour market. The fields of female work possibilities decreased, especially in the private enterprise dealt with by the Treuhand, and also in agriculture, construction, mining and the energy sector. The labour market in East Germany developed into a field of segregation of female economic activity. Women who wanted to start or continue working had to familiarize themselves with the new demands concerning work intensity and new technical systems much faster than their male counterparts.

With unification, the possibility for East German women of combining work and motherhood have changed fundamentally. While a job on the one hand and children on the other had been taken for granted, a segregation of the two was initiated with German unification. It was especially women who were the victims of job cuts due to privatization and restoration of enterprises. The possibilities of finding a new job were very restricted for women with small children, above all. Employment offices report that it was much easier for young women without children to find a new job. The reintegration of women with small children is especially difficult. The desire of these women to continue working was often jeopardized by the personnel policies in companies, which preferred the employment of men and young, unmarried women without children. In the meantime, there is a preference for men even in the traditionally female workplaces in banks, postal services and transport. Women are becoming more and more discouraged. Apart from this, the rise in the price of child care has had a negative impact on the desire to work outside the home (Fig. 5).

Simultaneously with the ecological restructuring in East Germany, new possibilities opened up for women so that they could continue their professional lives, which most of them wanted to do. The high percentage of women among the unemployed was not only a consequence of discrimination against women in the job market. It was also caused by the nature of women's employment in the former GDR. Most workplaces for women were found in administration and trade, but also in industry, agriculture and forestry. It was precisely in these branches that production plants were closed from 1990 on. These workplaces were lost for good. In 1989, just before the political and economic breakdown of the GDR, 31% of industrial workers and 8.5% of those in agriculture and forestry were women (Winkler, 1990b: 66). When these sites were closed, the majority of the affected workers were women. The decisions to close certain production plants were rooted not only in market-economics, but also in environmental problems.

It is this group of unemployed women that constitutes an important potential pushing for environmental changes in East Germany. The ecological

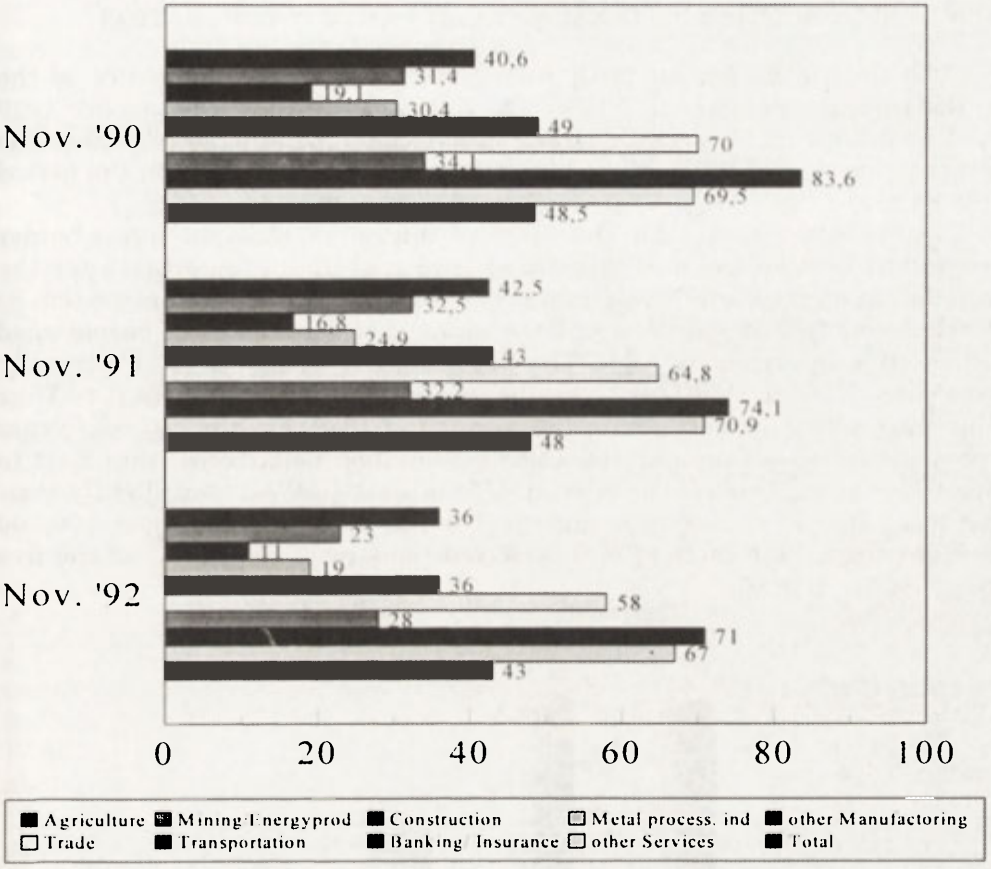

Fig. 5. Women's share of employees according to branches, %
Source: S. Schenk, U. Schlegel, 1993, Frauen in den neuen Bundeslandern-Zurück in eine andere Moderne, Berliner Journal fur Soziologie, 3, p. 375

reconstruction programmes in East Germany provide for restructuring of highly contaminated areas into nature reserves. Landscape gardening, caring for plants and trees, laying out and extending footpaths and conservation areas are, along with many other things, part of this materially and financially extensive programme. Unemployed women, with their long experience of work in agriculture and forestry, would be particularly suited for tackling the given job. This group of women should be given special attention in the environmental restructuring process with regard to the reduction of female unemployment.

DECLINE IN BIRTHS AND INNER-GERMAN EAST-WEST MIGRATION

The drastic decline in birth rates was not only a consequence of the transformation process after 1990. The fall of the Wall on 9 November 1989 and East-West mobility had a strong influence on the number of births. The average number of children per woman sank from 1.58 to 1.50 in the period 1989-1990.

At the same time, the character of migration changed (cross-border migration became internal migration), and with it its importance for the population structure of East Germany. The balance of internal migration in East Germany was negative and the number of departures of people aged 20 to 40 was extremely high. The population structure of East Germany was susceptible to modification by the internal migration from East to West Germany which increased after the summer of 1989. For the last four years the registration offices counted about one million departures from East to West Germany. This strong migration from East to West was slightly compensated by the reverse stream, the West-East migration. About 100,000 persons from the former FRG transferred their residence to one of the five new Lander (Fig. 6).

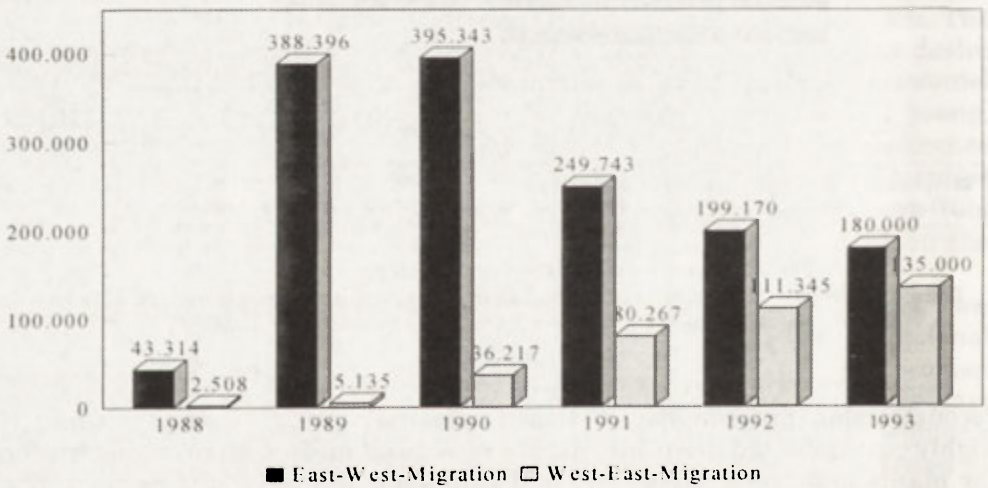

Fig. 6. Migration between East and West Germany
Source: Statistisches Bundesamt 1993

The absolute numbers of internal migration do not provide any information about the relationship between arrivals and departures. In the year 1989 the ratio was 247 departures from East Germany per single arrival from West Germany. As a result of German unification and the constitution of the five new Länder as well as the new structure of administration, the ratio of departures and arrivals in East Germany changed. In 1990 it was 14 departures from East Germany per single arrival from West Germany.

The East German balance of migration remained negative, whereas the proportion of departures and arrivals changed to 1.33:1 within the following three years.

Considering the age distribution, on the one hand we still find the particularity of the dominant East-West internal migration, and on the other hand a changing age structure of the East German population due to migration.

In 1989, 388,396 persons left the territory of the former GDR. That year East-West migration was mostly male. The same was the case in 1990. Not until 1991 was the proportion of men and women moving westwards in the age-group of 18 to 25 years similar. With 57.7%, persons aged 18 to 40 made up the biggest proportion of the East-West migrants. This tendency continued in 1990. The proportion of 18 to 40 year-olds was now at 63.8%. With 61.1% of the total number of East-West migrants, the proportion coming from this age-group was still dominant in 1991. In 1989 the age-group 18 to 25 still constituted 20.5% of the migrants to West Germany, and this number increased to 29% in 1990. The year 1991 was marked among other things by a further increase in the age-group 18 to 25 as a proportion of East-West migrants.

But the influence of East-West migration on the development of births must not be overrated. A mere 10% of the immense decline in births during the years from 1989 to 1993 can be attributed to it: 90% is caused by the great transformation problems already mentioned at length. Prognoses concerning the development of fertility in the eastern parts of the country indicate a less serious decline. East German behaviour ought to have adapted to West German by the first decade of the new century. Of course this will also be dependent on whether or not living conditions have approached one another by then. Diverse concepts to alleviate the transformation crisis and stop the decline in birth rates are being discussed.

OUTLOOK

From the present perspective, the point is to try and find ways to minimize deindustrialization in East Germany. It would constitute a first step if in future economic policy in the five new Lander were to give priority to restoring the production sites and coping with the ecological damage. This about-turn of economic policy from market economic privatization to restoring the productivity of the industrial and agricultural businesses would lead to a reduction of unemployment. The emphasis should be on the construction of regional industrial and service complexes rather than on the reconstruction of old capacities. Such a yet to be drafted economic policy would help restore the ecological balance of still existing production sites and would put an end to the hopelessness many East Germans feel. The number of people employed would rise again, were such a policy to be implemented in the five new Lander. The propensity of highly qualified East Germans to leave the former GDR in search of jobs in the West would noticeably decrease.

Finally, I would like to present such a concept which could help make job expectations and job opportunities more compatible. East German women would still like to take part in an active working life. This desire is also nourished by the rather high number of single-parent families due to the large amount of divorces (in 1989 there were 130,989 marriages and more than 50,000 divorces), the habit of East German women of working outside the home, larger consumption, and the rise in prices. In order to combine the desire to work with the role of a mother, new structures must be implemented on the job market. In these circumstances, part-time work in private companies as well as in administration are a real perspective. According to calculations by the Institute of Employment Research of the Federal Employment Services, 460,000 jobs could be created if the percentage of part-time jobs in East Germany was adapted to West German standards. These jobs would help reduce the large number of unemployed women in the East and provide them with social security. Apart from these measures, it would be necessary in order for them to combine work in and out of the home: for the many child-care facilities in the East to continue to be supported. Financial help from the government would be needed here. It would be very useful, since working parents do welcome the possibilities of child-care facilities.

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GEOGRAPHIA POLONICA 64, 1995

CHANGEMENTS RECENTS DES COMPORTEMENTS DEMOGRAPHIQUES ET RESIDENTIELS DANS LES AIRES INDUSTRIALISEES DE TOSCANE

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RESUME: La Toscane, région d'Italie centrale, est caractérisée, à l'exception de son chef-lieu, Florence, par des villes petites et moyennes. La région n'est pas homogène ni du point de vue des densités de population ni du point de vue économique. Il existe une dichotomie entre le nord et le sud ainsi qu'entre la côte et l'intérieur. Notre intention est de comparer la courbe de la présence industrielle avec les dernières variations démographiques afin de mettre en évidence d'éventuelles correspondances. Au cours de ces dernières années se vérifient en effet une corrélation qui n'est pas forcément étroite entre désindustrialisation et pertes démographiques, et une chute de l'importance industrielle et démographique de la bande côtière. Il résulte surtout que les villes s'approprient de plus en plus des fonctions directives et de service et créent ainsi un continuum rurbain.

MOTS-CLES: Toscane, fonction urbaine, comportement démographique, industrialisation, variations 1951/1991.

Dans l'ensemble du cadre géoéconomique italien, la Toscane peut être définie comme une région moyennement industrialisée dans laquelle les activités touristiques et agricoles ont toujours joué un rôle très important. Une bonne partie des revenus dérivent en effet des activités touristiques et annexes, et son image, là où l'intervention de l'homme a eu lieu, est le résultat d'un modelage à des fins touristiques et agricoles.

Région d'Italie centrale, la Toscane présente un réseau urbain important, caractérisé par de nombreuses villes petites et moyennes, à l'exception de Florence, ce qui lui vaut, depuis des siècles, de faire partie de "l'Italie urbaine".

Sa position géographique et ses paramètres socio-économiques font d'elle une région médiane à tous égards. Cela ne signifie pas toutefois que la région soit homogène. Il existe une forte différence entre le nord caractérisé par un net développement économique et une forte densité de population qui correspond au bas et moyen Valdarno (c'est dans l'ensemble l'aire qui se rapproche le plus de la réalité des régions septentrionales italiennes auxquelles elle est également soudé physiquement), et le sud qui se distingue

par une présence industrielle faible et sporadique et un paysage déterminé par une utilisation traditonnellement rurale du sol (dans cette partie méridionale, le phénomène urbain bien que fameux — par exemple Sienne — est un facteur épisodique et isolé). Ces caractères de la Toscane du sud présentent déjà des aspects typiques des régions centro-méridionales de la Péninsule.

En outre le développement relativement récent a provoqué ensuite une dichotomie ultérieure entre la bande côtière et l'intérieur des terres. En effet au cours de ce siècle, et de façon massive durant les quarante dernières années, la côte, surtout dans sa partie nord, s'est urbanisée, déterminant ainsi un continuum résidentiel qui de Livourne jusqu'à la frontière française présente une succession ininterrompue de ports, d'aires touristiques et plus génériquement d'aires urbanisées. Cette vocation "maritime" est nouvelle dans l'histoire de la Toscane qui, si l'on fait abstraction de la République maritime de Pise, a toujours été caractérisée par une certaine "continentalité".

La diffusion actuelle des activités industrielles se calque assez fidèlement sur la configuration urbaine. En fait, les villes toscanes ne peuvent pas être définies comme des villes industrielles. Aucune d'entre elles n'est vraiment marquée par les fonctions industrielles.

Le tissu industriel toscan est celui qui aux dires des économistes qualifie la "Troisième Italie", modèle intermédiaire entre l'Italie du nord-ouest fortement industrialisée et caractérisée par les grandes industries, reliées entre elles par des bassins industriels très consistants et diversifiés, et l'Italie du Mezzogiorno où les industries sont rares et regroupées dans des pôles localisés le long de la côte. La Toscane, au contraire, comme l'Emilie et la Vénétie possède une structure productive de petites industries essentiellement développées dans les secteurs traditionnels et quelques pôles industriels côtiers voués à l'industrie de base en relation avec les fonctions portuaires. Il en résulte une diffusion des aires industrielles particulièrement denses sur la moitié nord de la côte qui se prolonge dans le Valdarno jusqu'à Florence où viennent se greffer deux dérivations méridionales qui correspondent respectivement à la Vallée de l'Era et à la Vallée de l'Elsa.

Ce schéma traditionnel, dans sa forme générale, n'a presque pas connu de modifications au cours de ces dernières décennies si ce n'est celles que je m'apprête à signaler et qui peuvent indiquer de manière significative les évolutions de la tendance.

Il s'agit ici de comparer la courbe de la présence industrielle avec les dernières dynamiques démographiques afin de voir s'il existe une quelconque correspondance entre les deux processus.

Si l'on considère les variations de l'occupation industrielle entre 1981 et 1991 on observe que la distribution en pourcentage sur la région entière entre les différentes provinces reste en gros inchangée et confirme la prépondérance de la province de Florence.

En ce qui concerne le nombre des personnes employées dans l'industrie, on constate une nette diminution dans les neuf provinces toscanes qui revèle

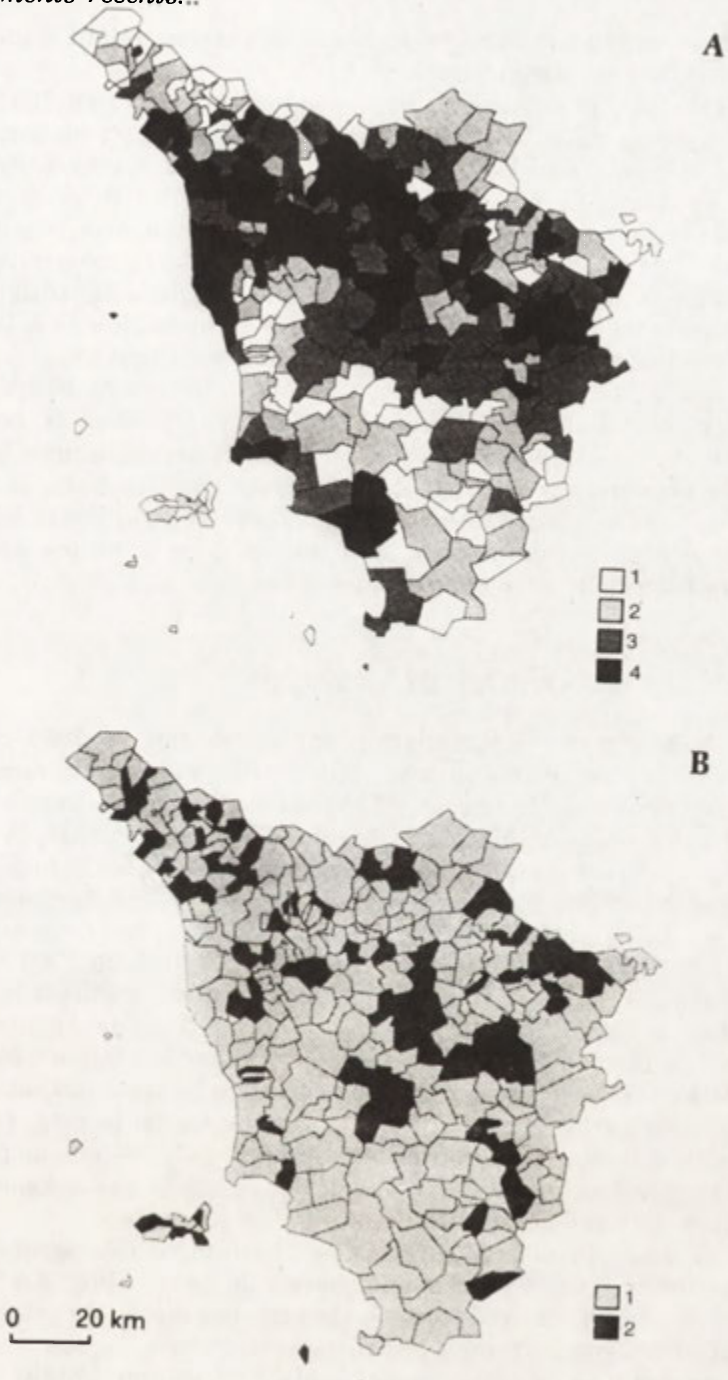

Fig. 1. Nombre d'employés dans l'industrie par commune en 1991
A — Valeurs absolues: 1 — moins de 163, 2 — 163-644, 3 — 644,1-1871, 4 — plus de 1871
B — Variations en pourcentage 1981/1991: 1 — en diminution, 2 — en augmentation

une désindustrialisation souterraine de la région correspondant à une diminution en parallèle des entreprises.

Si l'on observe la distribution du taux d'industrialisation en 1991 (pourcentage des employés dans le secteur industriel par rapport au total de la population) on constate que la présence des activités industrielles persiste dans tout le Valdarno et se renforce même le long des deux digitations méridionales de la Valdelsa et de la Valdera mais que, par contre, elle diminue considérablement le long du front maritime. L'évaluation des variations qui ont eu lieu dans la période 1981/1991 confirme que la zone côtière et la partie méridionale de la région déjà faiblement industrialisées à l'origine, connaissent les chutes les plus fortes dans ce secteur (Fig. 1).

L'analyse des valeurs absolues présente, que le moyen et bas Valdarno et la côte septentrionale continuent à prédominer même si ces aires connaissent une perte d'importance relative. En effet les communes toscanes qui en valeurs absolues, présentent une tendance positive dans la période allant de 1981 à 1991 sont peu nombreuses. Plusieurs d'entre elles se localisent dans la partie centro-méridionale de la région ou bien dans les Apennins: deux zones traditionnelle ment peu industrielles.

LA SITUATION DEMOGRAPHIQUE DE LA REGION

L'analyse de la densité de population par communes en 1991 confirme l'existence d'une Toscane dichotomique (Fig. 2). Elle montre clairement que les densités majeures se trouvent dans le Valdarno, le long de la côte septentrionale, au nord de Livourne, et par îlots dans la zone centrale, là où sont les centres urbains (par exemple Sienne). Les densités les plus faibles caracterisent la partie méridionale, à l'exclusion de la côte, et les Apennins.

Pour décrire la dynamique démographique de ces dernières années, il faut analyser, tout d'abord la croissance de la population en 1991 (Fig. 3).

Une nette diminution de la population atteint de manière diffuse la plupart des 289 communes de la Toscane: presque toutes celles des Apennins sont concernées par ce phénomène qui intéresse également la majeure partie des communes de la Toscane méridionale de l'intérieur mais aussi, et cela est un fait nouveau et parlant, de nombreuses communes de la côte. En outre, il est intéressant de relever que toutes les communes chefs-lieux de province, sauf Grosseto, voient diminuer leur population; c'est le cas notamment de Pise et Florence et dans des proportions considérables.

Sans aucun doute la nouveauté dans le mouvement démographique de ces dernières années porte sur l'effondrement de la natalité. En Toscane, durant les années 1970, presque toutes les communes ont eu un solde naturel négatif qui atteint dans certaines aires des valeurs très basses.

La direction des flux migratoires ainsi que leur volume absolu ont subi, au même moment, eux aussi, des changements importants. En fait, les soldes migratoires négatifs ne touchent pas uniquement les aires traditionnelles

d'émigration; ils concernent parfois même le coeur du système métropolitain. Pise, Livourne, Pistoia, Florence et les communes de sa première ceinture connaissent des valeurs négatives qui cumulées avec la décroissance naturelle conduisent à une diminution non négligeable de la population résidante.

En bref, avec la période 1981/1991, toutes les provinces toscanes (à l'exception d'Arezzo) connaissent un solde démographique négatif. Durant la décennie 1971/1981 tous les soldes s'étaient avérés positifs (sauf pour Sienne). Le seuil des années 1980 représente donc un fléchissement de la dynamique démographique régionale.

Les quatre cartogrammes (Fig.4) traduisent les variations de population pour chaque commune entre les différents recensements s'étalant sur les années 1951/1991. Au cours de la première période (1951/1961) les

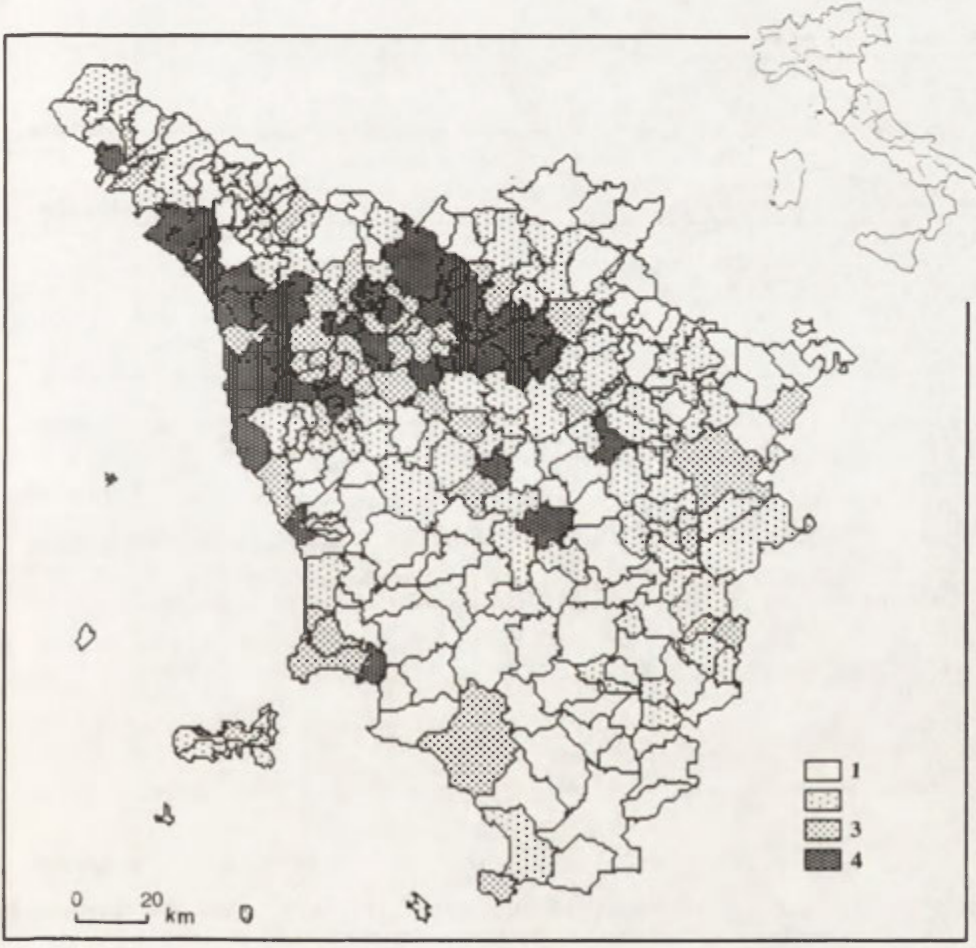

Fig. 2. Densité de population en Toscane (communes),1991
1 — Moins de 50 hab./km^2, 2 — 50-150 hab./km^2 , 3 — 150-300 , 4 — plus de 300 hab./km^2

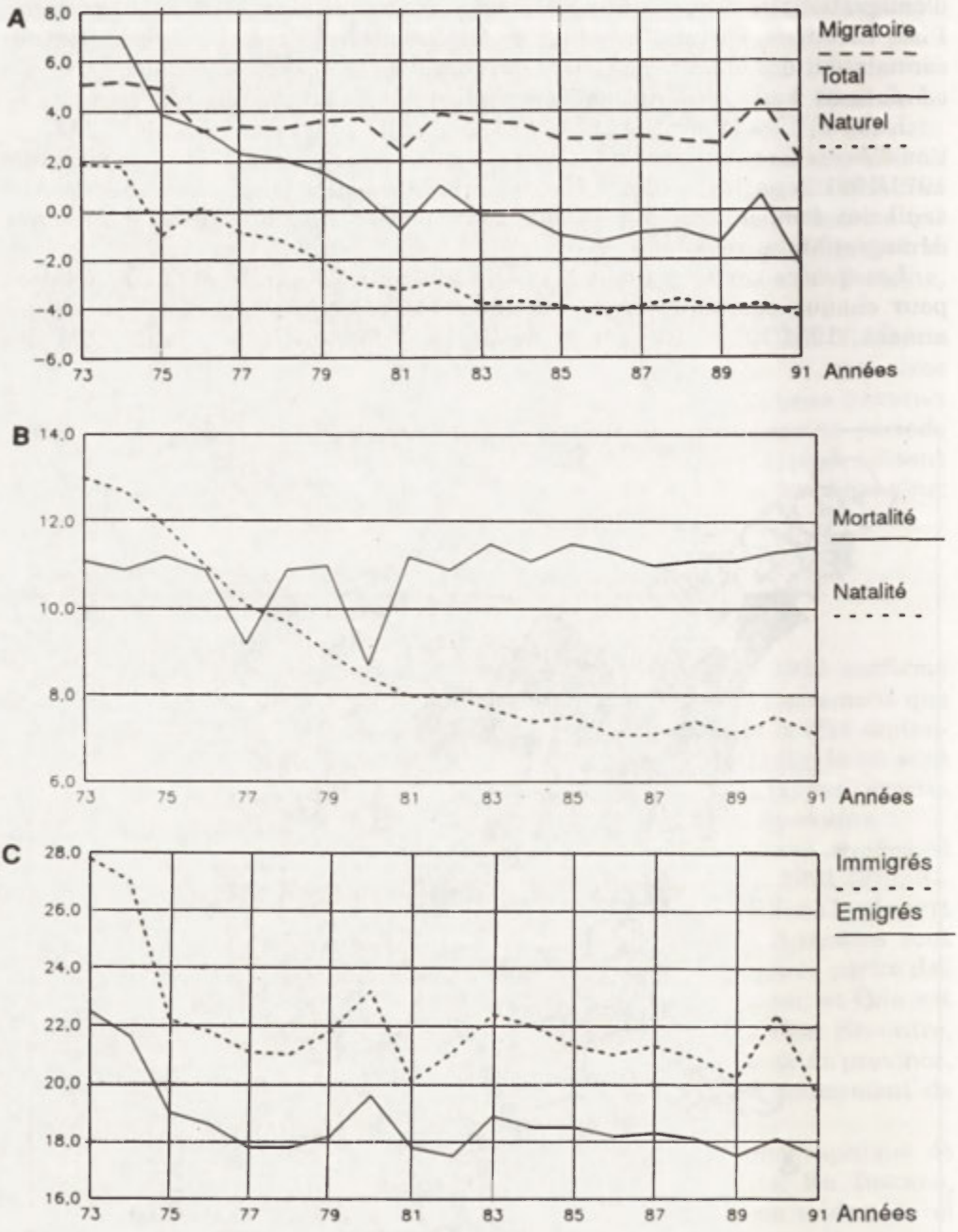

Fig. 3. A — Quotients d'accroissement naturel, migratoire et total en Toscane, B — Quotients de natalité et mortalité en Toscane, C — Immigrés et émigrés (pour 1000 hab.) en Toscane

Fig. 4. Population résidente dans les communes toscanes. Variations entre les recensements 1951-1991 (en %)
A — 1951/1961 , B — 1961/1971, C — 1971/1981, D — 1981/1991;
1 — moins de -10.0, 2 — -10.0- 0.0, 3 — 0.1-10.0, 4 — 10.1 et plus

accroissements démographiques sont nettement limités aux communes côtières et au Valdarno. Les valeurs les plus élevées sont presque toujours relatives aux villes moyennes et/ou petites. Dans la deuxième tranche (1961/1971) les aires d'augmentation de la population ne changent pas, mais on constate une atténuation générale du processus de concentration. Dans la décennie successive (1971/1981) la dichotomie du comportement démographique régional s'atténue beaucoup; seule Grosseto, parmi les chefs-lieux de province, présente des augmentations relatives au quartile supérieur. Il faut ajouter que les pourcentages les plus élevés d'accroissement se localisent souvent dans les communes de la première ceinture des villes moyennes, mais à Florence ils gagnent déjà la seconde ceinture. La dernière période (1981/1991) présente un univers de données beaucoup plus homogènes. Les communes qui croissent sont encore pour la plupart localisées dans le Valdarno, mais la côte semble avoir perdu son pouvoir d'attraction: il est vrai cependant que plusieurs communes de l'arrière-côte sont en phase de croissance. Les communes de première ceinture des centres urbains moyens augmentent presque toutes. A Florence, la seconde ceinture est déjà concernée par cette nouvelle vague. On assiste en outre à une chute démographique parfois dans des proportions considérables, dans toutes les villes moyennes. Cela dénote un processus évident de périurbanisation.

En général l'opposition démographique entre une Toscane forte, et une Toscane faible s'atténue dans le passage d'une période à l'autre, allant presque jusqu'à disparaître dans les dernières années.

Si l'on considère les données relatives aux revenus agricoles (données de 1986), elles mettent en evidence (dans le secteur agricole) que les communes les mieux dotées (on s'est basé pour établir le seuil de discrimination sur la valeur d'un revenu supérieur à 3 millions de lires par ha de SAU) se trouvent encore une fois dans le moyen et bas Valdarno, le long de la côte thyrrénienne, dans la Vallée de l'Elsa: c'est-à-dire dans les aires les plus industrialisées et urbanisées. Ces communes coincident avec les territoires où les cultures maraîchères, floricoles et viticoles sont les plus importantes.

Cette correspondance entre industrialisation et agriculture riche n'a rien de surprenant et n'est pas particulière à la Toscane. Nous avons de nombreux exemples de cette alliance. En Italie, la Lombardie est à la fois la région industrielle la plus importante et l'une des trois premières régions agricoles du pays. L'importance des processus de synergie à l'intérieur des aires développées n'est pas à nègliger.

Pour conclure, il existe une corrélation entre les dynamiques démographiques régionales et les vicissitudes des structures industrielles. Durant les dix années 1981/1991 la population a baissé de -2%, les actifs dans l'industrie de -16% (Fig. 5).

On observe donc qu'à une importante désindustrialisation, répond une chute démographique globale minimale.

L'analyse détaillée par aires, montre néanmoins qu'aux zones les plus marquées par une forte désindustrialisation correspondent celles qui ont les plus grosses pertes démographiques.

La bande côtière constitue un cas à part. Les pertes démographiques et la diminution des activités industrielles s'y produisent en des termes comparables. Cela peut s'expliquer par au moins deux causes concomitantes. La baisse de population se joint à une désindustrialisation mais aussi à un phénomène de congestion des espaces et à une compétiton sauvage pour l'utilisation du sol. Ce n'est pas par hasard que les communes de l'arrière-côte sont presque toujours en croissance démographique.

Il faut souligner que la croissance par vagues des communes de ceinture reproduit les étapes d'éloignement des localisations industrielles à l'égard des centres des aires métropolitaines.

Les villes s'approprient de plus en plus des fonctions directives et des services; le fait urbain tout comme le fait industriel se diffuse dans la campagne. Aujourd'hui le Valdarno et la Côte, bien que suivant des dynamiques

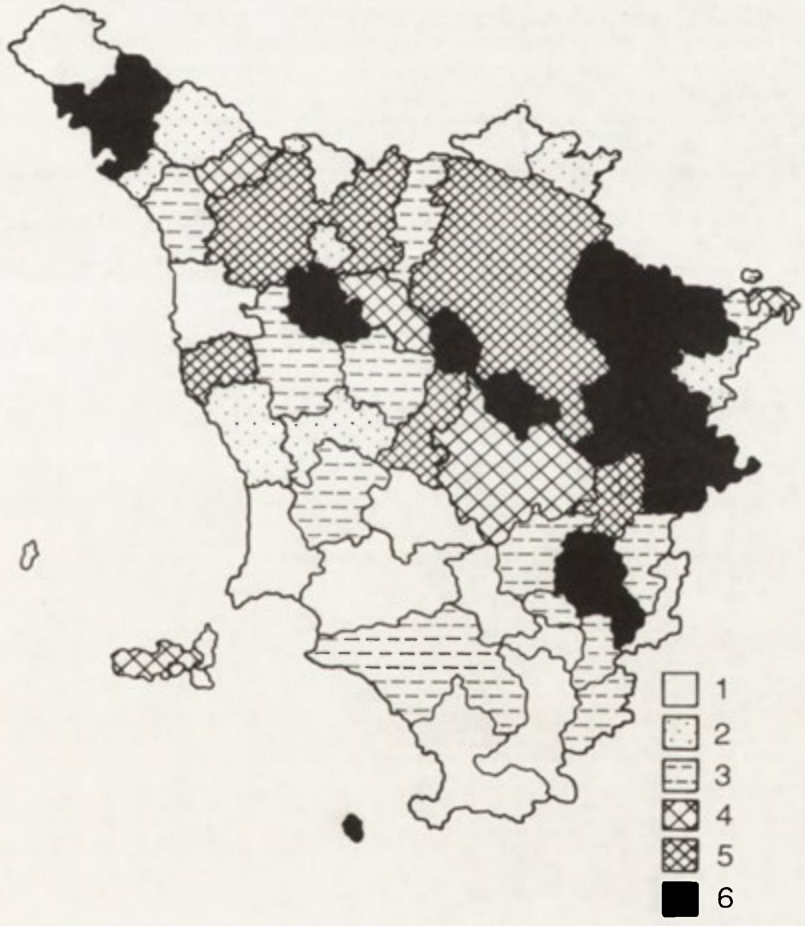

Fig. 5 .Employés dans l'industrie par cantons. Variations entre 1981/1991 (en%)
Valeur moyenne régionale: -16,2%

différentes, sont un continuum d'implantations résidentielles et de petites et moyennes industries qui brouille et annule les distinctions traditionnelles entre ville et campagne. Dans cet ample territoire rurbain les villes historiques se détachent et assument le rôle énergique de C.B.D. naissants. Florence peut, si l'on force un peu le trait, être considérée comme telle.

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CHANGING SETTLEMENT PATTERNS IN NORTH-EAST ESTONIA — A REGION OF POLLUTED ENVIRONMENT AND POLITICAL CONFLICTS

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ABSTRACT: This paper deals with North-East Estonia as the only urban agglomeration in the Baltic states that sprang up on the basis of mining industry. The focus is on three aspects: the phases of development that this relatively young industrial area has evolved through so far; how the mobility of the population and its composition have changed in the complicated political situation of the region; how industrialization has affected the environment and to what extent the local population is aware of it. Three trends — industrialization, urbanization and mobility of the population lie at the root of the peculiarities of the social environment.

KEY WORDS: Population, environment, agglomeration, oil-shale.

INTRODUCTION

Urban agglomerations that have sprung up on the base of mining industry are characteristic of most industrial countries. They are specific forms of settlement, whose origins and development demonstrate certain regularities. Depending on the stage of development and the economic potential of the country concerned, including the peculiarities of the mineral resource that is mined, the industrial agglomerations differ in their size, as well as in their territorial pattern and structure by branch. Also they show marked variety in age.

Regardless of these differences, the development of the industrial agglomerations demonstrates a number of similar regularities that are remarkably analogous to the widely discussed theories of cities and the product life-cycle:

(1) A rapid, sometimes even a stormy *initial stage* (a real take-off), caused by the youth and extensive growth of the mining industry. The result is simultaneous formation of numerous new urban centres;

(2) *Period of maturity* with emphasis on development towards greater variety in the processing industry. The urban settlements begin to differentiate, some grow faster than others, some retain their initial size;

(3) *Period of stagnation*: the main branch of the mining industry and

the related processing industry have reached the phase of maturity and eventually degeneration. The growth of towns slows down. This is especially true of towns where the mining industry plays a significant role;

(4) *Period of reconstruction and revival*, when the old exhausted branches are replaced by new ones, but at the expense of industry, there also occurs simultaneous expansion of the tertiary and the informatics sector. This period coincides with the general trend towards deindustrialization.

Each of these periods has its own problems of growth and reconstruction in the development of a settlement. One problem which is characteristic of all periods is environmental pollution and ways of avoiding it. But often it is the social milieu of the industrial areas that causes problems. Both in the periods of the initial growth, and in the period of stagnation there is an influx of immigrants, people who differ from each other and from the local inhabitants owing to their different provenance and cultural background. This may give rise to ethnic and social conflicts.

This paper deals with the development of the North-East Estonian industrial area, the only urban agglomeration in the post-socialist Baltic states that sprang up on the basis of the mining industry. The aim is to describe briefly:

— what are the phases of development that this relatively young industrial area, which was predominantly formed during the Soviet period, has traversed so far, and how does this development fit in the settlement and population development pattern of the older industrial areas;

— how have the mobility of the population and its ethnic, age and social composition changed, as seen against the background of the complicated political development of the region;

— how has industrialization affected the natural environment, and to what extent has the local population realize this and is able to cope with it.

In preparing this paper, data from the Statistical Office of Estonia (SOE) and the Virumaa Information System (VIS) were used. VIS databases (Meiner et al. 1990) were interfaced with different modules of Idrisi 4.1 by self-made programmes. HG was also used.

STAGES OF INDUSTRIAL DEVELOPMENT AND URBANIZATION

The area under investigation is the North-Eastern corner of Estonia, administratively the northern half of the Ida-Viru county, covering 2500 km^2. The terrain is basically the West-East-oriented North-East Estonian flatland, that borders the Gulf of Finland in the North and merges with the wooded and swampy Alutaguse lowland in the South. The latter borders the Northern shore of Lake Peipsi (Fig. 1).

The prerequisites to the industrial development of North-East Estonia are its local natural resources and its geographical situation. This area

possesses a substantial part of Estonia's mineral resources: over 90% of the minable oil-shale resources, a great quantity of turf, limestone and clay. The basement also contains phosphorite and radioactive compounds (uranium and molybdenum in the Dictyonema Shale (Althausen 1992; On Estonian Dictyonema Shales 1992), the mining and utility of which is still regarded as impossible due to unresolved environmental problems. In addition to the mineral resources, there are rich supplies of timber and fish, and in the past the falls of the Narva river also served as a source of power.

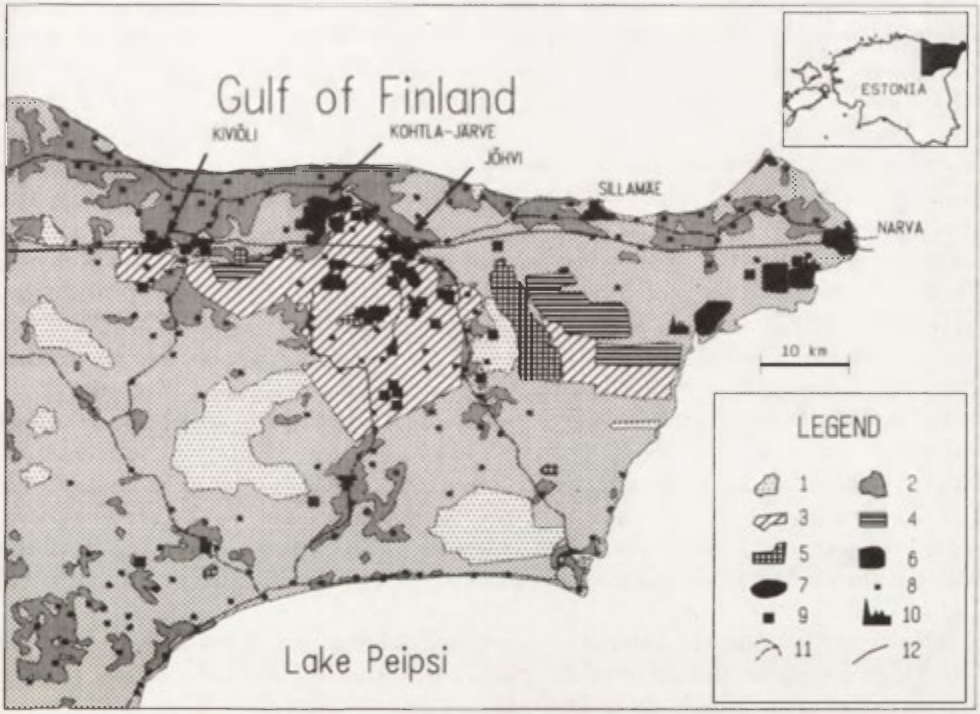

Fig. 1. Human impact in North-East Estonia
1 — nature reserve areas, 2 — arable land, 3 — land separated for oil-shale mining, 4 — oil-shale quarries, 5 — peat fields and peat deposits, 6 — ash plateaus of thermal power plants, 7 — urban places, 8 — rural settlements, 9 — other impact points: factories of chemicals and building materials, sand and gravel quarries, waste dumps, dirt or coke-ash heaps, collapsed surfaces etc., 10 — two biggest thermal power plants (the Baltic TPP and the Estonian TPP), 11 — main roads, 12 — the Tallinn-St.Petersburg railway

North-East Estonia lies on the traffic route connecting two large centres — Tallinn and St. Petersburg, and the proximity of both centres has stimulated the development of industry. As for the influence of St. Petersburg, it has been dependent on the status of Estonia dwindling in the years of Estonia's independence and prevailing when Estonia was part of the Russian Empire or the Soviet Union.

The initial period of the formation of the North-East industrial area can be divided into two stages. The first stage covered the last quarter of the 19th century and the beginning of the 20th century until the end of World War I, when Estonia was governed by Tsarist Russia. During that period only one powerful industrial centre emerged in North-East Estonia; Narva with its suburbs (1916: 45,000 people). Narva became a manufacturing, mainly textile centre (14,800 workers in 1913), first and foremost owing to its location on the traffic routes from West to East. The local resources, apart from labour power, played an insignificant role in its development.

The second stage in the development of North-East Estonia's industry was the period of the independent Republic of Estonia (1918-1940). In those years two opposite trends made themselves felt. On the one hand, the severing of the ties with the Russian market caused a marked decrease in manufacturing in Narva. By 1939 the number of industrial workers diminished threefold, the number of inhabitants of the town had fallen by half. On the other hand, foundations were laid for a new branch of large-scale industry, the oil-shale industry — mining and oil refineries — which contrary to earlier manufacture in Narva was oriented towards Estonia's internal market and Western European market (oil export). Three-fifths of the oil-shale industry belonged to foreign firms. Although the total output of the oil-shale industry was small, the second half of the 1930s can be regarded as the beginning of an extensive take-off in the industrial area of North-East Estonia.

In the years mentioned above there were functioning 8 oil-shale mines and 4 refineries, on the basis of which had risen 5 new industrial settlements, with a total of 11,000 inhabitants. The rapid development of industry also accelerated the growth of Jõhvi as its administrative and commercial centre, which was granted the rights of a town in 1938. Thus the contours of the future industrial agglomeration were taking shape. Still there prevailed rural population and settlements in Ida-Viru county.

The incorporation of Estonia into the Soviet Union by force and World War II, interrupted what may be called the small-scale take-off in the industrial region of North-East Estonia.

After the war the period of extensive development continued in the conditions of the centralized Soviet planned economy, and on a larger scale, characteristic of the great power, because St. Petersburg's (then Leningrad) region needed electric power and gas. This caused an enormous rise in the growth rate of oil-shale mining and the accompanying industries (oil refineries, artificial gas, electricity production, and production of building materials) — Figs 2-4.

In the Soviet period the development of the North-East Estonian industry can broadly be divided into the following stages:

1945-1955: rapid restoration and extension of the oil-shale industry, power engineering and cotton manufacture in Narva. The two former branches centred first and foremost in the region of Kohtla-Järve and Jõhvi, where the geological conditions for mining were most favourable. At Sillamäe a secret factory producing uranium concentrate was created;

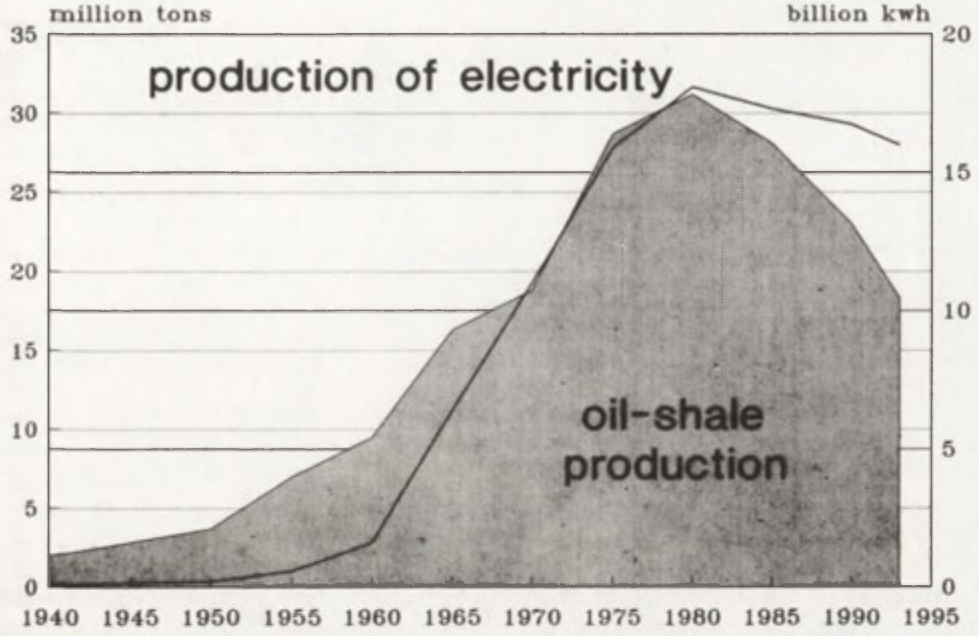

Fig. 2. Production of oil-shale and electricity in North-East Estonia, 1940-1993
Source: Data from Tepp (1990b) and VIS

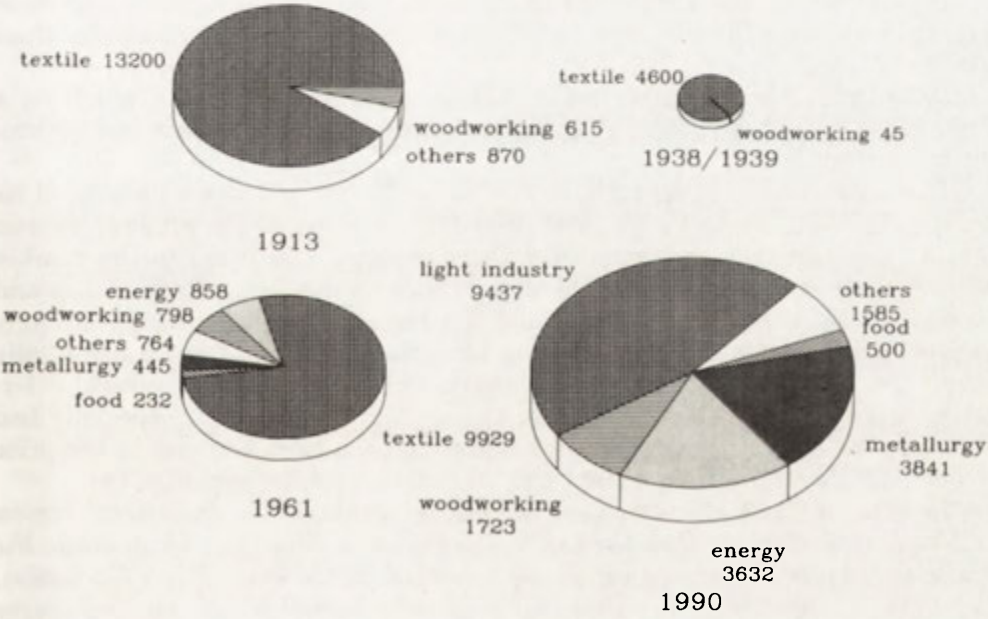

Fig. 3. Industrial structure of Narva in 1913 — 1990: number of employees by branches of industry

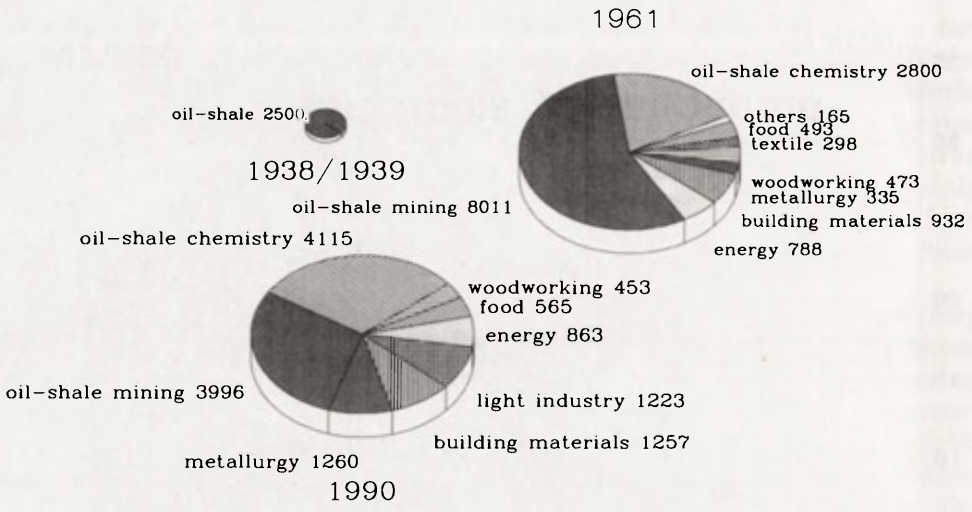

Fig. 4. Industrial structure of Kohtla-Jarve in 1938/1939 — 1990: number of employees by branches of industry

1955-1970: continuation of the fast extensive development, with special emphasis on power engineering (two large power stations near Narva) and on the manufacture of building materials. Oil shale mining also expanded eastward, nearer to the power station, and also southward from Kohtla-Jarve;

1970-1980: period of maturity in oil shale chemistry and power engineering; medium growth rate, more at the expense of labour productivity than new enterprises;

1980-1990: period of stagnation, which is expressed not so much as a decrease of output, but through the deterioration of the economic and technological indices.

The separation of Estonia from the Soviet Union and the regaining of its independence put the industry of North-East Estonia and of the whole of Estonia into a fundamentally new situation: there began a transition to the market economy, which involved a radical change both in the form of ownership and economic ties. The difficulties of transition have been felt especially strongly in North-East Estonia, whose leading branches of industry were essentially oriented to the Soviet market. Output has decreased dramatically, several enterprises have gone bankrupt and have closed. Things are in an especially bad shape in the building materials and cotton industry, and the rise in the price of oil-shale threatens to bankrupt the oil-shale chemistry factories too.

To sum up: *it is characteristic of the formation of the industrial region of North-East Estonia that the take-off period was relatively long, while the periods of maturity and stagnation were short. As to the stage of reconstruction, the industry of North-East Estonia has only launched it. The necessary reconstruction has been complicated by the general economic slump, which in the case of North-East Estonia might even be called an economic shock.*

All the factors described above are directly reflected in the settlement and population dynamics of North-East Estonia. Table 1 shows that the growth rate of the towns is directly dependent on the growth rate in industry. In the years 1945-1959 the growth rate was highest in settlements based on oil-shale industry, first and foremost in the Kohtla-Jarve agglomeration, later the growth was accelerated in Narva and Sillamae.

TABLE 1. Dynamics of the urban population in the North-East Estonia

Urban settlements	Population (in thousand)						
	1947	1952	1959	1970	1980	1991	1994
Narrowly specialized oil-shale centres[1]	4.0	9.8	12.2	13.7	13.0	11.4	10.4
Kohtla-Jarve — oil-shale and manufacturing centre[2]	8.9	50.6	57.0	68.3	70.2	76.2	72.3
Manufacturing centres[3]	–	23.3	39.4	75.5	96.0	117.4	105.2
including Narva	7.2	15.5	27.6	57.7	73.5	89.9	79.0
Total	20.6	83.7	108.6	157.5	182.2	198.0	187.9

[1] Kivioli, Viivikonna;
[2] Kohtla-Jarve is actually an agglomeration of 7 urban settlements, which were administratively one joint town in 1960-1989. Now it is divided into 3 administrative units: Kohtla-Jarve, Johvi and Kohtla-Nomme;
[3] Narva with Narva-Joesuu, Sillamae, Pussi.
Source: ESO data and Lugus, Vartia (1993).

Industry was given priority over all the other branches of the economy in the Soviet Union, this is why large capital investments were also made for housing construction in industrial regions. This holds true for towns in North-East Estonia, which surpassed the other larger Estonian towns as far as the relative supply of living space (m^2 per head) and the level of wealth were concerned. At Kohtla-Jarve, Narva and Sillamae 95-98% of the area of living-rooms are provided with central heating, bathroom or shower; in Tallinn, the capital, and the second large town, Tartu, the corresponding figures are 75 and 77 (*Elamu-ja...* 1992).

Irretrievable changes have taken place also in rural settlement of North-East Estonia. These changes are partly concerned with the official policy of the Soviet system to concentrate housing construction and the production units into central settlements of collective and state farms. But in the given region the restructuring of rural settlement has been severely affected by mining and towns, too. On the one hand, this influence has had a concentrating effect on the population: formation of several industrial townships and growth of population in the adjoining villages, where there are situated various institutions "evacuated" from towns. On the other hand, industry has also played the role of an extruder of rural settlement: several villages in the mining area have partly or fully been stamped out. Apart from that, life in some villages died out just because their menfolk went to work in the mines.

To sum up, alongside the general decrease in the numbers of rural population in the rural settlements of North-East Estonia there has been a marked concentration (Figs 5 and 6).

The population and economic activities have concentrated (or been preserved) in the rural local centres and industrial townships (Fig. 7, level

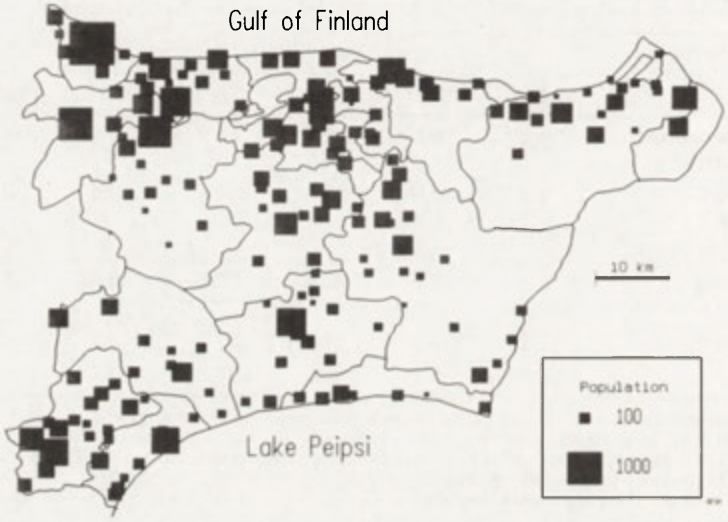

Fig. 5. Number of population in the rural settlements of North-East Estonia in 1959
Borders of current parishes are depicted

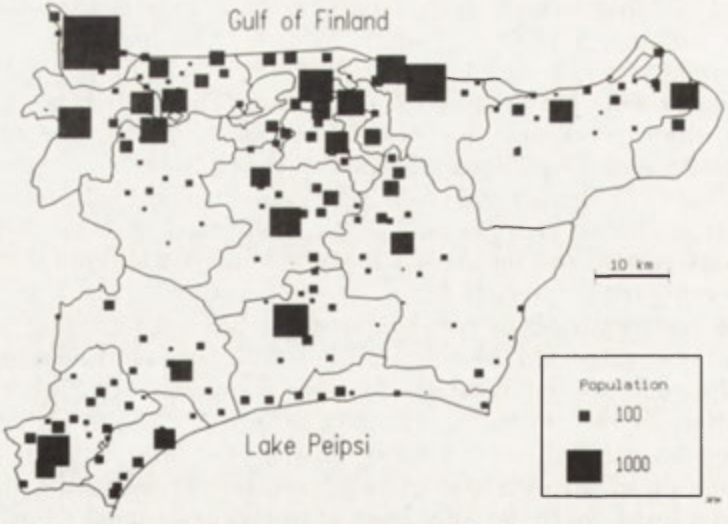

Fig. 6. Population in the rural settlements of North-East Estonia in 1992

5 and 4) and the large farm centres (level 3). As for the other villages, they mostly deal with agriculture and forestry (level 2), or are just residential villages without any dominant activities (level 1) and have retained less than half of their population.

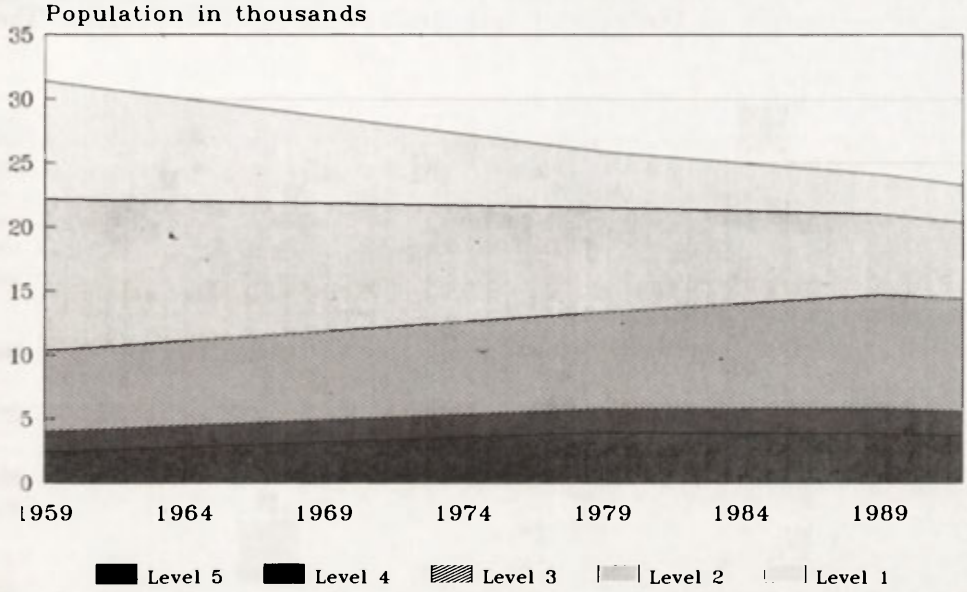

Fig. 7. Dynamics of rural population in North-East Estonia in the settlements of different levels 1 — residential villages without any dominant activities, 2 — villages dealing with agriculture and forestry, 3 — centres of the large farms, 4 — industrial townships, 5 — rural local centres

At the same time, the number of the cores of concentration has decreased. For instance, in 1959-1970, in the industrial northern part of Ida-Viru county the population numbers showed growth in 26 rural settlements; in 1970-1992 the number of growing rural settlements was reduced by half (Figs 8 and 9). Quite a number of the settlements under discussion are but formally rural settlements, in fact they are small urban places. Considering the present slump in industry it is probable that in the near future they will be losing part of their population.

CHANGING PATTERNS OF POPULATION MOBILITY

The political events and the uneven rhythm of its economic development have caused abrupt changes also in the spatial mobility of the population in North-East Estonia, both in its directions and volume. All this is reflected in the ethnic, age and social composition of the region's population. In the formation of the present population in North-East Estonia, two in-migration waves have played a decisive role, starting the process of repopulation in the region.

The first wave took place between 1945 and 1949 when, according to approximate counts (no exact statistics are available), the number of in-migrants exceeded that of out-migrants by something like 35,000 people. More than half of them settled down to work in the oil-shale mining and processing centres in the central and western parts of the region. The

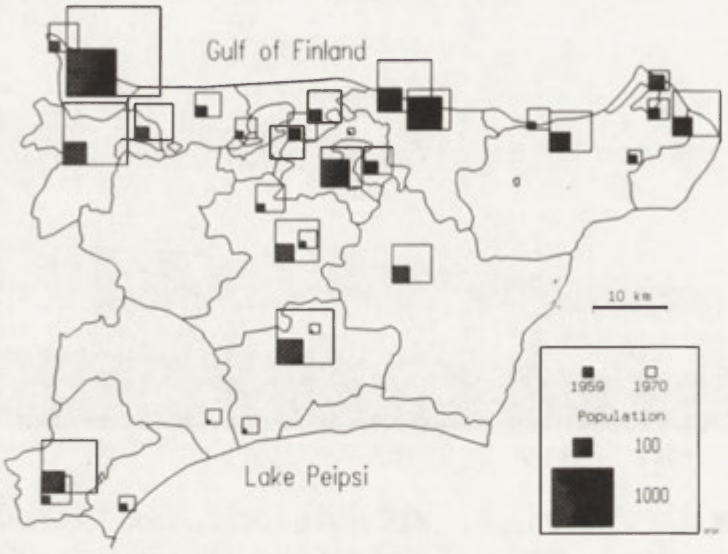

Fig. 8. The growing rural settlements of North-East Estonia in 1959 -1970

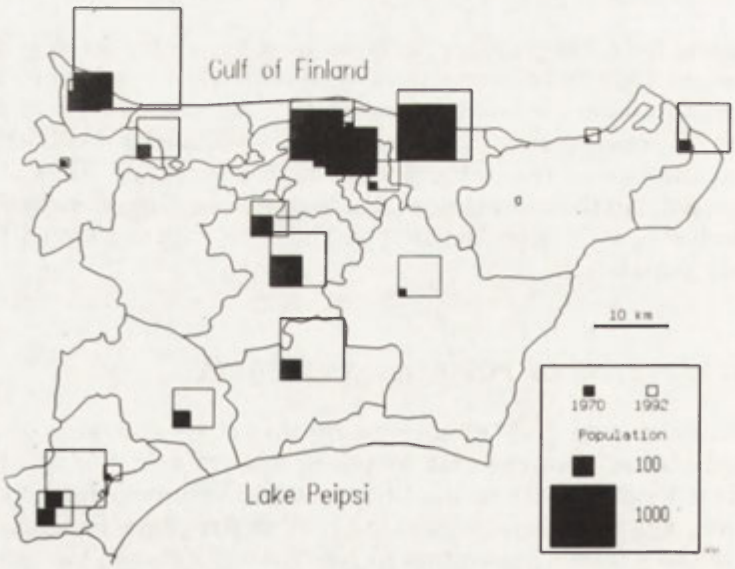

Fig. 9. The growing rural settlements of North-East Estonia in 1970 -1992

significance of this wave of migration for the formation of the basic, relatively immobile core of North-East Estonia's population is illustrated in Table 2.

TABLE 2. Percentage of locally born population by ethnic groups in 1989

	Locally-born people			People who have lived in this place since 1950 or earlier[1]		
	Total	Estonians	non Estonians	Total	Estonians	non Estonians
Total Estonia including:	37.6	43.6	28.1	45.7	51.4	36.5
— urban places	35.8	42.3	28.9	45.0	52.1	37.6
— rural areas	42.2	45.4	19.9	47.5	50.5	26.4
Ida-Viru county including:	38.9	56.1	35.0	48.7	67.4	44.4
— urban places	38.5	58.7	35.5	48.6	72.0	45.1
Narva	34.8	44.0	34.4	43.0	54.6	42.6
Kohtla-Jarve	44.5	64.3	39.3	56.7	78.5	50.9
Sillamae	31.0	43.3	30.5	40.9	48.2	40.6
Kivioli	43.5	55.0	35.7	54.9	69.8	44.8
— rural areas	42.5	51.7	26.1	49.4	59.8	30.9

[1] Among them locally-born people. Source: Tepp 1990a.

The second wave of in-migration came in the middle of the 1960s, bringing newcomers mainly to Narva, where large power stations were being built. Also during the following decades, when in-migration was gradually diminishing, the bulk of the migrants went to the towns of the eastern part of the region, to Narva and Sillamäe. In 1956-1969 Narva gained 27,200 migrants, that is 83% of the total urban net migration for this region. As the industry of the region reached the stages of maturity and stagnation the migration turnover and net migration diminished (Table 3). The natural gain followed the intensity curve of in-migration, falling as the influx of young people diminished and the average age of the standing population rose. In 1959-1963 the annual average natural growth rate was remarkably high in towns of North-East Estonia: 15.5 per 1000 people; in 1979-1983 it was 5.4, but at present it is in deficit. The proportion of pensioners (age of retirement being 60 for men, 55 for women) has increased: in 1959 only 8.4% of the urban population was of this age, in 1979 12.9, and in 1989 19.1.

During the whole Soviet period the in-migration from the other regions of the Soviet Union predominated. At the same time the North-East lost migrants to other parts of Estonia. Among the leavers were a disproportionate number of Estonians, especially young local-born people. The result of such a migration scheme was that the absolute number and the share of the Estonians was constantly decreasing and that of the non-Estonians kept increasing (Figs 10-13).

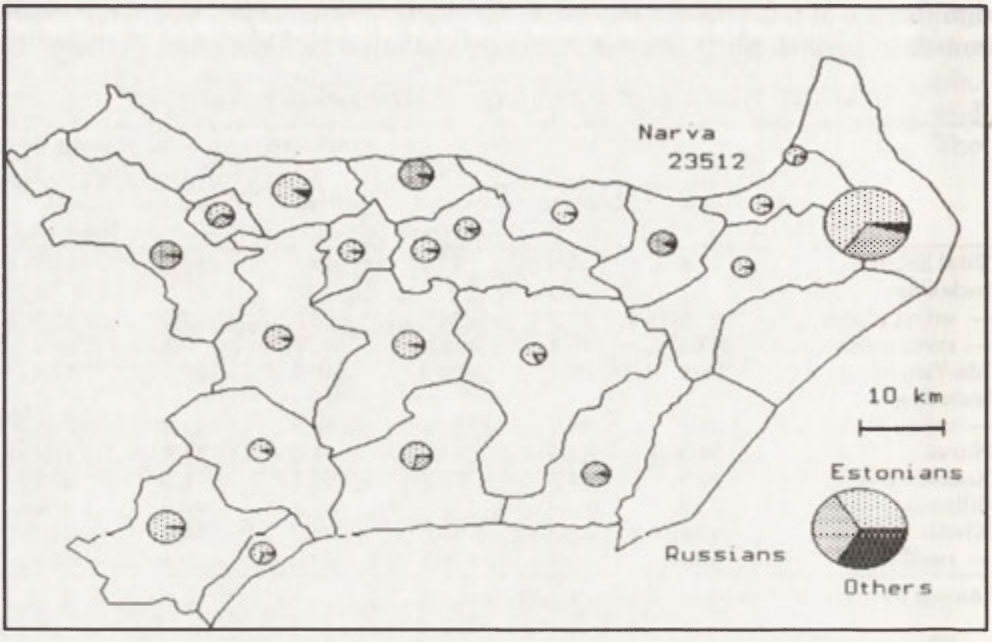

Fig. 10. Ethnic structure of population in North-East Estonia in 1934
Borders of communities in 1926 are depicted

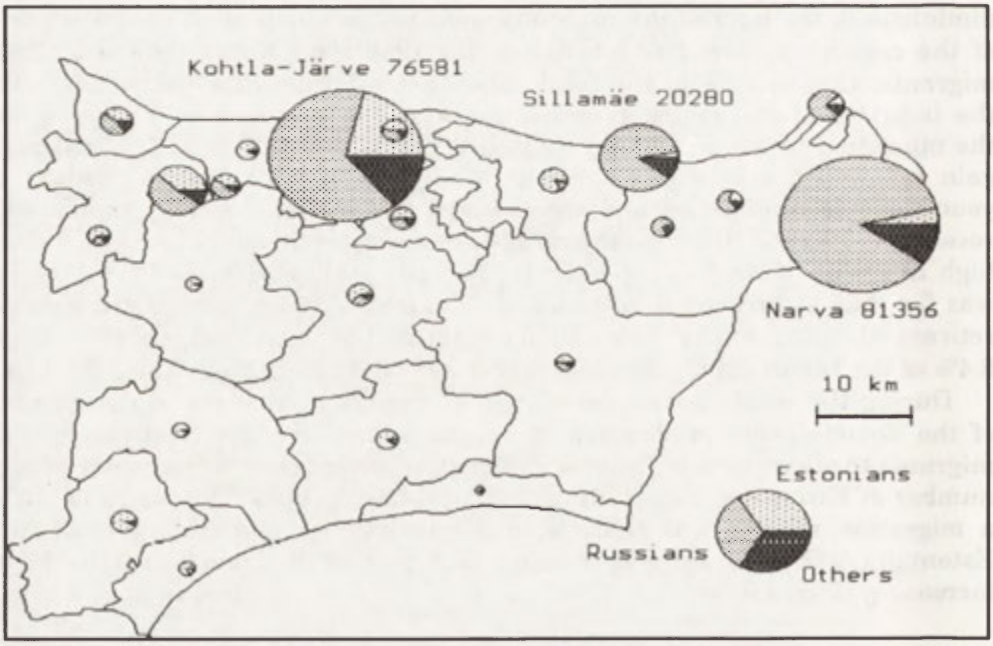

Fig. 11. Ethnic structure of population in North-East Estonia in 1989
Borders of communities in 1993 are depicted

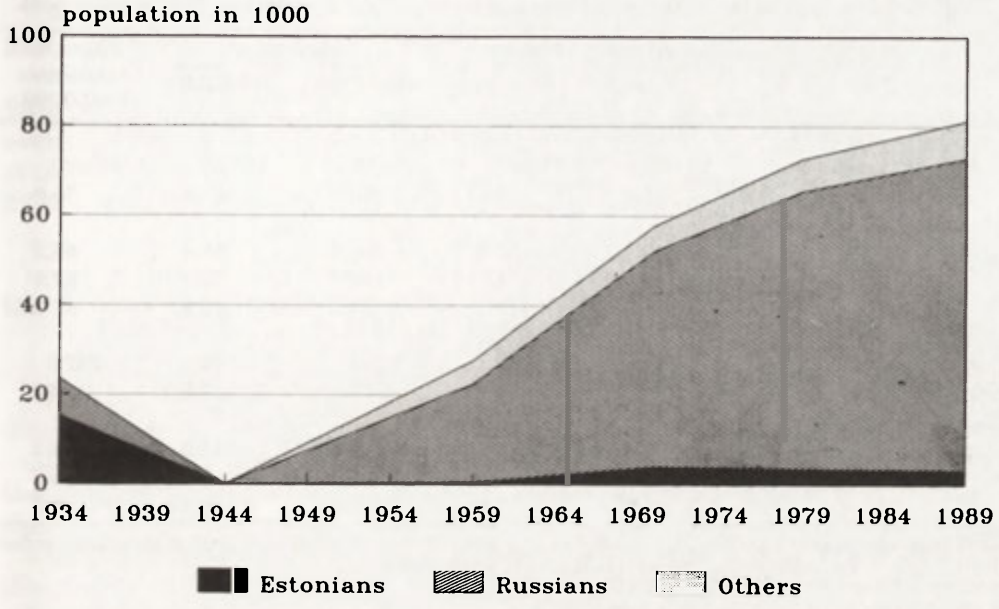

Fig. 12. Changes in the ethnic structure of Narva in 1934-1989

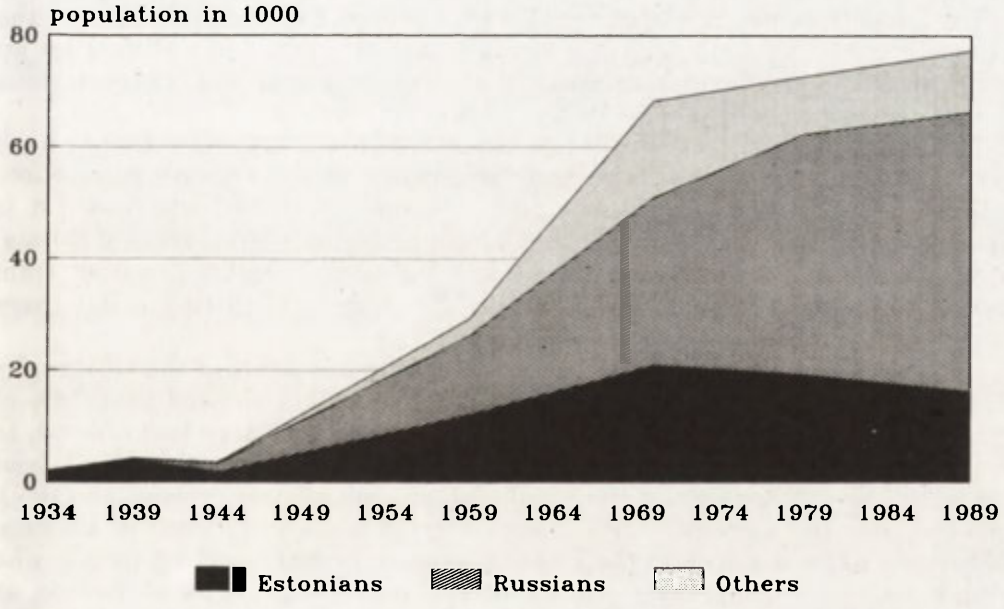

Fig. 13. Changes in the ethnic structure of Kohtla-Jarve in 1934-1989

TABLE 3. Changes in the migration of urban population by stages of industrial development

	Fast growth	Maturity	Stagnation		Shock of transition 1991-1993
	1956-1969	1970-1979	1980-1985	1986-1990	
Annual average migration turnover	18 870	23 346	18 891	11 766	10 990
migration rate	157.4	137.6	100.0	59.8	56.9
including urban groups: 1	155.0	156.3	104.5	85.4	68.2
2	141.3	124.2	104.7	72.7	57.9
3	181.7	145.2	96.0	69.5	51.3
Annual average net migration	2 338	1 479	1 273	516	-2375
net migration rate	20.3	8.7	6.7	2.6	-12.3
including urban groups: 1	-5.1	-5.6	-4.8	-11.9	-19.1
2	4.9	1.0	3.5	-0.1	-14.7
3	43.3*	17.3	10.6	6.2	-9.7

* approximate calculation. Groups: 1 — narrowly specialized oil-shale centres, 2 — oil-shale and manufacturing centre, 3 — manufacturing centres (see note below Table 1)
Source: Author's calculations based on SOE data.

The migration situation was radically changed when Estonia retrieved its independence. Out-migration predominated in external migration of North-East Estonia (as in the whole of Estonia), mainly remigration to the CIS-countries, but also emigration to foreign countries. In 1992 the net out-migration was 6900, in 1993: 2650. In internal migration, however, the arrivers outnumber the leavers (in 1992: 140 and in 1993: 400), also the Estonians having a slight net migration. Yet the latter is nullified by an abrupt fall in the birth rate and the resulting natural loss, characteristic of all post-socialist countries in the 1990s.

Summing up, the recent changes are still of too short a duration to have noticeably altered the number and composition of the region's population. At present it is hard to predict how the remigration will continue. It is probable that remigration will decrease because the industrial areas of Russia, the potential destinations of the local industrial workers, suffer from unemployment even more severely and the chances of getting a flat there are scarce.

Questionnaires administered by post-graduate students of the Geography Institute of Tartu University in the summer of 1993 showed that 78% of the Russian-speaking population of Kohtla-Järve and Narva had no wish to move; the number of potential migrants was larger among secondary school leavers (38%) than among the employed or unemployed grown-ups (16%). Of the potential migrants, 24% wished to go to some other place in Estonia. The prevailing majority of the latter groups consisted of young people who intended to continue their studies in the university towns of Tallinn or Tartu. Consequently the share of real potential remigrants was 16%.

An all-Estonian sociological questionaire carried out among non-Estonians in 1992 yielded principally the same result (Kirch at al. 1992).

A similar questionnaire carried out on Estonians living in North-East Estonia showed that the mobility of the school-leaving Estonian youth was even higher: 55% of them planned leaving Nort-East Estonia, although part of them saw no possibility of doing so immediately. Of the employed Estonians 22% contemplated leaving from their home region.

ENVIRONMENTAL CONDITIONS

The main factors in the human impact on the environment in this region are:

(1) Air pollution as a factor of sub-continental importance, which will be discussed in more detail;

(2) Water pollution having its influence through the Gulf of Finland on the whole of the Baltic Sea, phenol from oil-shale processing plants being the major polluting component;

(3) Environmental accidents consisting first of all in oil-shale catching fire (the fire in the Estonia mine in 1988/89 was ascribed the status of a catastrophe, which led to a release of phenols in considerable quantity into Lake Peipsi);

(4) Open-cast mining: more than 9770 ha of the land has been spoilt but during the reclamation (since 1959) 7780 ha of it has been reforested and 65 ha turned into agricultural land (Roose 1991);

(5) Industrial waste consisting of: (a) ash from thermal power plants; (b) dirt and residues from mining; (c) waste from the chemical industry; and (d) radioactive waste covering alltogether a territory of 2800 ha and making up more than 300 million tons (Roose 1993).

At Sillamäe, where during Soviet rule the concentrate of uranium was produced, solution of the following problems of environmental protection related to the Sillamäe Plant is under way (On Estonian... 1992):

— evaluation and recultivation of 100 ha of the radioactively polluted area;

— liquidation of the radioactive and toxic waste mixed with ash stockpiled on an area of 40 ha;

— deactivation of former, radioactively polluted metal storage on an area of 20 ha.

(6) Overground impact of underground mining, which depends first of all on the technology of mining: there are about 200 km^2 of mines, 120 km^2 of them are mined with double-face system and 80 km^2 with room-and-pillar system; narrow-web mining as a current technology, forcing the overlying strata to drop makes an artificial landscape which covers now about 600 ha; bigger and deeper land collapses have been filled with water due to which 380 ha of forests have been destroyed (Roose 1993; Toomik 1991).

(7) Hydrogeological problems of closed mines: in six such mines after the pumping out of groundwater was finished, two polluted underground lakes of about 25 km^2 have been formed (Roose 1991).

A special case in North-East Estonia is the *alkalization of environment*. Unlike the Scandinavian countries where deposition of sulphur and nitrogen leads to acid rain and damage of forests, the pH of precipitation may be even 6-9. The reason is that the base rock in North-Estonia is limestone, and the oil-shale ash from termal power plants (TPPs), as well as dust from the Kunda Cement Factory is very alkaline. The influence of this on ecosystems, an interesting research problem *per se*, is contradictory.

There is quite a dense network of environmental monitoring in North-East Estonia, governmental as well as that organized by different research institutes, but the standardization of methods and comparability of results should be much better.

The ecological situation in North-East Estonia is highly determined by the economic one, finding its expression in very high concentration of industry. In this way the 7 biggest enterprises (a mining company "Eesti Põlevkivi", three power plants, two oil-shale chemistry plants and one metallurgy--chemistry plant) producing 3/4 of industrial output of Ida-Viru county, are giving 95% of its water pollution, 97% of air pollution and 97% of solid waste deposition (data 1991-1992) (Roose 1993). The concentration of some pollutants is depicted in Fig. 14.

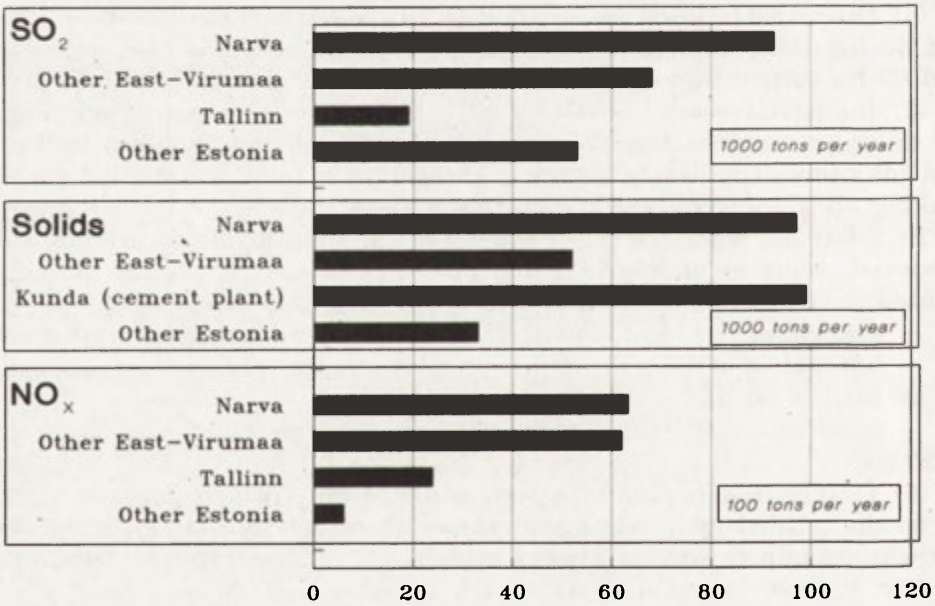

Fig. 14. Air pollution from the stationary sources in 1991 according to the official data (*Estonian...* 1991)

Two TPPs, the Baltic and the Estonian (see Fig. 1), are considered to be among the biggest source polluters in Europe (Lugus and Vartia 1993). Not having contemporary equipment for elimination of fly ash, but having tall

chimneys (250 m in the Estonian TPP), the huge emissions of dust, ash, sulphur, nitrogen and carbon oxides are deposited over a large territory. The pollutants contain heavy metals too: according to Roose (1991), 400 kgs of uranium per year from TPP. Pollution of soils with **Hg**, **Pb**, **Sb** will affect regions predominantly some distance from oil-shale processing plants (Lapo and Vdovets 1991).

There are several estimates of the territorial pattern of the **S** and $\mathbf{NO_x}$ concentration, based both on measurement and modelling. Taking sulphur as an example the calculation of territorial averages for the whole of Estonia — though it yields a non-representative picture of diminished pollution — gives data ranging from 1.26 g S/m^2 (data of EMEP for the year 1988) up to 1.99 g S/m^2 (data of J. Frey for the year 1987). Half of this was transboundary pollution, and 2/3 of our own sulphur was "supplied" to other countries. To the north of the Kohtla-Järve oil-shale chemistry plant this time the value was 28.6 g S/m^2 (Kallaste 1992).

Much attention, to problems of environmental protection, was given since 1966, including taking different economic measures, ranging from fines to taxes. During the Soviet type of economy when central planning was the absolute leading principle, real regulation was quite limited. Nowadays, decrease in production and depreciation of assets in power plants (the two biggest ones were launched in 1959 and in 1969) are important.

For a comprehensive assessment of air pollution levels in major cities generalized indices have been calculated by T. Kallaste (1992). In the results presented in Fig. 15, values higher than one imply that concentrations of measured pollutants are too high. It is interesting for us to compare the dynamics of different cities.

The influence of the polluted environment on the population has been studied since the seventies by the Ministry of Health of the Estonian SSR. An investigation carried out in 1980 involving 7937 persons from Kohtla-Järve and Kiviõli consisted of comparing various medical indices between regions.The results were processed statistically. The conclusion was that "the population's health in the oil-shale region differs considerably from that of the control region where air pollution is much lower" (Etlin and Redko 1990, p. 181). Some numbers from this paper follow:

— in relation to the index of the control region, discomfort (complaints about unpleasant smell) was 4 times higher, sleep disturbance 1.8 times, headache 1.3 (always $P<0.01$);

— frequency of aggravation of chronic diseases: in the case of diseases of respiratory organs it was 1.5 times higher and in case of cardiovascular system diseases 1.9 ($P<0.05$);

— variance analysis has demonstrated that the factor of living in the polluted region accounted for 29.5% of applications for medical advice in the case of diseases of respiratory organs, and that of working in the oil--shale processing plant, for 31.6%;

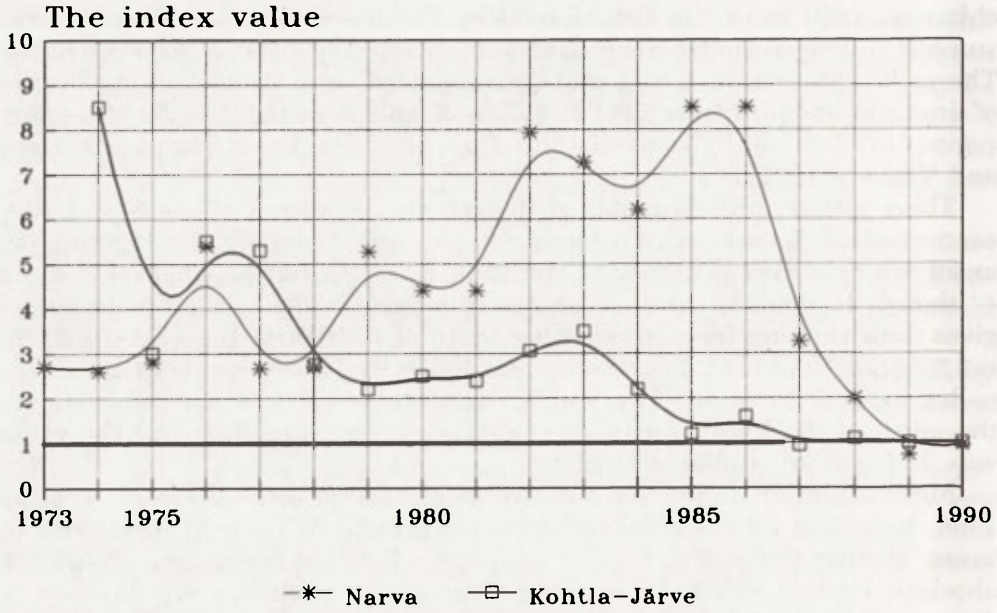

Fig. 15. Curves of the air pollution indexes (calculated by Kallaste, 1992)
Indexes are based on the average yearly immissions. For Narva, SO_2, CO, and NO_2 have been taken into account. For Kohtla-Jarve, SO_2, CO, NO_2, and phenols have been taken into account. Index value higher than one indicates excess over permissible pollution levels

— for cardiovascular system diseases, the same factors were 12.4% and 72.2%, respectively;

— no statistically relevant carcinogenic influence of atmospheric pollution was found.

The so-called Sillamae case of alopecia (hair falling out) in 1989 was caused by *mycobacterium*, which became active in the polluted environment: later study showed that the percentage of children suffering from this disease is 8.2% in Sillamae, 4.7% in Kohtla-Jarve, 4% in Narva, but 0.07% in other places in Estonia (Roose 1991).

The questionnaires administered by the post-graduate students of the Institute of Geography at Tartu University in the summer of 1993 showed that schoolchildren appear to be slightly better informed and more critical about the state of their surroundings. Environmental pollution was mentioned as a negative feature of their home neighbourhood by 20% of them. Estonians are more environment-conscious yet, but a few of them consider it as a reason for leaving the place. It appeared that among the adult Russian-speaking population the awareness of environmental pollution and of the accompanying dangers was surprisingly low. At Kohtla-Jarve barely 4 subjects out of 205 thought environmental pollution to be an alarming factor, in Narva 3 subjects out of 263. Such a lack of concern is caused by the following factors:

— throughout the Soviet period data about environmental pollution was

kept secret, at the present time the pertaining information is published mainly in the Estonian press;

— many of the recent in-migrants come from the industrial towns of the former Soviet Union, where environmental conditions are much worse;

— many vices in the present social surroundings, such as unemployment, low incomes, crimes, difficulties of naturalization and so on, outweigh the ecological problems.

Summing up, we can conclude that *pollution of the environment in this region has been proportional to production. The territorial pattern of pollution, as well as the ways it influences population are complicated. A potential danger consists of heavy metals and radioactive isotopes of oil-shale ash and dictyonema shale.*

CONCLUSIONS

The three trends discussed above — industrialization, urbanization and mobility of the population lie at the basis of the peculiarities of Nort-East Estonia's social environment. At the end of the Soviet period, the region (especially its individual towns) was predominantly tied up with industry whose structure was relatively one-sided. The large enterprises were subordinated to the all-Union ministries, which guaranteed, in comparison with the country's average, relatively good wages and the necessary allocations to housing construction and establishment of an acceptable social infrastructure. This is why the older and middle-aged inhabitants (born here or arrived predominantly with the two migration waves) were generally content with their lot. The leavers were part of the locally born young people who were dissatisfied with the one-sided choice of jobs. But they were soon replaced by new migrants, part of whom drifted towards Tallinn or returned to other regions of the Soviet Union. There was a certain amount of trouble with alcoholism, which was characteristic of industrial areas, and crime.

Neither the workers nor the management showed much concern about the technological backwardness of the industrial enterprises, in comparison with the Western countries, because their level was not lower than the average for the Soviet Union. In the 1980s it was mainly specialists and scientists of several Estonian research institutes, and also from foreign countries, that were worried about the economic and technological stagnation of North-East Estonian industry and the poor shape of the region's environment.

That relatively peaceful milieu was "shattered" by the collapse of the Soviet system, which created a number of economic troubles: unemployment and higher living cost, difficulties in communication with the CIS countries. This, in turn, caused bitter national and political problems among non-Estonians: some circles demanded separation, some demanded autonomy and dual citizenship, which is contrary to Estonian law. These problems

were especially acute in 1991-1992 (Kirch et al. 1992). Recent sociological research still shows that most of the people are primarily interested in economic questions and have withdrawn from politics. One grave problem is organized crime which seriously hampers the development of private enterprise.

The social well-being of this region depends on the success of restructuring its industry, as well as on its deindustrialization. Independent Estonia would not be able to manage a region with such heavy concentration of industry. Deindustrialization would also contribute to the improvement of the environmental conditions of the region.

ACKNOWLEDGEMENTS

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A SPECIAL REGIONAL ENVIRONMENTAL-SOCIAL CONFLICT ON THE GREAT HUNGARIAN PLAIN

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ABSTRACT: The territory officially called the Great Hungarian Plain is typically the macroregion of Hungary, occupying 46% of the country's total area. The paper highlights some of its new regional conflicts which have arisen as a result of the current socio--economic change of regime. Most important environmental problems are as follows: the imbalance of the water-economy, the increasing amount of territories where soils are exposed to some danger, the functioning of the new land-use system based on agricultural privatization and the changing relationship between production and the natural environment.

Owing to the change of regime, we have to face several new socio-economic conflicts, especially the decrease of industrial and agricultural production which is caused by the loss of the eastern markets. It is the main reason why the unemployment rate has become twice as high as the national average and why the income-creating ability of rural areas has decreased by half since 1990. As the new economic structure has been forming rather slowly, the main direction of social processes points towards pauper- ization.

It is worth analyzing whether the East Central European regions of this kind are able to renew themselves on their own, to solve the task of modernization and to overcome their disadvantages within a reasonable period of time.

KEY WORDS: Environment, socio-economic conflicts, unemployment, Great Hungarian Plain.

INTRODUCTION

The socio-economic change of regime in Eastern Central Europe has specific spatial aspects. New countries are being formed out of what used to be regions of single country, and the regional distribution of some of these newly-formed states is pending. The concept of region, which used to have a general meaning and use until recently has been gradually becoming European in size, sometimes with specific historical, political, ethnic, ecological or administrative meaning.

The territory, officially called the Great Hungarian Plain, is typically the macro-region of Hungary where on the regional level have appeared the syndromes following the socio-economic change of regime, which aroused the need and demand for a regional policy of a new routine and structure as well as the introduction of its institutional system as operating in conditions of market economy.

During the last one and a half years, nearly a hundred regional scientists joined their efforts led by the Alfold Institute, of the Research Centre for Regional Studies, Hungarian Academy of Sciences in an attempt to express these problems in terms of Hungarian territory and to try to conceptualize the feasibility, limitations and criteria for the future development of the region.

THE MAIN PROBLEMS OF THE GREAT HUNGARIAN PLAIN

The majority of the regional problems are not new; most of them have occurred in the last three years but no doubt the new economic-social-political circumstances have put them in a new light and scale of values. These are as follows:

— the characteristics of the natural-ecological unity of the region;

— problems that can be expressed on the basis of the situation of the economic (productive) sphere (especially the agricultural economy);

— characteristics of the spatial system of the region (settlement network, infrastructure);

— and the group of aspects arising from the specific situation, identity of the society on the Plain.

THE CHARACTERISTICS OF THE NATURAL AND ECOLOGICAL UNITY

The filled hollow character, the unified river-system, the climate that is becoming more arid, the unique regional-natural values that should be protected (flood area, mortlakes, moor lands, grasslands) and the general endangering of the environment require that on the Plain prospective regional development and regulation should aim at the preservation or, in many cases, the replacement of the diversification of the environment.

The river regulation of the last century and soil-formation, followed by the large-scale agricultural cultivation of the Soviet type has greatly affected the environment of the region and made it an almost totally unified agrarian-cultural area in a way that those comparative advantages which could previously be effective in terms of the potentialities of the environment have been lost step by step.

THE ONE-SIDEDNESS OF THE ECONOMIC STRUCTURE AND THE DECREASE IN ITS SUPPORTING CAPACITY

The one-sidedness of the economic structure (agriculture and food industry) and its inorganic development was disorganized in many respects, being connected with the failure of the earlier attempts at modernization on the Plain. Agriculture could always guarantee its market positions with mass--production only and at present when the last possibility of its maintenance, the Comecon has collapsed, it is in a difficult position. Almost two-thirds of the food industrial capacity of the region, in certain branches, is unused today and the protraction of agricultural reprivatization affects the further, partly necessary, decrease of production.

At the same time, in 1992-93 the level of industrial employment decreased by 35-40 % in the region indicating that during privatization the former state, socialist large industrial companies (the local industrial units on the Plain had settlements in Budapest or in other industrial towns and their production was controlled from there) wanted to "get rid of" their less efficient settlements first.

The result of the above-mentioned process is that the economic supporting capacity of the territory greatly decreased following the change of regime.

THE UNIQUE NATURE OF THE SETTLEMENT NETWORK AND THE GENERAL BACKWARDNESS OF THE INFRASTRUCTURE

The variety of the settlement network of the Plain and its several unique features have lost much importance as well. The results (advantages) of the unique historical development and area utilization of former so-called agro-towns and the related scattered settlement (farm) systems almost ceased to exist during the past forty years. The changes of these regional system-elements, similarly to the natural environment, are going towards unification. The backwardness of the tertiary sectors compared to similar regions of the country is especially serious (telephone network, road-system, public sewerage system, etc.) if the development of the tertiary sectors on the Plain was similar to that on Transdanubia the present unemployment rate (which is twice the national average) would decrease by half.

SOCIAL AND REGIONAL PUBLIC ADMINISTRATION PROBLEMS ON THE PLAIN

The present public administrative system of the Plain was established during the last century (after 1867); up to that time it had had several territories with unique privileges. The regional-administrative consequences of both world wars in the territory meant that local market, economic and social connections formed during the past long centuries had to be rearranged

artificially and new contacts had to be established. The civil development of the region and backwardness compared with their modernization possibilities, the weakness of the local (civil) societies are also serious difficulties associated with the development. This is one of the reasons why the Euro-regional social-economic integration of the Plain has been, for the time being, only a desire.

POTENTIAL STRATEGIES FOR THE DEVELOPMENT OF THE PLAIN

On the basis of the above-mentioned situation, researchers suggest the enforcement of four basic principles for the macro-regional strategic development of the Plain, to be enforced on the whole region:

A. *The protection of values created by nature or man on the Plain while preserving the difference and internal diversification of the Plain in compliance with the facilities.*

Further exploration and protection of the characteristics of the Plain are necessary, and rehabilitation of its advantageous features. Planning-development programmes should recreate the soil-forming, structuring and dividing functions of the system (farms, groups of trees, zones by the river, fen winds), which give the natural spatial framework of the region with the help of adequate land utilization, agricultural cultivation techniques and the necessary regulating-stimulating and prohibitive means. This can greatly contribute to achieving the ecological and soil protection aims as well, and its solution can be facilitated by the present land ownership.

One of the most critical tasks of the region is the protection of the waters on the surface and under the surface, and the water-supply of the Plain. This is the most arid region of the country and in accordance with the forecast of the research, in a short time it will become a windy zone where the watering and the continuous and complex economy of water-supply are the preliminary conditions for production. The waters on the surface and under the surface of the Plain will have a higher value and their utilization and protection will require the establishment of new priorities and a comprehensive water-economic plan, valid for the whole Plain.

The maintenance of the productivity and the soil of the Plain is a basic need for the territory and for agriculture. If it is not regulated with proper procedures, 80% of the land of the region will be exposed to some danger. As a strategic principle, priority should be given to soil protection, the prevention of impairment, and to changes conforming to the ecological principles of land utilization.

The maintenance of the native natural flora and fauna of the Plain, the protection of species, the maintenance of the genetic potential of the region are the conditions, as well as the possibility and aim of the international integration of the area. The tasks for the future as follows: logical, rational

and planned area utilization; land and soil protection and improvement; strict protection of the existing natural world in order to stop further gene erosion; putting the protected species in gene-banks and breeding stocks.

The maintenance of the traditional agrarian cultures on the Plain is a fundamental task from the point of view of the whole region and the country. The agricultural production that exceeds the national average generally by 1.5 and for certain cultures by 2-3 times, indicates the importance of the region.

The maintenance of the specific structure of the settlement system on the Plain, the utilization of its facilities, and the protection of architectural value are vital. The new system of local authorities can, in a way, affect the reconstruction of the original settlement system; the local independence of each settlement has been re-established; hierarchical relations the original settlement system have disappeared. The privatization and the disintegration of big state organizations loosened the hierarchical system of economy, and unemployment eliminated the fundamental settlement differences in the labour situation. The new way of settlement financing generally provides more advantageous possibilities for the villages than before, but it seems to be disadvantageous for the whole Plain. The differences in the settlement system — except the relatively developed institutional system in the two regional centres, Szeged and Debrecen — is reflected by the backwardness of the basic infrastructure of the former country-towns and huge villages. The settlement system on the Plain, owing to its features, can be suitable for receiving, preparing and executing the development programmes, building upon the regional-settlement-social characteristics regarding the historical development and local facilities on the basis of smaller areas formed by settlements with similar facilities.

The variety of the land and smaller areas on the Plain, the value of ethnographic and ethnical diversity of its society can provide a typical possibility for the application of a regional development model arising from "the bottom". The development programme of the Plain can probably be most successful if it is based upon the collaboration of smaller area-level building upon the territorial-historical-traditional economic and natural human regional connections. During the research 43 of the smaller areas were identified with regard to the above-mentioned features, and building upon these areas the best results in the exploration and mobilization of the local natural and social resources, the revival of the local identity and collaboration can be ensured. At the same time, this strategy can be the one which would maintain the historical differences of certain smaller areas and their traditions and, with these areas joining together regional development can evolve in favour of the whole Plain and the country.

B. *Setting up the criteria of sustainable development and ensuring its conditions for the whole area of Plain.*

A development policy should incorporate the criteria of sustainable development on the Plain. The decline in water- and air-pollution of industrial

origin, in the utilization of agricultural fertilizers and chemicals, in large-scale animal keeping, and in land cultivation by heavy machines are unfortunately not the results of environment-protective technologies and attitudes but those of a general economic decline and change in ownership. Therefore, at present the most important task is not the further decline but the preparation for a renewed increase. Structural-political concepts, legal regulations and economic stimulation should now be established to enable the planning of new growth areas and the prevention of previous mistakes.

The economic change of regime, being formed now, can trigger an improvement in environmental conditions. However, it should be considered that the deconcentration of ownership of the industrial and agricultural production deconcentrates the environment-polluting resources as well, exceeding the allowable environmental limit. Therefore each step should consciously be taken in order to connect the change of ownership with the improvement of environmental conditions. During the industrial privatization, environmental audit and neutrality should be employed. Also during agricultural compensation and privatization preferences should be enforced for a certain form of land utilization.

Maintainable development should be reinforced by economic means. The environment protection penalty cannot be the proper means; therefore, according to the interests of local societies, old and new owners should be interested in land utilization adequate to the ecological and pedological requirements, first of all by offering certain benefits. The price support of agricultural chemicals greatly decreased at the end of the eighties, but the enforcement of environment-protection preferences should invariably be continued in the consumer- and sale-tax systems as the fundamental form of environment--protection regulation. In certain areas it is reasonable to maintain administrative and prohibitive regulations as well, but it should be in accordance with the new ownership and owners' rights.

In respect of the protection of natural and cultural values, the primary danger on the Plain today is its becoming uninhabited and disowned. As for settlements that have a lot of architectural, national and cultural memorials, proper use, maintenance and rehabilitation should be supported through several means. The goal to maintain the vitality, the economic supporting capability of those settlements or populated places with cultural and historical value, should be promoted by employment policy and by the creation of new workplaces.

C. *Establishment of an economic structure adequate for the regional facilities and the requirements of international competitiveness, and the establishment of the terms of macro-euro-regional co-operation.*

Researches carried out to explore possibilities for the complex use of the facilities of the Plain to establish a competitive economic structure has proved that the territory has no unambiguous advantage or favourable facility that

could solely determine the developmental tendency of the region. From time to time, besides the favourable characteristics of agriculture, there are damages and market problems and the tendency to drought also increases costs. The reserves of subsoil wealth and hydrocarbon are getting depleted. As a result, on the Plain not only one feature but a combination of features can and should be considered as a base.

Among these, the most important feature is the human factor, the society, the man on the Plain. It is a general tendency of regional development that, parallel with the devaluation of the prices of mineral resources and the agrarian ecological potential on the world market, the human factor, its education, ability, discipline, organization, attitude to work and diligence becomes the most important factor in production, the determinant of competitiveness. On the Plain, especially in its former country-towns, private cultivation (enterprise), and ownership can be stabilized sooner than in other parts of the country. In most areas religious traditions can affect the development of the work-centric, accumulating forms of attitude (for example, 45% of the compensation demand is concentrated in five counties on the Plain where only 36% of the agricultural territory can be found). The fact that the density of population becomes nearly as high as in the industrial areas facilitated the development of intensive agrarian cultures with a strong labour demand. At the same time, the working population of the Plain has unfavourable characteristics as well. Its average qualification is lower than in other major regions of the country and the ratio of "marginal" labour is considerable.

Another special feature is the settlement network which is unique in Europe, too. The concentration of the agricultural population in such big settlements with defined urban functions can make the development of industrial and post-industrial social structures easier, and the development of the civil-infrastructural institutions cheaper. The order of magnitude of the majority of the settlements on the Plain is sufficient for the running of one or two small- or middle-sized industrial units, which means the most important bottle-neck of the structure of Hungarian industry. Therefore, retraining and programmes launched to stimulate the foundation of adaptable economic units of this size in new branches may have an important role.

D. *The elimination and the reduction of economic and social crises on the Plain.*

The solution to the acute social and employment crisis on the Plain can be suggested as an important task because the slow decline of the region came to a sudden stop at the beginning of the nineties. The worsening of the relative situation of agriculture and the loss of the eastern markets affected the Plain more seriously than other parts of the country. While the former socialist economic structures collapsed and declined in each part of Hungary, in respect of the development of new structures (company establishments, smaller enterprises, joint ventures, working capital import)

sharp differences emerged between the eastern and western parts of the country and between the capital and the country. Several regulating elements (e.g. taxes of labour-demanding branches, a decrease in agricultural support, etc.) proved more disadvantageous for the Plain. In 1992 a further significant decline in the situation on the Plain happened, which indicates that the collapse of the Plain accelerated. The number of industrial, and agricultural registered workplaces on the Plain is dramatically decreasing. In total it means that within two years 300,000 workplaces were lost on the Plain in organizations with more than 50 employees, so the ratio of unemployment greatly exceeds the national average.

All of the three sources of income ensuring a sufficient standard of living together only for families living in the former country-towns and villages — the main non-agricultural (industrial, building industrial) workplace, the common farm and the household plot — collapsed at the same time. We should take into consideration that today the Plain is wrestling first of all with acute employment, income and financial problems. Without a long-term, well-defined and state-promoted programme the collapse of the Plain and its division from the western parts of the country will increase unavoidably. Furthermore, this may be a brake on the decline of the region.

On executing the research programme, several groups in the society on the Plain proved their readiness to accept a programme of restructuring, building from the bottom and serving regional and national development purposes.

REGIONAL DEVELOPMENT TASKS FOR THE NEAR FUTURE

On the basis of the above-mentioned facts, the strategic tasks for the development of the Plain should be as follows:

— in the area of land utilization, three methods favoured in respect of the environment and countryside protection should be increased by at least 10% by the year 2010 (grass, forest, water surface) and these should be fitted into the green-corridor system to be built on the Plain;

— agricultural production should be based upon land economy mixing Hungarian traditions and the requirements of the world market, its up-to-date system of conditions and the promoted environmental protection;

— industry should establish new branches on the Plain, mainly units of small- and medium-size, using the specific settlement structural-social facilities of the region;

— in the area of infrastructure, besides improving the basic supply to the national average, both the international and national road and railway connections should be developed along with the subordinate (agricultural) road-system. The development of the telephone and other communication and information network systems is the precondition for the integration of the whole region;

— in the area of the settlement development, investing in inadequate

settlement infrastructure is the most urgent task. At the same time, it is necessary to strengthen integrated, small area-based collaboration of towns and their rural surroundings, renewing the system of settlement planning and development. On a long-term basis it is necessary to deepen the urbanization of the towns on the Plain and its extended effect considering that the "uniqueness" that can be expected from the development of the small area (town-country) requires the appearance of new economic, social, institutional participants necessary for the implementation of new methods and modernization;

— the development of tourism on the Plain based upon specific values (thermal, green, farm-village tourism, Lake Tisza and the national parks) should be undertaken by organizations that are able to utilize these facilities in smaller areas;

— regarding international regional connections the Plain can have a prominent, integrating role. Since half of the territory of the natural area extends over the borders, it can have a key role in frontier collaboration, in the external effects of the extending transit traffic and in the Carpathians--Tisza euro-regional initiation modelled on the Alps-Adria;

— in the system of economic means, the primary requirement is a significant increase in Country Development and Employment Funds and its proportional allocation on the Plain. Directing international supports towards the Plain can be a goal as well, following the indication and acceptance of conceptual elements mentioned above;

— finally, participants for the above regional development should be found.

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THE EFFECTS OF TOTAL WATER HARDNESS, SMOKE PARTICLES AND SULPHUR DIOXIDE LEVELS ON MORTALITY IN URBAN AREAS OF ENGLAND AND WALES

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ABSTRACT: This is a longitudinal study to investigate the association of total water hardness, and smoke particulate and sulphur dioxide air pollution, with premature adult mortality in England and Wales between 1971 and 1989. Associations were found, in the expected directions, but most of these were mitigated by socio-economic and geographic controls. Despite controls, men living in hard water areas were demonstrated to have significantly lower mortality than those living in soft water areas.

KEY WORDS: Longitudinal Study, water hardness, air pollution, mortality.

INTRODUCTION

The majority of studies based upon England and Wales indicate that there is a plausible inverse relationship between mortality and the level of hardness of drinking water. Water is predominately hard in the South East and soft in North and Western areas. Negative correlations have been found between water hardness and arteriosclerotic, hypertensive and ischaemic heart disease deaths and even larger negative correlations for cerebrovascular disease and myocardial degeneration (Hart 1970). The association therefore appears especially relevant to cardio-vascular disease (Pocock et al. 1980). It has been suggested that the relationship with water hardness is non-linear with little further reduction in standardized mortality ratios above 170 mg l^{-1} calcium carbonate equivalent (CCE), see Jones 1984; Lacey and Shaper 1984. Although some studies have failed to find an association, the weight of the evidence for this inverse relationship is substantial.

Acute air pollution has long been recognized as contributing to increased mortality levels (Arden Pope III et al. 1992; Daly 1959) but chronic low-level exposure is now recognized to have similar results. Despite personal air pollution from chronic smoking, community air pollution is thought to be an important cause of malignant and non-malignant disease. Quantification, however, has been difficult due to the confounding factor of smoking.

Bronchitis & Emphysema

It is difficult to compare studies since bronchitis is not always consistently defined and different measures of pollution have been considered, such as sulphur dioxide, suspended particles and presumptive measures, like fog density. In England, after accounting for the effects of population density and also, in later studies social class, a significant correlation between bronchitis mortality and smoke density was demonstrated (Stocks 1959). A significant correlation between sulphur dioxide pollution and bronchitis mortality rates for men over 45 years has also been shown but the results for women were less consistent, as were associations with suspended particulate pollution (Pemberton and Goldberg 1954). Another study, controlling for population density, social class and type of town, found a positive association between bronchitis mortality and air pollution (smoke and sulphur dioxide) in males (Ashley 1969). However, in none of the above three studies were any personal factors considered. With the inclusion of limited data on smoking, all positive associations with sulphur dioxide were weakened in males (Chinn et al. 1981).

Lung Cancer

Controlling for age, smoking habits and social class, death rates for lung cancer in England were found to be associated with urbanization and smoke particle pollution across six areas of the country, and with smoke and sulphur dioxide levels in two urban districts in England (Wicken and Buck 1990). In Utah (USA) there are reckoned to be 11-14% extra lung cancer deaths due to higher levels of air pollution involving smoke and sulphur dioxide (Archer 1990).

Links between mortality from non-respiratory tract cancers and air pollution have been more tenuous. There is some evidence of increased mortality from cancer of the stomach, especially in males (Gardner et al. 1969; Lave and Seskin 1977).

METHOD

Data set

The Longitudinal Study (LS) is a 1% sample of the population of England and Wales (about 600,000 people). Initially all people with birthdays on any of four dates of the year were selected from the 1971 Census. Thereafter details of new births and immigrants with these birth dates have been added to the data set. Further information on LS members is accrued at each census and a mechanism exists whereby death of a LS member can be identified and recorded in the data set. Thus the LS represents a continuous sample of the population of England and Wales, rather than a sample taken at one point in time. The study is administered by the Office of Population Censuses and Surveys (OPCS) who enforce strict rules on the use of the data, to ensure confidentiality.

All members of the LS, enumerated in 1971, and who were not defined as retired, sick (permanently or temporarily), students or members of the Armed Forces were selected. Two data sets were extracted, one for males and one for females.

The principal variables used in the analysis were:

Year of death

The period being considered was divided into five sections 1971-1973, 1974-1977, 1978-1981, 1982-1985 and 1986-1989. Deaths in the period 1971--1973 were ignored in an attempt to eliminate the 'healthy worker' effect (Goldblatt et al. 1990).

Age at entering LS

LS members between the ages of 16 and 60 years at the 1971 census were selected and were placed into one of seven age groups. Over the age of 60 years retirement rates increase and it becomes difficult to determine an individual's social class. Also, we wished to study premature mortality, which we accepted as death before the age of 70 years. Those groups that reached age 70 in one time period were censored from the analysis in the next time period. This led to 16,797 females and 20,619 males entering the first time period.

Environmental variables

The LS contains a number of environmental variables measured between 1969 and 1973 as part of the Royal Free Hospital Study into cardio-vascular disease (Shaper et al. 1980). These include total water hardness, outside smoke particle and sulphur dioxide levels, and are available for 228 urban areas in England and Wales. Each individual was assigned the values of the environmental variables for the area in which (s)he was resident and the values are therefore not specific to the individual's household. Unfortunately, this causes a misleading decrease in variance and reduces the potential explanatory power of the variable. This is a known problem that could be rectified by the use of multi-level modelling software. This software is specialized and was not available for this study.

1. *Total water hardness.* In most towns the water is derived from several separate sources and the estimated contribution from each source was used with the respective water quality data to calculate a 5 year weighted mean value. The range of hardness values was 10-500 mg per litre CCE, and the values were grouped into the tertiles; Low (0-111), Medium (112-268) and High (> 269). Such grouping was made despite previous suggestions of a non linear relationship between mortality and hardness after a value of 170mg per litre (Jones 1984; Lacey and Shaper 1984). This grouping was made due to the skewed distribution of hardness values, with small numbers of observations under 90 mg per litre CCE.

2. *Smoke particles.* The range of values was 75-1750 μg per m^3, thus

leading to recoding into tertiles of Low (75-390), Medium (391-580) and High (> 581).

3. *Sulphur dioxide*. The range of values was 206-2016 μg per m^3, thus leading to recoding into tertiles of Low (206-868), Medium (869-1213) and high (≥ 1214).

Other variables used as controls were:

Geographic Zone

Previous work indicated that major geographic differences in mortality could be adequately described by splitting England and Wales into two broad zones. The zones were formed of contiguous regions of health service administration, north and south of a line running approximately from the Severn Estuary in the West to The Wash in the East. This places Wales entirely in the North zone. The zones are of approximately equal population size but the South zone is slightly more affluent and of slightly higher average social class. It also has predominantly hard water whereas the north has predominantly soft water, although there are numerous local exceptions to this generalization. In general mortality rates are known to be higher in the north than the south, a fact that this study confirms.

Socio-economic controls

The study uses five indicators of socio-economic status, all seen to be useful controls in previous studies: family access/ownership of a car (has access/no access); economic position (employed/unemployed); housing tenure (owner occupier/rent accommodation); presence of spouse (has spouse/no spouse); social class (other/IV-V).

Analysis

Logistic regression was used to determine the effects on mortality (dependent variable) of the three different environmental variables, whilst taking into account the confounding influence of social factors and geographical zone. All regressions were controlled for age and time period. Results were presented as the relative odds (odds ratio) of dying, compared to a stated base category.

RESULTS

In models uncontrolled except for age and time period all three environmental factors were associated with changes in mortality risks in expected directions (Tables 1-3). A stepwise "dose-response" effect on risk was apparent in most models, with increasing levels of environmental factor. However in all models except the water hardness model for males the effects of environmental variables were outweighed by control variables, leaving reduced and non-significant effects.

TABLE 1. Total water hardness model: odds ratios of dying

	Male		Female		Male		Female	
	OR	p	OR	p	OR	p	OR	p
	Water hardness							
Low	1.00		1.00		1.00		1.00	
Medium	0.87	<0.001	0.93	0.108	0.93	0.040	1.03	0.498
High	0.78	<0.001	0.88	0.003	0.90	0.024	1.07	0.227
South Zone					1.00		1.00	
North Zone					1.16	<0.001	1.25	<0.001
Car access					1.00		1.00	
No car access					1.18	<0.001	1.31	<0.001
Own accommodation					1.00		1.00	
Rent accommodation					1.31	<0.001	1.23	<0.001
S/Class not IV-V					1.00		1.00	
S/Class IV-V					1.11	<0.001	1.02	<0.001
Employed					1.00		1.00	
Unemployed					1.51	<0.001	1.89	<0.001
Has spouse					1.00		1.00	
No spouse					1.16	<0.001	0.95	<0.001

All regressions are controlled for age and time period.
S/Class = Social Class

TABLE 2. Smoke particles model: odds ratios of dying

	Male		Female		Male		Female	
	OR	p	OR	p	OR	p	OR	p
	Smoke particles							
Low	1.00		1.00		1.00		1.00	
Medium	1.17	<0.001	1.11	<0.001	1.01	0.859	0.98	0.647
High	1.31	<0.001	1.30	<0.001	0.99	0.783	1.05	0.435
South zone					1.00		1.00	
North zone					1.24	<0.001	1.16	0.003
Car access					1.00		1.00	
No car access					1.19	<0.001	1.31	0.454
Own accommodation					1.00		1.00	
Rent Accommodation					1.30	<0.001	1.23	<0.001
S/Class not IV-V					1.00		1.00	
S/Class IV-V					1.11	<0.001	1.03	0.526
Employed					1.00		1.00	
Unemployed					1.52	<0.001	1.89	<0.001
Has spouse					1.00		1.00	
No spouse					1.16	<0.001	0.95	<0.001

All regressions are controlled for age and time period..
S/Class = Social Class

In fact a combination of geographical zone and car access alone were sufficient to outweigh the environmental variables in all cases, except for water hardness/males, as stated. Table 4 shows the model combining all three environmental variables. In the uncontrolled model the effects of water

TABLE 3. Sulphur dioxide model: odds ratios of dying

	Male		Female		Male		Female	
	OR	p	OR	p	OR	p	OR	p
Sulphur dioxide								
Low	1.00		1.00		1.00		1.00	
Medium	1.06	0.100	1.11	0.016	0.95	0.191	1.01	0.766
High	1.11	0.001	1.12	0.007	0.98	0.532	0.99	0.792
South zone					1.00		1.00	
North zone					1.25	<0.001	1.19	<0.001
Car access					1.00		1.00	
No car access					1.19	<0.001	1.32	<0.001
Own accommodation					1.00		1.00	
Rent accommodation					1.30	<0.001	1.24	<0.001
S/Class not IV-V					1.00		1.00	
S/Class IV-V					1.11	<0.001	1.02	<0.001
Employed					1.00		1.00	
Unemployed					1.51	<0.001	1.89	0.538
Has spouse					1.00		1.00	
No spouse					1.16	<0.001	0.95	0.230

All regressions are controlled for age and time period. S/Class= Social Class

TABLE 4. Combined model: odds ratios of dying

	Male		Female		Male		Female	
	OR	p	OR	p	OR	p	OR	p
Water hardness								
Low	1.00		1.00		1.00		1.00	
Medium	0.90	<0.001	0.99	0.966	0.92	0.033	1.04	0.431
High	0.83	<0.001	0.99	0.776	0.89	0.024	1.09	0.189
Smoke particles								
Low	1.00		1.00		1.00		1.00	
Medium	1.19	<0.001	1.11	0.052	1.06	0.218	0.97	0.609
High	1.22	<0.001	1.29	<0.001	1.02	0.709	1.05	0.481
Sulphur dioxide								
Low	1.00		1.00		1.00		1.00	
Medium	0.99	0.755	1.03	0.577	0.98	0.625	0.99	0.906
High	0.98	0.555	0.99	0.978	0.96	0.358	0.98	0.716
South zone					1.00		1.00	
North zone					1.15	0.010	1.22	0.005
Car access					1.00		1.00	
No car access					1.18	<0.001	1.31	<0.001
Own accommodation					1.00		1.00	
Rent accommodation					1.31	<0.001	1.23	<0.001
S/Class not not IV-V					1.00		1.00	
S/Class IV-V					1.11	<0.001	1.03	0.516
Employed					1.00		1.00	
Unemployed					1.51	<0.001	1.89	<0.001
Has spouse					1.00		1.00	
No spouse					1.16	<0.001	0.95	0.242

All regressions are controlled for age and time period. S/Class = Social Class

hardness and smoke appear to be independent. The effect of sulphur dioxide is not independent of the other environmental variables. It is in fact outweighed by the smoke variable alone (model not shown). The effect for water hardness remains significant in the male model despite controlling for the other environmental variables as well as socio-economic and geographic factors.

It would appear therefore that males living in hard water areas have a reduced mortality risk compared to those living in soft water areas. In areas of high hardness levels this amounts to an approximate 10% reduction in risk. Some reduction in risk is also seen in the medium hardness group. For women no effect is seen in controlled models.

For the other environmental factors effects those of smoke are stronger (likelihood ratio test not shown) and slightly more robust than those of sulphur dioxide. They are also independent of water hardness. However the effects of both air pollutants would seem to be confounded with socio-economic and geographic factors, and not independent of them.

DISCUSSION

The main shortcoming of this study is that of defining exposure. Although the members of the LS were classified as being exposed to the environmental factor at the specified level in 1971, we have no data on the duration of exposure. For example if an individual lived in a high smoke level area for a number of years, then moved to an area designated as low in 1971, and then died five years later, (s)he would be classified as "low exposure" despite having been exposed to high levels for perhaps many years.

The premise is that exposure levels of environmental factors around 1971 are a proxy for continuing exposure at those levels. The models are weakened wherever this premise is false and this may occur both through migration out of the area or by secular change in levels. However, in Britain, many people move house only short distances, often within the same town or area. Even these movements can reduce air pollution because the new residence may be outside the smoke shadow effect caused by the prevailing wind, or more distant from areas of high density traffic. A few hundred metres can make all the difference.

The possibility of moving to an area of substantially different water hardness is much smaller, nor has there been much secular change in levels. This suggests that the use of a single exposure value as a proxy indicator for the following years will be of much greater relevance for water hardness than air pollution.

It is likely that the more affluent have greater mobility and thus the ability to move away from environments that are unpleasant and possibly detrimental to health. It may be this effect that the car access variable is indicating. Access to a car suggests a reasonable level of income, and a

greater likelihood of moving out of the polluted area. The positive incentive to move away from areas of air pollution does not exist for water hardness as water quality is good everywhere and hardness is not considered a pollutant.

In previous studies where associations have been shown between smoke and sulphur dioxide and mortality, levels of the air pollutants have perhaps been higher than experienced in this study. Industrial pollution has been substantially reduced in the period between this study and the majority of former studies based in Britain.

A high proportion of the sulphur dioxide levels that were recorded in 1971 would have come from an industrial source. Since then these levels have probably declined and this is the most likely reason why the models for sulphur dioxide are the most fragile. Smoke particulate levels are more likely to come from roads and domestic heating systems. Again, those individuals who are wealthier will tend to reside away from the major roads. In stepwise regressions (not shown), controlling for car access is particularly effective at reducing the explanatory power of smoke levels.

Of the known risk factors, for both respiratory and cardio-vascular diseases, tobacco consumption is the best established. It was not possible to include this factor in the study since no information on consumption levels is collected in the decennial Census. This is unfortunate as this factor is clearly confounded with the mortality outcome, and with air pollution. In Britain smoking is more prevalent in the lower social classes and it is these individuals who are more likely to live in areas of high air pollution.

The one finding of clinical, as well as statistical, significance is the apparent protective effect for men living in a hard water area. This effect has been found before but we do not know of another British study that is both of this size, and longitudinal, with this length of follow-up. The physiological mechanism is unknown.

The fact that the effect is only apparent in men is probably because previous evidence points to an effect of water hardness on cardio-vascular disease particularly, and premature death from this cause is less common in women in Britain. This study deals with all-cause mortality and the effect, if working through cardio-vascular disease, is therefore probably much diluted for women. In fact the absence of the effect in women adds strength to our supposition that we have confirmed a true effect of water hardness, affecting mostly men, and therefore probably acting through premature cardio-vascular disease.

We are attempting to strengthen this study by restricting the analysis to those resident in the same place between 1971 and 1981, and therefore with known exposure of at least a decade, and to particular causes of death.

CONCLUSION

In general, the results show that when the three environmental factors are controlled by age and time period alone, the expected changes in mortality risk are seen. However, with the addition of socio-economic and geographic factors most results become insignificant; they are not independent of these factors. Reduced mortality risk for males in hard water areas remains significant in all models. Men in hard water areas experience a reduction in mortality risk compared to men living in soft water areas, and this effect is greatest where water is hardest. Reduction of risk is of the order of 10% in such areas.

In comparison to a number of studies on similar subjects, the number of cases in this analysis is quite large. This, in addition to the length of time that the individuals were followed, suggests that the results for water hardness merit further investigation. However, the main problem of the study is determining the actual length of exposure to the environmental factors. This is probably a greater problem for air pollution than water hardness.

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IV. Newly industrialized regions

DEMOGRAPHIC CONSEQUENCES OF THE BHOPAL DISASTER

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ABSTRACT: This paper examines the nature of the industrial disaster which shook the city of Bhopal during December, 1984, going into the debate as to why and how the incident occurred. Whether it was a human error, a technical flaw or a fait accomplie, the MIC gas leak from the Union Carbide plant damaged extensively the city's ecosystem. The impact lingers on. While welfare measures are in response to human sufferings, the dilemma of huge capital investment made in the Union Carbide project going to waste and a generation of people rendered physically disabled continues to haunt the nation.

KEY WORDS: Industrial disaster, Bhopal, India.

INTRODUCTION

The Union Carbide of India (UCIL) was set up in Bhopal[1] in 1969, as a small pesticide formulation plant, at a cost of Rs. 25 crores (35 million US dollars). The two highly toxic pesticides formulated were *Sevin* and *Temik* — both MIC (Methyl isocyanate) based, the technical concentrate for which was imported from U.S.A. during the early years and the work of blending and grinding was done in the plant at Bhopal. In 1975, the plant was issued a license to manufacture pesticides. It had a licensed capacity of 5,250 tons of MIC based pesticides; 200 tons of methabenzthiazuran; and 50 tons of propoxur.

In 1976, the plant set up a research and development division with an

[1] Bhopal city with a population of 1.7 million is the capital of the state of Madhya Pradesh in India. The plant was set up initially on a five acre plot of land at Kali Parade grounds in Bhopal and later expanded to almost 90 acres. The Union Carbide Corporation (UCC) of U.S.A. owned 50.99% shares in UCIL and UCIL management. The rest were owned by private Indian companies and individuals.

initial investment of Rs. 2 crores (US $ 3 million), with the aim to develop pesticides suitable for tropical conditions. The investment in this division has been increasing since then. In 1977, the Bhopal plant produced 321 tonnes of MIC based pesticides, the MIC being imported from U.S.A. The production picked up till 1979-1980. However, due to a delay in the arrival of the MIC consignment in 1977-1978, coupled with drought during that year which reduced the purchasing power of the farmers, and the introduction of other pesticides, the sales of Bhopal plant fell. In 1980, the MIC plant went into production again. In 1983, it started manufacturing pesticides with locally produced MIC.

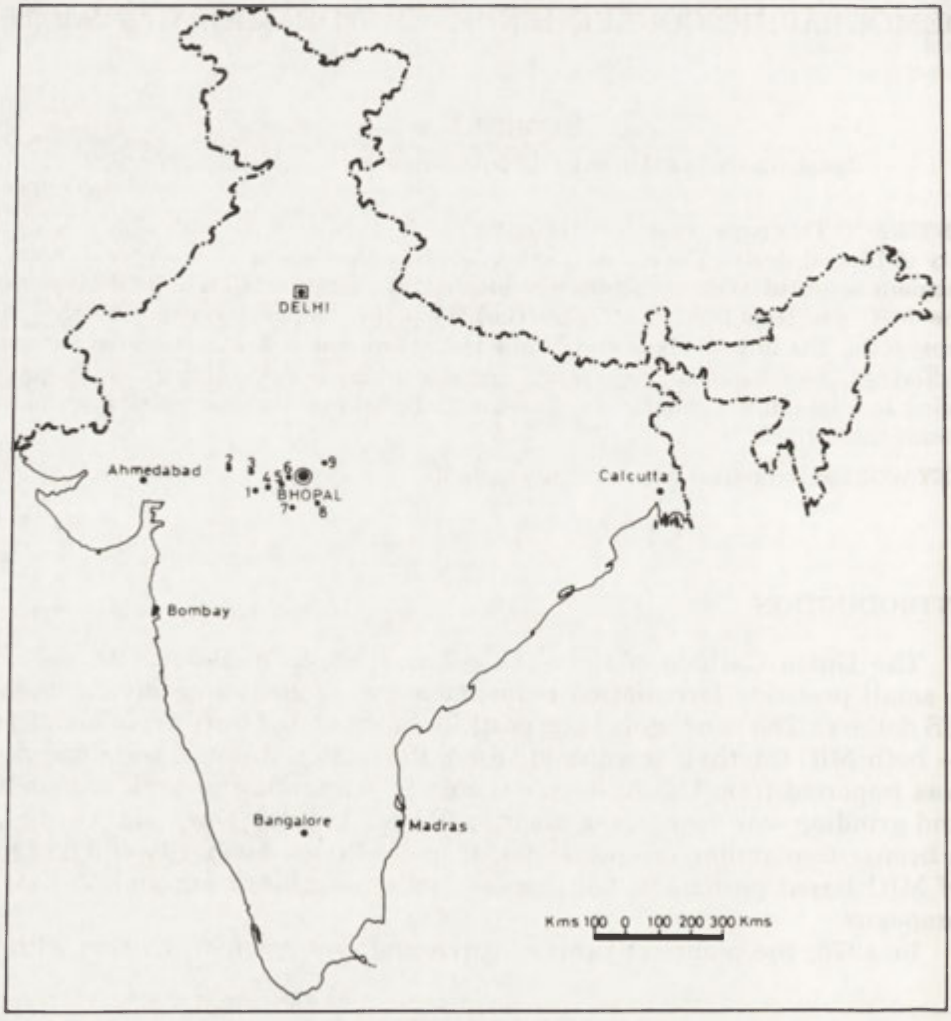

Fig. 1. Location of Bhopal in India
1 — Indore, 2 — Ratlam, 3 — Ujjain, 4 — Dewas, 5 — Ashta, 6 — Sehore, 7 — Hoshangabad, 8 — Obaidullaganj, 9 — Vidisha

INCIDENTS OF UNREST

The location of the plant at Bhopal was controversial from the very beginning partly because of its location in a densely inhabitated area of the city, partly because the plant handled toxic substances. Despite continuous irritation among the local people and bodies, the plant was allowed to expand in territory and diversify its product. From the first year itself, several leakages, big and small, were noticed in the plant but they were just brushed aside. The urban development plan of Bhopal, better know as master plan for 1975-1991, lists a set of "Obnoxious Industries", the Union Carbide being one of them. The factory was located so close to the commercial and residential area and had its history of occasional gas leakages that the local administrator of Bhopal, Mr. M.N. Buch, issued notice to the Union Carbide in 1975 to move out of Bhopal. But nothing happened.[2] Some of the incidents prior to the major disaster on 2/3 December 1984, which created furore in the public and among workers were:

(1) In 1978, there was a major fire in the naphtha storage area;

(2) In December 1981, a phosgene leak killed a maintenance worker;

(3) In January 1982, a phosgene leak left 24 persons severally ill;

(4) In October 1982, a flange broke and a mixture of gases (MIC, chloroform and hydrochloric gases) escaped causing a mini-stampede in the slum around the plant;

(5) In 1983, there were two more minor leaks;

(6) In January 1984, a factory worker died of chemical allergy after working at the plant.

The first death occurred in 1981 of a plant operator (named Mohammad Ashraf) on account of phosgene leak inhaled by him. After this fatal accident, a team of 3 experts from Union Carbide Corporation of USA surveyed safety measures in the plant and pointed towards the following serious lapses:

(a) There was a leakage of water into the tank which could contaminate it;

(b) The tank relief valve was defective and could not control runway reaction;

(c) Manual filling could lead to overfilling;

(d) The phosgene tank pressure gauge was defective;

(e) The valve leakage was endemic;

(f) The plant did not contain an efficient water spray system for fire protection or for vapour dispersal in the MIC operating area or the storage area.

These fears were repeated in a local weekly[3] in three articles under the

[2] Thanks to the clique between plant management, politicians and others who mattered. Thus, instead of factory moving out, the Administrator was transferred and Union Carbide donated Rs 25,000 to Municipal corporation for the development of a Park.

[3] Local weekly named Saptahik Report edited by Rajkumar Keswani. The articles appeared in the issues of September 17, October 1 and October 8, 1982, respectively. Keswani wrote another long article on the same lines in another local Hindi newspaper *Jansatta* but apparently no action was taken at any level.

titles — "Save, Please Save this City"; "Bhopal on the mouth of a Volcano"; and, "If you do not understand, you will be wiped out".

The factory employees' union wrote to the Chief Minister and Central Ministers of the warning of the dangers ahead but their fears were brushed aside. When requested to shift the factory elsewhere, the response was that "it was not a stone which could be lifted and placed elsewhere".

Only a few weeks before the major disaster, the plant was granted an environmental clearance certificate. The central government also extended the license and allowed Union Carbide to extend its collaboration with its parent corporation on the assurance that Union Carbide Corporation (UCC) would provide a safety know-how and technology on a continuous basis, for handling situations like toxic release. But it appears that these instructions remained on paper as no substantial improvement in safety measures was implemented and the plant continued to function with defective systems some of which are identified here.

1. Many instruments in the plant were out of order.
2. The plant did not have a computerized warning system nor computerized monitoring and control systems.
3. The plant's 200 page safety manual was hardly followed.
4. The trained and professional staff who were there when the project was designed had left by December 1984. The plant was running with reduced and less skilled manpower. Even the strength of operators in the MIC control room was reduced. On the day of the accident, MIC control room was being managed by a single operator, who found it virtually impossible to check the 70-odd panels, indicators and controller.
5. The company had not informed the public of evacuation procedures in case of emergency.
6. The plant was under-designed: the key safety device, the scrubber, was ill designed to control excessive feed rate of gas during emergency.
7. The second safety device in Bhopal plant, "the Flare Tower", also might not have worked, which otherwise was also designed to handle MIC only at the rate of a few hundred litres an hour.
8. There is sufficient evidence to show that the entire technology package transferred to India by the UCC was obsolete.
9. Employees morale was low as sales were dropping and the plant was running at 1/3rd of its capacity.

SEQUENCE OF EVENTS ON 2/3 DECEMBER NIGHT, 1984

From various reports, press clippings and eye-witnesses, the following sequence of events can be built up for the night of 2/3 December 1984.

A staff of nearly 120 workers worked inside the factory that night. At about 11 p.m., one of the workers noticed that pressure in Tank 610,[4] the tank from which the gas finally leaked, had risen from 2 lbs per square

inch (psi) as recorded by earlier shift to 10 pounds per square inch (psi). However, corresponding tank temperatures were not available as they were not logged normally. The five-fold increase in pressure within an hour of last reading was dismissed in the belief that the pressure measuring instrument could be defective.

At about 11.30 p.m., the workers realized that there was a MIC gas leak somewhere as they felt irritation and tears in their eyes. On examining the MIC structures, the workers noticed a drip of liquid about 50 ft. above the ground with some yellowish-white gas accompanying the drip. By 00.40 a.m., the situation became quite alarming: the temperature gauge in MIC tank 610 had reached 25°C and the pressure moved rapidly towards 40 lbs per square inch (psi). High temperature and heavy pressure created a tremendous sound like a cauldron. Suddenly, the concrete slab above the storage tank (60 ft. by 6" wide) cracked. The heat was like that of a blast furnace. One could not get within 6 ft[5]. And then there was a loud hissing sound, the gas leaked through a tall stack connected to the tank and formed a white cloud. The cloud started moving to the south, south-east and south-west, in the direction of the wind.

In the plant, the pressure indicator showed 55 lbs psi. The safety valve had opened releasing MIC from the storage tank. Looking at the enormity of the release, the workers sprayed water on the leak, but the water jet failed to the reach the top of 120 ft. stack from which MIC gas was leaking. Efforts were made to turn on the Vent Gas Scrubber (VGS) to neutralize the escaping gas but it did not work.

The Report of the Union Carbide Corporation indicates that at the time of the incident, MIC tank 610 had 90,000 lbs of MIC. The safety valve remained open for nearly two hours releasing over 50,000 lbs of MIC (in vapour and liquid form) and other gases like phosgene, hydrogen cyanide, and carbon dioxide. Sometime between 1.30 a.m. and 2.30 a.m., the safety valve reseated as the tank pressure came down to 40 lbs psi. The first siren was sounded around 1 a.m., one and-a-half hours after the gas started leaking. The wind direction was announced so the workers fled to the opposite direction and thus most of them got saved, but it created confusion among the general public who not knowing what had happened, ran towards the factory and met a fatal end.

The second time the public siren was sounded was at 3 a.m.. By that time, great damage was done to life, both human and animal. There were hundreds dead, and many breathing their last. It seemed as if the whole of Bhopal had come out on to the roads and lay collapsed.

[4] MIC is stored in three stainless tanks code numbered 610, 611 and 619.

[5] This account was given by one of the workers, Mr Suman Dey, who happened to be at that site.

WHAT CAUSED THE VIOLENT REACTION THAT NIGHT?

There seems to have been an "explosive runaway reaction in MIC". This gas can react with almost any chemical including itself, to generate substantial quantities of heat and carbon dioxide. The heat released causes the reaction to speed up which creates more heat and pressure can thus go on building up till it finally reaches an explosive limit. The longer the MIC sits in the storage tank, the greater the chance of side reactions building up the runaway reaction. It was reported that the MIC at Bhopal plant was sitting in the storage tank snce October.

From the reports and subsequent investigations, it appears that poor maintenance of plant, lack of safety measures and a defective warning system all culminated into the tragedy of 2/3 December night.

1. In poor maintenance, it is reported that the engineering control equipment had not been working for a long time before the December gas disaster.
2. Control instruments at the plant were faulty. Many valves, vent lnes and feed lines which should have been replaced every six months had leen overused for over two years.
3. The MIC refrigeration unit had been switched of as an economy measure.
4. The caustic soda scrubber and the flare had been out of service.
5. Chemical reactors' piping and valves had not been plugged, washed and aired before maintenance operations which caused a death by phosgene leak in 1981.
6. Vital devices like pressure gauges were not functioning
7. Unqualified and under qualified people were running the plant at the time of December release. People with chemical engineering background had been replaced by less skilled workers.
8. The number of blue collar workers in the plant was reduced from 850 to 642, over the preceding two years. This made the employees "overworled"'
9. The relieving system for the Operator was suspended. If someone failed to appear for a shift, the plant would run simply without the Operator.
10. Several parts of the safety system comprising the Relief Valve Vent Header (RVVH), the Vent Gas Scrubber (VGS) and the Flare Tower vere hardly in satisfactory condition. At the time of the accident, a vent line leading into RVVH was being washed, the line connecting the VGS to the flare tower was mastercarded for repairs, the motors meant for pumping caustic solutions into the VGS were down and certain metres in the control room panel monitoring the MIC tanks were malfunctioning. Poorly maintaned equipment led to conditions where certain chemicals could gain entry into parts of plants where their presence in minute quantity could start runaway reactons.
11. The plant has two safety devices: the first is a "Scrubber" which neutralizes the gas with caustic soda; if the scrubber fails, the gas goesinto the "Flair Tower" to be burnt off. Both the safety systems failed to work that night. Three other safety systems were either not used or were underdesigned. One, the network of water jets could not reach the height at which the MIC

gas was gushing into the air; two, the refrigeration system which kept the MIC cooled at 0^0C was not functioning; and three, the Bhopal plant has 3 tanks, one of which was always supposed to be kept empty so that it could be used in emergency. But all the tanks contained MIC that night.

AREAS AFFECTED BY MIC GAS LEAK

The MIC gas leak is stated to have affected nearly 40 km^2 and affected seriously the areas up to 5 to 8 km away. The gas clouds spread out to nearly 30 localities forming densely over the areas close to the factory. But for the two lakes of the city which lay en route of the gas clouds, the effect would have been still more disastrous. The colonies closed to the plant experienced the thickest of clouds, and maximum damage (Fig.2). In terms

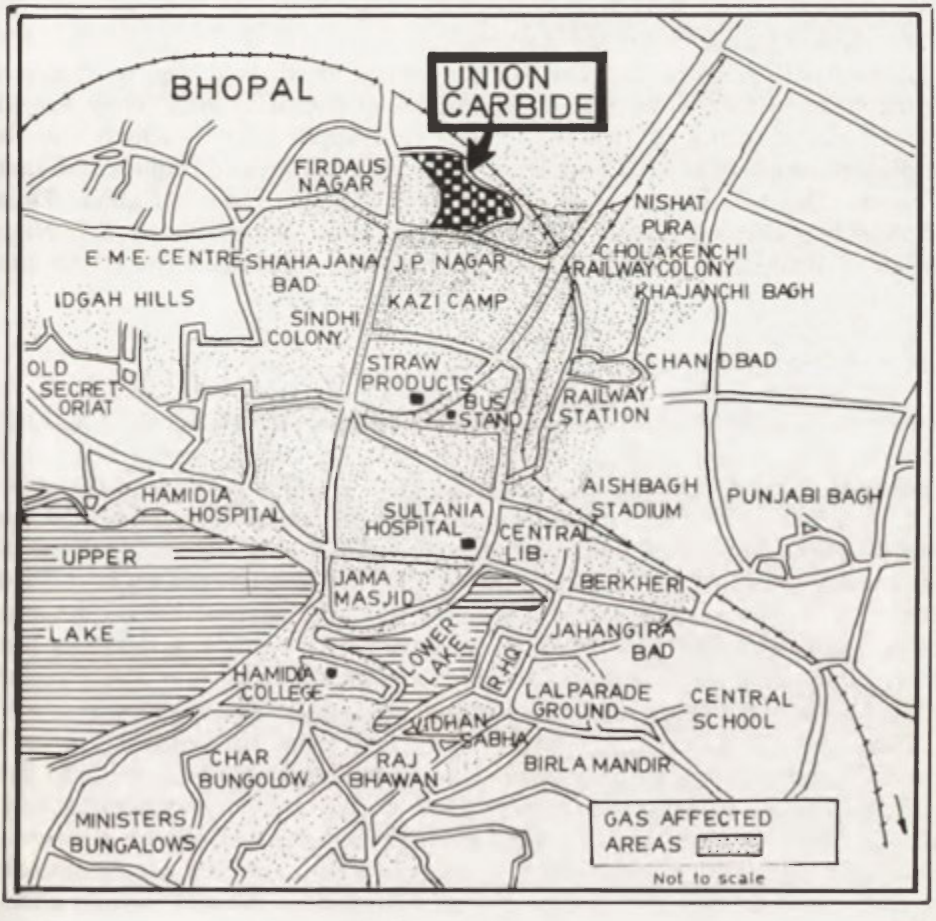

Fig. 2. Area affected by MIC gas leak in Bhopal
Source: Khandekar Sreekant, Suman Dubey (1984), p. 8

of intensity of impact of the MIC leakage, three zones of varying intensity could be identified:

A. The zone of maximum intensity

It includes ten localities, namely, J.P. Nagar, Chola Kazi camp, Dwaraka Nagar, Berasia slums, Nishatpura, Chola Kenchi, Railway colony, Khajanchi Bagh, Railway station and Chandbad. This area lies adjacent to the Union Carbide in south, east and south-east direction and being in the prevailing wind zone was subject to heavy damage to life and property.

B. The zone of moderate intensity

This zone includes the ten localities of Straw Products, Bus stand, Hamidia Hospital, Sultana hospital, Aish Bagh Stadium, Punjabi Bagh, Berkheri, Jama Masjid and Jahangirabad and Idgah hills.

C. The zone of low intensity

Lying furthest from the plant in the south, south-east and west are the ten localities with least intensity of impact of the MIC leak. They are also situated closer to the two lakes — lower and upper lake — which absorbed the poisonous effect of MIC and other gases and minimized impact of disaster on them. The ten localities are Professors Colony, Vidhan Sabha, Tagore hall, Central School, North T.T. Nagar, Malviya Nagar, South T.T. Nagar, Ministers' Bungalow, P.H.Q., beside EME centre located in the north-east.

POPULATION AFFECTED

The estimates of population affected are between two lakhs (200,000) to 3.2 lakhs (320,000). The deaths claimed vary from 1700 to 10,000. The number of patients admitted to the hospitals at one or other stage is estimated to be 1,73 lakhs (173,000). Indian government in its petition to U.S. Courts claimed 1700 dead while estimates of UNICEF officials visiting the site indicate 10,000 deaths. The Retail Merchants Association claims that 10,000 coffins' cloth was sold by them also puts the figures around ten thousand. But reading through the human trauma and suffering of the first few hours which is parallel to the human misery caused at Hiroshima and Nagasaki in World War II, the deaths caused may be many more.

The worst sufferers were the people who lived in slums close to the Union Carbide factory as they did not have protective walls or roofs to check the intrusion of poisonous gas into their shelters. The army units had to pull out families after families dead from their houses. Railway station and Bus Stand were the other centres of mass human calamity where houseless population lived. UNICEF study estimated that of the 200,000 people affected 75% lived in slums, 40% were children and 20% women in the reproductive age-group.

The others who suffered were those who ran out of the houses looking for a safer place after they woke up choking from the poisonous-gas leak. Those who ran on foot faced the worst calamity. A study conducted by the Centre for Social Medicine and Community Health at Jawaharlal Nehru University, New Delhi indicates that three-quarters of deaths came from those who ran on foot as nearly three-quarters of their sample ran on foot. Incidentally, none of those who moved in vehicles died.

The human consequences of this industrial disaster can be grouped into four phases: catastrophic, cataclysmic, climacteric and causative.

A. Catastrophic

The first three hours starting from 11.30 p.m. on 2 December was the period of great nightmare. As the gas cloud engulfed the city, it put several hundreds to death in sleep specially those who lived in slums and shanties and were exposed to the gas. The others woke up coughing violently with their eyes burning like with chilli powder. As the irritation grew, breathing became difficult, they fled, some with, others without their families. The factory siren did not give them clear directions. They ran towards factory sensing danger to the factory but got trapped in smoke. They ran towards the railway station and bus stand, again the areas of MIC gas concentration, causing in turn risk to themselves.

There was a panic at homes, on the roads, at the railway station. The main thoroughfares were jammed with uncontrollable streams of humanity, with human vomit and excreta, dead bodies of animals, men, women and children. Those who could not walk long just collapsed. Children were the worst sufferers, unable to keep pace with elders they simply collapsed on the roads, many got trampled and died. Others were separated from their parents and wandered in vain. Thousands fled out of the city to nearby towns of Sehore, Vidisha, Hoshangabad, Obaidullaganj, Ashta, Ujjain, Dewas, Indore, Ratlam and even Nagpur (Fig. 1). Hundreds of taxi, auto-rickshaw, tempo and truck operators risked their lives in evacuating the public, specially when the railway station was closed for traffic for almost seven hours.

Those who could not leave the city found their way to hospitals. At Bhopal's Hamidia hospital, the first patient with eye trouble reported at 1.15 a.m. Within five minutes there were a thousand and by 2.30 a.m., there were 4000 suffering not only from eye-ailments but also from respiratory problems. The hospitals lacked medicines to treat such a large volley of patients. The medical staff of the hospitals were soon affected by the gas. Only a few staff were available to look after the patients.

The army was pressed into service. Victims were brought by army trucks to hospitals. By 1 a.m., 25000 people were cramped into Hamida hospital. But in front of doctors, mute spectators, people started breathing their last. By the time sun rose, thousands lay dead in the hospitals, on the roads, in their homes, under the sheath. They died of suffocation, panic, trampled under the stampede and lack of medical care.

B. Cataclysmic

The second phase, which extended from 3 hours to 3 days, experienced the aftermath of the MIC gas leak trauma. The Indian Council of Medical Research claimed that most of the deaths occurred within 48-72 hours of the gas-leak accident. Official figures state about 1200 died in hospital wards and total deaths were probably 2000.

But there are many who tell a different story. Accordingly in the first two days, there were so many deaths that it was difficult to keep an account of them: corpses were picked up by the army in truck-loads and buried and cremated en masse. The army conducted a systematic search of houses for people trapped therein and in that process found families completely wiped out. At the cremation grounds, several pyres burnt simultaneously with several bodies burnt together on a single pyre. The city ran out of wood for pyres. People helping to remove dead bodies to cremation ground/grave-yards started showing signs of exhaustion. The gigantic task before the civic authorities and armed personnel had been to clear the city of the dirt caused by human illness, (vomiting, human excreta), removing the corpses of dead animals and human-bodies cremating or burying them, trying to unite lost members of the families and sending lost children to orphanage.

C. Climacteric

This phase extending up to 3 months highlighted the after effects of the gas-leak; the impact of faulty treatment on the health and well-being of the gas victims. It also revealed some of the acute problems confronting the gas victims.

The effect of inhaling poison a lethal dose not amounting to causing death, was soon visible in the general health conditions. This was further magnified by the wrong medicines injected into the system immediately after the gas leak and thereafter.

The gas victims suffered from respiratory problems like breathlessness and coughs; gastrointestinal symptoms like nausea, vomiting, burning in the stomach; psychiatric symptoms like depression, anxiety, sleep disturbance, gas phobia etc. The medical reports revealed that nearly 500 gas victims developed corneal ulcers and they could go blind. Some people showed signs of paralysis.

On the 7th day of gas-leak, a fresh panic struck the city. It was noticed that the Union Carbide plant was still left with a large amount of MIC. It had to be disposed off immediately lest the story got repeated. The government decided to start the plant to consume the remaining MIC manufacturing carbaryl. This made the people of Bhopal highly panicky and led to large scale exodus of people from the city. It is estimated that nearly 100,000 people left the city in panic again. The only people left behind in the sensitive localities were those who were too poor to leave. Panic was so high that even the indoor patients fled. Though the government stated through the press that there was no cause to worry, the schools were closed. People were

too sceptical to believe the government. By December 14, a quarter of Bhopal's population had fled the city.

On December 16, 1984, nearly 5 tons of MIC were converted into pesticides. On December 17, another 4 tons were used up and the process went on for 7 days indicating that there was lot more MIC gas in the tanks than expected. Nearly 24 tons of MIC were converted into pesticides.

One of the worst effects of the disaster was the generation of a deadly ecosystem. Nearly 7000 animal bodies had to be cremated and buried apart from hundreds of humans. The stink and filth generated all around made living difficult. Coupled with it was the fear of food poisoning. The quality of fruit, vegetable, fish, meat and water became doubtful. Samples of fish examined from 15 places showed that the sample coming from the gas infected areas had signs of anaemia. The Indian Council of Agricultural Research team reported that there was an immediate drying of milk of the milch-cows after exposure to gas. The Central Board for the Prevention and Control of Water Pollution examined the effect of MIC gas leak on plants and soils and found that the worst hit area was 3.5 km^2 around the plant-site. The Board's team suggested that fruits grown on the trees in the affected area should not be consumed. Another research team from Banaras Hindu University suggested that vegetables grown in the affected area should not be consumed and the entire crop should be destroyed.

Three weeks later, there were fears of epidemics as green flies invaded the city because of poor sanitary conditions, stink, improperly disposed animal carcases. The sanitary staff had to be requisitioned from other towns and help from the army was sought to overcome this problem.

Malnutrition and loss of work were two other problems haunting the gas-victims. Continuous headache, dizziness, lack of concentration, irritation in the eyes, allergy to fire and smoke, loss of physical stamina were some of the common complaints of those affected by MIC. They were physically not able to get up from their beds or cook their meals. They could not undertake manual work, hence the casual labour disappeared. Those who depended on livestock had lost them too. Side-effects of antibiotics created more problems like T.B., anaemia and dehydration, which added to the miseries of the gas victims.

The voluntary agencies working in Bhopal reported that nearly ten thousand people were incapable of performing physical labours many survivors turning to begging.

D. Causative

Nearly ten years after the incident, the misery for Bhopal gas victims remains unabated. More than one year after the catastrophe, about half the victims who underwent moderate or severe exposure remained debilitated. Nearly 100,000 people remained unable to work or live normally. About 50,000 had shown a significant deterioration in their condition, akin to those afflicted by a degenerative disease. The response to medical treatment in

most cases has been nil. Thus the future of thousands of them appears bleak. Some of the research studies bring out glaring realities.

A preliminary survey of 205 children in Bhopal showed that 6% have epilepsy, and 68% have difficulty in keeping up with their studies. Children seem to be the worst sufferers needing sympathetic counselling and massive rehabilitation.

Indian Council of Medical Research (ICMR) surveyed nearly 11,000 gas victims in 1985 and found that 1660 of them suffered from lung problems, 1425 from eye problems and 5067 from both. ICMR further identified 404 pregnant women 97 of whom had delivered. Five had still births, 17 had abortions, 3 new borns suffered from birth abnormalities. Most babies were of full term but low weight. ICMR's study of 114 women from two of the worst affected localities (J.P. Nagar and Kazi camp) showed that 90% suffered from leucorrhoea, 79% from pelvic inflammation diseases, 31% from excessive menstrual bleeding, 59% from suppression of lactation. All these figures were several times higher than those found in non-affected colonies of Bhopal. Experiments in a number of laboratories suggest that MIC may produce cancer and genetic change. ICMR investigations further revealed that MIC infected patients were suffering from chronic "cyanide poisoning". It instructed the state government to use "sodium thiosulphate" as patients given this injection showed remarkable improvement and tests showed 8 to 10 times increased quantities of thiocynate in the urine which indicated that the body was getting rid of the poison.

The International Medical Commission on Bhopal (IMCB) has found long--term damage to the brain in survivors of Bhopal gas disaster. The preliminary findings of the 15 member commission after 12 days clinical study in January 1994, said that a large number of people had impaired memories loss of motor-coordination and certain neurotoxic changes. Chromosomal abrasions had occurred in the survivors and the carbide gas had damaged their immune system. This had made them vulnerable to innumerable infectious diseases.

The Commission said that the survivors suffer acutely from breathlessness, chest pain, diminished vision, muscular fatigue, hypertension, anxiety, chronic depression, menstrual irregularities, tuberculosis of lungs and other physical and mental illnesses, besides neurotoxicity and post traumatic stress. The children born to women exposed to gas suffer congenital malformation and mental and physical retardation. The effect on women pregnant at the time of disaster could not be examined as spontaneous abortions went up considerably. This could have been due to some abnormality induced by the lethal gases. The mortality rate among the survivors is higher than that of the people elsewhere in the country. An estimated 10 to 15 people die every month after prolonged suffering. The study reported that the survivors continued to suffer from a complex combination of ailments unprecedented in medical history.

After several years of legal battle in the US Courts, the Government of India was able to secure compensation of a paltry US $ 470 million, which

actually is the insurance cover of the Union Carbide in India. This in no way compensates for the irreversible damage caused to the health of the survivors, the fall-out of which may linger for generations. Even within the country, their woes remain unheard; illness, unemployment, sufferings and humiliation are their fate. Dr. Gianni Tognoni, coordinator of the IMCB, is quoted to be saying that the health care system for Bhopal gas tragedy victims has been inadequate (Health Care... 1994). There is no proper follow-up system and the treatment is generally symptomatic. He stressed the need to overhaul the system from a hospital-based approach to a community--oriented one.

The chairman of the Commission Dr. Rosalie Bertell recommended (Brain Damage... 1994) that Indian Health Authorities should adopt Bhopal as a priority area for the state policy of a community-based health approach. This is necessary because of inadequate health care facilities in Bhopal hospitals.

THE CURRENT DILEMMA

The trauma of MIC gas-leak continues to haunt the two hundred thousand people of Bhopal, who directly or indirectly fell victim to its passage. Worse still is the indifference with which the victims are being treated. Many of the victims, unfit physically and psychologically, do not even know what have they lost. The inadequate health-care and the health degradation process are leading them to health-hazards which are likely to filter down to succeeding generations. Opportunism has crept into certain sections of society who want to cash in on the miseries of such people by filing false compensation claims. Those who escaped the tragedy are too shocked to say anything about the event. Inadequate employment, nutrition and family loss are matters of deep concern for the sufferers. Those who realize their state of affairs are critical of government's efforts and suspicious of bureaucracy, which often dismisses their claims labelling them as "lazy population greedy of compensation". The International Medical Commission on Bhopal noted that although the clinical conditions of victims might be elusive, the sufferings they were subjected to were heavy. The Commission's recommendation that social and not merely medical damage should be considered makes sense. At present only an inadequate set of medical criteria are used to determine compensation. The injury is considered temporary if the health today is worse than the health on the day of the accident. That lakhs of victims have persistent problems ten years after the accident makes it obligatory to recaste the whole concept of medical claimants. At present over 92% of the total claimants are classified with temporary injuries, 44% of the claimants have not yet been medically examined. Many victims received no documents in the chaos of the disaster so they run from pillar to post filing their claims, but they are just brushed aside as false claimants.

However, personal interviews of a few of the victims (conducted during April-May 1994) revealed that the State had fixed up a monthly allowance for all those who claimed damages till their final claims were settled. Those who received the monthly allowance (Rs. 200) and those who had already received their final compensation (Rs. 1 lakh if no apparent injury is caused) seemed to be quite pleased with government's efforts to rehabilitate them.

While rehabilitation and health of the victims continue to be priority areas for the government, the huge investment made in the Union Carbide factory remains idle. This is an awesome waste of land and capital resources in a developing country.

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POPULATION, POVERTY, AND POLLUTION IN CUBATÃO, SÃO PAULO

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ABSTRACT: The steel and petrochemical complex of Cubatao, on the Atlantic coast 40 km from the city of Sao Paulo, Brazil, became in the 1970s and 1980s a symbol of environmental disaster. Built in the period of rapid import-substitution industrialization of the 1950s and 1960s, Cubatao's industrial complex developed without consideration of geographic features which concentrated air and water pollution. Effects on deforestation, geologic destabilization, poisoning of mangrove swamps and on the health of local residents were ignored until the early 1980s. This paper describes this process and identifies in a series of specific migration mechanisms part of the explanation of the delay in dealing with this serious problem.

KEYWORDS: Population, poverty, pollution, deforestation, Cubatão.

INTRODUCTION TO AN ENVIRONMENTAL DISASTER

The 1980s placed Cubatão, the largest petrochemical complex in Latin America, in the public spotlight, in Brazil and internationally, as the epitome of industrial pollution. Acid rain, congenital defects, deforestation and pollution of air, water and soil were widely disseminated in the press and in scientific publications. Cubatão personified decades of industrial growth at the cost of environmental negligence. Although programmes of pollution control and recuperation are in progress since 1984, the Cubatão experience continues to challenge students of society and environment. In an era of environmental awareness, how was it possible to reach such a critical stage before corrective action was taken? We will have important clues for the answer if we understand who paid (and still pay) the price of pollution.

Far from a democratic and egalitarian plague, affecting all social classes equally, pollution is socially directed to certain segments of the population. The present text intends to examine the socio-demographic characteristics of those who live and work in Cubatão. We will examine in particular how several migratory mechanisms act to permit the maintenance of a local social structure predominantly composed of the poorest of the poor. These

mechanisms guarantee a highly qualified labour force for the petrochemical and steel-making industries which does not reside in the city. Residents include a large floating population with few occupational skills and a small middle and lower-middle class which took a long time to face the hazards of environmental pollution. This text draws a socio-demographic profile of these groups — resident and non-resident workers — and discusses how local environmental perceptions were formed and came to interfere in the control process.

CUBATAO: "THE MOST POLLUTED CITY IN THE WORLD"

Cubatão is a small city on the outskirts of São Paulo, 40 km from the capital, with a population of 91,049 residents in 1991 (Fig. 1). Together with Santos, Sao Vicente and other smaller cities, it is part of the Baixada Santista Region, a region of early urbanization, already predominantly urban in the 1940s. This nearly complete urbanization also characterizes the municipality of Cubatao (99.5% urban in 1991), with a larger proportion of migrants (69% against 59%) than the region as a whole.

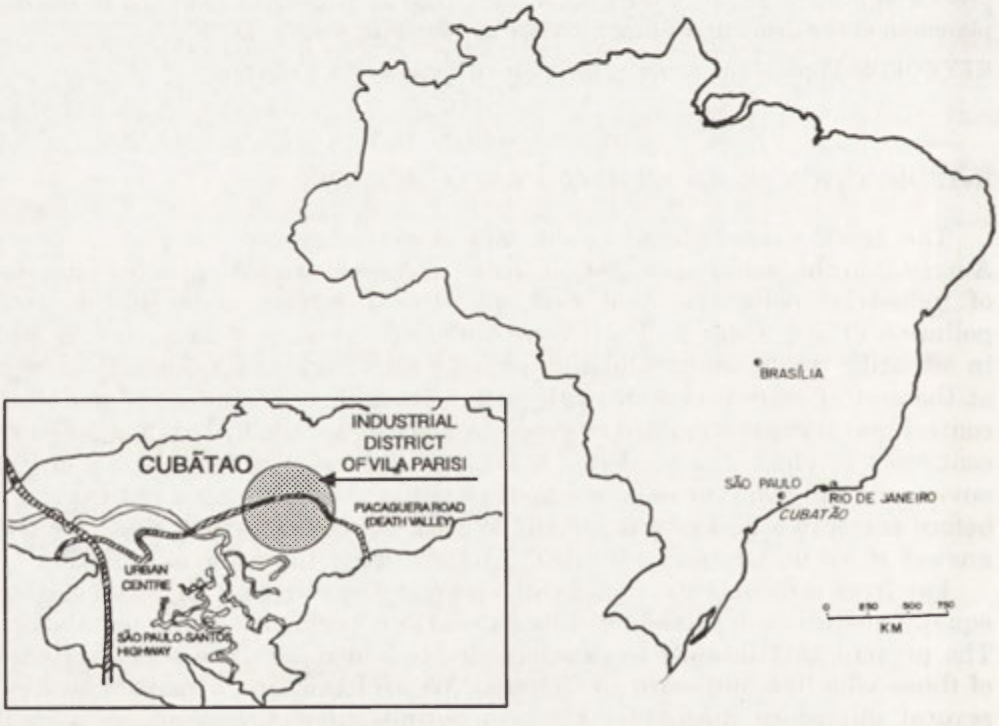

Fig. 1. Location of Cubatão, São Paulo

Separated from Santos as an independent municipality in 1949, Cubatão shares many characteristics with the region. The Sao Paulo coast is a narrow strip of land between the escarpment and the sea, and the trip up to the inland plateau, 700 m above, is short. The rain and wind regimes produce a hot and humid climate, and the region is often covered with clouds. The relief is marked by small hills (the *sugar loaves*), that act as barriers for the wind, creating pockets of micro-climates along the coast, and extensive swamp lands where the land emerges here and there permitting the occupation of the inter tidal zone.

This is especially the case of Cubatão, located at one end of an arm of the estuary of Santos. Decades of drainage and landfills have "created" land from the swamp, leading to the industrial and residential occupation of today. Although geographically integrated with the coast, separated from the city of São Paulo, Cubatão (as Santos) is an integral part of the metropolitan economy. Cubatão is essentially a specialized district of the industrial park of São Paulo (Goldenstein 1972).

Endowed with an excellent transportation system, which today includes the port of Santos, a railway and two superhighways, the city seemed a natural choice for a petroleum refinery (early 1950s) and a steel mill (1970s), both demanding large volumes of raw materials, to be transformed and transported to the industries up the mountain. These two large state-owned industries have now generated more than 20 others, especially petrochemicals, fertilizers and cement. The city is responsible today for 2.6% of Brazil's GNP

What turned this district into an environmental disaster was not simply the character of its industrial processes. These industries are certainly polluting anywhere. In some measure, this is a common situation for industrialized regions. But what is usually a *problem* for other communities is a *disaster* for Cubatão due primarily to geographical factors. Since winds are weak, pollutants in the atmosphere do not disperse quickly. And the direction of these winds, from sea to escarpment, means that the pollution, when it does disperse, falls on the forested slopes. The result is the deforestation and geological destabilization of the mountainside, threatening to bury the residents and the very industries that created the problem. After an avalanche in January of 1988 killed ten people, authorities remove the families from the risk areas during heavy rains.

On the other hand, the low velocity of the rivers, the tide, and the interruption of natural fluxes by draining and land filling mean that residues dumped in the water are not easily washed to the open sea. The result is the poisoning of the estuary, with all sorts of toxic substances, including mercury and other heavy metals (Amaral, Silva et al. 1982). Many ponds appeared dead, and residents complain that they fish less and less, and that blind and deformed fish have begun to appear.

Man has not escaped unharmed from this environmental assault. To detect, measure, and describe these consequences are more difficult tasks for many reasons, among which is the migration to be discussed below. But

benzene poisoning (Diesat 1988), the incidence of respiratory and dermatological diseases (Hogan 1990a), besides work accidents (Medrado-Faria et al. 1983), are eloquent testimonials of the suffering of the Cubatão population.

We are dealing, therefore, with a situation of severe environmental stress, where only recently have some corrective measures been taken. Although the results of the attempts to contain the erosion of the escarpment are still unknown, and residential and industrial residues continue to be dumped in the estuary, some progress is being reached in relation to the liberation of pollutants into the atmosphere[1]. And more importantly is that the official policy of the government of the State of São Paulo is now directed to solutions for these problems.

These conditions have as accomplices in crime a predatory developmentalism and twenty years of a dictatorship that gave *carte blanche* to big business. During a period when the rest of the world was waking up to the environmental question, the story of Cubatão was silenced. This happened as a direct consequence of press censorship and Cubatão's status as a "national security" municipality, and indirectly from an official position which opened the country to pollution as the price for progress. This position, defended by Brazil at the United Nations Conference on the Human Environment, in 1972 in Stockholm, guaranteed an unfortunate notoriety only partially diminished two decades later.

This analysis focuses especially on the period before the *prise de conscience* of the state government, and seeks to understand the factors which contributed to the silence which surrounded the problem: How did things get so bad before public attention was drawn to Cubatão? The history of the 1960s and 1970s records many environmental protests. Why not in Cubatão? Without discarding explanations in terms of ideology and economic interests, we focus here on a set of variables at the local community level. We seek to understand the contributions of social and demographic dynamics as key factors in the community and regional context.

COMMUTING TO CUBATÃO

In this region, the phenomenon of commuting[2] arises as a major factor in conciliating job opportunities and availability of residential land. The experience of Cubatão needs to be understood in this context. Integrating the Santos Government Region are eight cities: Santos, Cubatão, Guarujá, Itanhaem, Mongaguá, Peruíbe, Praia Grande and São Vicente. Observing the commuting patterns of this micro-region, three groups can be classified.

[1] This progress, however, is slow and ambiguous. Of 23 measuring stations of inhalable particles in the metropolitan region of Sao Paulo and Cubatao in 1991, Vila Parisi in Cubatao continued as pollution champion. The daily pattern of inhalable dust was surpassed more than 40% of the time in that year (Cetesb 1992).

[2] The census question refers to those who work or study in a place different from the place of residence. Although today the University of Sao Paulo maintains an Engineering School in Cubatao, it is unlikely that commuting to Cubatao in 1980 included students.

The first, formed by Cubatão and Santos, is characterized by a positive ratio between the incoming and outgoing populations. Cubatao stands out by the migratory intensity that the daily balance represents in relation to its total population (32.4%) and by a much higher ratio than Santos (6.5%). The second group, São Vicente and Guaruja, is characterized by a negative ratio. With a total population similar to the first group, São Vicente stands out not so much by the ratio of incoming to outgoing commuters, but by the impact that the migratory balance represents for its total population (18.1%). The third group is formed by Praia Grande, Mongaguá, Peruíbe and Itanhaem and is characterized by an equilibrium between outgoing and incoming the population. This equilibrium does not represent a significant alteration of the total population.

An important reason for the lack of reaction to the growing pollution problem was the ease with which commuting patterns were established. Thousands of jobs for technicians, administrators, engineers and skilled labour could be filled without having to pay the price of living with pollution. The excellent system of transportation and the proximity of neighbouring cities allowed the installation of an industrial park in this isolated — but not distant — district. Although pollution problems of neighbouring cities should not be ignored, the peculiar geographical factors of Cubatão concentrate pollution, and workers could leave at the end of their shift to nearby cities where the air, if not so clean, was less toxic than in Cubatão.

This commuting pattern has two principal, and related, consequences. In the first place, it means that consequences to health are felt especially by the resident population of Cubatão, exposed twenty-four hours a day, 365 days a year. This population is, in general, much poorer than commuters. They are unskilled construction workers, night watchmen and public transportation workers. The best jobs at the petrochemical industries and steel mill are held by commuters. Thus, commuting has the effect of socially concentrating the price of pollution.

In the second place, and this is the vicious circle of the Cubatão story, the truncated social pyramid that resulted from the migratory patterns diminished the potential for political action. The social, political and cultural capital which would permit the formation and success of social movements were removed from Cubatão via commuting. Not only the educated middle class, but also the skilled, unionized labour of the steel mill and oil refinery went home every night to Santos or São Vicente. Their wives and children did not even have to set foot in Cubatão. Precisely the segments with a political mobilization history were the least affected by pollution, and the least motivated to respond to its challenge.

The next paragraphs describe the volume and characteristics of these two groups. The demographic profiles present a vivid contrast between two worlds we always knew existed. The environmental dimension only confirms this division and widens our understanding of the mechanisms that maintain it. The volume of movement is remarkable and affects all aspects of life in

Cubatão. It is even more remarkable when we observe that 92% of them are men. The sex ratio of the municipality (residents) in 1980, 120 men to 100 women, is already the highest among the municipalities of the State of Sao Paulo; among commuters the ratio is 1,179 men to 100 women. They are also very concentrated at working ages: 90.9% are between the ages of 20 and 49 (compared to 46.9% for residents — already very high due to migrant selectivity). For this age group, commuting increases the municipality's sex ratio by 67.9%.

RACE

Cubatão is the only municipality in the State of São Paulo with a White minority, a situation to be discussed in the section on selectivity. It is interesting to observe that the proportion of Whites among commuters increases regularly with age. This reflects miscegenation as well as the fact that older commuters, who occupy positions of greater responsibility and authority, are White.

MARITAL STATUS

What does marital status reveal about differences between residents and commuters? That migrants are less stable, and with fewer ties, while residents are solid heads of the family? The data show the opposite: 59.3% of commuters, against 44.2% of residents, are married. The proportion of consensual unions is similar for both groups, although somewhat higher among residents (9.4%) than commuters (8.0%); the same is true for divorce and separation (2.7% for residents and 2.4% for commuters). The proportion of residents who are widowed is ten times that of commuters. And the proportion of "no answer" for residents (2.5%) is almost three times that of commuters (0.9%), probably reflecting other statuses than "marriage". In each age group in the 20-40 year old population (more than 90% of commuters), all these differences are maintained. The resident population, even when controlling for age, has a smaller probability of being married, and a greater probability of being divorced, separated, widowed, single or in consensual unions than commuters. This is a significant aspect of the social dimensions behind informal jobs and the itinerant characteristics of Cubatão's population.

REGION OF ORIGIN

Table 1 compares commuters with residents, controlling age, according to region of birth. Fewer than one quarter of residents and more than half

of commuters were born in the State of São Paulo. The situation is almost exactly the opposite for those born in the North-east. The better jobs of commuters (see the following section) are reserved for *paulistas*, while migrants from other states occupy lower positions in the local economy, especially in the services which require residence in the municipality.

TABLE 1. Residents and commuters, by region of birth, population 20-49 years old, Cubatão 1980

Region	Residents		Commuters	
	No.	%	No.	%
North	45	0.1	108	0.4
North-east	18,707	50.7	6,521	26.0
South-east				
São Paulo	8,984	24.4	14,320	57.1
Other South-east	6,964	18.9	2,461	9.8
South	1,460	4.0	742	3.0
Centre-West	161	0.4	140	0.6
Other Brazil	264	0.7	9	0.0
Foreign	276	0.7	752	3.0
No answer	23	0.1	8	0.0
Total	36,884	100.0	25,061	100.0

Source: F. IBGE 1980, Demographic Census, 25% sample.

OCCUPATION

In the analysis of occupation, we used the occupational scale elaborated by Valle Silva (1985) to examine differences among residents and commuters[3]. Table 2 demonstrates clearly the advantages of commuters, particularly those from Greater São Paulo, in relation to the residents of Cubatão. Since the large majority of commuters are men, the comparison is restricted to them. There is a difference of more than 50% between the scores of residents (9.67) and commuters (15.12). Among these, those from Greater São Paulo, with a score of 24.59, 63% higher than commuters in general, stand out. The well-known correlation between race and socio-economic status suggests that the racial composition of the two groups, discussed above, is part of the explanation of the differences found regarding occupation. In fact, Blacks and the Mixed-race population have the lowest scores, and the advantages of non-White commuters relative to non-White residents are not very significant. But White residents have little advantage (10.41) in relation to resident Blacks (8.48) or Mixed-race (9.15), while the difference among

[3] This scale produces a value between zero and one hundred for each of the occupational titles, ordering them on income and education.

commuters is much higher (16.82 vs. 9.88 and 10.40). The group denominated Yellow has the highest scores: 21.41 (residents), 37.26 (commuters), and 47.33 (commuters from Greater São Paulo). As we can see, the socio-economic advantage associated with color exists in a very attenuated form among residents of Cubatão, a group more homogeneous (standard deviation of 5.69 versus 15.28 for commuters) in its lower socio-economic position.

TABLE 2. Residents and commuters by occupation and race: average scores on the Valle Silva scale, men 15 years and older, Cubatao, 1980

Race	Residents	Commuters	Greater São Paulo Commuters
White	10.41	16.82	25.84
Black	8.48	9.88	11.32
Yellow	21.41	37.26	47.33
Mixed- race	9.15	10.40	12.93
Total	9.67	15.12	24.59

Source: F. IBGE 1980, Demographic Census, 25% sample.

Tables 3 and 4 confirm the image produced by the occupational scale scores. When we compare the most common occupations between residents and the most favoured commuters better placed — those originating from Greater São Paulo — the difference is clear. The occupations of residents (Table 3) are greatly varied — 203 occupational titles versus 71 for the commuters from São Paulo. Heading the list are those who do not declare occupation (12.85%), followed by "poorly specified" and unskilled occupations. The migrants from São Paulo (Table 4) are engineers (10.62%), managers (5.5%) and other more specialized professions.

TABLE 3. Resident men age 15 and over, by occupation, Cubatão, 1980: the ten most frequent occupations

Occupation	Number	Percent
Poorly specified occupations	2,040	6.97
Bricklayers' assistants	1,863	6.36
Chauffeurs	1,695	5.79
Carpenters	1,637	5.59
Bricklayers	1,212	4.14
Mechanics (unspecified)	965	3.30
Welders	943	3.22
Clerical assistants	892	3.05
Painters	793	2.71
Other industrial occupations	776	2.65
3,763 men (12.85% of this population) did not declare an occupation		
Total number of occupational titles	203	

Source: F. IBGE 1980, Demographic Census, 25% sample.

TABLE 4. Male commuters from Greater São Paulo to Cubatão 15 years and older, by occupation, 1980: the ten most frequent occupations

Occupation	Number	Percent
Engineers	113	10.62
Chauffeurs	87	8.18
Supervisers	59	5.55
Mechanics (unspecified)	59	5.55
Factory foremen	58	5.45
Poorly specified occupation	44	4.14
Draftsmen	37	3.48
Construction foremen	33	3.10
Bricklayers	29	2.73
Managers	28	2.63
Total number of occupational titles	71	

Source: F. IBGE 1980, Demographic Census, 25% sample.

FORMAL AND INFORMAL EMPLOYMENT

Another indicator of inferior socio-economic position is participation in the informal sector. In comparison to commuters, residents of Cubatão are less integrated to the formal job market. Commuters, as is expected, are almost always registered contributors to the social security system: among commuters aged 20 to 49, only 0.9% declare they do not contribute. The corresponding values for residents (4.3%) is almost five times greater. This fraction increases significantly among younger and older groups, where there are few commuters: 27.8% workers under 20 and 7.7% of those over 50 were not contributors. Once more, we capture the image of two worlds represented by residents and commuters: on the one hand registered workers in basic industrial sectors, and on the other a tendency for non-registered work in the informal sector.

EDUCATION

The last completed grade as a measure of education, reveals a great contrast. Only one quarter of residents versus more than half of commuters went beyond elementary school; a third of residents but only a fifth of commuters did not complete even elementary school. Once more Greater São Paulo commuters appear as the highest group: one quarter of them completed a university degree.

There are 3900 people with higher education working in Cubatão, 457 of whom reside in the municipality, 277 (7%) live in Greater São Paulo, while the others live in other municipalities of the Baixada Santista. The Greater São Paulo stream, if relatively more educated, is not homogeneous nor does it contribute the larger part of the more educated.

TABLE 5. Net intermunicipal migration, Santos Government Region, 1970-1980

Municipality	Net migration	% 1980 Population
Cubatao	-4,236	5.39
Guarujá	6,074	4.02
Itanhaem	-94	3.40
Mongaguá	-3	3.00
Peruíbe	-781	4.24
Praia Grande	6,769	10.22
Santos	-34,459	7.23
Sao Vicente	25,218	13.07

Source: F. IBGE 1980, Demographic Census, 25% sample.

If the majority of commuters originate from within the region, the opposite is true for more permanent movements. Table 5 shows that Cubatão lost population *vis à vis* other municipalities of the region between 1970 and 1980. The significant volume of immigration came from other regions, especially from the North-east. It is interesting to compare the signs of net intermunicipal migration with the net commuting: in all cases, municipalities with positive net migration had negative net commuting, and *vice-versa*. Although Cubatão is an extreme case, work and residence decidedly do not coincide in the Baixada Santista.

SELECTIVITY

Commuting may be the most notable migratory mechanism involved in the population/pollution dynamic in Cubatão, but three other factors must be mentioned. In the first place, the resident population discussed so far is composed almost entirely by persons not native to the municipality. Almost 70% of the population was born outside the municipality; if we consider the age group under study (20-49), migrants would form an even larger part. But the demographic growth promoted by the economic development of the last four decades is much different from that which characterized the State of São Paulo as a whole, a state that was one of the most important migrant destinations of this period. Poor living conditions, lack of urban amenities and environmental pollution related to these factors attracted a class of migrants generally poorer and more desperate. A vicious circle was established where pollution discouraged the more prepared (and competitive) migrants, with the potential to revert the situation of environmental degradation. Pollution worsened, making Cubatão more and more unattractive.

A brief comparison of socio-demographic characteristics of Cubatão, the Baixada Santista and the State of São Paulo confirm this situation. In 1980, 75% of the population of the state and 44% of that of Cubatão was White.

In 1950, in the early stages of industrialization in Cubatão, these differences were minimal: differential migration of Black and Mixed-race populations over the period led to the differences observed today. The proportion of the population 10 years old and over to have completed high school or university, at the three levels of aggregation, is a summary education measure. Although even at the State level, this value is only 12%, it is almost three times that of Cubatão. A major share of race and education differences is due to differential migration to Cubatão from the North-east. This movement continued in the seventies. Recent migrants (those who arrived in the seventies) from the South-east form a majority at the State level (67%) but a minority (46%) in Cubatão. North-east migrants constitute only 17% of the flow to the State, but 42% of those who arrive in Cubatao. Those migrants who could compete in the job market of Sao Paulo and other cities remained in these centres; those who could not went to Cubatão. And for as short a time possible.

TURNOVER

The third mechanism that distinguishes migration to Cubatão is its high turnover rate. The turnover index used here is the proportion of a decade's migrants with less than one year of residence in the municipality. A high and constant turnover rate means that, at any given moment, a larger proportion of migrants have less than a year's residence. It is possible, obviously, that the twelve months prior to the census represented a peculiar situation (of greater migration to Cubatão relative to the State or to the region). The index is presented in Table 6 for three successive decades, however, and the results are consistent: relative to the State, Cubatão has a larger proportion of recent migrants, and the index increases over time. In 1980 the index was 50% higher in Cubatao than in the State. Table 7 presents the indices for 1980 by sex, and the greater part of the difference is clearly due to mobility of men. There is little difference at the State level, while in Cubatão the index is 80% higher for men than for women. This observation is consistent with the data presented earlier about the marital status of residents of Cubatão. The city is more and more a place for migrant men without family ties who stay the shortest time possible. Thus, the turnover is related to the socio-demographic composition of the municipal population, and is an added factor which tends to dampen political mobilization. Those without roots are not motivated and not very capable of a political reaction directed to correcting the pollution situation.

TABLE 6. Recent migration: proportion of migrants who arrived at the municipality of residence in the last twelve months, State of Sao Paulo, Baixada Santista and Cubatao

	State of São Paulo	Baixada Santista	Cubatao
1960	11.5	10.6	11.9
1970	10.7	10.9	14.7
1980	9.6	11.0	14.8

Source: F. IBGE 1980, Demographic Census, 25% sample.

TABLE 7. Recent migration by sex: proportion of migrants with under one year's residence, state of Sao Paulo, Baixada Santista, and Cubatao, 1980

	State of Sao Paulo	Baixada Santista	Cubatao
Men	10.0	12.0	18.1
Women	9.3	10.1	10.6

Source: F. IBGE 1980, Demographic Census, 25% sample.

RESIDENTIAL SEGREGATION

Considering the recent origin of Cubatao and the high volume of migraton, it is not possible to characterize given neighbourhoods as migrant or native. Only one quarter of working age adults was born in the State of São Paulo, and only a fraction of those in the municipality of Cubatão. But the uniform description of this migrant population in the previous sections of this paper is certainly a simplification. Although the local social structure can be represented as a truncated pyramid, there are important distinctions. The migrants are distributed in neighbourhoods that vary from squatter settlements to typical middle class housing, and at different distances from the industrial park — known as the "Valley of Death". The most polluted neighbourhoods are located in the middle or at the margins of this region. A considerable part of the population lives at some distance from the Valley of Death, and this permitted the generation of the image of the pollution problem as affecting only Vila Parisi, a poor housing area squeezed between the steel mills and the fertilizer companies. During many years the solution for the environmental problem was a proposal to move Vila Parisi. (This proposal was, in fact, part of an integrated plan eventually adopted in 1984, and by 1992 the neighbourhood was almost extinct.) Other neighbourhoods were not seen as being affected by pollution, and their residents reacted strongly and negatively, to the campaign for pollution control by scientists and the press at the beginning of the 1980s. Thus, segments with greater conditions to insist on pollution control (commuters) were absent from the community, and the small lower middle-class resisted this control when extra-community elements finally started pressure for action. Why? In the following section, we turn our attention to this question. We will exanine

socially differentiated neighbourhoods in the discontinuous territory of Cubatão and residents' perceptions of pollution.

RESIDENTIAL SEGREGATION AND ENVIRONMENTAL PERCEPTION IN A SEGMENTED CITY

To say that Cubatão grew in an unorganized fashion, without urban planning, would be a banal half truth. Banal because this is the way almost all Brazilian cities grew; and to attribute urban sores to this factor would be to avoid a real explanation. Half truth because there is nothing random in the organization of the *economic* activity of the city. No other city built its industrial park in such a planned form. History has shown that the strategy was wrong but we cannot say that it was unplanned. The refinery and steel mill, and the industries that appeared as a result, were products of development plans elaborated at federal government levels, obeying national goals.

What is shocking, then, is not the lack of planning, but that this true example of rational and integrated planning contemplated only industry. The working population would be brought from other municipalities. That part of the workers would live in Cubatão, and that other sectors such as small business and construction activity would add to this local population, was ignored or left to chance. After occupying old banana fields and small plots of firm ground, the growing population went looking for space. Swamp lands were filled in, shacks were built on stilts over the swamps, and mountain slopes were built up, increasing the so called *cotas*, clearings opened in the forest during the construction of the Via Anchieta highway.

The contrast between the organized industrial park and the disconnected, precarious, and improvised residential area, is what most calls the attention of newcomers to Cubatão. With no organic urban design, Cubatão is an archipelago of neighbourhoods of difficult intercommunication. This impression is reinforced when we consider the ephemeral quality of the urban landscape. Parallel to the comings and goings of the population there are the comings and goings of the neighbourhoods: Vila Socó burned down, Vila Parisi is being removed, the *cotas* collapsed. On the other hand, Vila Sao José emerged from the ashes and Jardim Nova República from the swamp lands.

Very differentiated as to the quality of housing, of infrastructure and public services, do the neighbourhoods also differ in the pollution load they receive? For the outsider from the interior, pollution seems not to discriminate: as soon as the first of the *cotas* is in view, the dominant impression is that of a dirty omnipresent smoke. Traveling through the city, from Vila Parisi, alongside the steel mill and neighbour to fertilizer industries, all the way to Jardim Casqueiro, centre of the middle class at the other extreme of the municipality, with views to São Vicente, and the "Switzerland of the Baixada Santista', in the words of a resident, the observer never loses sight of the

pollution. Even when the sun shines, the light has a filtered quality which does not let us forget that the air is heavy with pollutants. Every roof and leaf are covered by a film of dirt that not even the heavy rains can clean. This was the case at Vila São José, the so called Vila Socó, which caught fire in 1984; at Jardim Nova República, a new housing development built by the city in the filled-in swamp lands between the Via Anchieta and Imigrantes highways to house those expelled from Vila Parisi; at Vila Fabril, a classic working class neighbourhood built in the 1920s by the Cia. Santista de Papel; at the Vila Light, at the foot of "Caminho do Mar" (the old mountain road); at Vila Nova, a central neighbourhood of lower middle class; and at the *cotas*, especially the most populous and closest to sea level.

This impression of a region permeated by pollution is not shared by the local population. It is common to hear that pollution is characteristic of the industrial zone, but not of residential areas. Vila Parisi, 15 km from the centre of the city, is not even considered as Cubatão. The efforts to call attention to the environmental situation, and to demand a solution, thus had to overcome not only the resistance of the industries and the government but also segments of the population itself. This enigma represents one of the greatest challenges for the comprehension of the Cubatão phenomenon. On the one hand we have already identified one partial explanation for the slowness of a political movement against pollution in the characteristics of migration dynamics. On the other hand, however, there are elements in the municipality that not only do not oppose the pollution but explicitly deny its existence. Who are these elements? How do they differ from the others? And how are they characterized in terms of migration situation and social class?

CUBATÃO SPEAKS OUT

To answer these questions about differential perception of environmental questions and about the health/disease experience, according to the situation of class and migration, we conducted exploratory interviews in several neighbourhoods of the municipality. The strategy in the interviews was to maintain a neutral attitude in the discussion of health (affected or not by pollution) and migration (whether the municipality was a desirable and permanent destination, or not), and let the population speak on its own. If in discussing health, the respondent did not mention pollution, and in discussing migration did not mention the attractiveness of the city, then we provoked discussion on these themes. The interviews were carried out at the place of residence. The person interviewed was, for the most part, the housewife and in some cases the husband (who worked in shifts or was unemployed).

The neutrality as strategy worked. It was quite clear for us when the

respondent *offered* information, and when this was *extracted* from him. But what characterized these interviews was the *sensitiveness* of the population of Cubatão to the question. Contrary to other investigations of our experience, where it was necessary to elaborate an explanation of our work, even explain what research is, the people of Cubatão dispensed the introduction. The city has been in the midst of this polemic for many years, and no one finds the presence of a group of researchers strange. On one of our first visits to the city, we looked for a newsstand in the centre. Inquiring about a local newspaper, we revealed ourselves immediately as outsiders, and the newsstand owner asked: "Have you come to research Cubatão?" Then followed a long defense of local good points, and the insinuation that the pollution polemic was a plot to denigrate the image of the municipality. In Vila Parisi, where the registering of residents with rights to a home in the new housing development had caused polemic and suspicion, one man asked us, apprehensively: "Excuse my asking, but are you a lawyer of the city?" And in Jardim Nova República, we felt that during the interview Sra. Sofia had a certain necessity to exalt excessively everything that was good in the new housing development. This was confirmed at the end when she asked: "But you aren't some city counselor who came to know the bad things to bad mouth the mayor?" After we reaffirmed our connections with the university, she stressed that nothing could be said or done to the mayor, for he was "giving a lot of help to all the people".

This high sensitivity marked our interviews. In the minefield of pre-elaborated positions and rehearsed answers, we could not draw conclusions about objective health conditions and of life in the city. Our object of analysis was the speach itself, and here we had a lot to learn.

VILA PARISI

We started in Vila Parisi, isolated about 15 km from the centre, in the middle of a basin whose geographical conditions concentrate pollutants. In Vila Parisi living conditions were precarious: heterogeneous construction materials, for the most part with dirt floors, peripheral location and poor access to public services. The houses were served by water and energy services but not provided with a sewage system and few had paved streets. The presence of open air sewage ditches, which drained to the nearest water courses, with children playing at these sites (ideal for the transmission of schistosomiasis, for example), was constantly observed in Vila Parisi. Smoke, the overcast sky, garbage thrown on the streets and empty lots produced an image of desolate abandonment.

With São Paulo's worst pollution indexes (in 1986 only 44.3% of the days had air between acceptable and good — see Table 8), Vila Parisi has been an obligatory point for national and foreign eco-tourism. During the field research, a dispute on the removal of the neighbourhood was resolved, and

at the time of the interviews we found the neighbourhood in demolition phase. The first proposals for removal, during the dictatorship (1970s), were answered with the slogan that it was necessary "to end pollution not population". Although the attention of the national and world press served to heighten these feelings, we found a climate of satisfaction. Many of the residents had already gone to Jardim Nova República, and the remaining were waiting their turn.

Poor families, originating especially from the North-east ("here there are more *pernambucanos* than people"), established themselves at the Vila because of proximity to the job. They are night guards or construction workers hired by local sub-contractors, rarely having a skilled occupation. Although many worked "at Cosipa", this almost always meant participating in the large contingent of construction workers, and not as workers of the steel mill.

There was not the least embarrassment in speaking of pollution. Old residents miss the early years, when water was clean, and the fish and bananas abundant. Sr. João, "founder of Vila Parisi" (today living in Jardim Nova República, where he was interviewed), came from Recife in 1958, when the streets were being laid out. As everything was swamp, he did not believe in it and did not buy a lot. Vila Parisi had fish, fine clean sand, aquatic birds, and clean water. There was no pollution, nobody was sick. There was only Cosipa and Copebras, with a "little black dust that stuck to the clothes, but came out when washed". Things started getting worse in 1965-66, with the fertilizer industries — Ultrafertil, Manah e Solorico.

TABLE 8. Air pollution in Cubatão: air quality indices registered in 1986 (number of days per category)

Neighbourhood	Air Quality							
	Good	Acceptable	Inadequate	Bad	Very bad	Critical	Total	%*
Vila Nova	245	82	7	1	0	0	335	97.6
Centre	137	190	27	6	0	0	360	90.8
Vila Parisi	20	129	114	66	7	0	336	44.3

*(Col. 1 + Col. 2)/Total
Source: Cetesb, 1987.

But even newcomers recognize the environmental degradation. Many hold to the migrant's dream of going back home. Sr. Manuel was only waiting for the keys to the new house so he could sell it and go back North. Cubatão was a disappointment, everything was better in the North. Dona Rosa and her family had already left the interior of Paraná for Paraguay, then to Curitiba and then Cubatão. What keeps them here now is the prospect of owning their own home in the new vila. Elias, a young single man, would go back North, but "only when I win the lottery, because I can't go back poor."

This geographic itinerancy corresponds to an occupational itinerancy in

Cubatão. The number of times that Sr. Manuel changed jobs is so great he cannot reconstruct his occupational history. This situation was even more marked among single men. We interviewed a group of single men, standing in front of a two-storey boarding house. There was graffiti on the wall demanding a solution to the eviction problem for single people. An old man, divorced for a long time, many years in Cubatão but having spent intervals away; a young mechanic, the only one with a more specialized job; a more bitter man; another suspicious: all spoke of the rumors about removal and the lack of housing for single people. The single population of the Vila is considerable. They were not temporary residents, with families in other places, but unmarried, separated and abandoned. One has the impression of a floating and itinerant population.

In the case of these individuals, the secular processes of population redistribution (rural/urban, north-east/south-east) are not translated to linear migratory histories. It is not a rupture with tradition followed by a new insertion in the urban-industrial world, nor a "stage migration", from smaller to larger city. With the destabilization of the institutional arrangements of the past, the individual is "freed" of his ties with the land. Life becomes a search for new ties, and the itinerancy that marks the histories of the residents of Vila Parisi and Jardim Nova República demonstrates that there is no guarantee that this search will be rewarded.

On the contrary, the pattern of movements revealed, as did the respondent's state of mind that living in Cubatão is a decision always subject to change. All the single population and many of the families had already gone back at least once to their place of origin, and this dream persists. Almost all had lived and worked in other cities of the South. At this moment, continuing in Cubatão seems a good option in view of the housing offered in the new development, an offer which does not include single people.

This phenomenon is not a privilege of Cubatão. What portion of national migrants can be characterized this way, however, would be difficult to estimate, but it is probably considerable. For this analysis, what matters is the contrast that this profile represents in relation to the population (also migrant) of the Vila Nova neighbourhood, to be analyzed below.

JARDIM NOVA REPÚBLICA

Jardim Nova República is a housing development built at a landfill between the Via Anchieta and Imigrantes highways, in the middle of the polluted and foul smelling swamp. The twin houses are simple, of concrete blocks, asbestos roof, exposed wires and pipes. There is a living room, kitchen, bathroom and two bedrooms, a common backyard with the house on the other street. The backyard is minuscule and utilitarian, but the front yard is of a reasonable size; the street is wide, with many trees, cement sidewalk, and the general aspect is very positive. All the streets are paved, with sewage,

water and light systems. There is a market, school, soccer field, assembly hall and church. There are almost 1000 houses planned, considerable movement, with 200-300 houses already occupied at the time of the interview. As for transportation, the neighbourhood has a bus line that, according to the residents, is frequent, and the distance to the place of work is not great.

The residents are the first Vila Parisi residents to have moved, although no single men or women were found. "Here the mayor doesn't permit the cabaret", namely prostitution. Among the praises for the new neighbourhood, this fact was cited many times. "At Jardim Nova República there is no violence; it is better than Vila Parisi, there's no pollution, no vagrancy." Policing in Vila Parisi existed "only for heads of family", that is, the police did not control the violence, only bothering decent people. The doctor who worked at the health centre in Vila Parisi confirmed the violence, pointing to a higher number of cases due to the consequences of fighting than to bronchitis or allergies.

VILA NOVA

Vila Nova is near the commercial centre of Cubatão, a "traditional" neighbourhood. Single story homes predominate, with a few buildings of two or three stories; the streets have many trees, are paved and illuminated; the sewage is piped; there is an established neighbourhood commerce. If it were not for the violent contrast provoked by the spectacular mountain slopes, that form the backdrops for streets and parks saturated by pollution (although less than in Vila Parisi: 97.6% vs. 44.3% of the days in 1986, air conditions were good or acceptable — see Table 8), Vila Nova would be indistinguishable from hundreds of pleasant cities in the interior of the State.

The population of the neighbourhood is lower middle class, and the frequency of cars in the garages suggests a reasonable standard of living. Our respondents had lived more years in Cubatão than those of other neighbourhoods, and had a higher continuity of residence.

COTA 200

The *cotas* are neighbourhoods formed at the time of construction of the Via Anchieta highway, clearings opened during the construction, where workers lived. They take their name from their altitude: 95, 200, 400 metres above sea level. If at first they housed construction and maintenance workers, recent decades attracted a larger population looking for cheaper housing. Sr. João Carlos, resident for 30 years in the neighbourhood, arrived when there were only State workers: "Here there was no one other than the State

workers... today, you take a bus, you hardly see any State workers. Very few of the ones you know... And the rest of the people around here are almost all people who invaded everything. People from Vila Parisi. There are even people here from Santos."

But these new residents came for many different reasons. The Bahian André, now that he has found a companion, left the construction barracks (between Vila Parisi and Cosipa) to look for a shack: "Live in a little shack, not pay rent. Because it is the rent ruins it. Rent is absurd, isn't it?" The Pernambucano Carlinhos, a family man, left Vila Parisi, where "we did not do well, because the fog, the pollution is very great. So we came back here, it is not good, but it is better than there." His daughter's bronchitis, a major reason for their moving, improved.

Refugees from pollution or rent, or both, the *cotas* grew, and were eventually equipped with urban infrastructure. Electric light, telephone, some paved streets, schools, health care centres, municipal bus lines; today these settlements have the appearance of any poor neighbourhood of a big city. With this infrastructure, however, there also came serious ecological consequences. With the elimination of the vegetation, the geological stability is threatened, endangering the mountain itself, the industries down below and, especially, the populations in the path of unexpected landslides, like the one that killed 10 people at Cota 95 in January of 1989. This accident inspired a decision by the authorities, temporizing this problem for a long time, to prohibit any new construction at the *cotas*, and to programme the removal of the population. The second goal has not yet been implemented, and the population is skeptical. But construction stopped: "in the last two months they are here all the time, the forestry police stay here, on duty, right? All the cars that go up with material, they go after and make come down again. Then they do not let us, no way. Not even the material so we can fix anything, you can not." (Joaquim, paulista from Barretos, more than 30 years in Cubatão).

As for pollution, the residents of Cota 200 think the situation is better than in downtown Cubatão, but not so much "...with the weather clouded over like this [on the day of the interview] it is easier for them to let out the pollution, because it is more difficult to tell, right? When it is clean, clear, we see the pollution, right? You can see it in the space, we notice the pollution. Especially at night they let it out, the refinery, and then we can feel it. It dries our throat" (Joaquim). "Here there are times when we get some air...Because we live sort of far from Cosipa. But when at a certain time, from midnight to one, we almost feel suffocated. It seems like the air goes down. And we are lying there sleeping, you can smell that bad smell that comes with the air."(André). But he would not work near Cosipa anymore. "Also at Cosipa I do not work anymore. I am looking for work further out." When he lived in the workers barracks and worked as a mailman at Cosipa, he contracted leucopenia ("at the time everyone was getting it").

MIGRATION, SOCIAL MOBILITY AND COMMUNITY SPIRIT

Vila Parisi and Jardim Nova República represent the same social strata, and with the exception of a few families who "bought" houses at the new development from the original owners (an irregular transaction whose frequency is unknown), are the same population, in a transition phase. There are migrants, some with many years residency in Cubatão. Most had lived in several different states before (and even after) arriving in Cubatão.

The residents and ex-residents of Vila Parisi have no inhibitions in discussing health and pollution. In none of the families interviewed was mention of bronchitis, pneumonia, grip, cough, tuberculosis or leucopenia omitted. The latter provokes irreparable damage to the immunological system and it was well known and commented. D. Rosa de Lourdes sent a son to spend some time in Curitiba, to cure him of bronchitis. Another resident of Jardim Nova República has a 13 year old son who lives in Ubatuba with his grandmother. He came to Cubatão when he was 6, but did not do well — after several days in the city, he suffered from lung problems. According to his mother, "He definitely does not adapt to the climate here."

We did not find any case of congenital disease, although there was no one who was unaware of the polemic on the issue. Some attributed congenital diseases to defects of character: "it is a fruit of the shamelessness of the women. They sleep with everyone; then the son is born with the arm of one, leg of the other...they drink a lot." But others worried: "I was afraid. The people of the Vila talked a lot" (D. Maria, Vila Nova República). "Yes, I was afraid, everyone was afraid" (D. Elzane, Vila Nova República). The same woman added, "but two sons were born with bronchitis. The older one, when he lived in the Vila, was in the hospital more than 30 times with bronchitis crisis."

Thus, respiratory problems and allergies were a constant for the residents of Vila Parisi, even separating families. They already felt better in Jardim Nova República, which received only praise. Leucopenia was common-place, although we did not find any cases; and anencephaly and other congenital anomalies left the women anxious, although, for these illnesses we also found no cases.

But in Vila Nova, attitudes were very different. "We have no health problems" (D. Alice, 60 years old). "We do not have anything. They talk about pollution, but we do not have any problems" (D. Ana Lúcia, 25 years old, separated, two children). For her, the congenital problems were "problems in the head." D. Maria, with 30 years in the neighbourhood, six children and three grandchildren, thinks "that they are problems in the parents' blood." All in her family are "healthy and intelligent". And health problems for D. Valdice (Cubatão native of 33 years of age, two children) are "only colds...people talk a lot. They say that the illnesses of the people here are because of pollution. But I think that has nothing to do with it." So, no mention of leucopenia, and no preoccupation with congenital anomalies. If anything, residents of Vila Nova have an occasional cold.

Does this enviable health of the residents of Vila Nova represent a more healthy environment, far from pollution? Is it "Because pollution in Cubatão is there at Cosipa, in Vila Parisi, here there is nothing", in the words of D. Valdice? Certainly our small sample does not substitute a more refined epidemiological study, and we have no way to evaluate the real incidence of any illness in the many neighbourhoods of the city. But together with good health there is community pride in Vila Nova. It is a hurt pride, which does not admit that the municipality be characterized as unhealthy.

D. Maria could not contain herself during the interview: "I always hear the TV speaking badly of Cubatão, especially 'Rede Globo', that said that children in Cubatao are born deficient because the pollution is too much, because it is 'Valley of Death'. That grows inside me... of course deficient children are born here, as they are born everywhere. There is pollution, yes, but like everywhere else.. I do not know what 'Rede Globo' has against Cubatao." D. Alice does not like "people who say bad things about Cubatão, even on TV! I think Cubatão has everything. I think the problems that exist in Cubatão exist in other places." And Valdice, who thinks "only Vila Parisi is polluted, you do not see pollution like they say...I do not know if you saw when they said Cubatao was the 'Valley of Death'. You can walk around and you will not see those dry leaves they showed on TV." For them, Cubatão has been good. "I like it here." "For me and my children the only place on earth is Cubatão."

The heterogeneity of the residents of Cota 200 reflected itself in the attitudes toward pollution. Although in general they are reticent and less defensive when talking about the subject, those who arrived more recently have a more critical position. Carlinhos, who left Vila Parisi to cure his daughter's bronchitis, thinks that "here pollution is better, but not so much." And André, who got leucopenia in the "Cosipa area", complains of the hours the industries "discharge". "Now, there are times you feel that suffocation, that bad smell, that you say: 'What is this? What is happening? Is something burning?'

Older residents, like those of Vila Nova, who managed to establish themselves in Cubatão, raise their families, and improve their lives, tend to overlook the problem. For João Carlos, the question of the landslides is "a lot of baloney". The risk areas of the neighbourhood are delimited: "I know all the risk areas. When we hold meetings, we said 'look, you can not build a house near the waterfall'." All his children have good health and good jobs, including a daughter who is a teacher. About pollution, he thinks "it is talked about too much...over in those areas (the Cosipa region) there is pollution, but here, at the foot of the mountain, I do not know if it is because of the forest, there is not much pollution." And Joaquim thinks the congenital defects problem "is a rumor". He intends to leave Cota 200 and Cubatão, but not because of pollution: "You know what it is? It is that we live here, we are never at ease, you understand? Because there is always talk of the government moving us, right? So we are never at ease. We want

to improve our home, we can not. We are afraid to spend, right? To spend money and then lose everything."

COMMUNITY PRIDE AND ENVIRONMENTAL PERCEPTION

That objective environmental conditions are worse in Vila Parisi is not contested. To affirm that pollution only harms health in that neighbourhood, however, is to hide the sun — but not particulate matter — with a sieve.

Both discourses represent, more than any difference in health, ideological differences. The residents of Vila Nova and the old residents of Cota 200, migrants or children of migrants, did well in Cubatão. One works for the city government, the other is in the military, another a retired refinery worker. Ana Lucia, separated, even thinks that "there are jobs for women, and there were not before." D. Maria's children are industrial employees, and a daughter is a teacher. They are people who came to Cubatão for the same reasons as the others, but for whom the dream came true. Jobs were more permanent, they managed to get their own housing; and life brought a better life style.

The residents of Vila Parisi on the other hand, are still on the same pilgrimage that brought them to Cubatão, 5, 10 or 30 years ago. Before they arrived at the municipality they already had been to other states looking for a place, and the years spent in Cubatão did not change this. Many still tried other places, some tried to go back to their home towns, and they all look for a stable job. Complaining about pollution, they do not run from it because "here there is always work." But this work is not a stable job that permits savings accumulation, buying a house, or any security for the future. Unskilled workers survive because with the end of one job there is always another at hand.

Materially deprived, they are also deprived of an ideology which exalts their community. Cubatão was not a setting for a self-realization leading to an identification with the town. For this population there is a critical distance between their lives and their community, which permits a more realistic view of pollution. For the residents of Vila Nova, on the contrary, there is not this distance. The progress they know is due to the growth of the city, and they identify with it. To criticize the city is to criticize its population, to wound their dignity. That this community pride was channeled demagogically, substituting the image of the Valley of Death for the Valley of Life, denying pollution, reflects the poverty of political leadership. What we want to underline here is another meaning to the discourse which denies pollution in Cubatão. It is not the case that the opposition or indifference toward pollution control efforts are due only to economic interests (of industries and their profits, workers and their jobs). To make Cubatão the synonym of pollution and environmental degradation touched the honour of those who call it home. If unconfessable interests manipulated these feelings to avoid

protests against pollution, and to define the problem according to their own advantage, this should not be attributed to the population of the town.

CONCLUSIONS

What can we conclude from this analysis of commuting, selectivity, turnover and residential segregation in Cubatao? What are the migration dynamics of Cubatao? How do these mechanisms determine who pays the price of pollution? And how does this relate to the delay in the response to this environmental assault — a response that finally had its origin from *outside* the community?

First, migration characteristics systematically differentiate the population of Cubatao from the general pattern: the commuting rate is higher; in relation to the State of Sao Paulo, migration is more male than female; it includes greater proportions of Blacks and Mixed-race populations; migrants have less schooling and there are more North-easterners; over the last three decades, and always to a more accentuated degree, migrants spend a shorter time in Cubatao before leaving; and the geography of Cubatao permitted a residential segregation which is more pronounced than in other places.

The analysis of commuters suggests that the many well-paid jobs created by rapid industrialization were occupied by men who avoided establishing residence in Cubatao. The local population is at a socio-economic disadvantage by all the indicators examined. The result of all of this made the population immune to mobilization for environmental control. Those who could have been mobilized deny the problem, a self-defense against the criticism of science and the environmental press. Thus, neither the residents (who should have been the most interested) nor the commuters (who had the necessary cultural and political capital but were more isolated from the effects of pollution) were moved to action. Only when press censorship ended as the dictatorship waned, and when the Brazilian Society for the Advancement of Science took over the cause in the early 1980s, did the case receive the attention it deserved. And only when the first state government elected in two decades assumed power were concrete measures to correct the situation taken.

In a larger context, then, constituted by the lack of priorities given to environmental problems in the 1960s and 1970s, by the climate of protectionism for big business guaranteed by the military government and by the control of social movements and of the press, migration dynamics are seen as important mechanisms in the history of Cubatao. These mechanisms are not merely the concrete manifestations of determinants of another order, such as the manipulation of interests by the firms installed in the region. They had an independent effect in determining the victims of pollution and in inhibiting the popular response to the problem.

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MIGRATION IN RESPONSE TO THE URBAN ENVIRONMENT: OUT-MIGRATION BY MIDDLE-CLASS WOMEN AND THEIR FAMILIES FROM MEXICO CITY AFTER 1985

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ABSTRACT: Based on present migration trends and environmental factors in Mexico City, the paper combines census and survey data with qualitative techniques (focus groups), to explore the role played by environmental perceptions, as well as individual, family and social factors, in the out-migration decision making of middle-class families from Mexico City to medium-sized cities in the central region of the country. The results confirm that women have played an active role in the decision of the family to migrate as a survival strategy in response to the perceived negative health impacts of the environment on their children. The paper also addresses attitudes towards environmental activities and suggests lines for future research and interventions.

KEY WORDS: urban environment, environmental perceptions, migration, family survival strategies, middle-class families, medium-sized cities, Mexico City.

1. INTRODUCTION

Slower growth in major cities with concurrent increases in migration flows towards smaller cities has occurred in many countries in Latin America during the 1980s, including Mexico (*World Urbanization...* 1991; Lattes 1993). Mexico City in 1940 had 1.67 million inhabitants; by 1990, this number had reached 15 million. Mexico City now consists of the Federal District (which is administratively treated as a separate state) and 27 surrounding urban municipalities (which are located in the state of Mexico). The city's highest growth rates, an average of 5% per annum, occurred from the 1940s through the 1960s. According to official census data, however, the city's growth rate declined through the 1980s to less than 1%. (Garza and Rivera 1994). Because

of possible overestimation of the population of Mexico City in the 1980 census (Camposortega 1992) and underestimation in the 1990 census (Corona 1991) the real decline in urban growth may have been somewhat more or somewhat less than published statistics indicate.

Changes in internal migration flows, however, further suggest that the city's power of attraction is declining. Prior to the 1980s the country's main internal migration flows were directed towards Mexico City. By 1985, however, this situation was transformed; a diversity of out-migration flows away from Mexico City characterized internal migration in the country (Negrete 1990; Gonzalez and Monterrubio 1992; Corona 1993). Although the urban area itself expanded due to trends towards greater settlement or "suburbanization" on the periphery, growth rates, as discussed above slowed dramatically. Since natural increase in the city was estimated at 2% during the 1980s yet the city's average annual growth rate for the period of 0.7% was lower, it is likely that for the first time in the 20th century Mexico City experienced negative net out-migration (Garza 1992, p. 24). Based on 1990 census data, we calculate that from 1985 to 1990 over half a million persons out-migrated from Mexico City while less than half a million persons in-migrated resulting in negative net migration to the City of over 100,000 persons (Table 1). This represents a loss of approximately 0.6% of the city's 1990 population. As noted above, deficiencies in published census data and changes in the administration boundaries of the city may limit the precision of these estimates. However, results from the 1987 National Urban Migration Survey (ENMAU) independently confirm that the proportion of in-migrants from Mexico City to other cities increased during the 1980s (CONAPO 1987).

TABLE 1. Calculation of in, out and net-migration for Mexico City 1985-1990

All in-migrants to Mexico City	1,015,851
Migrants from Federal District to 27 Urban Municipalities in State of Mexico	-509,585
Migrants from State of Mexico to Federal District	- 80,905
Calculated in-migration to Mexico City	425,361
Out-migration from Federal District to anywhere outside 27 Urban Municipalities	-526,173
Net-migration for Mexico City	-100,812

Source: *Resultados...* 1992.

Medium-sized cities in Mexico with populations of 500,000 to 1,000,000 have grown at 6 to 10% per annum during the last decade (*Programa de...* 1993; Garza and Rivera 1994). 1990 census data indicates that half (51%) of all out-migrants from Mexico City between 1985-1990 went to states in central Mexico (Trigueros 1992; *Resultados...* 1992). According to the 1987 ENMAU, those cities in central Mexico which received the largest number of out-migrants from Mexico City were San Luis Potosí, Puebla, León and Orizaba (Negrete 1990). However, there are also a number of other

medium-sized cities, including Cuernavaca, Pachuca and Querétaro, which were not included in the 1987 ENMAU which have also been important destinations for out-migrants from Mexico City (Fig. 1). According to the 1990 census between 1985 and 1990, over a third of in-migrants to the states in which Cuernavaca, Querétaro, San Luis Potosí and Pachuca are located (Table 1a) as well as the cities themselves (Table 1b) came from Mexico City (Fig.1).

TABLE 1a. States of Mexico and percentage of all in-migrants coming from Mexico City (Federal District only), 1985-1990

State (medium- sized city in State)	Percentage of all in-migrants from Mexico City (Federal District only)	State (median size city in State)	Percentage of all in-migrants from Mexico City (Federal District only)
Aguascalientes	33	Nayarit	8
Baja California	12	Nuevo León	10
Baja California Sur	14	Oaxaca	28
Campeche	7	Puebla	30
Coahuila	11	*Querétaro (Querétaro)*	41
Colima	10	Quintana Roo	12
Chiapas	23	*San Luis Potosí (S.L.P)*	25
Chihuahua	10	Sinaloa	6
Durango	10	Sonora	8
Guanajuato	36	Tabasco	11
Guerrero	34	Tamaulipas	9
Hidalgo (Pachuca)	43	Tlaxcala	35
Jalisco	21	Veracruz	21
Mexico	70[a]	Yucatán	26
Michoacá	33	Zacatecas	17
Morelos (Cuernavaca)	36		

[a] This includes intra-urban movements within Mexico City between the Federal District and 27 surrounding urban municipalities in the State of Mexico.
Source: *Resultados...* 1992; Cuadro, 5.

The 1987 ENMAU suggests that individuals with higher educational and occupational profiles may constitute an important proportion of out-migrants from Mexico City (Corona and Luque 1992). 1990 Census data indicates that over 40% of out-migrants from Mexico City had higher education levels (10 years or more) and over a third were engaged in higher occupations (professionals, technicians, educators, artists, officials, directors, administration and office workers); the educational and occupational level of out-migrants was higher than that for residents of Mexico City as well as the country as a whole (Table 2). Correspondingly, one third to one half of in-migrants from Mexico City to the states within which the cities of Pachuca, Cuernavaca, Querétaro and San Luis Potosí are located had higher educational and occupational levels; the educational and occupational profiles of these

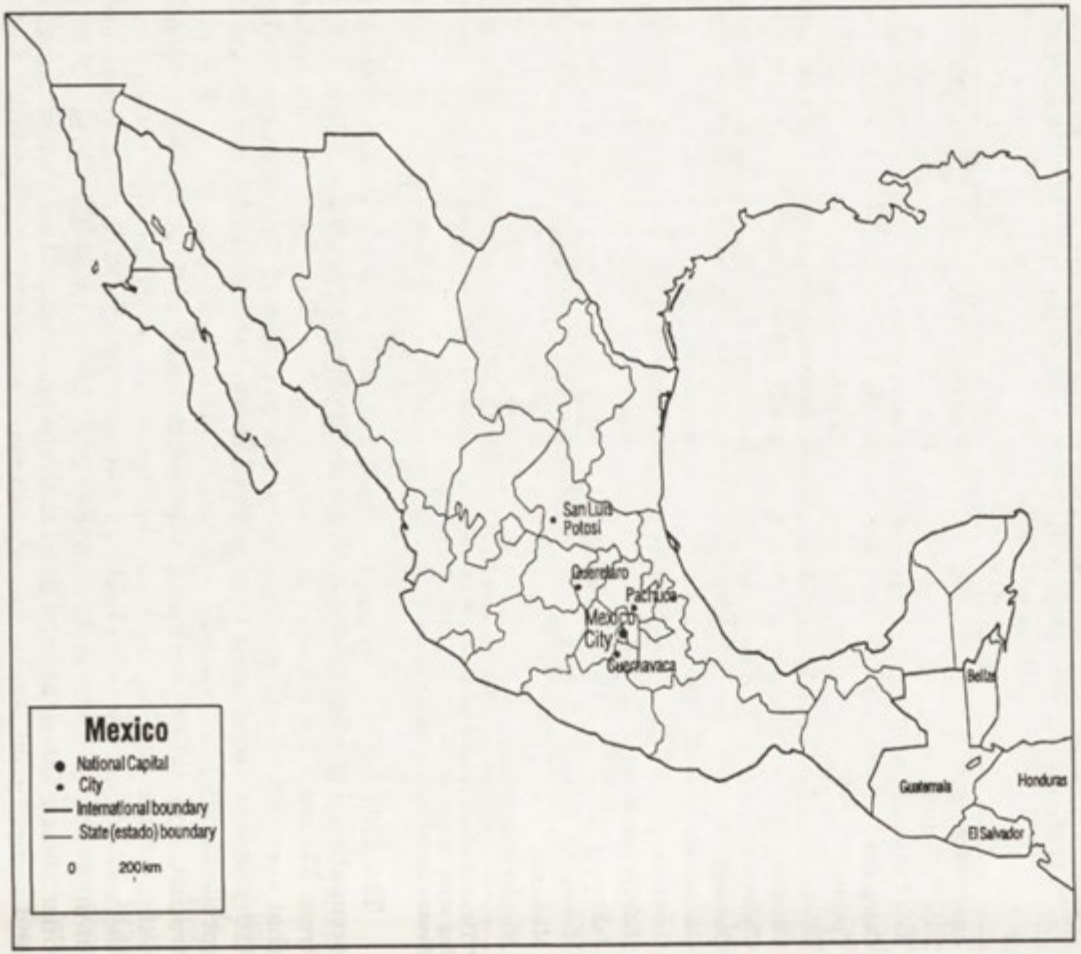

Fig. 1. Location of study cities in Central Mexico

in-migrants were also higher than residents in destination states and cities (Table 3)[1]. Thus, out-migration of middle-class individuals with higher educational and occupational levels from Mexico City to medium-sized cities may represent an important recent internal migration flow. Moreover, selectivity for the migration of middle-class individuals from Mexico City to these cities may be occurring.

TABLE 1b. Percentage of all in-migrants to select medium-sized cities in Central Mexico (Pachuca, Cuernavaca, Querétaro, and San Luis (Potosí) from Mexico City (Federal District only), 1985-1990

Medium-sized city (State)	Percentage of migrants from Mexico City (Federal District only)
Pachuca (Hidalgo)	45
Cuernavaca (Morelos)	38
Querétaro (Querétaro)	41
San Luis Potosí(San Luis Potosí)	32

Source: *Resultados...* 1992, Volúmenes Estatales.

TABLE 2. Selectivity of out-migration: out-migrants from Mexico City with higher education and occupation compared to the nation and residents of Mexico City, 1985-1990

Reference population	% with 10+ years higher education	% with higher occupation*
Nation	23	22
Residents of Mexico City	32	28
All out-migrants from Mexico City	46	34

* Includes: professionals, technicians, educators, artists, officials, directors, administration and office workers.
Source: Unpublished tabulations of 1990 Census Data.

A confluence of factors have no doubt led to the decreased growth and proliferation of out-migration flows from Mexico City between 1985-1990. The national economic crisis of the 1980s which particularly affected Mexico City has been seen as playing a major role. We hypothesize that adverse changes in the physical and social environment of Mexico City may also be playing a role particularly in out-migration by middle-class families to medium--sized cities in central Mexico. However, the current environment of Mexico City must also be seen as a product of its past industrial and demographic history. The first part of the discussion below focuses in more detail on the interrelated economic, industrial, demographic and environmental changes which have occurred in Mexico City. This is followed by brief consideration of the importance of studying the out-migration response of middle-class

[1] State-level data on educational and occupation characteristics of in-migrants from Mexico City to states in presumed to be representative of in-migrants from Mexico City to medium-sized cities within those states. This was presumed since data on educational and occupational characteristics of in-migrants by city were not available for tabulation.

families. This discussion lays the necessary basis for the remaining part of the paper which presents the research results.

TABLE 3. Differentials of in-migration: in-migrants from Mexico City to medium-sized cities with higher education and occupation compared to residents in destination state and city

Reference Population	% with 10+ years higher education	% with higher occupation
Hidalgo state (Pachuca)	16	15
Pachuca	40	37
In-migrants from Mexico City[*]	*33*	*31*
Morelos State (Cuernavaca)	25	21
Cuernavaca	31	26
In-migrants from Mexico City[*]	*47*	*41*
Querétaro State (Querétaro)	20	20
Queretaro	30	28
In-migrants from Mexico City[*]	*51*	*47*
San Luis Potosí State (S.L.P.)	18	19
San Luis Potosí City	33	31
In-migrants from Mexico City[*]	*46*	*42*

[*] To the whole state. State-level data on educational and occupation characteristics of in-migrants from Mexico City is presumed to be representative of in-migrants to medium-sized cities within those states. Source: Unpublished tabulations of Census Data 1990, and *Resultados*... 1992.

2. FURTHER CONSIDERATION OF INTERRELATED INDUSTRIAL, DEMOGRAPHIC AND ENVIRONMENTAL TRENDS IN MEXICO CITY

2.1. INDUSTRIAL AND RELATED ENVIRONMENTAL TRENDS TO 1990

In the 1950s and 1960s Mexico was characterized by the rapid growth and concentration of industry in Mexico City. This concentration was contingent with the country's (and much of the rest of Latin America's) pattern of development after World War II which focused on industrialization through import substitution. This "centric" type of development emphasized consumer-goods industries concentrated in the city which offered an established market (Roberts 1992). By 1970 Mexico City alone produced approximately half (47%) of the country's gross industrial domestic product (Garza and Rivera 1994). In contrast to urban development in Europe where industrial development was concentrated in several major cities, Mexico City reflected urban primacy or a "macrocephalic" pattern of urbanization with the overwhelming dominance of one large city.

This pattern of industrial development appears to have come to a halt during the 1980s leading some to identify a move towards the *desindustralizacion* of the City (Gamboa de Buen 1994). Although absolute industrial production in Mexico City continued to rise, its relative industrial activity,

indicated by its proportional contribution to the Gross Urban Manufacturing Product (Urban Manufacturing PIB), fell by 11 percentage points from 53 to 42% from 1970-1990 (Table 4) with the largest proportion of this fall probably occurring from 1980-1985 (Garza and Rivera 1994). In addition, the Federal District's contribution to the population economically active in industry may have fallen by a third between 1980-1990. Moreover, after 1988 virtually no new industry has solicited authorization to locate in Mexico City (Gamboa de Buen 1994) while Mexico City's proportion of the country's total industries fell from 28.0 to 25.4% with a net loss of over 2,000 manufacturing work places (Garza and Rivera 1994). Concurrently, industrial activity in urban areas in the North (Region II), Northeastern (Region III) and Central (Region V) parts of the country increased signaling not only deindustrialization but also deconcentration of industrial activity towards the smaller and medium-sized cities in these regions (see Table 4).

TABLE 4. Proportion of gross urban manufacturing product (Urban Manufacturing PIB) for Mexico City and other states by regions, 1970-1990

Region	1970	1990	% change
Mexico City	53.07	42.46	-10.61
Region I	5.28	4.45	-0.83
Region II	6.42	13.08	+6.66
Region III	12.70	14.32	+1.62
Region IV	11.59	11.33	-0.26
Region V	5.58	8.63	+3.05
Region VI	0.72	0.79	+0.07
Region VII	3.53	3.30	-0.23
Region VIII	1.12	0.66	-0.46

Source: Garza and Rivera 1993.

Both the contraction of industrial activity in Mexico City and deconcentration of industrial activity to cities in other regions has been related to economic changes in the 1980s. During the decade the country's external debt pulled large amounts of financial resources into interest payments diverting them from further investment in industry as well as investments in infrastructure of the city, eg. public transport (Negrete 1993). Simultaneously, with the country's adherence to the General Agreement of Tariffs and Trade (GATT) an overall reorientation of government policy from import substitution towards a more open economy occurred and export goods flooded the domestic market. Concurrently, domestic industries focusing on the production of consumer goods which were concentrated in Mexico City were particularly depressed. Moreover, increased land scarcity and land costs, and rising operation costs also made Mexico City less attractive to industries.

At the same time, the country's move to a more open economy also drove the apparent deconcentration of industrial activity to *maquiladoras* located in frontier cities in the North (Region II: Ciudad Juárez, Piedras Negras

and Ciudad Acuńa) and Northeast (Region III: for example, Matamoros, Reynosa and Rio Bravo). Increased industrial activity in urban areas in the central part of the country (Region V — the state of Hidalgo which includes the city of Pachuca, Morelos which includes Cuernavaca, Puebla which includes the city of Puebla, Querétaro which includes the city of Querétaro and Mexico and Tlaxcala states) surrounding Mexico City may be related to stricter environmental regulations that have encouraged relocation outside the city.

Historical patterns of industrial development in the city have played a major role in shaping the city's environment, particularly in relation to air quality (see for example, Lacey 1993; Herrera 1990). During the city's rapid urban and industrial growth from 1950-1980 there was little control over air emissions from any sources. As a result, the city's industrial development and related growth in the use of motor vehicles led to the production of sulfur oxide emissions, ozone[2], carbon monoxide and suspended particles as major causes of air pollution (Table 5). Wind erosion due to rapid land clearing for both industrial construction and human settlement, has also produced high-levels of suspended particles, another important source of air pollution. Moreover, the industrial development of the city has been characterized by the concentration of industry in the northern and eastern areas of the city from which the prevailing winds blow south; emissions thus, drift over the metropolitan area. Economic development accompanying industrialization has also stimulated increased levels of energy consumption, and motor vehicle use leading to a greater absolute quantity of emissions over time. These industrial factors have interacted synergistically with the city's natural setting to heighten air pollution[3].

In the mid-1980s the government undertook the first comprehensive measures to address physical environmental conditions in Mexico City, focusing on air pollution. These measures have included: the substitution of oil for natural gas in thermoelectric plants, the closure and relocalization of highly contaminating industries, inspection of cars (Programa de Verificación Obligatoria de Vehículos Automotores), the reduced use of leaded gasoline, and the institution of a programme of days for the noncirculation of vehicles

[2] Ozone is a secondary product created by the interaction of primary emissions of nitrogen oxide and hydrocarbon with sunlight.

[3] It is important to recognize that factors shaping air quality in ZMCM (la Zona Metropolitana de la Ciudad de México) include not only human activity, such as industrialization and demographic growth, but also the city's natural geography. Mexico City is naturally subjected to higher dust and natural suspended particle concentrations, major contributors to the city's air quallity problems, due to the erosion of the ancient systems of lake beds on which the city rests (Ezcurra 1990). The city's location within a valley (Valle de México) also results in weak wind patterns which predispose it to insufficient dispersion of air contaminants. This valley location also makes the city naturally predisposed to thermal inversions, or situations in which the lower layer of warmer air, where contaminants are most heavily concentrated, fails to rise and disperse in the upper atmosphere and remains trapped over the city. In addition, the city's high altitude (2,240 meters above sea level) is associated with greater amonts of ultraviolet radiation which enhances the conversion of primary air pollutants into secondary pollutants such as ozone; also motor vehicles function less efficiently, producing greater amounts of carbon monoxide and hydrocarbons (Herrera 1990).

(Programa Integral contra la Contaminación Atmosférica). In 1984 the government (SEDUE) first began to comprehensively monitor air pollution in the city through an Automatic Monitoring Network (RAMA) of 25 stations.

TABLE 5. Contaminating air emissions and sources in Metropolitan Mexico City, 1989

Source	Emission: % contribution by source (ozone precursors)					% contribution all emissions by source
	Sulfur oxide	Nitrogen oxide	Hydro-carbon	Carbon monoxide	Suspended particles	
Motor vehicles	21.8	75.4	52.5	96.7	2.1	76.7
Energy production	35.3	5.6	5.6	1.8	1.0	4.0
Industry and services	42.8	18.5	7.0	0.6	2.8	4.4
Wind erosion on cleared land	0.1	0.5	34.9	0.9	94.0	15.0
Total	100.0	100.0	100.0	100.0	100.0	100.0

Source: Pérez 1993, Cuadro 8, p. 125 and Herrera 1990, Table 5.

These measures, however, have been generally judged to be ineffective (Bravo et al. 1992; Legorreta and Flores 1992) although more stringent regulation on emissions has been seen as encouraging industries to relocate to other states with positive impacts on air quality in Mexico City (Gamboa de Buen 1994). The impact on those cities, including medium-sized cities, to which may relocate is not clear and may depend on their having equally stringent controls on emissions. In any case, since the late 1980s air quality appears to be continuing to deteriorate in Mexico City despite government measures. Emissions of carbon monoxide, ozone precursors (nitrogen oxide and hydro-carbons), and suspended particles have increasingly exceeded limits defined as safe for human health (Lacey 1993). Through information collected via the RAMA Network, a daily Metropolitan Air Quality Index (Indice Metropolitano de la Calidad del Aire-IMECA) has been calculated since 1986 and represents a combined index of emissions[4] (Pérez 1993). The IMECA ranges from 0-500 with an index over 100 judged as prejudicial to human health. The IMECA index was, however, 200 or more only every six days in 1988 compared to every other day in 1991 (Table 6).

TABLE 6. Number of days with an annual Metropolitan Air Quality Index (IMECA) over 200 for Mexico City, 1988-1991

Year	Days	Year	Days
1988	67	1990	86
1989	19	1991	192

Source: SEDUE Automatic Monitoring Network (RAMA) and Herrera 1992, Table 8, and *Reporte...* 1991.

[4] Emissions included in the index are ozone, carbon monoxide, suspended particles, sulfur dioxide, hydrocarbons and nitrogen oxide.

We now turn to consider in more detail concurrent demographic patterns of growth and spatial distribution in Mexico City which have occurred alongside these industrial and environmental trends.

2.2. DEMOGRAPHIC AND INTERRELATED ENVIRONMENTAL TRENDS TO 1990

Accompanying industrial concentration in Mexico City from 1950 till 1970, extensive rural-urban migration simultaneously occurred leading to concomitant demographic concentration of population in Mexico City. As noted above, during this period the city's growth rate was over 5% per annum. Concurrently the country underwent a process of "metropolitanization" in which it was transformed from a primarily rural to an urban nation where by 1980 half (56.2%) of the entire population resided in urban areas[5]. This trend, however, also came to a halt in the 1980s. Accompanying the contraction and possible deconcentration of industry out of Mexico City during the decade there was a proliferation of out-migration flows and probably negative net out-migration from Mexico City as touched on above. Concurrently growth rates in smaller or medium-sized cities with 500,000-1,000,000 inhabitants either increased or remained above 3% per annum while that of Mexico City fell below 1% (Table 7). In fact, the proportion of the country's urban population ceased to be as heavily concentrated in large urban areas such as Mexico City while an increasing proportion was spread out across smaller and medium-sized cities (Table 8). Demographic deconcentration of population, thus, has accompanied industrial contraction in and deconcentration from Mexico City during the 1980s. The economic changes discussed above have played a major role in this industrial and demographic deconcentration while the role played by formal policies of population and industrial redistribution has been minimal if non-existent (Garza and Rivera 1994; Roberts 1992; Ruiz Chiappeto 1990).

TABLE 7. Annual per cent population growth rates for Mexico City and medium-sized study cities

City	1970-1980	1980-1990
Mexico City	4.4	0.7
Cuernavaca	4.6	4.9
San Luis Potosí	4.6	3.4
Querétaro	6.5	5.9
Pachuca	2.7	4.6

Source: Adapted from Garza and Rivera 1993, Cuadro 7, p. 203.

[5] Although industrial and demographic concentration was most intense in Mexico City, similar processes occurred in Guadalajara, Monterrey and Puebla from 1950-1970 also contributing to the country's metropolitanization. Together Mexico City and these three cities accounted for over half of the total urban population by 1980 and formed „the spinal cord of the country's national economy... and the complementary process of urbanization" (Garza and Rivera 1993, p. 186).

The long-term implications of the above demographic (and industrial) trends for future patterns of development in Mexico are not clear. The current deconcentration of industry and population out of Mexico City may signal the move towards a more balanced model of urban development in which population and industry are spread out more evenly between smaller and medium-sized cities across the country. From another perspective, however, the deconcentration of industry and population towards frontier areas (Region II and III) may represent a new phase of concentration or the replication of unsustainable patterns of development and negative environmental conditions in other cities. Moreover, demographic and industrial growth in smaller and median size cities in the country's central region (Region V) closest to Mexico City may be viewed alternatively not as deconcentration but rather as a process of "megalopolization" for which Mexico City continues to form the core (Garza and Rivera 1994).

TABLE 8. Percentage of urban population in medium-sized cities (500,000-1,000,000 inhabitants) and cities with over a million inhabitants, 1970-1990

Year	% total urban population in medium-sized cities	% total urban population in cities with over a million inhabitants*
1970	3.1	48.9
1980	6.8	51.3
1990	11.0	45.1

* Mainly Mexico City, Guadalajara and Monterrey.
Source: Adapted from Garza and Rivera 1993, Cuadro 3, 197-198.

It is important to recognize that previous eras of rapid in-migration have shaped current patterns of population and environment relationships within Mexico City itself. During the city's period of rapid growth squatter settlements mushroomed causing the urban area to expand rapidly. Concurrently socio--spatial segregation of the city's population occurred (Negrete et al. 1993). Lower income populations, many of whom were new in-migrants, were concentrated in the ever-expanding periphery along with the newly growing industry or in isolated pockets within the city where services were poor and environmental conditions deleterious. These populations were thus, more subject to exposure to the environmental risks entailed by their close proximity to industrial sites and slum dwelling. In addition, rapid expansion of the urban area through squatter settlements on the periphery led to rapid changes in land use accompanied by high rates of soil erosion and suspended particles. Moreover, growth of Mexico City has been characterized by larger distances between residence and workplace for much of the population thus requiring greater use of motor vehicles which, in turn, generates higher levels of traffic and air pollution. The city was also hit by a major earthquake in 1985 which destroyed a large portion of the city centre. The greatest impact of the 1985 earthquake may have been on the spatial distribution of the

population within the city. The new demands placed on the infrastructure, in particular on roads, has lead to acute environmental problems, there including increased traffic and air pollution[6].

TABLE 9. Selected environmental indicators for Mexico City, circa 1990

Physical environment:	
Height above sea level	2,240 m
Total urban area[1]	1,273 km^2
Total population[2]	15,047,685 inhabitants
Population density	11,820 persons/km^2
Green areas[3]	5.2 m^2/person (WHO minimum 16 m^2/person)
Percentage houses with:	
acces to water	64
sewage disposal[2]	82
access to electricity[2]	99
Percentage total urban manufacturing product[4]	43
Percentage total national industry[4]	31
Total number of motor vehicles[4]	3.3 million
Automotive vehicles[3]	5 persons/vehicle
Traffic[5]	8 miles during rush hours
Noise pollution: (scale of 1-10)[5]	6
Contaminating atmospheric emissions[3]	12,055 tons/day (292 kg/person/year)
Solid waste production[4]	1.2 kg/inhabitant/day
Percentage total waste collected[4]	80
Days during year with air quality prejudicial to human health[6]	53%
Social environment:	
Population with psycological disorders[7]	10.1-14.0/1000 persons
% Population with alcoholism[7] (for men only)	12%
Suicides[7]	2.5-3.5/100,000 persons
Violence[8]	22.5 homicides/1000 persons

Sources: [1] Lacey 1993;
[2] *Resultados...* 1992 (Census Data);
[3] Legorreta and Flores 1992;
[4] Gamboa de Buen 1994;
[5] *Cities...* 1990;
[6] Herrera Legarreta 1992;
[7] Ibarra et al. 1986;
[8] Gómez de León et al. 1993, *Area Metropolitana...* 1991.

As well as the environmental implications of the city's population distribution, Mexico City's overall size of over 15 million and rapid growth have made it impossible for urban infrastructure (transport, services and housing) to keep pace thus leading to serious problems of air, water, soil and solid waste pollution in the city. In the face of this situation, not only the adverse impact of population on the urban environment but also the reciprocal adverse

[6] According to evidence from the ENMU 1987, the earthquake probably had no significant effect on out-migration from Mexico City.

impact of the urban environment on its population, needs to be considered. Although a lack of epidemiological data have been noted (Finkelman 1990; Santos Burgoa and Rojas 1992), adverse health impacts associated with the city's physical environment have been suggested throughout the 1980s (Castillejos 1991). Moreover, deterioration in the city's social environment and increased "social pathologies" such as alcoholism, drug addiction, mental disorders, and homicides have also been noted during the past decade (Gómez de León et al. 1993). The economic crisis of the 1980s and related contraction of industry in the city has led to even more rapid deterioration in already insufficient infrastructure thus further worsening the negative impact of the city environment on its population. A summary of current environmental indicators for Mexico City are collected in Table 9.

TABLE 10. Migration intentions of residents of Mexico City in 1987 National Urban Migration Survey (ENMAU) by educational level

Education	% would like to out-migrate
None (n = 224)	19
1-6 Years (n = 1,279)	26
7-9 Years (n = 485)	32
10+ Years (n = 1,075)	42
Total (N = 3,063)	32

Source: Unpublished tabulations of National Urban Migration Survey (ENMAU), 1987.

As noted at the outset, the negative environmental conditions reflected by these indicators may at present be playing a role in current out-migration patterns among some groups. Indeed, the 1987 ENMAU found that a third (32%) of all residents interviewed in Mexico City indicated that they would like to leave, in contrast to other cities where less than 10% of residents indicated will to out-migrate (Table 10 and *Caracteristicas...* 1987). Moreover, in contrast to other cities where economic motives dominated, the main reasons given for wanting to out-migrate from Mexico City related to the physical and social environment of the city (*Caracteristicas...* 1987; Negrete 1990; Negrete et al. 1993). A quarter to one half of potential out-migrants from Mexico City cited environmental factors related to stress (55%), pollution (41%), and violence (25%) as a reason for wanting to leave (Table 11). As suggested above, middle-class families in particular, may be responding to environmental conditions in Mexico City through out-migration. The importance of studying this group is, therefore, considered further below.

3. THE MIDDLE CLASS AS A FOCUS ANALYSIS

The middle class in Mexico, as well as in other developing countries, has received virtually no attention in relation to the urban environment. Middle--class families may, however, represent an important flow of out-migrants

from Mexico City in response to environmental conditions. According to the 1987 ENMAU the middle-class individuals surveyed (indicated by 10 or more years of education) reflected the largest proportion (42%) who stated they would like to out-migrate (Table 10). Moreover, among those middle--class individuals that indicated wanting to out-migrate over a third to more than a half indicated wanting to do so because of environmental factors related to stress (62%), pollution (47%), and violence (28%) (Table 11). At the same time, actual 1990 census data, as noted above, indicates possible selectivity for middle-class individuals among out-migrants from Mexico City (see Table 2) and in-migrants to medium-sized cities (see Table 3).

TABLE 11. Main reasons for out-migration cited by potential migrants from Mexico City by educational level (multiple response) in ENMAU, 1987

Level of Education	Percentage Citing*				
	Stress	Pollution	Violence	Work	Family
None (n = 42)	55	36	26	10	19
1-6 Years (n = 337)	44	34	22	10	13
7-9 Years (n = 155)	57	41	26	14	9
10+ Years (n = 451)	62	47	28	16	8
Total (n = 985)	55	41	26	14	11

* Percentages do not sum to 100%; respondants may have cited more than one reason.
Source: Unpublished tabulations of National Urban Migration Survey (ENMAU), 1987.

The importance of the middle class in Mexico, which is primarily an urban class, has recently been suggested on several grounds (Loaeza and Stern 1990) many of which have relevance towards the urban environment itself. The middle class in Mexico is characterized by a "political alertness" and has played an important role in periods of reform, independence and revolution; in this context, the middle class has frequently provided strong opposition against government authoritarian (Loaeza and Stern 1990). It may, thus, represent a key political group in terms of environmental activism. It has also been the class which has supposedly benefited most from the prevailing patterns of development in the country (*ibid*). Therefore, its increased out-migration in response to the environmental conditions created by this pattern of development in Mexico City may, in fact, suggest an important contradiction of this general assumption. In addition, the middle class may represent a key group in terms of consumption patterns. If middle--class families in Mexico are like their counterparts in industrialized countries, it is likely that their consumption levels, e.g. use of vehicles, disposable products, and environmental impacts are probably greater per family than among lower social classes. Moreover, the middle-class in Mexico is an influential group whose tastes and attitudes have tended to become the dominant one in Mexican society. Their behaviours, including consumption, may have a strong influence on other classes (*ibid*) and thus ultimately on environmental impacts.

Therefore, the study of the middle class relative to the urban environment and, specifically, in relation to recent out-migration from Mexico City, merits further consideration. Based on this assumption, we wanted to explore further the role played by environmental factors in the out-migration of middle-class families from Mexico City to medium-sized cities in central Mexico after 1985. The results of a qualitative study carried out to this end are described below.

4. PURPOSE OF STUDY, DATA AND METHODS

Middle-class families who out-migrated from Mexico City to medium-sized cities after 1985 were selected for study. Women from these middle-class families were chosen as informants due to the women's traditional roles as family caretakers in Latin America (Browner 1989) and their importance in internal migration flows (United Nations 1993). For the purpose of the study, middle-class status was defined as having higher education (10 years or more) and occupation (professionals, technicians, educators, artists, officials, directors, administration and office workers). Income was not used as a criterion since recent wage-freezes among higher occupations and the growth of the informal economy in Mexico make this measure less representative of overall socio-economic status. The period after 1985 was chosen for analysis since it coincided with the time frame covered by the 1990 Census and overlapped with the period covered by the 1987 National Urban Migration Survey (ENMAU).

Environmental perceptions of Mexico City and destination to medium-sized cities were the main variables of interest. "Environment" was not defined *a priori* but rather constructed through the course of the study according to the perceptions that emerged. The use of qualitative methods and focus groups was judged to be the most effective means of gathering detailed information on perceptions. Information was also collected on other factors affecting migration, e.g. work, migration decision-making, attitudes towards environmental activism and the basic socio-demographic characteristics of the women and their families.

A list of potential medium-sized cities in central Mexico were singled out as potential study sites based on their having a large percentage of out--migrants from Mexico City (see Table 1a and Table 1b). Four cities were chosen in which the investigators had contacts: Cuernavaca, Pachuca, Querétaro and San Luis Potosí (see Fig. 1). Purposeful selection of participants was employed and the investigators used their own social and professional networks to choose key women contacts in each of these four medium-sized cities based on the criteria that they were women of reproductive age with families, came from a middle-class background, had out-migrated from Mexico City with their family after 1985, and had indicated that environmental conditions in Mexico City played a role in their out-migration. These key

contacts were then requested to contact 5-8 other women in their city according to the same criteria by which the key informants were selected.

TABLE 12. Characteristics of medium-sized cites and focus groups studied

City (State)	Distance from Mexico City (km)	Total population 1990[a]	Main activity 1990[a]	Percentage Urb. Man. PIB 1970	Percentage Urb. Man. PIB 1990[b]	Focus Group Size
Pachuca (Hidalgo)	80	201,450	Commerce/ Services	0.16	0.35	8
Cuernavaca (Morelos)	85	511,779	Manufacturing, Commerce	0.41	1.68	7
Queretaro-City	215	555,491	Manufacturing	0.51	0.99	7
Queretaro-Suburb (Querétaro)						7
San Luis Potosí	417	658,712	Manufacturing Commerce	0.42	1.05	5
5 groups						34 women

[a] Source: *Programa...* 1993, Cuadro II.1 and III.1
[b] Percentage Urban Manufacturing Industrial Product (Urban Manufacturing PIB) given for Cuernavaca, Querétaro and San Luis Potosí; percentage Urban Commerce/Service Industry Product ("Otro") given for Pachuca.
Source: Garza and Rivera 1994, Cuadro 3.7, 153-155

The focus groups in each of the four cities were held during January 1994 in the home of the key contact and consisted of the key contacts and the subsequent contacts made by them. In most cases focus groups participants were previously acquainted with each other. One of the investigators served as moderator in each of the focus groups. Before beginning discussion, women were informed that they would be asked to discuss the role played by environmental factors in their decision to out-migrate. A focus group discussion guide (see Annex) and a self-completed questionnaire soliciting basic socio-demographic characteristics were developed. Two focus groups were held in Querétaro and one each in Cuernavaca, Pachuca and San Luis Potosí for

TABLE 13. Characteristics of 34 middle-class women who participated in the focus group and of their families

Family type	32 nuclear 2 extended
Mean family size	4 members
Mean number of children	2.0
Mean age of women focus group participants	35 years
Mean age of husband (n = 32)	39 years
Mean age of children	7 years
Mean time since out-migration from Mexico City	5 years

Source: Survey administered to women focus group participants.

a total of 5 groups with 34 women in all (Table 12). The groups were homogenous (Table 13) in that the majority of women came from nuclear families with young children and a family size below the national average of 4.9 (López and Izazola 1994). The education and occupational characteristics of women and their husbands confirmed the selection criteria of middle-class status. Initial results and a preliminary analysis of the focus groups data are presented below.

5. RESULTS

5.1. ENVIRONMENTAL PERCEPTIONS IN MEXICO CITY

As a criterion for selection, perceptions of the physical environment in Mexico City had to have played some role in their migration decision making. The most frequent negative environmental perceptions of Mexico City focused on the health impacts of air pollution. Over half the women (18) indicated that the physical environment in Mexico City had led to health problems in their children, themselves, their spouses or parents who resided with them. The most frequently reported health impacts perceived in children were: respiratory illness, skin rashes, ear and eye problems, allergies, and vomiting. Health impacts perceived in adults were: conjunctivitis, respiratory illness, throat illness and allergies.

Many participants also noted that they were profoundly affected by the fact that in Mexico City their children were frequently not allowed outside for recess or had to wear a face mask in school because of air pollution. Most participants also perceived other negative physical environmental factors in Mexico City including garbage, noise, poor services, and traffic. Negative aspects of limited family-living space were also noted when women were asked about the environment in Mexico. Many mentioned the difficulty of living in an apartment with small children. One participant perceived that in Mexico City children become "apartment children" who stay inside all day watching television. At the same time, women expressed their fear of having their children kidnapped or abused if they did go outside to play. Many also mentioned that they felt their children had limited contact with "nature" (animals, stars, green areas) in Mexico City.

Some positive perceptions of the environment of Mexico City also emerged from the groups. Many participants noted that educational opportunities for their children and their own professional opportunities were greater in Mexico City than at their destination. Many also spoke of the advantages of Mexico City in terms of entertainment (opera, cinema, theatre). Others, however, noted that it was impossible to take advantage of these attractions because of long distances and traffic. As one participant noted, "In Mexico City you live in a golden bowl because you have everything but cannot take advantage of anything".

When asked about perceptions of environment in Mexico City, all participants also mentioned abstract social and psychological factors. Violence, crime and the lack of security were frequently mentioned. The aggressiveness and "de-humanization of people" was also noted. One woman stated that in Mexico City people were "bad-tempered, aggressive and neurotic". Many women also noted a lack of *convivencia* or quality in their relationships with their spouse, family and friends in Mexico City when asked about the environment. One woman observed that on weekends "rather than go outside and do things as a family because of the air pollution, traffic, and stress all you do is sleep and watch television". Several noted that they saw their spouse only at breakfast and dinner and that their husbands, in particular, spent little time with the children. The perceived lack of *convivencia* extended to relationships with friends and extended family. Several noted that traffic made it difficult to visit friends and family in other parts of the city. One woman noted "the pollution in social relations" in Mexico City and the isolation of couples, families and individuals.

On an individual level many women perceived high levels of stress in Mexico City. Many felt that the traffic and poor health conditions of their children were sources of this stress. Many women perceived that the physical, social and psychological environment of the city had deteriorated since their own childhood. Several expressed that they felt obligated to give their children the opportunity to grow up in an environment equal to what they experienced in their youth and felt this was no longer possible in Mexico City. In some cases the women felt that they sacrificed their own professional development in leaving Mexico City but that this was necessary for the benefit of their children and family.

5.2. ENVIRONMENTAL PERCEPTIONS AT DESTINATION MEDIUM-SIZED CITIES

When asked to describe the environment at their destination cities most participants began with positive physical perceptions which bordered on the idealistic. One participant observed about Querétaro there were "millions of stars you would never see in Mexico City" and another stated "you would never see birds in Mexico, but there are so many birds here at times they cloud the sky". Several observed that upon arrival at their destination they thought, "It was perfect", "marvelous...zero contamination" and that they "felt as if they had arrived in paradise". Participants perceived that the health problems that they, their spouses and their children had in Mexico City and which they associated with air pollution improved immediately upon arrival at their destination. They also perceived that the physical environment was cleaner, there was less noise and that they and their children had greater contact with "nature" (animals, open spaces, trees, flowers) which they believed they "never had in Mexico City".

Many participants also perceived the positive impact of a larger physical living space on their family at destination. Most indicated that in moving

from Mexico to their destination they now lived in houses as opposed to an apartment; as a result, their children in particular had more room to play. The convenience of daily activities, e.g. driving the children to school and shopping was also perceived. Women also reflected positive perceptions of the social and psychological environment at destinations. They perceived greater *convivencia* or better quality of relationships with their spouses, family and friends. Women also perceived that their "life in the country" was less stressful. Many felt they had more time and could organize it better.

Negative environmental perceptions of the destination medium-sized cities also eventually emerged. Increasing air pollution was noted in all destination cities; however, the women did not report any negative health impacts of this pollution. Some felt the air pollution would never occur on the same scale as in Mexico City owing to different topography and smaller population; others indicated that in 5 years or less the medium-sized cities would experience the same levels of air pollution as Mexico City. In all destinations women also perceived that they had other environmental problems, namely water scarcity or contamination and garbage, that were greater than in Mexico City. In Pachuca women noted that the vegetables grown nearby were contaminated due to the use of waste water from Mexico City in their production. In all destinations women also perceived that they were experiencing water scarcity because much of this was being redirected to Mexico City. Most participants also perceived that their destination cities were growing in a rapid and disorganized manner leading to insufficient infrastructure, services (water, roads and schools), and environmental deterioration. Several participants concluded that pollution was everywhere and it was impossible to escape it.

Negative perceptions of the social and psychological environment at destinations also emerged. In Querétaro and San Luis Potosí some women felt rejected by residents. In all destinations women indicated that they missed their family and friends left behind in Mexico City; many returned frequently to visit them. In all destination cities the women also stated that their main social contact was with other migrants from Mexico City who were young couples with young children. All the women perceived that these social networks or "little Mexico Cities" offered them important social and psychological support as they adapted to their new cities. Daily or weekly commuting by husbands to Mexico City was reported by some women in all destinations except San Luis Potosí. Several women felt the stress of becoming *de facto* household heads in the absence of their husbands.

5.3. OTHER FACTORS RELATED TO OUT-MIGRATION FROM MEXICO CITY

Women felt they had played an active role in the decision to migrate in all cases but this role was varied. In many cases women indicated that they initiated the idea of moving mainly because of the perceived negative health impacts of the environment of Mexico City on their children. In other cases both they and their husbands felt it was necesesary to leave for the health

of their children, their spouse or themselves. In several instances, however, participants stated that if they had not had children they would not have left Mexico City but felt they had to do so for the welfare of their family. In three instances women indicated that their husbands did not want to leave Mexico City but they insisted because of the health of their children. In several cases, participants and their spouses were also influenced by physicians who suggested that their children or they would continue to experience health problems if they remained in Mexico City.

Women indicated that work opportunities were either adjusted or coincided with the desire to leave Mexico City. Among a third of the women, the desire to migrate for environmental reasons coincided with the husband's, and in two cases the women's, job transfer or work opportunity in the medium-sized city. In three cases women out-migrated with their families to medium-sized cities first and they and their husbands later found work. Among a third of the women (especially those living in Cuernavaca which was closest to Mexico City) commuting to Mexico City by husbands (and in two cases the women, themselves) occurred. Most of the women in all the cities felt there were fewer opportunities for their own employment. Among those women whose husbands had private businesses or worked as consultants they also felt business opportunities were more limited in their new destination. Many perceived that they were economically worse off than in Mexico City but felt that they had gained in terms of their family's health and quality of life. Several women noted, "you exchange one thing for the other".

Most women reported that their choice of destination was determined by several factors including most frequently "the physical attractiveness" of their destination city, and, ironically, closeness to Mexico City. Closeness to Mexico City was perceived as important since many still had family there or since they frequently had to go there for bureaucratic reasons, shopping or medical facilities. Six of the women indicated that the presence of family was also a reason for choosing their destination. In Cuernavaca, many women noted that they first had weekend homes in the city to which they eventually moved permanently.

5.4. ATTITUDES AND ACTIONS TOWARDS ENVIRONMENTAL ACTIVITIES

In all the focus groups women spoke about "putting in their grain of sand" and felt that they as families needed to begin to undertake ecological actions such as recycling; at the same time, they did not indicate any awareness of the impact of their own family's consumption patterns. For example, many women mentioned the need to undertake recycling but none mentioned reducing their use of non-degradable items[7]. The women had a skeptical attitude towards the government's role in protecting the environment. Many felt that

[7] The one exception to this contradiction was that the women in Cuernavaca (where garbage was mentioned as a particular problem) did discuss the impact of their use of disposable diapers, plastic grocery bags, and fast-food containers.

the government and private interests together were also behind many environmental abuses, particularly in relation to the disorganized and rapid urban growth they felt was occurring in their destination cities.

Participants stressed the importance of the ecological education of their children. Many noted that their children were already receiving education in school. Many felt this education had to be reinforced in the home, that as parents they needed to set an example for their children, and that environmental education should be extended to adults as well.

Several women joked about migrating again if the conditions in their medium-sized city became as bad as Mexico. Others, however, said they would "fight tooth and nail" to prevent similar conditions from recurring in their new destinations.

The majority of participants indicated that they had not contacted any environmental group before leaving Mexico City and most were not involved with groups in their medium-sized city destination. However, all indicated that they would like to participate in some kind of group.

6. DISCUSSION

The relationship between environmental perceptions and migration among the women studied is a complex one which we have only begun to unravel in our initial analysis. Thus, the following discussion aims to stimulate and suggest lines of interpretation rather than undertake conclusions in the traditional sense.

As with all qualitative study the degree of representativeness of the middle-class families and women studied cannot be established, thus leading to a lack of generalizability of results. In compensation, our results may offer greater intelligibility of the confluence of factors that may shape both environmental perceptions and migration in response to these perceptions among the particular group studied. On the other hand, the major shortcoming of the study is that time and resources did not allow consideration of a comparative or "control" group, for example of middle-class families who perceived environmental threats and did not out-migrate.

Our results confirm the fact that women have played an active role in the decision of their families to out-migrate and the decision to leave largely hinged on their environmental perceptions. Analysis of the degree to which the women's perceived health impact corresponded to the real threats posed by the physical and social environment in Mexico City was not possible since existing epidemiological information on the impact of environmental conditions is limited at present (see section 2.2). What is clear is that the environmental perceptions of the women studied encompassed both physical factors such as air pollution as well as the man-made physical environment (e.g. living spaces, transport, and services), and abstract social and psychological factors related to stress and the overall attitude of city inhabitants.

Their broad perceptions suggest that if environment is to be viewed as a variable which may have an impact on migration, the concept of environment needs to be extremely broad and must take into account social and psychological as well as physical factors. The need to account for the so-called "sociosphere" in the study of population-environment relationships has been noted elsewhere (Arizpe et al. 1993).

In most current research on population and environment relationships, the environment is defined *a priori* by the investigators (Marquette and Bilsborrow 1994). The rural environment is frequently conceptualized in terms of natural resources, e.g. forest, water, land and air. The urban environment has also been defined in relation to physical factors and problems related to these factors, e.g. air pollution, water contamination (see, for example, Satterthwaite 1993; Hardoy and Satterthwaite 1987). However, *a priori* definitions of the environment formulated by researchers do not necessarily correspond to the perceived environment to which a population responds. Further understanding of population-environment relationships in urban as well as rural areas may require greater attempts to understand perceived environments. Further understanding of environmental perceptions may perhaps be accomplished through continued qualitative, family-level or "micro-level research" (Jelin et al. 1986) such as that attempted in the present study.

Our results suggests that environmental perceptions and migration in response to these perceptions among the women and families studied was the result of a complex process involving the interaction of family, individual, and cultural factors as well as historical-structural forces such as social class. Understanding this process therefore requires various levels of analysis (individual, family and structural) as well as various theoretical perspectives. The individual profiles of the women undoubtedly shaped their environmental perceptions and, ultimately, their out-migration. For example, the women studied may have been more inclined to take risks and thus, out-migrate. In addition, there may be a series of other personality factors not directly associated with environmental perceptions or "latent strategies" (Lazarsfeld 1972: 256) in play in the out-migration of these women and their families. Further analysis of the impact of psychological factors on environmental induced migration thus also needs to be pursued in future analysis. Also, the blending of individual and social dynamics arising from the focus group situation (e.g. the role played by "peer pressure" in shaping the information conveyed by individual women, the emergence of "leaders" within the individual groups, patterns of interchange between women) must also be taken into account in future analysis.

In terms of family-level factors, namely family life-cycle effects, it is important to consider that many of the families studied were in the early stages of family formation with young growing children. Thus, they may have been predisposed towards perceiving the environmental threats and the small living space in Mexico City, where most lived in apartments. The

fact that most families were young nuclear families have also facilitated solidarity in making the decision to out-migrate. The impact of family life-cycle on the migration processes observed in this study also need to be further explored.

Cultural factors may also play a role in shaping environmental perceptions and the use of out-migration among the families studied. The women revealed that they valued the well-being of their family over their own professional development which they concurrently felt they had sacrificed upon leaving Mexico City. This self-sacrificing attitude may be related to traditional gender roles in Latin American society. Similarly, cultural factors may also have had an effect on their perception of illness, environment and the relationship between them (Martínez and Salles 1993). Factors associated with the culture of modern urban life, namely the media, may also have played a role in shaping perceptions. In this regard, it is interesting that most of the women concentrated on the negative effects of air pollution in Mexico City which may reflect the influence of government programmes and advertising which have been focused mainly on this environmental problem.

In future analysis, we feel it is essential to further analyze the interactive roles played by individual, family and cultural factors in shaping environmental perceptions and migration. The remaining discussion below, however, focuses on more detailed consideration of the role played by the additional factor of social class. We thereby hope to link our results with the literature on social reproduction and family survival strategies in Latin America. Family survival strategies may be briefly defined as those socio-economic and demographic behaviours (including migration) identifiable at the family level which contribute to the family's material (biological and economic) as well as non-material (social and psychological) well-being (Torrado 1986).

In addition to being shaped by family, individual and cultural factors discussed above, these survival strategies are also shaped by a family's position in the social structure. Concurrently, they contribute to the larger process of social reproduction, since in facilitating the reproduction of the family they also facilitate the reproduction of that family's social class. "Strategy" in this context obviously refers not to a premeditated plan but rather to a complex of dynamic factors that evolve over time. Since these survival strategies may be seen as shaped by a family's position in the social structure, they afford a way of conceptually linking macro- and micro-level forces that may be affecting migration outcomes. The concept of family survival strategies thus allows for linkages to be made between family level demographic behaviour, e.g. migration, and the larger structural forces captured by social class.

Migration, in particular labour migration, among *campesino* and poorer urban families in Latin-America has been interpreted as a class-related family survival strategy which has emerged in response to the economic conditions created by capitalistic development (see for example Arizpe 1982; Oliveira et al. 1988; Roberts 1992; Hugo 1993). Our results suggest that out-migration by middle-class families from Mexico City to medium-sized cities may also be viewed as a class-related family survival strategy which

has emerged in response to the environmental conditions created by this same pattern of development. For example, the higher educational levels of the women studied may have made them more aware of their children's health, more likely to connect environmental conditions with health problems, and more empowered in taking action in the face of these perceptions of environmental impacts. Moreover, their higher education and occupation, gave them greater options in terms of work arrangements, e.g. commuting, transferring work to their new destination, finding work subsequent to migration. This flexibility, in turn, facilitated the realization of their desire to migrate for environmental motives.

The use of migration as a survival strategy identified in our study may be only one of the many being adopted by middle-class families in Mexico City in response to environmental conditions. For example, many of the women in Cuernavaca indicated they first had weekend houses in that city. Leaving Mexico City for the weekend may thus represent an interim (Zelinsky, 1971) or an alternative survival strategy for this group. This strategy may be also shaped by social class, that is, as middle-class families they may have sufficient resources to maintain a weekend home. However just as social class may facilitate the use of out-migration in response to environmental conditions among middle-class families (who represent approximately 30% of the population of Mexico City (see Table 2), it may limit the options (Przeworski 1982) in response to environmental change which are available to most of the City's population who are of lower socio-economic status.

The 1987 ENMAU indicated that 10 to 32% of individuals of lower social class (indicated by educational levels less than 10 years) stated that they would like to out-migrate (Table 10). Moreover, close to a third or more of potential migrants of lower social class (again indicated by educational levels less than 10 years) indicated wanting to out-migrate for environmental reasons (stress, pollution or violence) (Table 11). The comparative environmental perceptions, similar patterns of out-migration, or alternative survival strategies being adopted by other social classes, or the majority of Mexico City's population, in response to environmental conditions in Mexico City, however, has yet to be investigated. In general, only a limited amount of recent research has addressed the impact of social class on population, migration and environment relationships in urban areas of Latin America (see for example Hogan 1993). Greater understanding of the impact of social class on population responses to (and impacts on) the environment, however, may be particularly important in urban areas where social inequality may be more pronounced.

The survival strategy of migration employed by the middle-class families studied suggests they are mainly proactive "environmental migrants" rather than reactive "environmental refugees" (Suhrke 1993: p. 9; Kavanagh and Lonergan 1992). In response to perceived negative environmental conditons their migration response is in the majority of cases proactive in the sense that it is the outcome of a process of active deliberation and choice from a range of possible actions (e.g. migration, having weekend homes, etc.) which

might improve family well-being. This contrasts with environmental refugees, e.g. famine victims, whose migration response is more reactive in the sense that it is the outcome of a situation in which choices are limited or nonexistent and the very life and death of the family is as stake[8]. In any case, our results suggest that there is a need to further refine concepts of environmentally induced migration and extend consideration to other social classes beyond lower socio-economic groups as well as to consider the urban context and other countries, especially the developed ones.

Perceptions of the environment in medium-sized destination cities provide some insight into the consequences of this survival strategy of "environmental migration" employed by the families. In the medium term (the average duration of residence was 5 years; Table 13) the women felt that migration had increased the quality of life for their families. All indicated that it had resulted in the improved health and well-being of their children, their spouses and themselves. As in all destination-based migration studies, the families captured may represent only the "successes". Moreover, the future consequences of migration for these families, are not known. It would be useful to follow-up the women and their families to determine long-term consequences. In this initial analysis one large gap has been the lack of consideration of differentials between focus groups in the different medium-sized cities studied (Pachuca, Cuernavaca, Querétaro and San Luis Potosí). There are clear differences between the study cities, for example of major industries and geographic setting, which suggest that consideration of differentials is important and would undoubtedly provide further insight into environmental perceptions and migration consequences.

Considered as a whole, however, the focus groups suggest that migration as a family survival strategy in response to negative environmental conditions in Mexico City may not be functional in the long-term at the family or societal level. In a wider context, migration as a family survival strategy adopted by middle-class families may not contribute to more sustainable patterns of urban development. "Sustainability" has been defined as an awareness of inter-generational responsibility (Brundtland 1990). The survival strategy of out-migration employed by the middle-class families studied, has in fact, evolved in response to this notion of sustainability at the family level. For example, many of the women directly stated that they felt a responsibility to give their children the opportunity to grow up in an environment as good as the one which they experienced as children and they believed out-migration facilitated this. However, family life strategies that promote sustainability at the family level do not necessarily lead to sustainable patterns at the societal level; indeed they may work against it (Arizpe et al. 1993). The survival strategy of out-migration by the middle-class families studied may, in fact, be adopted in *lieu* of changing that family-level

[8] Only 5 families among the 34 studied could be characterized as environmental refugees.

factor which may most immediatly affect the urban environment, namely consumption.

In urban areas the family, and in particular the middle-class family, is mainly a consuming entity and it is through its consumption patterns that urban families may have their greatest environmental impact (use of cars, energy use, etc.)[9]. However, the environmental perceptions of the women studied revealed little awareness of the impact of their family's consumption patterns on the environment. Indeed the women tended to perceive the manifestations of environmental problems (e.g. air pollution, traffic, garbage, crime) rather than family-level factors contributing to these problems (use of motor vehicles, use of non-degradable/non-recyclable goods). Out-migration from Mexico City thus may allow these women and their families, at least in the short term, to avoid confronting the environmental impact of their family's consumption patterns as well as the impact of larger forces such as the replication of negative industrialization patterns in medium-sized cities.

Out-migration, thus promotes a form of false consciousness in which both family and societal level factors which have environmental impacts in medium--sized cities are not recognized. Contradictions associated with this "false consciousness" indeed, emerged from the focus groups. For example, the women idealized the environment at destination (viewing it as "paradise") yet simultaneously perceived recurring and new environmental problems in their destination cities (water scarcity, garbage). At the societal level, an even larger contradiction may emerge. Middle-class families may out-migrate to escape perceived negative environmental conditions in Mexico City. However, in doing so they may ultimately confront and, by their own consumption patterns, contribute to the replication of negative environmental conditions in the cities to which they migrate.

At the same time, our results suggest that the middle-class urban families studied may be predisposed towards recognizing and changing both their own consumption patterns as well as towards undertaking political action with respect to larger social and economic forces affecting the environment[10]. First, as a group they were sensitized to environmental concerns to the extent that they have taken the relatively radical decision to migrate in response to perceived environmental conditions. Moreover, they had begun to realize that continued migration was not a long-term survival strategy or that "pollution was everywhere". Almost all the women had positive attitudes towards individual activism as well as participation in environmental groups. They also indicated their support for environmental education for their children and adults. These middle-class families may thus represent

[9] This contrasts with rural areas where both productive and consumption activities of the family may have environmental impacts (Pírez et al. 1983).

[10] It is likely that the focus groups, themselves, had a „Hawthorn Effect" of raising the participant's awareness of environmental issues. However, we feel this only enhanced an awareness which pre-existed since a criterion for inclusion in the groups was evidence of environmental motives for migrating in the first places.

a key group at which to target interventions which might be undertaken either by the state or private organizations at the national or local level. In contrast to out-migration, environmental activism and education may form part of an alternative family survival strategy that will contribute to sustainable urban development in the long term. Our research suggests that environmental issues might be included in national population policies by including measures aimed at affecting family-consumption levels, particularly among middle-class families. For example, existing techniques used in knowledge, attitude and practice (KAP) interventions aimed at changing fertility and family planning behaviour could be applied to affect family level consumption behaviour as well.

The consequences of the out-migration by the middle-class families for the environment in Mexico City are ambiguous. The loss of families who may be most aware of environmental issues may represent the loss of a key group for affecting change; at the same time, since it may contribute to the slower growth of the city and de-concentration of population to other cities it may contribute to a more balanced development. As far as these middle-class migrants may be settling in medium-sized cities in central Mexico surrounding Mexico City, this migration flow may add to the process of "megalopolization" and its related negative environmental impacts as touched on in the first part of this paper. Consequences of the middle-class migration studied for the environment at destination are also ambiguous. The influx of such families into medium-sized cities may contribute to the replication of negative environmental impacts as discussed above. At the same time, it may introduce families which with appropriate interventions may be more motivated to undertake more sustainable modes of existence, thus contributing to more sustainable development in medium-sized cities and the country as a whole.

Slowed growth in many major Latin American cities suggests that out--migration processes may be widespread (Lattes 1993). Data may continue to exist for identifying and describing the magnitude and direction of these increasingly complex migration flows but there is still little information available for understanding factors stimulating these flows including environmental conditions. In this respect, there is a need for more small-scale qualitative studies such as ours which draw on existing quantitative data for describing specific flows but also employ qualitative methods to explore the factors shaping these flows. Such research may contribute to the greater understanding not only of population-environment relationships but of internal migration as well.

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ANNEX

FOCUS GROUP DISCUSSION GUIDE

1. Why did you leave Mexico City?
2. What does environment mean to you?
3. Who took the decision to leave Mexico City?
4. Why did you pick this city to move to?
5. When you arrived at this city what were your perceptions of the environment here?
6. Do you think the same environmental problems in Mexico City might recur in this city?
7. Do you think that participation in activities to protect the environment is useful?
8. Before leaving Mexico City did you contact any environmental groups or were you involved in any activities to protect the environment? Did you know of the existence of any such groups?
9. Would you like to participate in some groups or activity that was involved in environmental protection now? Do you know of the existence of any such groups in this city?
10. Was it worthwhile leaving Mexico City and, if so, why?

METHODOLOGICAL NOTE

The questions used to collect information on migration in the 1990 census were: (1) In what state where you born? and (2) In what state did you live 5 years ago in 1985? As a result, information on the origins of migrants is available only at the state level. This presents problems in attempting to measure both in- and out-migration from Mexico City, since Mexico City consists of the Federal District (which was treated as a state in the census), and 27 urban municipalities located in the state of Mexico. Movements affecting the 27 urban municipalities cannot be separated out from data on the entire state of Mexico; therefore, direct calculation of in- and out-migration for the Mexico City is not possible and indirect methods must be used.

We chose to calculate in-migration by considering individuals who were enumerated in Mexico City in 1990 and who reported living in any other state besides the Federal District or state of Mexico in 1985. We therefore subtracted from total in-migration to Mexico City (1,015,851) any interurban movements from the Federal District to the 27 urban municipalities (509,585) and any movements from anywhere in the state of Mexico to the Federal

District (80,905). Estimated in-migration was, thus, 425,261. This estimate is probably an underestimate since in-migration from non-urban parts of the state of Mexico to Mexico City is not captured.

To calculate out-migration from Mexico City we used out-migration from the Federal District to anywhere else besides the 27 urban municipalities in the state of Mexico (526,173) as a proxy for all out-migration from Mexico City. Out-migration is probably, therefore, also underestimated since any out-migration from the urban municipalities is not captured. Alternatively we might have considered out-migrants from the Federal District and the entire state of Mexico as a representing all out-migration from Mexico City. Since a third of the population in the state of Mexico does not reside in the 27 urban municipalities this would lead to overestimation of out-migration. We preferred underestimation.

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V. *Perceptions and policies*

ELEMENTS OF BUILT ENVIRONMENT AND LIFESTYLE BEST SUITED TO THE NEEDS OF MODERN INDUSTRIAL SOCIETIES

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ABSTRACT: Adjusting to the historically unprecedented older age structures and high levels of urbanization now characteristic of industrialized countries requires changing both the built environment and human lifestyles. The *ultimate goal* is societies (a) where people are largely able to look after themselves, (b) where people are living lives of dignity and comfort as respected members of society, and where (c) lifestyles, social organization and physical layouts support coping, oneself, and the willingness and ability to render assistance and comfort to others. Prime *intermediate goals* to these ends are seen as: (a) less automobile usage, (b) livable cities, (c) provision of certain specific social services and facilities, (d) less use of age as a criterion for social participation, (e) development of coping and caring personality traits, and (f) more equal distribution of wealth and income.

KEY WORDS: Goals, means, ecological sustainability, demographic optimum.

INTRODUCTION

Two elements in the demographic structure of industrialized countries that are of particular significance to the issues to be addressed here are: (a) older age structures and (b) high levels of urbanization. Both are now at historically unprecedented levels in these countries; and further concentrations in the upper ages, at least, can be expected to become even greater in most of them over the next two to three decades.

OLDER AGE STRUCTURES

The change to older age structures, though part of a long-term process, has accelerated in recent years. This has come about through three processes: (a) the sudden marked increases in the birth rate (as well as in fertility in general) that took place after World War II; (b) recent declines in the birth rate (which, though partly attributable to changes in the age-pattern of childbearing, are primarily the result of lower fertility); and (c) recent — and, as it happens, quite unanticipated — declines in upper-age mortality (declines in which the relative gains have tended to be greater at successively older ages).

Recent fertility increases will retard this trend towards older age structures in some of these countries, but they are unlikely to reverse it, for the general pattern of these increases has been one of movement towards virtual stability at either replacement level or somewhat below it, and the increases themselves have not been very great. The reasons for expecting these countries' fertility levels to rise much higher than replacement seem far less persuasive than those for expecting them to remain at about (or slightly below) replacement level, instead (Day 1993). So far as fertility is concerned, these countries seem well on the way to meeting what I have argued (Day 1971) are the three demographic characteristics of an optimum population, namely, low mortality, an unchanging age and sex structure, and a zero growth rate.

As far as the mortality side of the equation is concerned, any additional gains in longevity at the upper ages would, of course, augment the ageing process still further. But such gains do not strike me as a very likely prospect (Day 1991) — despite numerous claims to the contrary — certainly not to a degree that would have much further effect on age structure. With mortality as with fertility, the reasons for expecting marked changes seem far less persuasive than those for expecting continuation at approximately current levels. Once the swollen cohorts of the post-World War II period pass through — and barring some major social change fraught with demographic significance — it seems reasonable to suppose that the age structures of industrialized countries will typically have slightly more than 10% of their numbers at ages 65-74 and slightly less than 10% at ages 75 and over. Compared with the present age structure of Sweden, this would represent increases of about half a percentage point at ages 65-74 and slightly more than two percentage points at ages 75 and over. (To the extent that fertility in these countries continues below replacement levels, these proportions would be even higher).

URBANIZATION

"Urbanization" as a concept has little of the statistical and conceptual precision enjoyed by "age structure". Urban settings are too diverse and the

definitions employed to distinguish "urban" from "non-urban" too various for it to be otherwise. Nevertheless, however defined, urbanization in all industrialized countries embodies a minimum of three elements: (a) small proportions of the work force engaged in agriculture, (b) extensive amounts of land taken up by dwellings, roads, and facilities for commerce, industry, storage (of vehicles, goods, materials to be processed), and waste disposal, and (c) high exposure to: noise, air pollution, and at least visual contact with strangers. From this there flow two consequences with particular significance for the present discussion. First of all, in comparison with their rural counter-parts, urban-dwellers have less contact with "nature". Living in a wholly human-created environment with diminished opportunities to experience nature, they are more likely than non-urban dwellers to be estranged from the natural systems that support their lives. In addition, they are more dependent; more dependent both on others and on the adequate functioning of institutions over which the individual has little or no personal control. This dependency extends not only to the basic necessities of life but, also, to those other elements of life that give pleasure and that determine one's social position and sense of self.

Given the existence of older age structures and high levels of urbanization, what conditions relative to built environments (and the lifestyles that underlie these environments) ought we to strive for if we are to serve the goal of human wellbeing in industrial societies? It is useful, here, to distinguish between two types of goals: ultimate and intermediate. At the most general level, the ultimate goals for these more aged, more urbanized populations are: (a) to enable people to look after themselves more effectively, (b) to enable people to live lives of dignity and reasonable comfort as participant, respected members of society, and (c) to develop at all levels of society those elements of personality and lifestyle, of social organization, of physical layout and functioning that are associated with being able to cope, oneself, and with being willing and able to render assistance and comfort to others.

ULTIMATE GOALS

Overall, these goals should be pursued in ways that are conducive to living in a manner that is appropriate to ecological realities and that does not compromise the ability of future generations to meet their own needs. But to introduce the concept of ecological reality is to introduce two more ultimate goals, namely, ecological sustainability and the demographic optimum. Although these are at a far higher level of generality than those just mentioned, they are of such overarching significance in today's world that they ought to be taken into consideration in the formulation of all current social policy.

The goal of "ecological sustainability" was first formulated in Australia. Recognizing, firstly, that there exists a complex relationship between economy,

environment, society, and human aspirations and, secondly, that current patterns of economic development are neither environmentally nor socially sustainable, it calls for: (a) ensuring the continued existence of the world's resource base, (b) ensuring the continuation of ecological processes, and (c) maintaining present levels of biodiversity. In comparison with the earlier and more widely-known concept of "sustainable development" embodied in the Brundtland Report (*Our common...* 1987), it envisages less scope for trading ecological values and natural resource use on behalf of current consumption without adversely affecting the choices available to future generations (Hare et al. 1990; *Ecologically...* 1991, p.4).

By "the demographic optimum" I mean a population that, irrespective of size, has: (a) low mortality, (b) a stable age and sex structure, and (c) a zero growth rate (Day 1971). Achievement of neither ecological sustainability nor the demographic optimum will ensure the existence of the "good life", but it would certainly make the good life more attainable. And, of course, in the very long run, either the absence of ecological sustainability or the continuation of population increase would jeopardize human existence altogether.

That we cannot expect to achieve any of these ultimate goals (either the most general, like ecological sustainability, or the more specific, like enabling people to live lives of dignity and reasonable comfort as respected members of society) either soon or in their entirety is no argument against establishing them. These goals are something to be striven for; something to indicate desirable directions of change, and to serve as criteria for assessing the relative worth and appropriateness of alternative policies and the extent of gains and losses over time. As the British historian, R.H. Tawney, observed over 60 years ago (1952, [1931] p.47):

"What matters to the health of society is the objective towards which its face is set, and to suggest that it is immaterial in which direction it moves, because, whatever the direction, the goal must always elude it, is not scientific, but irrational. It is like using the impossibility of absolute cleanliness as a pretext for rolling in a manure heap, or denying the importance of honesty because no one can be wholly honest".

So the rest of this discussion will deal not with ultimate goals but with certain intermediate goals; with, that is, the means through which to approach attainment of the ultimate goals. It should be recognized at the outset that the results of achieving any particular intermediate goal will not be specific. Each will serve more than one ultimate goal. What helps people to look after themselves, for example, is also likely to develop their coping skills and facilitate their participation in society. Moreover, the consequences of achieving one or another of the various intermediate goals will be marked by considerable overlapping, with many of these goals having much the same set of consequences. We can also expect a good deal of mutual causation — with changes in one direction reinforcing those in another, and vice versa. In the pursuit of social change you can never do just one thing.

INTERMEDIATE GOALS

There are six intermediate goals — all interrelated — that I consider to be of particular significance to attainment of the ultimate goal of human wellbeing in societies characterized by markedly older age structures and unprecedentedly high levels of urbanization. These are:

(a) Less automobile usage,

(b) Livable cities,

(c) Provision of certain specific social services and facilities,

(d) Less use of age as a criterion for social participation,

(e) Development of personality traits associated both with taking care of oneself and with caring for others,

(f) More equal distribution of income and wealth.

Because this paper's focus is on the built environment and lifestyle, I will confine my discussion to the first three.

Less automobile usage

By way of illustrating to his students how morality hinges on circumstance, a philosopher at the City College of New York in the 1930s is said to have used the following parable: Suppose a fallen angel offered you a device that would lighten the burden of your labours and make life altogether more interesting and enjoyable. The only thing that would be required of you in return would be the annual blood sacrifice of some of your finest young men and women. You would, of course, refuse to have anything to do with such a compact. Then came the automobile.

The automobile would have to be high on the list of the major determinants of lifestyles in industrialized countries — and its influence is rapidly spreading to the nonindustrialized, as well. The range of its effects extends from general employment levels to patterns of recreation and courtship, from the quality of the air we breathe and the physical layouts of our towns and cities to the future viability of the planet we live on. Yet, it is actually a quite recent phenomenon. Not until 1886 was one patented, and not until early this century did automobiles begin to appear in any great numbers. By 1985, however, there was an automobile for every 1.8 Americans, 2.3 Australians, 2.6 Swedes, 2.7 Germans, 2.7 Frenchmen, and 3.2 Britons (calculated from data in UN 1985/86, Table 145). Contrasted with the situation on the eve of World War II, this represents increases in the numbers of cars per person ranging from three-fold in the USA and six-fold in Australia to 18-fold in Sweden and 23-fold in Germany. As might be expected, this growth in numbers of cars has been accompanied by a marked extension of paved roads to accommodate them. In the USA, for example, the 50 years between 1937 and 1987 saw rural "high type" surface road mileage alone increase six and a half times, and, what with the widening of roads and verges that took place at the same time, the actual land area asphalted and concretized to this purpose probably thirteen to twenty times (Day 1992, p.149). The

extension of high-speed limited access motorways (which take up more land, occasion higher noise levels, and permit faster speeds — and, therefore, in most cases, higher rates of fuel consumption per distance traveled) has proceeded at a particularly rapid pace. By the mid-1980s, the mileages of such motorways in nonurban areas per 100 square miles of land area were 0.08 in Sweden, 0.47 in the UK, 1.25 in West Germany, 1.84 in the land-hungry Netherlands, and a whopping 3.93 in the spacious USA (*Ibid.*, 148-149).

Even if the automobile did not pollute, or take up great quantities of land, or contribute to global warming, or depend on a limited resource (for a particularly good study of the environmental costs of the automobile see Teufel et al. 1991), scaling down its use would be amply justified, firstly, because of its role in creating so many human, social, economic and environmental problems and, secondly, because of the encouragement it gives to the development of personality traits (like aggressiveness, short-temperedness, selfishness, competitiveness, and the desire for instant gratification) which, while occasionally useful in their place and time, are more than a little likely to have anti-social consequences, and the corresponding discouragement it gives to the development of personality traits (like tolerance, cooperativeness, patience and generosity) the social consequences of which are more likely to be beneficial. A high rate of automobile usage, because it reduces the extent of one's contact with the physical, social, and human environment, also militates against the development of various coping skills and traits — like self-confidence, self-discipline, and the ability (limited when one is insulated from them in the cocoon of a car) to encounter without fear or anxiety such elements of the social setting as novelty, strangers, human variety, and dissimilar life styles. Overall, while the gains from automobile usage are largely privatized, the costs are essentially socialized. Everyone pays — for the pollution, the lost amenity, the loss of ratable property, the costs of road construction and maintenance, the extra police, the extra judges, the extra health costs, the higher insurance rates — but only a few reap the rewards.

So far as the wellbeing specifically of a more aged population is concerned, the importance of reducing automobile usage derives mainly from three things:

(a) Expenditure on behalf of the automobile is such a significant part of total public expenditure that it inevitably restricts the amounts available for allocation to other areas of greater importance.

(b) Automobile usage is particularly encouraging of excessively low-density urban layouts; layouts that not only add greatly to the costs of establishing and maintaining urban services but, by militating against the provision of frequent public transport and of shops and other facilities within walking distance, make it especially difficult for older people to remain active participants in the community and to take major responsibility for their own care.

(c) The automobile is a major cause of air pollution — that form of pollution particularly harmful to the aged.

And let us not forget that, in addition, the automobile significantly

discourages people (of all ages) from acquiring those habits of physical exercise necessary to good health — both in the present and in later life.

Livable cities

Achieving any of the particular intermediate goals under discussion here will help achieve others, and changes in one direction can reinforce those in another. Probably nowhere is this more the case than with the two goals of reducing automobile usage and making cities more livable — making, that is, their areas of residence, work, and commerce more congruent with human needs and more suited to serving them. As a British editor has written of the American city, Detroit:

Detroit is synonymous with two things: cars and violent death... But the city does not just make cars; it has also been made by the car. The city core is dominated by an indoor shopping mall which you can only reach by automobile. The "Renaissance Centre" is surrounded by a network of access streets which funnel cars directly into cavernous underground parking lots. Outside, the old commercial streets are largely deserted and the buildings derelict. Detroit also has the highest per capita murder rate of any city in the West. Says local resident Ralph Slovenko: "Everything has been removed from the streets except cars and hoodlums. The more people you take off the streets, the more people become sitting ducks for crime". As a result, adds Slovenko, a professor of law and psychiatry at Wayne State University, "in cities like Detroit, cars are used more for protection than for transportation" (Ellwood 1989, p.4).

The advanced levels of urbanization and increasing proportions of older people in the industrialized countries add force to the desirability of ensuring that their cities and towns are eminently livable. Older people's needs are not all that different from other people's. Many facilities and conditions likely to improve the lot of the aged would also improve life for people at other ages, as well; perhaps most particularly teenagers and young adults. But there is no denying that having a higher proportion of older people in a population can place added emphasis on certain issues of adjustment. When it comes to the layout and functioning of towns and cities, the particular needs of the elderly include such as the following:

(a) Ready availability of affordable, safe, and clean public transport;

(b) A high degree of freedom from the physical, visual, aural, olfactory, and neurological intrusion of trucks and automobiles;

(c) Higher-density — but not high-rise — urban layouts, to permit greater environmental (and economic) efficiency in the provision of services and greater ease of mobility and readier contact with others. Although high-rise buildings might appear, at first, to meet such criteria, they are unacceptable for several reasons. Their use entails dependence upon elevators and they deprive some residences and workplaces of sunlight and views of the sky. They are also less conducive to the development of that degree of informal surveillance necessary to life in large groups; and, for some reason, vertical

distances seem more insurmountable than horizontal when it comes to the development of neighborliness and cooperation. And how high is "high-rise"? For residential purposes, the limit should probably be no higher than about four or five storeys; no higher, that is, than would permit a parent on the topmost floor to call to a child on the ground outside and be both heard and believed. For office blocks, it should probably be no higher than 10 or 11 storeys;

(d) Readily accessible local parks, promenades, and informal meeting places that, at a minimum, are safe and clean, and, one would hope, attractive and interesting as well;

(e) Shops and eating places that are to human scale, readily accessible physically and, perhaps (of particular significance to older as well as younger people), readily accessible emotionally, as well. An establishment in which it is possible to have direct interpersonal relations between customer and shopkeeper can, in that fact alone, more readily provide a less daunting setting for someone a little unsure of himself, occasionally confused, possibly even a bit forgetful. It can also more readily serve some of the other functions that make for a humane society. The American Harry Golden's account (1958, pp. 296-297) of why he did not buy cigars by the box provides an example:

"I buy three cigars at a time, and make my purchases two or three times a day at a drugstore, a restaurant, a newsstand, or in a hotel lobby.... I buy them when I need them and wherever I happen to be at the moment. Thus, during the course of any week, I will have made cigar purchases in at least eight different establishments — the establishments of neighbours in my community, in my city. This is good .... Over the years I've made a dozen new friends, and have seen many hundreds of new people and have heard many fine new stories and anecdotes. What in the world is better than to go into a business establishment, put some money on the counter, and buy the man's merchandise!... It is good for me. It is good for him. It does something for the morale".

If attainment of this pattern of commercial establishments necessitates some broadening of our view of what is "productive" or "efficient", some reduction in the number of available consumer "choices", even, possibly, some subsidization of commercial rents, the social gains to be had could hardly be anything but cheap at the price;

(f) Little geographic specialization by stage-of-life and economic function. It is not good for one sector of a society to be deprived of the opportunity for frequent, informal contact with the others. The aged need such opportunities if they are to remain participant members of the society for as long as it is physically and mentally possible, and if they are to have others nearby on whom they can rely for occasional help. And children, in turn, need to have contact with old people — so they will learn not to fear them; and so they will learn something of the needs and thoughts of old people, and of what to expect when their own parents, and later they themselves, reach that stage of life.

If cities are to be made livable, specialization by function should not be excessive, either. Mixing residential with commercial and governmental uses

is one of the most effective ways of livening up the downtown areas of cities. It also broadens the variety of available residential types and increases the accessibility of shops, offices, and community facilities. In addition, it reduces traffic (and, therefore, all the deleterious consequences of traffic) through increasing accessibility by foot and bicycle; and because people on sidewalks are a particularly effective surveillance force, it also reduces crime;

(g) Diversity in available housing types and living arrangements. Not everyone is married, living with spouse, with at least one but no more than three children living at home, willing and able to drive a car, and with an inordinate fondness for gardening. But you would never know it, to look at the acres upon acres of single-family detached houses that have sprung up on the fringes of cities and towns in industrialized countries over the last few decades. These projects embody high servicing costs, frequently some environmental degradation, the loss of farmland that was once the source of fresh fruit and vegetables for the region's residents, stage-of-life segregation, dependence upon private transport, and residential inflexibility. It is not that everyone has to live in one type of housing or the other; only that human needs will be better served if there is a wide choice of housing types, and if one can change from one type to another without also having to change one's neighbourhood.

Provision of certain specific social services

These are of two types: those specifically geared to meeting the needs of the aged (and infirm) and those geared to meeting the needs of persons in a wider range of ages (and conditions). Among the first type would be such as the following: (a) assistance in the home with bathing, dressing, toileting, cleaning, laundry, and the planning and preparation of meals; (b) household repair and maintenance services; (c) meals-on-wheels; (d) shopping and delivery services; (e) household technical aids — like warning devices, lifts to upper floors, call buttons, and aids to telephone usage; (f) day and recreational centres and facilities; and (g) respite services to provide occasional relief to care-givers. The purpose of providing such services and facilities would be: to enhance the ability of the recipients to manage largely on their own, to help them obtain assistance when it is needed and to assist their caregivers to monitor their condition, to give caregivers some relief from the burdens and responsibilities of their task, and to make life pleasanter and more rewarding for everyone.

Among the services and facilities from which the aged and infirm could benefit but which could directly benefit other sectors of society as well are: (a) walk-in health and counselling services, (b) inexpensive recreational facilities (for swimming, dancing, bowling, croquet, card-playing, or chess, for example), (c) libraries (both fixed and mobile), (d) clean, safe public spaces, (e) clean public toilets, and (f) public activities (like open-air band concerts, amateur theatricals, and free night-time amateur soccer games). And a word could be put in, too, for the value of having (g) a well-run neighbourhood

pub. These would give people some exercise, get them into public areas, mix different sectors of the population together, and introduce some variety and interest, even some fun, into people's lives. Such services and facilities could strengthen initiative and independence, even add to a sense of community. But specifically with older people, by reducing the likelihood of their becoming entrapped in a low-expectations model that emphasized deterioration and loss of function with age, these services and facilities could help counteract the tendency to focus on one's limitations and view oneself as a burden (Phillipson 1982, pp. 113-119), while at the same time enriching the lives of these people and putting them in a better frame of mind for coping with life's exigencies.

Some of these services and facilities lend themselves to private provision — the neighbourhood pub, for example. But most will require at least some form of public support, and this, in turn, will require abandoning the prejudice that exists in some quarters against having a larger public sector in the economy. Whatever the occasional claims to the contrary, governments can create wealth.

CONCLUSION

In the most general terms, the elements of built environment and lifestyle best suited to the needs of modern industrial societies are those of a *livable society*; a society that, as a minimum: (a) is built, in terms of its physical layout, and structured, in terms of interpersonal relations, to human scale; (b) gives priority in physical movement to pedestrians and cyclists rather than to motorized vehicles and, so far as the latter are concerned, to public rather than private carriers; (c) enjoys a high degree of behavioral predictability; (d) is safe; (e) is free of air, water, and soil pollution; and (f) has in operation a high-quality safety net with respect to housing, health and custodial care, rehabilitation and counselling services. The means to such a society are of essentially three types: (a) education and persuasion, (b) differential pricing in the marketplace, and (c) regulation. Their appropriateness will vary with circumstances, but each will be required to some extent. The need is there, and so are the means to meeting it. Whether this need is met is essentially a matter of priorities and administration; it is not a matter of the availability of means.

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CHANGING IMAGES OF ENVIRONMENT AND WELLBEING: PERCEPTIONS OF THE ENVIRONMENT AS AN INTERMEDIATE VARIABLE IN DEMOGRAPHIC BEHAVIOUR

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ABSTRACT: Using examples from the USA, Europe and Australia, this paper explores a model of perception of the environment as variables that mediate between demographic behaviour and environmental conditions, producing modifications in both. Perceptions can themselves be agents of change. Public views that, for example, environmental toxins discriminate against low income populations, who often have little choice but to remain in polluted areas, can lead to plants closing, controls on industries, urban redevelopment, and large scale out-migration. Global perceptions of the environment and health are changing — shifting responsibility for reducing morbidity and mortality away from individuals and towards social policies that foster healthy conditions. These processes are illustrated by conference papers on environmental disasters in Poland, India and Brazil.

KEY WORDS: Perceptions, environment, intermediate variables, demographic behaviour.

INTRODUCTION: A CHALLENGING TASK

The Conference organizers have presented me with a challenge, that is, to look at perceptions of the environment as "intermediate variables" that shape or modify demographic behaviour. The demographic variables the Committee suggested that I consider are morbidity and mobility.

There are few precedents in the demographic literature for this approach. While most studies on demographic behaviour implicitly acknowledge the role of perceptions, they have not looked explicitly at attitudes toward the environment as factors affecting patterns of health or migration. The challenge of this paper, therefore, is to design a new framework for demographic analysis — one that incorporates perceptions of the environment as a factor in accounting for demographic trends. In this paper, I propose to use the findings from my research in the United States and Australia, together with relevant

materials from other sources, to suggest how the meanings that people attach to the world around them can themselves become agents of change in demographic behaviour.

In trying to develop a framework for this conference, I have found that the task is deceptively simple and yet highly complex. However, I think it is well worth making the effort, and I hope to present my ideas with as little mystification as possible.

DEFINITIONS

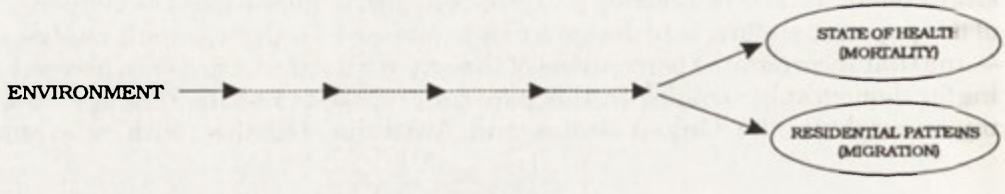
In venturing into new waters such as this, it is important to be clear about definitions. This is especially true here, since I write more from the perspective of a sociologist than of a demographer.

For the present purposes, I shall use the term, *perceptions*, to refer to the totality of views that individuals (or societies, if the case may be) hold about the social and physical conditions that impinge upon their lives. These views are shaped by broad historical, political, and economic conditions, as well as by everyday personal experience (Passuth and Bengtson 1988, p. 347). Perceptions, then, include the full spectrum of values, beliefs, attitudes, and ideologies that people use in defining the context of their lives.

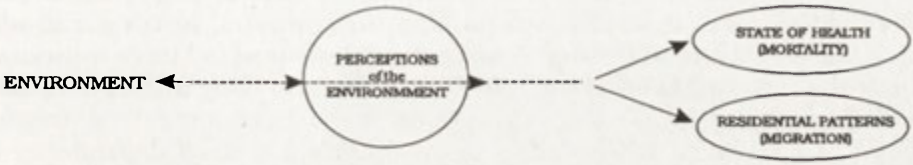
The term, *environment*, in this paper is also broadly defined. It includes the social setting as well as the built and natural world. Social factors in the environment would include, for example: group norms, institutional arrangements, laws, government regulations, political orientations, agricultural and industrial practices, and patterns of waste disposal. Natural and physical conditions include, for example: the built environment, such as housing design and systems of transport, as well as air and water quality, the volume of industrial and transport effluent, soil and land use, parks and open spaces in urban areas.

MODELS: RELATION BETWEEN ENVIRONMENT AND DEMOGRAPHIC BEHAVIOUR

To define *intermediate variables*, I shall use a model to show how perceptions of the environment operate in shaping or modifying demographic behaviour. The model typically used in research on population and the environment consists of two variables. In the present instance, these could be, say, environment and health, or environment and patterns of residence.



The association is ordinarily seen as a one-way process. For example, the quality of the air and water in a given area affects the residents' state of health and is a factor in individuals' decisions about whether to move into or away from that area. However, the possibility that the relationship may operate in a reverse direction — that is, for example, that a population's general health and residential pattern may become factors in modifying the condition of the environment, is seldom considered.



In the *intermediate variables* model, the impact of the environment on health is filtered or mediated through a third variable, *perceptions of the environment*, and, moreover, the relationship is seen as a two-way, interactive process. Thus, views about the environment are seen as having consequences for the state of health of individuals, as well as, colouring their preferences about where to live. At the same time, demographic conditions, such as a rise in mortality, loop back through people's attitudes to alter environmental conditions. The perceptions, for example, that infant mortality is rising due to toxic air or water may generate social action to improve the quality of the conditions seen to be responsible for these undesirable demographic trends.

PERCEPTIONS: INDIVIDUAL AND SOCIETAL LEVELS

It is important, here, to note two additional refinements in the analysis. First, is that the *intermediate variables* model can be applied on two levels of demographic behaviour: individual and societal. Second, is that to understand how mortality and migration are modified through perceptions of the environment, we need to look at the processes that link subjective views to changes in behaviour. This is where designing a framework for this analysis — that initially seems quite straight forward — becomes more complex. Here are some examples of what I mean.

Individual level

From the stand point of individual behaviour, the question, for example, is: how does the way in which a person visualizes the environment around them affect their lifestyles related to health, or their preferences about where to settle — to bring up children or to retire. Does he or she see it as beautiful or ugly, benign or threatening, safe or hazardous, comfortable or difficult, supportive or undermining, isolating or participatory, lonely or gregarious, happy or sad, familiar or strange, compatible or alien, affluent or poor, interesting or dull, prestigious or degrading, healthy or sick, clean or polluted?

The hypothesis here is that views as these, which are at least partially independent of the "objective" character of the milieu, have the potential to affect a person's mental wellbeing, physical health, and patterns of movement — both in her immediate neighbourhood and farther afield. If a person sees the environment as threatening for any reason — because of fear of violence or concern about crossing heavily travelled roads, for instance — this perception can affect the way she conducts her daily activities; whether, that is, she walks, uses public transport, or depends upon driving a car or getting rides from others. The mode of getting around, in turn, can affect health and a sense of wellbeing. Among the elderly people I have interviewed in both the United States (Day 1991) and Australia (Day and Harris 1992), avoiding going out because of perceptions of the environment as unsafe or difficult to maneuver in was likely to precipitate a cycle of dependency and loss of control. Remaining at home, withdrawing from community activities, and feeling isolated and lonely are associated with poor health and deterioration of physical and mental capacities.

Societal level

From the societal perspective, the role of perceptions of the environment in modifying demographic behaviour can be framed as follows: how do social orientations toward the environment, reflected, say, in research grants, government programmes and legislation concerning the practices of business and industry, affect the levels of morbidity and patterns of residence of sub-groups or whole populations?

The links between the variables at this level can be illustrated by the emerging concern in industrialized countries with what has been termed, "environmental justice". The perception at issue here is that living in physical environments degraded by, say, toxic waste or traffic noise, or a lack of parks and natural spaces, is a form of social injustice: it has adverse effects on health and tends to fall most heavily on low income populations, people who have fewer opportunities to choose where they want to settle. The perception is that living in a polluted environment not only increases morbidity, but also places the residents at a social disadvantage relative to people living in cleaner environments.

An example of the potential consequences of this perception for modifying demographic conditions is suggested by the World Bank's support of research assessing the health benefits of reducing concentrations of particulates, sulphur dioxide (SO_2), and lead in five countries in Central and Eastern Europe — Bulgaria, the Czech Republic, Hungary, Poland, and Ukraine (Krupnick et al. 1993).

The findings establish that the adverse effects of poor air quality range from asthma attacks and so-called restricted-activity days to heart disease and premature mortality. The authors conclude that "the benefits of reducing these effects appear significant" (*ibid*). Should this conclusion be incorporated into policy, the result could be reductions in morbidity levels among the populations affected.

In another example from the United States: perception of pollution as injustice has prompted some American politicians to advocate legislation affecting industrial practices. Eleanor Norton, member of Congress for the District of Columbia, USA, has proposed an amendment to the Clean Water Act calling for cleaning up the Anacostia River in Saint George's County, Maryland. She argues that exposure to a polluted environment jeopardizes health and aggravates social disadvantage. Based on this perception of clean water as an equity issue, passage of the Norton Bill could result in changes in environmental practices leading to an improvement in health among the predominantly low income populations currently living in proximity to the river. This illustrates one path through which ideologies concerning environmental conditions can result in modifying levels of mortality.

ENVIRONMENT, PERCEPTIONS AND WELLBEING: OLDER AUSTRALIAN COMMONWEALTH TERRITORY (ACT) RESIDENTS

The research that I conducted 1991 to 1993 among older residents of Canberra, Australia, provides further insights into the processes that link perceptions of the environment and demographic variables — particularly in respect to lifestyles that affect health and images of place that affect where people want to settle.

The team I worked with on this research was multidisciplinary — including, as well as myself, a sociologist — a biologist and an anthropologist. We were interested in the links between the environment and wellbeing from both theoretical and policy perspectives. From a theoretical perspective, for example, we wanted to know: Was there a relation between older people's attitudes toward Canberra as a place to live, and their general health and sense of wellbeing. Stated as a more general proposition: Are positive perceptions of place associated with positive ratings of health — and *vice versa*. Second, from a policy perspective, a primary interest was in the impact of environmental conditions (such as housing and accommodation, urban planning, transport, community services, and access to nature) on two kinds of capacities that the older people in industrial countries consistently say are central to their wellbeing — namely, the capacity to engage in independent activity, and the capacity to maintain close, supportive ties with others. Stated in policy terms, we were interested in the relation between older people's perceptions of the environment and their practical suggestions about how to make Canberra a city that was more supportive of their desires for both independence and interdependence.

To investigate these questions, the study included social factors associated with older people's wellbeing, such as living arrangements and sources of support. But unlike research usually conducted to determine factors related to wellbeing, we also explored the role of the *physical environment* in contributing to the quality of life. We wanted to know, for example, how

older people felt about the quality of the air, the design of Canberra as a city, the convenience of public transport, the comfort and safety of their homes, the importance to them of accessibility to open space, birds and wildlife, gardens, and neighbourhood parks.

Method

The sample consisted of 613 residents of Canberra, 60 years of age and older, living in 6 different areas of the city. Eligible respondents were identified in a street to street screening of households within "collectors districts", established by the Australian Bureau of Statistics (ABS). Four sets of personal interviews were conducted — two each in North and South Canberra. The first two compiled basic information about the demographic and social characteristics of the respondents and their attitudes toward Canberra as a place to retire. Each of these surveys was then followed up six months later by another interview with respondents interviewed previously to gather more detailed information about the links between attitudes, status of wellbeing, and environmental conditions.

Findings

A major finding was that, in Canberra, a completely planned city of nearly 300,000 people, clean air and access to the natural environment significantly contribute to health and a sense of wellbeing. Respondents perceived gardens, birdlife, nature parks and open space as highly important to their satisfaction with living in Canberra. Many said these environmental characteristics were instrumental in their decision to settle there. In addition, the sample identified the following as conditions contributing to their capacities for self-help and maintaining contact with others:

"A convenient, affordable bus service, proximity to small, local shops, well-lit streets, well maintained foot paths, a variety of affordable housing types, sufficient income to permit meeting day-to-day needs without anxiety about future self-support; and urban design that facilitates informal social intercourse, access to nature through neighbourhood parks, gardens and open space, and a stable government system that provides opportunities for people of all ages and social positions to participate in the decisions that affect their lives".

Can these perceptions of the environmental conditions that make for a sense of wellbeing and ease of conducting daily activities be generalized to younger age groups and people in other industrialized countries? Studies of people's favourite places to live suggest that there is a growing consensus along these lines. For example, in its 1993 survey into "the most livable city in America", the American magazine, *Money*, found that Rochester, Minnesota (described as a "leafy community" of 107,000 people and 61 parks), received top marks. From the 43 factors listed in the survey, the respondents ranked clean water, a low crime rate and unpolluted air as the most important, followed by plentiful hospitals and doctors, stable state government and a strong housing market. These are similar to those selected by elderly residents of Canberra.

PERCEPTIONS OF THE ENVIRONMENT — GLOBAL

So far I have been talking about perceptions of the environment as they apply in local, fairly well-defined areas — the neighborhood, the city, the state, the nation. The last section of the paper deals with a change in perceptions of the environment on a global scale. It is a change that, I believe, has enormous potential for shaping and modifying the two demographic variables with which we are concerned here — mortality and migration. Known as "the new public health", briefly, it consists of a new orientation toward the factors underlying health and wellbeing. In effect, this is a philosophy of social health that shifts the balance of responsibility away from individual choices about lifestyles (such as, smoking, exercise, nutrition, drug consumption), and towards social policies that make the environment more supportive of healthy living (Day 1991, 44-45). Social justice, full employment, reduced levels of violence (both domestic and public), and environmental quality are considered key factors in such support.

ENVIRONMENT AND HEALTH — CHANGING WORLD VIEWS

Belief in the power of subjective views to influence the course of events has been around for a long time. "Thinking makes it so", says Polonius in Shakespeare's "Hamlet", proffering some fatherly advice to his son, Laertes. Demographic behaviour is no exception. Most scientists and policy makers today start from the premise that perceptions are instrumental in shaping people's behaviour, including such diverse forms as family building practices, lifestyles that affect health, or decisions that underlie movement within and across national boundaries.

What is new is the emphasis being put on the significance of the physical environment for individual and global wellbeing. It is now widely recognized that progress in public health over the past 150 years has been due less to doctors and medical technology, than to the imposition of environmental controls: the regulation of water supplies, waste disposal, food purity, and housing design. For example, the "new public health", mentioned above, which proclaims the crucial importance of environmental factors in health, was adopted by the World Health Organization's *Global Strategy for All by the Year 2000*, 1981, and has been endorsed by all WHO member states. Calling for the creation of healthy environments to support people in making healthy choices (Ashton and Seymour 1988), the *Strategy* maintains that such disruptive elements of lifestyle, as alcohol and other drug dependencies, smoking, unbalanced nutrition, lack of exercise, and sexually transmitted diseases can be reduced by information and education. But information and education, insist advocates of this approach, must be bolstered by public policies that make "healthy choices the easy choices", and this, they say, "may involve legislative and regulatory controls" (*ibid*).

The significance of the new public health view cannot be overstated. In effect, it shifts the balance of responsibility for reducing morbidity away from individual choices about lifestyles and towards social policies that make the physical environment more supportive of healthy living (Day 1991, 44-45).

A.J. McMichael, formerly of the University of Adelaide, and newly appointed to the Chair of Epidemiology at the University of London, has raised the *ante*, so to speak, in terms of the critical role in human health played by perceptions of the environment. He sees a serious threat to long-term population health from the ethos of "our growth-oriented international economic system".

"The aggregate of human economic activity in the world — he writes — has enlarged rapidly this century, and, in absolute terms, ... is accelerating. It is grounded in a market ethos that values tangibility, manifest utility and immediacy — and that mostly ignores non-exchangeable environmental resources, and discounts the future. In consequence, while acknowledging the many material benefits that this economic system has conferred on human wellbeing, health and survival (especially in the developed world), it is now emerging as a source of new, potentially great, risk to human health" (McMichael 1993).

The growing confrontation between the world views represented by the "new public health", on the one hand, and the "growth-oriented international economic system", on the other, is illustrated by the World Bank's Environmental Action Programme for Central and Eastern Europe. Researchers funded by the Bank are investigating strategies to provide economic incentives to reduce air pollution emissions and in so doing to improve morbidity levels in the region (Krupnick et al.,1993; Tolman 1993). Reading between the lines, however, the themes of the investigations reflect a strong desire that improvement in the quality of air should not be permitted to impede the pace of economic development (Edelburn 1993). A major aim of the research is to identify the most cost-effective mechanisms for dealing with environmental problems so that economic growth will be sustained, even, presumably, at the cost of retarding major improvements in people's health.

ILLUSTRATIONS FROM CONFERENCE PAPERS

This conference has offered a number of illustrations of differing perceptions of the environment and their impact on demographic processes. None are so striking as those presented by the Polish participants in describing changes since the post-war era in public perceptions of the trade-offs between industrial development and the drastic worsening of health conditions in the so-called "areas of ecological hazard" (Kozlowski 1994; Kowalska 1994). Whereas industrialization once was regarded primarily in terms of its positive consequences for employment and development, the balance has now shifted to emphasis on the negative consequences for social equality and health

(Górka and Zborowski 1994). This change in perceptions has led to the closing down of some of the most polluting parts of plants, and the attempts of urban planners to introduce greater social equality into the spatial distribution of the cities like Warsaw and Cracow.

Górka and Zborowski (1994, p. 6) said, for example, that in Cracow, "the slogans of an egalitarian society that characterized the socialist epoch" led at first to expectations that the spatial and demographic patterns in the city would reflect standards of equality. However, this proved far from the reality. Instead, the industrial development in Nowa Huta led to the creation of social segregation and spatial polarization — with the rise of exclusive residential areas located in the western district outside the zone of highest pollution, and the clustering of the lowest income segments in the eastern sector within the zone most hazardous to health.

Similarly, in India, in respect to victims of the Bhopal disaster (Nangia 1994), and in Brazil, in respect to workers in the petrochemical complex in Cubatão, São Paulo — far from a demographic outcome that affected all social classes equally — in each of these cases, the poorest segments of the population occupied the worst environments and were the most victimized by environmental conditions over which they had no control. In the discussion period, Wednesday, June 29, following the session on "Demographic Consequences of Industrial Disasters", participants agreed with Daniel Hogan's conclusion that such inequitable demographic processes were seldom the result of random effects. Rather, they were the outcome of policies and practices that were "socially-directed" to certain elements of the population (Hogan 1994). In each of these situations, i.e., Cracow, Bhopal, Cubatão, moreover, a crucial element in reversing inequities in demographic conditions is the ideological confrontation between viewing the environment in terms of social justice (that is, the effects on health and living conditions, for example) and viewing the environment in terms of its economic pay-off (that is, the effects on economic growth and industrial development).

CONCLUSIONS: PERCEPTIONS OF THE ENVIRONMENT *INTERMEDIATE VARIABLES* IN DEMOGRAPHIC BEHAVIOUR[1]

What can we conclude, then, about the key perceptual variables that work to modify demographic behaviour, in this case, levels of morbidity and mobility?

Level of analysis

So far as level of analysis is concerned, the relations between environment, perceptions and health are complex and multi-dimensional. We need to ask:

[1] Key points: 1 — Level of analysis: individual, societal, global, 2 — Interconnection of individual and social levels, 3 — Salience of proximate environmental conditions, 4 — Environmental factors and successful ageing, 5 — Environment, perceptions and health: the challenge

are we looking at perceptions and their consequences for demographic behaviour on the individual level or on the level of whole societies — at the mediating effects of a person's values and beliefs about the environment on his/her own particular wellbeing and choices about where to live, or at societal perceptions of the environment that are reflected in public policies and government programmes affecting levels of morbidity and mobility of whole populations? This is a crucial decision affecting the identification of environmental perceptions and seeing how they work to modify demographic behaviour.

Being able to choose where to live becoming more crucial to the determination of one's health and quality of life. In industrial societies, people are increasingly being deprived of access to nature and an unpolluted environment, and as well to affordable housing within walking distance of their work. These opportunities are determined by conditions in the broader social and physical environment over which people as individuals have little control. They can be modified only by changing social orientations toward the environment at the national and global level.

Interconnection of social and individual levels

As regards the impact of perceptions of the environment on demographic behaviour, individual and social levels are inseparably interconnected. Images of the environment at the social level colour people's expectations and set limits to the range of demographic behaviours available to them. In turn, the perceptions of individuals become agents of change in industrial societies, affecting the orientations toward environment taken in politics and legislation.

Salience of proximate environmental conditions.

The findings from my research and other relevant materials suggest that the perceptions that are most decisive for health and patterns of residence are those that relate directly to the quality of day-to-day living: the air and water quality, access to unspoiled natural environments, the availability of affordable housing, urban design catering to comfort, convenience and sociability, systems of transport that permit the conduct of daily activities without the stress of long delays or negotiating heavy traffic, stable social conditions, and a system of government that permits a high degree of predictability and citizen participation.

Environmental factors and successful ageing

In studies of ageing and wellbeing, where one might expect the physical environment to be a matter of particular research interest, the links between environmental factors and the health have tended to be passed over in favour of more traditional approaches stressing illness symptoms and the needs of ageing populations for economic and social support. Our study among older Canberra residents, which did look at the environment, found strong support for modifying physical conditions (such as, transport systems, housing design,

and access to nature) as means to improving general health and life satisfaction by fostering an active, socially-involved life, which most elderly people desire themselves.

Environment, perceptions and health: the challenge

Environments that enable people to enjoy nature, have clean air and water, live independently in affordable, well-designed housing, and be in close daily contact with others in a non-threatening social milieu are at once those that people in industrialized countries say they want, and those that would also raise levels of health for people of all ages. Creating and sustaining such conditions in a world haunted by rapid population increase and dominated by a growth-oriented economic ethos is the health challenge facing industrialized societies today.

PRIORITIES OF 613 AUSTRIALIAN COMMONWEALTH TERRITORY RESIDENTS OF 60 AND OLDER

Tranquil ambience, clean air, natural beauty

Many residents in the study were concerned that development will destroy the peaceful ambience and natural beauty of Canberra: urban in-fill, busy roads through residential neighbourhoods, acceleration in the pace and harried nature of life were deplored.

Convencience to shops and facilities

There was general dislike of the build-up of traffic, concern about crossing busy roads, the closing down of local shops, disappearance of amenities (e.g., local banking) in neighbourhood shopping centres making doing things for oneself more difficult.

Easy access to community health facilities

Particularly in North Canberra, respondents expressed anger and grief about the closing of the Royal Canberra Hospital. They were concerned that community health services are deteriorating under self-government. Publicity about hospital waiting lists was causing considerable anxiety.

Management of cold and escalation of costs

Cold weather was the main feature about Canberra that people in this study disliked. They worried about heating costs. They saw this as a consequence of: greater susceptibility to cold, more time spent at home, less money to go around, and living on a fixed income.

Importance of personal security to social participation

Neighbourhood Watch seems to be performing a needed service, but there

is fear, particularly among women living on their own, that the climate of safety has deteriorated. The considerable emphasis on crime in the media causes anxiety and discourages people from going out.

Affordable bus service and integrated transport system

The design and routing of buses discourages some people from using them, and transport remains a pressing need, particularly for non-drivers, people who are less mobile, and older women living on their own.

Proximity to nature — open space, parks, gardens, walks

There is strong agreement that contact with nature is a major feature of the good life. Whatever form it takes, whether it is tending one's own plot of land, walking to see one's neighbour's flowers, or watering trees in public parks — people in our sample describe being in touch with nature as contributing substantially to their pleasure. Older people in Canberra are walkers. Seven out of 10 walk at least once a week. Ready access to nature makes Canberra "a special place".

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POPULATION AND ENVIRONMENT IN INDUSTRIALIZED REGIONS: SOME GENERAL POLICY RECOMMENDATIONS

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ABSTRACT: This paper draws together the general policy implications of research presented at the Seminar on "Population and Environment in Industrialized Regions" organized by IUSSP Scientific Committee on Population and Environment and the Institute of Geography and Spatial Organization of the Polish Academy of Sciences, and held at the Polish Academy of Sciences, Warsaw, Poland and the Institute of Geography of the Jagellonian University, Cracow, Poland, 27-30 June 1994. Major points considered include: the need for multisectoral information, analysis and planning; opportunities for more sustainable relationships in the "post-industrial" era; the need for risk-managment and responsibility; and urban areas as a critical focus for policy makers. Illustrative examples from current research and specific entry-points for immediate action are discussed.

KEY WORDS: Policy, multisectoral cooperation, sustainable development, deindustrialization and restructuring, risk-managment and responsibility, urban areas.

1. SOME CHARACTERISTICS OF POPULATION-ENVIRONMENT RELATIONSHIPS IN INDUSTRIALIZED REGIONS RELEVANT TO POLICY MAKERS

The first challenge confronting policy makers who aim to address population-environment relationships in industrialized regions is that of understanding the reciprocal relationships which exist. The spatial distribution of population, in particular the concentration of population and labour resources in urban areas, is a key requirement for industrial development. Industrial activity and the pull of higher urban wages, in turn, encourages further in-migration to cities. Higher population concentration or "density" in cities may allow the widespread provision of basic services, especially schools and health facilities, higher standards of living, and better environmental conditions. At the same time, high urban population density and the consumption patterns of a rapidly growing urban population create various

physical environmental problems with, for example, waste disposal and vehicle emissions. Industrial activity also directly transforms the environment through the production of industrial wastes leading to problems of water, soil, and air pollution. Environments polluted by industrial activity, in turn, adversely affect population health.

These reciprocal relationships between industrial, population and environmental trends may vary according to the temporal and geographic scale at which they occur and policy measures should be adjusted accordingly. Concurrent long-term global trends of increased population growth, population concentration, consumption, and industrial activity are believed to play some role in global environmental changes such as acid rain, ozone depletion, and climatic warming. Policy makers seeking to modify these trends should work within international forums to support the continued monitoring of global change and global policy responses. The 1992 United Nations Conference on Environment and Development held in Brazil and the 1994 United Nations Conference on Population and Development held in Cairo, both of which produced major policy documents, have presented an opportunity for such global monitoring and policy formulation. The overwhelming majority of impacts between population, environment, and industry, however, occur at the local level. Acute industrial disasters, for example oil spills, toxic waste production, and nuclear power accidents, make this fact strikingly apparent. The monitoring and analysis of these local impacts through the use of existing data collection systems, the establishment of new systems, and the carrying out of specialized studies is important. Based on such information policy makers at the national and local level as well as industries, private organizations, non-governmental organizations, and groups of affected populations will be able to more effectively shape local-level conditions.

In considering local environmental impacts of population and industrial activity the baseline fragility of particular ecosystems undergoing population and industrial growth must also be taken into account. Coastal areas, which are frequently the setting for urban development, are inherently subject to natural transformations such as sea-level rise or erosion. Population or industrial activity may both affect and be affected by these natural processes. For example, in coastal areas of California sea-level rise related to global warming and continued development has lead to increased flooding which threatens the ever-increasing coastal population. Similarly, cities in mountain valleys, such as Mexico City or Cracow, Poland, may be predisposed to problems of air pollution due to natural wind circulation patterns. In planning and assessing past or future impacts policy makers should take into account baseline natural resource characteristics and endowments.

Frequently the geographic and temporal scale of impacts between population, environment and industry may not be clearly defined. Although industrial pollution may emanate from a localized source its impacts may extend across geographic and administrative boundaries. Moreover, several resources (water, air, soil) or several distinct populations may be affected

at the same time. Distinction may be made between endemic long-term deterioration and short-term disaster situations, for example due to industrial accidents or natural calamities. However, it is often difficult to classify the time frame of population, environment and industrial relationships since effects are often lagged. For example, the impact of industrial pollution on populations or the environment may not be apparent until several decades after it occurs. A need, therefore, exists for determining "situations" as opposed to sites. Analysis of impacts may need to go beyond geographic and administrative boundaries to consider wider interacting productive, ecological, and demographic "systems". In addition, both long and short term impacts should be considered.

Whatever the geographic or time scale considered, social and economic factors mediate relationships between population, environment and industry and must also be taken into account, particularly in identifying affected populations. The segregation of economic groups within cities means that poorer populations are exposed to more negative environmental conditions in city slums, peripheral squatter settlements, or industrial areas. At the same time, more well-off groups may reside in better neighborhoods or "suburbs" which are not as affected by industrial activity and environmental pollution. Socio-demographic factors such as age may also enhance negative environmental impacts. For example, children and the elderly are naturally more vulnerable to negative environmental conditions. The mediating role played by numerous socio-economic factors also suggests that identifying direct causal relationships between demographic, environmental, and industrial changes may not be feasible. Rather, relationships should be understood within the particular historical, social, and economic context in which they evolve.

1.1. STRATEGIES FOR INFORMATION COLLECTION AND ANALYSIS

Understanding these reciprocal and varied relationships requires the collection and synthesis of a large range of information on industry, population, environment, and socio-economic conditions. Although easily stated, this is a daunting task requiring the collection and integration of multisectoral information across government ministries and local governments, non-governmental groups, community groups and research institutions. The availability and quality of sectoral information varies between countries and between sectors within countries. Highly industrialized countries such as in the United States and Europe with a high level of institutional regulation of industry and environment and specialized departments dedicated to these tasks have more and better quality data as well as more integrated analysis of information. In rapidly industrializing countries in Asia, Latin America and Africa where institutionalized record keeping and environmental and industrial regulation is nascent, the infrastructure, availability, and quality of data and their integrated analysis at any level may be limited. Also, the quality and availability of information between sectors may be unequal.

Data incompatibilities or a lack of communication between government ministries may also make it difficult to link information for integrated analysis.

Recent advances in information technology may help facilitate the combination of multisectoral information and integrated analysis. The creation of Geographic Information Systems (GIS) technology allows multisectoral social, population, environmental and industry-related information to be displayed on a single map image. However, the use of GIS systems to produce information for planners and policy makers requires a high degree of coordination among sectors which may or may not exist. GIS and other multisectoral approaches required to understand relationships between population, environment, and industry, may require initiating or strengthening multisectoral data collection as well as cooperation.

1.2. AN EXAMPLE FROM POLAND: THE IDENTIFICATION OF HAZARD AREAS

Information on industrial activity and environmental and population change have been collected in Poland since at least the 1950s. However, only during the 1980s was this information linked by geographers through the use of Geographic Information Systems (GIS) technology. As a result 27 "hazard areas" in the country have been identified where industrial activity has created significant ecological and health risks (see Stefan Kozlowski's chapter in this volume, Fig. 2). These hazard regions cover 10% of the country's total territory, and a third of the total population (10 million people). Between 1985 and 1990 a "Survey of the Demographic Consequence of Environmental Degradation" in 22 urban hazard areas (including Warsaw and Cracow) revealed that increased mortality and sickness among adults and, in particular, children was significantly related to urban environmental pollution. In response to these findings, various sectors of the government have undertaken several policy measures including instituting stricter industrial regulation, the development of environmental curricula for schools, and the initiation of health promotion programmes in hospitals. The potential exists for the development and identification of hazard areas in other countries based on Poland's example. Comparative studies of hazard areas between countries may allow the development of international standards for ranking situations. This would afford policy makers at all levels a tool for both assessing current situations and prioritizing policy responses.

2. NEW OPPORTUNITIES FOR SUSTAINABLE DEVELOPMENT IN INDUSTRIALIZED REGIONS

2.1. THE CONCEPT OF SUSTAINABLE DEVELOPMENT

The idea of "sustainable development", which emerged in the early 1970s, has become a guiding principle in the formulation of policies addressing the

relationships between population, environment, and industrial development. Generally speaking, sustainable development means that (1) social and economic development is to be pursued in conjunction with the protection and preservation of the earth's resources for current and future generations and (2) the recognition that natural resources and the capacity of natural systems to respond and adjust to man-made changes is limited. With the aim of institutionalizing sustainable development among member states, the United Nations in 1987 established the World Commission on Environment and Development, or the "Brundtland Commission" named in honor of its chair, the Norwegian Prime Minister Gro Haarlem Brundtland. The Commission report, entitled *Our Common Future*, defined five clear principles of sustainable development for policy makers to follow which include:

(1) Changing current patterns of economic growth, technology, production, and management which may have negative impacts on the environment and population;

(2) Ensuring employment, food, energy, safe water, and sanitary services for all populations;

(3) Controlling global population growth;

(4) Protecting natural resources for future generations;

(5) Integrating economic, environmental and population considerations in policy decision-making and planning.

The current transition of many Central and Eastern European countries from centralized resource control and unregulated industrial development to private resource management, market economies, and more stringent industrial regulation presents a major window of opportunity for the creation of "sustainable development". However, former Eastern Block countries also bring into focus the challenge confronting all regions of the world which aspire to sustainable development. This challenge consists of moving away from narrowly focused policies supporting industrialization to reshaping and creating comprehensive policies in all sectors which may affect population, environment, and industry.

2.2. STRATEGIES FOR SUSTAINABLE DEVELOPMENT IN INDUSTRIALIZED REGIONS

To accomplish sustainable development, governments should continue to play an active role at all levels. Many countries have created environmental ministries, departments, or agencies to accomplish this. The scope of environmental ministries is necessarily broad and may consist of a portfolio of activities including regulation and monitoring of industry, agriculture, energy and transport systems, population health, waste management, and natural resources. The policy instruments available to ministries vary but generally include formulating and reinforcing laws, undertaking industrial reform and regulation, establishing environmental protection funds and incentives, extending environmental education and, supporting continued research.

Arguments for governments to play an active role in pursuing sustainable development in free market environments rest on the fact that industry cannot be relied upon to regulate itself. Industries may be expected to maximize profit and reduce costs by the efficient use of energy and raw materials as well as keeping their workforce healthy. However, the incentive is equally strong to reduce operating expenses and production costs making investment and spending on environmental or worker protection measures and equipments unattractive. Thus, national and local legislation, planning, administration, monitoring, and enforcement may be necessary to both regulate current impacts and guide future development. These activities may need to be among a government's highest priorities since the health, productivity and natural resource base of the nation are at stake.

Less developed countries confront the problem of having limited funds available for channeling into environmental ministries and state regulation. However, environmental and health economics increasingly suggest that the economic costs of negative industrial impacts may be significant. In Poland, losses to industry caused by environmental pollution may amount to from 5 to 10% of the Gross National Product (GNP). Costs related to health impacts on population may also be significant. There may be powerful economic reasons for environmental protection and monitoring regardless of a country's development status. In the past economists have had a major effect on policy makers and planners and the formulation of development strategies. New economic perspectives, such as those of environmental and health economists who work to quantify health and environmental costs due to industrial activity should also be integrated into policy making and development planning.

Government activity should occur alongside the development of non-governmental and grassroots activity by community and local groups. Changes in environmental as well as political policies in Poland, in fact, came largely through the activities of worker unions, the most well known of which was "Solidarity". Certain environmental resources such as water whose availability and quality may vary according to local circumstance may be more responsive to solutions undertaken by local authorities and other community or private business groups. The availability of information and political empowerment of different populations may affect the degree to which such activity occurs. In this context, environmental education and increased availability of information as well as forums for airing concerns are important.

2.3. AN EXAMPLE FROM HUNGARY: SUSTAINABLE DEVELOPMENT ON THE HUNGARIAN PLAIN

The example of the Hungarian Plain reflects the opportunities and challenges for sustainable development which political change in Eastern Europe presents. During the post war period the region became a centre for large-scale collective agriculture and food processing under centralized

state production. In conjunction with the growth of these farm and food industries, large agro-towns developed on the plain in which population densities rose without the development of infrastructure (roads, schools, other services). With the demise of centralized government in the 1980s and the shift to a market economy, these farm and food industries have declined and the region is currently experiencing economic depression and high levels of unemployment. Also, previous years of unregulated agricultural activity has produced widespread water and soil pollution. The future fate of the plain is not clear and its rehabilitation and development has become and issue of national concern.

Geographers have suggested a plan which includes developing infrastructure to make the region competitive with other areas in attracting industry, regulating population settlement patterns, and undertaking active conservation measures to rehabilitate the region's ecology. This may be partly accomplished by a return to traditional agricultural systems used on the plain prior to collectivization. The degree to which such sustainable development will occur and to which the opportunity presented by political change will be seized is not yet clear. Because of the scale of development which must be undertaken, this may depend to a large extent on government commitment. The example of the Hungarian Plain suggests that:

Sustainable development requires an integrated plan focusing on future population, industry and environmental relationships while addressing the consequences of past patterns of development.

3. RELATIONSHIPS BETWEEN POPULATION, ENVIRONMENT, AND INDUSTRY IN THE "POST-INDUSTRIAL" ERA

3.1. IMPACTS OF INDUSTRIAL RESTRUCTURING

In the West a general correspondence between industrial and demographic trends has generally occurred (Table 1). Urban growth, increased standards of living and declines in family size and mortality went hand in hand with industrialization. Common policy assumptions made based on this historical experience are that government measures encouraging socio-economic and industrial development may stimulate urban growth and an improved quality of life. However, even in historical Western experience important local-level variation in the relationships between industrial and demographic trends occurred. For example, in rural areas of Belgium, as well as other countries during the earlier stages of the industrial revolution standards of living were actually lower in cities than in the countryside and urban mortality was actually higher. Policy makers cannot assume that economic, industrial or population distribution measures will necessarily have predictable effects on each other.

TABLE 1. Historical correspondence between industry, population and environment trends

Stage	Industry	Population	Environment
Initiation	Rapid growth of heavy industry in urban areas	Rapid urban population growth	Direct and indirect Impact of population and industrial activity not yet apparent
Maturity	Concentration of heavy industry in urban areas	Population concentration in urban areas	Short-term impacts of population and industrial activity apparent
Stagnation	Stagnation and decline of heavy industry in urban areas	Decline in urban population growth	Short nad long-term direct impact of population and industrial activity apparent
Restructuring	Restructuring from heavy to light industry	Stability of population growth in primary urban areas and growth of secondary urban areas	Active efforts to regulate population and industrial impacts

Adapated from: Marksoo A., Roosare J., 1995, Changing settlement patterns in North-East Estonia, A region of polluted environment and political conflicts, Geographia Polonica 64.

This may be even more important in the current era. In both older and more recently industrialized countries industry and population concentration traditionally grew up around local resources and heavy industry such as coal, iron, steel, and shipbuilding. Due to rapid technological change in recent years demands for these products have declined and many countries have undergone a common transition away from heavier industries based on raw materials to lighter consumer (plastics, fiber, communication) and service industries. Meanwhile, all countries have become more and more interdependent as greater "economic globalization" occurs. This overall sequence of events has been termed "deindustrialization" although the more appropriate term may be "restructuralization" since industrial activity in many instances has changed rather than declined altogether. Many social scientists see this restructuralization as ushering in a new historical epoch, or the "post-industrial" society.

In post-industrial society new industries, new skills, and new amounts of labour are needed to make a country competitive. However, industrial restructuring has not occurred sufficiently in most countries. Even in highly industrialized nations, programmes and education systems needed to train or retrain workers in new skills have not been adequate while labour-saving technologies have become more and more pervasive. As a result, restructuralization or (rather a lack of it) has in many countries been accompanied by rising unemployment and economic depression. In many Central and Eastern European countries these negative trends have been enhanced by the abrupt transition from a centralized to market economy. This economic downturn

has been associated with a concurrent "demographic" depression in many areas of Eastern and Central Europe, including Poland and Germany, where fertility has dropped dramatically in urban areas and urban growth has slowed. In other countries, particularly in Africa, population growth has remained high despite the deteriorating economic situation on the continent.

Ironically, decreased activity of heavy industry combined with new technologies in recent years have had beneficial impacts on the environment in many countries due to fewer industrial emissions. This raises the question as to what may happen if industrial activity once again picks up? In a sense, declining industrial activity has created a "breathing space" in which environmental policies may be restructured alongside industry. In this context, the need to establish resource management and regulation may be a priority. Many countries in Eastern and Central Europe, including Poland, are responding to this window of opportunity by the creation of active environmental ministries alongside measures to reshape industry and the economy.

Another important trend accompanying the current era of change which has implications for population and environment in many countries is the growth of tourism. Tourism forms an important part of the economy particularly in many developing countries. However, it introduces large numbers of "temporary" migrants, hotels, and other service industries which may have significant physical and social impacts on local environment. The potential for negative impacts is particularly great with "ecotourism" into protected areas and fragile ecosystems such as rain forests and game reserves in South America, Asia, and Africa. The environmental, social, and economic impact of tourism should also be integrated into development planning and policy at the local and national level.

4. RISK MANAGEMENT AND RESPONSIBLITY

The threat of negative impacts from industrial activity will always exist even with the highest levels of monitoring and regulation. Governments, private industry, and affected populations must, therefore, engage in a continuous process of "risk-management". Government planners and policy makers at all levels should weigh the needs for increased production and socio-economic improvement against the potential for short or long-term industrial pollution or disaster. Environmental impact assessments included as a regular part of development planning offer a means of assuring such deliberation. Private industry should also actively weigh the higher short-term cost of environmentally safe production processes against the long-term benefits on both the environment and health of their worker population. Public and private industry and multinational cooperations should undertake appropriate protective measures and disaster planning in relation to their worker population and the communities and environments in which they locate. At the same time, potentially affected populations should be aware

of the risks posed by local industries and their work environment. Educational activities have an important role to play in promoting such awareness.

If short- or long-term negative impacts occur governments and private industry should be ready to assume responsibility for population and environmental outcomes. Legislation should support the compensation of victims, environmental clean up measures, and industrial reform. Affected populations should also have a means of actively making claims and perusing compensation. Since the impacts of cumulative industrial pollution and even short-term disasters may have a lagged effect on population and the environment, governments, industry, and affected populations should take into account both long- and short-term consequences. In short, what is called for is the creation of a "new societal disposition" where government, industry and affected populations share a sense of mutual responsibility to the environment and to each other. Recent short and long term disasters in India and Brazil give some idea of the degree to which these "ideals" may or may not be achieved.

4.1. AN EXAMPLE FROM INDIA: THE BHOPAL CHEMICAL DISASTER

In 1984 a major leak of toxic chemical gas occurred from Union Carbide Chemical Plant in the city of Bhopal, India with a population of 200,000 due to a combined lack of safety monitoring and enforcement by both the government and the Union Carbide Company. A total of 320,000 people in Bhopal and surrounding towns were exposed to toxic gas, as many as 10,000 died immediately, and an estimated 100,000 persons continue to suffer from chronic eye, respiratory, gastrointestinal and psychiatric illnesses and cannot live or work normally. The environment and economy in Bhopal has also suffered due to water, soil, food, and livestock contamination. The poorest population living in the slums around the Union Carbide plant suffered the brunt of these impacts.

The Indian government sought legal compensation from Union Carbide in United States and received a sum of $470 million dollars, an amount which may be inadequate to cover the long-term health, economic, and human impacts caused by the disaster. Distribution of these funds has proved problematic because of the difficulty of establishing compensation criteria. Also many in the affected population are incapable of making claims owing to a lack of information or mental and physical illness related to the disaster. The Indian Council of Medical Research, UNICEF and an international medical commission undertook baseline surveys of victims immediately following the disaster. However, the existing hospital-based health system in the region is inadequate to carry out proper follow up and treatment which requires more extensive community-oriented services. Important issues such as the resettlement of population away from the plant area and the creation of employment opportunities for the affected and disabled population which

now have disabilities have yet to be addressed. The response by the government and Union Carbide has, therefore, been deemed inadequate and incomplete. The Bhopal disaster underlines:

(1) The problem governments confront in formulating a response to disaster situations when poverty levels are high and health infrastructures and government resources are severely limited, and

(2) The need for private multinational (or public) industries to take some responsibility towards the environments and populations they locate within.

4.2. AN EXAMPLE FROM BRAZIL: CUBATÃO, "THE MOST POLLUTED CITY IN THE WORLD"

Cubatão, a city of 91,000 people on the outskirts of São Paulo, Brazil, contains one of the largest petrochemical complexes in Latin America and has been known as "the most polluted city in the world". Unregulated industrial growth of state and private industries since the 1940s has been associated with negative environmental impacts such as acid rain, deforestation, pollution, and adverse population health impacts (infectious, respiratory, skin, and congenital disease). Only after 1984, were the long-term impacts of industrial activity in Cubatão officially recognized by the government. Previously, official policy held that some amount of environmental pollution was the price to be paid for progress. However, the lack of attention to the health impacts of long-term pollution in Cubatão is also related to the fact that the most affected populations were poorer groups of the workers who lived in the vicinity of the industrial area but lacked the power to organize and bring attention to their claims. More empowered groups of middle-class professional workers commuted daily to Cubatão but resided elsewhere and were, therefore, not inclined to lobby for change. The example of Cubatão underlines the fact that: (1) Socio-economic factors mediate not only the impact of environmental pollution on population but also the response by affected populations to such impacts, and (2) Government responses (as well as those by industry and affected populations) are shaped by their own priorities or perceptions.

Education at the community level and the activity of non-governmental, labour and grassroots organizations may have an important role to play in changing such perceptions as well as in empowering affected groups.

The above examples from India and Brazil consider crisis situations and represent what are in a sense are policy failures. However, in looking for "lessons-learned" it is equally important to consider successes or situations where industrial development has occurred successfully without widespread negative environmental and health impacts. Documentation of successes are limited at present. This gap in information underlines the fact that monitoring, evaluation, and regulation by policy makers and non-governmental or community groups should work to identify not only problems but solutions as well.

5. INDUSTRIALIZATION AND URBANIZATION

The majority of population and industry in Western and Eastern Europe and United States is currently concentrated in or around urban areas. Shortly after the year 2000 it will be the same in the developing world. Even with the process of industrial restructuring towards lighter or service industries, cities will remain responsible for producing the largest proportion of the gross national product (GNP) in most countries. This constant process of urbanization has and will continue to shape the urban environment. In the developing world the process of urbanization and industrialization has been more rapid and more concentrated in time and space than in historical Europe and the United States. "Megacities" (Sao Paulo, Mexico City, Shanghai, Bombay, Buenos Aires, Rio de Janerio) have grown up whose populations have soared to over 10 million in less than three decades.

To alleviate the demographic and economic dominance of megacities many developing countries have instituted explicit "decentralization" policies aimed at developing industry, administrative activities, and population settlement in smaller or "secondary" size cities. The efficacy of these explicit policies to develop secondary cities has been confounded by industrial restructuralization and the loss of attractive power in major urban areas in recent years. In any case, the existing size of large cities continues to be of concern to policy makers in both older and more newly industrialized countries. Existing urban areas clearly bring into focus the reciprocal impacts at play. Urban policy makers, therefore, must consider both the environmental impacts of urban population and industrial activity as well as the population impacts of environmental and industrial change.

5.1. THE ENVIRONMENTAL IMPACTS OF POPULATION AND INDUSTRY

Rapid urban population growth occurs mainly through in-migration and affects the environment in two ways: (1) by expanding the actual land area covered by the city and (2) by increasing "population density" or the number of people that live in already settled urban areas. New migrants to the city, as well as new industries, frequently settle on the urban periphery where land is more available and less expensive. In this way, the urban area continually expands and incorporates surrounding areas transforming former fields and villages into residences and roads. Growth of the urban area also creates demands for the extension of services such as transport, water, and waste disposal which may or may not be successfully met. This rapid land use change and pressure for infrastructure development associated with urban expansion may upset natural ecosystems and introduce pollution causing wastes and emissions. Rather than settle peripheral areas, migrants to urban areas may alternatively join relatives or friends who are already living in the city, leading to increased population density. Increasing population

density results in increased demands placed on existing urban services. If these services do not keep pace with this demand, they will deteriorate along with urban environmental quality. Deterioration in the urban environment due to rapid urban expansion and increased population density has been called "overurbanization".

The process of overurbanization, although related to population growth, is clearly mediated by social and economic conditions. For example, high density living areas in cities are frequently also the poorest areas. The greatest demand for services exists in areas least capable of making the investments needed to support such services. Poorer individuals also tend to settle in squatter areas on the city periphery where standards of living may be lower. Overall efforts to address overurbanization, therefore, should involve not only limiting urban population growth (for example by encouraging the development of secondary cities) but also addressing the socio-economic differentials inherent in that growth. In doing this, the role of central and local government should be balanced against the activity of non-governmental organizations, community groups, and the informal economic sector. In Mexico City, for example, a large informal industry has developed around garbage collection and recycling. This informal economic activity may facilitate the extension of services which the public sector alone could not achieve while providing a viable source of income for the individuals involved.

Another important aspect of population impacts on the urban environment relates to consumption levels. In contrast to rural areas where households most directly affect their environment through productive activities on the land, urban households have their greatest impacts on the environment through their consumption patterns, including their use of cars, fossil fuels, and disposable products. The overall size of the urban population clearly affects consumption levels and environmental impacts. For example, more people will use greater numbers of vehicles leading to more air pollution. At the same time it is important to recognize that consumption levels are also mediated by social and economic factors including income and social class. More affluent groups have higher consumption levels. For example, they are likely to more often own and more often use cars. Because of their higher consumption levels more affluent groups, although they are fewer in number, have a greater impact on the environment than the larger yet poorer urban population. As such, environmental education aimed at changing consumption patterns among high income groups may be an important measure for reducing environmental impacts.

Having singled out urban areas for attention, it is important to recognize the "urban-rural continuum" or that relationships between population, environment, and industry also link urban and rural areas together. Rural areas closest to cities are most affected by land use change and incorporation as the urban area grows. The flow of working age individuals from rural to urban industrial areas creates a shortage of working age population in rural areas. In Latin America, Asia, and especially Africa, this trend has been

associated with rural social and economic crisis and environmental degradation. Urban demands for food, water, and other rural-based resources may also severely limit their availability in rural areas. At the international level, the demand for illegal drugs in cities in the North has lead to the conversion of significant proportions of countryside as well as rural economies in Asia, the Middle East and Latin America to dependence on drug-producing crops and industries. The negative environmental, economic and social consequences of this process in drug-consuming and producing countries are widely recognized.

5.2. THE POPULATION IMPACTS OF INDUSTRY AND ENVIRONMENT: EXAMPLES FROM POLAND AND MEXICO

Acute disasters, for example earthquakes and industrial accidents may have dramatic negative impacts on urban population health and distribution. However, most negative impacts of the urban-industrial environment on population are evident over the long term. Decades of unregulated industrial growth within Poland's major cities, for example, has lead to serious problems of water and air pollution. A survey of 22 major cities during the late 1980s indicated that infant and general mortality and morbidity levels among all age groups (and especially among men) were higher in these cities than elsewhere. One serious finding was that certain air pollutants were related to long-term genetic damage among urban populations. Current mortality in urban areas has contributed to the fact that Poland was one of the few countries in the world where life expectancy has recently decreased. This contrasts with historical Western experience where urbanization was generally accompanied by rising standards of living across all socio-economic groups and a continual increase in life expectancies. The example of Poland suggests that: (1) The impact of industrial activity and environmental pollution on population must be considered over both the short- and long-term and that (2) Improvements in living conditions may not automatically accompany urbanization and industrialization.

In Mexico City some middle-class families have related illnesses in their children to acute air pollution problems in the city. In response they have taken the radical step of leaving Mexico City for smaller cities. The option of out-migration from Mexico City in response to deteriorating urban environmental conditions may be open to more affluent groups who have the resources to relocate and greater flexibility in labour options. The poorer majority of Mexico City's urban population may have a much more limited range of responses. Little information on how different economic groups cope with urban environmental deterioration is available and may be an important area for future research. The example of Mexico City reinforces the point that: socio-economic factors play an important role in mediating environmental and industrial impacts on population as well as population responses to these impacts.

5.3. QUALITY OF LIFE AND LIVABLE CITIES

The urban environment is largely man-made. The scope for policies in shaping urban environments is, therefore apparent. As such, cities bring into focus the issue of the "quality of life" or the expectations governments and urban populations may have as to what constitutes acceptable living conditions and the degree to which these expectations may be realized. Notions of the quality of urban life and what constitutes "livable cities" may vary widely between countries and cultures. However, with the majority of the world's population increasingly concentrated in urban areas the need exists for definition of some general criteria.

The principles of sustainable development provide some guidelines for the development of such criteria which include ecologically-oriented urban development and access to employment, food, energy, water supplies, and sanitary facilities by city residents. Another specific measure which may contribute to the creation of more livable cities is decreased reliance on automobiles and increased reliance on public transport. Automobiles may adversely affect the physical and social environment not only by contributing to air pollution but also by absorbing large amounts of land for parking and roads and by reducing human interaction. Additional measures for improving the quality of urban life may include increasing the availability of public spaces, designing new forms of high density dwellings, and developing mixed commercial and residential areas which are accessible and encourage human interaction rather than isolation.

6. POLICY CONCLUSIONS

A variety of potential strategies for the formulation of policy aimed at improving population-environment relationships in industrialized settings have been discussed. Specific entry points for immediate action may be gathered from this general discussion. They include:

1. *Multisectoral policy and planning*

The formulation of effective policy affecting population, environment and industry calls for activity across different sectors. Many countries have opted for the creation of a specialized agency or ministry to carry out this task. In any case, the comprehensive policies required can only be designed through the use of multisectoral information. Policy-makers should encourage the collection and integrated analysis of multisectoral information and multisectoral cooperation in development planning and policy formulation.

2. *Undertaking sustainable development, risk-management, and responsibility*

Correspondence between industrial, demographic and population trends

cannot be assumed by planners and policy makers despite correlations that may have historically existed. The principles of sustainable development, however, offer some guidelines for pursuing socio-economic development and should be adopted in the creation of national development plans.

While new opportunities for sustainable development exist, particularly in Central and Eastern Europe, the consequences of past decades of unregulated industrial activity and the ever-existent threat of industrial disaster and negative impacts should also be recognized and addressed through risk-management. When negative industrial impacts occur governments and industry should assume responsibility for meeting the needs of affected populations. These populations in turn should have outlets for making their grievances heard.

3. *Integration of government, industry and affected populations in policy process*

Governments at the national and local level have an important role to play in the shaping better relationships between population, environment, and industrial activity. However, the pursuit of sustainable development, risk-management and responsibility calls for the creation of a "new socetal disposition" on a wide scale. In this process, there is a role to be played by all stakeholders: national and local government, non-governmental organizations, industry, and affected populations. Educational activities in particular may be important in encouraging this broad participation.

4. *Emphasis on urban areas*

The majority of the world's population will soon reside in urban-industrial areas. Cities, therefore, represent a critical locus for the pursuit of sustainable development. The formulation of common expectations and criteria for 'the quality of life" and "livable cities" should guide sustainable development in urban areas.

CONCLUSION

The various contributions to the conference have confirmed the general statement that reciprocal interactions between population and environment exist in different industrial regions of the world. Although diversity exists among industrialized regions, they also share certain historical similarities such as the concentration of industry and population around local resources. There exists a common contemporary transition from heavier industries based on raw materials to lighter consumer industries that rely on the market and labour supply offered by large cities. As a result, many older industrialized areas may now be experiencing "deindustrialization" accompanied by both the growth in service industry and high unemployment. So, we need to examine the two-way relationship between population and environment and the impact of population in industrial areas as well as how populations have been affected by industrialization as well as deindustrialization. These interrelationships should be examined at different geographical levels extending from the locality to the globe.

The conference concluded with a general discussion during which participants concurred on major topical, methodological, and data issues for further research. The need for further study of the reciprocal relationships between population, and deindustrialization, environment, and the social and economic factors mediating these relationships, has been reaffirmed. It should be noted that variation in these relationships probably existed rather than any consistent pattern.

General methodological issues include the need to develop meaningful units of analysis. In this context, it was noted that although industrial pollution may emanate from a localized source its impacts may extend over an extensive geographical region irrespective of administrative boundaries. The importance of distinguishing between long-term "endemic" environmental degradation and "epidemic" or disaster situations and their respective relationships with population was also mentioned. The need to study perceptions (perceived environments, public awareness of degradation, perceptions of policy makers) as well as more measurable population and environmental relationships was also noted. The more complete study of the multiple dimensions of population variables (migration, morbidity, fertility, distribution, and migration) as well as of the environmental variables (physical environment, social environment, quality of life) in industrialized settings was also raised.

With respect to data, the future analysis of new and previously inaccessible environmental and population data sources in Central and Eastern European countries, including Poland, available as result of recent political changes was seen as offering new possibilities for investigation. The papers presented at the conference actively pointed to numerous ways for using existing data sources which in Poland were recognized as particularly rich. The research should go beyond descriptive analysis to further explore causal relationships between population and environmental trends.

Some general issues with policy relevance also emerged from the concluding discussion. The current transition of many Central and Eastern European countries from centralized resource control and unregulated industrial development to private resource management, market economies, and more stringent industrial regulation was seen as presenting new opportunities for more sustainable population and environmental relationships. The relative roles of government and centralized policies, as compared to more grassroots movements among affected populations, in addressing environmental degradation was also raised in this regard. The possibility should be considered that the recent "deindustrialization" and decreased industrial activity may have had a greater impact on recent improvements in environmental conditions in countries such as Poland than any formal regulation or environmental policies should be considered.

Alina Potrykowska
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