

MARIA PAWLACZYK-SZPIŁOWA\*, ELŻBIETA DZIENDZIEL\*

## POLLUTION OF THE RIVER NYSA ŁUŻYCKA IN TUROSZÓW COAL MINING REGION

### PART II. BACTERIOLOGICAL ASSESSMENT OF POLLUTION CONDITIONS

The purpose of present paper was to determine the pollution conditions of the river Nysa Łużycka from bacteriological analyses. Low values of coliform count and large amounts of psychro- and mesophilous bacteria stated in the water of the river investigated (between estuaries of Biedrzychówka and Witka) give the evidence to the substantial pollution of the river examined, exceeding the standards for inland waters.

#### 1. INTRODUCTION

The investigations concerning the pollution conditions of the Nysa Łużycka waters conducted in the Turosszów region (from 191.8 km to 166.4 km of the water course) included the assessment of physicochemical (Part I), hydrobiological (Par III), and bacteriological conditions as well as the estimation of their economical and industrial usability. The description of sampling stations and their characteristics have been discussed in Part I.

#### 2. MATERIAL AND METHODS

The investigations were performed in one month intervals since September 1976 to August 1977. For bacteriological analyses the samples of water were taken in the predetermined stations at the depth of 10–15 cm under the water level. Water samples taken to

---

\* Institute of Environment Protection Engineering, Technical University of Wrocław, pl. Grunwaldzki 9, 50-377 Wrocław, Poland.

sterile flasks were poured into vacuum flasks with ice and transported to the laboratory.

The investigations were performed according to the methods assumed for bacteriological water analysis:

the number of mesophilous bacteria was determined on nutrient agar in 1 cm<sup>3</sup> of water at 37°C after 24 h,

the number of psychrophilous bacteria on gelatine was determined in 1 cm<sup>3</sup> of water at 20°C after 48 h,

coli test on Eijkman's lactose medium was performed at 37°C after 48 h, using the test-tube fermentation method.

### 3. RESULTS OF ANALYSES

An intense bacteriological pollution of water stated at the station 3 situated above the influent of Turów mine was caused by industrial wastewaters and domestic sewage introduced into the river examined (fig. 1). The maximum growth of psychro- and mesophilous bacteria and a decrease in the number of coli bacteria have been stated at the station 4 in 1976. These conditions have been probably influenced by the river Biedrzychówka, which introduced substantial amounts of nutrients, especially phosphates and inorganic nitrogen. The second maximal growth of psychrophilous bacteria was stated above the river Miedzianka estuary (station 20), and that of mesophilous bacteria — below the effluent of this river (station 21). The discharge of the river Miedzianka water caused, however, the reduction in the number of psychrophilous bacteria.

The discharge of the river Biedrzychówka water in October 1976 (fig. 2) resulted in a slight drop of mesophilous bacteria. At the same time the number of coliform bacteria was reduced. At the river segment to the estuary of the river Miedzianka the numbers of psychro- and mesophilous bacteria decreased rapidly, whereas coli titre after a distinct decrease ( $10^{-9}$ ) due to the water discharged from the pumping station Turów I gradually increased. The water inflowing from the Miedzianka river deteriorated bacteriological conditions of the water at station 21, while clean waters of the river Witka distinctly improved these parameters.

Variations in bacteriological conditions in November are presented in fig. 3. First of all, it should be noticed that the numbers of meso- and psychrophilous bacteria are relatively low within the whole segment examined. Small maxima observed were at the stations 5, 7 and 20, but the coli titre at the stations 3, 4, 6, 20, and 21, amounting to  $10^{-9}$ , are worthy noticing.

The number of mesophilous bacteria, as it follows from fig. 4, was still low. The maximal values of coli titre ( $10^{-6}$ ) were stated above and below the water discharged by the river Miedzianka (stations 20 and 21).

Within the group of psychrophilous bacteria two maxima were observed, mainly at the stations 5, 20 and 21. There is a distinct positive effect of the river Witka water on the de-

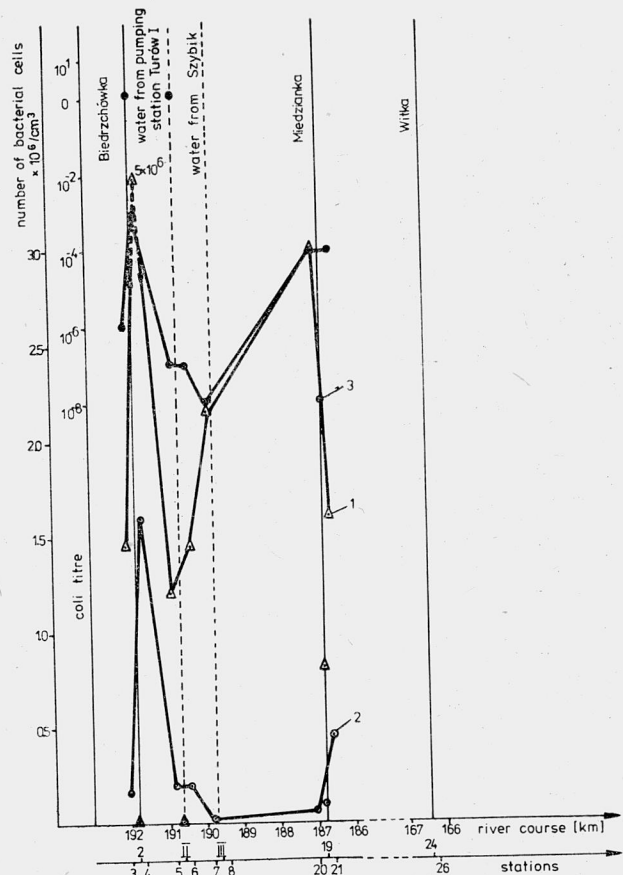


Fig. 1. Variations in the numbers of psychro- (1) and mesophilous (2) bacteria and the values of the coli titre (3) in Nysa Łużycka water, September 1976

Rys. 1. Zmiany ilości bakterii psychrofilnych (1) i mezofilnych (2) oraz miana coli (3) w wodach Nysy Łużyckiej w wrześniu 1976

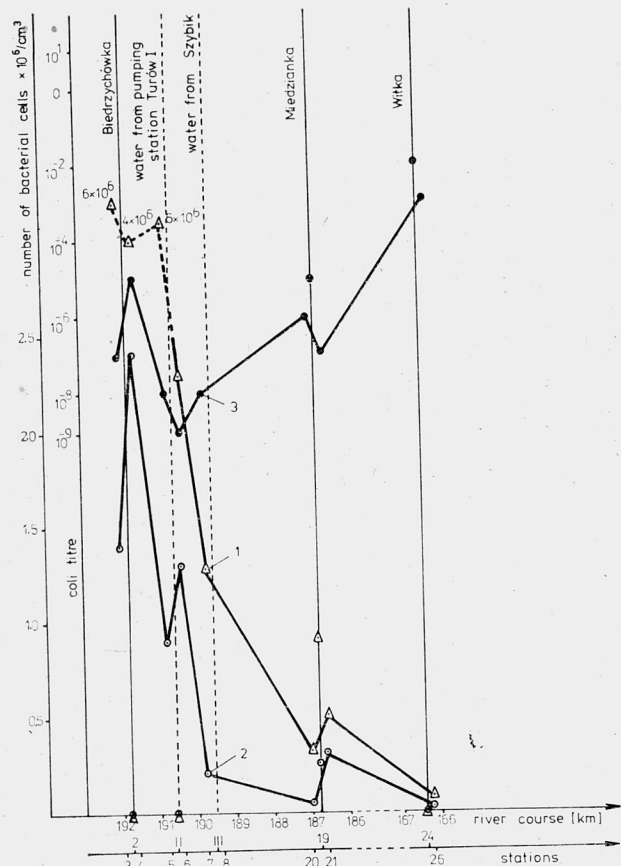


Fig. 2. Variations in the numbers of psychro- (1) and mesophilous (2) bacteria and the values of the coli titre (3) in Nysa Łużycka water, October 1976

Rys. 2. Zmiany ilości bakterii psychrofilnych (1), mezofilnych (2) oraz miana coli (3) w wodach Nysy Łużyckiej w październiku 1976

crease of bacteriological indices. In February (fig. 5) the numbers of psychro- and mesophilous bacteria were relatively low. The maximal number of psychrophilous bacteria ( $53 \times 10^4/1 \text{ cm}^3$  water) was stated at the station 4. The lowest value of coli titre ( $10^{-6}$ ) occurred at the stations 4 and 6.

In March 1977 the bacteriological indices (fig. 6) changed distinctly with respect to those in February. In general, the numbers of psychro- and mesophilous bacteria were higher. The maximal numbers for psychrophilous bacteria were stated at the stations 5 and 6, and for mesophilous bacteria — at the station 4. The lowest value of coli titre ( $10^{-8}$ ) occurred at the station 6 owing to the dilution with the waters of the river Witka which improved bacteriological conditions of the river examined.

Figure 7 illustrates the variations in bacteriological conditions of the river Nysa Łużycka in April 1977. The number of mesophilous bacteria was somewhat lower, the values of coli titre were not high ranging within  $10^{-2}$ – $10^{-4}$ . The highest numbers of psychrophilous bacteria were stated at the station 5.

The variations in bacteriological indices occurring in May are presented in fig. 8. The highest frequency of mesophilous bacteria was stated in the station 20. At the station the number of psychrophilous bacteria was also the highest one. The lowest value ( $10^{-6}$ ) of coli titre was stated at the stations 4, 6, 7, 20, and 21. In general, the number of bacteria occurring in water of the examined segment increased distinctly with respect to April. Below the estuary of the river Witka the bacteriological conditions of the river Nysa Łużycka improve rapidly. The variations in bacteriological conditions of water, presented in fig. 9, show high numbers of psychro- and mesophilous bacteria at the station 5.

These numbers were decreased by the water inflow of the Biedzychówka river. The repeated bacterial growth was observed at the stations 6, 20, and 21. The lowest value of coli titre occurred at the station 21 and amounted to  $10^{-7}$ . In July 1977 (fig. 10) psychrophilous bacteria achieved their maximal numbers at the station 4 below the emptying of Biedzychówka and at the station 21 below the estuary of Miedzianka. The maximal number of mesophilous bacteria were recorded at the stations 5, 4 and 21. The lowest value of coli titre ( $10^{-8}$ ) occurred at the station 6. In general, a positive effect of the river Witka water can be stated.

Non-typical bacteriological conditions in water with respect to the previous months were observed in August 1977 (fig. 11). First of all the numbers of meso- and psychrophilous bacteria are rather low, value of coli titre being relatively high. It seems probable that these conditions were caused by long-lasting precipitation which diluted the waters of Nysa Łużycka. While comparing the results of physicochemical analysis it may be noticed that the concentration of phosphates is relatively low. The only exception is the station 6. Hence, it seems that the deficiency of phosphorus could have an influence on the above situation.

#### 4. DISCUSSION

The purpose of the paper was to estimate bacteriological conditions of the river Nysa Łużycka water in the area of the Turoszów coal mining region. The river examined above

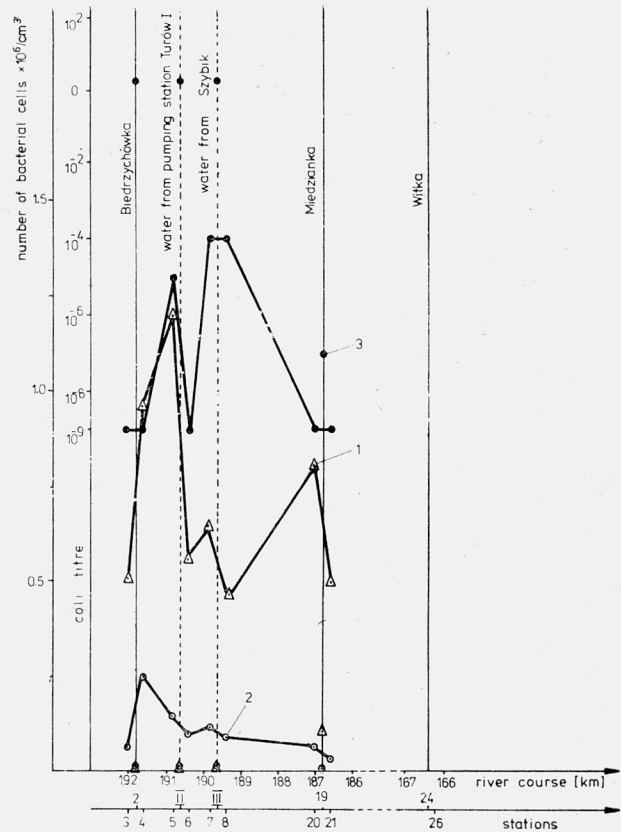


Fig. 3. Variations in the numbers of psychro- (1) and mesophilous (2) bacteria and the values of the coli titre (3) in Nysa Łużycka water, November 1976

Rys. 3. Zmiany ilości bakterii psychrofilnych (1) i mezofilnych (2) oraz miana coli (3) w wodach Nysy Łużyckiej w listopadzie 1976

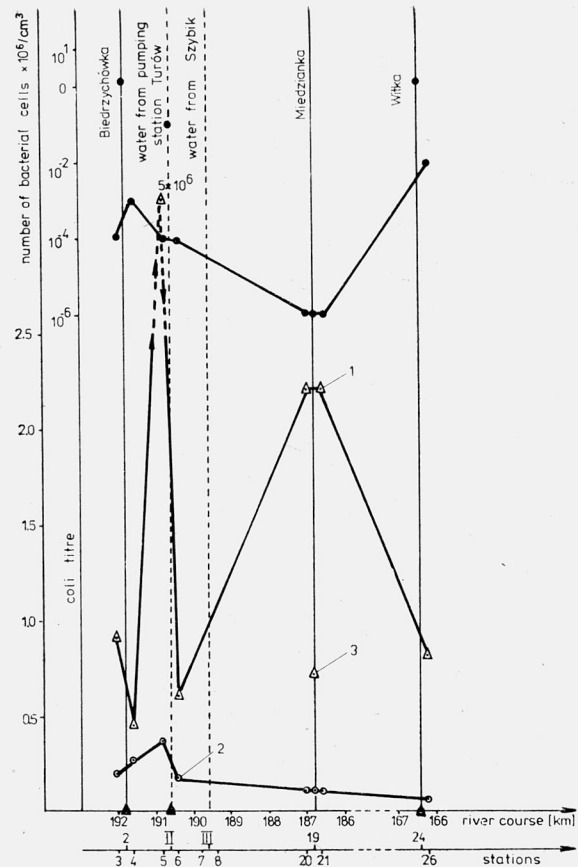


Fig. 4. Variations in the numbers of psychro- (1) and mesophilous (2) bacteria and the values of the coli titre (3) in Nysa Łużycka water, January 1977

Rys. 4. Zmiany ilości bakterii psychrofilnych (1) i mezofilnych (2) oraz miana coli (3) w wodach Nysy Łużyckiej w styczniu 1977

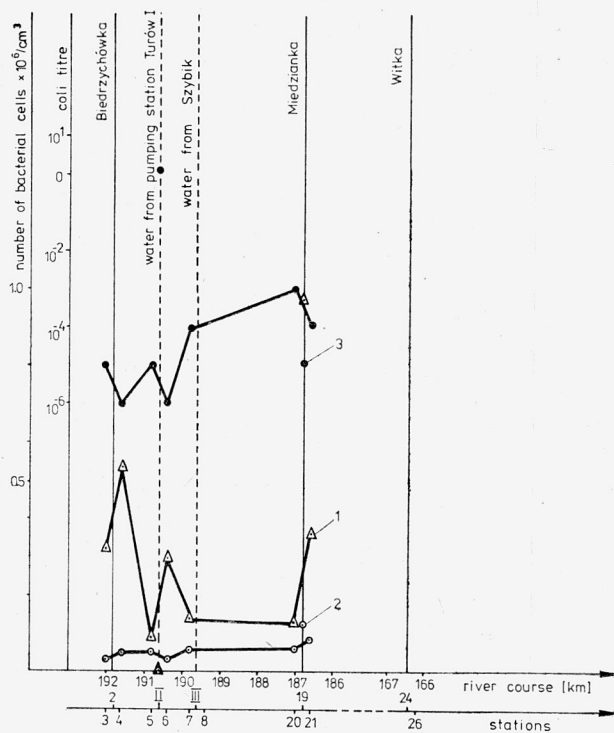


Fig. 5. Variations in the numbers of psychro- (1) and mesophilous (2) bacteria and the values of the coli titre (3) in Nysa Łużycka water, February 1977

Rys. 5. Zmiany ilości bakterii psychrofilnych (1) i mezofilnych (2) oraz miana coli (3) w wodach Nysy Łużyckiej w lutym 1977

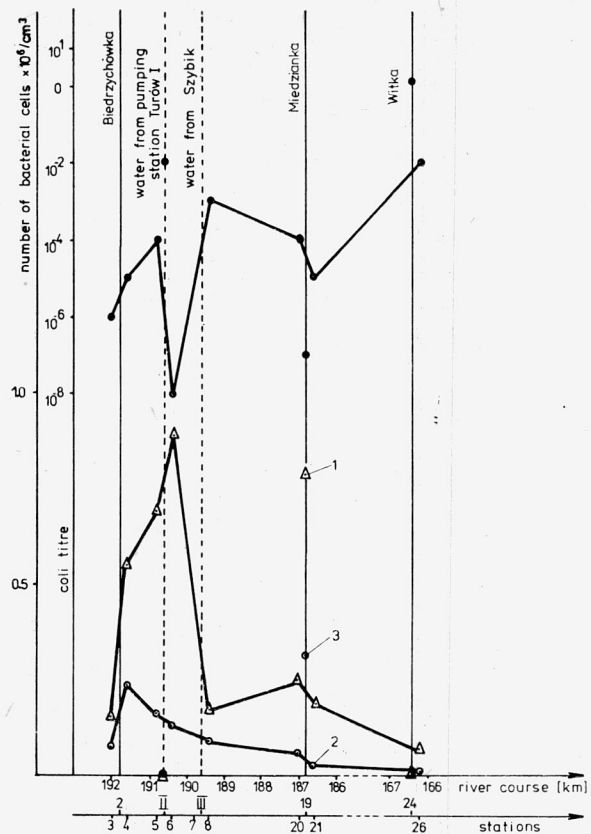


Fig. 6. Variations in the numbers of psychro- (1) and mesophilous (2) bacteria and the values of the coli titre (3) in Nysa Łużycka water, March 1977

Ryc. 6. Zmiany ilości bakterii psychrofilnych (1) i mezofilnych (2) oraz miana coli (3) w wodach Nysy Łużyckiej w marcu 1977

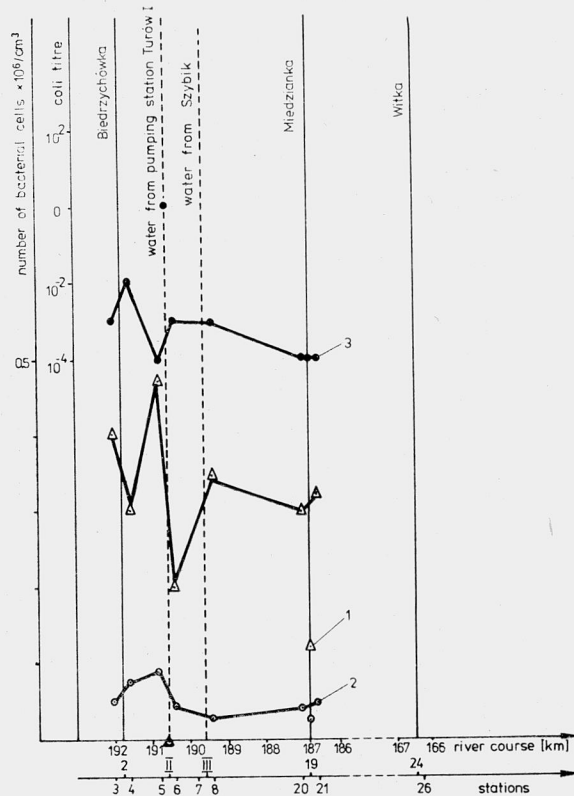


Fig. 7. Variations in the numbers of psychro- (1) and mesophilous (2) bacteria and the values of the coli titre (3) in Nysa Łużycka water, April 1977

Rys. 7. Zmiany ilości bakterii psychrofilnych (1) i mezofilnych (2) oraz miana coli (3) w wodach Nysy Łużyckiej w kwietniu 1977

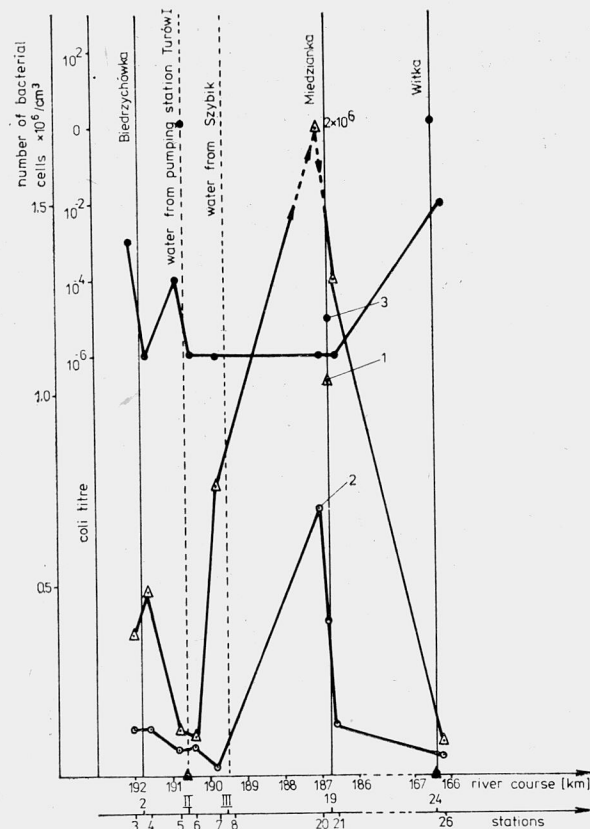


Fig. 8. Variations in the numbers of psychro- (1) and mesophilous (2) bacteria and the values of the coli titre (3) in Nysa Łużycka water, May 1977

Rys. 8. Zmiany ilości bakterii psychrofilnych (1) i mezofilnych (2) oraz miana coli (3) w wodach Nysy Łużyckiej w maju 1977

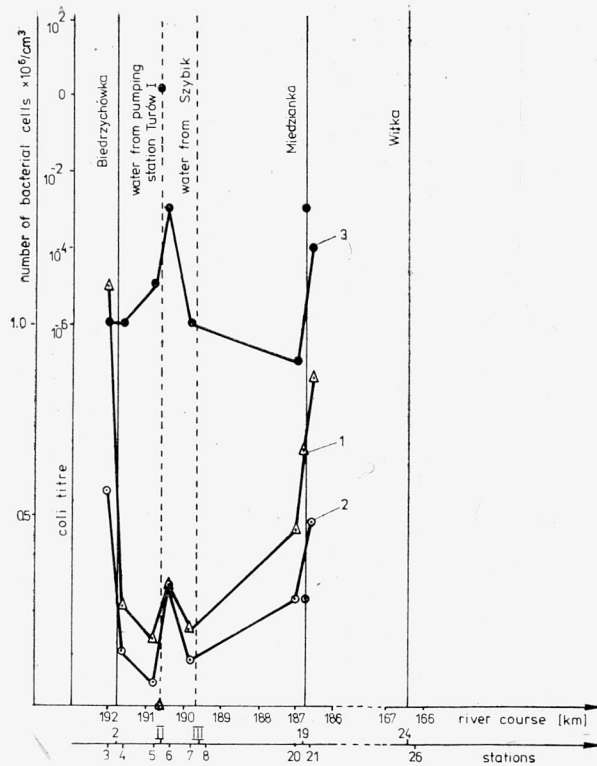


Fig. 9. Variations in the numbers of psychro- (1) and mesophilous (2) bacteria and the values of the coli titre (3) in Nysa Łużycka water, June 1977

Rys. 9. Zmiany ilości bakterii psychrofilnych (1) i mezofilnych (2) oraz miana coli (3) w wodach Nysy Łużyckiej w czerwcu 1977

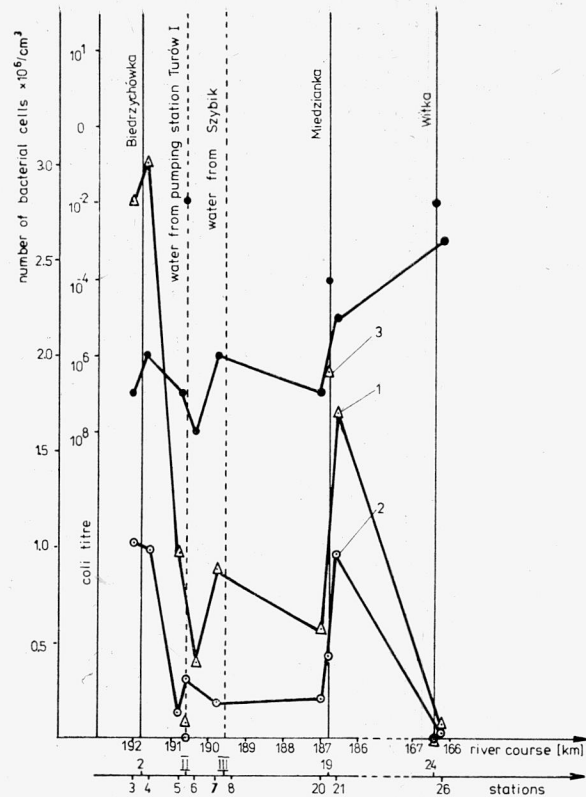


Fig. 10. Variations in the numbers of psychro- (1) and mesophilous (2) bacteria and the values of the coli titre (3) in Nysa Łużycka water, July 1977

Rys. 10. Zmiany ilości bakterii psychrofilnych (1) i mezofilnych (2) oraz miana coli (3) w wodach Nysy Łużyckiej w lipcu 1977



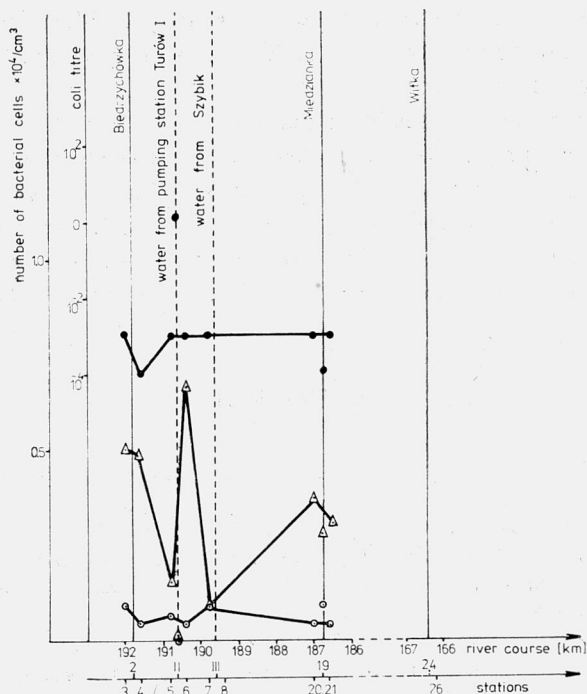


Fig. 11. Variations in the numbers of psychro- (1) and mesophilous (2) bacteria and the values of the coli titre (3) in Nysa Łużycka water, August 1977

Rys. 11. Zmiany ilości bakterii psychrofilnych (1) i mezofilnych (2) oraz miana coli (3) w wodach Nysy Łużyckiej w sierpniu 1977

Biedrzychówka (station 3) is severely polluted from bacteriological view-point, which is testified by the numbers of psychro- and mesophilous bacteria.

These conditions were deteriorated by the water of the river Biedrzychówka (station 4). Although its bacteriological pollution was only the average one, but it had high contents of phosphates, causing probably seasonal increase of bacterial frequency stated in the water of Nysa Łużycka.

In the segment between the estuaries of Biedrzychówka and Miedzianka there are introduced mine waters from the pumping stations Turów I and Turów II and from the so-called small shaft. It has been stated that these waters improved in general the bacteriological conditions of the Nysa Łużycka waters, but they introduced substantial amounts of iron, manganese and suspended matter.

The water in the river Miedzianka was very strongly polluted. High frequency of bacteria and low values of the coli titre — stated in the prevailing part of the investigation cycle — would indicate that the main pollutants are from domestic sewage. The river Miedzianka water significantly affected the flora of the river Nysa Łużycka. In October 1976,

February, April, June, and July 1977, below the estuary of Miedzianka, bacteriological indices were higher, in the remaining months the waters of Miedzianka did not change the values of bacteriological pollution.

The last station (26) on the river Nysa Łużycka was situated below the estuary of the river Witka. The latter is relatively clean, whence its positive effect on water quality (with respect to bacteriological conditions) of the river Nysa Łużycka waters.

Summing up, the examined segment of the river Nysa Łużycka is characterized by a high pollution degree. Sanitary conditions of this water — as confirmed by bacteriological analyses — does not meet the admissible state standards [6].

#### REFERENCES

- [1] *Atlas zanieczyszczeń rzek w Polsce*, 1973, Research Institute for Environmental Development (IKS), Rosenbergów 28, Wrocław.
- [2] PALUCH J., *Mikrobiologia wód*, PWN, Warszawa 1973.
- [3] PAWLACZYK-SZPIŁOWA M., TRACZEWSKA T., ZAWADZKA Z., *Pollution of the river Nysa Łużycka in Turoszów coal mining region. Part I. Physicochemical evaluation of pollution*, Environ. Prot. Eng., Vol. 9 (1983), No. 3, pp. 47–66.
- [4] PAWLACZYK-SZPIŁOWA M., TRACZEWSKA T., ZAWADZKA Z., *Pollution of the river Nysa Łużycka in Turoszów coal mining region. Part III. Ecological changes in biocenosis and saprobial state of the river*, Environ. Prot. Eng., Vol. 9 (1983), No. 3, pp. 79–98.
- [5] RODINA A., *Mikrobiologiczne metody badania wód*, PWRiL, Warszawa 1968.
- [6] Rozporządzenie Rady Ministrów z dnia 29 listopada 1975 r. Dz. Ustaw Nr 41, Poz. 214 w sprawie klasyfikacji wód, warunków jakim powinny odpowiadać ścieki oraz kar pieniężnych za naruszenie tych warunków.

#### STAN ZANIECZYSZCZENIA NYSY ŁUŻYCKIEJ W REGIONIE TUROSZOWSKIM CZĘŚĆ II. BAKTERIOLOGICZNA OCENA STANU ZANIECZYSZCZENIA

Celem pracy było określenie stanu zanieczyszczenia Nysy Łużyckiej na podstawie analizy bakteriologicznej. W wodzie badanej rzeki od ujścia Biedrzychówki do ujścia Witki stwierdzono niskie wartości miana coli oraz duże ilości bakterii psychrofilnych i mezofilnych, przekraczające normy zanieczyszczeń wód śródlądowych i świadczące o dużym zanieczyszczeniu rzeki.

#### DIE VERSCHMUTZUNG DER LAUSITZER NEISSE IM REGION VON TUROSZÓW TEIL II. BEURTEILUNG DES BAKTERIOLOGISCHEN VERSCHMUTZUNG

Anhand der bakteriologischen Analyse wurde der Verunreinigungsstand der Lausitzer Neiße bestimmt. Im untersuchten Gewässer der Fluss von der Mündung des Flusses Biedrzychówka bis zur Mündung des Flusses Witka wurden kleine Werte von Colititer und große Mengen von Psychrophil- und Mesophilbakterien festgestellt. Diese Werte übersteigen die Binnengewässerverunreinigungsnormen und zeugen von großer Verunreinigung des Flusses.

**СТЕПЕНЬ ЗАГРЯЗНЕНИЯ НЫСЫ ЛУЖИЦКОЙ В ТУРОШОВСКОМ РАЙОНЕ  
ЧАСТЬ II. БАКТЕРИОЛОГИЧЕСКАЯ ОЦЕНКА ЗАГРЯЗНЕНИЯ**

Цель работы состояла в определении степени загрязнения Нысы Лужицкой на основе проведенного бактериологического анализа. В водах этой реки на отрезке от устья Беджихувки к устью Витки отмечены малые значения коли-титра, а также большое количество психрофильных и мезофильных бактерий, превышающее нормы загрязнения внутренних вод и свидетельствующее о большом загрязнении реки.