CHANGING A GREAT CITY IN EASTERN EUROPE – CRACOW: ENVIRONMENTAL CHANGES

Joanna Pociask-Karteckza

ABSTRACT: The main factor in the location of medieval Cracow was drainage. In the 700-year history of the City, there were numerous changes in water conditions, particularly in channel network, runoff, ground water level, and ice phenomena. The most dangerous threat to surface water and ground water in Cracow in the last decades has been from industrial and municipal sewage. Currently there are no rivers that meet Drinking Water Quality standards in Cracow. The quality of the ground water has declined because of infiltration of contaminated river water, water from sewage disposal ponds, and pollution from the atmosphere and soil. Cracow does not have enough waste water plants to meet its needs. Most municipal and industrial sewage has not been treated or has been treated only partially. Because of considerable contamination of surface and ground waters in Cracow, more than half of the city’s fresh water is pumped about 50 kilometers from a reservoir on the Raba River. A Polish government declaration of April 4, 1989, recognized Cracow as an area of particular protection, and directed that a number of actions be undertaken for the protection of environmental quality.

(KEY TERMS: Eastern Europe; Cracow; environmental quality; water conditions.)

INTRODUCTION

Cracow is representative of cities in Eastern Europe where economic development after World War II devastated the natural environment. Situated in the southern part of Poland, in accord with the location act given to the City in 1257 by Prince Boleslav, the Prudent, Cracow has become one of the greatest cultural, scientific, and economic centers in Poland and in Europe (Figure 1).

The main factor in the location of medieval Cracow was drainage. The floor of the Vistula River Valley was covered by swamps dominated by dry Jurassic limestone hills. The earliest settlements appeared on these hills. For this reason, the structure of the medieval city was island-like (Figure 2). The island settlements were defensible, being surrounded by rivers and impassable wet land. Dispersed settlements were linked by dikes. Cracow’s position as a crossroad of main European trade routes favored territorial expansion of the City (Bromek, 1975; Dynowski, 1974).

In the Middle Ages and Renaissance, pools and ponds were objects of pride to many of the City residents. People referred with respect to water. It was their defense against enemies, as well as a fundamental resource of life (Tobiasz, 1988).

Between the thirteenth and the late seventeenth centuries, water conditions in the Cracow area

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changed. Moats and mill races created new river channels, bogs were drained, ponds and lakes were filled, and new reservoirs were built. Water availability and accessibility became better adjusted to the needs of the City over the centuries (Mikowski, 1957).

The second half of the seventeenth century and the beginning of the eighteenth century were periods of wars and destruction in Cracow. Battles, sieges, annexations, robberies, and fires ruined the City and its water supply systems. Since water fortifications no longer provided obstacles or protection against advanced military techniques, the fortifications were not rebuilt. Channels, moats, and ponds became smaller, filled with silt and, finally, dry land. Larger and larger areas were drained for building.

The first Vistula River engineering works were begun in the middle of the nineteenth century and were connected with an organization of navigation channel network in Europe. These works were supervised by the Austrian government when the south of Poland was annexed by Austria. The works were continued in independent Poland — between World War I and World War II — and after World War II also. The river channel was shortened, and downcutting of the river increased. Between 1813 and 1960, the Vistula River deepened by about 3.5 meters. The drop in the river bed lowered ground water levels, and considerable areas were dried, partially ameliorating the humid, marlbaric climate. After World War II, a development of industry and urbanization caused a special interest in water
In recent years (1973-1987), withdrawal of water for industry, municipal use, and agriculture in the Vistula River Basin has increased. In spite of increasing precipitation, runoff of the Vistula River and its tributaries has been decreasing (Table 1).

<table>
<thead>
<tr>
<th>Water Level</th>
<th>Mean Runoff (cubic meter/s)</th>
<th>Regression Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vistula-Tyniec</td>
<td>89.1</td>
<td>-2.037</td>
</tr>
<tr>
<td>Rudawa-Balice</td>
<td>2.43</td>
<td>-0.092</td>
</tr>
<tr>
<td>Pradnick-Olsza</td>
<td>1.08</td>
<td>-0.022</td>
</tr>
<tr>
<td>Dlubnia-Zeslawice</td>
<td>1.10</td>
<td>-0.037</td>
</tr>
</tbody>
</table>

*Regression coefficient significant at the 0.05 level.

Note: *0.007 – regression coefficient for precipitation in Cracow in the period 1976-1987; not significant at the 0.05 level.

The most dangerous threat to quality of surface and ground water in Cracow in the last decades has been industrial and municipal sewage from Cracow and other regions, particularly Silesia (Figure 3). Before World War II, water in the Vistula basin was in the 1st class according to the contemporary Drinking Water Quality Standards. Contamination of the Vistula River began increasing in the 1950s, when an unrestrained development of industry and disordered development of urbanization occurred. And, at the beginning of the 1980s, pollution increased rapidly because of the opening of four new mines in Silesia. Primary pollutants in the water of the Vistula River are chlorides, phenols, cyanides, oils, greases, heavy metals, sulfates, and coal mud. Currently, no rivers exist with water that meets Drinking Water Quality Standards in the Cracow area (Figure 4). Vistula River flow into the City exceeds the Polish water quality classification scheme (Table 2). Tributaries of the Vistula flow into Cracow with 2nd and 3rd class water, but, after flowing through the city they, too, are polluted beyond classification (Table 2, Atlas Miasta Krakowa, 1988). Cracow does not have enough

**Figure 4. Quality of Water in Cracow.** (1: 2nd class water; 2: 3rd class water; 3: water beyond classification; 4: waste disposal ponds; 5: area with polluted ground water; 6: stream gauge.)

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wastewater plants to meet its needs. Most municipal and industrial sewage has not been treated or has been treated only partially.

<table>
<thead>
<tr>
<th>TABLE 2. Classes of Water Quality Used in Poland.</th>
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<tbody>
<tr>
<td>1st Class</td>
</tr>
<tr>
<td>2nd Class</td>
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<tr>
<td>3rd Class</td>
</tr>
</tbody>
</table>

Sewage disposal has caused warming of the Vistula River. Although the river was frozen for more than a month each year at the beginning of this century, it does not freeze today, and has not frozen over for almost 40 years. Ice phenomena have disappeared. Brash ice and float ice occur only sporadically.

Ground water quality has declined because of the infiltration of contaminated river water, water from disposal ponds, and pollution from the atmosphere and soil.

In sum, water quality throughout Poland deteriorated badly during the regime of the post World War II socialist government. The laws were not obeyed, and it was more economic to pay fines and to pollute than to introduce a new technology or to build water treatment plants.

Annually, Cracow requires about 100 million cubic meters of water. Because of the considerable contamination of surface and ground water, fresh water must be imported. More than half of the fresh water is pumped (at a rate of 2 cubic meters/second) from a reservoir on the Raba River in the Carpathian Mountains, about 50 kilometers from Cracow. The rest of the City’s water needs are met by local intakes from the Vistula’s tributaries located on the border of the City, and from deep ground water intakes. The entire City water supply is handled by four water treatment plants. In the future, water from the Dunajec River will be diverted to the Raba River to increase water availability for Cracow.

Human activities in the Cracow region have strongly affected natural changes in the geographical environment during the twentieth century. Such changes should increase in the future. One must believe that recent political and economic changes in Poland will improve the geographic environment, and will not allow it to be degraded further by pollutive industries. The Polish government declaration of April 4, 1989, recognized Cracow as an area for particular protection. A number of actions to protect environmental quality were initiated (Malecki, 1988): the Sendzimir Steelworks (previously the Lenin Steelworks), which recently has an annual discharge of over 76,000,000 cubic meters of wastewater, will be totally redesigned by 1994, and the city center will be heated by gas and electricity instead of coal.

The advent of a new political system has already led to the implementation of suggestions of ecologists and scientists to improve the Cracow environment. The most important are:

1. The production process in the Soda Works in Cracow has been gradually restructured. Until recently, the plant discharged 600 tons of salt daily to the Vistula River (80 percent of the total amount of salt discharge from all of industrial Cracow) and over 16,000,000 cubic meters of wastewater yearly.
2. Cars are not allowed in the city center.

There must be installed filters and water treatment plants in Cracow. Only about 20 percent of wastewater is treated in Cracow. The rest of it returns to the rivers. Sources of pollution and their treatment should be continually controlled by specialist crews. Water law should be stronger and fines should be higher. To fulfill these postulates, a country government should develop water statutory law. And there should be found a source of finances in a country budget to realize “The Vistula Plan” and plans protecting natural environment.

We hope that, once again, water will be used not only for industrial and municipal purposes, but also to enhance the beauty of the City, as it was in earlier centuries. We believe, too, that the control of unfavorable changes in water conditions will avoid further irreversible changes in microclimate, soils, and vegetation cover.

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LITERATURE CITED
