CONTRIBUTION TO THE KNOWLEDGE OF THE FRESHWATER FAUNA OF LA RÉUNION (MASCARENE)

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RÉSUMÉ

Dans le cadre de l'étude hydrobiologique et faunistique des eaux courantes des îles tropicales de l'Océan Indien, des recherches ont été effectuées dans quelques rivières de la Réunion. Les facteurs écologiques tels que la vitesse du courant, la température, la chimie des eaux et la nature des substrats ont été étudiés.

Ce rapport préliminaire concerne la situation générale, la géologie, le climat et les conditions physicochimiques des rivières étudiées. Il donne également un schéma général des communautés animales dans les différents biotopes et les différentes zones des cours d'eau, et analyse la zonation longitudinale des espèces récoltées, de la zone à l'embouchure.

ABSTRACT

In continuation of hydrobiological and faunistic studies on the fauna of running waters in isolated tropical islands in the Indian Ocean a study was carried out, under consideration of ecological factors, such as temperature, velocity of the current, sort of bottom and chemistry, in selected rivers of La Réunion. These preliminary report deals with the general situation, geology, climat, physical and chemical condition of the investigated rivers. A survey of the animal-communities in the different biotops of the differents parts of the running waters is given. In consequence is also compared the distribution of the found species (or groups) from the headwaters down to the mouth-regions.

ZUSAMMENFASSUNG

In Fortsetzung der hydrobiologischen und faunistischen Studien der Fließgewässer-Fauna auf isolierten tropischen Inseln des Indischen Ozean wurde eine Untersuchung auf der Insel La Réunion durchgeführt. Bei den Aufsammlungen wurden verschiedene ökologische Faktoren, wie Temperatur, Strömungsgeschwindigkeit, Art des Bodengrundes und Chemismus berücksichtigt. Dieser vorläufige Bericht gibt eine erste Übersicht über die Geologie, das Klima, die physikalischen und chemischen Gegebenheiten der untersuchten Fließgewässer. Weiters wird eine Zusammelstellung der tierischen Vergesellschaftungen in den verschiedenen Lebensräumen der Bach-und Flußabschnitte gegeben. Außerdem wird die Verteilung der einzelnen Arten (oder Gruppen) zwischen dem Quellgebiet und den Mündungen dargestellt.

1. INTRODUCTION

In continuation of hydrobiological and faunistic studies on the fauna and flora of running waters on geologically longtime-isolated continental and oceanic islands in Indopacific, a study was carried out, under consideration of ecological factors like temperature of water, velocity of the current, kind of bottom and chemistry, in selected rivers of La Réunion, the bigest island of the Mascarene Archipelago.

Studies on rivers and streams of Indopacific

tropical islands was carried out in Sri Lanka (Ceylon) by STARMÜHLNER and COSTA (1972), and WENINGER (1972). In the Pacific area in New Caledonia by STARMÜHLNER (1968, 1969 and 1970) and WENINGER (1968). The freshwater-fauna of Madagascar, the bigest Indian Ocean island and very near to La Réunion was studied by different authors, like PAULIAN (1953), STARMÜHLNER (1962 and 1969), RAMANANKASINA (1968). Very few contributions are to find about the freshwater-fauna of the Mascarene Archipelago, mostly systematically studies from BORY St. VINCENT (1803), PESCHET (1917), PELLEGRIN (1933), GERMAIN (1921), BALFOUR-BROWNE (1954 and 1958).

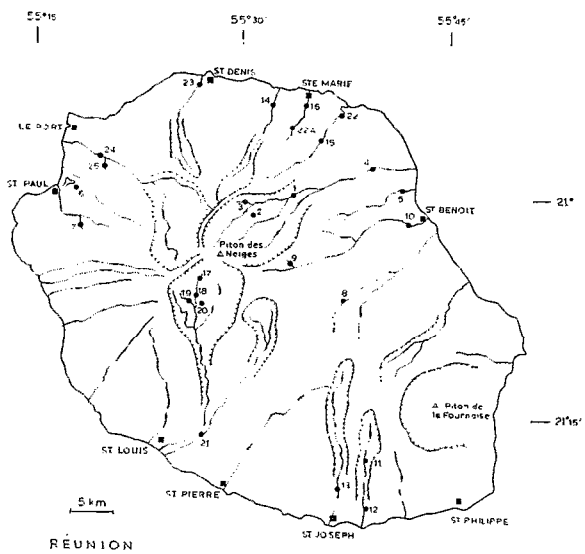

Fig. 1. — Map of the Island of La Réunion with the figures of the sampling points on the rivers.
Carte de l'île de La Réunion, avec les numéros des stations de prélèvement.

The mission to La Réunion was carried out in April 1974 and the members of the mission collected samples from 26 stations on streams and some stillwaters near streams (fig. 1). At nearly every station, samples were collected in different habitats, such as muddy-sandy banks and pools between cascades, on and under stones in the stronger current and on rocks and boulders in the rapids. If developed, it was also collected on the vegetation such as filamentous algae and higher water plants.

2. METHODS

The animals were collected both qualitatively and quantitatively. Plants, mostly algae, were collected only qualitatively, scratched of from the stones and rocks. The freely swimming or crawling species of running water, animals such as fishes, tadpoles, crabs, water beetles, water bugs, shrimps etc. were collected by net or larger sieves.

The qualitative collections of the mesofauna were made by means of different wiremesh sieves (mesh-width: 0.1-0.5 mm) with mud, sand and finer gravel soil, whereas on larger pebbles and boulders the collections were made by removing the animals from the stones with tweezers and placing them into a plastic dish or container. Collections from rocks (mostly in rapids, torrents, waterfalls) were made exclusively with forceps only.

Regarding the quantitative collections, as a rule stones from a ground of 1/16 m^2 (squares of 25 cm lenght) were taken and the collections where then poured into plastic dishes; the remaining sediments were sieved. Apart from that the density of population of the most frequent species of the mesofauna was determined per 1 dm^2 or 1/16 m^2 (only for larger species such as biger gastropods, crabs etc. per 1/4 m^2 or 1 m^2). Most freshwater animals were conserved in 75 % alcohol, but fishes, frogs, tadpoles, oligochaets, algae and waterplants were preserved in 4 % formol. Turbellaria (Tricladida), rarely oligochaetes and gastropods, were fixed in BOUIN's liquid for subsequent histological examination. The separation of the animals (and plants), collected from different habitats of a station, took place in the laboratories of the first Zoological Institute of the University of Vienna, Section of Malacology.

3. GEOLOGY AND CLIMATE

La Réunion lies about 700 km E of Madagascar and has a total surface of 2512 km^2. The island is built by two volcanoes, the now extinct Piton des Neiges (3069 m, fig. 3) in the NW and the still active Piton de la Fournaise (2366 m) which forms the SE one-third of La Réunion. Piton des Neiges is a large shield volcano and approximately circular in outline with a diameter of about 50 km. Apart from a number of spectacular gorges with torrents, the original form of Piton des Neiges is quite well preserved. In marked contrast, the central regions have been eroded into great cirques, an extreme development of amphitheatre-headed valley erosion: Cirque de Cilaos, de Mafate et de Salazie [UPTON and WADSWORTH (1965)] (fig. 1). As a result of the geological studies carried out by FISHER and *al.* (1967), MCDOUGALL (1971) and MONTAGGIONI (1974), the Piton des Neiges is apparently unique in its combination of extreme dissection and variety of rock types. Not only the youngest lavas and ashes largely preserved but, as a result of the valley erosion on a prodigious scale, relatively ancient suites of effusive and intrusive rock, ranging from

ultrabasic to acid in composition, are displayed for examination deep within the core of the original volcano.

A number of ancient terraces, composed of fluviatile sands and pebble-beds, occur in the river gorges draining out from the cirques. Some of these, through which the streams have trenched deep ravines, are more than 100 m thick. Presently, deposition of this sort of material is occuring only in the deltaic fans at the seaward ends of the gorges (fig. 6, 7). Palaeomagnetic studies by CHAMALAUN and McDOUGALL (1966), and K-Ar studies by McDOUGALL (1971) show that the lavas of Piton des Neiges were erupted from the late Pliocene at about 3 to 1 million years and 0.55 to 0.43 million years ago. Following a third episode, a hiatus of about 100.000 years, alcali andesites and basalts were erupted in a fourth episode between about 350.000 and 70.000 years ago.

The climate of La Réunion, which is tropical on the whole, is actually altered by the Ocean and by altitude—two factors determining a host of micro-climates. There are two seasons: the fresh season lasts from may to november with a general fall in temperature with persistent drought in the zone « Under the wind ». Fine weather then prevails on the island, the only disturbance being occasional showers in the « Windy zone ». The hot season between december and march has trade winds with low intensity and the warmimg of the air affects the isle as a whole. The long-period annual mean temperature at different altitudes is:

1.550 m	964 m	400 m	10 m	5 m
13.2° C	16.1° C	21° C	23.6° C	23.1° C

and the annual mean rainfall is:

1550 m	964 m	850 m	400 m	10 m	5 m
2313 mm	2393 mm	7578 mm	1555 mm	1157 mm	541 mm

The heaviest rainfalls are in the mountains situated in the « windy zone » and reaches till more than 7.5 meter a year! The original vegetation of the island with more than 300 endemic species is today only to find in the high mountain region, but the last trace of vegetation encountered before reaching the aridity of the summits. In the lower parts the original vegetation is expelled by man and cultivated areas are covering the hills and plains near the coast, dominated by sugar-cane fields.

4. PHYSICAL CONDITIONS OF THE RIVERS

The slopes from the eroded amphitheatre headed central massives of the extinct volcanoes are very steep (fig. 3) and the upper courses of the streams are mostly waterfalls and torrents of hundred and more meters high. In the table 1 is given a survey of lenght and average gradient of some rivers (fig. 2):

TABLE 1

Lenght (km) and average gradient °/₀₀) of some rivers of la Réunion.
Longueur (km) et pente moyenne (°/₀₀) de quelques cours d'eau de la Réunion.

River	Lenght	Upper course	Middle course	Lower course	Average
River Mât	ca. 30 km	100-200°/₀₀	21°/₀₀	14°/₀₀	30-40°/₀₀
River Galets	ca. 25 km	150°/₀₀	32°/₀₀	16°/₀₀	60-70°/₀₀
River Cilaos	ca. 25 km	250-300°/₀₀	50°/₀₀	20°/₀₀	90°/₀₀
River des Pluies	ca. 18 km	580°/₀₀	80°/₀₀	20°/₀₀	90°/₀₀
River Saint-Denis	ca. 13 km	500°/₀₀ (!)	40°/₀₀	20°/₀₀	100°/₀₀

In consequence of these steep gradients, especially in the upper parts, the streams of La Réunion are typically mountain rivers with torrents, cascades and rapids with strong currents of more than 1 m/sec on the average and a bottom of basaltic rocks, boulders and gravel. Only near the banks are there zones with shallow creeks, and between the cascade-zones stair-like series of pools with very slow current or nearly stillwaters. Some of the streams like the Ravine Sèche in the Plaine des Palmistes are flowing only in the rainy season, outside of these season rest only biger and smaller rock-pools (fig. 5). The bottom of the banks and pools between cascades is built by sand and mud, covered with vegetable debris, deposited after floods.

The vegetation of the mountain streams cover with cushion-like water-mosses, floating filamentous green-and blue-algae and overgrowth of diatoms is sometimes very rich.

According to the measurements made in april 1974, the water-temperatures increase from:

the headwaters (1500 m)	15° C
the upper courses (1200 m-400-500 m)	18.2-23.4° C

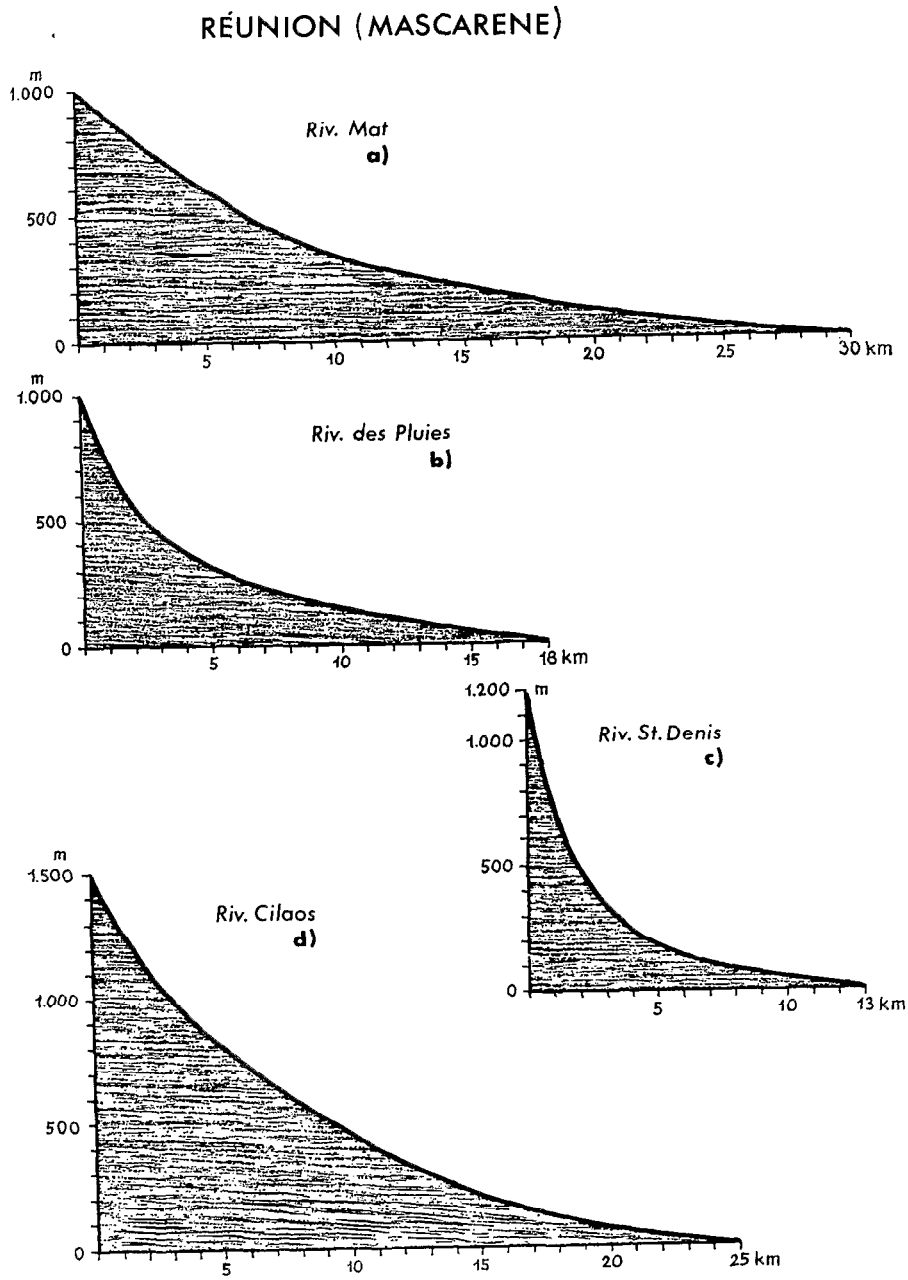

Fig. 2. — Gradient of different rivers of La Réunion.
Profil des pentes de quelques rivières de la Réunion.

the middle courses (400/500 m-100 m) 19-24.5° C
the lower courses (100 m-0 m) 22.7-28.4° C

The average differences between the lowest temperatures at the headwaters and the mouth-region was in april, 1974, 13.6 °C. The differences of the highest to the lowest day-temperatures were in the headwaters and upper courses approx. 4 °C to 5 °C, in the lower courses and the mouth region approx. 4 °C to 6 °C.

5. CHEMICAL CONDITIONS OF THE RIVERS

The islands of the Mascarene Archipelago are of volcanic origin and, at La Réunion, are composed

of different series of lavas from different eruption phases, ranging from ultrabasic to acidic in compositions. In the table 2 are shown the average values of pH, Conductivity and Total Hardness in the different parts of the rivers of La Réunion from measurments in april 1974.

The table 2 shows that the highest values were found in the region of the upper to the middle courses down to the transition to lower courses. The different values depend on the different lavas eroded by the streams, especially in the mountains of the Piton des Neiges which is apparently unique in its combination of extrem dissection and variety of rock types! If the streams cross cultivated areas with plantations and villages some pollution is evident. Different are also the values found in some stillwaters (table 3).

6. THE ANIMAL COMMUNITIES IN THE DIFFERENT ZONES

6.1. *Headwater in 1500 m altitude:*

6.1.1. *Banks and pools (0-30 cm/s):*
Sicilicula borbonica

6.1.2. *Medium to strong current (30 cm/s->1 m/s):*
Orthocladiinae gen. spec.

6.2. *Upper courses between 1500 m and 700 m altitude* (fig. 4) :

6.2.1. *Banks and pools (0-30 cm/s):*
Pseudagrion punctum, Ceriagrion glabrum, Anisoptera gen. spec.; Hydroptilidae gen. spec.; Chironomini gen. spp., *Rheotanytarsus* sp. (30 cm/s); Rhagionidae gen. sp., *Lymnaea (Radix) mauritiana; Physa borbonica*; *Bufo regularis*; Surface : Veliidae gen. spec.; *Gyrinus nitidulus* (rock-pools); *Dineutus indus olivaceus*

6.2.2. *Medium current (30 cm/sec-75 cm/s):*

Hydropsychidae gen. spp., Hydroptilidae gen. spec. (in troops under stones); Orthocladiinae gen. spp., Rhagionidae gen. sp., Simuliidae gen. spp.; *Lymnaea (R.) mauritiana* (up to 50 cm/s). *Physa borbonica* (up to 50 cm/s)

6.2.3 *Strong current (75 cm/s->1 m/s):*
Hydropsychidae gen. spp., Hydroptilidae gen. spec. (in troops under stones); Orthocladiinae gen. spp., Simuliidae gen. spp.

6.2.4. *Hygropetric areas on rocks:*
Limonia cf. *tipulipes* (fig. 12)

6.3. *Upper to Middle courses between 700 m and 200 m altitude*

6.3.1. *Banks and pools (0-30 cm/s):*
Zygoptera gen. spp., *Anax imperator*; Hydroptilidae gen. spp. (in troops under stones); Orthocladiinae gen. spp.; *Hyphydrus distinctus, Guignotus strigicollis, G. lobulatus, Laccophilus irroratus, Paracymus chalceus, Dactylosternum* nov. sp. (all beetles mostly in flood pools near the border of the rivers); *Thiara scabra, Omphalotropis picturata* (from the border !), *Lymnaea (R.) mauritiana, Physa borbonica*; Surface : Veliidae gen. spp., *Gyrinus nitidulus, Dineutus indus olivaceus*

6.3.2. *Medium current (30-75 cm/s):*

Baetidae gen. spec.; Hydropsychidae gen. spp., cf. Hydroptilidae gen. spec. (in troops under stones); Orthocladiinae gen. spp., *Rheotanytarsus* spec., Rhagionidae gen. sp., Simuliidae gen. spp.; *Thiara scabra* (up to 50 cm/s), *Lymnaea (R.) mauritiana* (up to 50 cm/s), *Physa borbonica* (up to 50 cm/s)

6.3.3. *Strong current (75 cm/sec->1 m/s):*

Baetidae gen. spec.; Hydropsychidae gen. spp., cf. Hydroptilidae gen. spec. (in troops under stones); Orthocladiinae gen. spp., *Rheotanytarsus* sp., Simuliidae gen. spp.

6.3.4. *Hygropetric areas on rocks:*

Limonia cf. *tipulipes* (fig. 12); *Sarcophaga* sp. *Lymnaea (R.) mauritiana, Physa borbonica*

6.4. *Middle to Lower courses between 200 m and 50 m altitude:*

6.4.1. *Banks and pools (0-30 cm/s):*

Eunapius sp.; *Nais communisi*; *Caridina typus, C. brachydactyla brachydactyla, Atya pilipes*; Zygoptera gen. spp., *Trithemis annulata* and other Anisoptera gen. spp.; Hydroptilidae gen. spec. (in troops under stones); Orthocladiinae gen. spp., *Rheotanytarsus* sp. (30 cm/s), *Anopheles coustani, A. gambiae*; *Laccobius mascarensis, L. starmuehlneri*; *Neritina gagates* (from 170 m), *Thiara scabra, Lymnaea (R.) mauritiana, Physa borbonica*; tadpoles of *Bufo regularis*; Surface : Veliidae gen. spec.; *Dineutus aereus*

6.4.2. *Medium current (30-75 cm/s):*

Macrobrachium australe; Anisoptera gen. spp.; Hydropsychidae gen. spp., cf. Hydroptilidae gen. spec. (in troops under stones); Orthocladiinae gen. spp., *Rheotanytarsus* sp., Simuliidae gen. spp.; Ephydridae gen. spec. (in filamentous algae of a waterfall); *Neritina gagates* (from 170 m), *Septaria borbonica* (from 170 m), *Thiara scabra, Lymnaea (R.) mauritiana* (up to 50 cm/s), *Physa borbonica* (up to 50 cm/s); *Sicyopterus (Sicydium) lagocephalus* (with ventral sucker, attached on stones; from 80 m)

6.4.3. *Strong current (75 cm/s->1 m/s):*

Hydropsychidae gen. spp., cf. Hydroptilidae gen. spp. (in troops under stones); Orthocladiinae gen. spp., *Rheotanytarsus* sp., Simuliidae gen. spp., Ephydridae gen. spec. (in filamentous algae of a waterfall); *Neritina gagates* (under stones; from 170 m), *Septaria borbonica* (from 170 m); *Sicyopterus (Sicydium) lagocephalus* (with ventral sucker attached on stones; from 80 m)

6.5. *Lower courses to the mouth between 50 m and 0 m altitude* (figs. 6-10) :

6.5.1. *Banks and pools (0-30 cm/s):*

Dugesia aff. *gonocephala*; *Caridina typus, C. brachydactyla brachydactyla, C. serratirostris, Atya pilipes, Varuna litterata*; *Pseudagrion punctum, Ceriagrion glabrum, Trithemis annulata, Anax imperator*; *Thiara scabra, Syncera (= Assiminea) hidalgoi granum, Lymnaea (R.) mauritiana, Physa borbonica, Indoplanorbis exustus*; *Gambusia affinis holbrooki*, in the regions with brackish water during high tide : some marine and brackish water fishes; tadpoles of *Bufo regularis*; Surface : Veliidae gen. spec., Gerridae gen. spec.

6.5.2. *Medium current (30-75 cm/s):*

Dugesia aff. *gonocephala*; *Macrobrachium australe*, *M. lar*; Anisoptera gen. spp., Hydropsychidae gen. spp.; Orthocladiinae gen. spp., *Rheotanytarsus* sp., Simuliidae gen. spp.; *Neritina gagates*, *Clithon coronata* (fig. 13) (from about 10 m altitude, near the region of the recurrent flow during high-tide), *Septaria borbonica*, *Neritilia consimilis*, *Thiara scabra* (up to 50 cm/s), *Syncera (= Assiminea) hidalgoi granum* sp., *Lymnaea (R.) mauritiana* (up to 50 cm/s), *Physa borbonica* (up to 50 cm/s), *Indoplanorbis exustus* (up to 50 cm/s), *Ferrissia* (*Pellancylus*) cf. *modesta*

6.5.3. *Strong current (75 cm/s->1 m/s):*

Hydropsychidae gen. spp.; Orthocladiinae gen. spp., *Rheotanytarsus* sp., Simuliidae gen. spp.; *Neritina gagates* (under stones), *Clithon coronata* (under stones; fig. 13); *Septaria borbonica* (upside of stones), *Neritilia consimilis*.

TABLE 2

Mean values of pH, conductivity and total hardness in the different parts of the rivers of La Réunion (april 1974).
Valeurs moyennes du pH, de la conductivité et de la dureté totale dans différentes sections des cours d'eau de La Réunion (avril 1974).

	pH	Conductivity in µSiemens	Total Hardness in °dH
Sources-Headwaters 1500 m.....	7.9	52	1.15
Upper courses 1400 m-700 m.....	7.85-8	62-130	1.25-3
Upper to Middle courses 700 m-200 m.....	7.75-8.3	69-250	1.1-5.75
Middle to Lower courses 200 m-50 m.....	7.1-8.8	69-258	1-8
Lower courses to the Mouth Region 50 m-0 m.....	7-8.4	62-105	1-2.5

7. THE DISTRIBUTION AND DENSITY OF THE FOUND ANIMALS BETWEEN THE HEADWATERS AND THE MOUTH

TABLE 3

Mean values of pH, conductivity and total hardness in different stillwaters of La Réunion.
Valeurs moyennes du pH, de la conductivité et de la dureté totale dans différentes collections d'eau dormante de La Réunion.

	pH	Conductivity in µSiemens	Total Hardness in °dH
Polluted pond near the town of Cilaos (1220 m).....	9.2	160	3.8
Source-pond and origine of the Ravine sèche, an intermittend stream in the Plaine des Palmistes (950 m).....	6.95	24	0.45
Mare au Poule d'eau, a small mountain-pond (679 m)....	8.6	240	5
Étang St. Paul swampy pond, in connection with the source-pond Moulin d'Eau; the pond is near the E-coast in connection with brackish water (20 m-10 m).....	8	1600 (!)	10.7

TABLE 4

Distribution and density of animals in streams between the headwaters and the mouths.
Distribution et densité des organismes dans les rivières entre les sources et l'embouchure.

Section	H.			U.C.				U.C.-M.C.				M.C.-L.C.			L.C.-M.		
Altitude (m)	1500			1500-700				700-200				200-50			50-0		
Current speed (cm/s.)	0-30	30-75	75-100	0-30	30-75	75-100	Hyg.	0-30	30-75	75-100	Hyg.	0-30	30-75	75-100	0-30	30-75	75-100
Eunapius sp.....												+					
Dugesia aff. gonoceph...															15	+	
Caridina typus.....												++			++		
C. brachydactyla.....												++			++		
C. serratirostris.....															++		
Atya pilipes.....												++			++		
Macrobrachium austr...													+			+	
M. lar.....																+	
Varuna litterata.....																	
Baetidae gen. spp.....									+	+							
Pseudagrion punctum...				+				?				?			+		
Ceriagrion glabrum.....				+				?				?			+		
Trithemis annulata.....				?				?				+			+		
Anax imperator.....								+				?			+		

Section	H.			U.C.				U.C.-M.C.				M.C.-L.C.			L.C.-M.		
Altitude (m)	1500			1500-700				700-200				200-50			50-0		
Current speed (cm/s.)	0-30	30-75	75-100	0-30	30-75	75-100	Hyg.	0-30	30-75	75-100	Hyg.	0-30	30-75	75-100	0-30	30-75	75-100
Hydropsychidaegen. spp.					20	20			45	45			45	45		15	15
cf. *Hydroptilidae gen.* spp				++	++	++		++	90	60		+++	45	45			
Orthocladiinae gen. spp.		++	++		15	15		+	90	90		?	150	150			
Rheotanytarsus sp.				+	?	?		?	120	120		500	1200	165	?	240	?
[2]*Anopheles coustani*												++			?		
[2]*Anopheles gambiae*												++			?		
Simuliidae gen. spp					+	675			+	30			25	45		30	60
Limonia cf. tipulipes							++				20						
[1]*Ephydridae gen.* spp													+	+			
Rhagionidae gen. spp				+	+			+	+								
Sarcophaga sp											+						
Gerridae gen. spp															++		
Veliidae gen. spp				++				++				++			++		
[2]*Hyphydrus distinctus*								+				?			?		
[2]*Guignotus strigicollis*								+				?			?		
[2]*G. lobulatus*								+				?			?		
[2]*Laccophilus irroratus*								+				?			?		
[2]*Paracymus chalceus*								+				?			?		
[2]*Dactylosternum* sp								+				?			?		
[2]*Laccobius mascarensis*												++					
[2]*L. starmühlneri*												++					
Gyrinus nitidulus				+				+									
Dineutus aereus												+					
D. indus olivaceus				+				+									
Sicilicula borbonica	++																
Omphalotropis picturata								+									
[3]*Neritina gagates*												+	10	10	+	45	45
[4]*Clithon coronata*																[1]10	10
[3]*Septaria borbonica*													+	+		7	12
Neritilia consimilis															+	60	60
Thiara scabra								15	12			60	+		45	30	
Syncera hidalgoi granum															+	upto	3000
Lymnaea (R.) mauritiana				45	+			45	+		+	50	+		60	18	
Physa borbonica				45	+			45	+		+	50	+		60	25	
Indoplanorbis exustus															75	18	
Ferrissia (Pellanc.) sp.															+	250	++
[5]*Sicyopteris (S.) lagoc.*													+	+		+	+
Gambusia affinis h.															+		
Bufo regularis; *tadpoles*				?				?				++			+		
toad				+				?				?			?		

Abbreviations : H. = Headwater (ruisseau de source) ;
U.C. = Upper course (cours supérieur) ;
M.C. = Middle course (cours moyen) ;
L.C. = Lower course (cours inférieur) ;
M. = Mouth (embouchure) ;
Hyg. = Hygropetric area.

Density : + = sporadic ; ++ = medium ; +++ = very frequent ; ? = not recolted, but probably present ; the numbers indicate the average numbers of individuals on 1/16 m² (quantitative sampling).

Densité : + = rare ; ++ = fréquent ; +++ = très fréquent ; ? = non récolté, mais probablement présent ; les chiffres indiquent le nombre moyen d'individus pour 1/16 m² (échantillons quantitatifs).

[1] = Ocurring in floating filamentous green-algae of a waterfall (dans des algues vertes filamenteuses flottantes d'une chute d'eau).

[2] = Ocurring in small flood-ponds and rock-pools near the border of the rivers (dans des petites mares d'inondation et dans des trous de rochers près des rivières).

[3] = Ocurring from approx. 170-150 m altitude (présent jusqu'à l'altitude de 150-170 m).

[4] = Occuring from approx. 10 m altitude (présent jusqu'à l'altitude de 10 m environ).

[5] = Occuring from approx. 80-50 m altitude (présent jusqu'à l'altitude de 80-50 m environ).

La Réunion is the youngest and highest island of the Mascarene-Archipelago. The sources and headwaters of the streams are in altitudes of 1500 m and more. They flow as waterfalls and torrents, depending on the gradient of the slopes of the eroded shield volcanoes to the deep eroded valleys (fig. 4).

In the region of about 1500 m with a water temperature of 15 °C was found the unique element of the "Crenon" (after the conception of ILLIES and BOTOSEANU, 1963) the fauna of source (Eucrenon) and headwaters (Hypocrenon). This is the hydraenid beetle *Sicilicula borbonica*, endemic to the high mountain region of the Piton des Neiges. It is possible that the larvae of Orthocladiinae, found at the same region, are also a typical element of the Crenon, but the determination is not finished.

In the upper courses between 1500 and 700 m altitude "petricole" forms dominate attached to rocks, boulders and gravel such as larvae (and pupae) of Hydropsychidae, cf. Hydroptilidae (in troops on sides and under stones), Orthocladiinae, *Rheotanytarsus* sp. and Simuliidae. The last group mostly found on rocks and big boulders in waterfalls and cascades in very high density with an average of 675 individuals per 1/16 m² if the current is more than 1 m/s! On hygropetric areas occur the larvae of *Limonia* cf. *tipulipes* (fig. 12). Near the banks in creeks and in pools between the stair-like cascades are found Zygoptera-larvae, such as *Pseudagrion punctum* and *Ceriagrion glabrum*. *Caridina* species dont occur in these higher parts of streams. These may be explained by the extremly strong current of these torrents, which not admit the deposit of a higher quantity of vegetable debris, the nutrition of Caridae. The pulmonate snails *Lymnaea (Radix) mauritiana* and *Physa borbonica*, also the tadpoles of *Bufo regularis* (introduced to La Réunion) occurs in these biotops, feeding on algae. They are to find from the mountain region in 1400 m altitude up to the coast region. On the surface of these biotops with low current, regular Veliidae and the gyrinid *Dineutus indus olivaceus* are found. In rock-pools of an intermittend stream (fig. 5) occurs also *Gyrinus nitidulus* and in the water *Berosus vinsoni* and Notonectidae.

In the transitions from the upper to the middle courses, and even in the higher parts of the lower courses, in the streams of the eroded valleys, where the gradient is lower there is a *Rheotanytarsus* sp. in muddy tubes very frequent on the surfaces and sides of the stones covered with mud and algae. Also, species of Orthocladiinae, Hydropsychidae and, in troops, of cf. Hydroptilidae are dominant in the medium to strong current. Only the species of Simuliidae decreases clear in number in comparison with the waterfalls in the torrents of the slopes.

In the biotops with lower current (banks and pools between cascades) the same species as indicated above in the upper courses. In rock-pools, filled with stream water after floods and in creeks at the side of larger pools below waterfalls, rich in algae and vegetable debris, are to be found different small water beetles, Hydrophilidae, such as *Dactylosternum* nov. sp., *Laccobius mascarensis*, *L. starmuehlneri* and *Paracymus chalceus* and the Dytiscidae, such as *Hyphydrus distinctus*, *Guignotus strigicollis*, *G. lobulatus* and *Laccophilus irroratus*. Together with the pulmonate snails, cited above, is *Thiara scabra* a typical form of the riverbanks and pools, found under stones up to a current of 50 cm/s. But the highest density, between 15 and 60 individuals per 1/16 m² is found in a current between 20-30 cm/s.

In the transitions between the middle courses and the lower courses are *Caridina* species, such as *C. typus*, *C. brachydactyla brachydactyla* and *Atya pilipes* dominating in the regions of the banks and in pools between cascades, rich on vegetable debris deposit from the steep slopes in the valleys (figs. 6-10). On the surface occurs besides Veliidae and Gerridae, the gyrinid *Dineutus aereus*. Under stones are found in these regions *Macrobrachium australe* and *M. lar*, on stones *Neritina gagates* (on the sides and in stronger current below the stones) and *Septaria borbonica* on the surface of the stones. Typically is also a Gobiidae *Sicyopterus (Sicydium) lagocephalus* with a ventral sucker, attached on boulders and rocks in the stronger current. Near the mouth appears *Caridina serratirostris* beside the other *Caridina* species, listed above and the Grapsidae crab *Varuna litterata*, a species ocurring also in brackish water.

In the lower courses, near the coasts (fig. 7-9) the primary production of algae and higher water-plants, like *Potamogeton pectinans*, *Najas madagascariensis* and others, is very high, as consequence of pollution from plantations (fertilizer!) and villages, appears in addition to high density of *Lymnaea (R.) mauritiana*, *Physa borbonica* and *Thiara scabra*, the planorbid snail *Indoplanorbis exustus*, and the limpet-like *Ferrissia (Pettancylus)* cf. *modesta*. If the lower parts of the lower courses receive the return current of seawater during high tide, the longspined *Clithon coronata* (fig. 13) is to find on stones. Also a small *Neritilia consimilis* in troops on stones near the water surface and sometimes, in slightly brackish water the minute *Syncera (=Assiminea) hidalgoi granum* appears in high density up to 3000 individuals per 1/16 m²!

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Fig. 3. — Cirque de Cilaos, view of the steep slopes.
Cirque de Cilaos, vue des pentes escarpées.

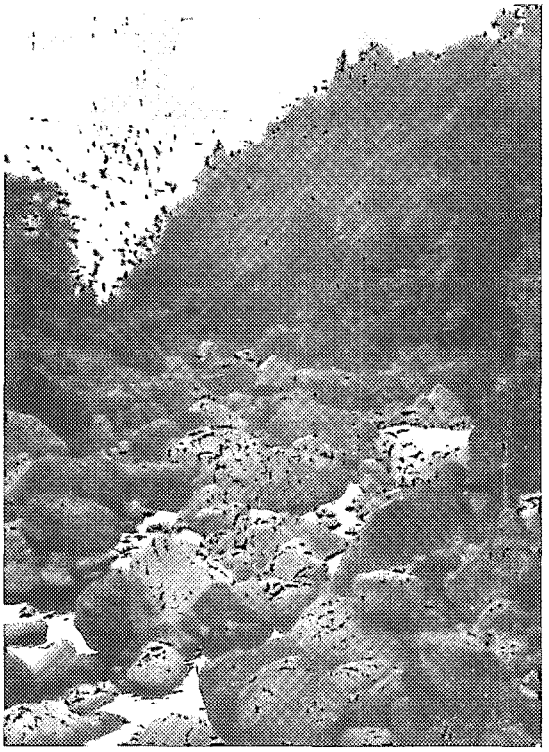
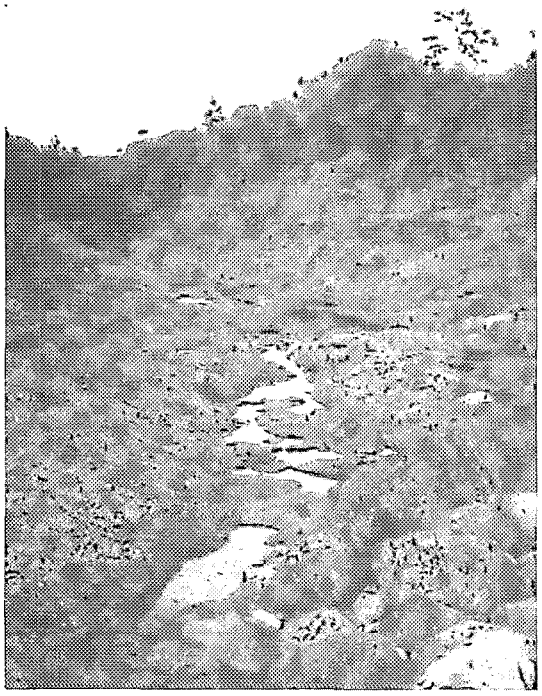


Fig. 4. — Bras des Benjouin, an affluent of the upper course of the River Cilaos (1400 m) ; behind, the slopes of Piton des Neiges.
Bras des Benjouin, un affluent du cours supérieur de la Rivière Cilaos (1400 m) ; derrière, les pentes du Piton des Neiges.



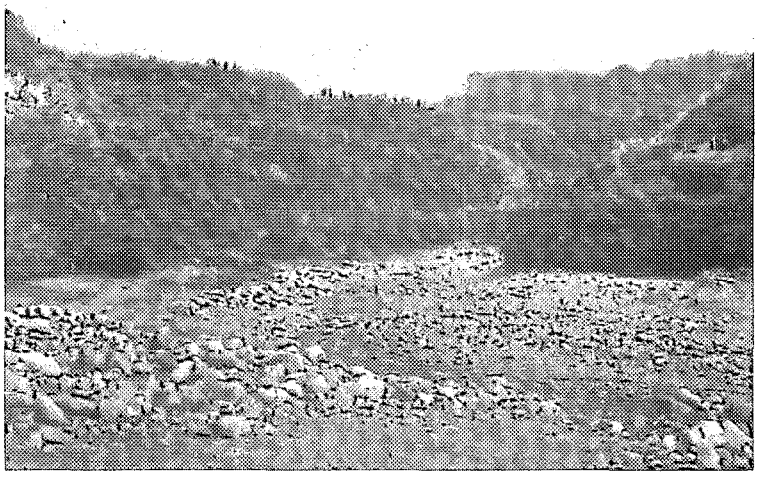


Fig. 6. — Lower course of the River des Pluies.
Cours inférieur de la Rivière des Pluies.

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Fig. 5. — Ravine Sèche, an intermittent stream with pools on the border in the Plaine des Palmistes.
Ravine Sèche, rivière intermittente avec des mares près de la rive, de la Plaine des Palmistes.

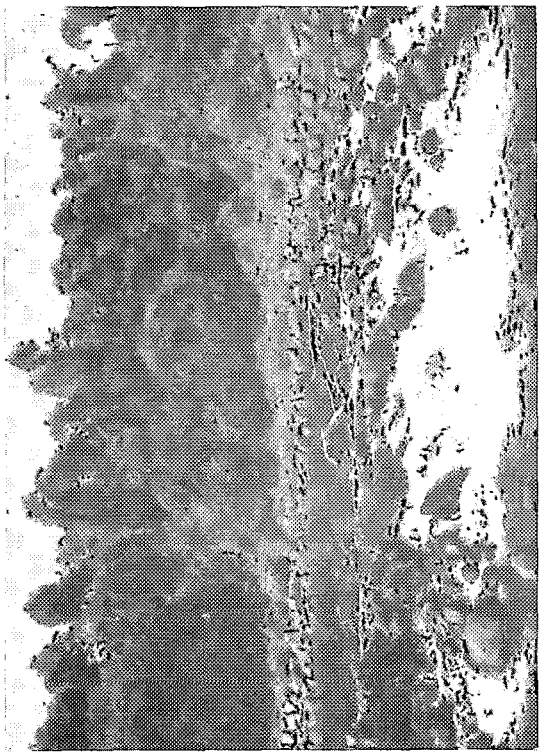

Fig. 8. — Lower course of the River des Roches.
Cours inférieur de la Rivière des Roches.

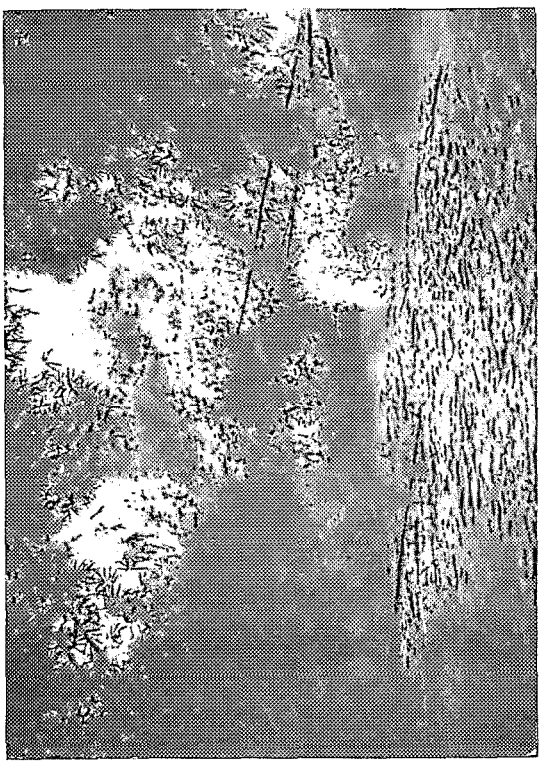

Fig. 10. — Lower course of the River St. Suzanne.
Cours inférieur de la Rivière Sainte-Suzanne.

Fig. 7. — Lower course of the River des Galets.
Cours inférieur de la Rivière des Galets.

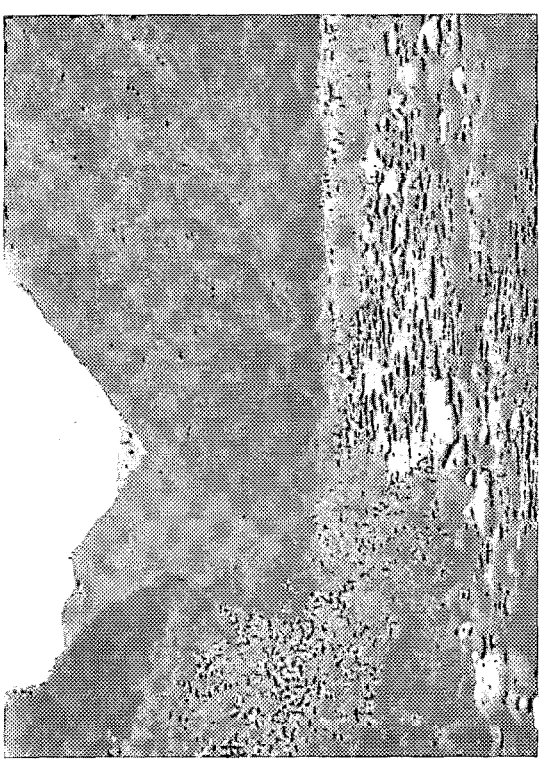

Fig. 9. — Lower course of the River St. Denis.
Cours inférieur de la rivière Saint-Denis.

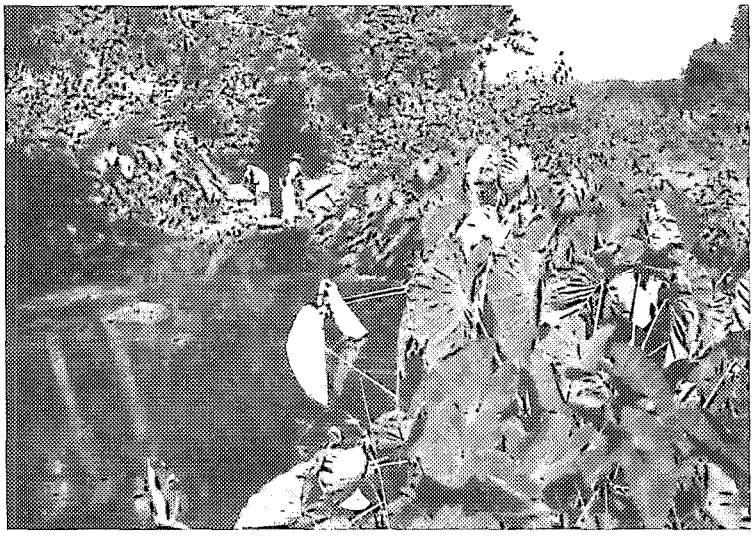

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Fig. 11. — Source de Moulin d'eau with dense vegetation of *Colocasia antiquorum* on the border.
Source de Moulin d'eau avec une végétation dense de *Colocasia antiquorum* sur le bord.

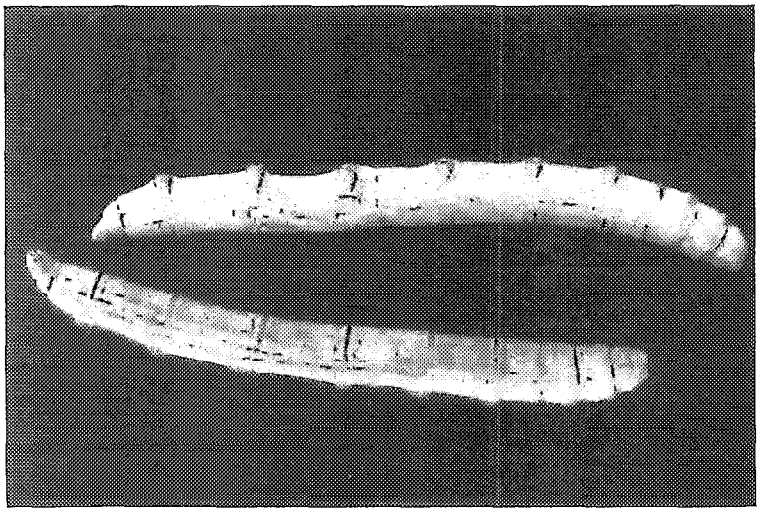

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Fig. 12. — Larvae of *Limonia* cf. *lipulipes* (Hygropetric areas of the River Mât ; upper course).
Larve de *Limonia* cf. *lipulipes* (cours supérieur de la rivière Mât).

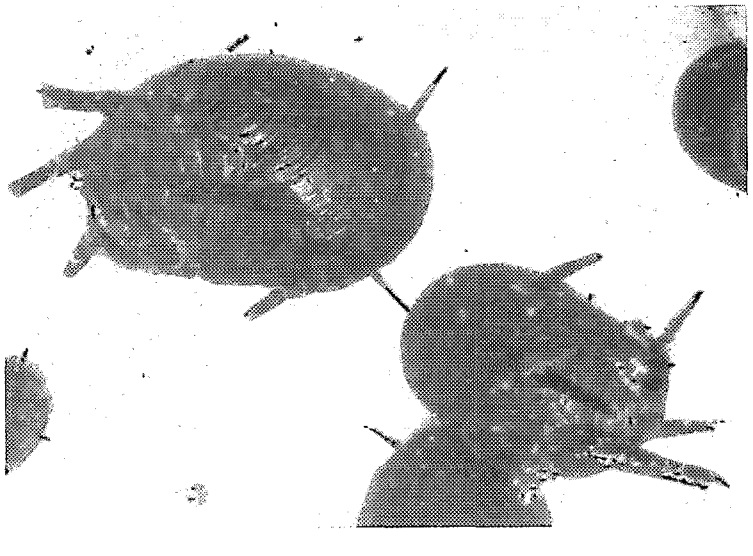

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Fig. 13. — *Clithon coronata* from the lower course of the River des Roches.
Clithon coronata du cours inférieur de la Rivière des Roches.