

AQUATIC MICROBIOLOGY IN ESTONIA

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Abstract. The present paper sums up the history of aquatic microbial research work done in Estonia. A review of the most important stages and the subject matter of the projects are presented. Also the institutional establishments and the reports of scientists working there are given. Nowadays the projects connected with aquatic microbiology are mostly carried out at the Institute of Zoology and Botany, at Tartu University, and at the Laboratory of Water Protection at Technical University of Tallinn.

Key words: aquatic microbiology, hydrobiology, history.

Bernhard Eduard Otto Körber (1837—1915) worked in the bacteriological laboratory of the Tartu University during the period from 1879 till 1895, as one can read from history books (Tartu Ülikooli..., 1982). In 1889 he further perfected himself under R. Koch in Berlin; after that, in addition to other works that he did, Körber supervised the bacteriological investigations of water (wells, the river Emajõgi, the waterworks of the University). Dmitri Tatarov, a member of the working group, described the species of bacteria of the water of Tartu (Tataroff, D. Die Dorpater Trinkwasserbakterien. Inaug. Dissert. Dorpat, 1891). As his descriptions were used in the early bacterial systematics, we shall give here some examples:

1. *Bacillus fluorescens putidus colloides* Tataroff, 1891
2. *Bacillus fluorescens mesentericus* Tataroff, 1891
3. *Bacillus aquatilis graveolens* Tataroff, 1891
4. *Bacillus liquefaciens* Tataroff, 1891
5. *Bacillus crassus aromaticus* Tataroff, 1891
6. *Bacillus cuticularis albus* Tataroff, 1891

In the system of W. Migula, after some corrections had been made, the mentioned bacteria had been given new names (Красильников, 1949):

1. *Pseudomonas colloides* (Tataroff) Migula, 1900
2. *Pseudomonas mesenterica* (Tataroff) Migula, 1900
3. *Pseudomonas graveolens* Migula, 1900
4. *Pseudomonas liquefaciens* Migula, 1900
5. *Pseudomonas aromatica* (Tataroff) Migula, 1900
6. *Bacillus subcuticularis* (Tataroff) Migula, 1900

N. A. Krassilnikov considered first two of these to be different forms of *Pseudomonas fluorescens* Migula, 1895, and the fifth to be a different form of *Pseudomonas fragi* (Eichholz) Hussong, Long et Hammer, 1937,

Nevertheless, in more modern systems (Bergey's Manual . . . , 1974) we can find just *Pseudomonas aromatica* Migula, 1900. So, unfortunately Tatarov's name has got lost.

In 1908 Jevgeni Shepilevski began a lecture course on bacterial systematics; he also carried out practical exercises at the Department of Hygiene of the University. Among other things he paid attention to the self-purification processes of natural water in connection with the activities of protozoa.

In the earlier review of the history of Estonian microbiology (Rahno, Pärsim, 1972) the investigations of B. Körber and J. Shepilevski are considered to be within the limits of medical microbiology, but, as we can see, there is something biological, too. So we can find the origins of aquatic microbiology in Estonia in the studies on hygiene carried out at Tartu University at the end of the XIX century.

The first complex lake research where the morphometry, bottom deposits, the physical and chemical qualities, flora, fauna, as well as bacteria were investigated was carried out on Lake Ülemiste during the period from 1900 to 1906. The results are summarized in Guido Schneider's publication "Der Obersee bei Reval" (Schneider, 1908). These investigations were done because of the mass water blooming in the lake in 1896 and because of the need to test the quality of the water used in the waterworks of Tallinn. The summary of the bacteriological part of the research was presented by H. von Winkler and E. von Husen in the chapter "Die Bakterien", where the data about the seasonal dynamics of the bacteria growing on the meat-peptonic gelatin medium are given. Ebba von Husen determined 12 species of bacteria from the lake water pumped to the town. It is interesting to note that among them were also those described by D. Tatarov.

At the beginning of the XX century in the laboratories of Tallinn (the laboratory of H. von Winkler, the laboratories of sanitary and bacteriology) the works similar to those done later in the Sanitary and Epidemiology Stations (now the Public Health Centres), were done. Hydrobiological investigations were more closely connected with Tartu (the works of the Lake Commission of the Naturalists Society (LUS), M. zur Mühlen and the Committee for the Investigation of Estonian Waters (EVUK). Data about the studies connected with aquatic microbiology are absent.

In the early 1960s the aquatic microbiological studies in the complex of hydrobiological research were started thanks to the initiative of Neeme Mikelsaar, Head of the Department of Hydrobiology of the Institute of Zoology and Botany. He considered thorough investigations of Estonian waterbodies to be really necessary. In 1961 the first studies were carried out on the Gulf of Riga (Локк, 1974), and in 1962 on Lake Peipsi and Lakes Neeruti (Мяэметс, 1966; Mäemets, Mäemets, 1976). At the Võrtsjärv Limnological Station a laboratory of aquatic microbiology was established, where from 1961 to 1967 worked Aime Mäemets, and from 1963 Saida Lokk, who got a special training under Prof. A. G. Rodina in Leningrad. In 1971 S. Lokk finished her study on the amount and biomass of bacteria in the pelagical and littoral zone of Lake Võrtsjärv (Локк, 1971) and got her candidate's degree.

From 1968 on the research workers of the Limnological Station have been sampling the water of Lake Võrtsjärv with the aim of getting data about the bacterioplankton, phyto- and zooplankton, to watch the long-term changes in waterbody (Lokk, 1973; Lokk, Tammert, 1984). Later the studies expanded to the small lakes, where in the complex of hydrochemical and hydrobiological research the numbers and biomass of bacterioplankton and the numbers of saprophytic bacteria were

determined; also seston was studied. As a result of these studies based on the data from as many as 160 lakes gradations of microbiological index for different lake types of Estonia (Lokk, 1982) has been composed. The lack of previous data and the complexity of research works were responsible for the content of aquatic microbiological studies, which was the determination of the most general microbiological data and the preliminary estimation of the bacterioplankton as one of the links of the ecosystem. As especially in field studies made under the terms of agreements data of sanitary microbiology (numbers of coliform and enterococcus) have been required, there are overlaps with hygiene up to now. The history has reached back to Lake Ülemiste. In the seventies a study connected with an agreement was carried out (Порк, Локк, 1979). At present we have the results of the microbiological analyses of water made from about 300 Estonian lakes. Using quite a lot of data, the peculiarities of the distribution of bacterioplankton in stratified and unstratified lakes have become evident and species of bacteria typical to the particular lake type and to the concrete ecological conditions have been found (Горленко, Локк, 1979; Драбкова et al., 1980). The estimation of natural state and development of Kurtna and Pandivere lake groups (Laugaste et al., 1987; Mäemets et al., 1989; Lokk, 1990a) and the determination of water quality of the quarry lakes of the mining areas (Lokk, Laugaste, 1991) were complex researches of small lakes also worthy of note. In addition to small lakes the Narva reservoir coupled with the influence of ash fields have also been an object of investigations (Lokk, 1985). In the years of 1984—1987 the workers of the Limnological Station participated in the state research program of Lake Peipsi (Lokk et al., 1988b; Lokk, 1990b). Still earlier, in 1980, in addition to the usual microbiological data the seston and the intensity of destruction in the bottom deposits was determined (Локк, 1986). The rivers flowing into the lake were sampled three times during the vegetation period in the years 1984—1987 (Lokk et al., 1988a).

In the 1980s determining of bacterial production was started at first on Lake Võrtsjärv and later on Lake Peipsi. This was mostly done by H. Tammert, who has been working at the Limnological Station since 1975. In the beginning the bottles method (by Ivanov) was used, but since 1990 it is determined by using radio-active tracers. The method of using 3H-thymidine was first applied in Estonia on Lake Võrtsjärv and on 30 small lakes (Ojaveer et al., 1993). In 1991 the seasonal research of bacterial production was carried out on Lake Võrtsjärv, Lake Arbi and Lake Verevi. These investigations were a part of the complex study of carbon circulation.

Some expeditions have been made outside Estonia. Microbiological analyses of water samples in the complex of hydrobiological and ichthyological research have been made on Lake Paleostom, Georgia (1977), on the Danube river system (1979) and on Lake Jashan, Turkmenistan (1981, 1988).

From the late 1970s on the students of Tartu University (the Department of Plant Physiology and Biochemistry) have been taking part in the microbiological investigations of the Limnological Station, gathering data for their course-papers and graduation works. In connection with the creation of the Department of Hydrobiology at the University in 1992, the links of microbiologists of Limnological Station with the University have become more close. T. Nõges is leading a theoretical and practical course of aquatic microbiology. She is also the author of the first textbook in aquatic microbiology in Estonian (Nõges, 1993).

The investigations of Prof. A. Saava, who is an expert in the field of hygiene, have been closely connected with aquatic microbiology, as

well. She has been investigating rivers and the Gulf of Finland since the 1960s up to nowadays. In addition to sanitary research much attention has been paid to studying the bacterial aspects of pollution and the processes of self-purification (Saava, 1967; Саава, 1981). Her works in the field of intercalibration of the microbiological analyses of water are of great importance, too (Saava, Rinne, 1987). Investigations in connection with the pollution load, self-purification of rivers and the problems of waste water purification have been carried out at Technical University of Tallinn (Леесмент et al., 1969; Вельнер et al., 1973).

In 1978 at the Department of Plant Physiology and Biochemistry of the University Assistant Professors V. Tohver and L. Viileberg began the instruction on the investigations of microbial associations in Estonian rivers. Most carefully were studied reducers (denitrifiers and sulphate reducers), oligocarbophilic bacteria and yeasts. Several graduation works have been done and articles have been published on these subjects. A thorough review of these studies connected with the nitrogen pool in the water ecosystem is given in a publication by V. Tohver (Тохвер, 1988), where the results of the investigation of about ten years have been gathered together and analysed.

In 1988 the workers of the same Department started the investigations of mining waters of Estonia. Graduation works have been done and articles have been published on this subject (Alamäe et al., 1990; Kokassaar et al., 1991).

The problems of adaptation of microbes in sea water and in river waters, also the factors influencing adaptation have been studied in Estonia as well. L. Alton has been engaged in such work since the late 1970s. There are several articles on the results of these studies (Алтон, 1983; 1990).

At present time the investigations of marine waters are carried out in the Laboratory of Water Protection at the Technical University of Tallinn, where K. Künis has studied the vertical distribution of bacterioplankton and heterotrophic bacteria in several small bays and in the longitudinal section of the Gulf of Finland (Künis, Saava, 1989; Künis, 1991). At the Võrtsjärv Limnological Station the investigations connected with microbes and water are continued. The aim of studying small lakes is to estimate their present state, the changes which have taken place, and to give recommendations of how to use and protect them. Researchers participate in monitoring programs, too (on Lake Peipsi). The studies connected with the production of bacteria are going on. In 1990 the production of bacteria was determined in the Gulf of Finland by 3H-thymidine method (Nõges). Since 1991, the microbiological analyses of water are also made at the Reserach Group of River Biology of the Institute of Zoology and Botany. In the booklet of the Estonian Society for Microbiology (Microbiological Research..., 1993), 4—5 research projects connected with aquatic microbiology and carried out in Estonia now are presented. There are some more projects related to this branch of science. They all are mostly carried out at the Institute of Zoology and Botany of the Estonian Academy of Sciences or at Tartu University.

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VEEMIKROBIOLOOGIA EESTIS

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On käsitletud veemikrobioloogiaalaste uurimistööde ajalugu Eestis ning toodud välja olulisemad etapid selle teadusharu arengus ja tööde temaatika. On antud ülevaade veemikrobioloogia probleemidega tegelejad asutustest ja seal töötanud teadlaste tööde tulemustest. Käesoleval ajal tehakse veemikrobioloogia alal uuringuid Eesti Teaduste Akadeemia Zooloogia ja Botaanika Instituudis, Tartu Ülikoolis ja Tallinna Tehnikaülikooli vetekaitse laboratooriumis.

ВОДНАЯ МИКРОБИОЛОГИЯ В ЭСТОНИИ

Пеэтер ПАЛЛЬ, Сайда ЛОКК

Рассматривается история изучения водной микробиологии в Эстонии. Приводятся наиболее существенные этапы развития этой отрасли науки, а также дается обзор тематики проведенных научных работ. Перечисляются учреждения, занимающиеся проблемами водной микробиологии. В настоящее время водной микробиологией занимаются в Институте зоологии и ботаники, в Тартуском университете и в лаборатории водной охраны Таллиннского технического университета.