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ABOUT A PECULIAR TYPE OF RHEOCRENE SPRING IN THE HIGH ATLAS (MOROCCO). DESCRIPTION OF A SIMULIID CHARACTERISTIC OF THIS HABITAT, *SIMULIUM* (*CRENOSIMULIUM* N. SG.) *KNIDIRII* N. SP. (DIPTERA, SIMULIIDAE). [1)]

Jean GIUDICELLI & Alain THIERY

ABSTRACT

In the High Atlas we have studied a peculiar type of spring representing an environment close to the madicolous habitats. The main ecological characteristics of this habitat and of its community are given. Immature stages of a previously unknown simuliid fly are abundant. The species, *Simulium knidirii* n.sp., is described; it is closely related to *Simulium lamachei* Doby & David known from a few localities in southern France and in northern Morocco (Rif). The pupae of these two species differ from those of all palearctic Simuliidae mainly by their two-branched tube-like gills. Study of all stages has convinced us that both *S. lamachei* and *S. knidirii* represent a new subgenus, which we named *Crenosimulium*. The subgenus is limited in its distribution to a few isolated spring-fed streamlets in southern France and Morocco. The larvae, found almost exclusively attached to stones over which water trickles, are able to utilize the madicolous environments of such small streamlets. They feed by scraping benthic algae.

RÉSUMÉ

Dans le Haut Atlas nous avons étudié un type particulier de source rhéocrène qui s'apparente au milieu madicole. Nous donnons les caractéristiques écologiques de cet habitat et de sa communauté. Les stades préimaginaux d'une simulie inédite constituent l'élément dominant de la communauté. L'espèce, *Simulium knidirii* n. sp., est décrite ici; elle est étroitement apparentée à *Simulium lamachei* Doby & David connue de quelques localités du sud de la France et du nord du Maroc (Rif). Les nymphes des deux espèces sont bien différentes de celles de toutes les autres simulies paléarctiques par leur appareil respiratoire formé de deux tubes épais et annelés. L'étude de tous les stades nous a amenés à considérer *S. lamachei* et *S. knidirii* comme les représentants d'un nouveau sous-genre, *Crenosimulium* n. sg.. Sa répartition est limitée à quelques petits ruisseaux de source isolés dans le sud de la France et au Maroc. Les larves, qui vivent presque toujours fixées sur des pierres recouvertes d'une mince pellicule d'eau courante, sont capables de vivre dans les habitats madicoles qui se développent dans ces petits écoulements. Elles se nourissent en raclant les algues benthiques sur le substrat.

[1)] Action intégrée franco-marocaine no. 82-24; Jeune Equipe C.N.R.S. "Ecologie des eaux continentales méditerranéennes".

On several occasions (1981, 1982, 1983) we had opportunity to collect many samples from a small spring belonging to a rather special category in the moroccan High Atlas at an altitude of about 2500 m.

The animal community in this biotope is made up of a limited number of crenobiont and crenophile species and of madicole species. The predominant element is made up of the larvae and pupae of a simuliid fly which turned out to belong to an unknown species and subgenus. This simuliid, representatives of which were found in 1983 in another spring in the same area, is also peculiar from an ecological and biogeographical standpoint.

Location and description of the biotope.-

The reference locality lies in the High Atlas in the Marrakech area, at an elevation of 2550 m, at the foot of the northern side of the Oukaimeden circus.

According to its characteristics, which are intermediate between a small rheocrene spring and a permanent ooze, the biotope belongs to both crenal and a madicolous (hygropetric) environment.

The steep grade is 30-40 m long, 10 to 60 cm wide, the drain is a few centimeters deep.

The water arises from pebbles on a slope located at the foot of projecting rocks (granodiorites). The water flows through a grassy spot on the colluvium at the foot of the slope. In the upper part of the channel, the substratum consists of angular pebbles, while downstream it is made up of sand, gravel and silt, which favour the presence of aquatic and hygrophile plants.

The vegetation in the channel consists mainly of *Roripa atlantica* (in cushions) and *Ranunculus dyris* with some *Orchis latifolia*. These plants intercept the silt, which thus clogs the gravelly bottom. The grassy spot is composed of *Carex intricata* and *Poa annua*, strewn with *Narcissus bulbocodium nivalis*.

The water is never more than 1 to 15 mm deep and is slowly but continuously replaced; the flow is no more than 30 ml/s. The water trickles on the upstream pebbles and at some small breaks along the slope brought about by the clusters of plants. In the main part of the channel the water moves forth by capillarity, so that the madicolous environment is an important part of the whole system.

The water runs only over a distance of about 40 m, then disappearing into the ground.

Facing north, the spring is either frozen or covered with snow about 4 months of the year; it retains some water during the rainless months.

In April, between 1 and 3 p.m., we have measured a few physical and chemical data:

- air temperature : 25 °C
- water temperature : 11.5 °C
- pH : 7.2
- electrical conductivity : 150 µS
- dissolved oxygen : 13.1 mg/l (170 %)
- calcium : 13 mg/l
- magnesium : 6 mg/l
- sulfates : nihil
- chloride : 1.5 mg/l
- hydrogenocarbonates : 40 mg/l

Animal community.-

The pebbles shelter the densest and the most diversified population; this kind of environment is what Vaillant (1956) called this petrimadicolous habitat. Tricladida, larvae and pupae of Simuliidae are the predominant elements of the petricolous and rheophilous community. The pebbles are covered with minute organic particles and with a film of microscopic algae (30 species have been recorded, mostly diatoms) which form food for gastropods, larvae of *Dixa*, of *Thaumalea*, of Chironomidae, Tanytarsini and of Simuliidae (based on gut contents). Larvae of *Baetis*, of *Protonemura*, of *Plectrocnemia* and of *Stenophylax* live under the same pebbles; they feed on more or less decayed plant fragments. In the channel, the substratum consists of pebbles and of silt patches. The silty substratum represents the limnimadicolous habitat populated by burrowing organisms (*Eiseniella*, tipulid larvae).

All the species collected in this spring, except the Simuliidae, had been previously recorded by Vaillant (1956) in High Atlas madicolous biotopes.

The population of the spring is faunistically quite different from that of larger running waters in the High Atlas mountains. This is

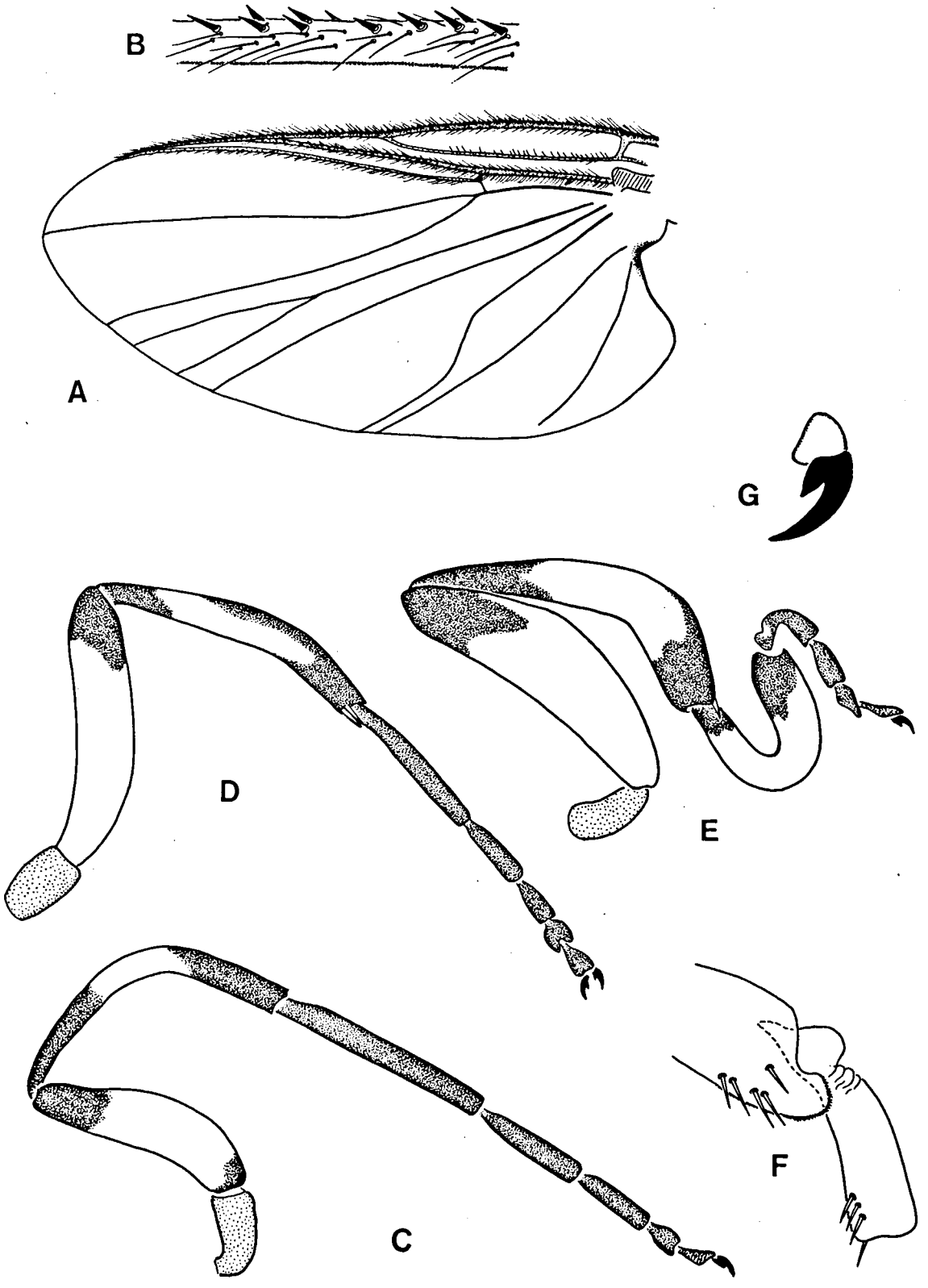


Fig. 1. *Simulium (Crenosimulium) knidirii* n.sp.. Adult. A, wing venation; B, part of vein C; C, fore leg; D, middle leg; E, hind leg; F, tip of hind basitarsus and second tarsal segment, female; G, tarsal claw.

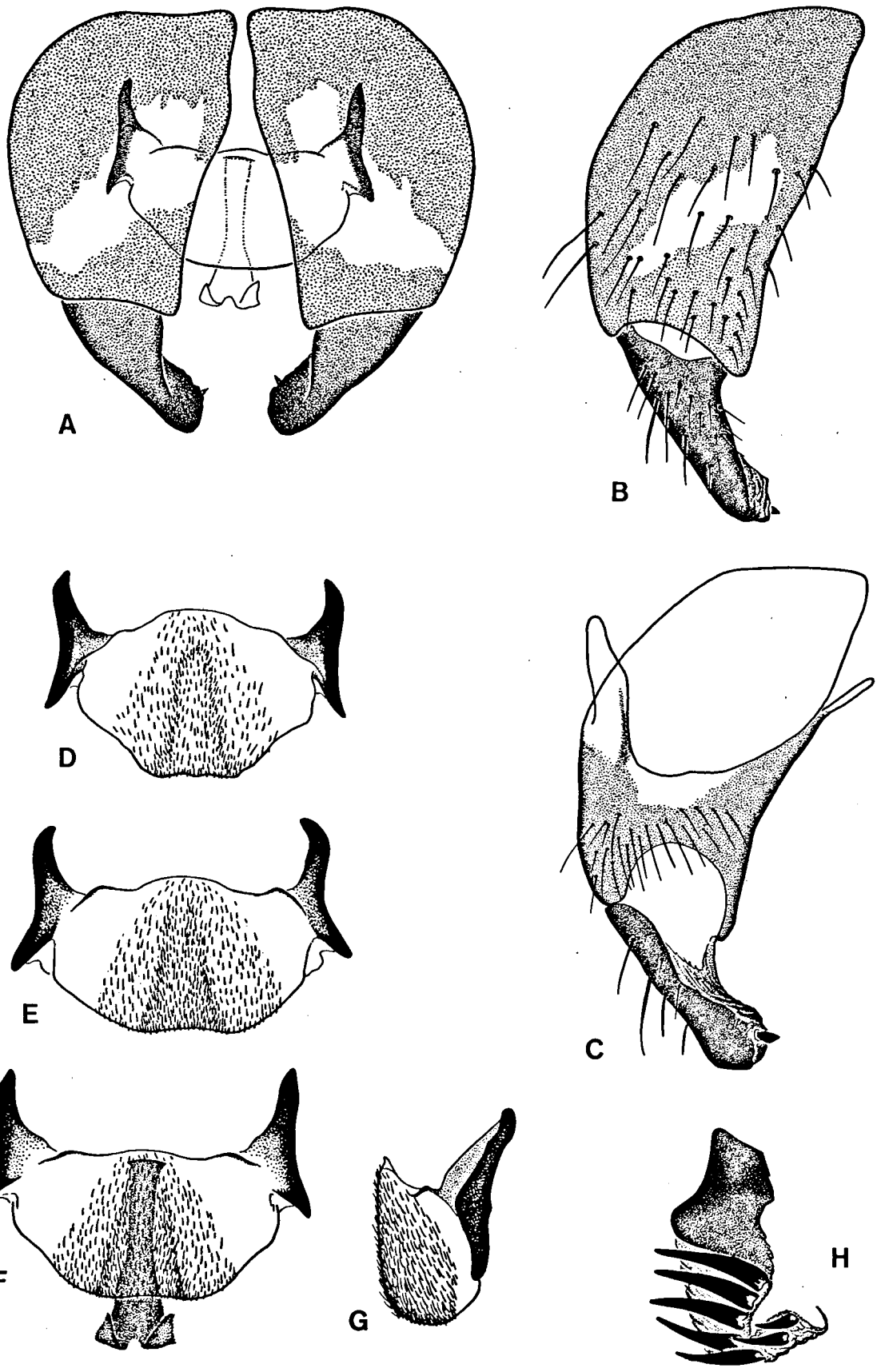


Fig. 2. *Simulium (Crenosimulium) knidirii* n.sp.. Male. A, ventral view of genitalia; B, ventrolateral view of gonopod; C, dorsolateral view of gonopod; D, E, F, ventral views of ventral plate; G, lateral view of ventral plate; H, paramere.

shown by comparison of the community in the spring with that in the assif (stream) Oukaimeden 50 m downstream (table I).

Simulium knidirii n.sp.

Material.-

The ♂ holotype and ♂ paratypes, as well as the ♀ paratypes listed are pharate adults dissected from mature pupae and preserved in alcohol.

- Holotype ♂ (mounted on slide). Spring in Oukaimeden circus (High Atlas, Morocco), altitude 2550 m, 19.IX.1982.
- Allotype ♀. Specimen hatched from a pupa collected in the spring of assif Tiferguine, tributary of assif Oukaimeden (High Atlas), 2700 m altitude, 1.X.1983
- Paratypes. 9 ♂, 3♀, 25 pupae, 6 larvae, Oukaimeden 19.IX.1982; 2 pupae, 30 larvae, Oukaimeden 23.VI.1982; 11 pupae, spring of assif Tiferguine 1.X.1983.

Holotype ♂ and paratype material deposited in coll. J. Giudicelli (Marseilles), with the exception of 8 pupae (2 pharate males) and 8 larvae which are in the Institut Scientifique (Rabat, Morocco), and of 8 pupae (2 pharate males) and 8 larvae in Zoölogisch Museum (Amsterdam).

Description male (figs. 1, 2).-

Head: ground colour dark brown; antennae 11-segmented, entirely dark; maxillary palp darkish and with a sensory vesicle.

Thorax: scutum, scutellum and postnotum concolourous, dark, without any pattern and with uniform pale yellowish hairs; pleural membrane and katepisternum bare.

Wings (figs. 1A, B): wing length 4 mm. Costa and vein R1 with spiniform macrotrichia intermixed with hair-like setae; Sc with few setae; basal section of radius (R) haired; Rs not forked; Cu2 curved twice; no evident basal cell; membrane evenly covered with normal microtrichia.

Legs (figs. 1C, D, E, F): fore tarsus slender, fore basitarsus about 8 times as long as its greatest width. Hind leg with pedisulcus and with well developed calcipala; hind basitarsus greatly widened, its length about 4 times the greatest width of the segment. Tarsal claws with large basal tooth. Coxae and trochanters light brown; femora, tibiae and hind basitarsi yellow except for apices which are blackish brown.

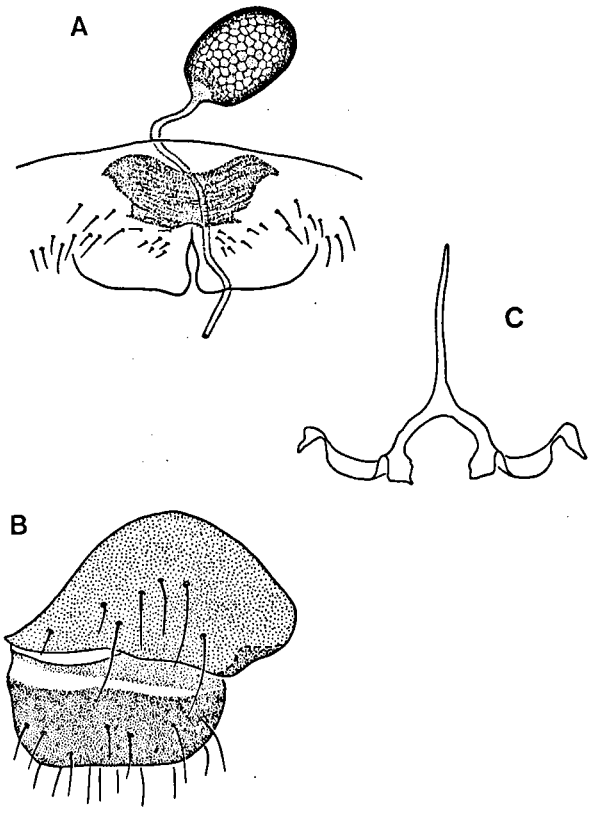


Fig. 3. *Simulium (Crenosimulium) knidirii* n.sp.. Female. A, ventral view of genitalia; B, lateral view of cercus and paraproct; C, genital fork.

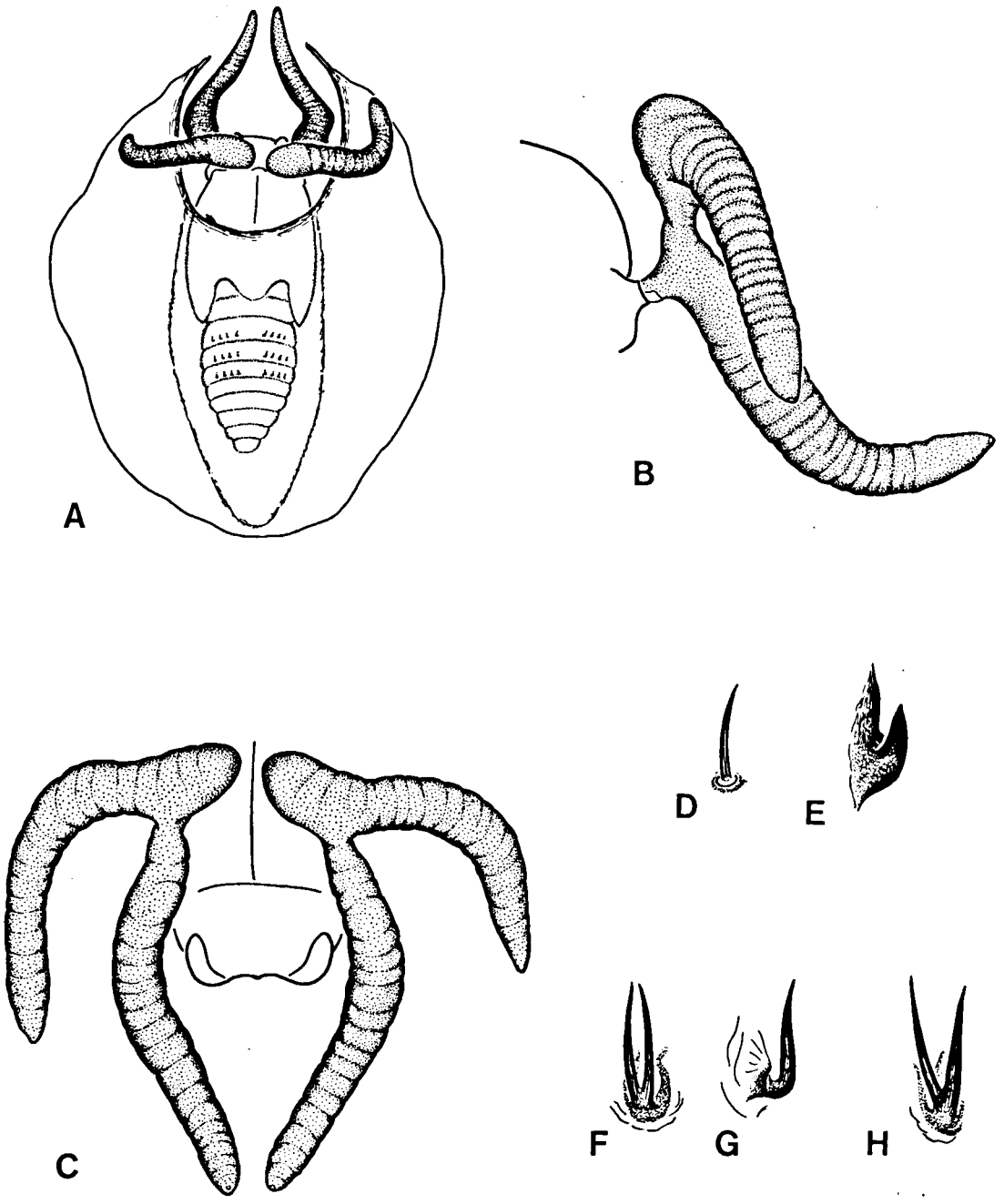


Fig. 4. *Simulium (Crenosimulium) knidirii* n.sp.. Pupa. A, dorsal view; B, lateral view of gill C, front view of gills; D, dorsal spine of segment 2; E, dorsal hook of segment 4; F ventral hook of segment 4; G, ventral spine of segment 4; H, ventral hook of segment 5.

Abdomen: basal fringe long and pale; dorsal side brown; ventral side with light ground colour, a narrow brownish median stripe.

Genitalia (fig. 2): coxites stout, length about twice the greatest width. Styles small, less than a half as long as coxite, curved and twisted inwardly; tip pointed in ventral view; styles narrowly truncate apically in lateral view, but protruding beyond the level at which the apical spinule is inserted. Ventral plate lamellate, strongly transverse, with broad triangular haired keel; strong short parallel basal arms with outwardly protruding tip on their base. Median sclerite strap-like, dilated or bifurcate apically. Parameres large, each bearing 5 subequal strong parameral hooks and 2 smaller ones.

Description female (fig. 3).-

Body length 5.3 mm; wing length 5.1 mm.

Head: posterior surface, frons and clypeus blackish, all bearing abundant pale yellow hairs; some black bristles on frons and occiput. Antenna with pedicel and scape yellow, flagellum brown, palpus light grey, third segment almost black; length of sensory vesicle about one half the length of the segment. Mandible with about 12 inner teeth and 25-27 outer teeth. Cibarium unarmed.

Thorax: scutum with no pattern, uniformly dull dark, covered with recumbent yellow hairs. Scutellum white yellow, bearing erect dark hairs. Postnotum dark brown and bare. Sides brown, pleural membrane bare.

Legs: same colour as in male. Hind basitarsus not conspicuously enlarged, with a well marked pedisulcus.

Abdomen: most of abdomen light brown; membranous areas of ventral and anterior parts dirty white. Tergites with short yellow hairs. Hairs on sides of segments 4-8 dark and longer than elsewhere on the abdomen. Median depression of sternite 8 strongly sclerotized. Spermatheca with reticulate pattern on its surface. Gonapophyses simple bluntly rounded lobes. Paraprocts slightly widened; cerci subquadrate in lateral view.

Description pupa (fig. 4).-

Body length: 4.4-5.4 mm (pupae collected in early summer), 3.2-3.6 mm (pupae collected in autumn).

Cocoon: very broad, flat and circular, without neck; well woven with thin threads visible in the texture; anterior margin regular, slightly thickened and without median process. The cocoon covers the pupal abdomen and a part of the thorax.

Head and thorax: cuticle of head and thorax dorsum heavily covered with rounded low microscopic tubercles (3-6 µm); the thoracic ones with rough surface, the cephalic ones with smooth surface. Thoracic trichomes simple, hair-like, very inconspicuous.

Gill: not filamentous, consisting of a thin-walled and slightly annulated two-branched tube. Branches not joining to form a common stalk; but a short basal stalk arising from the thorax reaches the base of the lower branch. The tube narrows at the joint of upper and lower branches. On each side, the two branches diverge at right angle to each other. The lower branches of both sides are forwardly directed and curved so that their distal part runs parallel to the substratum; furthermore they are parallel or converging towards each other. The upper branches are curved downwards, but are entirely in a same plane. Gills shorter than about one half of the length of the pupa.

Abdomen: tergite 2 with 4 spine-like setae, tergites 3-4 with 4 strong posterior hooks on either side; the more distal tergites lacking anterior spine rows. Sternites 4-7 with 4 slender two-branched posterior hooks; those on sternite 4 in close pairs, each pair with a single hook and a two-branched hook. Terminal tubercle very blunt.

Description larva (fig. 5).-

Body length: 10-11 mm (mature larvae collected in spring), 6.7-7.4 mm (mature larvae collected in autumn). Ground colour of body pale yellow.

Head: ground colour yellow; head pattern positive, with well marked spots. Eye spots well formed, eyebrow stripe clearly marked. Postgenal cleft very small and shallow, lateral edges of the cleft non parallel to each other. Hypostomium with 9 high teeth; middle tooth and corner teeth prominent; lateral margin with two

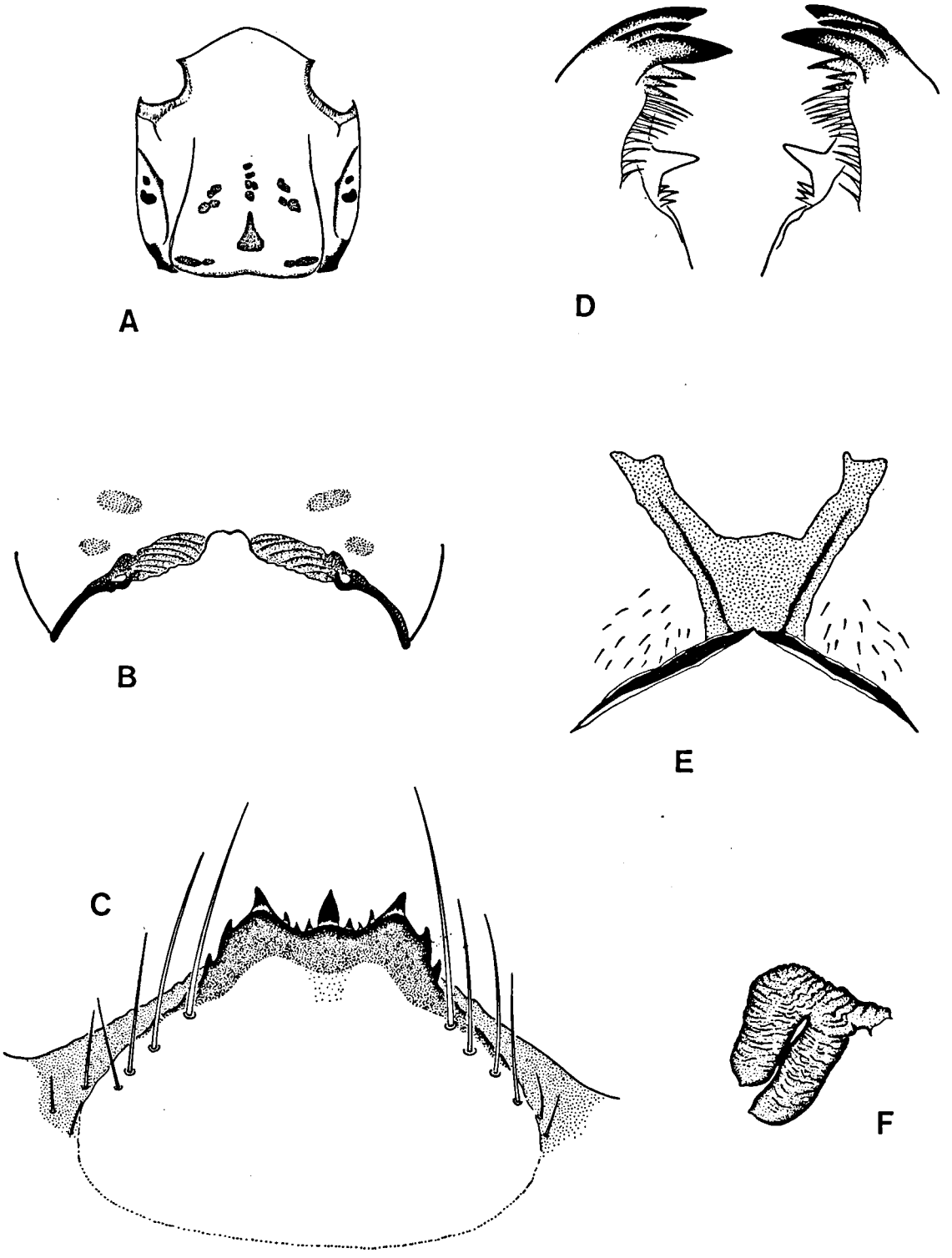


Fig. 5. *Simulium (Crenosimulium) knidirii* n.sp.. Larva (last instar). A, dorsal head pattern; B, postgenal cleft of head capsule; C, hypostomium; D, tip of mandible; E, anal sclerite; F, histoblast of pupal gill.

strong serrations; 7 lateral setae, 4 of which strong. Antennae long, with 3 colourless segments; end of second segment markedly exceeding the apex of stem of cephalic fan. Cephalic fan with 26-35 slender main fan rays; all rays with weak filter apparatus. Mandible tip with 11-13 thin spines in preapical row; inner preapical ridge with a very strong tooth and, proximal to it, 3 subsidiary teeth.

Abdomen: shape normal, widest at seventh or eight segment. Cuticle bare, rectal scales absent. Last abdominal segment with a pair of large conical ventral papillae. Anal sclerite with anterior arms as long as posterior, thin and surrounded by brown sclerotized areas. Rectal gills never extruded but we have dissected them from mature larvae; each lobe with 6-8 secondary thumb-like lobules. Anal hooks 12-16 per row in about 85 rows.

We have much pleasure in naming this species in honour of Professor M. Knidiri, Dean of the Science Faculty of the University of Marrakech (Morroco).

Discussion.-

The moroccan species is closely related to *Simulium lamachei* Doby & David 1960, as shown by all stages of its development. The two species form a special taxonomic group, the status of which is made more clear in this paper.

Shared characters:

- The general colour of the body and legs of the adults; a large basal tooth on the tarsal claws; male: the shape of gonopods, ventral plate and parameres; female: the shape of furca, gonapophyses, paraprocts and cerci.
- The gills of the pupa (two thick cylinder-shaped and slightly annulated tubes arising from the thorax by a short and narrow basal trunk).
- The very light colour of the larva, the pigmentation of the head and the shape of the postgenal cleft.

Differential characters:

- Male: *S. knidirii* has gonostyles much more flat at their distal end and a ventral plate with more developed lateral arms.
- Pupa: 1. *S. lamachei* has an elliptical and loosely woven cocoon without important lateral projections; the anterior rim of the cocoon is not thickened but has a short median process. *S. knidirii* has a flat, circular and closely woven cocoon, anterior rim of which is thickened and without median process. 2. *S. lamachei:* the two gill tubes are in the same vertical plane. *S. knidirii:* the two gill tubes are in two perpendicular planes.
- Larva: *S. lamachei:* inner preapical ridge of mandible with a big tooth and a small one. *S. knidirii:* inner preapical ridge of mandible with a big tooth following 3 small close-set teeth.

Both species must be placed in the genus *Simulium* sensu lato. The position of *S. lamachei* among the *Simulium* subgenera (= genera sensu Rubzov) is still not clear although this species was described as early as 1960. In the original description Doby & David placed it in the subgenus *Simulium* sensu stricto. Rubzov (1965) put it in the genus *Gibbinsiellum* which he had created earlier for all African species belonging to the *griseicolle* group. In this group certain pupae exhibit thick bifid (or trifid) gills that look somewhat like those of *S. lamachei*. The species was listed by Rubzov under the generic designation of *Gibbinsiellum* in the 1st edition of Limnofauna Europaea (Rubzov, 1968).

In his review of african Simuliidae Crosskey (1969) contested the validity of *Gibbinsiellum* and moved the species listed by Rubzov in this genus into the subgenus *Byssodon* Enderlein (genus *Simulium* s.l.). Crosskey took into account the African species of *Gibbinsiellum* only, since he did not mention *S. lamachei* anywhere.

Following Doby & David (1960), H. Zwick listed *S. lamachei* in *Simulium* s. str. in the latest edition (1978) of Limnofauna Europaea.

It is not possible to include *S. lamachei* and *S. knidirii* in the subgenus *Simulium*. As a matter of fact, this subgenus is part of a group of Palearctic subgenera (*Simulium* Latreille s. str., *Odagmia* Enderlein, *Tetisimulium* Rubzov, *Obuchovia* Rubzov, *Cleitosimulium* Seguy & Dorier, *Boophtora* Enderlein), which have a bare basal section of the radius. In contradistinc-

tion, in *S. lamachei* and *S. knidirii* the first radial vein is covered with hairs all over its length. Moreover, the two species cannot be included in the Palearctic subgenera that have a hairy basal section of the radius (*Eusimulium* Rubzov, *Chelocnetha* Enderlein, *Cnetha* Enderlein, *Wilhelmia* Enderlein) owing to quite different genitalic, pupal and larval features.

In the African fauna there are some species with a pupal gill somewhat like that of *S. lamachei* and *S. knidirii*; these are the non filamentous gilled species of the subgenera *Byssodon* and *Pomeroyellum*. Our two species cannot belong to *Byssodon* because one major characteristic of the subgenus is a hairless basal section of the radius. *S. lamachei* and *S. knidirii* seem to be closer to *Pomeroyellum*; the characters shared by the adults are a hairy basal section of the radius, a large basal tooth on the tarsal claws, the shape of the male gonopods and that of the ventral plate. But these two species cannot be classified in this African subgenus because the male genitalia of *Pomeroyellum* have only one parameral hook instead of having 5-7 hooks as do *S. lamachei* and *S. knidirii*. Furthermore, the larvae are very different both in pigmentation of the head and in the shape of the postgenal cleft.

On account of their genitalic, larval, and pupal features, we believe that these two species should be set apart in a distinct subgenus we name *Crenosimulium* in allusion to the springs in which the larvae and the pupae occur.

Subgenus *CRENOSIMULIUM* n.sg.

Type species.-

Simulium (Crenosimulium) lamachei Doby & David 1960.

Included species.-

Simulium (Crenosimulium) knidirii n.sp.

Diagnosis.-

♂, ♀. Basal section of radius haired. Pleural membrane bare. Katepisternum bare. Fore tarsus slender; fore basitarsus approximately 8 times as long as its greatest width. Calcipala and pedisulcus normally developped. Tarsal claws with a distinct large basal tooth. Scutum dark, without definite pattern.

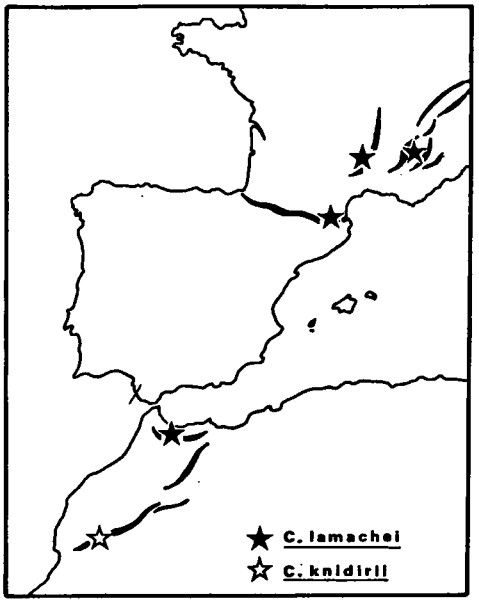


Fig. 6. Distribution of *Crenosimulium*.

Male: genitalia with styles shorter than coxites; style cone-shaped, wide at its base and tapering gently, one apical spinule; ventral plate large and transverse with broad haired median keel, small and strong forwardly directed basal arms; median sclerite in the shape of a wide and long strap, the edges of which are parallel or slightly diverging and widening towards the apex; parameres in the shape of small subtriangular plates each bearing 5 to 7 parameral hooks.

Female: cibarium unarmed; gonapophyses simple bluntly rounded lobes; paraprocts normal, slightly projecting ventrally; spermatheca with polygonal pattern.

Pupa: gill of conspicuous shape and consisting of two broad thin-walled annulated tubes; the two tubes are perpendicular - at least in their basal part - either in the same vertical plane or in two different vertical planes; the dorsal tube shows a sharp bend at some distance from its base. Abdomen with normal onchotaxy, terminal abdominal tubercles blunt. Cocoon "slipper-shaped" with spread-out lateral expansions; front edge either provided with a short median process or not.

Larva: the whole body of very light colour; ground colour of head capsule pale yellow; all

head-spots very distinctly dark; eye-spots well formed, eyebrow stripe clearly marked. Postgenal cleft small but clearly delineated forming a slight subquadrate notch on posteroventral margin of head. Hypostomium with 9 apical sharply pointed teeth; median and corner teeth prominent; well-marked serrations of antero-lateral margin; 6-7 lateral setae in each hypostomial row, first 4 of which much stronger than the others. Antennae long and slender with 3 non-pigmented segments. Cephalic fan with 30-35 rays in the main series. Mandible normal; inner preapical ridge of mandible with a large tooth and 1 or 3 subsidiary teeth widely separated from the base of the main tooth; long and thin preapical spines. Abdomen cuticle bare, rectal scales absent; ventral papillae large and subconical; posterior circlet with about 85-90 rows of 12-15 hooks.

Distribution and biology.-

Crenosimulium is a relatively rare taxon, recorded to date in a few places in southern France and Morocco, so that it is among the most rare Palearctic genera of Simuliidae (fig. 6).

Crenosimulium lamachei has been found in only 4 places in France: Dep. Pyrénées-Orientales, Olette, altitude 700 m (Doby & David, 1960); Southern Massif Central, Dep. Lozère, altitude 690 m (Beaucournu-Saguez, 1972); Alps, Dep. Savoie, near Bourg-Saint-Maurice, altitude about 1000 m (Bernard et al., 1974) and Dep. Hautes-Alpes, near l'Argentière, elevation about 1600 m (Rivier, in verb.). Recently we found specimens of this species in Morocco in a small spring in the Rif, altitude 1600 m (Giudicelli & Dakki, 1984).

If we take into account the two locations for *C. knidirii*, the distribution of *Crenosimulium* seems to be confined to a few isolated places in some restricted areas in the western Mediterranean basin. The paucity of records is certainly related to the specialized type of the larval habitat.

The immature stages of these insects are always confined to small trickles where larvae develop under a thin layer of water. The larvae and pupae of *C. lamachei* occur in cool and stable conditions of small spring-fed streams along the few meters immediately after the water arises from the ground. These trickles are a few metres long, 10-20 cm wide and 1 mm to a few cm deep. Describing the habitat of *C. lamachei*, Beaucournu-Saguez (1972) mentions a hygropetric surface; Doby & David (1960) mention a few cm deep irrigation drain. Furthermore, the immature stages of *C. lamachei* in Lozère and in the Rif, as well as those of *C. knidirii* in the High Atlas, occur in oozes at the foot of a pebble slope.

All authors just mentioned stressed the low luminosity of the larval habitats. This peculiar feature also applies to the Rif locality of *C. lamachei* (a spring-fed, shaded streamlet in a cedar grove); this does not apply to *C. knidirii*, the locations of which are in a grassy spot of the alpine zone.

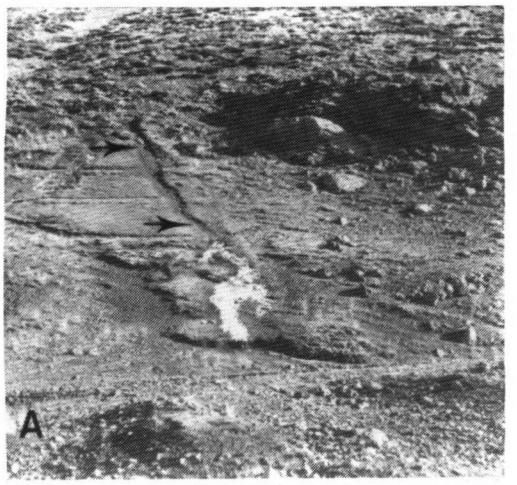
In all instances the aquatic stages of *Crenosimulium* have been found in the crenal (hypocrenal). This biotope hardly harbours Simuliidae. Even though a few Simuliidae occur in springs, they are not crenobiont species as they inhabit mainly the upper reaches of hill and mountain streams. Among the European Simuliidae only the aquatic stages of *Cnetha costata* (Fried.) and *Cnetha fucensis* (Riv.) are confined to slowly flowing spring-fed streams (Davies, 1966; Rivosecchi, 1978).

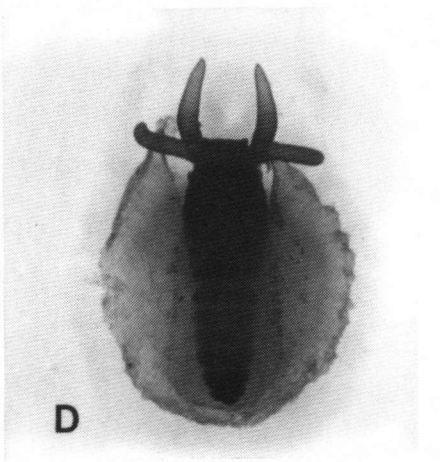
Another striking thing about *Crenosimulium* is the preference of the larvae for hygropetric environments.

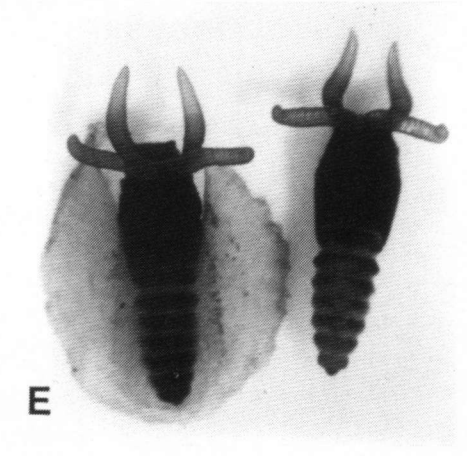
The very thin water film and the slow trickling that characterize this habitat are not very appropriate for the blackfly larvae, because these are dependent on current to bring food, so that they would starve in hygropetric habitats.

Most blackfly larvae are indisciminate filter-feeders; they feed on a wide variety of minute organisms and detritus drifted by the water flow. Several authors (Puri, 1925; Grenier, 1949; Peterson, 1956; Williams & al., 1961) have reported the presence of various particulate materials in the midgut of the larvae: algae (mostly diatoms), fragments of small arthropods, and much unidentifiable organic material.

Direct observations made by Peterson (1956) and by Serra-Tosio (1967) revealed that the







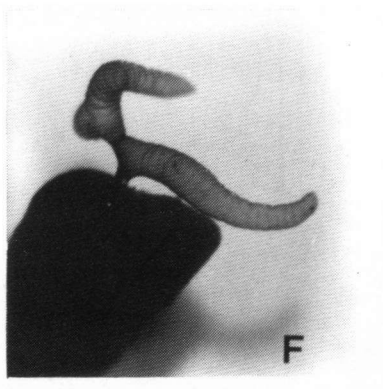


Plate I. A, Spring at Oukaimeden (November); B, Spring at Oukaimeden (April); C, Channel of the spring; D, E. Pupae of *Simulium (Crenosimulium) knidirii* n.sp.; F, Pupal gill in lateral view.

larvae increase their food supply by scrapping benthic algae from the substratum close to them. Owing to the paucity or to the absence of drifting particulate material in their habitat, the larvae of *Crenosimulium* obtain their food by scraping the stony substratum to which they are attached. Indeed, we observed that benthic diatoms are the main material in the gut of the larvae of *C. knidirii* (table II presents a list of algae found in two larvae).

So, larvae of *Crenosimulium* are more substratum-scrapers than filter-feeders. Among the european Simuliidae, only *Cnetha dolomitensis* Riv. has been found during its aquatic stages in an almost similar environment: dripping cliffs (Rivosechci, 1978).

Collection data suggest that *Crenosimulium knidirii* is a bivoltine species. Large larvae and pupae occur in spring, followed by emergence of adults in May-June; small larvae and pupae occur throughout the summer with adults emerging in early autumn.

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Jean Giudicelli,
Laboratoire de Biologie Animale - Ecologie,
Faculté des Sciences et Techniques de St-Jérôme,
13397 Marseille Cédex 13,
France.

Alain Thiery,
Laboratoire d'Hydrobiologie,
Faculté des Sciences,
Marrakech,
Maroc.

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Table I. Animal communities of spring and stream (assif) at Oukaimeden (+ present, ++ common, +++ abundant).

Group	Species (and other taxa)	Occurrence	
		Spring	Stream
Tricladida	*Polycelis felina* (Dalyell)	+++	
	Dugesia gonocephala (Dugès)		++
Oligochaeta	*Eiseniella tetraedra* (Sav)	++	
Gastropoda	*Ancylus fluviatilis* Müller	+	++
	Lymnaea truncatula Müller	+	
Collembola	*Isotomurus palustris* Müller	++	
Ephemeroptera	*Baetis navasi* Müller Liebenau	+	++
	B. maurus Kimm.		++
	B. rhodani Pict.		+
	Ecdyonurus sp.		+
	Rhithrogena sp.		++
	Epeorus geminus Eaton		+++
Plecoptera	*Protonemura talboti* Aubert	+	
	Amphinemura chiffensis Aubert		++
	Leuctra maroccana Aubert	++	
	Perla marginata Panzer		+
Coleoptera	*Agabus chalconotus* Panzer	++	+
	Potamonectes griseostriatus (Deg.)		+
	Deronectes theryi Peyerh.		+
	Hydroporus planus (Fabr.)		+
	Helodes sp.	++	
Trichoptera	*Rhycophila munda* McL		+
	Agapetus dolichopterus Giud. & Dakki		+
	Hydropsyche fezana Navas		+
	Plectrocnemia laetabilis McL.	++	
	Stenophylax espanioli Schmid	+	
	Micrasema moestum Hagen		++
	Schizopelex festiva Ramb.		++
Diptera	P Simuliidae		
	Prosimulium latimucro (End.)		++
	Simulium knidirii sp.n.	+++	
	T Tipulidae		
	Tipula mediterranea Lack.	+	+
	Dixidae		
	Dixa sp.	++	
	C Chironomidae		
	Tanytarsini	++	
	Orthocladiinae		+++
	Thaumaleidae		
	Thaumalea bernardi Vaill.	++	

Table II. List of benthic algae found in the gut of two larvae of *Simulium (Crenosimulium) knidirii* (The identification of the algae has been carried out by our colleague A. Cazaubon whom we than here).

	Larva 1	Larva 2
Diatomophyceae		
Achnanthes affinis	58	51
" *lanceolata*	131	46
" *minutissima*	74	71
Amphora ovalis	7	4
Cocconeis placentula	17	42
Cyclotella sp.	1	
Cymbella affinis	10	13
" *cistula*	2	2
" *ventricosa*	58	38
Diatoma hiemale	6	8
Diploneis elliptica	1	
Eunotia pectinalis	11	5
Gomphonema angustatum	74	33
" *intricatum*	4	2
" *longiceps*	2	
Nitzschia dissipata	6	6
" *linearis*	6	16
" *romana*	4	
Pinnularia viridis	3	2
Navicula sp.	4	1
Rhoicosphenia curvata	1	
Synedra acus	2	
" *ulna*	2	
Chlorophyceae		
Chlamydomonas sp.	4	1
Oedogonium sp.	4	
Euglenophyceae		
Euglena sp.	1	2
Total	493	343