Allacma fusca (L.) and Allacma gallica (Carl) in Holland (Collembola: Sminthuridae)

by

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The presence of *Allacma fusca* (Linnaeus, 1758) in Holland was ascertained as early as 1859 by SNELLEN VAN VOLLENHOVEN. His figure of *A. fusca* is far inferior to the first published drawing of this species, given by DE GEER, 1743, but his description is sufficient to recognize the species. As a matter of fact, *fusca* is very common in our country, as a rule easily found in any stretch of deciduous woodland between about April and October.

The presence of *Allacma gallica* (Carl, 1899) in the Netherlands was discovered only in 1969 by J. W. BLEYS in the course of a study on the ecology of epigeic Collembola. He collected a fair number of specimens in the dune area near Castricum (territories of the "Provinciale Waterleidingduinen Noord-Holland") with the use of a sweeping net (BLEYS, in preparation). Afterwards the present author and his wife found large colonies of *gallica* in the deciduous woods in the old (inner) dunes at Bergen (Oude Hof), Santpoort (Duin en Kruidberg), and Vogelenzang (Amsterdamse Waterleidingduinen). It is striking that these sites are all situated within the dune region. Although we collected *fusca* in large numbers everywhere in the country, and specially searched for *fusca* and *gallica* on several occasions, we never found the latter species outside the dune area.

It seems that outside of the Netherlands *gallica* is not common either. So far the species was known only from France and Switzerland. CARL described *Sminthurus gallicus* after two specimens collected under the bark of trees at Lyons-la-Forêt (Eure, Normandie). CARL, 1901, rediscovered the species in the Unter-Engadin and in the neighbourhood of Genève (later confirmed by GISIN, 1948). In a posthumous note, reproduced by DENIS, 1933, CARL presents a redescription of *A. gallica* based on material from Chars (Val-d'Oise). Other localities in France are: departments Haute-Savoie and Ain (GISIN, 1948) and Haute-Garonne (BETSCH and CASSAGNAU, 1966). In the collection of the Laboratoire d'Ecologie générale du Muséum, Brunoy, material is preserved from Haute-Savoie, Essonne, Aude and Haute-Garonne. In the park that belongs to the laboratory *gallica* as well as *fusca* are quite common (personal communication MASSOUD). The specimens, figured and described by DALLAI, 1960, from the Monte Freddone in the Apuan Alps and referred by him to *fusca* also belong to *gallica*, as I could ascertain after a specimen kindly lent to me by Dr. DALLAI. This is the first find of *gallica* south of the Alps.

GISIN, 1948, described the habitats of *gallica* and *fusca* as being sharply contrasted. *Allacma gallica* is considered by him as a species of "forêts xérothermiques", whereas *fusca* is a characteristic species of moister and denser woods. As a matter of fact, in the relevés presented by this author both species do not occur together. However, in the Dutch dunes quite the reverse is true. Here *gallica* and *fusca* are often seen together on the same lump of decaying wood. Most of the

collecting sites have a luxuriant undergrowth, and in these places both species seem to prefer branches lying on the ground; moreover, some specimens could be captured by sweeping and only a few were found on tree boles. However, an old wood at Bergen of *Quercus robur* and *Fagus sylvatica*, at the collection site practically without undergrowth, yielded quite another picture (24 August 1972). Randomly collecting on (the base of) tree boles and branches, pieces of bark etc. lying on the ground, we found:

		branches	tree boles
gallica	adult	32	2
	juvenile	34	3
fusca	adult	9	42
	juvenile	39	48

Not only did we find here a general preference of *gallica* for branches and of *fusca* for tree boles ($\chi^2_{[1]} = 61.67$, $P \ll 0.001$), but there is also a strong indication that this preference in *fusca* is manifest specially in the adults ($\chi^2_{[1]} = 11.01$, $P < 0.001$), whereas their young are more catholic.

Another intriguing problem raised by *A. gallica* is the coexistence of two colour forms, between which there seems to exist no intergradation. CARL described *gallica* originally as a faintly pigmented species, with some diffuse pigment laterally on the abdomen, some more pigment on the coxae and subcoxae, two transversal stripes over the head and an intensely pigmented patch dorsally on the postabdomen. In 1901, he reports a much more pigmented type from Switzerland (apart from details in the pigmentation of the head identical with the majority of the Dutch material, described below). In 1948 GISIN reports that he could find both forms occurring together. The pale form has been found in the Netherlands only twice: in Castricum two adult females of this type were captured (20.vi.1969 and 2.ix.1972). In both cases the pale specimens were collected together with numerous heavily pigmented animals. The pale and the dark Dutch specimens don't show any difference in the pigmentation of the head.

Since *Allacma gallica* is not so well known, I give below a differential description of the species, with *fusca* as reference. (I refer to STACH, 1956, for an elaborate description of *fusca*).

Living *gallica* is recognized even with the naked eye with a fair degree of certainty by the much more shining abdomen, which almost always (cf. above) seems black as jet. (This effect is enhanced by the more globular shape of the abdomen). Moreover, *gallica* is distinctly smaller than *fusca* (largest *fusca* measures approx. 4 mm; largest *gallica* 2.7 mm). Immatures of *gallica* have the head white or almost so (except the eye-patches and the rear of the head). This contrasts sharply with the black abdomen, and gives them a very striking appearance, totally different from the larger, duller, less strongly pigmented *fusca*. In the adults this difference is a little slighter, though still easily seen as a rule. The macrochaetae of *gallica* are stiff, erect (and blunt), those of *fusca* are thinner, more slender and bent. Preserved specimens, which usually have their furca

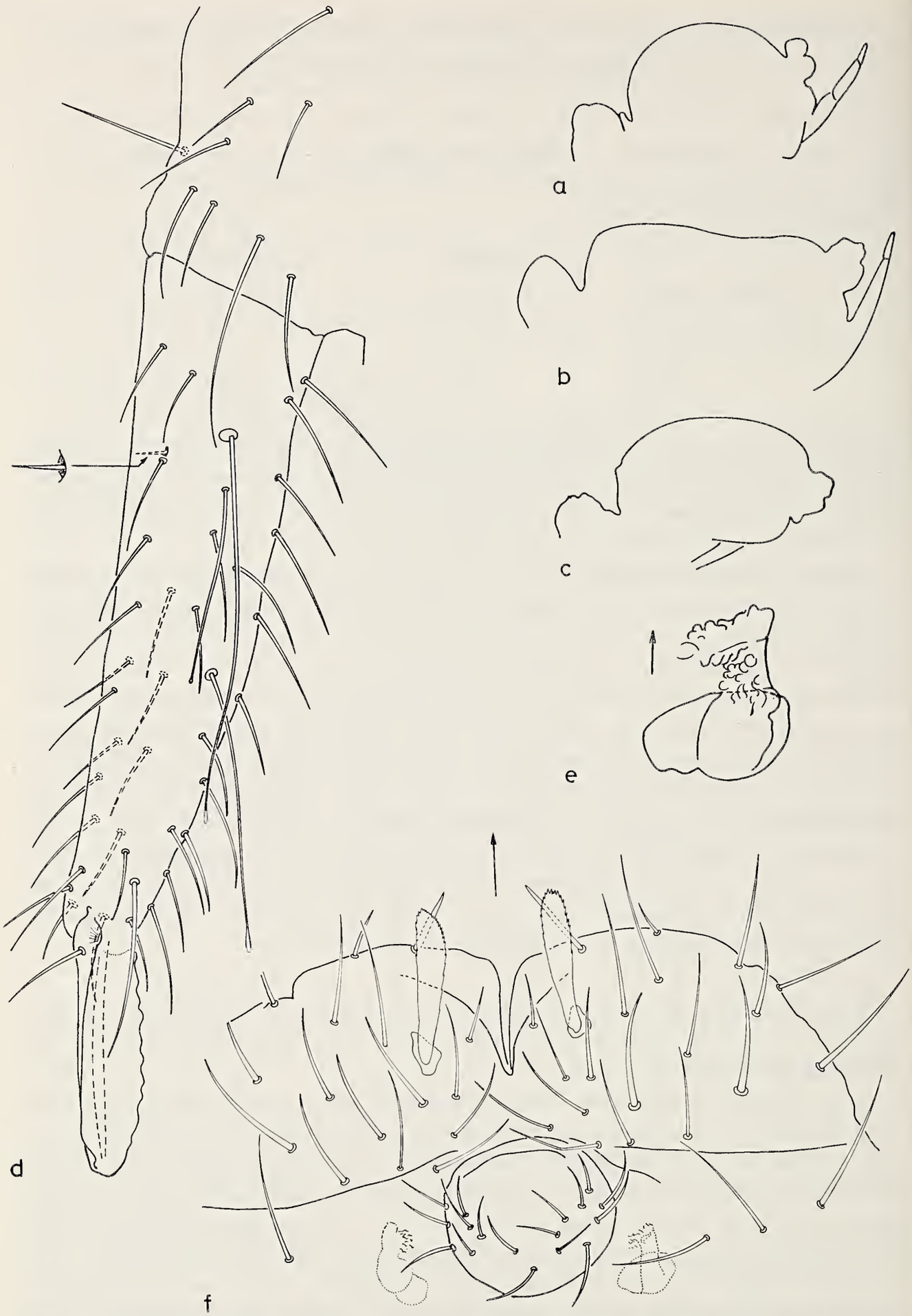

Plate 1. *Allacma fusca* and *gallica* — unless stated otherwise all figures are after Dutch material. a: *gallica*, outline of abdomen of a preserved specimen; b: *fusca*, the same; c: *fusca*, for comparison outline of abdomen of a living specimen; d: *fusca*, posterior face of furca; e: *gallica* ♀, receptaculum seminis; f: *gallica* ♀, postabdomen.

stretched backward, have the outline of the abdomen about saddle-shaped in *fusca,* but highly arched in *gallica* (fig. 1a, b, c). Young *fusca* have the colour of blue litmus, the abdomen a shade darker than the head. Without exception the pigment is mottled. Young *gallica* have a very dark, uniformly violet, practically never mottled abdomen; the head is white. Adult *fusca* is coloured essentially as are the juveniles, though darker and with a more brownish tinge. In adult *gallica* the abdomen remains black-violet, but the head turns brownish yellow, with blue pigment suffused over the head and the extremities. Fully coloured adults have black eyepatches, a very dark frontal ocellus, the rear of the head heavily pigmented. The face is diffusely pigmented, but an irregular transversal stripe, just below the frontal ocellus is free from pigment (fig. 3). Just below and above this line some epidermis cells are somewhat stronger pigmented than usual. It may be pointed out already here that the two well delimited transversal stripes found by GISIN and CARL are largely obliterated in all Dutch material. The feet are white except some faint blue distally at the tibiotarsi; furca feebly pigmented.

The postantennal organ of *gallica* is more elongate, and apically pointed, in contrast to the subglobular bladder of *fusca* (fig. 2f, h). The fourth antennomere is divided in 14 subsegments (16 in *fusca*). (As STACH's description of the antenna is somewhat quick, I give the antennal chaetotaxy of both species: ant. 1: 5 simple, slightly rugose setae + 2 small curved smooth apical setulae; ant. 2, basal half: 3 very small curved setulae + 7 ± large outstanding rugose setae, distal half: a whorl of 8 short almost smooth setae; ant. 3, basal half: 6 strong outstanding hairs which are rugose — except one, slightly thinner, that is almost smooth —, distal half: subapically an irregular whorl of 9 smooth short setae and apically a whorl of 4 moderately weak rugose setae + 2 small smooth setae + the antennal organ).

Apart from the differences in the habit of the dorsal macrochaetae, already mentioned, the abdomen bears in *gallica* laterocaudally, about at the point of flexure of the manubrium three very strong stiff and blunt moderately long macrochaetae (fig. 2a). In *fusca* the corresponding setae are not differentiated. The dorsal tubelike glands that take the place of the pores in *fusca* were already described by GISIN (fig. 2d). The anal appendages of *fusca* are a little more slender than in *gallica,* and apically somewhat coarser serrate, but this is no practical differential character (fig. 2b, c). The postabdomen bears ventrally (in *gallica*) some setae that differ from the normal setae in being basally somewhat inflated. This is evident especially in the male, and most so in the setae that are homologous with the female anal appendages. In *fusca* these hairs are not differentiated. I wish to draw attention to a pair of hollow structures in the postabdomen of the female, which are connected with the female genital pore (fig. 1e, f). With HÜTHER, 1970, I call these provisionally "receptacula seminis". They are present in a wide variety of Collembola species of all families. Their form could be of systematic value. The "plicaldornen" that CARL, 1933, was unable to find are present (also in Swiss and Italian material), though not easily observed.

Furca: omitting the apical whorl of setae, the dens bears anteriorly in both species subbasally a small seta, about halfway an odd seta, and in the distal half 3

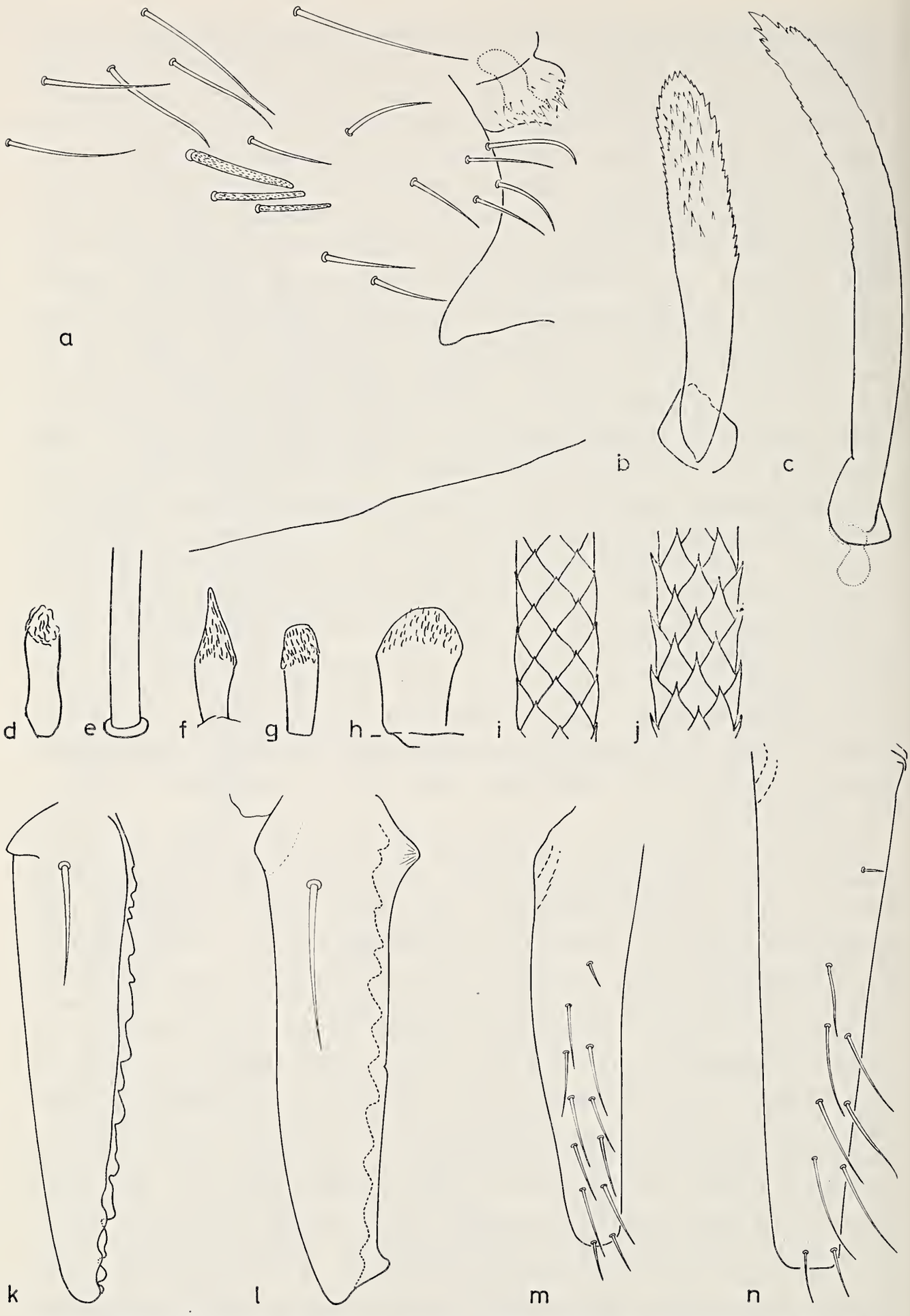

Plate 2. *Allacma fusca* and *A. gallica*. a: *gallica*, differentiated setae laterally on abdomen; b: *gallica* ♀, appendix analis; c: *fusca* ♀, appendix analis; d: *gallica*, dorsal gland with e: neighbouring seta; f: *gallica*, postantennal organ; g: *gallica* from Genève, postantennal organ; h: *fusca*, postantennal organ; i: *gallica*, surface sculpture of macrochaeta; j: *fusca*, the same; k: *gallica*, mucro; l: *fusca*, mucro; m: *gallica*, anterior chaetotaxy of dens; n: *fusca*, the same.

(*fusca*) respectively 4 (*gallica*) pairs of setae (fig. 2m, n). The posterior surface in the Dutch material of *fusca* invariably bears 3 elongate apically clavate setae (fig. 1d). In none of my *gallica* I could observe clavate hairs here. The mucro of *fusca* has the interior margin regularly undulate, and the external margin smooth, with a large tooth apically, and another subbasally (fig. 2l). The Dutch *gallica* on the other hand have the external lamella plain, with 3 distal undulations (in one exceptional specimen this lamella was undulated along its whole length). The apical tooth is reduced to one of the 3 undulations, the basal tooth has vanished (fig. 2k).

For comparison I studied some material from outside the Netherlands. Through the kind assistance of Dr. B. HAUSER of the Genève Museum I could study twelve specimens from the collection of GISIN, originating from the surroundings of Genève. Moreover, I could study one specimen from the Apuan Alps, through the courtesy of Dr. R. DALLAI, and I have seen some ten specimens from various localities in France in the collection of the Laboratoire d'Ecologie générale du Museum, Brunoy.

Although the number of specimens evidently is very small, there seems to be an indication that the relative frequency of the pale form is generally much higher than in the Netherlands, especially so in the Swiss material. Because the material from the Swiss collection was in a better condition than the French, and in a larger number than the Italian, I shall compare the Dutch specimens mainly with the GISIN material. Swiss specimens differ at a first glance from Dutch ones by their head, which is frontally white with two well demarcated transverse stripes, thus giving them quite another "face". Apart from this difference in pigmentation, the postantennal organ in Dutch *gallica* is slender, and apically pointed; Swiss *gallica* have this organ stouter and apically rounded (fig. 2g). The largest Dutch *gallica* is about 2.7 mm long, the largest Swiss one measures 2.1 mm. CARL expressely mentions clavate hairs on the dens; GISIN repeats this but I cannot find any distal swelling on the dental setae of the Swiss (or French) *gallica* that I could study. I suppose that GISIN was confused by some dust particles that often tend to clog to the apex of hairs. CARL states that the external mucronal lamella is only distally undulated; this agrees with the Dutch material (with the one exception referred to above), but in all except one Swiss specimen where this character could be studied the undulations were found along the whole external margin. Finally, the macrochaetae of the Swiss specimens are even stronger and stouter built than in the Dutch material.

All French specimens studied had dental setae acute; the external mucronal lamella was more or less strongly undulated, except in a male from the Haute-Garonne, where there was a heavy distal, and two weaker basal teeth. The head pigmentation of a specimen from the Haute-Savoie is as in the Genève material; contrariwise, all specimens (7) from the departments Aude and Haute-Garonne had the head capsule diffusely pigmented. One of these specimens was exceptional because of having the feet and furca strongly pigmented.

The single specimen that I have studied from the Apuan Alps (an adult male) was identical to the dark form of the Dutch specimens, except the following: the

size is a little smaller, the long outstanding hairs at the posterior face of the dentes are very feebly clavate (most evidently still in the basal one). Finally the pigmentation of the head is very different: from the side of the "neck" an intensely pigmented dark stripe runs horizontally over the head, straight through the ocellar patches. The neck and head otherwise are totally white.

We thus have four types of pigmentation of the head:

1. The Genève type: a black stripe runs transversally on the head, below the insertion of the antennae and below the frontal ocellus; a second stripe starting from the ± black occiput runs through the eyepaths, tapering downward toward the frontal ocellus. Head otherwise white, leaving a white zone between the two black stripes. (The cephalic pigmentation of the type material, to judge from CARL's figure, resembles this type, but the dorsal stripe is broader, not tapering towards the frontal ocellus).
2. The South-East French type: head diffusely pigmented.
3. Monte Freddone type: one single stripe runs well above the insertion of the antennae through the eyes, and thus crosses the head well above the frontal ocellus. Rear of the head white (cf. DALLAI, 1970).
4. Dutch dunes type: rear of the head strongly darkened, face only diffusely pigmented, a transversal stripe below the frontal ocellus free of pigment.

These facts are very suggestive for the fragmentation of the species in a number of subspecies. In view, however of the limited number of specimens and localities studied I refrain from a formal nomenclatural action until much more material has become available.

CARL, 1899, 1901, and 1933, placed *gallica* in the genus *Sminthurus*; this was questioned by DENIS, 1933, who suspected a close relationship with *Allacma fusca*. GISIN, 1948, was the first to discover the dorsal glands, characteristic for the genus *Allacma*, in this species. Unfortunately, GISIN's remark remained unnoticed by STACH, 1956, SALMON, 1964, and even by RICHARDS, 1968. PALISSA, [1964], is the only compiler who placed *gallica* in its right place. It is difficult to identify *gallica* using GISIN's key, since he used the very instable external mucronal lamella and the cephalic pigmentation as key characters.

RICHARDS, 1968, differentiated the genus *Allacma* within the Sminthurini by the sensory clubs of the antennal organ, which are deeply invaginated, the presence of a trochanteral spine, and the setae of the metatrochanteral organ being serrate or plumose. The last character however, cannot be upheld, since in the type species *fusca* these hairs are smooth or nearly so. RICHARDS surprisingly discards the presence of abdominal glands as a character of generic importance. I cannot agree with him in this; these glands are a very original character. The wax-like substance which they secrete forms an effective protection against the attacks of tree-dwelling ants (VANNIER, 1971), and against desiccation. Both species of *Allacma* are often seen standing prolonged droughts without any protection, and do in fact occupy one of the most inhospitable microclimates one can imagine for Collembola.

Plate 3. *Allacma gallica*, cephalic chaetotaxy and pigmentation.

Finally some remarks have to be made concerning the structure of the setae of both species. In both species all setae (with one exception) are basically equally built, and covered with imbricated lozenge-shaped "scales". At their distal apex these scales are somewhat detached, thus giving the hair a rough surface. In *gallica* these scales are regular lozenges, but in *fusca* they have their distal apex somewhat attenuated (fig. 2i, j). Doubtless this is related to the fact that the setae of *gallica* are stiff and erect, but those of *fusca* more flexible. The only hairs that deviate from this picture are the setae at the anterior face of the dens. These hairs have very narrow bases, and in connection therewith are closely appressed to the body of the dens. This, of course, is morphologically quite logical, because this part of the furca is kept close to the animal's venter. The surface of these hairs is not scaly, but smooth with an array of fine ridges. These ridges are visible with an optical microscope, and then seem to form a spiral structure. A study of these hairs with the use of a scanning electron microscope, undertaken by Dr. Z. MASSOUD of the Laboratoire d'Ecologie générale du Muséum, Brunoy, France, however revealed that these ridges form some sort of a herringbone pattern (fig. 4d, e, f). A similar structure is present in the same setae of *Sminthurus viridis* (Linnaeus, 1758), and even of the only distantly related *Dicyrtomina minuta* (Fabricius, 1783) (fig. 4a, b, c). Presumably this setae structure is inhaerent to the appressed habit of the hairs. I am very grateful to my friend, Dr. MASSOUD for his assistance in studying this structure, and for preparing the scanning microphotos.

Summary

The known range of *Allacma gallica* is enlarged to include Italy and the Netherlands. The Dutch localities are all restricted to the dune area. The ecology of

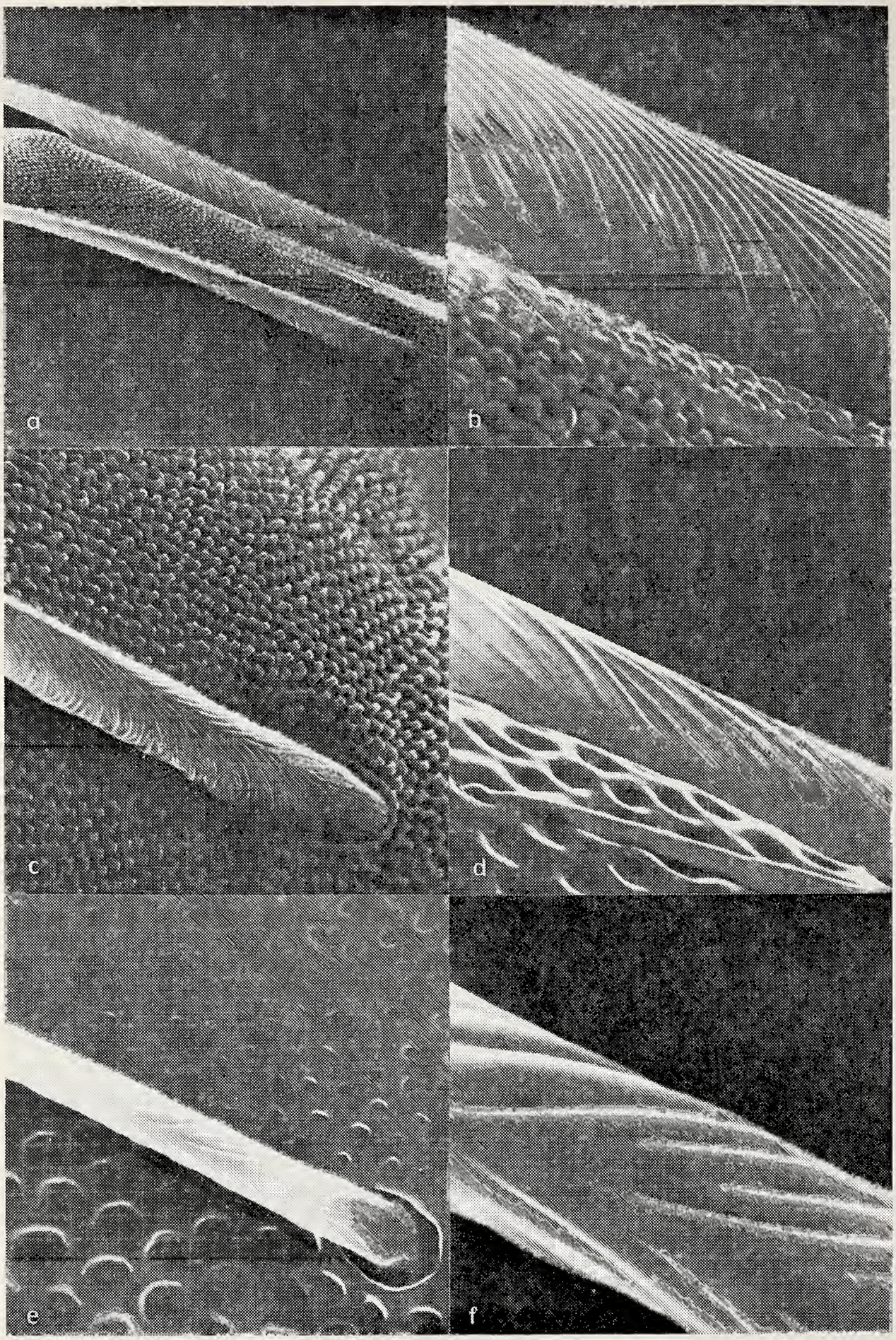

Plate 4. Scanning electron microscope photographs of setae from the anterior face of the dens. a—c: *Dicyrtomina minuta* (Fabricius) from Brunoy; a: 2100 ×; b: 10.500 ×; c: 5.200 ×; d—f: *Allacma gallica* from Brunoy; d: 11.000 ×; e: 5.000 ×; f: 20.000 ×.

gallica and *fusca* in Holland is compared, and a considerable amount of overlap in habitat is demonstrated. A differential diagnose of *gallica* is given, and some new differential characters are presented. It is suggested that the Dutch, Italian, Southern French and North-Central French + Swiss material might belong to four different subspecies, based on some morphological characters and especially on the pigmentation of the head.

The setae on the anterior face of the dens are found to be of a special built, differring from all other setae in being smooth with a system of fine ridges. This same structure is met in other Symphypleona having the anterior dental setae closely appressed against the body of the dens.

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