

## HYGIENIC BACTERIOLOGICAL INVESTIGATIONS OF THE BACKWATERS AT MÁRTÉLY AND KÖRTVÉLYES

MÁRIA HEGEDÜS and MARGIT ZSIGÓ  
Public Health Station of Csongrád County  
H-6701 Szeged, Hungary  
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### Abstract

In the area of the Mártély Region of Scenery Protection two backwaters can be found (at Mártély and at Körtvélyes) the water of which has been regularly investigated within the last five years. On the basis of the results of these investigations conclusions could be drawn concerning the quantitative and qualitative conditions of the obligate and facultative faecal indicator bacteria, and also the changes in space and time of the incidentally occurring bacterial contamination could be followed. 202 samples were withdrawn from the water of both backwaters and 910 investigations were carried out.

The obtained results are as follows:

- In the majority of cases the water of both backwaters proved to be of 1st class “pure” water quality.
- The obligate faecal indicator bacteria could be detected only rarely and in a small number.
- The quantitative change of the facultative faecal indicator bacteria announced well the floods, the rinsing of the sewage lagoons (in the Mártély backwater) and the stagnant bodies of water developed at high water and low water.
- The water quality of both backwaters showed a seasonal dynamism which could be observed also on the basis of the results of the hygienic bacteriological investigations.

### Introduction

The creation of regions of scenery protection is besides the aim of nature preservation, significant also from the aspects of a general cultural and environmental arrangement because it makes possible a general scenery protection organized uniformly and extending to all the components of the scenery. The Mártély Region of Scenery Protection has been assigned after the Tihany and Badacsony regions as the third Region of Scenery Protection in Hungary by the decree 390/1971 of the OTVH (National Office for Nature Preservation). In the area of this region of scenery protection two backwaters can be found: those at Mártély and Körtvélyes. Though the physiognomy of both backwaters is different quite a number of similarities is observable.

### Description of the backwaters at Mártély:

The Tisza backwater at Mártély is a flood-plain backwater on the left bank of the river Tisza, separated from the river by a low summer-time dam, and located between kilometer marks of 206.4 and 208.5 of river Tisza. It is connected with the

river only at high water. Besides the flood period the water supply of the backwater is solved only partially because the inland waters are lifted up from the main channel of Mártély—Darvasszék from an area of about 48 km<sup>2</sup> by a pump station of only 1.0 m<sup>3</sup> s<sup>-1</sup> (VÍZITERV 1972—74). The water level of the backwater follows with a smaller shift the level of the main Tisza river which is 2—3 m at low water and 5—6 m at high water. In normal weather the river Tisza inundates the area at springtime and early summer by a water layer of 1—3 m whereas in rainy years floods are occurring also at late fall and in winter as well (EGYED 1979). The northern branch of the backwater became swampy and its southern end is connected with river Tisza by a trench of 3—4 m width. At higher water (floods) of river Tisza, the water of the river flows through the backwater and, respectively, it inundates the entire flood-plain, including also the recreation area established in the riverside belt. When the water level decreases, excess water returns to the river from the backwater through the southern connecting channel. Though the floods are causing significant damages in the recreation area, this is the only way for the exchange of water since the flow of water through the backwater is not ensured (ZSÍROS 1977).

The utilization of backwaters is known to be manysided. The Mártély backwater is similarly a surface water serving partly as a reservoir of inland waters and partly for recreation and bathing purposes. Though the pisciculture is not intensive, also netting is carried out each falltime by the Fishing Cooperative. At the same time the angling of the guests is ensured almost during the whole year. Water-chestnut is growing in most part of the water surface since only the bathing and rowing areas have been liberated from this plant.

A detailed description and characterisation of the Körtvélyes backwater can be found in the paper of DR. KLÁRA K. FÜGEDI.

The water of both backwaters has been regularly investigated in the last five years in collaboration with the ATIVIZIG laboratory. Hygienic bacteriological investigations have been carried out in the KÖJÁL (Station for Public Health and Epidemiology) of Csongrád County since these results are quite indispensable in the evaluation of the water quality and in the comparative analysis of surface waters.

At the evaluation of the hygienic water quality the definitive parameters are in surface waters according to our opinion (DEÁK 1977) the *obligate faecal indicator bacteria*: the faecal coliform, the *Streptococcus faecalis* and the faecal streptococci, respectively, the so-called “enteral phages” dissolving the intestinal bacteria, the pathogen intestinal bacteria. The *facultative faecal indicator bacteria* are in turn those which may originate, besides haematotherma, to a smaller extent also from other contaminating sources.

The first complex investigation extending equally to bacteriological, chemical and biological parameters was carried out in the water of the Mártély backwater by UHERKOVICH (1971) and his associates in 1967. On the basis of the data of the bacteriological investigations it was found that the value of the coliform number exceeded the limit value from a hygienical aspect only in August, and this problem of water quality has been attributed to the stagnancy of the water in summer.

The determination of the “non-hygienic” bacterium number came into the foreground in hydrobiology in the last decade (FELFÖLDY 1981). OLÁH (1973, 1974) investigated the bacterioplankton of Lake Balaton and Lake Velence, and later called attention to the unusually high stand of bacterioplankton accompanying the fish death occurring in 1975 (OLÁH 1975).

Data are known also of the bacterioplankton of river Tisza, particularly concerning the Kisköre region (HAMAR a, b, c, TÓTH 1978). It was found that the amount

of total bacterioplankton is closely related to the suspended alluvial deposit. B. TÓTH called attention also (1977) to the peculiarities of the masses of water in the floodplain. On investigating the hydroecological conditions of backwaters within the area of the Kisköre reservoir she carried out also determinations of bacterioplankton and she found that the bacterioplankton of the backwaters discloses conditions characteristic of the eutrophic waters. In summer, quite corresponding to the more intensive bacterial decomposition process, higher values have been recorded than those observed at falltime.

The hygienic bacteriological investigation of greater rivers and stagnant waters has been regularly carried out in the last decades by several investigators. The Tisza reach at Szeged was investigated by ROSZTOCZY (1935), VETRÓ, KISS and MINDSZENTY (1966) and HEGEDÜS (1979, 1980). To our knowledge, no hygienic bacteriological investigations were carried out in the Körtvélyes backwater before 1976.

### Materials and Methods

In the last five years 202 samples were withdrawn from the water of the Tisza backwaters at Mártély and Körtvélyes, and 910 investigations were carried out in these samples. Sampling sites were in the Mártély backwater: at the pier of the bath, at the occurrence of sturgeons, at the occurrence of sturgeons, at the southern outfall (both last sampling sites were used only in 1975). Samples from the Körtvélyes backwater were withdrawn at the observation site of the Tisza-investigating station (weir-keeper house).

For the hygienic bacteriological investigations water samples of 100 ml and for the enrichment of *Salmonella* samples of 1000 ml were withdrawn at a depth of about 20 cm below the water surface. The water samples were transported under cooling to the laboratory where they were processed on the day of sampling but not later than 24 hours after sampling. The number of coliform, faecal coliform, faecal streptococcus and streptococcus faecalis, respectively, further of the *Clostridium* and the heterotrophic psychrophilic, mesophilic total colony-forming bacteria were determined.

The bacteriological investigations were carried out according to the "Methodological Instructions" (1977) issued by the Department for Water Hygiene of the National Institute of Public Hygiene and to the standard "Bacteriological investigation of drinking water" (1971) (in Hungarian). The detailed description of the methods of investigation and the limit values of the hygienic evaluation of water can be found in the paper of Hegedüs (1980) published in Volume XV of *Tiscia*.

### Results of the hygienic bacteriological investigation of the Mártély backwater in the period 1975—1980

#### 1. Results of the hygienic bacteriological investigations in 1975

According to the results of the bacteriological investigations the water quality of the backwater is as follows, on taking into account the aspects of the hygienic evaluation of surface waters (see Fig. 1).

86.8% of the investigated samples is of category I "pure" and only 13.2% is of category II "slightly contaminated". In 1975 all of the investigated parameters showed the most unfavourable values in April, June and November. At the sampling in June the water level was high due to the flood of river Tisza also in the backwater, and the resort area was covered by about 50 cm deep water. These conditions are responsible for the rather unfavourable result. In November 1975, after the recreation and bathing season, again higher values were observed at a durable low water

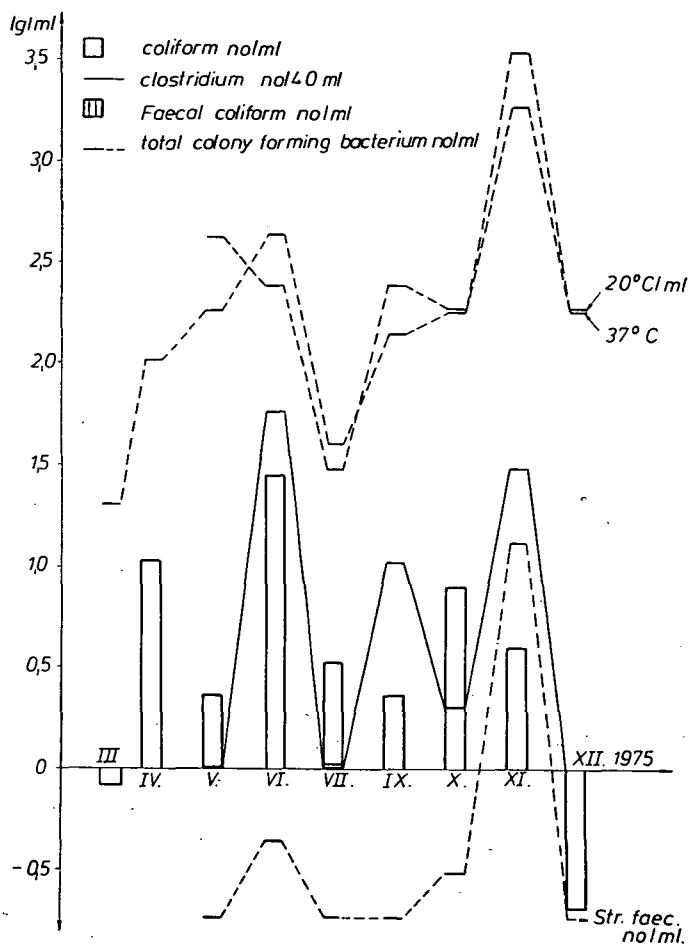


Fig. 1

level which values were indicated by the total number of colony-forming bacteria, the number of *Streptococcus faecalis* (ml and of *Clostridium*) 40 ml.

Water samples withdrawn "at the outfall" and at "the occurrence of sturgeons" (i.e. from the southern and northern reaches of the backwater) were in each case of 1st class "pure" quality according to the hygienic bacteriological investigations.

## 2. Results of investigations carried out in 1976 (Fig. 2)

The average, median and quarterly values of the coliform and direct bacterium numbers and the quarterly range (DEÁK 1969) were much lower than those in 1975. At the same time the numbers of the total colony-forming bacteria at 20 °C and 37 °C and the values of the *Clostridium* number/40 ml showed still not observed peak values in March and December. In these months the water of river Tisza streamed-in to the backwater from south to the north. The high values of 7000—3600/ml of

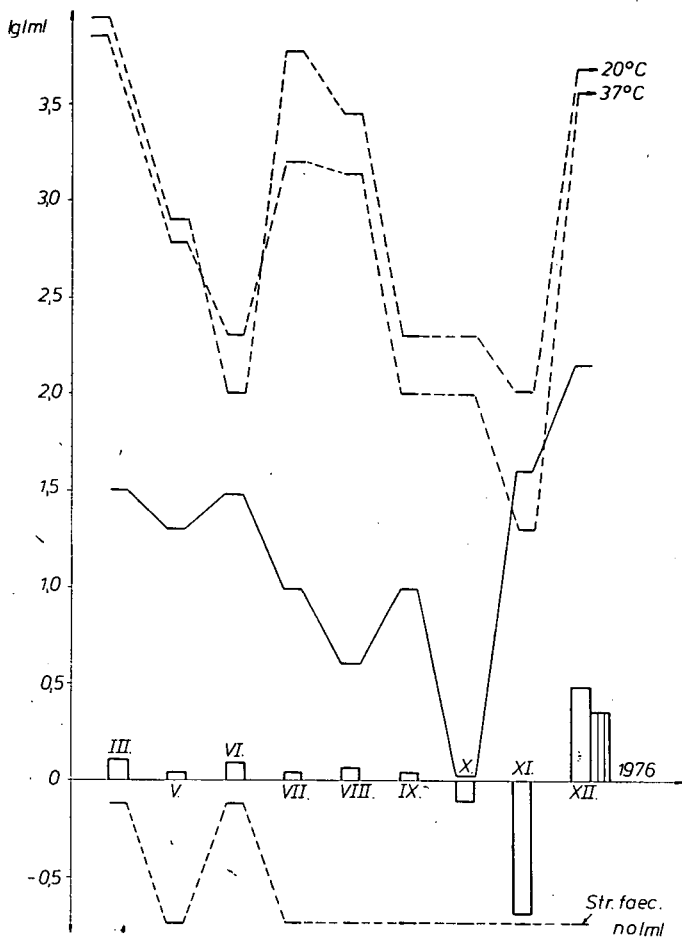


Fig. 2.

the germ count and the *Clostridium* number of 140/40 ml indicated that owing to the strong current the "silt" was mixed up in the backwater and bacteria originating from the silt formed there the "flora". During the whole year according to the values of the coliform, the *Streptococcus faecalis* numbers/ml the water quality of the backwater was 1st class "pure". On following the seasonal variations it can be stated that except for the time of floods at spring and in December, faecal contamination was hardly detectable in the water of the backwater. At the sampling site: pier of the bath of the backwater, in two years (1975—76) from water samples of 1000 ml, bacteria belonging to the *Salmonella* genus could be isolated only in December 1976 which proved on serotypization to be *Salmonella agona*. This serotype has been isolated already in November at the sampling site Mindszent of river Tisza. The *Salmonella* bacterium entered the backwater presumably with the streaming-in of Tisza water.

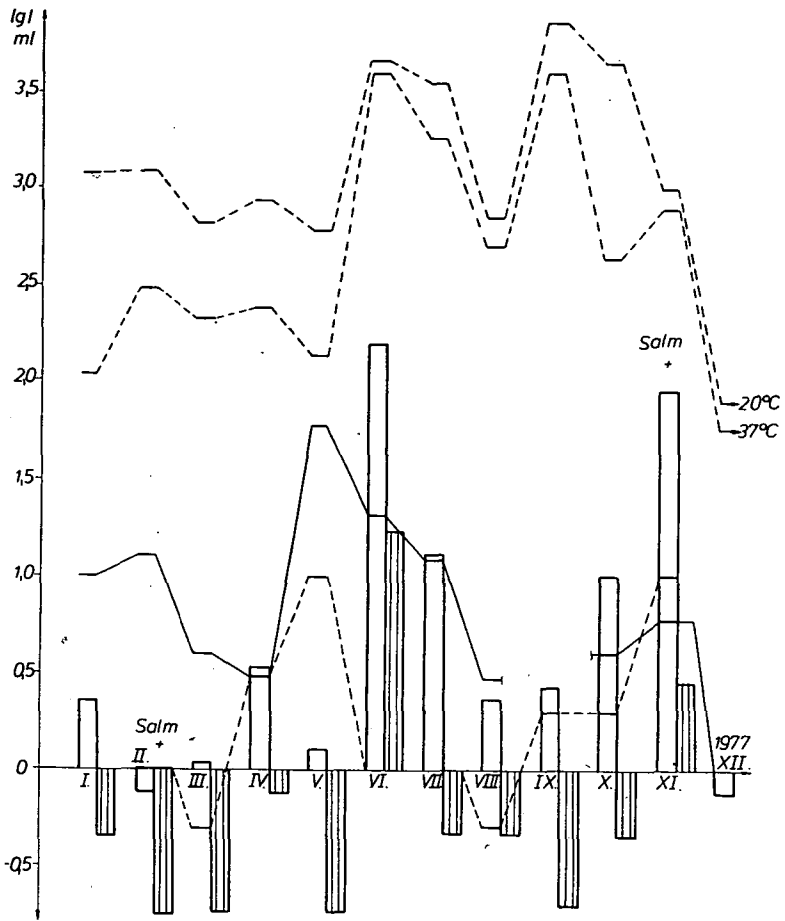


Fig. 3

### 3. Results of the hygienic bacteriological investigations in 1977 (Fig. 3)

On the basis of the hygienic water evaluation 75% of the samples was Ist class "pure" whereas 25% was IInd class and qualified as "slightly contaminated". The percentage of *Salmonella* positivity slightly increased in comparison to that observed in former years, it disclosed a value of 16.6% on the basis of a serial investigation. However, this value is still favourable since it does not exceed the limit value of 33%. The water sample withdrawn from the Mártély backwater was *Salmonella*-positive in February and in November. In both cases strains of *Salmonella typhi-murium* were bred which differed from each other from the aspect of phage and biotype. The phage type of the strains bred in February was not typifiable whereas its biotype was: 3. At the same time strains of *Salmonella typhi-murium* isolated from river Tisza showed also these phage and biotypes. Strains, however, of *Salmonella typhi-murium* isolated from the backwater in November proved to be of phage type Ia. var. Id. and of biotype 2.

On observing the seasonal variations it can be stated similarly that the least favourable results occurred at the floods at early springtime and early summer floods, furthermore in case of "stagnant water" at late falltime, with the difference that the value of faecal indicator bacteria was much higher than in 1976. After the flood in May e.g. the peak value of the coliform number was 160/ml and the value of the faecal coliform number 17/ml. After the "stagnant water" in summer the values of the aforementioned parameters changed to 92/ml and 2.3/ml, respectively. On the basis of the results of investigations it could be stated as well that immediately after the flood of the backwater, numbers of the coliform, the heterotrophic mesophil and psychrophil bacteria increased rapidly.

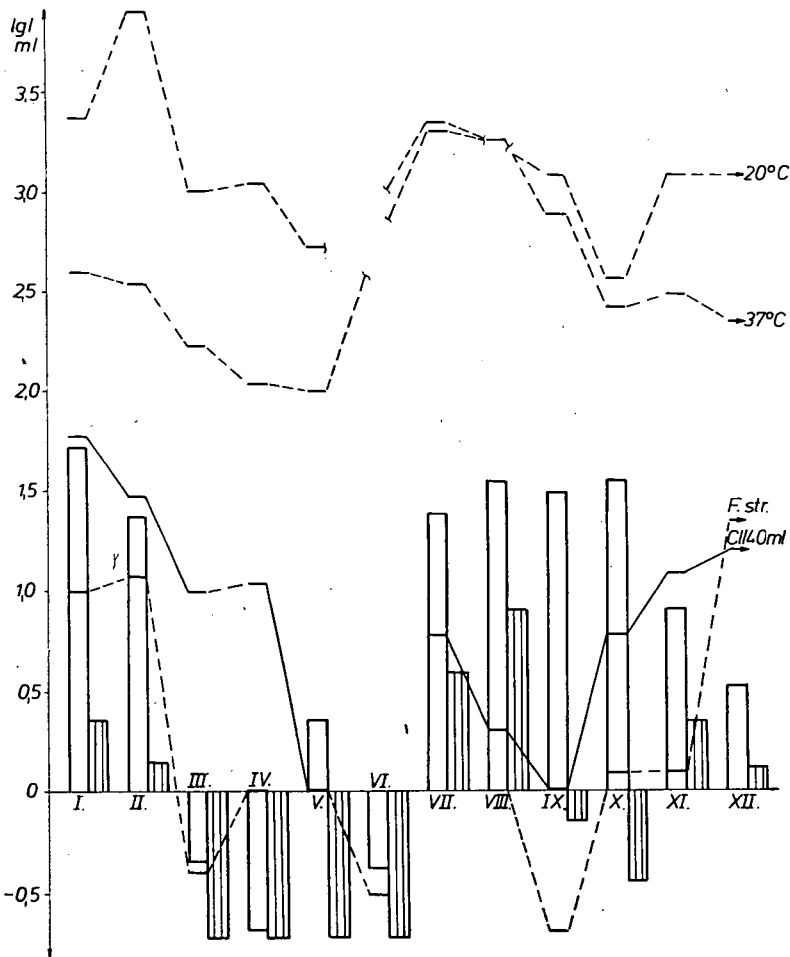


Fig. 4

#### 4. Results of bacteriological investigations carried out in 1978 (Fig. 4)

The hygienic water quality of the backwater was on the basis of the investigated parameters in 42% of class II "slightly contaminated" and in 58% of Ist class, "pure". Bacteria belonging to the genus *Salmonella* could never be detected in any 1000 ml water sample. In 1978 the river Tisza had from springtime to midsummer a high water level and flooded the backwater also even at late falltime several times. Thus, owing to the intensive rinsing, the obligate faecal indicator bacteria were present up to June 15 only in a relatively small number. However, after July 15 these values increased significantly, due likely to the fact that the stagnancy of the water occurred during the durable floods, at a higher water level. This state developed not only in the river bed but also in the water mass covering the entire flood-plain. This is shown also by the peak values (not measured up to the present) of the medians and of the mean values.

#### 5. Results of the bacteriological investigations carried out in 1979—1980 (Fig. 5)

In these years water samples were withdrawn mainly in the summer bathing season. The results disclosed rather great deviations in the order of magnitude in comparison to those observed in the previous years but their characters were similar to each other. On the basis of the hygienic parameters of investigation the water quality was in both years mostly Ist class "pure" and only in some cases IInd class "slightly contaminated". The duality characterizing the backwater could be recorded also in these years: flooding, durable flood, and the bacteriological results of the stagnant water at high and low water. Bacteria belonging to the genus *Salmonella* could never been detected in 1000 ml water samples during the mentioned two-year period.

#### 6. Results of investigations of bacterioplankton (Fig. 6)

Total bacterium counts have been determined in the period 1975—1978. In the water of the Mártély backwater in general values ranging from 1 to 10 millions/ were the most frequently observed during four years. Values of the direct bacterium count/ml did not show any unequivocal correlation with the number of the cultured all colony-forming bacteria. However, it could be stated that the total bacterium count is in general higher (12—58 millions/ml) when the backwater is being flooded by the river Tisza. These observations can be interpreted by the stirring of the sediments of the backwater, and on the other hand, they point to the also otherwise high bacterioplankton stand of river Tisza. The amount of bacterioplankton recorded in the Mártély backwater was on average greater than that observed in Lake Balaton but slightly lower than that recorded in the backwaters in the area of the Kisköre reservoir. In accordance with the results of investigations of B. Tóth (1977) the amount of bacterioplankton was in the autumnal season in general smaller when the Tisza was not flooded.

On summarizing shortly the results of bacteriological investigations carried out in the period 1975—1980 in the water of the Mártély backwater it can be stated that

1. The water quality of the Mártély backwater is characteristically of Ist class type "pure" according to the examined hygienic parameters.



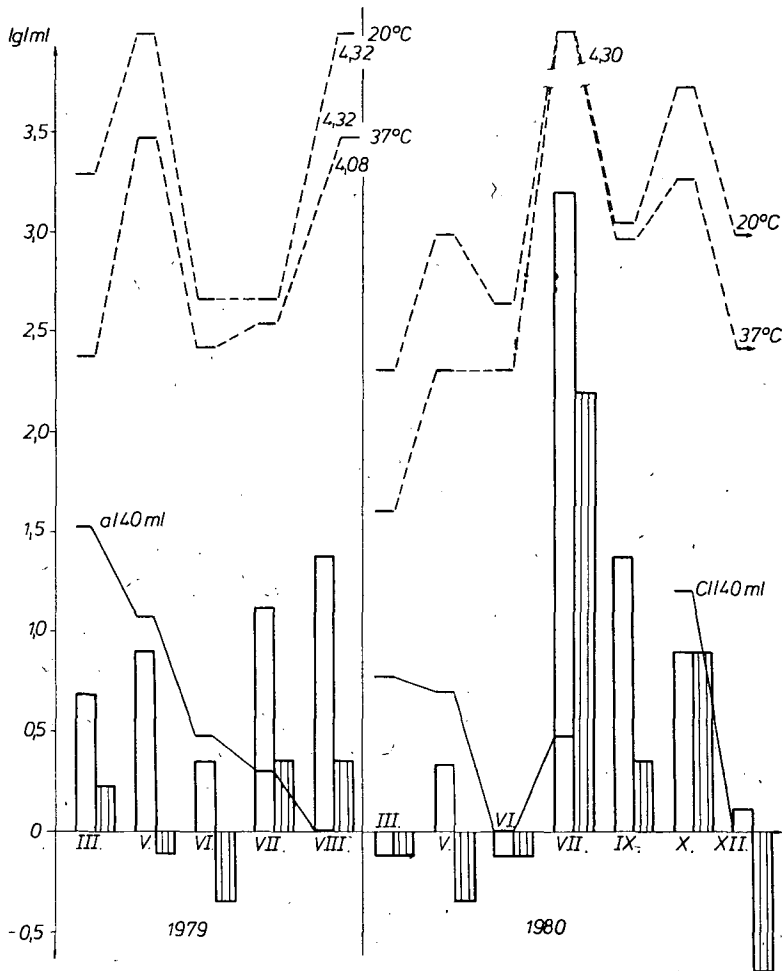


Fig. 5

2. Bacteria belonging to the genus *Salmonella* could be detected only occasionally and thus the percentage of the occurrence of *Salmonella* is low and it does not exceed the limit value of 33%.

3. The median values showed during the last six years a remarkable constancy at the coliform, faecal coliform, *Streptococcus faecalis* and faecalis streptotoccus counts/ml values.

4. The results of the hygienic bacteriological investigations indicated the least favourable water quality in 1978 which can be attributed to the repeated floods and to the subsequent stagnancy at high water.

5. The counts of all the colony-forming bacteria at 20 °C and 37 °C further the median values of the *Clostridium* count/40 ml were very varying in this period. The number of psychrophilic bacteria (20 °C) indicates contamination of non-faecal origin but it may point also to an infiltration or stirring up from the soil and from

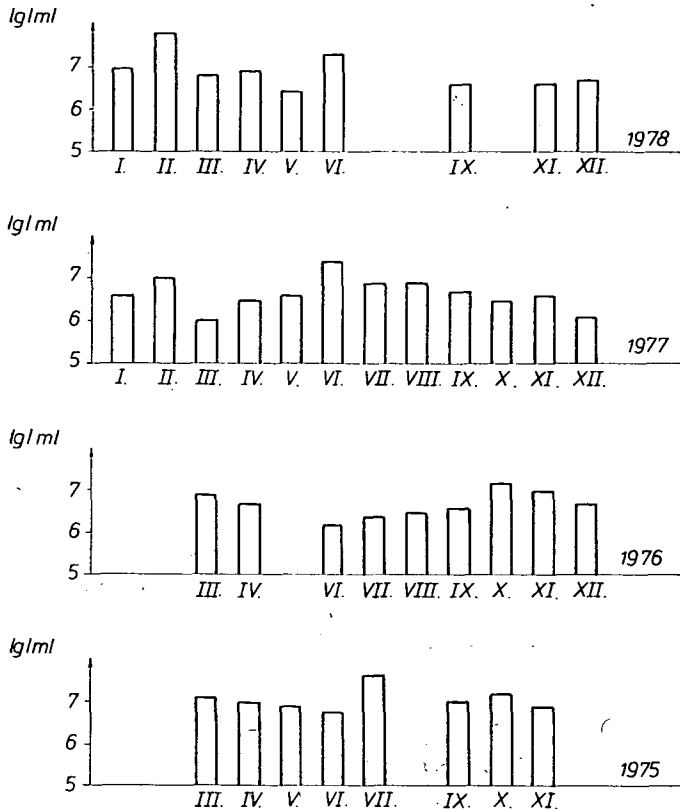


Fig. 6

the sediment. This was observable when the backwater was flooded by river Tisza or when its water was impouring into the southern connecting channel, stirring up the sediment of the water mass. The presence of a great number of other facultative faecal indicator bacteria in the water of the backwater pointed to the predominance of the mineralization of organic substances and of the anaerobic processes.

6. At the peak values of the coliform and faecal coliform counts generally also the amount of all the colony-forming bacteria significantly increased and on the other hand the value of the psychrophilic bacteria/ml was always higher than that of mesophilic bacteria.

### Results of the hygienic bacteriological investigations of the Körtvélyes backwater in the period 1976—1980

#### 1. Results of bacteriological investigations carried out in 1976 (Fig. 7)

On taking into account the limit values of the hygienic water evaluation 75% of the investigated samples was Ist class "pure" whereas 25% was Hnd class "slightly contaminated". The peak value of the coliform count/ml appeared in August and

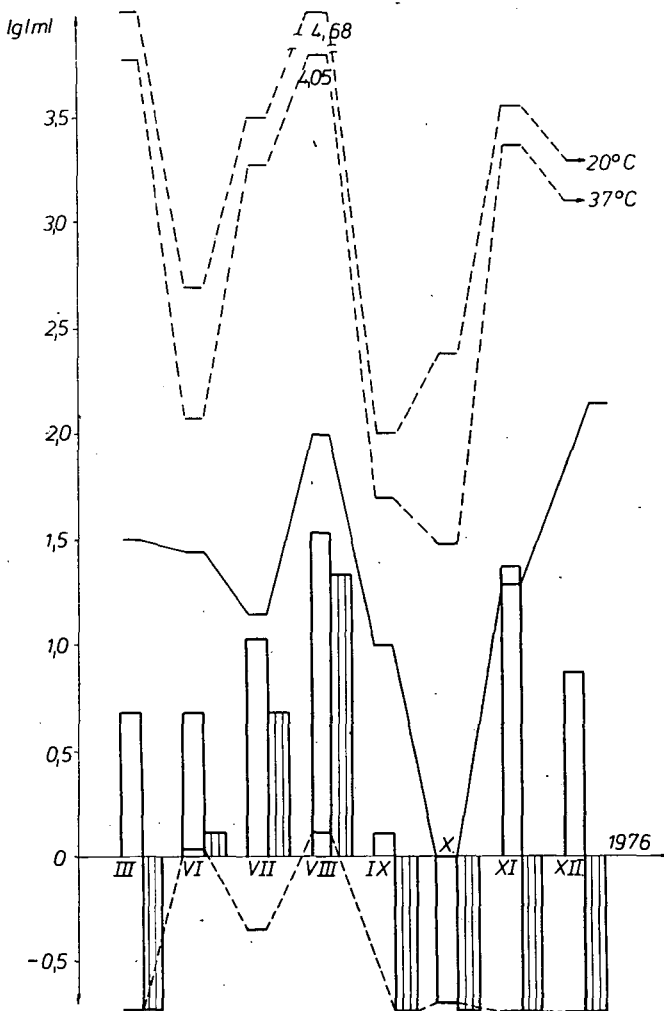


Fig. 7

October. The peak value of the coliform count in August was followed in the order of magnitude by the values of the counts of the faecal coliform, the psychrophilic and mesophilic bacteria, the *Streptococcus faecalis* and of *Clostridium*. These values characterized the typical stagnant water conditions of the backwater. The higher values recorded in November pointed to the flood of river Tisza.

Of 1000 ml volumes of the investigated samples bacteria belonging to the genus *Salmonella* were isolated only in one single case, on June 30, 1976. These proved to be of the following serotypes: *Salmonella schleissheim*, *Salmonella arizonae* (38; r; z.) and *Salmonella reading* (O<sub>5</sub> antigen positive). This latter serotype was at that time typical in various sewages of Csongrád county. A rarely isolated serotype is *Salmonella arizonae* which is frequent according to data of literature mainly in animal colonies.

2. Results of bacteriological investigations carried out in 1977  
(Fig. 8)

66.7% of the investigated samples was Ist class "pure" whereas 33.3% was IInd class "slightly contaminated" on the basis of the limit values of the hygienic water evaluation. The percentage of *Salmonella* positivity was similar to that observed in the previous year i.e. bacteria belonging to the genus *Salmonella* could be detected in water samples of 1000 g only in August, and these proved to be O<sub>5</sub> antigen-deficient *Salmonella typhi-murium*.

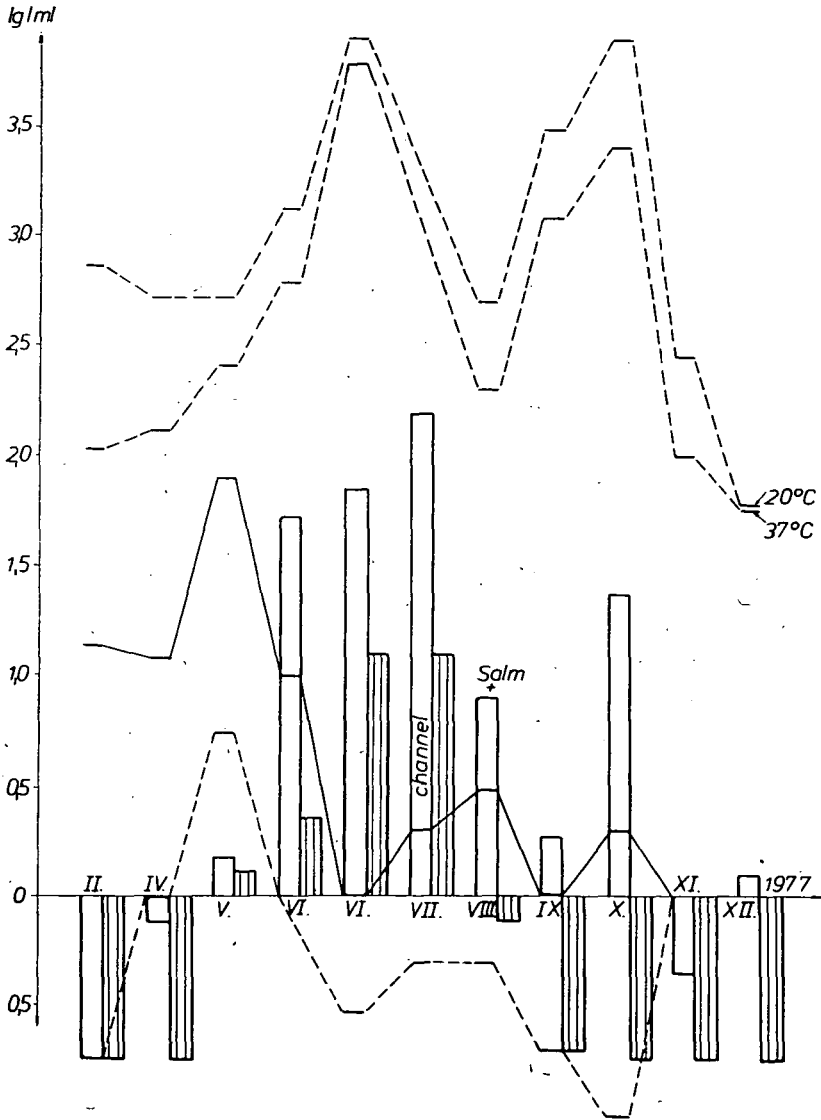


Fig. 8

On 13 August 1977 fish deaths were observed in the water of the backwater but this was reported only on 17 August. Thus water samples could be withdrawn after 5 days i.e. on 18 August only. It is likely that the eventual contamination would be indicated besides the *Salmonella* also by other groups of bacteria in case of an earlier sampling. At the fish deaths water samples were withdrawn also from the water of the Körtvélyes channel where the water quality was of IIIrd class "contaminated". On observing the seasonal changes it can be stated that, similarly to the Mártély backwater, the peak values in late falltime can be attributed to the durable stagnancy of the water. The peak values of the *Clostridium* and faecal *Streptococcus* counts were recorded end of May at a lower water level after a flood when the great number of *Clostridium* may have indicated also the predominance of the anaerobic processes.

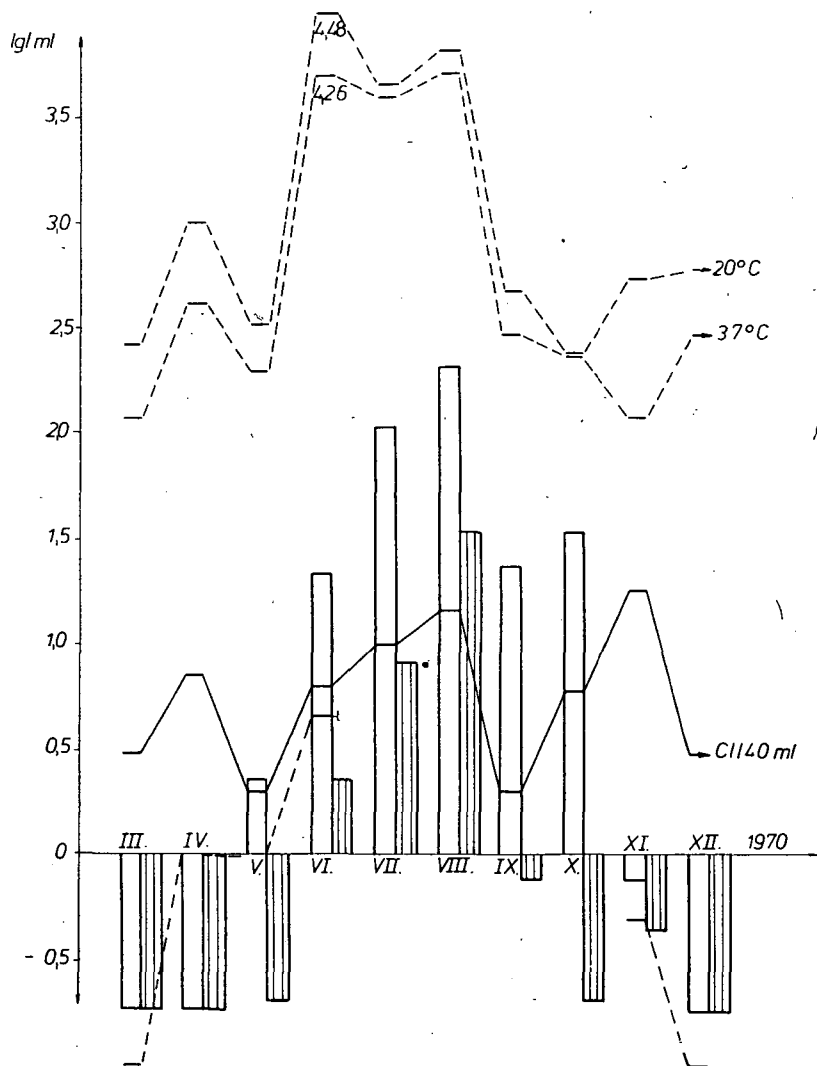


Fig. 9

### 3. Results of the bacteriological investigations carried out in 1978 (Fig. 9)

50% of the investigated samples was Ist class "pure" water and the other 50% IInd class "slightly contaminated" water, indicating in comparison to the previous years a rather significant deterioration of the water quality. Bacteria belonging to the genus *Salmonella* could be never isolated in any of the water samples of 1000 ml.

The results obtained in 1978 are quite in accordance with the water quality of the Mártély backwater. Changes in the water quality of the Körtvélyes backwater can be also attributed to the factors mentioned there. Namely, the investigated

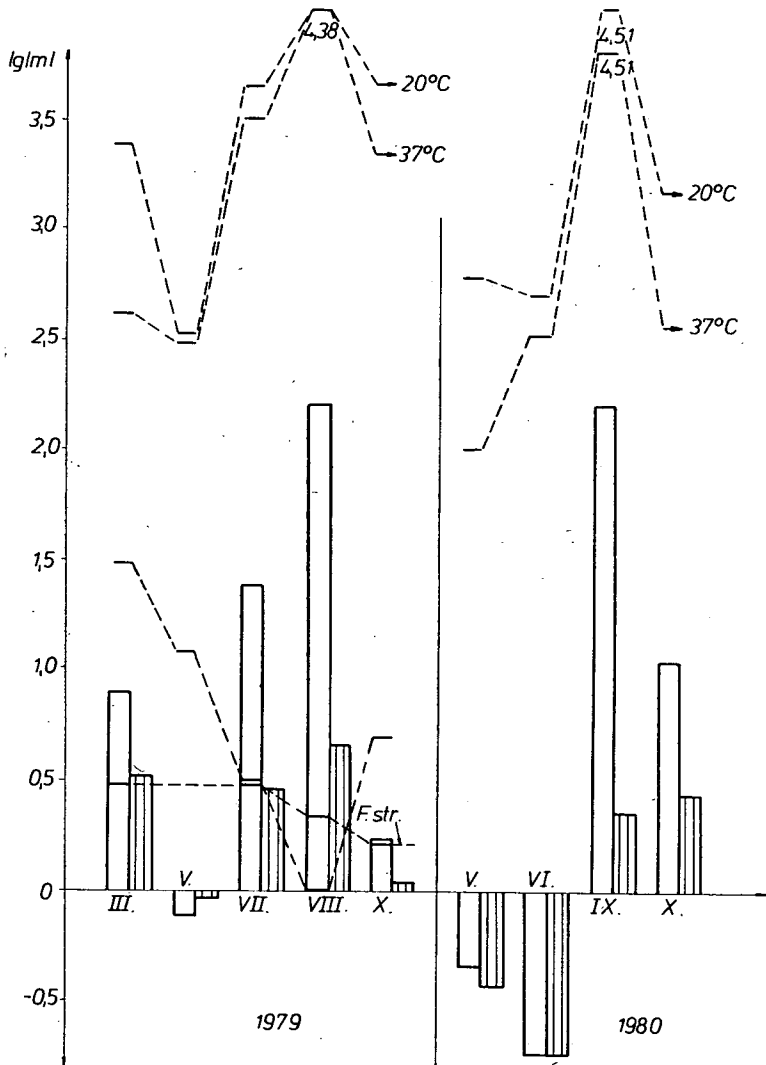


Fig. 10

parameters of hygiene indicated up to the month June a relatively favourable value even at a durably high water level (excepting the values of the *Clostridium* count/40 ml).

Though in June and July the flood-plain of the backwater was still covered with water, the tendency was receding. This was then followed by two smaller floods which were well indicated by the peak values of the counts of the coliform and heterotrophic bacteria. Two further floods (in September and October) were similarly indicated by the values of the coliform counts. In November and December, in turn, the water quality of the backwater was Ist class "pure", and at this time again the character of stagnant water predominated.

#### 4. Results of the bacteriological investigations carried out in 1979—1980 (Fig. 10)

On the basis of the hygienic bacteriological parameters the water quality of the backwater was in both years Ist class "pure" which was characteristic mainly for the first half of the years. The stagnant waters at falltime were of IIInd class, due to the

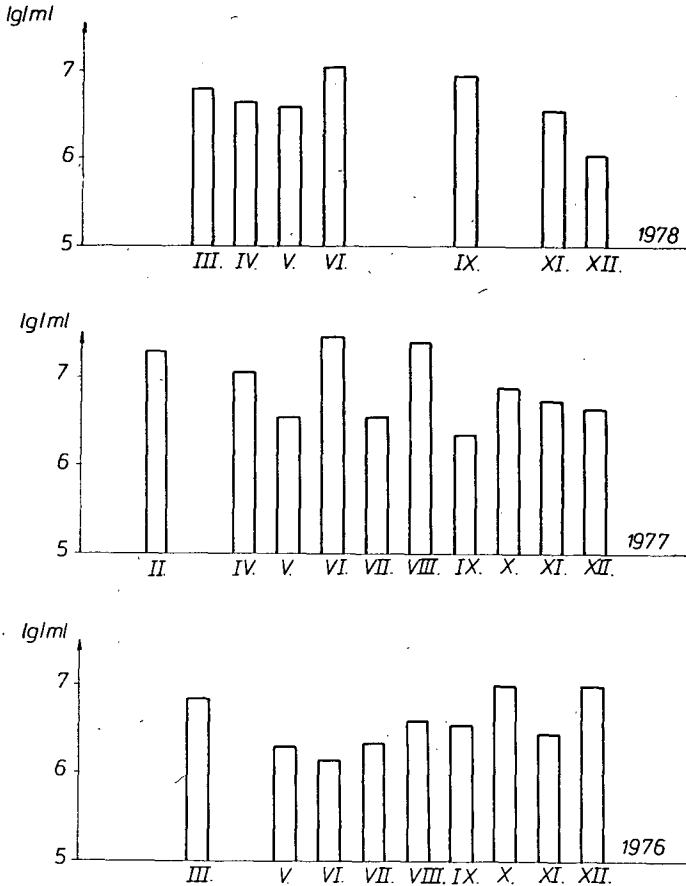


Fig. 11

duality described above, characterizing the water mass of the backwater. Bacteria belonging to the genus *Salmonella* were not detectable in any of the 1000 ml water samples withdrawn during the two years.

### 5. Results of the investigations of bacterioplankton (Fig. 11)

The direct bacterium count was determined in the water of the Körtvélyes backwater in 1976—1978. During this 3-year period values of 1—10 millions/ml were recorded most frequently in the water of this backwater. Unequivocal correlations

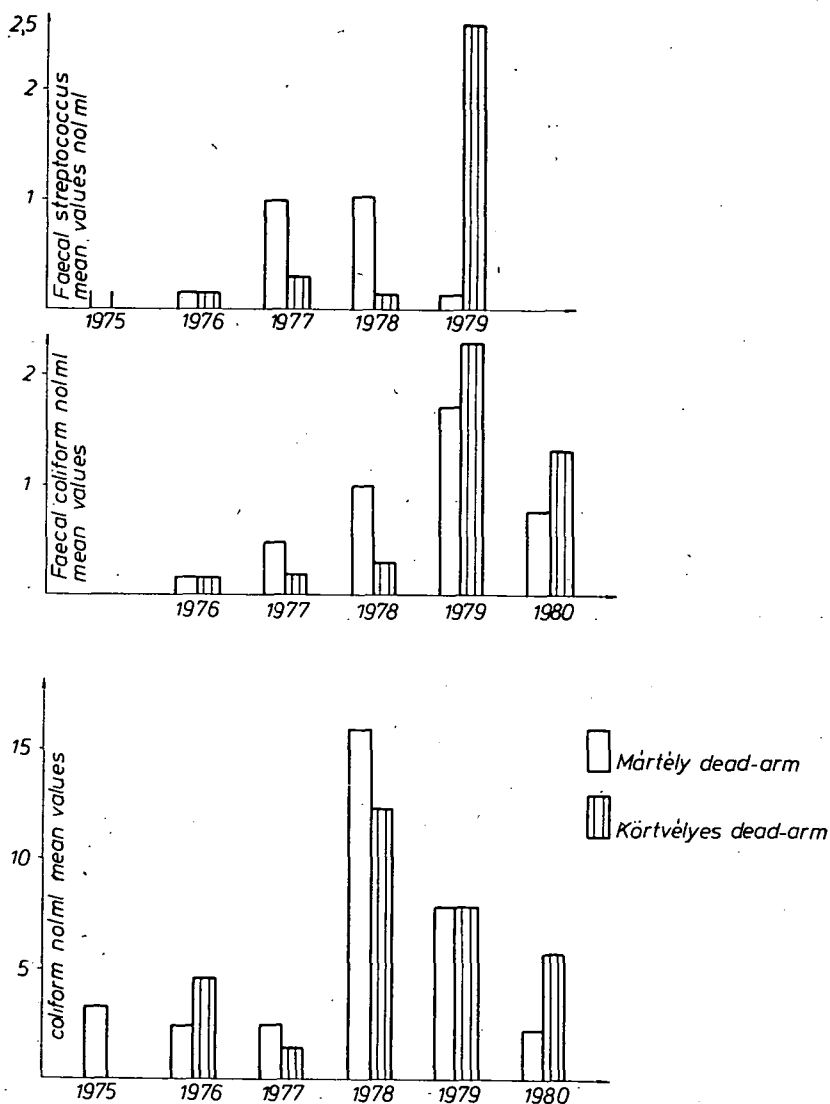


Fig. 12



between the bacterium counts in 20 °C and 37 °C cultures on one hand, and the direct bacterium count, on the other hand could not be detected in the water of the Körtvélyes backwater, either. On the basis of the results of investigations carried out for three years the following can be stated of the changes in the bacterioplankton stand: the quantity of this stand decreases in general in the autumnal season whereas the peak values appear during the floods of river Tisza when the backwater is inundated.

### Comparison of the hygienic water quality of both backwaters

The median values of the parameters are shown for each year in a columnar diagram (Figs. 12 and 13) in order to facilitate the evaluation of the changes in each parameter of the water quality of both backwaters.

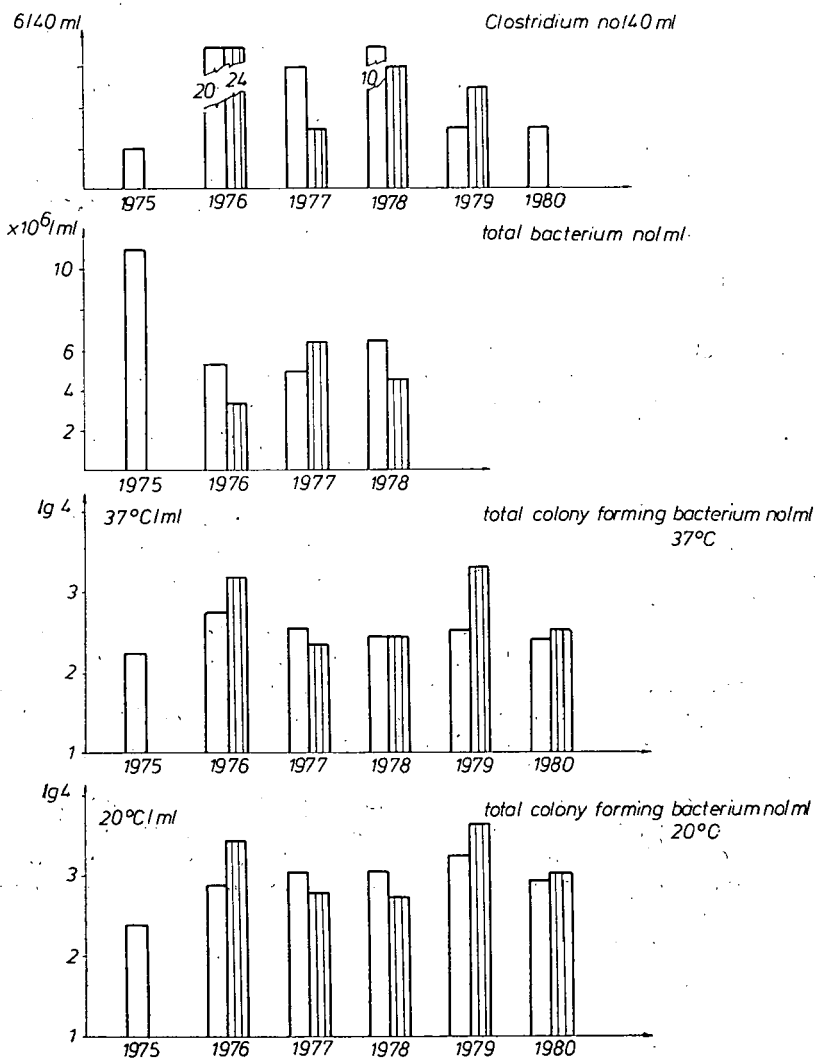


Fig. 13

It can be observed that in 1976 the median values of the investigated bacteriological indicators were higher in the Körtvélyes backwater whereas in the years 1977 and 1978 the median values of almost all the parameters were higher in the water of the Mártély backwater (excepting in 1977 the values of the psychrophilic and the total bacterium counts). In 1979—1980, in turn, the median values of the investigated results disclosed again a change since all the parameters were higher in the water of the Körtvélyes backwater i.e. from an annual aspect the water quality proved less favourable in this water mass.

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The hygienic bacteriological investigation of the waters of the two backwaters in the Mártély Region of Scenery Protection was carried out from 1976 to 1980. On the basis of the results of these investigations it can be stated:

1. The water of both backwaters is in the majority of cases of 1st class "pure" quality.

2. The obligate faecal indicator bacteria (faecal coliform, faecal *Streptococcus* bacteria and bacteria belonging to the genus *Salmonella*) were detectable only relatively rarely and in small numbers.

3. Of the facultative faecal indicator bacteria the value of the coliform count and the heterotrophic bacterium count indicated well the floods, the rinsing of the sewage lagoons (in the Mártély backwater) and the stagnant water masses developed at high and low waters.

4. The values of the *Clostridium* count/40 ml indicated the stirring-up of the "silt" of backwaters and occasionally the predominance of the anaerobic processes.

5. The value of bacterioplankton/ml varied in the water of both backwaters on average in the order of magnitude of 1—10 millions/ml. During floods their numbers increased and in the autumnal season diminished.

6. The quality of water of both backwaters disclosed a seasonal dynamism which could be observed also on the basis of the hygienic bacteriological investigations.

7. The hygienic water quality of the backwaters Mártély and Körtvélyes is almost identical. The water of the Mártély backwater is utilized also for recreational and bathing purposes which has unfavourable effects on the quality of the water mass since during floods significant amounts of pollutants are entering the backwater.

Occasionally some major faecal contaminations could be detected in the water of the Körtvélyes backwater as well which was indicated also by the change of the ratio of coliform bacteria to the faecal coliform bacteria. The water of the Körtvélyes backwater is contaminated by the rainfall and the sewages of Orosháza, Szentetornya, and of the sanatoria Kakasszék and Kútvölgy, furthermore by the leakage and drainage waters of the paddy-fields.

On summarizing the results of the investigations it can be stated that the hygienic bacteriological investigation of the waters of backwaters is indispensable in solving the actual problems of environmental protection and recreation, furthermore, as a parameter of the biological water qualification it promotes also the development of a uniform contemplation.

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## Higiénés bakteriológiai vizsgálatok a Mártélyi és a Körtvéyesi holt ágak vizéből

HEGEDÜS MÁRIA és ZSIGÓ MARGIT  
Csongrád megyei Közegészségügyi-Járványügyi Állomás, Szeged, Hungary

### Kivonat

A Mártélyi Tájvédelmi Körzet területe két holtágának vizét az elmúlt öt év alatt rendszeresen vizsgáltuk. A vizsgálatok eredményei alapján következtethettünk az obligát és a fakultatív faecal indikátor baktériumok mennyiségi és minőségi viszonyaira, valamint figyelemmel kísérhettük az esetenként bekövetkező bakteriális szennyezettség tér és időbeli változását is. A két holt ág vizéből 202 mintát vettünk és 910 vizsgálatot végeztünk el.

Eredményeink a következők:

- Mindkét holtág vize az esetek többségében I. osztályú "tisztá" vízminőségű volt.
- Az obligát faecal indikátor baktériumok csak ritkán és kis számban voltak ki mutathatók.
- A fakultatív faecal indikátor baktériumok mennyiségi változása jól jelezte az áradásokat, a szennyvíz-szikkasztók kimosását (Mártélyi holt ág nál) és a magas, valamint alacsony vízállásnál kialakult pangó víztereket.
- A két holt ág vízminősége a higiénés bakteriológiai vizsgálatok eredményei alapján is megfigyelhető évszakos dinamizmust mutatott.

## Bakteriolóško-zdravstvena ispitivanja vode mrtvaja Mártély i Körtvéyes

HEGEDÜS MÁRIA i ZSIGÓ MARGIT  
Zdravstveno-epidemiološka stanica županije Csongrád, Szeged, Hungaria

### Abstrakt

Za proteklih pet godina vršena su redovna ispitivanja vode naznačene dve mrtvaje na području zaštićenog okruga Mártély. Rezultati naših ispitivanja ukazivali su na kvantitativne i kvalitativne vrednosti obligatornih i fakultativnih faecal-indikatornih bakterija. Takođe su registrovana i povremena bakteriološka zagadjenja u prostornom i vremenskom aspektu.

Rezultati 910 analiza 202 uzoraka vode mrtvaja su sledeći:

- Vode obe mrtvaje u većini slučajeva pripadaju I. kategoriji.
- Obligatorne faecal-indikatorne bakterije se javljaju sporadično i u malom broju.
- Promenljiva količina fakultativnih faecal-indikatornih bakterija je u direktnoj vezi sa visokim vodostajem, sa isušivanjem bazena za otpadne vode (kod mrtvaje Mártély) kao i sa baruštinama koje se javljaju pri visokim i niskim vodostajima.
- Rezultati zdravstveno-bakterioloških analiza ukazuju na sezonski dinamizam promena kvaliteta vode obe mrtvaje.

## ГИГИЕНИЧЕСКО-БАКТЕРИОЛОГИЧЕСКИЕ ИССЛЕДОВАНИЯ ВОДЫ СТАРИЦ МАРТЕЙ И КЁРТВЕЙЕШ

М. Хегедюш и М. Жиго  
Чонградская медико-эпидемиологическая станция  
Сегед, ВНР.

### Резюме

В заказнике Мартей, умеются две старицы (Мартей и Кёртвейеш), воды которых в последние пять лет систематически изучались нами.

На основании результатов исследований удалось показать качественные отношения obligатных и факультативных индикаторов бактерии фекалий, а также внимательно проследите за изменением пространства и времени бактериальной засоренности.

Из воды двух стариц взяли 202 образца и привели 910 исследований.

Исследования показали следующие результаты:

— Воды обеих стариц, в большинстве случаев, характеризуются чистотой первой степени.

— Обязательный индикатор бактерии фекалии только изредка появлялся в небольшом количестве.

Количественные смены факультативных индикаторов бактерии фекалии хорошо сигнализировало наступающих наводнениях вымывании сточных вод (старицы Мартейи), а также возникших в будущем площади водных застоев при низких и высоких уровнях воды.

— На основании результатов гигиенически-бактериологических исследований воды, качество обеих стариц показали сезонную динамику.