

Results of the Austrian-Ceylonese Hydrobiological Mission 1970 of the 1st Zoological Institute of the University of Vienna (Austria) and the Department of Zoology of the Vidyalankara University of Ceylon, Kelaniya

PART I.—Preliminary Report : INTRODUCTION AND DESCRIPTION OF THE STATIONS

By

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1. INTRODUCTION

The study of the biology and ecology of the flowing water systems such as springs, brooks, torrents, rivers and streams has progressed immensely in the last few decades. However, in view of the ever increasing pollution of the inland waters by industrial pollutants and by domestic sewage, the investigations of the natural, still unaffected, water systems have become more and more difficult. Primarily in Europe, North-America, but sporadically also in Asia, Africa, Australia and South-America the brook and river systems have been investigated as to their fauna and flora (see : ILLIES and BOTOSANEANU, 1963 and HYNES, 1970). The results of this basic research enable us to establish an ecological classification of the plants and animals living in the water systems. This fact has gained in practical importance in the past few years owing to the ever increasing pollution of freshwaters.

In contrast to those in the temperate zones, relatively few tropical flowing water systems have been investigated systematically. In South-America specially the Amazon River-system has been investigated by the Department of Tropical Ecology, Max Planck Institute of Limnology in Plön (Western Germany). The results of these have been published by FITTKAU, 1953, SCHUBART, 1953, GESSNER 1960, 1961 and 1965, ILLIES 1964, FITTKAU and al, 1968/69 and others. Investigations have also been carried out in the tropical parts of Africa (MARLIER, 1947, HYNES and WILLIAMS, 1962)¹ in Malaysia (JOHNSON, 1957) and in India (HORA, 1923, 1928, 1930 and 1936, CHACKO and GANAPATI, 1952). The 1st Zoological Institute of the University of Vienna has been conducting collections and investigations in mountain brooks and rivers of isolated tropical islands in the area of the Indo-Pacific since 1958. In such mountain brooks ecosystems largely nearly unaffected by man—have been able to develop over geologically long periods. In such isolated water systems, sometimes relict forms have been able to survive which now give information about the former distribution as well as the geological structure. In 1958, the investigation of the mountain-and jungle brooks and rivers of Madagascar (STARMÜHLNER, 1962, 1969) took place.

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This was followed in 1965 by the investigation of the streams of New Caledonia in the Southwest Pacific (STARMÜHLNER, 1968, 1970). The results of these studies have largely been published already (refer inter alia to "Memoirs de l'Institut Scientifique de Madagascar, Ser. A." and "Cahiers de l'Office Recherches Scientifique et Technique Outre Mer (ORSTOM), Ser. Hydrobiologie"); thus comparisons are already possible with results from tropical flowing water systems of other regions.

The main incentive for this Study came from the results of the investigations in Madagascar, as they have shown numerous bonds of the prevailing insular fauna to the oriental fauna, above all to Ceylon and South-India (suggesting similar investigations in the old precambrian mountain blocks of the Southwest Ceylon). During a short stay of Professor F. STARMÜHLNER, for marine-biological studies, in Colombo in January 1968, and after a discussion with the head of the Department of Zoology of the Vidyalankara University of Ceylon in Kelaniya, Professor Dr. H. H. COSTA, plans were developed for a common study of the fauna and the ecology of the mountain and jungle brooks and streams of Southwest Ceylon.

Up to date, the investigations of the freshwater fauna of Ceylon have been mainly conducted by the Fisheries Research Station of the Department of Fisheries in Colombo, where naturally the most important investigations have been carried out on freshwater fishes. MENDIS and FERNANDO, 1962 published "A Guide to the Freshwater Fauna of Ceylon" which FERNANDO supplemented in 1964. In both monographs, numerous literature references are contained about the systematics of the freshwater animal species. COSTA and FERNANDO, 1967 studied the meso- and macrofauna in a small mountainous stream near Kandy and GEISLER, 1967 has made some limnological and ichthyological studies in streams in the hill country of Southwest Ceylon. In 1962, the University of Lund (Sweden), carried out extensive collections in Ceylon, including also inland waters. The first results of this mission were published by ENCKELL, 1970, BOTT, 1970, BRINCK and al. 1971. Further Reports are to be expected. The Austrian-Ceylonese Hydrobiological Mission lasted from November 1970 until beginning of January 1971. The participants were—beside both authors—Mrs. Edith STARMÜHLNER (who carried out the chemical analyses of the water samples on the site of the collection) and Dr. Günther WENINGER who took water samples to Vienna for subsequent chemical analyses; he also studied the drifts of the torrents and rivers and collected the Algae.

A total of 36 flowing water systems, the majority of them in the mountainous region of Southwest Ceylon were investigated, and more than 200 animal and plant samples were collected. They were chosen from the brook and river banks to the strongest currents in the cascades of the torrents. Apart from these, 38 water samples of 1 liter each were collected and analysed in the laboratory of Dr. WENINGER in Vienna. Three samples were collected subsequently by Dr. Alfred Radda and Prof. Dr. H. H. Costa from sites of collections in the Sinharaja mountains and sent to the laboratory of Dr. Weninger in Vienna in August 1971. Our mission collected samples in 6 different spots of Southwestern highlands of Ceylon (Fig. 1):

1. Region of Deniyaya (Sinharaja-Forest)
 - 1.1. Tributaries of the Gin-Ganga and
 - 1.2. Tributaries of the Nilwala-Ganga.
2. Region of Ratnapura
 - 2.1. Tributaries and Kalu-Ganga.

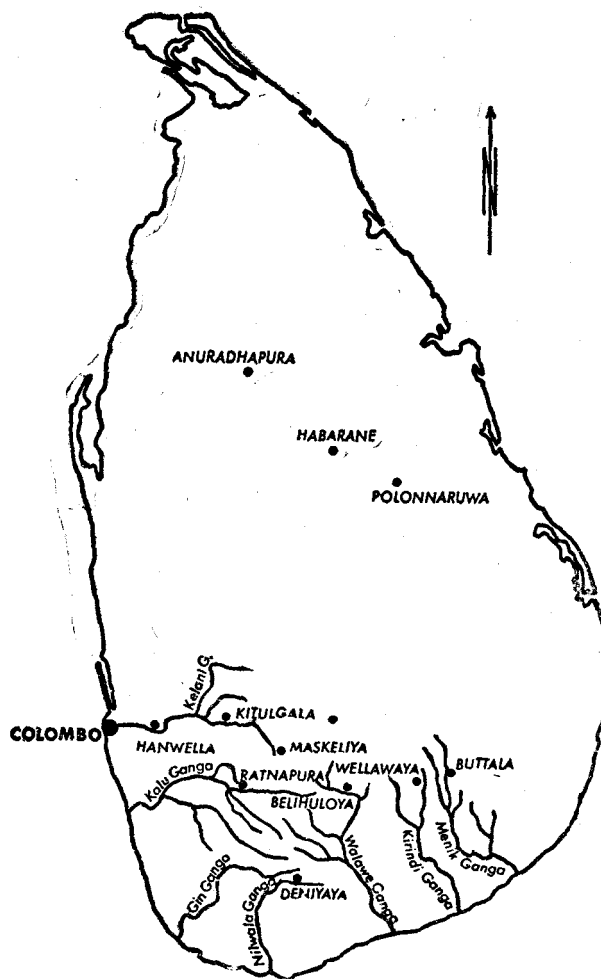


Fig. I Map of Ceylon indicating the rivers and the sampling areas

3. Region of Maskeliya
 - 3.1. Tributaries of the Maskeliya-barrage.
4. Region of Nuwara Eliya
 - 4.1. Hakgala-Dola and Nuwara-Eliya-Dola
5. Region of Belihuloya-Buttala
 - 5.1. Tributaries of the Wallawe-Ganga
 - 5.2. Tributaries of the Menik-Ganga
 - 5.3. Tributaries of the Kirindi-Ganga
 - 5.4. We-Ganga (a tributary of Kalu-Ganga) (see also 2.1).
6. Region of Kitulgala
 - 6.1. Tributaries and main river of the Kelani-Ganga.
7. Region of Anuradhapura and Polonnaruwa (Central and North-Ceylon)—only collections of freshwater-molluscs.

2. METHODS

The animal specimens were collected qualitatively and quantitatively. Usually the following partial biotopes were investigated at each site of collection : (a) bank : a.1 inhabitants on the surface of the water (nekton), a.2 inhabitants of the bottom or ground, on sand and mud, as well as plant material (debris) that had been washed from land. (b) sections and regions of the medium to strong current (between 30 and 75 cm/sec) with gravel bottom and with sandy spots in between ; (c) cascades in the area of strong current (more than 1m/sec.) with boulders and granitic rocks on the bottom ; (d) pools, i.e., mostly deeper grooves with slight current (0-30 cm/sec), lying between cascades—where the inhabitants are the same as in the bank regions.

The freely swimming or crawling species such as fishes, crabs and shrimps and also the plants and the drift were collected separately.

The qualitative collections were made by means of a wiremesh sieve (mesh-width : 0.5mm.) with mud, sand and finer gravel soil, whereas on larger pebbles and boulders the collections were made—after having removed the stones with tweezers—into a plastic dish or else into a catcher. Collections from rocks were made exclusively with forceps only. Regarding the quantitative collections, as a rule stones from a ground of $1/16\text{m}^2$ (squares of 25 cm. length) were taken and the collections were then poured into plastic dishes, the remaining dredges were sieved. Apart from that, also with qualitative samples the density of population of the most frequent animal species was determined per 1dm^2 or $1/16$ square meter. The animals were conserved in 75% alcohol; fishes, frogs and tadpoles, also algae, higher waterplants were preserved in 4% formol. Turbellaria rarely Oligochaeta and Molluscs were fixed in BOUIN's liquid for subsequent histological examination. The separation of the animal specimens took place in the laboratory of the 1st Zoological Institute of Vienna. Consequently the specimens were handed over to various experts and specialists for exact determinations :

Algae : M. BOURRELLY (Paris)

Turbellaria : P. de BEAUCHAMP (Paris)

Oligochaeta : R. O. BRINKHURST (Toronto)

Hirudinea : P. H. D. H. de SILVA (Colombo)

Hydracarina : O. VIETS (Wilhelmshaven)

Ephemerida :

Baetidae : I. MÜLLER-LIEBENAU (Plon)

Other groups : W. L. PETERS and G. F. EDMUNDS jun. (Utah)

Plecoptera : P. ZWICK (Schlitz)

Odonata : M. A. LIEFTINCK (Rhenen) and D. ST. QUENTIN (Wien)

Trichoptera : H. MALICKI (Lunz a. See)

—Coleoptera :

Dytiscidae : G. WEWALKA (Wien)

Hydrophilidae : P. J. SPANGLER (Washington)

Gyrinidae : H. P. BRINCK (Lund)

Dryopidae, Elminthidae : M. J. DELEVE (Brussel)

Limnecidae : H. PAULUS (Wien)

- Larvae of water-beetles : H. BERTRAND (Paris)
- Hemiptera : J. T. POLHEMUS (Englewood)
- Diptera :
- Simuliidae : H. P. GRENIER (Paris)
- Blepharoceridae : A. STUCKENBERG (Pietermaritzburg)
- Chironomidae : E. J. FITTKAU (Plön)
- Tipulidae : Br. THEOWALD (Amsterdam)
- Culicidae : A. G. U. MENON (Trivandrum)
- Ceratopogonidae : N. GERTZ (Schlitz)
- Dolichopodidae : C. E. DYTE (Datchet, Bucks)
- Acalyprata : R. A. HARRISON (Auckland)
- Stratiomyidae : E. LINDNER (Stuttgart)
- Mollusca : F. STARMÜHLNER (Wien)
- Crustacea :
- Brachyura : G. PRETZMANN (Wien)
- Decapoda Caridea : H. H. COSTA (Colombo)
- Pisces : A. RADDA (Wien)
- Anura and Reptilia : P. van den ELZEN (Wien).

The detailed results of these determinations and investigations on the collected material as well as a summary and ecological analysis of all the results will be published in informal sequence in this periodical, under a common heading.

The speeds of the currents of the facial waters were measured with floating corks, for a given distance of the brook or stream, together with the time-taken by means of a stop watch (values in cm. or m. per second). The water temperature was determined during the collection at hourly intervals with a scooping thermometer (ranging up to +35° centigrade and, divided into tenths of centigrade). At the site of collection, the pH was determined by means of MERCK's Indicator sticks (MERCK, Darmstadt) ; the total hardness was roughly determined by means of Aquamerck tablets and indicator solution in German Hardness degrees (°dH). 1°dH=1'25° English Hardness degrees=1'79° French Hardness degree. For the determination of pH, 1 liter of each sample was taken into the field laboratory for determination by the electric SEIBOLD pH-meter. Also the alkalinity, as well the total Hardness and carbonate Hardness were measured exactly in the field laboratory. Furthermore, a Normameter with ear-phones was used for determining the electrolytic conductivity of the water samples. Of each specimen sample, a second, identical sample was taken from each site of collection for the laboratory at Vienna, where our associate, Dr. G. Weninger conducted accurate chemical analysis. Dr. Weninger's results of his chemical studies will be published separately in this periodical.

4. DESCRIPTION OF THE STATIONS

1. Region of Deniyaya

1.1 : TRIBUTARIES OF THE GIN-GANGA :

FC 1 : 9.11.1970 : Meda-Dola in the Sinharaja-Forest, torrent running through primary rain-forest, shady.

Alt. : 1000 m.	Che.: pH : 5'8
Br. : 3-6 m.	Tot. H.: 1'5° dH
D. : 5-15 cm.	Ca.H. : 0'84°dH
Curr. : 30-75 cm./sec.	CaO : 2 mg./l
Gr. : granitic rocks, on the banks : sand and washed vegetable debris on the bank	Alk. : 0'3 mval.
Te. : 20'2°C(11 ^h).	

a : bank : on the surface and on the sandy ground : Veliidae, Gerridae, Notonectidae, larvae of Odonata, larvae of *Rhabdoblatta* sp.. **b : under stones near the banks** : Ephemera-larvae, *Neoperla* s., *Euphaea splendens* (2-3/dm²), *Eubrianax* sp. (1/dm²), **c : under stones in the current of 50-75 cm./sec.** : *Neoperla* sp. (1/dm²), *Euphaea splendens* (2-3/dm²), Hydropsychidae-larvae (2-3/dm²) Leptoceridae-larvae, *Eubrianax* sp. (1/dm²), *Ordobrevia fletcheri*, *Ilamelmis foveicollis*, *Ilamelmis brunnescens*, *Zaitzevaria bicolor*. **d** : fishes. **e** : *Paratelphusa* sp. **f** : Algae from the stones.

FC 2 : 9.11.1970 : Bungalow at Campden Hill, Deniyaya : Adult Odonata : *Drepanosticta* spec. nov. (larvae probably in the torrents of the region).

FC 3 : 10.11.1970 : HOLA-DOLA, torrent coming from the Sinharaja-Forest and running through tea-plantations in cascades, no shadow (Fig. 2).

Alt. : 700 m.	Te.: cascades : 21'1°C (9 ³⁰)
Br. : 5-8 m.	21'7°C (12 ^h)
D. : 5-30 cm.	banks : 21'5°C (9 ³⁰)
Curr. : 75cm./sec.-1m./sec.	22'2°C (12 ^h)
Gr. : granitic rocks, boulders and sand on the banks	Che.: pH : 5'8
	Alk : 0'1 mval
	Tot. H. : 0'25°dH
	Ca. H. : 0'28°dH
	CaO : 2 mg./l

a : bank : on the surface and on the sandy ground : Veliidae, Gerridae, Micronectidae, Ephemera-larvae, Tipulidae-larvae, Zygoptera-larvae. **b : under stones in the stronger current, cascades** : Ephemera-larvae, *Neoperla* sp., *Euphaea splendens*, *Eubrianax* sp., *Podelmis quadriplagiata* *Dugesia* sp. **c** : Algae from stones in the cascades. **d** : fishes : *Garra ceylonensis*, *Noemacheilus notostigma*. **e** : *Paratelphusa rugosa*. **f** : quantitative sample from 1/16m.² boulders. **g** : adult Odonata from the border : *Neurobasis c. chinensis*, *Euphaea splendens*.



Fig. 2 FC 3: HOLA DOLA

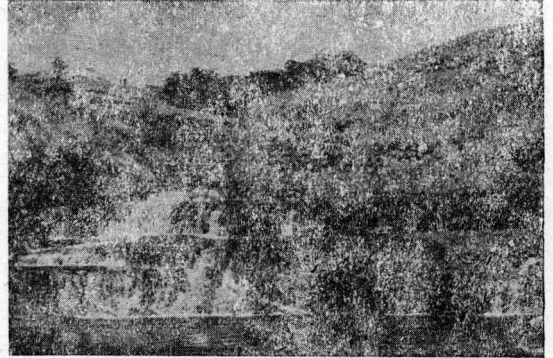


Fig. 3 FC 4: PASUMALE DOLA



Fig. 4 FC 6: KAIWEL DOLA

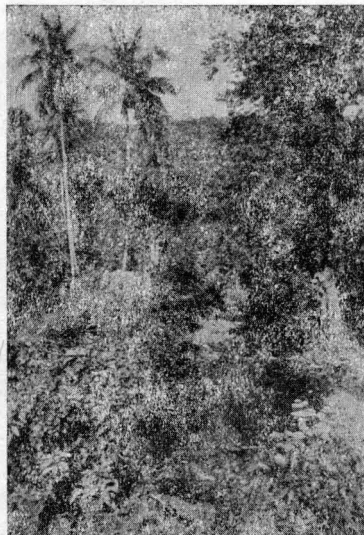


Fig. 5 FC 8: NAGHAKETA DOLA



Fig. 6 FC 9: BODATHPITIYA ELLA

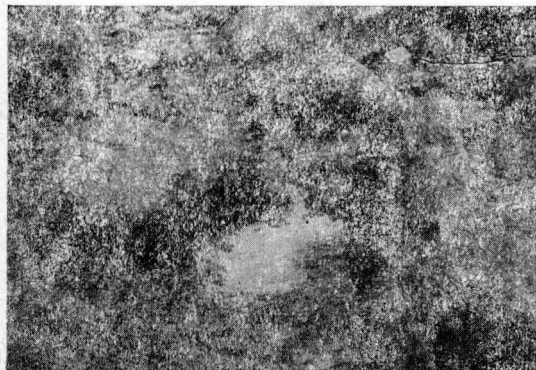


Fig. 7 F Campden Hill DOLA



Fig. 8 FC 7: THANIPITA DOLA

FC 4 : 10.11.1970 : Pasumale-Dola, torrent with broad cascades and pools, large regions with very slight current ; running between tea-plantations, no shadow, very sunny (Fig. 3).

Alt. : 700m.	Te. : cascades : 27°7°C (15 ^h)
Br. : 10-20m.	pool regions : 28°2°C (15 ^h)
D. : cascades : 0'5mm.-1cm. deeper pools with slight current : 30-50cm.	Che. : pH : 5'8 Tot. H. : 0'6°dH Ca. H. : 0'56°dH
Curr. : cascades : 1-2m./sec. : deeper pools : 0-30cm./sec.	Alk. : 0'2 mval CaO : 2mg./l
Gr. : granitic rock	

a : banks and pools with slight current : *Caridina*-species, Hydrophilidae, Dytiscidae, Anisoptera-larvae, Corixidae, Ephemerida-larvae, on the surface : *Aulonogyrus* sp., *Orectochilus* sp. **b :** rocks in the cascades : on the border under a very thin film of running water : tubes of—*Psychomyidae* sp. (5-10/dm²) in direction of the centre of the cascades : *Aulacodes* sp. (2-5/dm.²), in the centre of the cascades (current : more than 1m./sec.) : Simuliidae-larvae (750/dm.²) and Hydropsychidae-larvae (5/dm²). **c :** fishes : *Garra ceylonensis*, *Noemacheilus notostigma*, *Lepidocephalus thermalis* ; crabs : *Paratelphusa* sp.; frogs and tadpoles.

FC 5 : 11.11.1970 : Campden Hill-Dola, torrent running between Tea-plantations, no shadow (Fig. 7).

Alt. : 700 m.	Che. : pH : 5'8
Br. : 3-10 m.	Tot. H. : 0' 6°dH
D. : 10-20cm.	Ca. H. : 0'56°dH
Curr. : Cascades : 75cm-1m./sec.	Alk. : 0'2 mval
Gr. : granitic boulders, pebbles, sand, stones with slimy cover of Algae	CaO : 2 mg./l
Te. : 24°1°C (9 ^h) 24°7°C (11)	

a : bank : on the surface and on the sandy ground : Gerridae, Veliidae, *Heliocoris bengalensis* (very frequent !), Notonectidae, *Aulonogyrus* sp., *Orectochilus* sp., Odonata-larvae, *Caridina pristin*. **b :** under stones in the stronger current : *Dugesia* sp., Ecdyonuridae-larvae, Hydropsychidae-larvae, Simuliidae-larvae (rare), *Podelmis quadriplagiata*. **c :** surface of rocks in very strong current : *Aulacodes* sp. (1/dm²), Simuliidae-larvae (2-3/cm.²), Hydropsychidae-larvae (2-3/dm²). **d :** quantitative sample from 1/16m² : Baetidae-larvae, *Rheotanyrasus* sp.—larvae, Simuliidae-larvae, Ecdyonuridae-larvae (rare). **e :** fishes : *Garra ceylonensis*, *Belontia signata*, *Ophiocephalus gachua*, *Noemacheilus notostigma*. **f :** Algae. **g :** *Macrobrachium latimanus* (from a small cave under a boulder)-**h :** adult Odonata from the border : *Trithemis festiva*.

FC 6 : 11.11.1970 : Kiriwel-Dola, before the tea-factory of Enselwatte-Group, running between plantations, no shadow (Fig. 4).

Alt. : 700m.	Che. : pH : 5.8
Br. : 5-10m.	Tot. H. : 0.6°dH
D. : 30-50cm.	Ca. H. : 0.56°dH
Curr. : 30-75cm./sec.	Alk. : 0.2 mval
Gr. : pebbles, sand	CaO : 2mg/l
Te. : 23.8°C (15 ^h)	El ₂₀ : 26μ Siemens

a : bank : on the sandy ground : Odonata-larvae, Corixidae, *Caridina*—species. **b** : under stones in the stronger current : *Dugesia* sp. (1-2/dm.²), Ecdyonuridae-larvae (1-2/dm.²), Baetidae-larvae (2-5/dm.²/lm.²), *Neoperla* sp., *Euphaea-Splendens*, *Agapetus* (?)sp.-larvae (2-5/dm.²), Hydropsychidae larvae, Simuliidae-larvae, *Eubrianax* sp., *Ilamelmis foveicollis*, *I. brunnescens*, *Ordobrevia fletcheri flavolineata*. **c** : sample with Bouin's liquid : *Dugesia* sp., **d** : Algae. **f** : fishes.

1.2 : TRIBUTARIES OF THE NILWALA-GANGA

FC 7 : 12.11.1970 : Thanipita-Dola, torrent running through forest and tea-plantations, partial with shadow (Fig. 8).

Alt. : 600m.	Che. : pH : 6.0
Br. : 3-5m.	El ₂₀ : 35μ Siemens
D. : 5-20cm.	Tot. H. : 1.2°dH
Curr. : 50cm./sec. on cascades : 1m./sec.	Ca. H. : 0.84°dH Alk. : 0.3 mval
Gr. : pebbles, gravel, sand, some regions with boulders	CaO : 4mg/l
Te. : 25.1°C (9 ³⁰) 27.3°C (12 ^h)	

a : bank : on the surface and on the sandy ground : Gerridae, Corixidae, Odonata-larvae *Caridina nilotica simoni*. **b** : under stones near the banks : Ephemera-, *Neoperla* sp., -and Odonata-larvae. **c** : under stones in the stronger current : Baetidae-larvae (5-10/dm.²), *Neoperla* sp., *Euphaea splendens*, *Rheotanytarsus* sp. (3-5/cm.²), *Eubrianax* sp., *Ilamelmis brunnescens*, Elminthinae (nov. gen. nov. spec.)-adults and larvae. **d** : *Paratelfusa rugosa*. **e** : *Macrobrachium* and other shrimps. **f** : fishes : *Rasbora daniconius*, *Lepidocephalus thermalis*, *Ophiocephalus gachua*, *Belontia signata*, *Anguilla bicolor*. **g** : *Paludomus-Loricatus*, *Melanoides tuberculatus*, *Thiara* sp. **h** : Algae. **i** : *Natrix piscator asperrimus*, *Cerberus rhyncops*. **j** : adult Odonata : *Euphaea splendens*, *Trithemis festiva*, *Zygonyx iris ceylanica*.

FC 8 : 13.11.1970 : Naghaketa-Dola, torrent running through forest and plantations, partial with shadow (Fig. 5).

Alt. : 500 m.	Che. : pH : 5'8
Br. : 8-10m.	El ₂₀ : 35 μ Siemens
D. : 5-10cm. some pools : 20-50cm.	Tot. H. : 1°dH Ca.H. : 0'56°dH
Curr. : 50cm.-1m./sec. some pools 5-10cm./sec.	Alk. : 0'3 mval CaO : 2mg./l
Gr. : granitic boulders pebbles, gravel and sand	
Te. : 24'2°C(9 ^h)-25'4°C(10 ³⁰)	

a : bank : on the surface : Veliidae, Gerridae (frequent). **b : under stones in the stronger current :** Ecdyonuridae-larvae (3-5/dm²), *Neoperla* sp. (3-5/dm²), *Euphaea splendens* (2-3/dm²), Anisoptera-larvae (rare), Hydropsychidae-larvae (1-2/dm²), Leptoceridae (?) -larvae, *Eubrianax* sp. (1-2/dm²), *Ilamelmis brunnescens*, *Aulacodes* sp., **c :** *Paludomus-Loricatus*. (1-2/m²). **d :** fishes : *Garra ceylonensis*, *Lepidocephalus thermalis*, *Noemacheilus notostigma*, *Ophiocephalus gachua*, *Puntius sarana*, *P. nigrofasciatus*, *Macrognathus aculeatus*. **e :** crabs and shrimps. **f :** Algae. **g :** quantitative sample from 2,500 cm² surface of stones : Baetidae- Chironomidae-larvae. **h :** adult Odonata from the banks : *Neurobasis c. chinensis*, *Euphaea splendens*, *Libellago greeni*.

2. Region of Ratnapura

2.1 : TRIBUTARIES OF THE KALU GANGA AND KALU-GANGA :

FC 9 : 17.11.1970 : Bodathpitiya-Ela, torrent from the Bodathpitiya-waterfall, cascades changes with sectors of slight current, coming from forest and running through plantations, no shadow (Fig. 6).

Alt. : 500 m.	Che. : pH : 6
Br. : 5-30m.	El ₂₀ : 35 μ Siemens
D. : 10cm. to 50cm. in pools with slight current	Tot. H. : 1'1°dH Ca.H. : 0'84°dH
Curr. : cascades : 75cm. more then 1m/sec, most parts : 50cm./sec., pools with slight current : 0-30cm./sec.	Alk. : 0'3 mval CaO : 2mg./l
Gr. : granitic rock, boulders, pebbles, gravel ; sandy in banks and pools with slight current	
Te. : 26°C (10 ³⁰)-27'2°C (13 ^h)	

a : bank : surface and sandy ground : Veliidae, Naucoridae, *Ranatra* sp., Anisoptera-larvae, *Caridina nilotica simoni*. **b : under stones near the banks and in pools** : *Dugesia* sp. (2-5/dm²), Ephermerida-larvae, Plecoptera-larvae, *Euphaea splendens*, Leptoceridae (?) -larvae, *Eubrianax* sp., *Ordobrevia fletcheri flavolineata*, *Ilamelmis foveicollis* var., *Helichus naviculus*. **c : under stones in the cascades** : Ecdyonuridae-larvae (1-2/dm²), *Neoperla* sp. (1-2/dm²), *Eubrianax* sp., Hydropsychidae-larvae, *Aulacodes* sp. -larvae (2-5/dm²). **d** : *Paludomus neritoides*, *P. loricatus* (2-5/1.4m²), *Melanoides tuberculatus* (in sand !). **e** : sample of *Dugesia* sp. in BOUIN's liquid. **f** : fishes : *Belontia signata*, *Rasbora vaterifloris*, *Puntius nigrofasciatus*, *Glossogobius giuris* (very frequent on sandy ground !). **g** : Algae from stones. **h** : adult Odonata from the banks : *Libellago greeni*, *Prodasineura sita*.

FC 10 : 18.11.1970 : Katugas-Ela, torrent with waterfalls in a narrow gorge, forest, very shady (Fig 9).

Alt.	: 450 m.	Che. : pH	: 5'8
Br.	: 1-10m.	El ₂₀	: 29/μ Siemens
D.	: cascades : 1cm. pools with slight current :	Tot. H.	0'6°dH
	50cm.-1m.	Ca. H.	: 0'20dH
		Alk.	: 0'2 mval
Curr.	: cascades : more than 1m./sec. pools with slight current : 30-50cm./sec.	CaO	: 2mg./l
Gr.	: granitic rocks, boulders, in pools with slight currents : gravel, sand		
Te.	: 25' 1°C (9 ³⁰) - 25.3°C (12 ^h)		

a : bank : surface and sandy ground : Veliidae, Gerridae, Corixidae, small larvae of Anisoptera. **b : under stones near the banks and in regions with slight current** : Ephermerida-larvae, tubes of Psychomyidae, *Euphaea splendens* (1/1dm²), *Caridina*-species. **c : under stones in the cascades and on rocks** : Ecdyonuridae-larvae (1-2/dm²), *Neoperla* sp., *Rhabdoblatta* sp. (larvae), Hydropsychidae-larvae (2-3/dm²), *Aulacodes* sp.-larvae (rare), Simuliidae-larvae (3/cm²), Blepharoceridae-larvae (3-5/dm²). **d** : *Paludomus neritoides* (1-2/1/4m²) on stones and rocks. **e** : fishes : *Garra ceylonensis*, *Rasbora vaterifloris* (both species frequent), *Ophiocephalus gachua*, *Puntius sarana*, *P. bimaculatus*, *Panchax lineatus dayi*, *Belontia signata*, *Glossogobius giuris*. **f** : Algae from the stones and rocks.

FC 11 : 19.11.1970 : Rajanawa-Dola, torrent with waterfalls running through forest shady.

Alt.	: 250 m.	Che. : pH	: 5'8
Br.	: 50cm.-3m.	El ₂₀	: 29 μ Siemens
D.	: cascades : 1-3cm. pools with slight current :	Tot. H.	0'6°dH
	10-50cm.	Ca. H.	: 0'56°dH
		Alk.	: 0'2 mval
Curr.	: cascades : more than 1m./sec. pools with slight current 0-10cm./sec.	CaO	: 2mg./l
Gr.	: granitic rocks, boulders, gravel with sand		
Te.	24' 6°C (9 ^h) - 25' 8° (12 ^h) 26' 1°C (13 ^h)		

a : bank : on the surface and sandy ground : Veliidae, Gerridae, Corixidae, Hydrophilidae, Dytiscidae, *Caridina nilotica*, *C. pristis*. **b** : under stones near the bank : *Dugesia* sp. (2-3/dm²), Ephemera-larvae (1-2/dm²), *Euphaea splendens* (1/dm²), Leptoceridae-larvae (3-5/dm²), Helicopsychidae-larvae (rare), *Eubrianax* sp. (1-2/dm²). **c** : under stones and on rocks in the cascades : Ecdyonuridae-larvae (3-5/dm²), *Neoperla* sp. (1-2/dm²), *Euphaea splendens* (3-5/dm²), Anisoptera-larvae (1/dm²), Hydropsychidae-larvae (under stones : small species—10-15/dm², on rocks : big species—5/dm²), *Aulacodes* sp.-larvae (3-5/dm²), *Eubrianax* sp. (rare), *Ordobrevia fletcheri flavolineta*. **d** : *Paludomus neritoides* (3-5/1/16m²), *P. loricatus* (1-3/1/16m²). **e** : fishes : *Garra ceylonensis*, *Ophiocephalus gachua*, *Lepidocephalus thermalis*, *Rasbora daniconius*, *Puntius bimaculatus* ; shrimps : *Macrobrachium* sp. **f** : Algae from stones. **g** : adult Odonata : *Euphaea splendens*, *Elattonera centralis*.

FC 12 : 20.11.1971 : Kalu-Ganga before the town of Ratnapura, the river is in a deep valley running between plantations and forests (Fig. 10).

Alt. : 30m.	Che. : pH : 6'5
Br. : 20-30m.	El ₂₀ : 46 μ Siemens
D. : to 3m. in the middle of the river	Tot. H. : 1' 2°dH
	Ca. H. : 1' 12°dH
Curr. : cascades : more than 1m./sec. on the banks : 0-30cm./sec.	Alk. : 0'4 mval
	CaO : 6mg./l
Gr. : granitic boulders, gravel and on the banks with muddy sand.	
Te. : 26'1°C (10 ^h) - 26'6° (11 ³⁰)	

a : bank : on the surface and on the sandy ground : Veliidae, Gerridae, *Caridina* sp. **b** : under stones near the banks : *Dugesia* sp., Ephemera-larvae, *Neoperla* sp., Hydropsychidae-larvae, Chironomidae-larvae, *Eubrianax* sp. **c** : under stones in the cascades : *Dugesia* sp., Baetidae-larvae (20-30/dm²) !, Hydropsychidae-larvae (5-10/dm²), *Aulacodes* sp.-larvae, Simuliidae-larvae (30-50/dm²), *Eubrianax* sp., **d** : *Paludomus neritoides*, *P. loricatus* (on stones and rocks), *Thiara* sp. (on sandy bottom). **e** : fishes : *Rasbora vaterifloris* *R. daniconius*, *Puntius bimaculatus*, *P. sarana*, *P. nigrofasciatus*, *Chela laubuca*, *Panchax lineatus dayi*, *Ophiocephalus gachua*, *Anabas testudineus*, *Horadandiyia atukorali*, *Glossogobius giuris*, *Belontia signata*, *Anguilla nebulosa*, *Macrognathus aculeatus*, *Wallago attu*. **f** : Algae from stones.

FC 13 : 21.11.1970 : Upper reaches of Kalu-Ganga at Malwala, running through plantations, no shadow (Fig. 11).

Alt. : 80m.	Che. : pH : 7'2
Br. : 15-20m.	El ₂₀ : 41 μ Siemens
D. : 30-50cm.	Tot. H. : 1' 15°dH
Curr. : 50-75cm./sec., pools with slight current : 5-10cm./sec.	Alk. : 0'4 mval
	CaO : 6'38mg./l
Gr. : granitic rocks, boulders, gravel, on the stones were found long water-plants floating in the current, banks and pools with sand	MgO : 3'6mg./l
	SiO ₂ : 9'7mg./l
	Cl : 1'94mg./l
	NO ₃ : 0'094mg./l
	NH ₄ : 0'16mg./l
	P ₂ O ₅ : 0'12mg./l
Te. : 26'7° (13 ³⁰) - 26'3° (16 ^h)	



Fig. 9 FC 10, Kaluganga Era



Fig. 10 FC 12 Kaluganga near Rutnapura



Fig. 11 FC 13, Kaluganga near Malwala



Fig. 12 FC 15 Ira Handha Pana Dola



Fig. 13 FC 16 Maha Dola



Fig. 14 FC 17 Gartmore Estate Dola (behind)

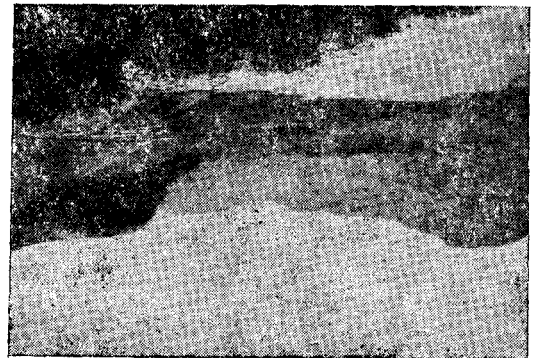


Fig. 15 FC 18 Gartmore Estate Dola

a : bank : on the surface and on the sandy ground : Veliidae, Gerridae, Odonata-larvae, *Ranatra* sp. **b : under stones near the banks** : larvae of Ephemera, Plecoptera and Odonata, *Eubrianax* sp. (very frequent). **c : under stones in the cascades** : larvae of Ephemera and Plecoptera, Hydropsychidae-larvae, *Ilamelmis foveicollis*. **d : on floating water-plants** : Leptophlebiidae-larvae, Leptoceridae-larvae, Lepidoptera-larvae, *Helichus naviculus*. **e** : *Paludomus-Loricatus* and *Neritoides* **f** : sample of water-plants. **g** : fishes : *Puntius sarana*, *Rasbora daniconius*, *Belontia signata*, *Chela laubuca*, *Mastacembelus armatus*, *Glossogobius giuris*, *Anguilla nebulosa*.

FC 14 : 22.11.1970 : Upper reaches of Kalu-Ganga on the south flank of the Adam's Peak, near Carney-Estate, deep gorge in primary rain-forest, very shady.

Alt. : 800m.	Che. : pH : 6'5
Br. : 2-10m.	El ₂₀ : 14'6 μ Siemens
D. : cascades : 1-3 cm. in pools with slight current : 30-50cm.	Tot. H. : 0'25°dH
	Alk. : 0' 14 mval
	CaO : 1' 12mg./l
Curr. : cascades, 75cm.-1m./sec. pools with slight current : 15-30cm./sec.	MgO : 0'99mg./l
	SiO ₂ : 7'4mg./l
	Cl : 1'6mg./l
Gr. : granitic rocks and boulders of 1-3m., gravel, sand.	NO ₃ : 0'94mg./l
	NH ₄ : 0'21mg./l
Te. : 22'8°C (10 ^h) - 23'8°C (12 ^h)	P ₂ O ₅ : 0'12mg./l

a : stone from a pool with a current of 30cm/sec : 20-dm² : *Dugesia* sp. (3-5/dm²), Leptophlebiidae-larvae (5/20dm²), Hydropsychidae-larvae (1/20dm²), *Eubrianax* sp. (2/20dm²). **b : stones from the cascades** : *Dugesia* sp. (rare), Ecdyonuridae-larvae (2-5/dm²), *Neoperla* sp. (1-3/dm²), Hydropsychidae-larvae (1-2/1/16m²), *Eubrianax* sp. (1-3/dm²), *Ilamelmis brunnescens*, *Podelmis quadriplagiata* (1-3/1/16m²). **c : bank** : surface and on sandy ground : Veliidae, Gerridae, *Orectochilus* sp., *Aulonogyrus* sp., *Caridina* sp. **d** : *Paludomus neritoides*. **e** : drift. **f** : Algae from the stones and rocks. **g** : fishes : *Garra ceylonensis* (very frequent), *Puntius dorsalis* (frequent), *Lepidocephalus thermalis*, *Belontia signata*, *Anguilla nebulosa*. **h** : adult Odonata from the banks : *Neurobasis c. chinensis*, *Vestalis apicalis nigrescens*, *Euphaea splendens*, *Libellago ferialis*, *Elatoneuris tenax*.

FC 15 : 23.11.1970 : Ira Handha Pana-Dola, torrent and tributary of Kalu-Ganga, running through plantations, no shadow (Fig. 12).

Alt. : 100m.	Che. : pH : 6'7
Br. : 2-4m.	El ₂₀ : 25'5 μ Siemens
D. : 10-20cm. in pools with slight current : 30-50cm.	Tot. H. : 0'5°dH
	Alk. : 0'25 mval
	CaO : 2'35mg./l
Curr. : Cascades : more than 1m./sec. in pools with slight current : 30-50cm. sec.	MgO : 1'90mg./l
	SiO ₂ : 4'40mg./l
	Cl : 1.60mg./l
Gr. : granitic boulders from 50cm.-2m., gravel, sand	NO ₃ : 0'101mg./l
	NH ₄ : 0'08mg./l
Te. : 18'7°C (9 ³⁰) - 20'7°C (12 ^h)	P ₂ O ₅ : 0

a : bank : on the surface and on sandy ground : Veliidae, Gerridae, *Cardina* sp. **b : under stones near the banks** : Leptophlebiidae-larvae, Odonata-larvae, *Eubrianax* sp. (very frequent), *Dugesia* sp. **c : under stones in the cascades** : Baetidae-larvae (3-5/cm²), Ecdyonuridae-larvae

(1-2/dm²), *Neoperla* sp., Hydropsychidae-larvae (1/1dm²), Corixidae, *Rheotanytarsus* sp.-larvae in tubes, *Dugesia* sp., *Paludomus loricatus* sp. (3-5/1/4m²), juvenile animals : (3/1/16m²). e : fishes and frogs. f : Algae from stones. g : drift.

3. Region of Maskeliya

3.1 : TRIBUTARIES OF MASKELI OYA—

FC 16 : 28.11.1970 : Mocha-Dola, torrent running through the Adam's Peak-Estate (tea-plantations), no shadow (Fig. 13).

Alt. : 1300m.	Che. : pH : 6'1
Br. : 2-5m.	El ₂₀ : 25 μ Siemens
D. : 20-50cm.	Tot. H. : 0'4°dH
Curr. : cascades : more than 1m./sec., in pools with slight current : 30-50cm. /sec.	CaO : 2'57mg./l MgO : 1'02 mg./l SiO ₂ : 4'44 mg./l Cl : 2'84 mg./l
Gr. : granitic boulders, gravel, sand	NO ₃ : 0'283 mg./l NH ₄ : 0'1 mg./l
Te. : 18'7°C (9 ³⁰) - 20'7°C(12 ^h)	P ₂ O ₅ : 0'17 mg./l

a : bank : on the surface and on the sandy ground : Veliidae, Gerridae, *Orectochilus* sp., *Aulonogyrus* sp., Corixidae. b : under stones in the current of 50-75cm./sec. : *Dugesia* sp. (rare), Ecdyonuridae-larvae (1-2/dm²), *Neoperla* sp., Hydropsychidae-larvae, *Rheotanytarsus* sp. -larvae in tubes, Simuliidae-larvae, *Ilamelmis foveicollis*, *Ordobrevia fletcheri*, *Podelmis quadriplagiata*. c : on rocks in cascades : Baetidae-larvae (10-20/dm²), Hydropsychidae-larvae (5-10/dm²), Simuliidae-larvae (single specimens), Blepharoceridae-larvae (10-20/dm²) and-pupae (10/dm²). d : drift. e : fishes : *Carassius carassius*, *Xiphophorus helleri*, *Chela laubuca*. f : crabs : *Paratelphusa* sp. g : Algae from the stones. Molluscs absent

FC 17 : 29.11.1970 : Gartmore-Estate-Dola, small torrent coming from the primary rain-forest ; beyond the collecting-place is a waterfall falling more than 100m. in to the valley of the Gartmore-Estate, partially shady (Fig. 14).

Alt. : 1850m.	Che. : pH : 5'68
Br. 2-5m.	El ₂₀ : 8'8 μ Siemens
D. : 5-50cm.	Tot. H. : 0'08°dH
Curr. : 10-50cm./sec. on cascades : 1m./sec.	Alk. : 0'05 mval CaO : 0'33mg./l MgO : 0'43mg./l
Gr. : granitic rocks, gravel, sandy banks	SiO ₂ : 2'61mg./l Cl : 1'14mg./l
Te. : 16.1°C(10 ^h)-17.2°C(12 ^h)	NO ₃ : 0'048mg./l NH ₄ : 0'245mg./l P ₂ O ₅ : 0

a : bank : on the surface and on the sandy ground : Veliidae, Gerridae, *Aulonogyrus* sp., *Orectochilus* sp., *Neoperla* sp. -larvae, *Paratelphusa* sp., tadpoles. b : under stones near the banks *Dugesia* sp. (rare), Ecdyonuridae-larvae (3-5/1/16m²), *Euphaea splendens*, *Neoperla* sp., Helicopsychidae-larvae (5-10/dm²). c : under stones in cascades : Ecdyonuridae-, Baetidae-larvae, on rocks : Hydropsychidae-larvae (10-20/dm²), Simuliidae-larvae (2-5/cm²) Blepharoceridae-larvae (10/dm²). d : drift. e : tadpoles. f : Algae and water-moss on stones. No Molluscs.

FC 18 : 30.11.1970 : Gartmore-Estate-Dola, below the waterfall after FC 17, in the Gartmore-Estate-valley, torrent running through tea-plantations, no shadow (Fig. 15).

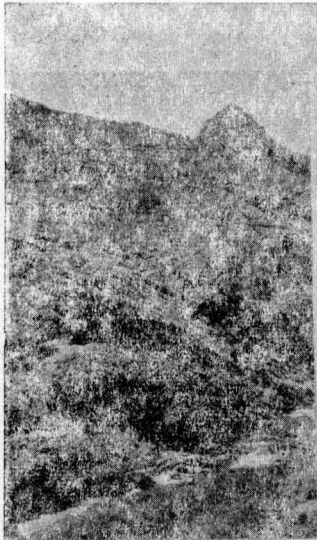
Alt. : 1500m.	Che. : pH : 5'95
Br. : 10-20m.	El ₂₀ : 1'02 μ Siemens
D. : 20-50cm.	Tot. H. : 0'13°dH
Cur. : cascades : more than 1m./sec. near the banks : 10-50cm./sec.	Alk. : 0'05 mval
Gr. : granitic boulders from 0.5 to 2m., gravel, sand	CaO : 0'78mg./l
Te. : 16'9°C (10 ^h)	MgO : 0'78mg./l
	SiO ₂ : 1'98mg./l
	Cl : 1'42mg./l
	NO ₃ : 0'045mg./l
	NH ₄ : 0'245mg./l
	P ₂ O ₅ : 0'02mg./l

a : bank : on the surface and the sandy ground : Veliidae, Gerridae, *Orectochilus* sp., *Aulonogyrus* sp., Anisoptera-larvae, tadpoles. **b : under stones in cascades :** *Dugesia* sp. (3-5/dm²), Ecdyonuridae-larvae, *Neoperla* sp., Leptoceridae-larvae (10-20/1/16m²), Helicopsychidae-larvae (3-5/1/16m²), Hydropsychidae-larvae (rare), *Ilamelmis foveicollis*, *Podelmis quadriplagiata*. **c : drift.** **d :** muddy Algae from the stones. No Molluscs.

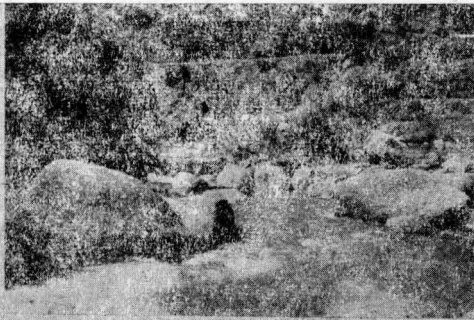
FC 19 : 30.11.1970 : Tributary of the Gartmore-Estate-Dola near the Estate Manager's Bungalow, torrent running through tea-plantations and gardens, no shadow.

Alt. : 1500m.	Che. : pH : 6'28
Br. : 2-3m.	El ₂₀ : 23'8 μ Siemens
D. : 1-5cm., in pools with slight current : 10-40cm.	Tot. H. : 0'45°dH
Curr. : cascades : more than 1m./sec. in pools with slight current : 10-30cm./ sec.	Alk. : 0'07 mval
Gr. : granitic rocks, boulders, gravel, in pools with slight current : mud and sand	CaO : 2'68mg./l
	MgO : 1'3 mg./l
	SiO ₂ : 4'44mg./l
	Cl : 2'84mg./l
	NO ₃ : 0'754mg./l
	NH ₄ : 0
	P ₂ O ₅ : 0'1mg./l
Te. : 18'9°C (15 ^h) - 18'3°C (17 ^h) - 17'7°C (19 ^h) 17'3°C (21 ^h) - 15'5°C (6 ^h) - 15'3°C (7 ^h) 19'4°C (15 ^h) - 19'3°C (16 ^h) - 18'9°C (17 ^h) 18'5°C (18 ^h) - 18°C (19 ^h) - 16'3°C (23 ^h)	

a : bank and pools : surface and on muddy sand : Veliidae, Gerridae, *Aulonogyrus* sp., *Orectochilus* sp., Notonectidae. **b : under stones in the pools :** *Dugesia* sp. (5-10/dm²), Ephermeida, Plecoptera-larvae, Leptoceridae-larvae, Helicopsychidae-larvae, Ryacophilidae-larvae, *Podelmis quadriplagiata* (10-20/dm²). **c : under stones in the cascades :** Baetidae-larvae (5-10/dm²), Ecdyonuridae-larvae, Hydropsychidae-pupae, Leptoceridae-larvae, Rhyacophilidae-larvae, *Podelmis quadriplagiata* (adult : 5-10/dm²), also some larvae). **d :** tadpoles and frog. **e :** drift. **f :** Algae from stones. No Molluscs.



16



17



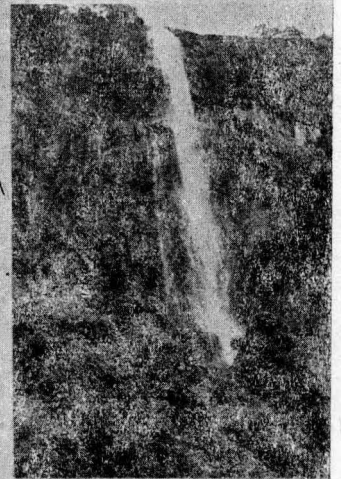
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22



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Fig. 16, FC. 20 Maskeliya Dola,

Fig. 17, FC. 23 Dick Oya,

Fig. 18, FC. 21 Hakgala Dola

Fig. 19, FC. 25 Kirikatu Oya.,

Fig. 20, FC. 26 Veli Oya.,

Fig. 21, FC. 27 Kuda Oya.,

Fig. 22. FC. 29 Diyalama Falls

FC 20 : 1.12.1970 : Maskeliya-Dola, on the north flank of the Adam's Peak, torrent running in a deep gorge through tea-plantations and forest, shady (Fig. 16).

Alt. : 1200m.	Che.: pH : 6'36
Br. : 5-8m.	El ₂₀ : 11 μ Siemens
D. 20-50cm., in pools with slight current : 50cm.-1m.	Tot. H. : 0'15°dH Alk. : 0'07 mval.
Curr. : cascades : more than 1m./sec. pools with slight current : 0-30cm./sec.	CaO : 0'84mg./l MgO : 0'44mg./l SiO ₂ : 3'15mg./l
Gr. : granitic rock, boulders, gravel, in regions with slight current : sand	Cl : 1'7mg./l NO ₃ : 0'042mg./l NH ₄ : 0'015mg./l
Te. : 18.3°C (11 ^h) - 19.9°C (13 ^h)	P ₂ O ₅ : 0

a : bank : on the surface and on the sandy ground : Veliidae, Gerridae, Anisoptera-larvae, Notonectidae, *Aulonogyrus* sp., *Orectochilus* sp., **b : under stones near the banks** : *Dugesia* sp. (10-20/dm²), Leptophlebiidae-larvae (10-20/dm²), Ecdyonuridae-larvae (1-2/dm²). **c : under stone in cascades** : Ecdyonuridae-larvae (2-3/dm²), *Rheotynytarsus*-, and other Chironomidae-larvae *Dugesia* sp. (rare), **on stones and rocks** : Baetidae-larvae (10-20/dm²), Hydropsychidae-larvae (rate), Blepharoceridae-larvae (20-30/dm²) also many pupae. **d** : fishes : *Garra ceylonensis*, *Chela laubuca* ; tadpoles and *Paratelphusa* sp. **e** : drift (in the sample one *Arrhenurus* sp. (?)). No Molluscs.

FC 23 : 3.12.1970 : Dick-Oya, along the road between Maskeliya and Hatton, running through plantations and a small forest, no shadow (Fig. 17).

Alt. : 1200m.	Che.: pH : 6'53
Br. : 5-10m.	El ₂₀ : 36 μ Siemens
D. : cascades : 10-20 cm. pools with slight current : 30cm.-1m.	Tot. H. : 0'6°dH CaO : 4'1mg./l MgO : 1'3mg./l
Curr. : 75-1m./sec., on the banks and pools : 0-30cm./sec.	Alk. : 0'4 mval SiO ₂ : 7'2mg./l
Gr. : granitic rocks, boulders from 2-5m., banks: sandy	Cl : 4'97mg./l NO ₃ : 0'128mg./l
Te. : 18.6°C (11 ^h) - 20.8°C (13 ^h)	NH ₄ : 0'04mg./l P ₂ O ₅ : 0'07 mg./l

a : banks : on the surface and on the sandy ground : larvae of Odonata, Veliidae, Gerridae, *Aulonogyrus* sp., *Orectochilus* sp., *Odontomyia* sp., under stones : *Dugesia* sp. **b : under and on rocks stones of the cascades** : Baetidae-larvae (10-20/dm²), Hydropsychidae-larvae (5-10/dm²), Chironomidae-larvae (10-20/dm²). **c** : fishes : *Chela laubuca*, *Panchax* sp., *Xiphophorus helleri*. **d** : *Paratelphusa*

rugosa. e : drift. f : Algae from stones. g : adult Odonata from the banks : *Euphaea splendens*, *Trithemis festiva*, *Libellago* sp. No Molluscs.

4. Region of Nuwara Eliya

FC 21 : 2.12.1970 : Hakgala-Dola, a small torrent in the Hakgala gardens near Nuwara Eliya, coming through a dense-forest, shady (Fig. 18).

Alt. : 2000m.	Che.: pH : 6'9
Br. : 1-1'5m.	El ₂₀ : 26 μ Siemens
D. : 1-5cm., in pools with slight current : 20-30cm.	Tot. H. : 0'65°dH
Curr. : 50cm.-1m./sec. in pools with slight current : 0-10cm./sec.	Alk. : 0'25 mval
Gr. : gravel and sand, artificial cascades	CaO : 2'6mg./l
Te. : 14'9°C (11 ^h) - 15'2°C (13 ^h)	MgO : 2'7mg./l
	SiO ₂ : 13'3mg./l
	Cl : 2'55mg./l
	NO ₃ : 0'067 mg./l
	NH ₄ : 0'2mg./l
	P ₂ O ₅ : 0'02 mg./l

a : bank : on the surface and on the sandy bottom : Veliidae, Gerridae, Zygoptera-larvae Trichoptera-larvae, Hydrophilidae, Dytiscidae, tadpoles. b : under stones in the cascades : *Dugesia* sp. (more under stones near the banks : (2-5/dm²), Baetidae-larvae (2-5/dm²), Ecdyonuridae-larvae (rare), Hydropsychidae-larvae, Simuliidae-larvae (3-5/cm²), *Eubrianax* sp. c : *Paludomus nigricans* (on rocks and stones : 2-3/dm²), on sandy ground : 10-20/1/16m²). d : *Paludomus* and *Dugesia* in BOUIN's liquid. e : *Paratelphusa soror* ; frog. f : Algae from stones.

FC 22 : 2.12.1970 : Nuwara-Eliya-Dola, coming from the town, polluted, no shadow.

Alt. : 2000m.	Curr. : 50-75cm./sec.
Br. : 2m.	Gr. : gravel, putrid mud.
D. : 10-50cm.	Te. : 15'3°C (16 ^h)

No chemical analysis.

a : on stones : Chironomidae-larvae, *Dugesia* sp. (5-10/dm²), Simuliidae-larvae (rare), in putrid mud between gravel : *Tubifex tubifex*, *Limnodrilus hoffmeisteri* (?), *Lumbriculus variegatus* (?).

5. Region of Belihuloya

5.1 : TRIBUTARIES OF THE WALLAWE-GANGA :

FC 24 : 7.12.1970 : Belihul-Oya, near the Rest-house, no shadow.

Alt. : 650m.	Che.: pH : 6'6
Br. : 5-6m.	El ₂₀ : 23 μ Siemens
D. : 30-50cm. in pools with slight current : 50cm.-1m.	Tot. H. : 0'55°dH
Curr. : cascades : 1m./sec., pools with slight current : 0-30cm./sec.	Alk. : 0'3 mval.
Gr. : granitic rocks, gravel, sand	CaO : 2'3mg./l
Te. : 21'3°C (15 ^h) - 21'4° (17 ^h)	MgO : 2'3mg./l
18'3°C (7 ^h)	SiO ₂ : 9mg./l
	Cl : 1'42mg./l
	NO ₃ : 0.123mg./l
	NH ₄ : 0'03mg./l
	P ₂ O ₅ : 0'17mg./l

a : bank : on the surface and on the sandy ground : Veliidae, Gerridae, Corixidae, Notonectidae, Odonata-larvae, *Caridina* sp. **b : under stones (0-50cm./sec.) :** *Dugesia* sp., *Neoperla* sp., Leptophlebiidae-larvae, Ecdyonuridae-larvae, *Euphaea splendens*, *Eubrianax* sp., *Ilamelmis foveicollis*, *Ilamelmis brunnescens*. **c : on rocks in cascades :** Baetidae-larvae (5-10/dm²), Hydropsychidae-larvae (rare), Simuliidae-larvae (3-5/cm²), Blepharoceridae-larvae (2-5/dm²). **d :** *Paludomus loricatus* and *neritoides*(rare). **e :** fishes : *Garra ceylonensis*, *Noemacheilus notostigma*, *Puntius sarana* ; frogs : *Paratelphusa* sp., **f :** drift. **g :** Algae from stones. **h :** adult Odonata : *Lestes* (L.) *elata*.

FC 25 : 8.12.1970 : Kirikatu-Oya, coming from the Horton Plains. At World's End ; the Oya runs down as a torrent some 100m. down the cascades, no shadow (Fig. 19).

Alt. : 700m.	Che.: pH : 7'1
Br. : 5-8m.	El ₂₀ : 34 μ Siemens
D. : 20cm. to 1m.	Tot. H. : 1°dH
Curr. : 40-50cm./sec., over cascades: more than 1m./sec. in pools with slight current : 0-20cm./sec.	Alk. : 0'45 mval
Gr. : granitic rocks, boulders (1-3m.), gravel, sand	CaO : 4'7mg./l
Te. : 18'8°C (9 ^h) - 19'6°C (12 ^h)	MgO : 3'8mg./l
	SiO ₂ : 11mg./l
	Cl : 1'42mg./l
	NO ₃ : 0'071mg./l
	NH ₄ : 0'03mg./l
	P ₂ O ₅ : 0'14mg./l

a : bank : on the surface and on sandy ground : Veliidae, Gerridae, *Aulonogyrus* sp., *Orectochilus* sp., *Ephemera* sp. (in the sand), Hydrophilidae, Anisoptera-larvae. **b : under stones near the banks :** *Dugesia* sp., Leptophlebiidae-larvae, (1-3/dm²), Ecdyonuridae-larvae (1/dm²), Baetidae-larvae (in current more than 50cm./sec.), *Neoperla* sp. (1/dm²), Anisoptera-larvae, *Eubrianax* sp. **c : cascades, under stones :** Ecdyonuridae-larvae, *Neoperla* sp., Anisoptera-larvae (1/dm²) ; **on rocks :** Baetidae-larvae (5-10/dm²), Simuliidae-larvae (3-5/cm²), Chironomidae-larvae (5-10/dm²). **d :** *Paludomus loricatus* and *neritoides* (0-20cm./sec.: 5/dm²), 30m.-1m./sec. 3-5/1/16m²). **e :** fishes : *Garra ceylonensis*, *Puntius sarana*, *Puntius bimaculatus*, *Noemacheilus notostigma*, *Rasbora* sp. (frequent), *Belontia signata*, *Ophiocephalus gachua* ; frogs, *Natrix* sp.; *Paratelphusa* sp. **f :** drift. **g :** Algae on stones. **h :** adult Odonata : *Euphaea splendens*.

FC 26 : 8.12.1970 : Veli-Oya, torrent, no shadow (Fig. 20).

Alt. : 700m.	Che.: pH : 7
Br. : 10-15m.	El ₂₀ : 45 μ Siemens
D. : 20cm.-1m.	Tot. H. : 1'3°dH
Curr. : 50cm.-1m./sec., cascades: more than 1m./sec. pools with slight current : 0-20cm./sec.	Alk. : 0'53 mval.
Gr. : granitic boulders (1-3m.), gravel, sand	CaO : 6'8mg./l
Te. : 21°C (16 ^h) - 20.8/20.8°C (17 ^h)	MgO : 4'4mg./l
	SiO ₂ : 13mg./l
	Cl : 1'84mg./l
	NO ₃ : 0'101mg./l
	NH ₄ : 0
	P ₂ O ₅ : 0'1mg./l

a : bank : on the surface and on sandy ground : Veliidae, Gerridae, *Orectochilus* sp. (frequent), Corixidae, *Anisops*, sp., Zygoptera-larvae. **b : under stones** : Trichoptera-pupae (*Agapetus* sp.?), Anisoptera-larvae, *Podelmis aenea*, *Ilamelmis foveicollis*; **on boulders, cascades**: Baetidae-larvae, Hydropsychidae-larvae, Blepharoceridae-larvae, Simuliidae-larvae.. **c** : *Paludomus neritoides* (frequeneylike FC 25). **d** : fishes : *Garra ceylonensis* ; tadpoles. **e** : drift. **f** : Algae from stones.

5.2 : TRIBUTARIES OF THE MENIK-GANGA :

FC 27 : 9.12.1970 : Kuda-Oya, near Buttala in the Southeast of Ceylon, running through forest and very shady (Fig. 22).

Alt. : 150m.	Che.: pH : 7'7
Br. 10-15m.	El ₂₀ : 295 μ Siemens
D. : 20cm.-1m.	Tot. H. : 9'2°dH
Curr. : 30-50cm./sec. on small cascades : 1m./sec.	Alk. : 3'55 mval. CaO : 52mg./l
Gr. : gravel, sand between some rocks	MgO : 28'9mg./l SiO ₂ : 28'8mg./l
Te. : 25'5°C (11 ^h)	Cl : 7'1mg./l NO ₃ : 0'108mg./l NH ₄ : 0'02mg./l P ₂ O ₅ : 0'11mg./l

a : bank : on the surface and on sandy ground : Veliidae, Gerridae, Corixidae, *Ranatra* sp., Zygoptera-larvae, Leptophlebiidae-larvae, *Caridina* sp., **b : under stones in the stronger current** : Baetidae-larvae, Plecoptera-larvae, Hydropsychidae-larvae, *Eubrianax* sp. (frequent), *Ordobrevia fletcheri flavolineata*, Hydraenidae, *Potamophilinus costatus*. **c** : *Paludomus chilinoides Thiara* sp. **d** : fishes : *Chela laubuca*, *Puntius dorsalis*, *Glossogobius giuris*, *Puntius bimaculatus*, *Puntius* sp., *Ophiocephalus* sp.; frogs ; *Paratelphusa* sp. **e** : drift. **f** : adult Odonata : *Euphaea splendens*, *Libellago greeni*.

5.3 : AFFLUENTS OF THE KIRINDI-GANGA :

FC 28 : 9.12.1970 : Wetakei-Ela, small torrent in the dense forests near Wellawaya (Southeast-Ceylon), shady, calcareous sinter on the stones.

Alt. : 200m.	Che.: pH : 8'3
Br. : 1-2m.	El ₂₀ : 360 μ Siemens
D. : 5-20cm., in pools with slight current : 1m.	Tot. H. : 11'6°dH Alk. : 4'7 mval.

Curr. : 30-50cm/sec	cascades :	Alk. : 4'7mval
	1m/sec.	CaO : 59'4mg/1
Gr. : calcareous rocks, gravel,		MgO : 40'8mg/1
sand, calcareous sinter on		SiO ₂ : 54'8mg/1
the stones		Cl : 2'55 mg/1
Te. : 23'9°C(14 ^h)		NO ₃ : 0'101mg/1
		NH ₄ : 0'08mg/1
		P ₂ O ₅ : 0'0 mg/1

a : bank : on the sand : *Caridina* sp. **b : under stones :** Ephemera and Plecoptera larvae, Helicopsychidae-larvae (very frequent), Litho tanytarsidae in tubes in the calcareous sinter, *Eubrianax* sp. **c :** two different species of *Paludomus*: 5-10/1/16m², young specimens. 5-10/dm² on sand and stones near the banks. **d :** Algae and calcareous sinter (5-10cm. high). **e :** adult Odonata : *Libellago greeni*.

FC 29 : 9.12.1970 : Diyaluma-Falls, coming from the Horton Plain at World's End and fall about 150m. no shadow (Fig. 21).

Alt. : 500m	Che : pH : 6'7
Br. : 10m	El ₂₀ : 34 μ Siemens
D. : 1-3cm in	Tot.H. : 0'8°dH
pools 50cm	Alk. : 0'3 mval
Curr. : more than 1m/sec	SiO ₂ : 24'8mg/1
Gr. : granitic rocks, boulders	Cl : 2'41mg/1
Te. : around 20°C(17 ^h)	NO ₃ : 0'35mg/1
	NH ₄ : 0'08mg/1
	P ₂ O ₅ : 0'06mg/1

a : Cascades, on the rocks : Baetidae-larvae, Simuliidae-larvae, Blepharoceridae-larvae. **b :** Algae from the rocks. **c :** 2 different species of *Paludomus*, one on the rocks, the other more on the border. **d :** fishes : *Garra ceylonensis*, *Rasbora daniconius*, *Puntius dorsalis*, *Ophiocephalus gachua* ; shrimps : *Macrobrachium* sp. and *Caridina simoni*.

5.4 : We-Ganga (a tributary of Kalu-Ganga) :
10.12.1970 :

FC 30 : 10.12.1970 : We Ganga near Balangoda running in a deep gorge between forest and paddy fields, pools on the border with reeds ; muddy and sandy bottom (Fig. 23).

Alt. : 400m	Che. : pH : 7'2
Br. : 5-10m	El ₂₀ : 89 μ Siemens
D. : cascades : 1-5cm,	Tot. H. : 2'35°dH
in pools : 50cm-1m	Alk. : 0'97 mval
Curr. : cascades : more than 1m/sec	CaO : 15'6mg/1
pools : 0-30cm/sec	MgO : 5'7mg/1
Gr. : granitic rocks, boulders,	SiO ₂ : 24'8mg/1
gravel, on the banks sand and	Cl : 4'82mg/1
mud, with reeds and rushes	NO ₃ : 0'05 ₂ mg/1
Te. : 24'7°C(10 ^h)-25'6°C(12 ^h)	NH ₄ : 0'04mg/1
	P ₂ O ₅ : 0'17mg/1

a : bank : on the surface and on sandy ground : Veliidae, larvae of Odonata, Corixidae, Hydrophilidae, Dytiscidae. **b** : on the rocks of the cascades : Baetidae-larvae (3/cm²), Hydropsychidae larvae (10-20/dm²), *Aulacodes* sp. larvae (5/dm²), Simuliidae larvae (5/cm²) and many pupae, *Potamophilinus costatus*, Chironomidae larvae. **c** : *Paludomus necitoides* (5-10/1/16m²), *Melanoides tuberculatus* (10-15/dm² on muddy sand), *Thiara* sp., *Bulimus* sp. (on stones near the banks : 3-5/dm²), *Indoplanorbis* sp. (between algae in the reed-region). **d** : fishes : *Ophiocephalus gachua*, *Puntius dorsalis*, *Puntius bimaculatus*, *Garra ceylonensis*, *Rasbora daniconius*, *Anguilla* sp., crabs : *Paratelphusa* sp. ; shrimps : *Macrobrachium* sp. **e** : drift. **f** : Algae from the rocks and from the reed region. **g** : adult Odonata *Trithemis festiva*, *Trithemis aurora*.

6. Region of Kitulgala

6.1 : TRIBUTARIES AND BED OF KELANI GANGA :

FC 34 : 26.12.1970 : Bibili-Oya, a tributary of Kelani Ganga, near Kitulgala partially shady (Fig. 24 and 25).

Alt. : 80m	Che.: pH : 6
Br. : 6-10m	Tot. H. : 0'8°dH
D. : 10-50cm., in pools : 1m.	
Curr. : 50cm.-1m/sec	
Gr. : granitic boulders (30cm-2m) gravel, sand, on submerged rocks floating waterplants	
Te. : 25'4°C (14 ^h) - 25'8°C (16 ^h)	

a : bank : on the surface and on sandy ground : Veliidae, Gerridae, Corixidae, larvae of Anisoptera, *Aulonogyrus* sp., *Orectochilus* sp., *Caridina* sp. **b** : under stones in the current of 50cm. 1m/sec : *Dugesia* sp., Baetidae-larvae (5-10/dm²), Ecdyonuridae-larvae (1-2/dm²), *Neoperla* sp., -larvae (1/dm²), Anisoptera-larvae (1-2/dm²), Leptoceridae-larvae (2-3/dm²), Helicopsychidae-larvae—*Aulacodes* sp.—larvae, *Eubrianax* sp., *Taprobanelmis carinata*; on the rocks of cascades : Baetidae-larvae (5/cm²), Hydropsychidae-larvae (1-2/dm²), Simuliidae-larvae (5-10/cm²). **c** : fishes : *Garra ceylonensis*, *Puntius cumingi*, *Puntius sarana*, *Glossogobius giuris*, *Rasbora daniconius*, *Ophiocephalus gachua*, *Belontia signata* ; frogs. **d** : drift. **e** : floating waterplants with Baetidae-larvae, Plecoptera-larvae, Lepidoptera-caterpillars, Leptoceridae-larvae. **f** : Algae from stones.

FC 35 : 27.12.1970 : Hal-Oya near Ginigathhena, a tributary torrent of Kelani-Ganga, no shadow (Fig. 27).

Alt. : 650m	Che.: pH : 6'8
Br. : 1-5m	El ₂₀ : 36 μ Siemens
D. : 10-50cm, in pools : 1m	Tot. H. : 0'82°dH
Curr. : 30-50cm/sec, in cascades : more than 1m/sec., in pools : 0-2 cm/sec.	Alk. : 0'4 mval.
Gr. : granitic boulders (1-2m), gravel, sand	CaO : 5'15mg/l
Te. : 22'5°C (9 ^h) - 23'1°C (11 ^h)	MgO : 2'16mg/l
	SiO ₂ : 12'3mg/l
	Cl : 1'99mg/l
	NO ₃ : 0'04mg/l
	NH ₄ : 0'03mg/l
	P ₂ O ₅ : 0'16mg/l



Fig. 23 FC 30 We ganga



Fig. 24 FC 36 Rambukpoth Oya

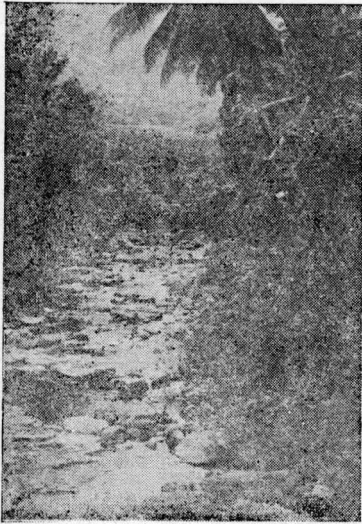


Fig. 25 FC 34 Bibili Oya

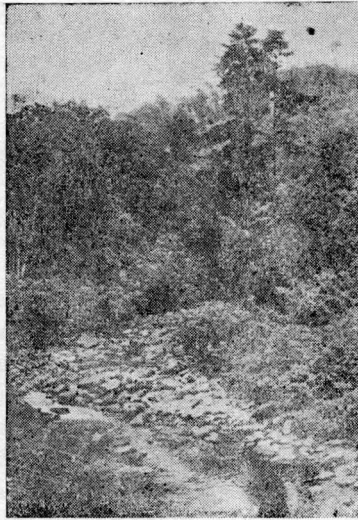


Fig. 26 FC 34 Bibili Oya



Fig. 27 FC 35 Hal Oya

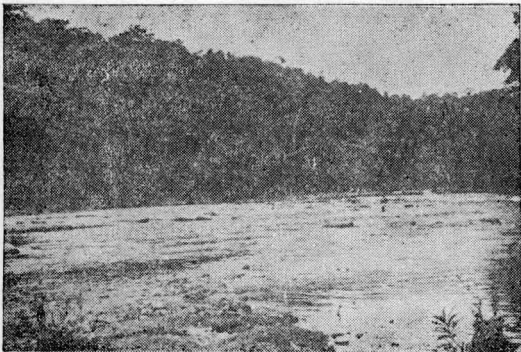


Fig. 28 FC 37 Kelani ganga near Kitulgala



Fig. 29 FC 38 Kelani ganga near Hanwella

a : bank : on the surface and on the sandy ground : Veliidae, Gerridae, Notonectidae, larvae of Zygoptera, *Aulonogyrus* sp., *Orectochilus* sp., tadpoles. **b : under stones near the banks** : Leptophlebiidae-larvae (on sand under stones : 2-3/dm²), Ecdyonuridae-larvae (under stones : 3-5/dm²), Plecoptera-larvae, (*Euphaea splendens* (2-3/1/16m²), *Eubrianax* sp. (2-3/dm²)). **c : on rocks of cascades** : larvae of Baetidae, Hydropsychidae, Simuliidae, Blepharoceridae, *Aulacodes* sp., Rhyacophilidae and rarely *Dugesia* sp. **d** : *Paludomus neritoides* (2-5/1/16m²). **e** : fishes, frogs, crabs and shrimps. **f** : drift. **g** : Algae from stones. **h** : adult Odonata : *Euphaea splendens*.

FC 36 : 27.12.1970 : Rambukpoth-Oya near Pitawela, a tributary torrent of Kelani-Ganga, running through a deep gorge, no shadow (Fig. 26),

Alt. : 625m	Che.: pH : 6'7
Br. : 5-8m	El ₂₀ : 18'7 μ Siemens
D. : 5-30cm, in pools : 50cm	Tot. H. : 0'36°dH
Curr. : 30-75cm/sec., in cascades : more than 1m/sec	Alk. : 0'14 mval CaO : 0'89mg/1
Gr. : granitic boulders (1-3m), gravel, sand	MgO : 1'92mg/1 SiO ₂ : 11'2mg/1
Te. : 25'1°C (13 ^h)	Cl : 1'70mg/1 NO ₃ : 0'037mg/1 NH ₄ : 0'03mg/1 P ₂ O ₅ : 0'18mg/1

a : bank : on the surface and on the sandy ground : Veliidae, Gerridae, Notonectidae, *Aulonogyrus* sp., *Orectochilus* sp., *Paratelphusa* sp., Hydrophilidae, Dytiscidae, tadpoles. **b : under stones near the banks** : *Dugesia* sp., Ecdyonuridae-larvae (3/dm²), Plecoptera-larvae (1/dm²), *Euphaea splendens* (2-3/1/16m²), Helicopsychidae-larvae (1-3/dm²), *Synagapetus hanumata*—pupae (3-5/dm²), *Eubrianax* sp. (1-2/dm²), *Ilamelmis brunnescens* (frequent). **c : on the rocks of cascades** : Baetidae-larvae (very frequent), Hydropsychidae-larvae (and pupae), Simuliidae-larvae (and pupae), Blepharoceridae-larvae. **d** : *Paludomus neritoides* (5-10/1/16m²). **e** : *Paratelphusa* sp., *Macrobrachium* sp., frog **f** : Algae from stones.

FC 37 : 28.12.1970 : Kelani-Ganga near the Kitulgala Resthouse (Fig. 28).

Alt. : 60m	Che.: pH : 6'65
Br. : 30-40m	ElII : 33'5 μ Siemens
D. : 30-50cm	Tot. H. : 0'71°dH
Curr. : 50cm-1m/sec	Alk. : 0'28 mval
Gr. : granitic rocks, gravel, sand, sometimes with floating waterplants	CaO : 4'48mg/1 MgO : 1'84mg/1 SiO : 6'5mg/1

Te. : 24'3°C (7^h) - 24'5°C (9^h) -
25.8°C (11^h) - 26.4°C (18^h)

Cl : 2'41mg/l
NO₃ : 0'128mg/l
NH₄ : 0'08mg/l
P₂O₅ : 0'18mg/l

a : bank : on the surface and on sandy ground : Veliidae, Gerridae, Naucoridae, Ephemerida-larvae, Plecoptera-larvae, Zygoptera-larvae, *Eubrianax* sp. (only on stones). **b : on stones near the banks** : *Dugesia* sp. (1-2/dm²), Leptophlebiidae-larvae, (Plecoptera-larvae, Leptoceridae-larvae (1-6/dm²), Tanytarsidae-larvae with mud-tubes (*Eubrianax* sp. (1/dm²)). **c : under and on stones in the stronger current** : Baetidae-larvae (20-30/dm²), Ecdyonuridae-larvae (1-2/dm²), Plecoptera-larvae (1-2/dm²), Leptoceridae-larvae (in groups), Trichoptera-larvae with long tubes from small stones, *Helichus naviculus*, *Ordobrevia fletcheri flavolineata*. **d : on floating waterplants** : Baetidae-larvae, Plecoptera-larvae, Lampyridae-larvae, *Ordobrevia fletcheri flavolineatus*. **e** : *Paludomus loricatus* & *neritoides* (rare), *Thiara* sp. (rare). **f** : fishes : *Puntius nigrofasciatus*, *Chela laubuca*, *Rasbora daniconius*, *Noemacheilus notostigma*, *Glossogobius giuris*, *Macrogathus aculeatus*, *Ophiocephalus gachua*, *Anguilla nebulosa*, *Belontia signata*, *Tor khudree longispinis*, *Macrones vittatus*, *Clarias teysmanni brachysoma*; shrimps : *Atya spinipes*, *Macrobrachium* sp.; frogs. **g** : drift. **h** : Algae from the stones, waterplants and water-moss.

FC 38 : 28.12.1970 : Kelani-Ganga near Hanwella. Running through plantations. No shadow (Fig. 29).

Alt. : 20m
Br. : 50-100m
D. : more than 1m
Gr. : mud and sand
Te. : 27'2°C (15^h)

Che. : pH : 6'4
El₂₀ : 27 μ Siemens
Tot. H. : 03'6°dH
Alc. : 0'03 mval.
CaO : 2'52mg/l
MgO : 0'8mg/l
SiO₂ : 3'5mg/l
Cl : 2'84mg/l
NO₃ : 0'162m/l
NH₄ : 0'01mg/l
P₂O₅ : 0'02mg/l

a : bank : fishes and shrimps (*Caridina* sp.). No other animals.

7. Region of Anuradhapura and Polonnaruwa

In the northern part of Ceylon the Mission collected only from two streams and only Molluscs were collected.

7.1 : Region of Anuradhapura :

FC 31 : 15.12.1970 : Small canal near the temple of Isurumuniya, water polluted, colour : yellow-brown, not shady.

Br. : 50cm
D. : 50cm
Curr. : 30cm/sec

Che : Temp. : 25°C
Che : Tot. H. : 7°dH
pH : 7

Only *Paludomus* sp. from the border was collected.

7.2 : Region of Polonnaruwa :

FC 32 : 15.12.1970 : Small stream in a forest, crossing the road between Habarane and Dambulla in the west of Polonnaruwa, shady.

Br. : 1'5-3m	Che.: pH : 7'25
D. : 10-50cm	El ₂₀ : 605 μ Siemens
Curr. : 30cm/sec	Tot. H. : 12'9°dH
Gr. : sand, on the border of the stream are roots hanging and floating in the current	Alk. : 1'6 mval.
Te. : 25'5°C (18 ^h)	CaO : 50'9 mg/1
	MgO : 56mg/1
	SiO ₂ : 15mg/1
	Cl : 145'6mg/1
	NO ₃ : 0'081mg/1
	NH ₄ : 0'22mg/1
	P ₂ O ₅ : 0'18mg/1

Only Molluscs were collected : *Paludomus chilinoides* and *Lamellidens marginalis*.

(Abbreviations : Alt.:Altitude (in m.), Br.:Breadth (in cm. or m.), D.: Depth (in cm. or m.), Curr.: Current (in m/sec.); Gr.: Ground ; Te.: Temperature (in °Celsius) ; Che.: Chemistry ; Tot.H.: Total Hardness (in °dH=German Hardness degree, 1°dH=1'25°, English Hardness degree=1'79° French Hardness degree) ; Ca.H.: Carbonate Hardness (in °dH=German Hardness degree) ; Alk.: Alkalinity ; El₂₀ : Conductivity (in μ Siemens, Temperature : 20°C) ; CaO : Calcium ; MgO : Magnesium ; SiO₂ : Silicate ; Cl : Chloride ; NO₃ : Nitrate ; NH₄ : Ammonium ; P₂O₅ : Phosphate.)

5- GENERAL COMMENTS

Of the 36 flowing water systems investigated by the mission in Ceylon, 32 were in the region of the crystalline precambrian rocks. Two samples taken from the Kuda-Oya, a tributary of the Menik-Ganga near Buttala (FC 27), and from the Wetakei-Ela, a small tributary of the Kirindi-Ganga near Wellawaya (FC 28), however markedly differed chemically from the other samples collected from the rivers and streams in the mountain region. Both these rivers run through the hilly region in front of the mountains of Southwest Ceylon and traverse the crystalline chalk layers, While usually the electrolytic conductivity in the brooks and rivers in the crystalline precambrian rock regions ranged between 8'8 and 89 μ Siemens (mean values 10 to 30 μ Siemens) and was therefore rather low, these two rivers (FC 27 and 28) however showed an electrolytic conductivity of 295 and 360 μ Siemens respectively. Also the total hardness of these rivers reflects a higher dissolved mineral content : with FC 27 it was 9'2°dH and with FC 28 it amounted to 11'6°dH. The mountain brooks and rivers in the crystalline zone vary in their total hardness from 0.08°dH up to 2'35°dH. Another exception to this were the two samples taken from the miocene chalk-region in the north-central part of Ceylon, FC 31 (near Anuradhapura) and FC 32 (near Polonnaruwa) where the total hardness is between 7° and 12'9°dH. The electrolytic conductivity only measured at FC 32, reached 606 μ Siemens. The detailed chemical data collected will be the subject of the paper by G. Weninger in this periodical. These results show that the flowing water systems in the Southeastern crystalline mountain region of Ceylon are extremely poor in electrolytes, very soft and slightly acidic. The CaO contents in their courses (brooks, torrents, rivers) amount from 1 to 5 mg/1. Only the Calcium rich brooks in the Southeast and North (FC 27, 28 and FC 32) attain higher values, i.e., 50 mg./1.

The water temperatures in the months of November and December 1970—increased over a distance of 100 to 150 km. (with a variation in altitude of 2,000m. from springs and river sources to the mouths of the large streams) by 15° to 28°C on the average, i.e., a variation of approximately 13°C. Following is a chart giving a survey on the average temperatures of the flowing water systems in the various altitude levels (see also Fig. 30) in November and December, 1970.

	Between 1,800m. and 2,000m. altitude level :	15°C
„	1,500m. and 1,700m. „ „ :	17°C
„	1,100m. and 1,400m. „ „ :	19°6°C
	1,000m. „ „ :	20'2°C
Between	800m. and 900m. „ „ :	22.3°C
„	600m. and 700m. „ „ :	24.8°C
	500m. „ „ :	25.1°C
	250m. „ „ :	25.6°C
	100m. „ „ :	26°C
	50m. „ „ :	26'3°C
	20m. „ „ :	27'2/C
	river mouth „ „ :	28°C

At the steep gradient of the Horton Plains (World's End) in the South-east of the island fall of the water over several hundred meters at a height of 600m. increased the temperature only to 20°C !

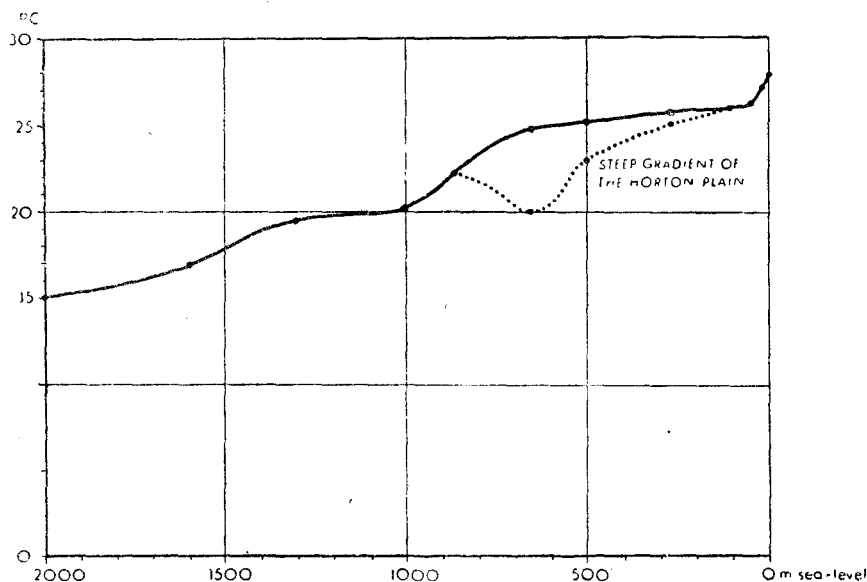


Fig. 30 Increase of the water-temperature of running waters from the sources at 2000m altitude to the mouth of the stream.

The average increase in temperature of running water per 100m. sealevel is approximately 0'75° to 1'5°C. It is interesting to note that with the steep gradient at World's End, where the water gushes down several hundred meters from more than 1,500m above sealevel to 700 and 600m (FC 24, 25, 26, 29) the increase in temperature is markedly less than that in the remaining highlands, where the rivers descend gradually.

The differences between day-and night-temperatures become less pronounced when recorded from the mountainous regions towards the coastal regions.

1,300m above sealevel : 4°-5°C Difference between maximum and minimum temperatures
(day and night)

600m above sealevel : 3°-4°C Do.

60m above sealevel : 2°-3°C Do.

These values show that in the higher mountain regions, the brooks and torrents are cooling off more—due to the greater radiation—compared to the hilly region and the lowlands where day and night temperatures are about equal.

Due to their short courses, the brooks and rivers of the Ceylonese mountain region have strong falls ; on the average it is 15 p.m. (difference in height : 2,000 m. over a course of appr. 130km.). In the region of the sources and upper courses, the percentage of the falls rises to 50 p.m. and more in the hilly region and in lowlands alike, it amounts to only 5 p.m. and above.

The remarkable falls cause high current velocities, mostly in the region of the spring sources and the upper courses of brooks and rivers. Frequently cascades lie on the way which may descend for several hundred metres in some instances where the base goes down in steep gradients like cataracts. (e.g., steep gradients of the Horton Plains at World's End toward South east).

According to our measurements, the average flow velocity of the mountain brooks reaches 50cm. to 100cm. per second. In the cascades the current becomes turbulently rapid and soars to more than 150 to 200 cm./sec. Between the cascades are frequently—covering larger and shorter distances—groove-like pools, where the current reaches only a maximum of 30cm./second. This situation may also be found at river banks. In the pools are often deep water regions where deep water-fauna may colonize. However, these regions are flooded from time to time after showers of heavy rain and, therefore, are included into the regions of the strong currents for a short periods of time.

The formation of the bottom is a consequence of the high flow velocity ; the bottom structure is important for the occurrence of any given animal species. In currents over 150 cm./sec. the bottom of the Ceylonese mountain brooks is mainly formed of standing, smooth granite rocks over which the water spurts at a few centimeters' depth. Around 150cm./sec. current, the bottom is formed of large boulders with blocks of several square meters surface and up to 1m. in diameter, over which small torrents dash. At a current velocity of 100cm./sec. there are medium-sized boulders of 30 to 80cm. diameter, small cascades are followed by deeper pools which are filled with sand. Shallower portions with a flow velocity of 50cm. to 75cm./sec. are covered with gravel (5cm. to 20 cm. in diameter) which is usually covered in turn by a layer of coarse sand. Towards the river bank regions and pools, where the flow velocity decreases to 20cm.-30cm./sec., is a region with fine sand which gets gradually mixed with mud when the flow velocity reaches less than 10cm./sec. In the river bays there are frequently dense layers of vegetable debris that had been washed over the stratum of fine sand and mud.

The depth of the most mountain brooks and torrents—having a width of 2m. to 10m. (at low water level)—hardly surpass 20cm. to 30cm. in the regions with stronger current, whereas the bottom sinks to 50cm. and more in the pools and river-bay sections. In the middle courses (e.g., Kalu-Ganga near Ratnapura or Kelani-Ganga near Kitulgala) the river centre sometimes reaches a depth of 1m. to several meters.

The following main regions may be differentiated in the biotopes of a mountain brook or torrent ; river banks ; pools (with slight current or deep-water regions) ; stones on the river banks covered with sand, pebble and gravel ; and rocks. Each of these regions has a characteristic fauna in them :

1. River Banks :

- 1.1. Region where the water dashes on to rocks and stones, along side the cascades : *Euscelimena givalis* (Tetrigidae, Saltatoria) and *Paranemobius pictus* (Gryllidae), and also algae.
- 1.2. If a dense growth of plants is prevailing : *Deroceras laeve* (Pulmonata, Gastropoda).

2. Bank-Region and pools between cascades (current : 0 to 30cm/sec) :

- 2.1. Facial (surface of the water): Veliidae, Gerridae, Gyrrinidae (*Aulonogyrus* sp., *Orectochilus* sp.).
- 2.2. On the sand, mud and washed out vegetable debris : Zygoptera- and Anisoptera-larvae, Leptophlebiidae-larvae, Naucoridae, Notonectidae, *Caridina nilotica*, *Caridina pristis*, *Melanoides tuberculatus*, *Thiara* sp.
- 2.3. In sand mixed with mud : Anisoptera-larvae (*Anax* sp.), *Ephemera* sp. -larvae.
- 2.4. Stones near the river bank (covered with sand and mud) : Zygoptera-larvae (above all *Euphaea splendens*), Anisoptera-larvae, *Eubrianax* sp., *Heleocoris bengalensis*, *Paludomus neritoides*, *Paludomus loricatus*, *Dugesia* sp.
- 2.5. Beneath stones on the river bank : *Paratelphusa* sp.

3. Pebble and gravel stones (current : 50cm. to 1m./sec.) :

Euphaea splendens-larvae, Anisoptera larvae, Baetidae-larvae, *Neoperla* sp. -larvae, Leptoceridae-larvae, *Agapetus* sp. (?) -larvae, Hydropsychidae-larvae, Rhyacophilidae-larvae *Aulacodes* sp. -larvae, *Eubrianax* sp.—larvae, Dryopidae (adults and larvae) : *Helchus naviculus*, Elmintidae (adults and larvae) : *Potamophilinus costatus*, *Ordobrevia fletcheri* and *O. fletcheri* subspec. *flavolineata*, *Ilamelmis foveicollis*, *I. foveicollis* var., *Ilamelmis brunnescens*, *Podelmis aenea*, *Podelmis quadriplagiata*, *Taprobanelmis carinata*, *Zaitzevaria bicolor*, Elminthinae nov. gen., nov. spec., Simuliidae-larvae, *Rheotanytarsus* sp. -larvae, *Paludomus neritoides*, *Paludomus loricatus*, *Dugesia* sp.

4. Rocks (cascades, with a current above 1m./sec.) :

Baetidae-larvae, Simuliidae-larvae, Blepharoceridae-larvae, Hydropsychidae-larvae, *Aulacodes* sp.-larvae.

The quantitative collections in the various altitudes above sea level yielded the following mean values of individuals of the macro-and mesofauna per 1/16m² :

Altitude above sea-level	River bank or pools (current : 0 to 30cm./sec.)	Pebble or gravel region (current : 50cm. to 1m./sec)	Rock (Region of the cascades, current : more than 1m./sec.)
1.500m. to 2.000m. (sources and brooks) ..	25-30	50-200	300 up to 500
appr. 1.000m. (brooks, torrents, upper courses of the rivers) ..	30	35-75	400 up to 750
50 to 250m. (brooks, middle courses of the rivers)	10	20-70	500 up to 750

This average compilation shows a significant increase of the density of population towards the strong current. It becomes apparent that the highest number of species may be found in the region of the pebbles and gravel, while in the region of spurting water there are only a few species which have extensively adapted themselves to the strong current ; however this region is high in individual numbers (mostly Simuliidae-larvae).

The density of the various species and groups (average number of individuals per 1/16m²) from the different regions of the torrential streams : with different current is as follows:—

				0-30cm./sec.	30-75cm./sec.	75-more 1m./sec.
Turb.:	<i>Dugesia</i> sp.	..	..	10-80	sp.	—
Eph.:	Leptophlebiidae—1.	..	..	15-80	—	—
	Ecdyonuridae—1.	..	..	5	15	—
	Baetidae—1.	..		sp.	80	25-more than 100
	<i>Ephemera</i> sp.—1.	..	..	sp.	—	—
Plec.:	<i>Neoperla</i> sp.—1.	..	..	sp.	2-20	—
Odon.:	Zygoptera—1. (mostly <i>Euphaea splendens</i>)..			sp.	5	—
	Anisoptera—1.	..	..	sp.	sp.	—
Trich.:	Helicopsychidae—1.	..	..	35	13	—
	Leptoceridae—1.	..	..	20-80	15	—
	Hydropsychidae—1.	..	..	—	10	10-250
	Rhyacophilidae—1.	..	..	sp.	sp.	sp.
Lepid.:	<i>Aulacodes</i> sp.—1.	..	..	—	sp.	10-20
Dipt.:	Tipulidae—1.	..	..	sp.	—	—
	<i>Rheotanytarsus</i> sp.—1.	..	..	—	up to over 100	—
	Simuliidae—1.	..	..	—	50-70	up to 500
	Blepharoceridae—1.	..	..	—	—	20-250
Coleopt.:	Hydrophilidae (adult)	..	..	sp.	—	—
	Dytiscidae (adult)	..	..	sp.	—	—
	Dryopidae and Elmintidae (adult)	..	..	—	sp.	sp.
	<i>Eubrianax</i> sp.—1.	..	..	7 (on stones !)	2-15	—
	Gyrinidae (adult)	..	..	3-5	—	—
Mollusca :	<i>Paludomus neritoides</i>	..	..	sp.	2-3	—
	<i>Paludomus loricatus</i>	..	..	sp.	sp.	—
	<i>Melanoides tuberculatus</i>	..	..	sp. to 50 (on muddy sand)	—	—
	<i>Thiara</i> sp.	..	..	sp.	—	—
	<i>Bulsimus Sthenothyroides</i>	..	..	sp.	—	—

Abbreviation : sp: sporadic,—: absent.

After the detailed determinations of the animals by the specialists a more detailed biocenotic characterization will be set up in relation to the ecological data that have been collected by the mission. These ecological relationships of the fauna of the mountainous brooks and streams of South west Ceylon will be published as the final part of the publications.

SUMMARY

The Austrian-Ceylonese Hydrobiological Mission of 1970 investigated and made collections from 36 flowing water systems (brooks, torrents, rivers) ; of these 34 water systems were in the mountainous regions of Southwest and Southeast of Ceylon. In the crystalline mountain region, the water systems are extremely poor in electrolytes, very soft and slightly acid ; these torrential streams have strong falls, high flow velocities and boulder bottoms. The water temperatures increase from the sources and brooks at 2,000m. altitude to the mouths from 15°C to 28°C. The density of animal population (macro-and mesofauna) increases from the river bank regions (and pools) towards the sections with strong current and reaches on the rocks in the cascades a density of 500 to appr. 750 individuals/1/16m².

ZUSAMMENFASSUNG

Die Österreichisch-Ceylonesische Hydrobiologische Mission 1970 untersuchte und besammelte 36 Fließgewässer (Bäche, Wasserfälle, Flüsse). 34 dieser Gewässer lagen in der Bergregion von Südwest- bzw. Südost-Ceylon. Die Fließgewässer der kristallinen Gebirge sind extrem elektrolytarm sehr weich und schwach sauer. Sie zeigen ein starkes Gefälle mit hohen Fließgeschwindigkeiten, und Geröllgrund. Die Wassertemperaturen steigen von den Quellen und Bergbächen in 2000m Seehöhe bis zur Mündungsregion der Flüsse von 15°C auf 28°C im Durchschnitt. Die Individuendichte der Makro- und Mesofauna steigt von den Uferregionen (und Kolken) zu den Abschnitten der starken Strömung an. Sie erreicht an den Felsen in den Wasserfällen eine Dichte von 500 bis ca. 750 Individuen/1/16m².

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