

A REVISION OF THE BRITISH SYMPHYLA

BY

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[Accepted 10th June 1958]

(With 13 figures in the text)

CONTENTS		Page
Order Symphyla Ryder		404
Introduction		404
Occurrence of the Symphyla		404
Mounting technique		405
Geographical distribution		406
Key to British families of Symphyla		407
Family Scutigerellidae Bagnall		407
Key to British genera of Scutigerellidae		407
Genus <i>Scutigerella</i> Ryder		408
Key to British species of <i>Scutigerella</i>		409
<i>Scutigerella immaculata</i> Newport		410
<i>Scutigerella palmonii</i> Michelbacher		413
<i>Scutigerella linsleyi</i> Michelbacher		415
<i>Scutigerella lineatus</i> sp. n.		417
<i>Scutigerella causeyae</i> Michelbacher		418
Genus <i>Hanseniella</i> Bagnall		420
Key to British species of <i>Hanseniella</i>		421
<i>Hanseniella unguiculata</i> Hansen		421
<i>Hanseniella caldaria</i> Hansen		423
Genus <i>Neoscutigerella</i> Bagnall		424
<i>Neoscutigerella hanseni</i> Bagnall		424
Family Scolopendrellidae Bagnall		425
Key to British genera of Scolopendrellidae		425
Genus <i>Symphylellopsis</i> Ribaut		425
Key to British species of <i>Symphylellopsis</i>		426
<i>Symphylellopsis subnuda</i> Hansen		426
<i>Symphylellopsis arvernorum</i> Ribaut		428
Genus <i>Scolopendrella</i> Gervais		429
<i>Scolopendrella notucantha</i> Gervais		430
Genus <i>Symphylella</i> Silvestri		431
Key to British species of <i>Symphylella</i>		432
<i>Symphylella hintoni</i> sp. n.		432
<i>Symphylella vulgaris</i> Hansen		434
<i>Symphylella isabellae</i> Grassi		436
Summary		438
Acknowledgments		438
References		438

Order SYMPHYLA Ryder

1880 *Symphyla* Ryder, Amer. Nat. 14: 375-376.

Head separate, setose, with entognathous mouthparts, two-segmented mandibles with single cranial articulation, maxillae of two segments and second maxillae fused to form a labium. Internal thickening of dorsal integument known as central rod present; one pair of spiracles only, opening at sides of head. *Antennae* five to sixty segmented with intrinsic muscles in each segment; setae and sensory organs present on most segments. Eyes absent. Post-antennal organs at base of antennae. *Trunk* of fourteen segments with fifteen to twenty-two scuta, first scutum often reduced or absent. Paired gonads opening without external genitalia, on fourth trunk segment just anterior to fourth pair of legs. Paired sensory organs known as calicles at sides of last scutum, each bearing a very long sensory seta. Twelve pairs of legs, the first usually reduced more or less strongly, sometimes scarcely distinguishable from others. Normal leg consisting of six segments: coxa, trochanter, femur, tibia, tarsus and paired claws; styli present at bases of last ten pairs of legs, sometimes very reduced; eversible coxal sacs present between legs 3-9, 3-10, or 3-11, on remaining legs they are degenerate, except on the first where they are absent. Cerci, which are part of thirteenth segment, conical and terminating in one or two longer setae; with paired silk glands opening near tip.

INTRODUCTION

Only about fifty papers have been written on the taxonomy of the Symphyla and several genera are still in a chaotic state. This is largely due to the amount of variation of characters found in most of the genera studied. Authors have established new species on single damaged specimens, have used characters which are often only local variations, and have often based their descriptions on immature specimens.

In his "Synopsis of the British Symphyla" (1913), Bagnall gives keys and descriptions of thirteen species. Of these only seven can now be accepted for reasons given in this paper. In the present work these seven species are more fully described and a further seven species are described; including five species new to the British Isles and two species new to science. Wherever possible large numbers of specimens of these species have been collected and the range of variation of the various characters observed and recorded. A statistical treatment of some of the characters, such as numbers of setae on various organs would have been of value, but it has not been found practicable to attempt this here.

OCCURRENCE OF THE SYMPHYLA

Much of the material examined, was obtained in the course of a series of ecological studies of the Order carried out in the South West of England. At first only those species which were of economic importance were collected, but later the survey was extended to include all species.

Symphylids are most abundant in light soils rich in humus, with plants growing at the surface. They are, however, found in a variety of other situations such as in moss, under bark, under stones, among leaf humus, and even in uncultivated barren soils (Michelbacher, 1948).

Wherever specimens were found they were usually present in very large numbers and could be collected readily. Populations of some species as high as 80,000,000 per acre have been estimated in some localities (Edwards, 1955 a). Collection from soil can be easily carried out by breaking open clods of earth so that the runways are exposed. This method, however, is very tedious, and, in addition, at certain seasons many species of Symphyla go down too deep to be found. Hence, where as many specimens as possible are required, the best method of obtaining them is by placing a section of soil in a container of water (Michelbacher, 1939). The symphylids readily float to the surface when the water is stirred, and can be picked up with a fine brush, and if desired kept alive on a plaster of Paris culture medium (Edwards, 1955 b). Alternatively, a Berlese funnel can be used, but the number of specimens recovered from a soil sample are less by this method than by a flotation method.

Specimens are found under a variety of soil conditions, and are often abundant at soil temperatures as low as 2°C and as high as 28°C. They seem to prefer soil with a high organic content and are never found in dry soils, since they require a minimum soil moisture content of about 6 per cent for survival in an average loam soil.

Symphylids have been found at all altitudes. They are frequently found on the banks of rivers and even near the high tide level*. They are common in all types of soils but occur less frequently in clay soils, probably due to the difficulty of constructing runways in clay.

Species of the genus *Scutigerella* were usually found in the soil around the roots of growing plants (an exception is *Scutigerella causeyae* Michelbacher, which is more often found among forest litter, humus, etc.). All British species of the genus with the exception of the latter, have been found to be of considerable economic importance, both under glass and outdoors, since they will attack practically any plant possessing young succulent roots.

Specimens of the genus *Hanseniella* were also found around growing roots in tropical hothouses. Although their food was not determined they were most numerous close to the plant roots.

Specimens of the genera *Symphyla*, *Symphylellopsis* and *Scolopendrella* were more frequently found widely distributed throughout the soil. They were also found around growing roots, but it is believed that they were only feeding on decaying root tissues.

MOUNTING TECHNIQUE

It is important that a standardised mounting technique should be adopted, since a number of characters used in determinations are comparative. In the present study three main methods have been used. All specimens have been stored in 70 per cent alcohol to which a little glycerine has been added. For determinations specimens have been examined as temporary mounts in lactic acid under a cover slip, and gently warmed for about 10 min. to clear them.

Two types of permanent mount have been used. A number of specimens from each locality were mounted in polyvinyl alcohol Type A3 (Salmon,

* I have been informed by Dr H. E. Hinton that he has seen a species below high tide level at Yealmpton, Devon.

1951). This is made up by first heating 60 gm. Phenol Detached Crystals B.P. with 60 c.c. lactic acid B.P. Then to 15 c.c. Elvanol 51 A 05 polyvinyl alcohol, 15 c.c. distilled water is added drop by drop. This gives a fluffy paste which may be cleared by gently heating on a water bath. When specimens are mounted in this medium they should be left to set in an oven at about 50°C. This extends the appendages very satisfactorily. Such mounts have been kept four years with very little deterioration. A further refinement is to add a few grains of the stain lignin pink to the medium. This is taken up by the specimen and makes observations of setae and other structures very much simpler. Most of the drawings were made from this type of mount, since P.V.A. has the advantage of extending the specimen, a feature of great value in examining specimens with large numbers of legs.

The alternative type of permanent mount was made in the following way : the specimen was cleared for forty-eight hours in 10 per cent KOH solution, or alternatively gently warmed for five minutes in a drop of 10 per cent KOH on a microscope slide. A better mount was obtained if the animal was first killed by trapping it under a cover glass and flooding it with acetic acid in order to fix it in a flat position. After clearing, the specimen was stained in acetic acid fuchsin for twenty-four to forty-eight hours and then dehydrated and mounted in Canada Balsam.

It should be noted here that certain characters that have been used in determinations can be affected by the type of mounting medium, pressure of the cover slip and so on. Such characters are the length and width of the head, width of antennal segments (which also varies with the degree of contraction taking place when the specimen is killed), and width of the cerci in relation to their length.

In no case was it possible to make accurate determinations of immature specimens ; and care should always be taken to ensure that the specimens examined possess the full adult number of legs.

GEOGRAPHICAL DISTRIBUTION

The present survey covers mainly the south-west of England including Cornwall, Devon, Somerset, Dorset, Gloucestershire, Wiltshire, the Isles of Scilly and the Channel Islands, but records from other counties are also included.

Of the genus *Scutigera*, all the species recorded are quite common over this area with the exception of *S. linsleyi* Michelbacher, which was only found in one place in Devon.

Representatives of the genus *Hanseniella* were only found twice, in a hot-house at Kew and in a glasshouse which had contained tropical plants on the Isles of Scilly. Other European records are also from hothouses and so it seems unlikely that it is an indigenous species.

A specimen of *Neoscutigerella* has only been recorded once, a single damaged example from which the genus was described.

Symphylella species seem to be commoner than those of the other genera, *Symphylella vulgaris* Hansen and *Symphylella isabellae* Silvestri being the

ones most commonly found, while *Symphylella hintoni* sp. n. was found in a number of localities.

Scolopendrella notacantha Gervais was found only in two localities.

Symphylellopsis subnuda Hansen and *Symphylellopsis arvernorum* Ribaut are quite common, but are not as numerous as *Scutigerella* or *Symphylella* species and are often overlooked due to their small size.

KEY TO BRITISH FAMILIES OF SYMPHYLA

1. Paired sense calicles with many setae irregularly distributed around margin of pit. Cerci without stripes or sculpturing near tip. Styli at base of legs well developed. First pair of legs more than half as long as following pair. Length usually more than 4 mm. SCUTIGERELLIDAE Bagnall
- . Paired sense calicles without setae around margin of pit. Cerci with stripes or sculpturing near tip. Styli poorly developed or reduced to slight protuberances. First pair of legs less than half as long as following pair. Length usually less than 4 mm. SCOLOPENDRELLIDAE Bagnall

Family SCUTIGERELLIDAE Bagnall

1913 Scutigerellinae Bagnall, J. Linn. Soc. (Zool.) **82**: 195-199.

1926 Scutigerellidae Attems, in Kukenthal, *Handbuch der Zoologie* **4** (1): 11-19.

Head distinctly separated from neck, central rod not interrupted in middle. *Antennae* usually more than 20-segmented, bearing two kinds of setae and sense organs, including a large branched terminal one. *Scuta* simple, not divided into pretergite and metatergite; intertergal areas between all scuta. Fifteen scuta present, including first which is very reduced; all others except last with posterior margins rounded or emarginate, but if emarginate, lobes are seldom angular, or if angular are several times broader than long. *Legs* each corresponding with a single scutum except, fourth, sixth and eighth which correspond with two scuta; first pair of legs well developed and more than half length of following pair. Styli well developed and bearing two or more setae*. Calicles with serrated border. *Coxal sacs* eight or nine in number. *Cerci* with smooth terminal area.

KEY TO BRITISH GENERA OF SCUTIGERELLIDAE

1. With a deep cavity beneath middle of posterior end of last scutum, between the cerci; last scutum more or less emarginate; antero-lateral setae directed mainly backwards *Scutigerella* Ryder
- . Without a cavity beneath posterior end of last scutum; last scutum not emarginate; antero-lateral setae directed mainly forward or laterally 2.
2. All setae on scuta blunt and fusiform except an antero-lateral pair on first scutum *Neoscutigerella* Bagnall
- . All setae on scuta long and pointed, not blunt and fusiform; antero-lateral setae on most scuta *Hanseniella* Bagnall

* If Ewing's nomenclature (1928) is followed, the second leg consists of coxa, trochanter, femur, tibia and tarsus and paired claw. In this case I consider the missing joint to be the femur.

Genus *SCUTIGERELLA* Ryder

1882 *Scutigere*l^{la} Ryder, Proc. U.S. nat. Mus. 5: 234.

Head pyriform ; length and breadth nearly equal ; spiracle opening in the anterior part of each side of the head ; a distinct neck ; a central rod sharply defined at posterior end but less distinct in anterior portion, lateral anterior branches running forward to the base of the antennae, two diagonal thickenings running from base of head to posterior end of post-antennal organs ; main rod interrupted at posterior end by circular area more or less distinct ; dorsal surface of head set with setae mostly short, some long, the longest lying lateral to post-antennal organ. *Antennae* of twenty to fifty segments with two main types of setae ; outer ones thicker and more strongly developed than inner ; setae arranged in whorls ; one whorl on segments nearest head, two on intermediate ones, three or even four on those nearest tip ; small sensory organs and fine sensory hairs present on all segments except first five ; terminal sensory organ present and always stalked. *Scuta* differ in shape, size and degree of emargination of the posterior margin ; third, sixth, ninth, twelfth and fourteenth scuta longer and more emarginate than others ; margins of scuta with many short and fewer longer outstanding marginal and sub-marginal setae which vary in length and number ; antero-lateral setae usually present on anterior scuta ; last scutum of different shape to others, with only a very slight emargination in centre overlying cavity between cerci ; no more than two setae in cavity between cerci. *Legs* with intricate patterns of sculpturing on some segments and densely setose ; setae on outer dorsal surface of legs much longer than those on inner ventral surface ; first pair of legs with one segment less than following pair, and sparsely clothed with setae, some long, the longest one lying on the inner surface of the trochanter (in *Scutigere*l^{la} *lineatus* this is replaced by a peg-like outgrowth). *Styli* present on last ten pairs of legs and each bearing two to three setae. *Coxal sacs* usually eight in number on legs three to ten. *Cerci* densely clothed with setae nearly to tip and terminating in long and short setae with opening of silk gland between them. *Length* 2.5–8.3 mm.

Taxonomic features

It is important to note that accurate determinations can only be made on mature adult specimens. The instar of a specimen of this genus can be estimated from the shape of the penultimate scutum, which has a smooth posterior margin when mature, but an irregularly scalloped one when immature (see Michelbacher, 1938, 1942).

All species of the genus have many variable characters, and, as most species have been described from a few specimens taken in a single locality, the range of variation in many species has not yet been defined. In addition distortion can be caused by the mounting technique used.

The length of the head, the length of the setae lying between the post-antennal organ and the spiracle, and the number of segments in unbroken antennae all offer good specific characters. The length/width ratio of the head, its shape, and the width of the third antennal segment, have all been

used by Michelbacher and Hansen. These are not reliable characters however as they can vary with the mounting technique.

The best specific characters appear to be the shape and size of the dorsal scuta. The first six and the last scuta have been described here. The greatest specific differences are found in the second and sixth scuta. The difference in number of marginal and submarginal setae is not a good character, since the variation in number within a species may overlap with that of other species. The length of the long outstanding, marginal and submarginal setae in relation to that of the short setae does show good specific variation. Long outstanding setae are present on the second scutum of all species described at present, but the number of scuta on which these setae can be distinguished varies with the species. The shape of the last scutum and the cavity beneath it, is of some taxonomic value, but shows a little variation and may be distorted in mounting. There are two setae in this cavity, which vary considerably in length in different species. The shape of the cercus is a slightly variable character and the length/width ratio of the cercus can be affected by pressure. The length of the long fine seta at the end of the cercus, measured from notch to tip, and the amount of expansion at the end of the cercus provide good specific characters. The relative dimensions of the segments of the legs are too variable to be good characters, but the density of their setae, particularly that of the first pair, is a good character. The first pair of legs of two species (one British) bear a peg-like projection on the inner surface of the trochanter. The number of coxal sacs, the shape and number of setae borne on the last two coxal sacs, and the body length measured from front of head to tip of cercus all show good specific differences.

KEY TO BRITISH SPECIES OF SCUTIGERELLA

- | | | |
|---|----|---------------------------------|
| 1. Posterior margin of second scutum strongly emarginate. | 2. | |
| -. Posterior margin of second scutum slightly emarginate, almost linear | 4. | |
| 2. Coxal plates corresponding with last pair of legs, with no setae; scuta very deeply emarginate, legs sparsely setose, very small species less than 5 mm. long | | <i>S. linsleyi</i> Michelbacher |
| -. Coxal plates corresponding with last pair of legs with at least one seta, usually two or more; scuta not so deeply emarginate; legs densely setose, larger species usually more than 5 mm. long | 3. | |
| 3. Long outstanding antero-lateral setae on nearly all scuta; 2nd scutum only very moderately emarginate; cavity beneath last scutum usually V-shaped and with fewer long setae overlying it | | <i>S. palmonii</i> Michelbacher |
| -. Antero-lateral setae not so long and outstanding, not present on posterior scuta; second scutum more deeply emarginate; cavity beneath last scutum broadly U-shaped with many short setae overlying it | | <i>S. immaculata</i> Newport |
| 4. Small species less than 4.8 mm. long; setae sparse and short; male with peg-like projection on inner surface of trochanter of first leg | | <i>S. lineatus</i> sp. n. |
| -. Large species more than 5.1 mm. long; setae longer and numerous; no peg-like projection on first leg in either sex. | | <i>S. causeyae</i> Michelbacher |

SCUTIGERELLA IMMACULATA Newport

1845 *Scolopendrella immaculata* Newport, Trans. Linn. Soc. Lond. (Zool.) 19: 373.

1873 *Scolopendrella americana* Packard, Proc. Boston Soc. nat. Hist. 16: 111.

1882 *Scutigereilla immaculata* Ryder, Proc. U.S. nat. Mus. 5: 234.

1905 *Scutigereilla californica* Woodworth, Calif. J. Tech. 6: 38.

1914 *Scutigereilla biscutata* Bagnall, Trans. nat. Hist. Soc. Northumb. 4: 17.

1914 *Scutigereilla spinipes* Bagnall, *ibid.* 4: 17.

Adult: Length 5.5–7.0 mm. *Head* (Fig. 1f) with setae mostly short, 0.017–0.067 mm. long; longest seta post-antennal, 0.056–0.067 mm. long. *Antenna* of twenty-six to thirty-four segments, usually thirty segmented. *Scuta* (Fig. 1a–e) moderately emarginate posteriorly; long marginal and submarginal setae seldom more than twice as long as corresponding short setae; long setae becoming progressively shorter posteriorly and not distinguishable from the short, after the sixth or seventh scutum (see Table); last scutum (Fig. 1g) usually only shallowly emarginate in centre, with a large number of

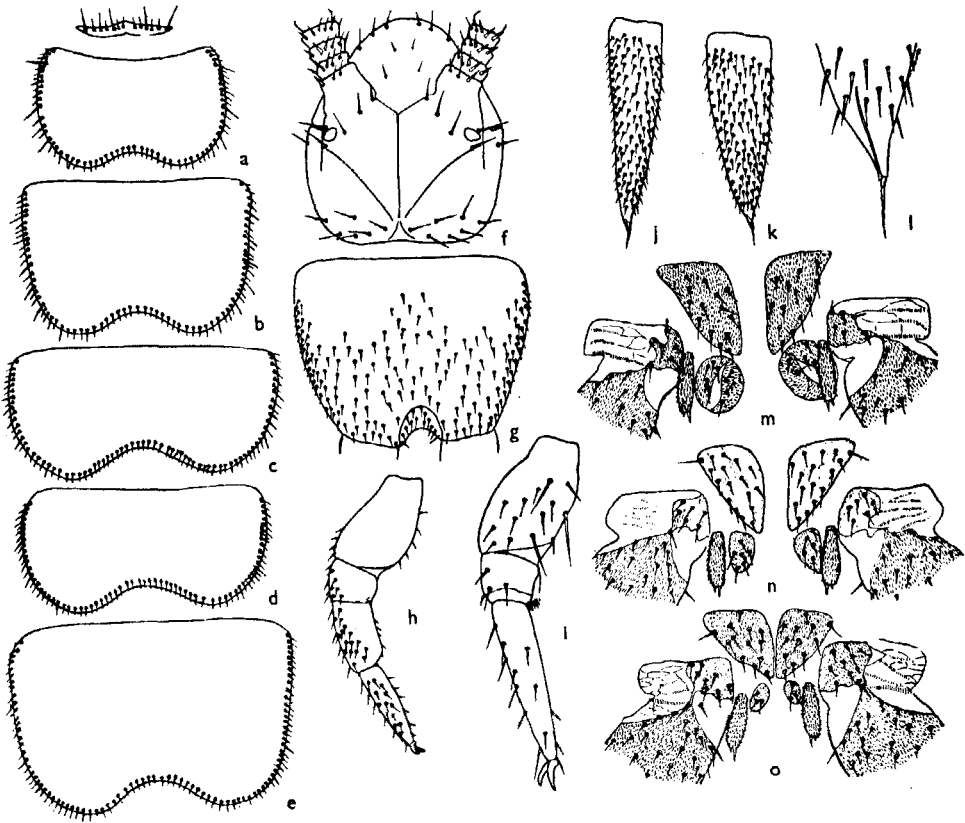


Fig. 1.—*Scutigereilla immaculata* Newport.

a–e, first to sixth dorsal scuta; f, dorsal view of head; g, last dorsal scutum; h, posterior view of last leg of left side; i, posterior view of first leg of left side; j, dorsal view of right cercus; k, alternative type of right cercus; l, tip of cercus; m–o, ventral view of bases of last three pairs of legs. All $\times 72$ except i and l which are $\times 190$ and m–o which are $\times 140$.

setae overlying U-shaped cavity ; setae in cavity quite short. *Legs* densely clothed with setae. *Styli* (Fig. 1m) each with two setae only. *Coxal plates* (Fig. 1m-o) of last pair of legs each with two to three setae ; those of penultimate pair with four to six setae. *Cerci* (Fig. 1 j, k) densely clothed with short setae and with terminal area moderately expanded ; apical seta short 0.038-0.047 mm. long.

Chaetotaxy

1. Dorsal scuta (based on sixty-two adult specimens from seventeen localities).

	Total No. of marginal setae	No. of long marginal setae	Width of scutum (mm.)	Length of antero-lateral seta (mm.)
Second scutum	48-61	6-8	0.35-0.39	0.046-0.049
Third scutum	64-74	8-10	0.41-0.48	0.042-0.046
Fourth scutum	60-70	6-8	0.46-0.53	0.035-0.042
Fifth scutum	58-68	6-8	0.42-0.49	0.032-0.035
Sixth scutum	70-96	6-8	0.49-0.56	0.028-0.035

2. Number of setae on first pair of legs.

	Outer, dorsal	Inner, ventral	Anterior	Posterior	Total
Tarsus	5-6	2-4	3-4	4-6	16-17
Tibia	1-2	0	0	2-3	4
Trochanter	0-1	2-3	0	9-10	13-14

3. Number of setae on last pair of legs.

	Outer, dorsal	Inner, ventral	Anterior	Posterior	Total
Tarsus	6-7	6-7	15-19	13-16	43-48
Tibia	5-6	4-5	16-20	14-17	40-46
Femur	3-4	0	9-11	4-8	36-40
Trochanter	3-4	5-7	28-35	1	37-40

Type : Once deposited in the British Museum (Natural History), now apparently lost. *Type locality* ; St. John's Wood, London. The present description is based on specimens from Jersey, Channel Isles.

Distribution : Cosmopolitan. Recorded previously in Britain from Scotland, Ireland, Durham, Yorkshire, and Cheshire. In addition I have found it in Gloucestershire, Somerset, Wiltshire, Dorset, Devon, Cornwall, the Isles of Scilly and the Channel Isles.

Comparative notes: *S. immaculata* is most closely related to *S. silvestri* Mich. from which it may be distinguished by the presence of two setae instead of three on the styli and the much shorter cerci. *S. silvestri* is also longer.

Hansen (1903) claims there are nineteen to fifty antennal segments, but his specimens with few segments were probably immature, and those with many belonged to other species. Michelbacher (1942) figures no long setae on the fourth scutum, but such setae are present on specimens named by him and deposited in the British Museum (Natural History). In his key he uses the number of marginal and sub-marginal setae on the second scutum as a diagnostic character, *S. immaculata* and *S. silvestri* having more than fifty-two such setae. In fact some of his specimens only possess fifty such setae and some British specimens as few as forty-eight. The principal diagnostic features of *S. immaculata* are the numerous short setae over the body and the rounded deeply emarginate scuta.

Scolopendrella americana Packard and *Scutigereilla californica* Woodworth are synonyms of *S. immaculata*, as shown by Michelbacher (1942). *Scutigereilla*

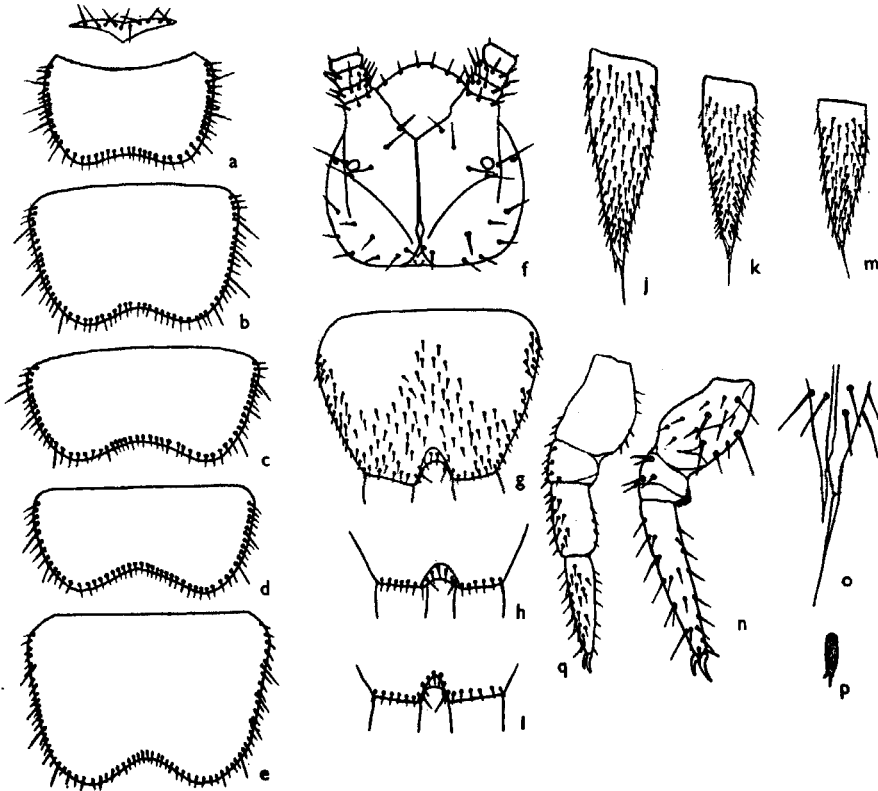


Fig. 2.—*Scutigereilla palmonii* Michelbacher.

a-e, first to sixth dorsal scuta; f, dorsal view of head; g, last dorsal scutum; h-i, alternative shapes of cavity below last scutum; j-m, dorsal view of right cercus (with alternative types); n, posterior view of first leg of left side; o, tip of cercus; p, typical stylus; q, posterior view of last leg of left side. All $\times 72$ except n and o which are $\times 190$.

biscutata Bagnall and *Scutigereella spinipes* Bagnall are fifth and seventh instar individuals of *S. immaculata* respectively, as is evident from the descriptions and from an examination of topotypes of these species in the British Museum.

Habits : *S. immaculata* can most easily be found around the roots of growing plants on which it feeds, particularly in moist soil. It is commonly a pest of cultivated crops, but it may also be found under stones, in forest litter and at considerable depths in the soil.

SCUTIGERELLA PALMONII Michelbacher

1942 Ann. ent. Soc. Amer. 35: 274.

Adult : length 4.1–7.0 mm. *Head* (Fig. 2 f) with setae mostly short, some very long 0.017–0.088 mm. long ; longest seta post-antennal 0.067–0.088 mm. long. *Antenna* of twenty-seven to forty-three segments usually thirty-seven segmented. *Scuta* (Fig. 2 a–e) with second scutum slightly emarginate, others moderately emarginate, lateral margins relatively straight ; long marginal and submarginal setae inset from the margin and very conspicuous, usually two or three times as long as corresponding short setae ; long setae present on almost all scuta ; last scutum (Fig. 2 g) with moderately deep median emargination overlying V-shaped cavity containing two long setae ; never more than eight setae around the border of this emargination. *Styli* each with two setae only. *Coxal plates* of last pair of legs each with one to three setae and those of penultimate pair with four to six setae. *Cerci* (Fig. 2 j–m) densely clothed with setae ; little expansion of terminal area ; apical seta long 0.055–0.070 mm. in length.

Chaetotaxy

1. Dorsal scuta (based on forty-four specimens from fifteen localities).

	Total No. of marginal setae	No. of long marginal setae	Width of scutum (mm.)	Length of antero-lateral seta (mm.)
Second scutum	36–50	6–8	0.24–0.42	0.06–0.067
Third scutum	45–66	6–10	0.38–0.56	0.06–0.067
Fourth scutum	46–62	6–8	0.44–0.63	0.056–0.063
Fifth scutum	45–64	4–6	0.42–0.60	0.049–0.053
Sixth scutum	68–86	10–12	0.50–0.67	0.049–0.053

2. Number of setae on first pair of legs.

	Outer, dorsal	Inner, ventral	Anterior	Posterior	Total
Tarsus	6	5–7	5–7	6–8	24–27
Tibia	2–3	0	0–1	3	5–6
Trochanter	0	2–3	0	12–15	14–17

3. Number of setae on last pair of legs.

	Outer, dorsal	Inner, ventral	Anterior	Posterior	Total
Tarsus	6-8	7-10	10-17	16-32	39-66
Tibia	6-8	4-5	16-33	9-20	36-67
Femur	4-5	0	9-12	1-4	17-22
Trochanter	2-3	6-8	32-42	0	42-49

Type : In the collection of the University of California, No. 5191. Type locality : banks of River Jordan, Palestine. The present description is based on specimens from Cheddar, Somerset.

Distribution : Previously recorded only from the type locality. I have found it in eight localities in Somerset, two in Dorset, four in Devon and one in Lancashire.

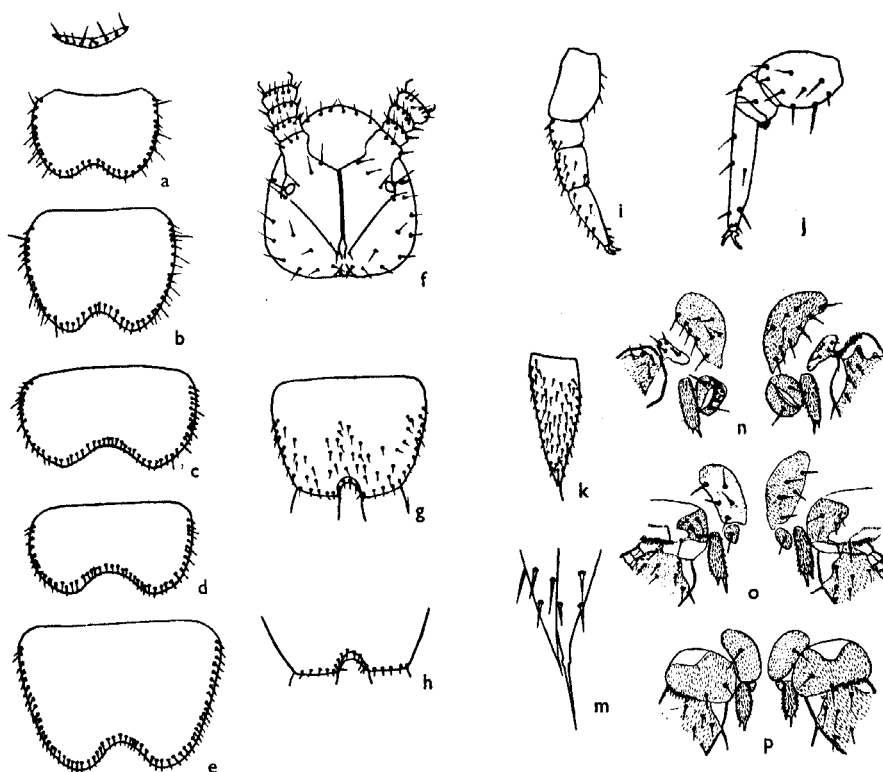


Fig. 3.—*Scutigrella linsleyi* Micholbacher.

a-e, first to sixth dorsal scuta ; f, dorsal view of head ; g, last scutum ; h, alternative shape of cavity below last scutum ; i, posterior view of last leg of left side ; j, posterior view of first leg of left side ; k, dorsal view of right cercus ; m, tip of cercus ; n-p, ventral view of bases of last three pairs of legs. All $\times 72$ except j and m which are $\times 190$, and n-p which are $\times 140$.

Comparative notes : *S. palmonii* is most closely related to *S. immaculata*, from which it may be distinguished by the presence of certain longer setae, particularly the post-antennal seta, the antero-lateral seta, those at the tips of the cerci, and those in the cavity below the last scutum. This cavity is much more V-shaped than that of *S. immaculata*, the posterior margins of the scuta are less emarginate, the head is broader and more angled at the sides and the cerci are more pointed.

Habits : *S. palmonii* is found in identical situations to *S. immaculata* and also attacks a wide range of plants with succulent root systems.

SCUTIGERELLA LINSLEYI Michelbacher

1942 Ann. ent. Soc. Amer. 35: 283.

Adult : Length 3.5–4.9 mm. *Head* (Fig. 3 f) with setae, mostly short, some longer 0.014–0.063 mm. long. *Antenna* of twenty to twenty-four segments, usually twenty-two segmented. *Scuta* (Fig. 3 a–e) very strongly emarginate posteriorly, lateral margins rounded; long marginal and submarginal setae never more than twice as long as the corresponding short ones; these long setae becoming progressively shorter posteriorly (see Table) and not distinguishable from short setae after fifth or six scutum. Last scutum (Fig. 3 g) deeply emarginate, overlying broadly U-shaped cavity; setae in cavity short. *Styli* (Fig. 3 n–p) each with two setae only. *Coxal plates* (Fig. 3 n–p) of last pair of legs very small and bearing no setae; those of penultimate pair only slightly larger and each bearing only one seta. *Cerci* (Fig. 3 k–m) short and densely clothed with setae; terminal area not expanded; apical seta short 0.39 mm. long.

Chaetotaxy

1. Dorsal scuta (based on four specimens from one locality).

	Total No. of marginal setae	No. of long marginal setae	Width of scutum (mm.)	Length of antero-lateral seta (mm.)
Second scutum	33–42	6–8	0.28–0.29	0.045
Third scutum	40–50	6–8	0.35–0.36	0.038
Fourth scutum	40–52	6–8	0.40–0.41	0.035
Fifth scutum	40–46	4	0.38–0.39	0.026
Sixth scutum	56–62	0	0.42–0.43	0.025

2. Number of setae on first pair of legs.

	Outer, dorsal	Inner, ventral	Anterior	Posterior	Total
Tarsus	3–4	2–3	2–4	1–2	9–11
Tibia	1	0	0	2	2
Trochanter	0	3	0	6–7	9–10

3. Number of setae on last pair of legs.

	Outer, dorsal	Inner, ventral	Anterior	Posterior	Total
Tarsus	4-5	3-4	4-7	4-5	16-19
Tibia	4	0-1	3-7	5-7	13-16
Femur	2-3	0	3-5	1	7-9
Trochantor	0	1-5	10-16	0	13-17

Type : In the collection of the University of California, No. 5194. Type locality : Idyllwild, California. The present description is based on specimens from Bishopsteignton, Devon.

Distribution : Recorded previously only from the type locality. I have only found it in one locality, Bishopsteignton, Devon.

Comparative notes : *S. linsleyi* is most closely related to *S. immaculata*, from which it may be distinguished by its small size, deep emargination of the

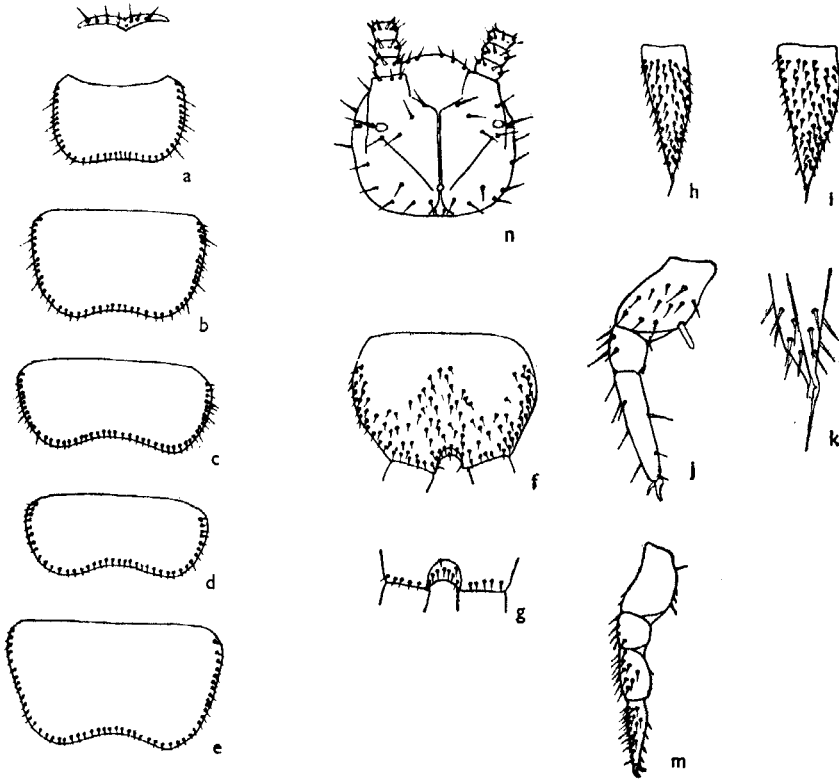


Fig. 4.—*Scutigrella lineatus*, sp. n.

a-e, first to sixth dorsal scuta ; f, last scutum ; g, alternative shape of cavity below last scutum ; h-i, dorsal view of two types of right cercus ; j, posterior view of first leg of left side of male ; k, tip of cercus ; m, posterior view of last leg of left side ; n, dorsal view of head. All $\times 72$ except j and k which are $\times 180$.

posterior margin of the scuta and few setae on the posterior coxal plates. In addition it is distinctive in having not more than twenty-four antennal segments, and relatively sparse setae on the scuta and legs.

Habits : It was found in the upper layers of the soil in extremely large numbers causing considerable damage to the roots of cabbage plants.

SCUTIGERELLA LINEATUS sp. n.

Adult : Length 2·8–4·8 mm. *Head* (Fig. 4 n) with setae, mostly short, some long 0·014–0·049 mm. long. *Antenna* of twenty-two to thirty-two segments, usually twenty-eight segmented. *Scuta* (Fig. 4 a–e) with posterior margin of second scutum almost linear, others only slightly emarginate posteriorly; long marginal and submarginal setae usually less than twice as long as corresponding short setae; long setae becoming progressively shorter posteriorly and not distinguishable from the short after fifth or sixth scutum (see Table); last scutum (Fig. 4 f) only moderately emarginate and overlying broad U-shaped cavity; setae in cavity short. *Coxal plates* of last pair of legs each with one seta only; those of penultimate pair each with one to four setae. *Styli* each with two setae only. *Cerci* (Fig. 4 h–i) short, densely clothed with short setae and with terminal area moderately expanded; apical seta short 0·039–0·049 mm. long.

Chaetotaxy

1. Dorsal scuta (based on fourteen adult specimens from five localities).

	Total No. of marginal setae	No. of long marginal setae	Width of scutum (mm.)	Length of antero-lateral seta (mm.)
Second scutum	36–42	6	0·23–0·29	0·035–0·042
Third scutum	46–56	6–8	0·29–0·40	0·034–0·039
Fourth scutum	42–50	4	0·33–0·43	0·026–0·030
Fifth scutum	40–50	4	0·31–0·40	0·024–0·028
Sixth scutum	50–60	0	0·37–0·46	0·021–0·024

2. Number of setae on first pair of legs.

	Outer, dorsal	Inner, ventral	Anterior	Posterior	Total
Tarsus	4–7	1–4	2–4	5–7	15–20
Tibia	2	0	2	1–2	5–6
Trochanter	0–1	0(P)	9–12	0	9–12

3. Number of setae on last pair of legs.

	Outer, dorsal	Inner, ventral	Anterior	Posterior	Total
Tarsus	4-7	4-5	10-12	12-15	32-36
Tibia	4-6	1-4	8-10	12-16	27-32
Femur	3-4	0	4-6	4-5	12-14
Trochanter	2-3	2-5	18-22	0	25-28

Type : Deposited in British Museum. Type locality : Cheddar Valley Nurseries, Cheddar, Somerset.

Distribution : Bath, Cheddar, Draycott, and Langford in Somerset. South Tawton in Devon.

Comparative notes : *S. lineatus* is most closely related to *S. armata* Hansen, a species only recorded from Algeria, and which is characterized by a peg-like projection on the inner surface of the trochanter of the first leg, in the same position as a very long seta in other species. *S. lineatus* has a similar structure on the first leg, but in this species it is found only in the male. The species may also be distinguished from *S. armata* by the much more linear posterior margins of the scuta and the much shorter cerci. The scuta have a rather similar shape to *S. causeyae* Michelbacher but this is a very much smaller species.

Habits : It has been found for the most part in cultivated soils, particularly in greenhouses, feeding on growing plant roots.

SCUTIGERELLA CAUSEYAE Michelbacher

1942 *Ann. ent. Soc. Amer.* **35**: 280.

Adult : length 5.1-8.2 mm. *Head* (Fig. 5 f) broad, with setae mostly short, some very long 0.021-0.080 mm. long ; longest seta post-antennal 0.080-0.105 mm. long. *Antenna* of twenty-eight to thirty-nine segments usually thirty segmented. *Scuta* (Fig. 5 a-e) particularly the second, only very slightly emarginate; long marginal and submarginal setae, slightly inset from the margin and more than three times as long as the corresponding short setae ; long setae becoming progressively shorter posteriorly, not distinguishable from the short after the fifth or sixth scutum ; last scutum (Fig. 5 g) usually with only a shallow median emargination, and with numerous setae overlying a broadly U-shaped cavity ; setae in cavity quite short. *Coxal plates* of last pair of legs each with one to two setae ; those of penultimate pair with four to six setae. *Styli* each with two setae only. *Cerci* (Fig. 5 k) large and densely clothed with short setae ; terminal area strongly expanded ; apical setae long 0.046-0.056 mm. long.

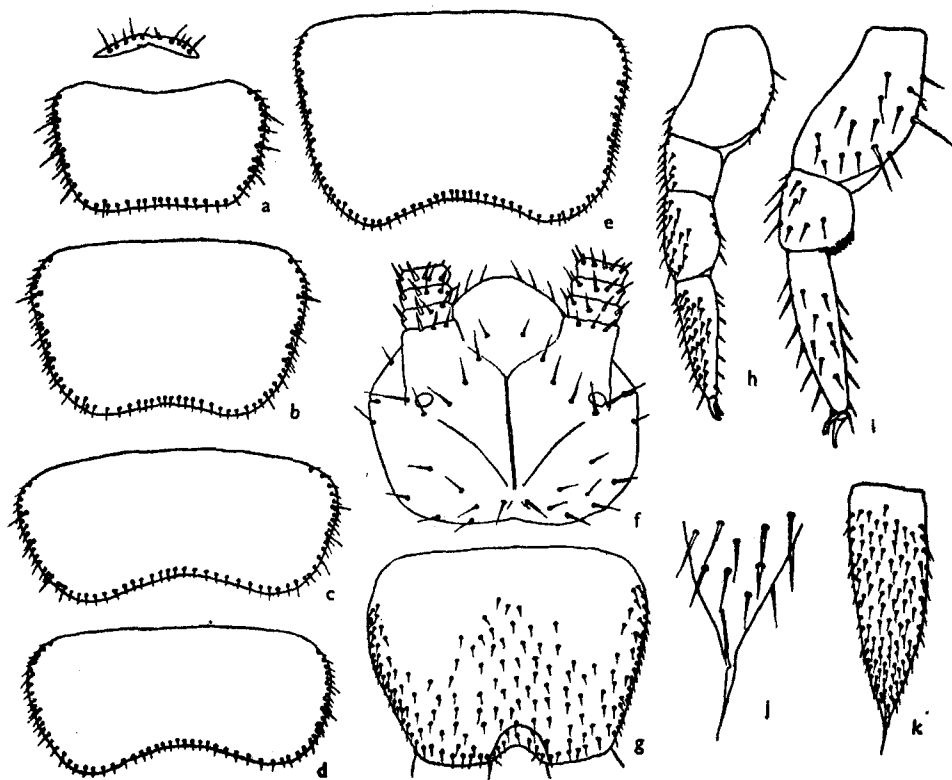


Fig. 5.—*Scutigrella causeyae* Michelbacher.

a-e, first to sixth dorsal scuta ; f, dorsal view of head ; g, last scutum ; h, posterior view of last leg of left side ; i, posterior view of first leg of left side ; j, tip of right cercus ; k, dorsal view of right cercus. All $\times 72$ except i and j which are $\times 180$.

Chaetotaxy

1. Dorsal scuta (based on twenty-three specimens from fifteen localities).

	Total No. of marginal setae	No. of long marginal setae	Width of scutum (mm.)	Length of anterolateral seta (mm.)
Second scutum	38-48	6-8	0.42-0.49	0.053-0.060
Third scutum	54-68	6-8	0.52-0.62	0.053-0.056
Fourth scutum	48-62	6	0.62-0.69	0.046-0.049
Fifth scutum	48-54	4-6	0.60-0.67	0.042-0.046
Sixth scutum	64-82	6-8	0.69-0.79	0.035-0.039

2. Number of setae on first pair of legs.

	Outer, dorsal	Inner, ventral	Anterior	Posterior	Total
Tarsus	4-7	4-6	4-7	4-10	18-26
Tibia	2-4	0	4-7	0	8-10
Trochanter	0	3-4	14-18	0	17-23

3. Number of setae on last pair of legs.

	Outer, dorsal	Inner, ventral	Anterior	Posterior	Total
Tarsus	5-10	6-10	23-54	22-36	56-106
Tibia	4-6	3-4	12-28	10-24	32-64
Femur	2-4	0	8-18	6-8	14-30
Trochanter	0-4	3-5	26-52	0	30-56

Type : In the collection of the University of California No. 5193. Type locality : Durham, North Carolina. The present description is based on specimens from Draycott, Somerset, England.

Distribution : Recorded previously only from type locality. It seems to be the commonest species in Britain, and I have found it in six localities in Somerset and also in Dorset, Hampshire, Devon, Surrey, Leicestershire, Derbyshire and Lancashire. I have also seen specimens from Cumberland and Ireland.

Comparative notes : *S. causeyae* Michelbacher is most closely related to *S. verhoeffi* Michelbacher from which it may be distinguished by the possession of eight pairs of coxal sacs instead of nine and the U-shaped cavity beneath the last scutum instead of a strongly V-shaped one in *S. verhoeffi*. All the British specimens found and in addition some from Sweden, had more numerous setae and were of a much larger size than those of the other species.

Habits : This species appears to be most common in forest litter and soils containing a high proportion of organic matter.

Genus *HANSENIELLA* Bagnall

1913 *Hanseniella* Bagnall, J. Linn. Soc. (Zool.) **32**, 197.

Head rounded with central rod only distinct in middle, not continuous through entire length and without anterior branches ; no diagonal sutures ; dorsal surface with some long setae on anterior portion, longest seta not post-antennal. *Antenna* of twenty to forty-five segments with only stout setae present. *Scuta* : first two and last scuta with rounded posterior margins, others emarginate ; long outstanding antero-lateral setae on scuta 2, 3, 4, 6, 7 and 9 ; directed forward on first two scuta. No cavity present under last scutum between cerci. *Legs* densely setose, setae on dorsal surface of tarsus not appreciably longer than those on ventral surface. *Coxal Sacs* only fully developed on legs 3 to 9. *Styli* long and narrow with two long terminal setae and sometimes additional ones. *Cerci* with elongated terminal area.

KEY TO BRITISH SPECIES OF *HANSENIELLA*

1. Posterior claw of last leg strongly curved and only half as long as anterior claw ; primary whorl of antennal setae on eleventh segment as long ventrally as dorsally *H. unguiculata* Hansen
- . Posterior claw of last leg only moderately curved and more than half as long as anterior claw ; primary whorl of antennal setae on eleventh segment much shorter ventrally than dorsally *H. caldaria* Hansen

HANSENIELLA UNGUICULATA Hansen

1904 *Scutigerella unguiculata* Hansen, Quart. J. micr. Sci. **47**: 1.

1913 *Hanseniella unguiculata* Bagnall, J. Linn. Soc. (Zool.) **32**: 197.

Adult : Length 3.0–3.6 mm. *Head* (Fig. 6g) with setae, mostly short 0.010–0.037 mm. long ; with a few longer at front of head ; post-antennal seta not longer than others. *Antenna* (Fig. 6p–q) of twenty-two to thirty-four segments, setae in primary whorl long, both dorsally and ventrally on segments of distal half of antenna ; those of eleventh segment ± 0.034 mm. above, 0.031 mm. below. *Scuta* (Fig. 6a–f) ; second, third and last scuta with rounded posterior margins, other scuta slightly emarginate ; antero-lateral setae very long and outstanding, directed forwards on first two segments and backwards on segments 4, 6, 7 and 9 ; these setae much shorter on other segments ; no cavity beneath last scutum. *Legs* (Fig. 6m–n) with anterior claw of last pair of legs very long and robust, posterior claw very curved, only half as long as anterior ; first pair of legs with posterior claw very small and slender. *Coxal sacs* fully developed at bases of third to ninth pairs of legs, with only rudimentary plates at bases of tenth and eleventh pairs, completely absent on twelfth pair. *Styli* (Fig. 6c), large, with two long setae. *Cerci* (Fig. 6j) densely clothed with short setae ; terminal area long and narrow, as long as apical seta.

Chaetotaxy

1. Dorsal scuta (based on ten adult specimens from two localities).

No. of scutum	Total No. of marginal setae	Width of scutum (mm.)
Second scutum	30–34	0.23–0.27
Third scutum	38–42	0.33–0.42
Fourth scutum	40–44	0.42–0.50
Fifth scutum	40–44	0.42–0.48
Sixth scutum	44–50	0.47–0.53

2. Length of antero-lateral setae.

No. of scutum	Length of seta (mm.)	No. of scutum	Length of seta (mm.)
Second scutum	0.073-0.081	Eighth scutum	0.035-0.042
Third scutum	0.073-0.081	Ninth scutum	0.073-0.081
Fourth scutum	0.073-0.081	Tenth scutum	0.031-0.038
Fifth scutum	0.035-0.042	Eleventh scutum	0.024-0.032
Sixth scutum	0.073-0.081	Twelfth scutum	0.028-0.035
Seventh scutum	0.073-0.081	Thirteenth scutum	0.024-0.032

3. Number of setae on first pair of legs.

	Outer, dorsal	Inner, ventral	Anterior	Posterior	Total
Tarsus	3-5	2-3	3-7	3-4	12-16
Tibia	2	0	3-4	0	5-6
Trochanter	0	1-2	13-17	0	4-18

4. Number of setae on last pair of legs.

	Outer, dorsal	Inner, ventral	Anterior	Posterior	Total
Tarsus	5-7	5-6	9-12	8-12	29-35
Tibia	5-7	3-4	16-19	9-13	36-40
Femur	3	0	9-11	2-5	14-17
Trochanter	1-2	5-8	29-33	0	38-41

Type : In Copenhagen Museum. Type locality : La Moka, Venezuela. This description is based on specimens from Kew Gardens, London.

Distribution : This species has previously been known only from the type locality. I have found it in Britain in a tropical house at Kew and a hothouse at Tresco, Isles of Scilly.

Comparative notes : *H. unguiculata* is most closely related to *H. subunguiculata* Imms from which it may be distinguished by the greater emargination of the posterior margin of the penultimate scutum, and the greater length of the posterior claw of the last pair of legs. It is also closely related to *H. caldaria* Hansen. The cerci are shorter here than in Hansen's original description, but this is a variable character in many species of *Symphyla*.

Habits : This species has only been found in this country in hothouses and it has probably been introduced among the roots of tropical plants. Nearly

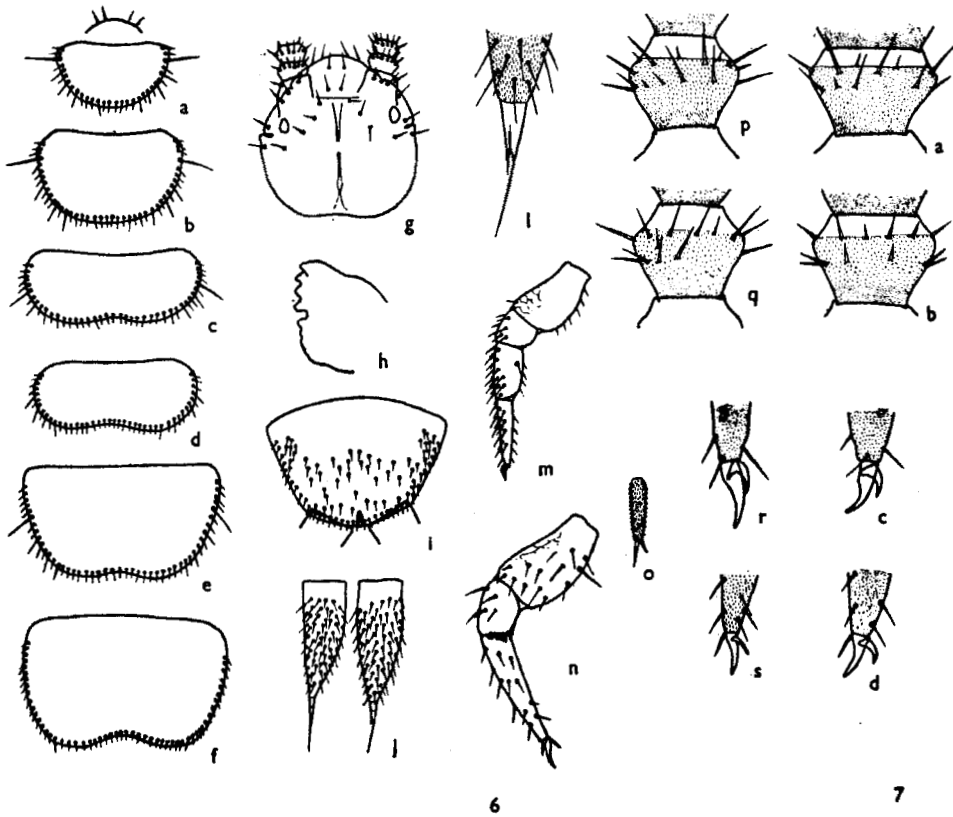


Fig. 6.—*Hanseniella unguiculata* Hansen.

a-f, first to seventh dorsal scuta ; g, dorsal view of head ; h, right mandible ; i, last dorsal scutum ; j, right cercus from side and above ; l, tip of cercus ; m, posterior view of last leg of left side ; n, posterior view of first leg of left side ; o, typical stylus ; p, eleventh antennal segment, dorsal view ; q, eleventh antennal segment, ventral view ; r, dorsal view of claw of last leg of right side ; s, dorsal view of claw of first leg of right side.

Fig. 7.—*Hanseniella caldaria* Hansen.

a, eleventh antennal segment, dorsal view ; b, eleventh antennal segment, ventral view ; c, dorsal view of claw of last leg of right side ; d, dorsal view of claw of first leg of right side. All $\times 72$ except 6 l, n & o, which are $\times 180$ and 6 p-s, and 7a-d which are $\times 316$.

all the species of the genus *Hanseniella* are tropical. It is not known whether it is a primary plant feeder, but the weak teeth on the mandibles indicate that this is not the case.

HANSENIELLA CALDARIA Hansen

1904 *Scutigereilla caldaria* Hansen, Quart. J. micr. Sci. 47: 1.

1913 *Hanseniella caldaria* Bagnall, J. Linn. Soc. (Zool.) 32: 197.

Adult: Length 2.8–4.0 mm. *Head* as in *H. unguiculata*. *Antenna* (Fig. 7 a–b) of twenty-three to twenty-eight segments ; primary whorl of antennal setae much shorter ventrally than dorsally, those of eleventh segment about 0.038 mm. dorsally 0.021 mm. ventrally. *Scuta* shaped as those of *H. unguiculata*, but antero-lateral setae longer and distinguishable even on the penultimate scutum.

Legs (Fig. 7 c-d) with anterior claw of last pair of legs less than twice as long as posterior; posterior claw robust and not very curved; posterior claw of first pair of legs well-developed and not more than half as long as anterior. *Coxal sacs*, *styli*, *Cerci* like those of *H. unguiculata*.

Chaetotaxy

Length of antero-lateral setae (based on five specimens).

No. of scutum	Length of seta (mm.)	No. of scutum	Length of seta (mm.)
Second scutum	0.084-0.088	Eighth scutum	0.052-0.060
Third scutum	0.084-0.088	Ninth scutum	0.084-0.088
Fourth scutum	0.084-0.088	Tenth scutum	0.056-0.063
Fifth scutum	0.052-0.060	Eleventh scutum	0.052-0.060
Sixth scutum	0.084-0.088	Twelfth scutum	0.060-0.067
Seventh scutum	0.084-0.088	Thirteenth scutum	0.052-0.060

Type: In the Copenhagen Museum. *Type locality*: South America.

Distribution: Recorded in hothouses in Kew, Glasgow, Northumberland and Durham.

Comparative notes: *H. caldaria* is most closely related to *H. unguiculata* Hansen from which it may be distinguished by its shorter anterior claw, less curved posterior claw on the last pair of legs; the relatively large posterior claw on the first pair of legs; and the antennal setae which are shorter on the ventral surface than the dorsal surface. The antero-lateral setae of scuta 2, 3, 4, 6, 7 and 9 are longer, but less than twice as long as those of other scuta, whereas in *H. unguiculata* they are shorter but at least twice as long as those on other scuta.

Habits: Its habits are similar to those of *H. unguiculata*.

Genus *NEOScutigerella* Bagnall

1911 *Neoscutigerella* Bagnall, J. Linn. Soc. (Zool.) **32**: 197.

Head: rounded. *Scuta* with posterior margin emarginate or only slightly rounded; with a long antero-lateral seta on second scutum, which may also be present on other scuta; all setae on scuta with exception of antero-laterals, short and blunt. *Cerci* short; with long stiff setae; long and narrow terminal area.

NEOScutigerella HANSENI Bagnall

1911 *Scutigerella hanseni* Bagnall, Trans. nat. Hist. Soc. Northumb. **4**: 17.

1913 *Neoscutigerella hanseni* Bagnall, J. Linn. Soc. (Zool.) **32**: 197.

Adult: Length 4.65 mm. *Head* rounded, dorsal surface with setae mostly characteristically short, blunt, and fusiform in posterior half; some long and slender in anterior half. *Antennae* long, thirty-eight segmented, setae stout and of only one type, not longer on inner surface than on outer.

Scuta, first two only slightly emarginate, outstanding antero-lateral setae on second scutum only ; all other setae short, blunt and broad in the middle. *Legs* strongly setose, some setae being short and blunt as those on the scuta, but majority long and thin. *Cerci* with a moderate number of long stiff setae.

Distribution : A single specimen was described by Bagnall from Co. Durham. A second species of the genus, based on a unique specimen has recently been described from Madagascar by Aubry and Masson.

Comparative notes : The short blunt setae easily distinguish it from all other species.

Family SCOLOPENDRELLIDAE Bagnall

1913 Scolopendrellidae Bagnall, J. Linn. Soc. (Zool.) 32: 195.

1926 Scolopendrellidae Attems, in Kukenthal *Handbuch der Zoologie* 4: 11.

Head not distinctly separated from neck ; central rod interrupted in middle. *Antenna* usually less than twenty segmented, bearing only one kind of seta and some sense organs. *Scuta* complex, seventeen to twenty-four in number, including first, which may be very reduced or quite well-developed ; some scuta divided into pretergite and metatergite ; if lobes present they are triangular in shape, longer than broad and present on thirteen scuta ; in one genus (*Geophilella*), scuta only represented by paired oval plates. *Calicles* with a smooth border. *Legs* 4, 6, 8, 10 and 12 never corresponding with a single scutum ; other scuta may be single or double according to species ; first pair of legs moderately developed, never more than half the length of the following pair. *Styli* poorly developed or rudimentary. *Coxal Sacs* never more than seven in number. *Cerci* with striated terminal area.

KEY TO BRITISH GENERA OF SCOLOPENDRELLIDAE

- 1. Twenty-one or twenty-two poorly defined dorsal scuta, first relatively well-developed. *Cerci* short with long conical terminal area *Symphylellopsis* Ribaut
- Only seventeen dorsal scuta, first represented only by setae. *Cerci* long with small expanded terminal area 2.
- 2. First pair of legs relatively well-developed. Posterior margins of scuta between projections with transverse belt of longitudinal striae *Scolopendrella* Gervais
- First pair of legs vestigial, only represented by slight swelling behind head. Posterior margins of scuta without transverse belts of longitudinal striae *Symphylella* Silvestri

Genus SYMPHYLELLOPSIS Ribaut

1931 *Symphylellopsis* Ribaut, Bull. Soc. Hist. nat. Toulouse 46: 463.

Head oval, elongate, longer than broad, with central rod only distinct in posterior portion, broken in middle without lateral branches and barely visible in anterior portion ; spiracles opening at sides of head slightly posteriorly. Post-antennal organ indistinct ; opening to exterior by narrow tube. Dorsal surface of head set with short setae. *Antennae* of less than twenty segments with only small short setae, particularly on distal segments ; only main whorls of

setae and weak subsidiary whorls present. *Scuta* twenty-one or twenty-two in number; thirteen of these with paired processes considerably longer than broad; first scutum relatively well-developed with diagonal thickenings; those scuta corresponding with legs 5, 7, 9, 11 and 12 (and sometimes 3) double, and separated by only a simple suture; other paired scuta separated by an intertergal zone. *Legs* very short, first pair fairly well-developed with three movable joints; not more than half as long as following pair. *Styli* rudimentary. *Coxal Sacs* not well-developed, seven in number, present at base of legs 3-9. *Cerci* short, without honeycomb structure, not more than four times as long as wide; sparsely setose and with large conical terminal area, striated and with ring of setae around terminal area, ending with large single apical seta.

KEY TO BRITISH SPECIES OF *SYMPHYLELLOPSIS*

1. Third pair of legs corresponding with a single scutum; first scutum short; posterior projections of scuta narrow and considerably farther apart than their length *S. subnuda* Hansen
- . Third pair of legs corresponding with a double scutum; first scutum longer; posterior projections of scuta broader and about the same distance apart as their length *S. arvernorum* Ribaut

SYMPHYLELLOPSIS SUBNUDA Hansen

- 1903 *Scolopendrella subnuda* Hansen, Quart. J. micr. Sci. 47: 1.
 1913 *Scolopendrellopsis subnuda* Bagnall, J. Linn. Soc. (Zool.) 32: 197.
 1931 *Symphylellopsis subnuda* Ribaut, Bull. Soc. Hist. nat. Toulouse 62: 463.

Adult: Length 1.2-2.0 mm. *Head* oval with sparse short setae 0.005-0.01 mm. long; post-antennal organ with distinct tube opening to exterior. Central rod broken in middle; indistinct in anterior portion, with no trace of lateral branches. *Antenna* of thirteen to twenty segments, usually sixteen segmented; setae well-developed on basal segments, very small on distal ones. *Scuta* (Fig. 8 a-g) twenty-two in number including first which is reduced to a narrow oval plate with a pair of diagonal bands (Fig. 8 a). Triangular projections on posterior margins of scuta considerably longer than broad, and present only on scuta 2, 3, 4, 5, 7, 8, 9, 11, 12, 13, 15, 16, 19; distance between projections considerably more than their length from base to tip. Second scutum with distance from front margin to base of projection much less than length of projection. Setae on posterior scuta relatively long 0.013-0.016 mm. long. *Legs* (Fig. 8 i) short with very few setae. First leg fairly well-developed with anterior claw twice as long as posterior. *Styli* only represented by minute knobs. *Coxal plates* very small, coxal sacs only present at base of legs 3-9. *Cerci* (Fig. 8 h) small, slightly more than three times as long as wide; set with sparse, long setae; terminal area long with seven transverse ridges on dorsal surface; apical seta longer than terminal area, 0.026-0.032 mm. long.

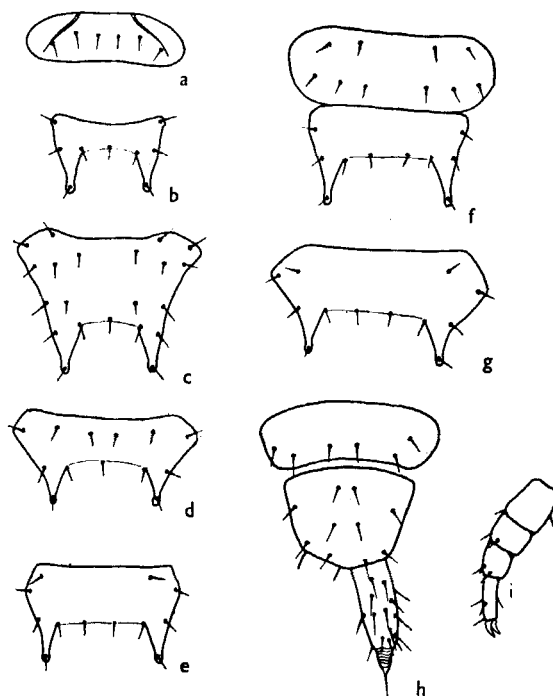


Fig. 8.—*Symphylellopsis subnuda* Hansen.
a-g, first to eighth dorsal scuta ; h, penultimate and last scuta and right cercus ; i, posterior view of last leg of left side. All $\times 180$.

Chaetotaxy of scuta

No. of scutum	Greatest width of scutum (mm.)	Length of projection (base to tip) (mm.)	Distance between projections (mm.)
Second scutum	0.073-0.085	0.031-0.036	0.052-0.062
Third scutum	0.125-0.155	0.031-0.036	0.057-0.067
Fourth scutum	0.130-0.165	0.031-0.036	0.062-0.090
Fifth scutum	0.082-0.105	0.031-0.036	0.080-0.090

Type : In Copenhagen Museum. Type locality ; Palmi, Calabria. This description is based on specimens from Wimborne, Dorset, England.

Distribution : Previously recorded from Durham and Isle of Arran, Scotland. I have found specimens at Wimborne, Dorset ; Redruth, Cornwall ; Isles of Scilly and in Bedfordshire. It is probably quite common but can be easily overlooked because of its minute size.

Comparative notes : There are only two other species of the genus described, and *S. subnuda* is most closely related to *S. arvernorum* Ribaut from which it is readily distinguished by the single scutum which corresponds with the third

pair of legs. Other distinguishing characters are the longer setae, particularly on the cerci ; greater distance apart of the projections on the scuta ; shape of the scuta, particularly the first and second ; and greater overlapping of the scuta.

Habits : This species is very slow moving and its distribution in the soil indicates that it is not a primary plant feeder. It is not found in such large numbers as some species of the genera *Symphylella* and *Scutigereila*.

SYMPHYLELLOPSIS ARVERNORUM Ribaut

1931 *Symphylellopsis arvernorum* Ribaut, Bull. Soc. Hist. nat. Toulouse 62: 464.

Adult : Length 1.8–2.4 mm. *Head* (Fig. 9 w) oval, with sparse short setae 0.005–0.01 mm. long ; post-antennal organ with distinct tube opening to exterior. Central rod broken in middle, indistinct in anterior portion, with faint traces of lateral branches. *Antenna* of fourteen to nineteen segments, usually eighteen segmented ; setae well-developed on basal segments, very small on distal ones. *Scuta* (Fig. 9 a–t) twenty-one in number, including first, which is reduced to a broad oval plate with diagonal bands. Triangular

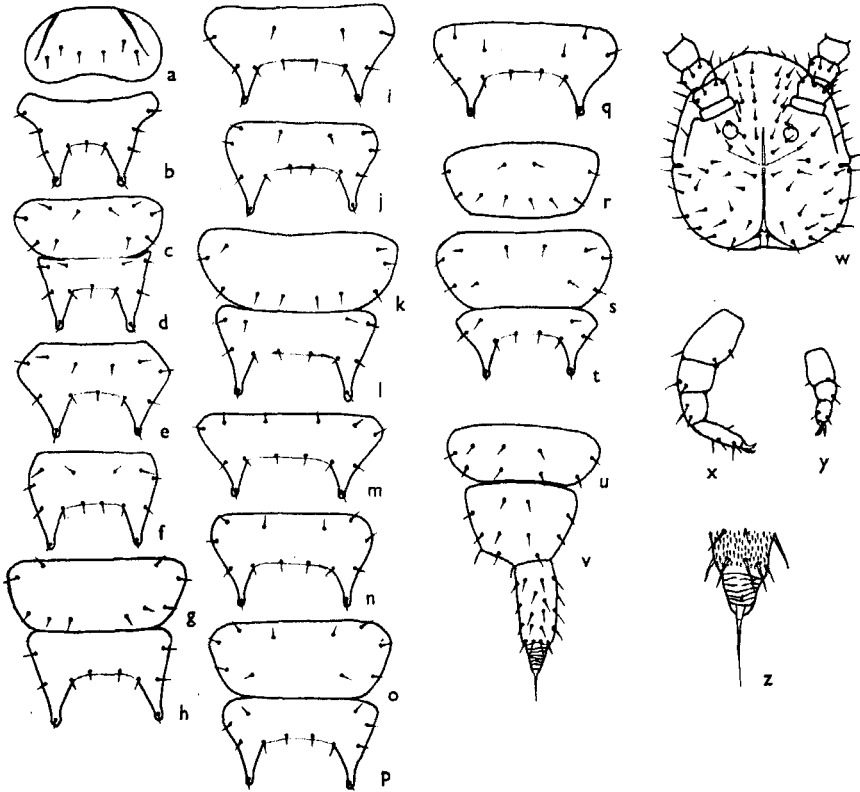


Fig. 9.—*Symphylellopsis arvernorum* Ribaut.

a–u, first to twenty-first dorsal scuta ; v, last scutum and right cercus ; w, dorsal view of head ; x, posterior view of last leg of left side ; y, posterior view of first leg of right side ; z, tip of cercus. All $\times 180$ except z which is $\times 316$.

projections longer than broad, present on posterior margins of scuta 2, 4, 5, 6, 8, 9, 10, 12, 13, 14, 16, 17, and 20; distance between projections only a little more than their length. Second scutum with distance from front edge to base of projection about the same as length of projection. Setae on posterior scuta relatively short, 0.010–0.013 mm. long. *Legs* (Fig. 9 x–y) short with very few setae. Anterior claw of first leg twice as long as posterior. Styli represented only by minute knobs. *Coxal plates* very small; present at bases of legs 3–9. *Cerci* (Fig. 9 v–z) small about three times as long as wide; set with sparse, short setae; terminal area long with seven ridges on dorsal surface; apical seta longer than terminal area 0.019–0.026 mm. long.

Chaetotaxy of scuta

No. of scutum	Greatest width of scutum (mm.)	Length of projection (base to tip) (mm.)	Distance between projections (mm.)
Second scutum	0.083–0.104	0.029–0.034	0.042–0.057
Third scutum	0.104–0.130	0.029–0.034	0.052–0.068
Fourth scutum	0.115–0.156	0.029–0.034	0.062–0.080
Fifth scutum	0.080–0.104	0.029–0.034	0.073–0.090

Type: in the collection of M. Ribaut. This description is based on a specimen from Axbridge, Somerset. *Type locality*: Orcines, France.

Distribution: Originally described from Orcines, and not previously recorded from Great Britain. I have found specimens at Cheddar and Axbridge in Somerset, and Warminster in Wiltshire.

Comparative notes: *S. arvernorum* is most closely related to *S. subnuda* Hansen and can be distinguished as shown under the heading of that species.

Habits: These are similar to those of *Symphylellopsis subnuda*.

Genus *SCOLOPENDRELLA* Gervais

1840 *Scolopendrella* Gervais, Rev. Zool. 2: 279.

Head oval, slightly longer than broad, central rod broken in middle, distinct in both anterior and posterior portions, dividing anteriorly into two indistinct branches ending near base of antennae. Post-antennal organ small. Dorsal surface of head set with numerous moderately long setae. *Antennae* with fifteen to twenty segments bearing moderately long setae, secondary whorls of setae only weakly developed. *Scuta* seventeen in number; first scutum vestigial, represented only by row of setae; thirteen other scuta bearing paired triangular processes on posterior margins; all scuta except last two separated by intertergal areas, only last two divided by a simple suture; posterior margins of scuta clearly-demarcated and bearing a transverse belt of longitudinal striae between the projections; lateral margins of scuta curved and bearing another long seta in addition to the antero-lateral seta. *Legs* short, robust and sparsely setose; claws almost equal in length; first pair of legs well-developed, three segmented, almost half as long as last pair, with

posterior claw shorter and more curved than anterior. Styli rudimentary. *Coxal plates* with fully developed sacs at only bases of legs 3-9. *Cerci* short, sharply pointed, nearly conical, sparsely setose; terminal area conical and not expanded, with intricate pattern of striae, apical seta about as long as terminal area.

SCOLOPENDRELLA NOTACANTHA Gervais

1840 *Scolopendrella notacantha* Gervais, Rev. Zool. 2: 281.

Adult: Length 3.0-3.5 mm. *Head* (Fig. 10 p) oval, sparsely setose; central rod broken in middle with short lateral branches, diagonal frontal branches indistinct. *Post-antennal organ* small. *Antenna* of fourteen to eighteen segments, usually eighteen segmented; antennal setae simple, secondary whorl of setae not strongly developed and only present on distal segments. *Scuta* (Fig. 10a-g) seventeen in number, first vestigial; posterior margins between projections semi-circular and bearing belts of longitudinal striae; lateral margins of scuta curved and bearing another long seta in

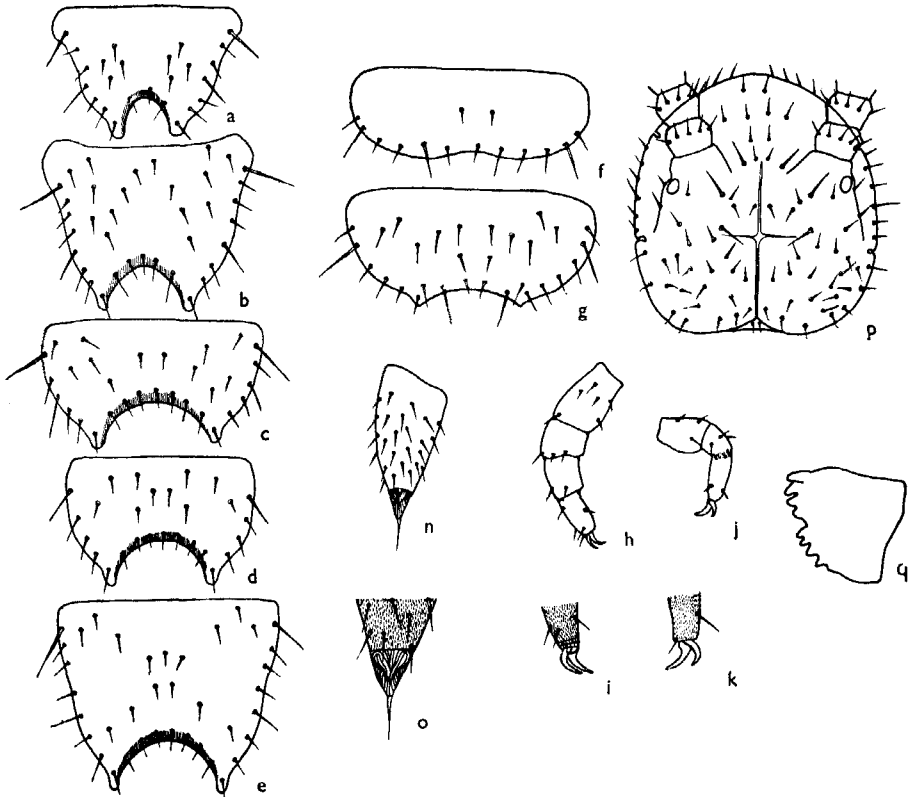


Fig. 10.—*Scolopendrella notacantha* Gervais.

a-e, second to sixth dorsal scuta; f, g, fourteenth and fifteenth dorsal scuta; h, posterior view of last leg of left side; i, claws of last leg; j, posterior view of first leg of right side; k, claws of first leg; n, dorsal view of right cercus; o, tip of cercus; p, dorsal view of head; q, right mandible. All $\times 140$ except i, k, o, q, which are $\times 316$.

addition to the anterior-lateral seta. *Legs* (Fig. 10 h-k) short, robust and sparsely setose; claws almost equal in length; first pair of legs well-developed, almost half as long as last pair, with posterior claw shorter and more curved than anterior. *Styli* only rudimentary. *Coxal plates* fully developed as sacs only at bases of legs 3-9. *Cerci* (Fig. 10 n-o) short, nearly conical; set with few setae; terminal area conical, with intricate pattern of striae; apical seta long, about as long as terminal area.

Chaetotaxy

No. of scutum	Length of antero-lateral seta (mm.)	Length of long seta in middle of scutum (mm.)	Length of typical marginal seta (mm.)
Second scutum	0.049-0.055	0.036-0.042	0.020-0.025
Third scutum	0.049-0.055	0.036-0.042	0.020-0.025
Fourth scutum	0.049-0.055	0.032-0.036	0.020-0.025
Fifth scutum	0.026-0.031	0.021-0.026	0.020-0.025
Sixth scutum	0.051-0.057	0.036-0.042	0.020-0.025

Type: In Copenhagen Museum. *Type locality*: Rome, Italy. Present description based on specimens from Torquay, Devon.

Distribution: Previously recorded from Durham. I have only found it at Torquay in Devon.

Comparative notes: *S. notacantha* is the only species of the genus so far described, so there is no difficulty in distinguishing it from *Symphylella* species to which it is most closely related. It can be distinguished by the well-developed first pair of legs and the striate belts at the posterior margins of the scuta.

Habits: It is one of the more slowly moving species, inhabiting similar situations to *Symphylella* species.

Genus *SYMPHYLELLA* Silvestri

1902 *Symphylella* Silvestri, in Berlese, *Acari Myriapoda et Scorpioles hucusque in Italia Reperta* 96: 10.

Head oval, longer than broad; central rod broken and distinct in both anterior and posterior portions, no lateral branches at break, diagonal frontal branches distinct. Post-antennal organ distinct, opening to exterior by numerous small pores. *Antennae* with fourteen to twenty-two segments bearing moderately long setae, secondary whorls only moderately developed. *Scuta* seventeen in number, first scutum vestigial, represented only by a line of setae; thirteen other scuta bearing triangular processes on posterior margins, with no belts of longitudinal striae, lateral margins of scuta only slightly curved or straight. *Legs* fairly well-developed, bearing some long setae, claws nearly equal in length; first pair of legs only represented by small protuberances behind head. *Styli* rudimentary. *Coxal plates* with

sacs only fully developed on legs 3-9. Cerci relatively long, with sides parallel for considerable part of length; setae quite long; terminal area bulbous and with transverse stripes, ending in a single long seta.

Taxonomic features

This is a difficult genus due to the variability in chaetotaxy. The chaetotaxy of the dorsal scuta is frequently asymmetrical with several more setae on one side than the other, and to some extent the shape of the scuta may be variable. This has led to a great deal of confusion and erection of a large number of species many of which may be invalid. Of the species described by Bagnall (1913) *Symphylella dunelmensis* is probably a synonym of *S. isabellae* Grassi and the three species *Symphylella horrida*, *S. delicatula* and *S. minutissima*, are as far as can be ascertained from specimens deposited in the British Museum (Natural History), synonyms of *Symphylella vulgaris* Silvestri. In the material available in the present study three well-defined species stand out, and these have been described with tables giving variation in chaetotaxy. A considerable number of specimens which will not fit into these species have been found, and it is hoped in the future to describe further species in this genus, with complete keys to the genus.

KEY TO BRITISH SPECIES OF *SYMPHYLELLA*

1. First scutum represented by a row of eight to twelve setae; last pair of legs with four outstanding setae on outer dorsal surface of tarsus, posterior processes of scuta broad *S. isabellae* Grassi
- First scutum represented by a row of six setae; last pair of legs with less than four outstanding setae on outer dorsal surface of tarsus, posterior processes of scuta narrow 2.
2. No setae on inner edge of posterior processes of scuta; last pair of legs with only two outstanding setae on outer dorsal surface of tarsus; cerci short, with long setae, including two very long outstanding setae on outer margin of cercus *S. hintoni*, sp. n.
- At least one seta on inner edge of posterior processes of scuta; last pair of legs with three outstanding setae on outer dorsal surface of tarsus; cerci long, with short setae *S. vulgaris* Hansen.

***SYMPHYLELLA HINTONI* sp. n.**

Adult: Length 1.6-2.7 mm. *Head* (Fig. 11 i) longer than broad, with short setae 0.008-0.016 mm. long; central rod distinct throughout length, only very slightly interrupted in middle; without lateral branches; indistinct diagonal branches from posterior end of central rod to base of antennae; central rod without posterior projection. Post-antennal organ small and oval. *Antenna* of fifteen to nineteen segments usually eighteen segmented. *Scuta* (Figs. 11 a g) with few setae; first scutum only represented by row of six setae; margins of scuta straight with sharp angles; posterior processes narrow without obvious knob at tip. *Legs* (Fig. 11 l) short, with few long outstanding setae; tarsus only about two and a half times as long as wide. Styli reduced to small protuberances. *Coxal sacs* fully developed at base of legs 3-9 only. *Cerci* (Fig. 9 h k) small, short, conical; with long sparse setae, and with two outstanding setae on outer margin. Terminal area expanded and bearing seven or eight raised transverse striae; single apical seta 0.026-0.024 mm. long.

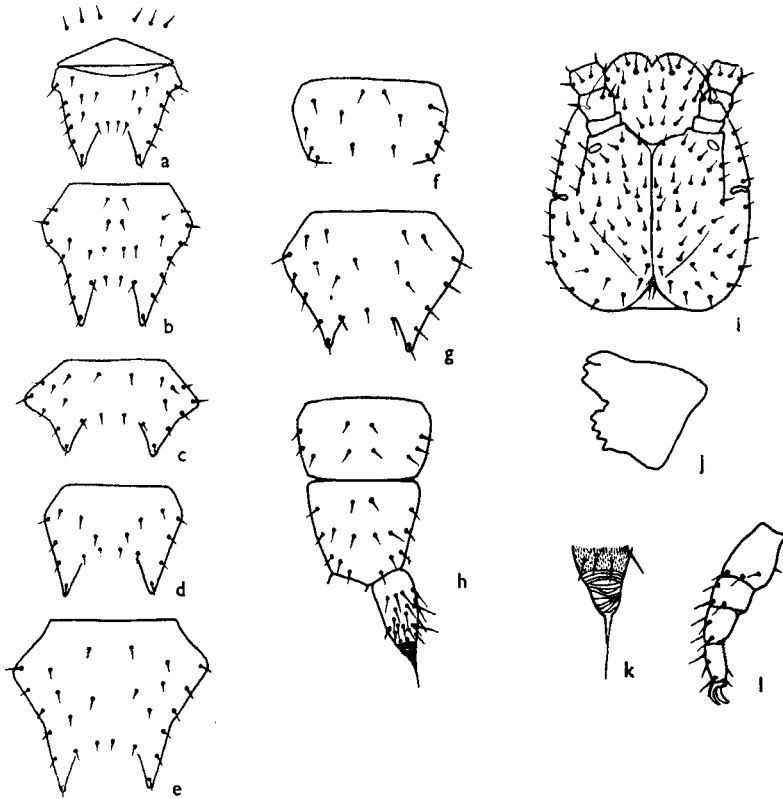


Fig. 11.—*Symphylella hintoni*, sp. n.

a-e, first to sixth dorsal scuta ; f, g, fourteenth and fifteenth dorsal scuta ; h, penultimate and last scutum and right cercus ; i, dorsal view of head ; j, right mandible ; k, tip of cercus ; l, posterior view of last leg of left side. All $\times 140$ except j and k which are $\times 316$.

Chaetotaxy

1. Dorsal scuta (based on twelve specimens from five localities).

No. of scutum	No. of setae between antero-lateral seta and apical seta	Length of antero-lateral seta (mm.)	Length of average seta (mm.)
Second scutum	2-4	0.013-0.016	0.008-0.010
Third scutum	3-5	0.013-0.016	0.008-0.012
Fourth scutum	2-3	0.013-0.016	0.008-0.012
Fifth scutum	2-3	0.013-0.016	0.008-0.012

2. Number of setae on last pair of legs.

	Outer, dorsal	Inner, ventral	Anterior	Posterior	Total
Tarsus	2	1	1-2	2	6-7
Tibia	1-2	0-1	1-2	1-2	5-7
Femur	1-2	0	1-2	1-2	4-6
Trochanter	1	0	0	2-3	3-4

Type : Deposited in British Museum (Natural History). Type locality : Rosewarne, Cornwall.

Distribution : So far found at Rosewarne, Cornwall ; Cheddar and Fontnell Magna, Somerset ; and Westbury, Wiltshire*.

Comparative notes : *S. hintoni* is most closely related to *S. vulgaris* Hansen, but it is easily distinguished by its small size and paucity of setae. No other species has as few as two outstanding setae on the outer dorsal surface of the tarsus. Other characters which distinguish it from *S. vulgaris*, are the absence of setae on the inner surface of the scutal processes, sharp angles of the outlines of the scuta, two long outstanding setae on the outer side of the cerci, small post-antennal organ, possession of only seven teeth on the mandibles (*S. vulgaris* has eight), and short legs and cerci.

Habits : This is a very slow moving species found in large numbers. It does not seem to be a primary plant feeder, probably living on decaying matter and bacteria in the soil.

SYMPHYLELLA VULGARIS Hansen

1884 *Scolopendrella notacantha* Latzel, *Die Myriapoden der osterreichisch-ungarischen Monarchie* 2: 11.

1903 *Scolopendrella vulgaris* Hansen, *Quart. J. Micr. Sci.* 47: 1.

1913 *Symphylella vulgaris* Hansen, *J. Linn. Soc. (Zool.)* 32: 195.

Adult : Length 2.4-3.5 mm. *Head* (Fig. 12j) oval, with numerous short setae 0.008-0.029 mm. long ; mandibles with eight teeth ; central rod interrupted strongly in middle ; posterior and anterior branches distinct in entire length. Post-antennal organ circular, opening to exterior by pores. *Antenna* of fourteen to twenty-one segments, usually nineteen segmented ; secondary whorl of setae only weakly present on distal half of antenna. *Scuta* (Fig. 12 a-h) with processes longer than broad and with small knob at tip. *Legs* (Fig. 12 n-o) moderate in length ; sparsely covered with long setae ; anterior claw rather longer than posterior on last pair of legs. Tarsus four or five times as long as broad. Styli reduced to small protuberances. *Coxal sacs* fully developed at base of legs 3-9 only. *Cerci* (Fig. 12 k-l) about three times as long as broad, moderately setose. Terminal area expanded with eight or nine raised striae. Apical seta single 0.029-0.037 mm. long.

* I have also received specimens of this species from Dr H. Gisin, Geneva, Switzerland.

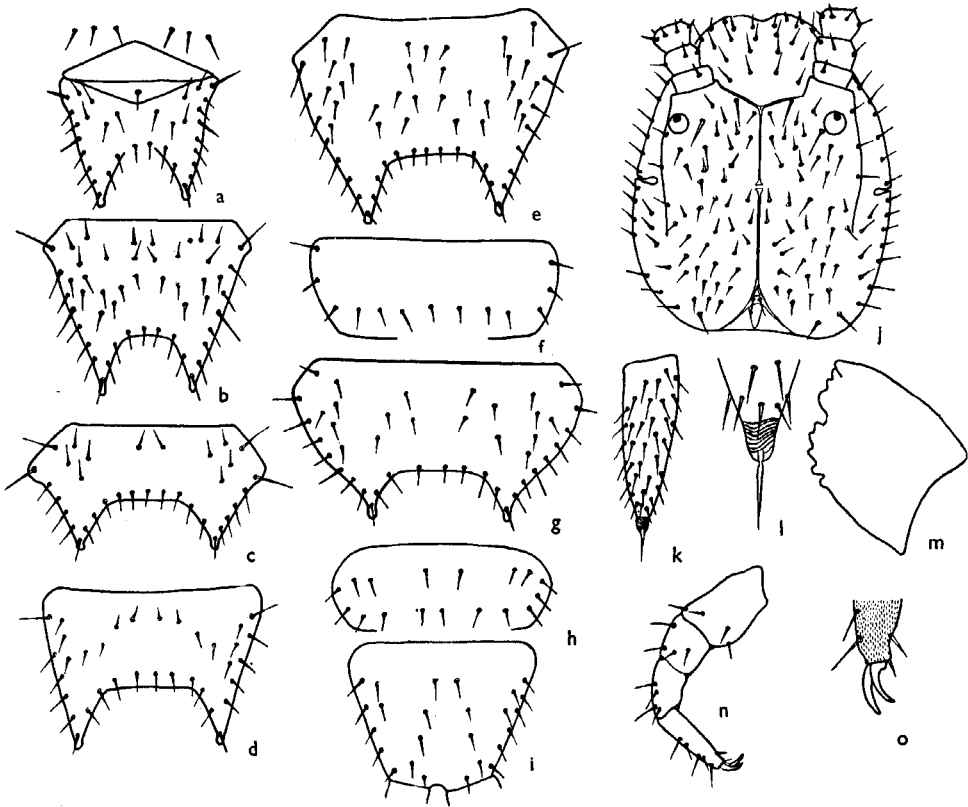


Fig. 12.—*Symphylella vulgaris* Hansen.

a-e, first to sixth dorsal scuta ; f, g, fourteenth and fifteenth dorsal scuta ; h, i, penultimate and last dorsal scuta ; j, dorsal view of head ; k, dorsal view of right cercus ; l, tip of cercus ; m, right mandible ; n, posterior view of last leg of left side ; o, claws of last leg of left side. All $\times 140$ except l, m and o which are $\times 316$.

Chaetotaxy

1. Dorsal scuta (based on seventy-one specimens from eighteen localities).

No. of scutum	No. of setae between antero-lateral seta and apical seta	Length of antero-lateral seta (mm.)	Length of average seta (mm.)
Second scutum	4-7	0.034-0.042	0.013-0.023
Third scutum	5-8	0.034-0.042	0.013-0.023
Fourth scutum	4-6	0.034-0.042	0.013-0.023
Fifth scutum	4-6	0.029-0.034	0.013-0.023
Sixth scutum	6-8	0.031-0.036	0.013-0.023

2. Number of setae on last pair of legs.

	Outer, dorsal	Inner, ventral	Anterior	Posterior	Total
Tarsus	3	1	1-3	3-5	8-10
Tibia	2	0	1-3	1-3	4-6
Femur	2	0	2-4	1-3	6-8
Trochanter	1	1	1-3	3-6	7-9

Type : In Copenhagen Museum. *Type locality* : Scilla, Italy. Present description based on specimens from Dawlish, Devon.

Distribution : Cosmopolitan. It has previously been recorded from numerous localities in the North of England, and it is very common in the South West of England. I have found it in thirty-two localities distributed in Gloucestershire, Somerset, Wiltshire, Dorset, Devon and Cornwall.*

Comparative notes : *S. vulgaris* is most closely related to *S. hintoni* and can be separated from this species as shown under the heading of the latter species. It is also closely related to *S. isabellae* Grassi, and it can be distinguished from this species by its much smaller size, presence of only three outstanding setae on the outer dorsal surface of the tarsus, much shorter cerci with fewer setae, narrower processes on the posterior margins of the scuta, only six setae representing the first scutum, and the presence of a projection at the posterior end of the central rod.

Habits : These appear to be similar to those of *S. hintoni*.

SYMPHYLELLA ISABELLAE Grassi

1886 *Scolopendrella isabellae* Grassi, *Mem. R. Accad. Sci. Torino* (2) **37**: 594.

1913 *Symphylella isabellae* Grassi, *J. Linn. Soc. (Zool.)* **32**: 195.

Adult : Length 2.3-4.6 mm. *Head* (Fig. 13 f) oval, with numerous setae 0.010 mm.-0.047 mm. long ; mandibles with seven teeth. Central rod interrupted strongly in middle ; posterior and anterior branches distinct in whole length. Post-antennal organs circular, opening to exterior by pores, not so distinct as *S. vulgaris*. *Antenna* of fifteen to twenty-two segments usually eighteen segmented ; secondary whorl, and traces of tertiary whorl of setae present on distal half of antenna. *Scuta* (Fig. 13a-e) with processes about as long as broad, with only slight traces of knob at tip. First scutum represented by eight to twelve setae. Scutal setae long. *Legs* (Fig. 13 h-i) long, sparsely covered with long setae ; anterior claw slightly longer than posterior on last pair of legs. Tarsus about five times as long as broad. Styli reduced to small protuberances. *Coxal sacs* fully developed at base of legs 3-9 only. *Cerci* (Fig. 13 j-k) four to five times as long as broad, densely covered with short setae. Terminal area expanded with eight to nine raised transverse striae ; apical seta single 0.028-0.039 mm. long.

* I also found this species commonly in Wisconsin, U.S.A.

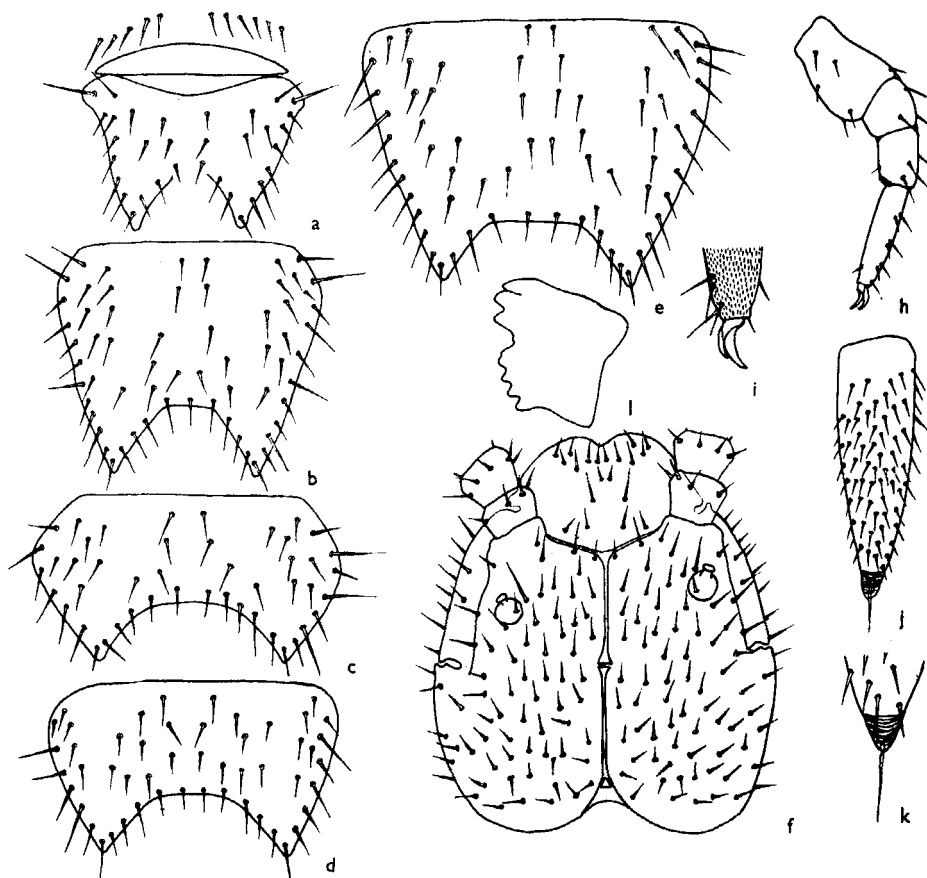


Fig. 13.—*Symphylella isabellae* Grassi.

a-e, first to sixth dorsal scuta ; f, dorsal view of head ; h, posterior view of last leg of right side ; i, claws of last leg of left side ; j, dorsal view of right cercus ; k, tip of cercus ; l, right mandible. All $\times 140$ except i, k and l which are $\times 316$.

Chaetotaxy

1. Dorsal scuta (based on fifty-six specimens from twenty-four localities),

No. of scutum	No. of setae between antero-lateral seta and apical seta	Length of antero-lateral seta (mm.)	Length of average seta (mm.)
Second scutum	5-8	0.043-0.054	0.013-0.034
Third scutum	4-9	0.043-0.054	0.013-0.034
Fourth scutum	3-7	0.047-0.060	0.013-0.034
Fifth scutum	3-7	0.042-0.050	0.013-0.034
Sixth scutum	5-11	0.052-0.063	0.013-0.034

2. Number of setae on last pair of legs.

	Outer, dorsal	Inner, ventral	Anterior	Posterior	Total
Tarsus	4-5	1-2	4-6	3-6	14-18
Tibia	2-3	1	3-4	1-4	9-12
Femur	2	0	2-4	1-3	6-9
Trochanter	1	2-3	2-7	4-9	11-18

Type : Not given in original description. Present description based on a specimen from Dawlish, Devon.

Distribution : Not common in Europe ; only recorded previously once or twice from the North of England and twice from Italy. I have found it in twenty-seven localities in Gloucestershire, Wiltshire, Somerset, Dorset, Devon and Cornwall. It seems to be just as common in this area as *S. vulgaris*.

Comparative notes : *S. isabellae* is most closely related to *S. vulgaris* and can be distinguished by the characters listed under the latter species.

Habits : These are similar to those of *S. hintoni*.

SUMMARY

The collection, occurrence and geographical distribution of the British Symphyla is discussed. Methods of making temporary and permanent mounts suitable for taxonomic study are outlined.

Eight species of *Scutigereidae*, belonging to three genera are described, one species being new to science and four new to the British Isles. Six species of *Scolopendrellidae* belonging to three genera, one species being new to science and one new to the British Isles are described.

Symphyla vary considerably in size and chaetotaxy and because of this as many specimens as possible from a wide range of localities have been studied ; in all, specimens from 317 localities. This has enabled the range of variation to be expected in each species to be outlined.

ACKNOWLEDGMENTS

Thanks are due to the numerous workers who kindly sent me specimens ; to Dr G. O. Evans, British Museum (Natural History) for placing material and facilities at my disposal, and to Dr H. E. Hinton, University of Bristol, for his encouragement and advice. I have pleasure in naming *Symphyllella hintoni* after him.

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