Proc. Indian natn. Sci. Acad. Vol. 44, Part B, pp. 98-110 (1978)
Ecology

BIOLOGICAL INDICATORS OF POLLUTION

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Data collected on micro- and macrofauna as "biological indicators of pollution" associated with various degrees of pollution have been listed. The list is the outcome of the vast collection of ecological data from different water bodies of Nagpur, extending over several years.
The comparison of the data obtained with those of the Central European waters and from the biogeographical point of view it is possible to introduce the European saprobiety system in India for monitoring water pollution level. This is because of cosmopolitan distribution of organisms irrespective of the temperature variations.
The autoecological experiments done in the laboratory for determining the ecological potentialities for ciliate protozoa representing model studies of different degrees of pollution compared well with similar studies done in Central Europe. These studies have given valid information regarding their status in assessing the water qualities (indicator value).

INTRODUCTION

Pollution is essentially a biological phenomenon and its primary effect is on living things. Simple, rapid and reliable methods are needed for the evaluation of degrees of pollution.

Chemical methods for the assessment of pollution though well known, have the disadvantage of giving the picture only at the time of collection of the waters and are tedious and time-consuming. To some extent, the reasons why chemistry has consistently taken precedence over biology in this particular field seems to be historical.

The biological methods of monitoring water pollution are comparatively of recent origin and have the advantage of giving the past history of water sources. These require less time because the single series of samples reveals complete picture of the animal and plant communities which themselves represent the state of prevailing conditions.

Biological analysis also shows the effects of intermittent pollution. The advantage of biological assessment of water pollution lies in the fact that the animals and plants provide more or less static record of the prevailing conditions and they are not affected by the temporary changes especially the benthic fauna. At the same time numerous procedures developed for the biological estimation of water quality, make comparison of the methods more difficult. Bick (1963) has reviewed in great detail the various methods of biological assessment of pollution, and their applicability.

One of the methods for monitoring water quality is the 'Saprobien System' of Kolkwitz and Marsson (1908, 1909) and its modified form of the water quality system called 'K-M-L System' or 'Gute Klasse' water quality I, II, III and IV (Liebman, 1951, 1959, 1960, 1962). Kolkwitz and Marsson's Saprobien Systme is based on the observation that in the course of the self-purification process, an evenly running stream shows distinct zones of decreasing pollution (improved water quality). These zones are termed polysaprobic (grossly polluted), alpha-mesosaprobic, beta-mesosaprobic and oligosaprobic. Each zone is characterized by its content of oxygen, organic matter, products of septic decay, and products of mineralization. Biologically each zone affords optimal conditions for certain species and communities of organisms which are called 'indicator organisms'. The occurrence of organisms, at various degrees of pollution is mainly governed by oxygen content, ammonia, sulphides and available food supply. Studies on aquatic biology and limnology, mainly ecological and physiological, can be applied to biological monitoring of water pollution.

The saprobiety system or its modified form of water quality system developed in the Central Europe has yielded good results in Germany. This system should be of use in other countries also; above all in those with different climatic conditions and geographical distribution of particular indicator organism. Furthermore, the ecological potentialities of 'indicator organism' under different climatic conditions need be determind to asertain if these potentialities are the same all over the world. Studies were conducted at our Institute to investigate the geographical distribution of indicator organisms under Indian conditions. Preliminary results, both on the biogeography and autoecology of the organisms in Central Europe and in India and application of these organisms or the biocoenosis and association found by groups of them as indicators for various degrees of water pollution, are dealt in detail by Bick, Krishnamoorthi and Lakshminarayana (1967).

The work was extended at Nagpur :

(1) to ascertain the limit of applicability of Saprobien System by biological and chemical investigations, and

(2) to experimentally ascertain the ecological valencies of ciliate protozoan population (one of the major 'biological indicator' groups). The work included field and experimental studies, extending over a period of several years. The data also include the autoecological experimental studies with reference to the ciliate protozoa.

The above background information gives the scope and object of the present communication. It is proposed to present the data collected on the ecological potentialities of ciliate protozoa in the laboratory condition, representing different degrees of pollution during the decomposition of peptone, glucose, cellulose, synthetic sewage and sterilized raw sewage. Physical and chemical conditions and the succession of various biotic forms have been studied in detail both qualitatively and quantitatively. Observations were made on different water bodies at Nagpur with varying degrees of pollution. Attention was paid to ecological valency of the dominant species of ciliate protozoa featuring in each type of succession, based on the experimental and field data. Indicator organisms for varying degrees of pollution are listed.

MATERIALS AND METHODS

The various water bodies at Nagpur were visited once a fortnight or once a month and samples were collected for (a) epibiota, (b) endobiota, (c) associations, and (d) bottom fauna and biocoenosis. The plankton was collected using plankton-bolting silk net of 200 mesh and the bottom fauna using an Ekman dredge. For the phytoplankton, algae and diatom, the samples were collected as such. Two samples each were collected—one for qualitative and other for quantitative analysis. The samples were immediately transported to the laboratory for qualitative examination. For the quantitative examination the samples were preserved in 4% formalin and Lugol's iodine, and analysed by "Sedwick Rafter Cell Method", using Utermohl's plankton inverted miscrope. For the bottom fauna, the bottom material was seived through international seive No. 30 and the quantitative enumeration carried out using a Stereoscopic binocular. Detailed studies of Periphyton (Aufuchs) done at the stabilization ponds will be reported separately.

Simultaneously, water samples were collected for physical and chemical analysis, such as temperature, *p*H, dissolved oxygen, free CO_2, ammonia, phosphates, oxygen-absorbed test, and biochemical oxygen demand (20^0 C). For the chemical analysis of the water samples, procedure laid down in the *Standard Methods for the Examination of Water and Wastewater* (11th Ed.), was followed.

Laboratory experiments with the decomposition of peptone represent very good models of natural water bodies undergoing organic decomposition. The studies were aimed at :

(a) Succession of ciliates during decomposition of organic materials,
(b) Assessment of ecological valency of ciliates with regard to ammonia content and oxygen level and above all the upper limits of ammonia tolerance, and
(c) The 'indicator value' of ciliates, based on the environmental factors listed above, and *p*H and CO_2 levels.

The experiments were conducted in 20 litre glass aquaria filled completely with distilled water, and aerated for a period of 24 hr. Bactopeptone was added in varying quantities (250 mg/l, 500 mg/l, 750 mg/l, 1000 mg/l, 1250 mg/l, 1500 mg/l and 2500 mg/l).

In order to study the ecological tolerance of the ciliates, at increased ammonia levels, additional quantities of peptone (250 and 500 mg/l) were added into the aquaria at regular intervals. Several sets of experiments were conducted (room temperature 20° to 22°C and 31° to 33°C). After the addition of peptone a natural inoculum consisting of mixed population of a wide variety of organisms collected from the water bodies in the vicinity of campus was inoculated to each aquarium (500 ml of the inoculum for each aquaria). The series of aquaria had an illumination system of Osram 65 W/15, and Philips TL 65 W/29 table lights, 4' two each and the total illumination approximately corresponded to 5000 lux units.

Counts of the ciliates were made at 24 hr interval. But during the beginning of the experiment, and at the time of further addition of peptone, counts were made twice a day, using a 0·5 ml Kolkwitz's plankton chamber with Lugol's iodine as fixative. Separate counts were made for surface and bottom of each aquaria. In addition to the above counts chemical analysis of the surface and bottom water samples of the aquaria was done every day, for determining dissolved oxygen, ammonia content, *p*H and free CO_2. Both biological and chemical investigations were continued for at least 4 to 5 weeks or till such time as the autotrophic organisms made their appearance.

Besides peptone, experiments were also done using cellulose, a mixture of peptone and cellulose, glucose, sterilized synthetic sewage and sterilized raw sewage. The synthetic sewage used had the composition as follows: Glucose, 15 g; K_2HPO_4, 10.75g; $(NH_4)_3PO_4$, 10.75 g; NaCI, 1.5 g; $MgSO_4$, 1.5 g; $FeCl_3$, 0.3 g; and Nutrient broth, 1860 ml. All the ingredients were dissolved in 80 litres of distilled water.

OBSERVATIONS

Two oligotrophic reservoirs (Ambazari and Gorewara reservoirs) were among the different natural water bodies for which sampling was carried out for biocoenosis, micro- and macrofauna including the benthic forms, which serve as raw water sources for the city of Nagpur. Two small tanks in Ramtek (30 miles away from Nagpur, the Baki tank and Sindoarbowli tank), Gandhisagar Phutala tank and Sakradhara tank are either alpha or beta mesosaprobic in nature. The Sangam Puddle and the thirteen sampling points in the 19 km stretch of Nagnalla running across the city carrying domestic sewage, textile mill waste represent polysaprobic, mesosaprobic and oligosaprobic conditions in the different sampling points.

Ten sampling points with pollution status varying from oligosaprobic to betamesosaprobic, along the Kanhan river stretching up to 14 km were chosen as a part of the river survey programme. This river is the principal source of water supply to Nagpur. Among the sewage treatment plants the Stabilization Ponds at the Institute campus have been studied in detail representing alpha to beta mesosaprobic level.

For the sake of classification various zones of pollution are classified based on the chemical character and occurrence of biological indicator organisms as follows :

(a) *Polysaprobic zone* (gross pollution)—Characterized by heavy pollution with sewage or other organic material, mass development of bacteria which are involved in the decomposition process, high rate of oxygen consumption, practically no dissolved oxygen, high content of ammonia, production of methane and hydrogen sulphide, and no mineralization.

(b) *Betamesosaprobic zone*—High dissolved oxygen, low oxygen consumption, mineralization of organic material and high amounts of end products of mineralization, e.g. nitrates.

(c) *Alpha mesosaprobic zone*—Characterized by vigorous oxidation process, increased dissolved oxygen, oxygen consumption still high, oxidation of ammonia starts.

(d) *Oligosaprobic*—Mineralization is complete, the dissolved oxygen content is high and the oxygen consumption is practically zero.

The term animal indicator organism includes, protozoa and metazoa (Rotifer, Oligochaete, Insect and Mollusca). Above all ciliates are involved in the Saprobic System and more than 50 per cent of the indicator organisms of the highly polluted zones are ciliates. Owing to this reason attention was paid to ciliate population.

Tables I a, b, c indicate the organism concept with reference to various degrees of pollution. This has been done after exhaustive repeated qualitative and quantitative data obtained from the water bodies mentioned earlier. The data have also been compared with the results obtained at the Central Europe.

TABLE I a

Saprobien classification of organisms (Source: Poly saprobic organisms)

Organisms	Remarks
PROTOZOA	
Vahlkampfia limex Dujardin	Abundant in NN, SP and MB*
Euglena viridis Ehrenberg	SP Not very common
Caenomorpha medusala Perty	AP and MB Rare
Colpidium colpoda Ehrenberg	MB, SP and NN Abundant
Colpidium campylum Ehrenberg	MB, SP and NN
Glaucoma scintillans Ehrenberg	NN, MB and SP very common
Metopus spiralis Muller	MB occasionally present
Paramecium putrinum Clap & Lachm	NN, MB and SP very common
Tetrahymena pyriformis Ehrenberg	NN common
Vorticella microstomum Ehrenberg	NN common
ROTIFERA	
Rotaria rotatoria Ehrenberg	MB and NN Abundant SP common
OLICOCHAETA	
Limnodrilus hoffmeisteri	MB Abundant NN and SP common
Branchiura sowerbyi	MB, NN and SP common
INSECTA	
Chironomustentans	MB, NN and SP abundant
Eristalia tenax Line	MB, NN and SP common

* *MB*, Maharajbag nullah ; *NN*, Nagnullah ; *SP*, Sangam puddle

TABLE I b

Saprobien classification of organisms (Source: Meso saprobic organisms)

Organisms	Remarks
(a) mesosaprobic	
PROTOZOA	
Chilomonas peramecium	OP rarely*
Aspidisca costata	OP and OYP abundant
Carchesium polypinum	JT and OP
Chilodonella uncineta	OP and ST
Chilodonella cucullulus	OP and JT
Cyclidium citrallus	OP common
Lionotus fasciola	JT
Paramecium bursaria	Peptone experiments
Paramecium caudatum	OP, JT and ST
Spirostomum ambiguum	JT
Stentor coeruleus	OP, JT and ST rare
Vorticella convallaria	OP abundant JT common
HIRUDINLA	
Erpobdella octoculata	JT rare
(b) mesosaprobic	
PROTOZOA	
Amoeba proteus	OP, JT and PT
Amoeba radiosa	OP common
Euglypha olveolata	OP and OTP
Colopa hirtus	OP common
Didinium nasutum	OP common
Euplotes effinis	OP, JT and OTP
Halteria grandinella	OP abundant
Paremecium bursaria	OP, ST and Peptone experi.
Vorticella compapula	OP and PT
ROTIFERA	
Brachionus urceolaris	OP

* *JT;* Jumme Tank; *OP*, Oxidation Pond; *OTP*, other treatment plants; *PT*, Phutale Tank, *St*, Sakaradhra Tank.

TABLE I c

Saprobien classification of organisms (Source: Oligosaprobic organisms)

Organisms	Remarks
PROTOZOA	
Dileptes Anser Muller	AR and GR*
Prontonia accuminata	AR rare
Prorodon teres	AR
Strobilidium gyrans	AR and GR
ROTIFERA	
Notholca longispina	KR

* *AR*, Ambazari Reservoir; *GR*, Girewara Tank; *KR*, Kanhan River

TABLE II

Nature of analysis	Kanhan River at water works	Gorewara tank	Ambazari tank	Jumma tank	Sakaradhara tank	Maharaj bag nala	Nag nala	Oxidation pond
Turbidity	170	10	10	50	30	50	10-600	
*p*H	7·8	8·0	8·0	8·1	7·9	7·8	7-8·9	7-8·9
Total alkalinity (as $CaCO_3$)	200	145	109	510	200	360	100-700	250-350
Total Hardness	160	120	100	300	300	296	150-500	250-350
Chlorides (as C 1)	15	10	10	122	45	60	10-250	50-120
Oxygen consumed (4 hr test)	0·5	0·5	0·5	50	30	50	5-40	15-50
Dissolved oxygen	7·8	7·0	8·0	0-12·8		70-1	0-8	0·19
Biochemical oxygen demand	5	10	5	60	50	50-80	350-600	15-250

All values are expressed in parts per million except. *p*H Average values for over a year

TABLE III

Quantity of peptone (mg/1)	250	750	1000	1250	1500	1750	2500
Dissolved oxygen Range mg/1	0–14·3	0–13·4	0–6·4	0–4·8	0–2·8	0	0
CO_2 maximum mg/1	33·2	93	109	125	132	159	235
NH_4 maximum mg/1	28	115	125	165	175	240	300
Colpidium campylum	10000	90000	34000	40000	70000	76000	25000
Glaucoma scintillans	18000	34000	20000	23000	12000	18000	4000
Tetrahymena pyriformis	7000	10000	10000	8000	8000	7000	1500
Vorticella microstoma	100	370	1000	3000	1000	3000	+
Chilodonella uncinata	60	10	20	300	+	+	+
Chilodonella cucullulus	38	4	30	130	+	+	+
Colpoda steini	—	—	—	—	+	+	8000

The maximal individual counts of ciliates per ml
+ means the occurrence of a few individuals only

Table II gives analysis of various chemical parameters in different water bodies earlier. Chemical data collected were correlated with the biological data.

Tables IV and V indicate the benthic forms and the chemical and quantitative analysis of various factors of the bottom deposits from different water bodies with varying degrees of pollution.

TABLE IV

Physical and chemical analysis of bottom sediments

Bottom Sediment	Ambazari (potable water)	Sakardhara (medium polluted)	Gandhi Sagar (medium polluted)	Maharajbag (grossly polluted)
(1) Temperature	29·5°C	28·1°C	29·1°C	28·5°C
(2) Colour	Brown soily red	Blackish brown	Black (always showing presence of H_2S and CH_4)	Black
(3) Loss of H_2O (at 15°C)	28·29%	61·5%	61·24%	73·2%
(4) Volatile matter	2·67%	9·2%	12·93%	25·2%
(5) Total solids	71·80%	38·5%	38·76%	26·8%
(6) *p*H	8	8	8·3	8·1
(7) Alkalinity	125 ppm	155 ppm	390 ppm	350 ppm
(8) Free Ammonia	0·0466%	0·112%	0·256%	0·117%
(9) Organic nitrogen	0·0938%	0·139%	0·161%	0·683%
(10) Total nitrogen*	0·130%	0·251%	0·417%	0·800%
(11) Phosphorus* as P_2O_5	0·204%	0·438%	0·365%	0·523%
(12) Potassium	0·131%	0·243%	0·278%	0·258%
(13) Sulphates*	0·515%	0·603%	0·63%	0·14%
(14) Calcium*	3·22%	4·4%	5·63%	10·45%

* Values expressed on dry weight basis

Valuable information was obtained from experimental data on the decomposition of peptone, cellulose, glucose, sewage, etc., and the succession of the ciliate population during such decomposition. These experiments represented model studies on self-purification process of polluted water, with materials like peptone, sewage, cellulose, and glucose serving as decomposing organic materials. These experiments gave information on the ecological tolerance of ciliates concerned.

Peptone during decomposition showed generally more or less high qualities of NH_4, high *p*H level and lack of oxygen for varying periods. Under this rigorous environmental conditions, only a few ciliates occur although their number is high. Species and individual counts of ciliates were higher at the surface than at the bottom, obviously because of lack of oxygen at the bottom during early periods of the experiments. *Colpidium campylum*, *Glaucoma scintillans* and

TABLE V

Biological record of macrofauna from bottom sediment

Stations	Limnodrilus hoffmeisteri		Branchiura sowerbi		Eristylis sp.		Chironomus		Vivipara dissamills		Vivipara bengalensis		Malanidae		Bivalves	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Ambazari** (Potable Water Reservoir)	—	—	—	—	—	—	—	—	16*	32	8		16		4	28
Sakardhara (Medium polluted tank)	—		—		—		—		16	36	—		—		—	
Maharajbagh (grossly polluted place)	4,096	50,592	1		16	32	96	169	—		—		—		—	

* Values expressed are individuals per square foot of sample

** In all the samples from Ambazari, only dead sheels of Molluscs were recorded

Tetrahymane pyriformis were dominant in the initial stages. Later, ciliates, such as *Chilodonella cucullulus, Chilodonella uncinata, Paramecium bursaria, Paramecium caudatum, Paramecium trichium* and *Vorticella microstoma* appeared. During the course of decomposition of peptone, the number of species was very limited, whereas the individual count was rather high. In most of the experiments only *Colpidium campylum, Glaucoma scintillans* and *Vorticella microstoma* were recorded with high individual numbers. Another important point would be that the decomposition of peptone occurs rather rapidly resulting in the depletion of nutrient material at a very early stage. Therefore, the ciliate population is rather high in the beginning. The dominant ciliates in the peptone experiment comprised of polysaprobic and alpha mesosaprobic species which are able to tolerate high ammonia content, high *p*H level, as well as very low dissolved oxygen content.

Table III summarizes the main chemical data of the peptone experimental series, and also indicates the ciliates occurring in each experimental set up. From the table it is seen that the *Colpidium campylum* and *Glaucoma scintillans* are of high incidence. The individual counts of *Tetrahymena pyriformis* is somewhat lower. It is seen that at higher concentration this species occurs only in the early days of the experiments. Conditions for the development of *Vorticella microstoma* proved optimal in the middle of the dilution period. *Colpoda steini* showed mass development only in the highest concentration of peptone. Both *Chilodonella cucullulus* and *Chilodonella uncinata* thrived best in the lower concentration. From the table it is evident that high amounts of NH_4 and CO_2 and low levels of O_2 are no impediment to the development and survival of *Colpidium campylum*, and *Glaucoma scintillans*. This confirms the status of these two ciliates as 'biological indicators of polysaprobic' conditions. On the other hand *Tetrahymena pyriformis* and *Vorticella microstoma* are unable to develop throughout the range of environmental conditions probably hampered by the very high NH_4 content. Three species of *Paramecium* were recorded in succession, viz. *Paramecium bursaria, Paramecium caudatum,* and *Paramecium trichium* with high ammonia level. However, both *Paramecium caudatum*, and *Paramecium trichium* would not thrive at higher concentrations of peptone. *Paramecium bursaria* could tolerate and survive at higher concentrations of ammonia level and therefore this species is regarded as 'alpha-mesosaprobic indicator'. This finding is in agreement with the observations of Bick (1968). At higher concentration of peptone (2500 mg/l) during the second week mass development of *Colpoda steini* was observed, but then it disappeared after a few days. This observation is of considerable interest since this species was not observed at lower concentration and only few individuals occurred. Perhaps comparatively low competition for food at higher peptone concentration had disabled this species to develop in large number. This observation is also in agreement with the earlier observation by Bick (1964). It was found that the decomposition of cellulose and the succession of ciliate protozoa associated with was rather slow in comparison with sewage or peptone. The number of species of ciliates during decomposition of cellulose was higher than that with peptone. At the same time the individual counts were low. Experiments done with a mixture of peptone and cellulose gave comparatively more number of species with less individual counts. The succession of the organisms took place more slowly, due to the fact that the nutrients were available for longer durations as a result of slow decomposition of cellulose. On the contrary, the decomposition of peptone and sewage was rather rapid, resulting in quicker depletion of nutrient supply. The species most frequently associated with the cellulose and peptone decomposition are: *Chilodonella uncinata*, *Glaucoma pyriformis*, *Halteria grandinella*, *Lionotus lamella*, *Paramecium caudatum*, *Stylonychia putrina* and *Tetrahymena pyriformis.*

Discussion

The classic ecological method for the assessment of water quality is the 'Saprobien System' or the 'indicator organism' (Kolkwitz & Marsson, 1908, 1909 and Kolkwitz 1935, 1950). In fact, it is this foundation that enabled many workers later to improve upon this technique. Biologically, according to this system each zone of pollution affords optimum ecological conditions for certain species and communities of organisms called the indicator organism. This system has some validity but in recent years it has been subjected to much criticism. The criticism was mainly directed against the placing of certain organisms in the particular zone and classifying all the genus and species to different degrees of pollution. It is not possible to base the assessment of pollution on mere qualitative data (Bick, 1963). Therefore, the later workers have suggested that the whole animal and plant community in a water body must be taken into consideration and ecological data must be supplemented with chemical data (Liebmann, 1951-1959). In fact, the modern approach is to determine the physiological trends of the organisms met with various polluted zones. The laboratory experiments with peptone as the decomposing material have been useful in demonstrating the ecological valencies of the saprobic organisms. The saprobiety originally dealt with only sewage, but Liebmann, later on extended its use to waters in which the source of pollution was industrial wastes in addition to sewage. Secondly, the system was originally applied to slow-moving streams and it has been subsequently extended to static waters as well as other reservoirs receiving organic and inorganic wastes. In our present collection, water bodies of flowing and static nature have been chosen as the sampling stations. Application of saprobiety system to organic waste exposed to bacterial decomposition causes no difficulty, but the case is different with inorganic wastes, particularly the toxic ones (Hynes, 1960).

In the indicator organism concept, there are, however, certain lacunae with regard to fuller understanding of the ecological valencies of the organisms in question. These lacunae, which to a certain extent, were studied during decomposition experiments with peptone, glucose, cellulose, synthetic sewage and the succession of the ciliates in detail both in India and in Germany (Krishnamoorthi & Bick, 1966 a, b; Krishnamoorthi, 1969; and Bick, Krishnamoorthi & Lakshminarayana, 1967;

Bick, 1957; 1960; 1963; 1964; 1968), have given a clear insight into the autoecology of the ciliate and the biological indicator of polysaprobic and alpha and beta mesosaprobic ciliates. Results obtained in Germany and in India bear parallelism. The need for ascertaining real ecological valencies of the organism has been stressed by several workers (Bick, 1963; Sladecek, 1965). The present work was to gather data on the geographical distribution of particular indicator organism and it was also extended by the authors to investigate ecological valencies and potentialities of ciliates under tropical conditions different zones of pollution.

Although it has been shown by Kolkwitz and Marsson that all micro- and macrofauna can be classified under the category of indicator-organisms, however, we feel that the reliability of this method could be achieved only by examining the groups like ciliates, oligochaetes, the aquatic insect larvae and some molluscs. The other micro- and macrofauna do not seem to have any significance in this type of study.

Although information on the autoecology and saprobic nature of different organisms was not fully available, but the data available and our own studies show that the saprobiety system is valid under Indian conditions, because of cosmopolitan distribution of micro- and macrofauna. For preliminary findings concerning the potentialities of European Saprobien System for monitoring water quality under tropical conditions in India, reference may be made to the document by Bick, Krishnamoorthi and Lakshminarayana (1967).

The macro benthic fauna such as *Chironomus tendepediformis* and *C. tentans* (blood worms), rat tail maggot (Eristalis) were found to be associated with rich organic pollution and they can be designated as poly saprobic (alpha or beta) indicator. *Chironomus tentans* is more organic pollutant than *Chironomus tendepediformis*. Mass development of these forms causes putrefaction of matter, bottom of oxidation pond, sewage drains, bottom of eutrophic lakes and the ponds and lake mud with putrecible organic material. The same observation holds good for the oligochaetes like *Limnodrilus hoffmeisteri*. In addition to this form another tubificid which occurs in large numbers and is a rich organic pollutant is *Branchiurs sowerbi*. Further work on these lines is in progress.

Acknowledgements

The senior author is much thankful to Professor Dr Hartmut Bick, of Zoologischen Institut der Universitat Bonn, Federal Republic of Germany, for constant guidance and encouragement and, for providing necessary facilities for training to carry out this work under Indian conditions. Thanks are also due to the World Health Organization, Geneva, for financial support for undertaking work at Germany.

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