The Bog-mosses of Somerset.

BY WALTER WATSON, B.SC.

BOG-MOSSES are familiar to all lovers of a moorland ramble especially if they are not too fastidious in choosing a dry and easy path, but prefer to overcome difficulties of passage if, by so doing, they obtain a peep at another leaf of Nature's infinite and wondrous book. Those who have an interest in wild flowers, or in some of the curiosities of organic life, are amply rewarded for their labours when they visit the homes of the Bog-mosses for here they may find the pretty pink flowers of the Bog-pimpernel, the delicate blooms of the Bog-bean, the acid fruits of the Cranberry, the insectivorous Sundews and Butterworts, or other interesting or rare flowering plants. The microscopist who examines some of the water in which the Bog-moss grows is often delighted by the wealth and beauty of life revealed to his aided eye, some of the most beautiful Desmids, Diatoms and other Algae being found in company with many interesting forms of low animal life, whilst the entomologist " takes " some of his most interesting captures in the Bog-moss area.

Every moss which grows in a bog can be called a bog-moss, but many of these are not included in the plants called Bog-mosses in a more limited sense. These are also known as Turf-mosses or Peat-mosses but the best name is their botanical one of Sphagna, a name which is restricted to one definite group of plants usually growing in bogs, and cannot, like the other terms, be used in a general sense for any moss found in a bog, or on peat or turf.

From botanical reasons it is necessary to separate Sphagna from other mosses, in fact some botanists doubt the propriety of including them amongst the true mosses at all.

Structure of Plant.[1]

A Sphagnum plant has a stem bearing small leaves and is usually much branched, the branches often being so arranged that several arise from the stem at the same level (Fig. 1, A and B), some of these branches spreading out at right angles to the stem whilst others may hang down and almost hide the stem from view. The leaves of the divergent branches (Fig. 1, B) are larger and broader than those of the pendent ones and are more effective in obtaining the carbonaceous food from the surrounding air or water, the pendent branches being largely concerned in keeping the plant moist, the small chambers between them and the stem serving as capillary tubes along which the water passes. There are no roots whatever; in fact the adult plants have no means whereby they are attached to the soil, being kept in position merely by the crowded condition of the plants. In other mosses "root-hairs" (rhizoids) are present on the stem, and these serve as means of attachment, and partially for the absorption of water, but such hairs are only present in Sphagnum when the plant is in a juvenile condition.

The stem is almost thread-like and contains no true vascular tissue. A transverse section (Fig. 2, A) shows that it usually consists of a core of thin-walled and fairly large cells which gradually merge into smaller and thicker-walled ones so as to give a certain amount of strength and rigidity to the stem. Outside these the cells usually become much larger (Fig. 2, B) and in some cases have openings or pores in them, so that water is able to be absorbed quickly. In some cases the outermost layer of cells not only have pores but are also strengthened by fibres, *e.g. S. cymbifolium* (Fig. 2, N).

The leaves of a species of Sphagnum are variable in form and structure, the leaves of the branches being usually very distinct from those of the stem. The branch-leaf (Fig. 1, G) is oval or lance-shaped in form and is very thin, having only a single layer of cells (Fig. 1, J. Fig. 2, O and P). These

1. As Sphagna vary somewhat according to the species, any definite measurements or statements made must be understood to apply to *S. acutifolium* var. *subnitens* unless otherwise stated.

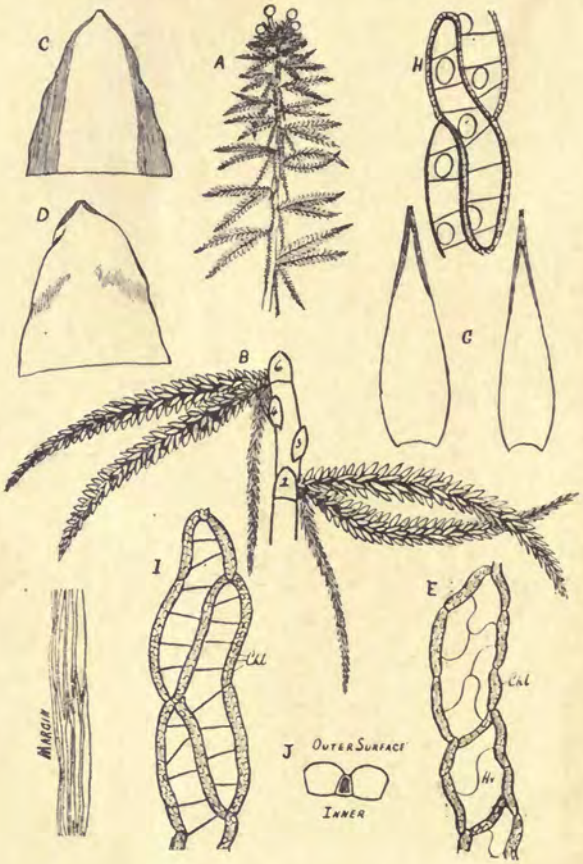


Fig. 1. *Sphagnum subnitens*, R. & W. A. Diagrammatic sketch of the fertile plant, × ½. B. Portion of the plant showing two fascicles or groups of branches × 3; the stem leaves are numbered to show the $\frac{2}{5}$ arrangement, leaves 2 and 5 being on the other side of the stem. The leaves 3 and 4 are usually nearer together than they are shown in the figure. C. Stem-leaf, × 17 indicating the border of narrow cells becoming broader below. D. Stem-leaf × 17 showing undulations and the margin inrolled at apex. E. Cells from the middle of the stem-leaf, × 210. Chl. Chlorophyllous cell with chlorophyll-granules. Hy. Hyaline or empty cell which is usually divided by oblique septa. F. Cells from the margin of the stem-leaf, × 210. G. Branch-leaves, × 17. H. Outer surface of branch-leaf showing fibres and pores, × 210. I. Inner surface of branch leaf, × 210. Chl. Chloroplastids. J. Portion of section of branch-leaf showing 2 hyaline and 1 chlorophyllous cell, × 210.

cells (Fig. 1, H, I and E) are of two kinds—(1) assimilating or chlorophyllous cells which contain the green colouring matter (chlorophyll) and are the agents by which the gaseous carbon dioxide of the air is changed into carbonaceous food for the plant ; (2) hyaline or empty cells which have no chlorophyll and appear empty. The latter are larger than the chlorophyllous cells, are provided with holes or pores through which water can readily enter and to prevent collapse have spiral and ring-like thickenings on their walls.

The stem-leaves (Fig. 1, C, D and E) are usually of a different shape, have a broader insertion, are often auricled at the base and chiefly consist of hyaline cells.

The upper branches are usually more crowded than the lower ones and form a capitulum (*see* Fig. 1, A) where the reproductive organs are borne. These, however, are rare in some species which simply continue to grow and multiply by the decaying away of the lower portions of the plant so that the lateral branches become separated and form distinct plants. From the reproductive organs shown in Fig. 2, E, small capsules (Fig. 2, J and K) are eventually produced, and in these many minute spores, (Fig. 2, M), each of which is capable of forming a new Sphagnum, are formed.

Life-cycle of Sphagnum.

In dealing with the life-history of an organism there is always the difficulty of selecting a starting-point. Should we begin with the fully-developed plant, or with the germ from which this comes ? From some points of view the best starting-post would be the former, but this course would involve too long a description owing to its complexity, and the spore is probably the most convenient stage from which to begin our survey of the life-cycle. The spore is a small, more-or-less rounded body of a yellowish colour[1] studded with minute warts and about twenty-eight micromillimetres[2]

1. *See* footnote 1 on page 167.

2. A micromillimetre is $\frac{1}{1000}$ of a millimetre, and as about 25 millimetres are contained in one inch, the spore is almost $\frac{1}{9000}$ of an inch in diameter.

in diameter (Fig. 2, M). After it falls on the ground it germinates and divides into a number of cells so that finally

Fig. 2. *Sphagnum subnitens*, R. & W. A. Portion of transverse section of stem, × 65. B. Longitudinal view of two cells from the outer layer of the stem, × 65. C-M. Reproductive organs. C. Perichaetial leaf × 10. D. Perichaetial leaf indicating the border of narrow cells, × 10. In the middle of the leaf the hyaline and chlorophyllous cells are distinct, in the lower part they are indistinctly differentiated, in the upper part they are smaller, relatively broader and not differentiated. The hyaline cells have no fibres or pores and are one- or more-septate. E. Archegonium, × 65, *o*, egg cell ; *n*, neck. F. Branch bearing antheridia in the portion *Ap.* × 17. G. Leaf and antheridium × 20. H. Two antheridia × 65, the larger one is older. The wall-cells only are shown ; the central cells are full of sperm-mother cells which give rise to the spermatozoids. I. Spermatozoid, × over 500. J. Sporogonium, with 2 perichaetial leaves, × about 3. K. Older sporogonium, × about 3 ; *l*, lid. L. Vertical section of sporogonium, × about 7 ; *N.* Neck of old archegonium. *C.* Calyptra. *S.* Spore-bearing portion. *Col.* Columella. *F.* Foot. *P.* False seta. *L.* Base of perichaetial leaf. M. 3 spores, × 240. The upper one shows the papillose surface, the two lower show the triradiate marks indicating where 3 other spores have been attached. N. *S. cymbifolium*, Ehrh. Two of the outer cells from the stem showing fibres and pores, × 240. *O. S. subsecundum*, Nees. Part of transverse section of branch-leaf, × 240, showing 2 hyaline and 3 chlorophyllous cells. P. *S. papillosum*, Lindb. Tranverse section of leaf, × 240.

a flat greenish plate of cells is produced. This protonema, as it is called, is very similar in appearance to the prothallium of a fern, but differs from this, since it is never more than one

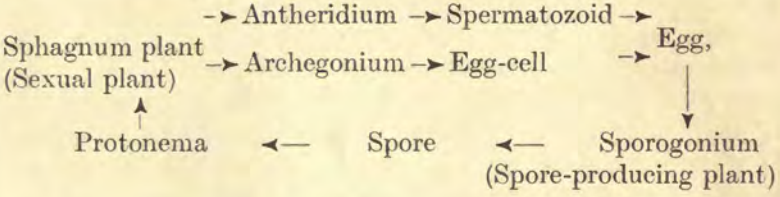
cell thick and is much smaller, usually less than 2 to 3 millimetres broad. On this plate of cells, colourless root-hairs (rhizoids) are formed at the margin, and these fasten it to the earth, whilst on the upper surface a protuberance which eventually becomes a bud is formed. From this bud the stem and leaves of the moss-plant are developed by ordinary growth and a plant 10 or more centimetres (about 4 inches) in length and with many branches is formed. Some of the branches differ from the vegetative ones which have been previously described, in having sexual bodies present in the axils of the leaves (Fig. 2, F and G). In *S. acutifolium* the leaves of these branches are usually red but in some of the Sphagna they remain green or only become yellowish or brownish. This sexual body is known as an antheridium (Fig. 2, H), is borne on a slender stalk, has a globular head, and, what is most important of all, within this head are produced a large number of male cells or spermatozoids (Fig. 2, I), each of which is a spiral nucleated mass of protoplasm with two exceedingly fine threads or cilia, the lashings of which enable the spermatozoid to swim through the water and ultimately reach one of the female cells which are described below.

The egg-bearing organs or archegonia are formed at the apex of a shoot, and each of them (Fig. 2, E) consists of a short stalk attaching it to the stem, a swollen-out portion (venter) and a narrower upper portion which is called the neck. In the bulging part a large cell which is known as the egg-cell, is formed. The inner cells of the neck form a kind of canal which leads down to the egg-cell, and at maturity disorganise into a mucilage which exerts an attractive influence on the male cells, so that these swim down to the egg-cell, and an egg is formed by the fusion of one of the male cells with the egg-cell. This egg begins to grow and soon gets too large for the case (venter) in which it is contained, so that a rupture necessarily takes place, the lower portion of the case remaining at the base of the embryo (developing egg) whilst the shrivelled-up neck may be carried up on the top of the enlarged embryo as a small cap. The embryo eventually develops into a spore-case (sporogonium,

Fig. 2, J and K), the middle portion of which produces some spore-forming tissue, each cell (spore-mother cell) forming four spores (Fig. 2, L and M). In order to provide for the nutrition of its tissues and developing spores, the spore-case swells out at its lower portion into a bulbous foot (F in Fig. 2, L) which acts as an absorbing organ whereby food is taken from the apex of the stem. The spores must also be dispersed and as this could scarcely be effected if the spore-case remained hidden amongst the perichaetial leaves (Fig. 2, C and D) at the top of the stem, the latter grows and carries the spore-case up with it so that when the spores are ripe, and the lid formed at the top of the case falls off, the spores can be carried some distance by the wind away from the parent plant.

In this life-cycle of Sphagnum we may see that there are two reproductive cells, the spore and the egg, each of these producing its own kind of plant; the egg never produces a moss directly but always a spore-bearing plant, whilst the spore always gives rise to a moss-plant. We may then consider that in the life-cycle of the moss two distinct generations alternate, one being the sexual plant bearing the sexual cells by the fusion of which the egg is produced, the other being the spore-producing plant which is somewhat parasitic on the sexual plant. The spores are so light that they are readily scattered by the wind, and so the moss becomes more widely distributed.

The following shows this cycle in a diagrammatic manner.



Habitat and Distribution.

Sphagna grow in boggy or peaty places, some species being completely immersed in boggy pools, whilst other species are able to grow in the drier parts of moorlands. They nearly

always grow in situations where the water has a very small percentage of mineral substances dissolved in it, and this is probably correlated with their remarkable powers of absorbing and retaining water.

The wetness of the habitat is one factor in the distribution of the various species, and the following list gives a general idea as to the preferences of the species for water, those coming first on the list preferring the moister situations :—*S. cuspidatum*, *S. subsecundum*, vars. *obesum* and *viride*, *S. riparium*, *S. intermedium*, *S. teres*, *S. acutifolium*, *S. squarrosum*, *S. girgensohnii*, *S. papillosum*, *S. cymbifolium*, *S. medium*, *S. acutifolium*, var. *quinquefarium*. It must be borne in mind that many departures from the order given in the above list may occur owing to the entrance of other influences, the amount of available water being only one of the factors affecting distribution.

Some attempts have been made of recent years to show that the mineral food is obtained from the water through the agency of some colloidal substance present in the cell-walls, the colloid adsorbing the base and liberating the acid from the mineral salt dissolved in the water, so that all water containing Sphagnum is of an acid character, and this theory has had a good case made out for it by its exponents. Much less satisfactory have been the attempts to make out a list showing the relative powers possessed by the different species of liberating the acid and of living in acid waters, but from actual field observations *Sphagnum acutifolium*, *S. cuspidatum* and *S. papillosum* appear to be the most tolerant to acid water, *S. subsecundum* and its varieties favour situations where the water is fresher, whilst *S. cymbifolium*, *S. intermedium* and *S. squarrosum* have an intermediate distribution in regard to the acidity factor.

The accompanying sketch-map of Somerset (Fig. 3) clearly shows the preference of Sphagna for the non-calcareous, uncultivated regions of the county, these being mainly on its western portion, where the bog-pools of the plateaus and the drainage areas of the flanks of Exmoor, Brendons, and Quantocks provide an abundance of Sphagna on the siliceous rocks of the Devonian system.

The geological distribution of Sphagna in Somerset may be summarised as follows :—

Devonian :—Exmoor, Brendons, Quantocks.

Old Red Sandstone :—North hill, Black Down, Beacon hill and Downhead Common, all on the Mendips. Failand.

Lower and Mid-Lias :—Blackdown hills, Chard Common.

Fig. 3. Sketch-map of Somerset to show the distribution of Sphagna. The areas where Sphagna have been found are shaded, dotted lines represent the contour-line of 700 feet, the continuous lines indicate the contour-line of 1000 feet. A few towns are indicated by crosses.

Kimeridge and Oxford Clays of the Oolite :—Kingsettle hill to Longleat.

Greensand :—Blackdown hill.

The Mendip region is chiefly formed of Carboniferous limestone and Sphagna are only found in a few localities where inliers of Old Red Sandstone occur. On the Wiltshire border (Kingsettle hill, Gare hill, Longleat) patches of Sphagnum are present on the Oolitic formation but always on the non-calcareous clays. On the Blackdown hills the Sphagnum

areas are on the Greensand or Lower Lias shales, whilst a small Sphagnum-moor still survives on the south side of Chard, this being on Mid-Lias siliceous or argillaceous beds.

The map also shows that Sphagnum is chiefly present in areas higher than 700 feet but this must not be taken to mean that it is only an upland plant, it rather shows the activity of man in draining and cultivating the lowland moors. The middle portion of Somerset with the more or less uncultivated Sedgemoor is chiefly on a calcareous substratum and Sphagnum is almost absent.

On the flanges of Exmoor Sphagna are sometimes present below an altitude of 400 feet, on the Brendons, Blackdowns and Quantocks they are rarely found below 600 feet whilst the Sphagnum areas of the Mendip region are all over 700 feet high. The lowest elevations in which Sphagna have been recorded for the county are Shapwick 50ft., Horner 300ft., Timberscombe 300ft., Chard Common 320ft., and Longleat 300ft., but in some counties where low moorland is present on siliceous soil certain species of Sphagna are found almost at sea-level. We may then regard the present upland distribution of Sphagnum as due to human activity having eliminated it from its former lowland situations.

Economic Uses.

Sphagnum is used by gardeners for potting and other purposes, it is very useful for germinating experiments, has often been employed for packing brittle articles and has lately been much used in hospitals both as an antiseptic and as a substitute for raw cotton. It is said to be used as a medium for giving molasses to poultry, and also is of interest in connection with peat and its many uses, since peat in many cases consists largely of the decayed remains of Sphagnum.

Classification and Nomenclature.

Sphagnum is usually placed with the mosses but it differs in so many respects from the ordinary mosses (Bryales) that it is better to create a distinct order (Sphagnales) for it, this

order having a single family (Sphagnaceæ) consisting of only one genus (Sphagnum). The naming of the species is a complicated question as so many authors have adopted different methods.

The nomenclature generally used in the British Isles has been that adopted by Braithwaite and Dixon but recently the Warnstorfian method has become much used by systematists.

In his nomenclature Warnstorf attaches great importance to (1) the position and form of the chlorophyllous cells as seen in transverse sections of the branch-leaf, (2) the form and distribution of the pores in the walls of the hyaline cells of the branch-leaf, and to a less extent, of the stem-leaf. This system seems to be an artificial one, but it works out fairly naturally in practice, except perhaps in the case of the *Sphagna subsecunda* group, still it is not such a natural method as the earlier one and splits up the genus into a number of species of unequal value, therefore I have preferred, in the main, to follow the earlier system, though the characters which Warnstorf emphasises, especially such a constant structural character as the position of the chlorophyllous cells, have been carefully considered when naming the plants. For the convenience of those who have used the Warnstorfian system I have given an additional list showing the distribution of the Warnstorfian species in Somerset.

List of Sphagna.

The numbers 5 and 6 refer to the two botanical vice-counties into which Somerset is divided, North Somerset (6) being the N. and E. portions of the county; South Somerset (5) being the portion S. and W. of the river Parrett and of a line drawn from Ilchester to the northern extremity of Dorset.

Frequency is indicated by "very common," "common," "frequent," "infrequent," "rare" and "very rare"; these frequency notes do not refer to the vice-county as a whole but only to the Sphagnum areas.

An asterisk denotes that the species is not given for the vice county in the Census Catalogue of British Mosses, 1907.

The species for which no first vice-comital records are given are recorded for the first time.

The heights given only refer to Somerset.

The sign "!" after the name of a collector indicates that the specimen has been examined by the author.

In cases of critical species the kind assistance of other bryologists is often indicated in the text; thus "*teste* Wheldon" means that the specimen has been examined and the naming agreed to by Wheldon. In some cases the presence of sporogonia on a plant is indicated by c. fr. (= *cum fructus*).

PHYLUM BRYOPHYTA.

ORDER SPHAGNALES. FAMILY SPHAGNACEÆ.

Genus Sphagnum.

SECTION I. CYMBIFOLIA.

This group contains the most robust species of Sphagnum. The superficial cells of the stem are fibrose and porose (Fig. 2, N), the stem leaves are not bordered with narrow cells, the branch leaves are very broad and much incurved at the apex.

S. cymbifolium, Ehrh. Very common in wet boggy places, by the sides of streams and pools, but seldom completely submerged. 300—1700ft. Sporogonia common.

First published records for V.C. 5 and 6. *Census Catalogue*, 1907, on the authorities of plants collected by Armitage on Exmoor (1891), and by Parsons on Gare hill (1868).

var. *squarrosulum*, N. and H. Infrequent; usually in shadier places, as by the sides of woodland streams, wet places shaded by hedges and other vegetation, and sides of ditches. 300—1000ft.

First published record for V.C. 5. "*A Somerset Heath and its Bryophytic Zonation*," W. Watson; *New Phytologist*, 1915; for V.C. 6, *Census Catalogue*, on the authority of Waterfall.

5.* Chard Common. Blagdon hill. Winsford hill.

6. Black Down and Burrington Combe, Mendip. King's Warren near Witham.

var. *congestum*, Schp. Rare. On drier moors.

5.* Winsford hill, 1000ft.

6.* Kingsettle hill, 700ft.

S. PAPILLOSUM, Lindb. Frequent in boggy places, 300—1200ft. Differs from *S. cymbifolium* in the hyaline cells of the branch-leaves having small conical papillae on their walls (Fig. 2, P).

First records for V.C. 5 and 6. *Census Catalogue*, on the authority of Waterfall.

5. Exmoor (Waterfall). Winsford hill and other places on Exmoor. Tonehead,[1] Brendon hills. Chard Common.

6. North hill, Mendip (Parsons. No specimen in herbarium).

var. *confertum*, Lindb. In drier places. Rare.

First record for V.C. 5. "*A Somerset Heath and its Bryophytic Zonation*," W. Watson, *New Phytologist*, 1915.

5.* Chard Common (350ft.).

var. *sublaeve*, Limpr. Infrequent in wet boggy or swampy places, 1000ft.

5.* Winsford hill and other places on Exmoor. Tonehead, Brendon hills.

SECTION II. SUBSECUNDA.

Stem with one layer (two to three layers in *S. laricinum*) of large superficial cells without fibres and pores. Branches often somewhat secund. Stem leaves bordered with narrow cells, the border of almost equal width to the base. Branch leaves more or less oval and usually narrow at apex, usually arranged in a somewhat secund manner, and with the chlorophyllous cells median (Fig. 2, O).

S. SUBSECUNDUM, Nees. Bogs, wet heaths, often by the sides

1. Tonehead means the higher reaches of the river Tone.

of streams and more or less immersed. Frequent. 300—1000ft. or higher. Sporogonia occasionally found.

First record for V.C. 5. "*Distribution of Bryophytes in the Woodlands of Somersetshire*," W. Watson, *New Phytologist*, 1909. For V.C. 6. *Census Catalogue* (collected by Parsons in 1881 at Gare hill).

5.* Chard Common. Leigh hill and Castle Neroche. Blackdowns. Combes of Quantock hills. Tonehead, Brendon hills. Ley hill near Porlock. Near Tarr Steps, Exmoor.

6. Gare hill (Parsons). North hill, Mendip (Roper !). Kingsettle hill. Near Cogley wood, Bruton.

var. *contortum*, Schp. One of the commonest Sphagna of the county, it is found in similar situations as the type but is much commoner. 300—1200ft. or higher. Sporogonia occasionally found.

5.* Very common on all the Sphagnum areas.

6. Very common. First record, *Census Catalogue* (collected on Downhead Common by Parsons in 1881).

var. *turgidum*, C.M. Frequent in wet places, peaty streams, bogs and boggy pools, but not usually wholly submerged. Sporogonia rare. 600—1200ft. or higher. Sporogonia rare.

5.* Winsford hill (c. fr.) and Ley hill, Exmoor. Hodder's Combe, Seven Wells Combe and Thorncombe hill, Quantocks. Widcombe moor, Blackdowns.

6.* Black Down, North hill (Roper !) and Beacon hill (Roper !), Mendip.

var. *obesum*, Schp. V. rare, submerged in very wet places as boggy pools, 1100ft. Sporogonia not seen.

5.* Winsford hill and Exford, Exmoor (*teste* Wheldon).

var. *viride*, Boul. Infrequent. In shady places, wet ditches, and ditch-holes ; usually submerged. 400—1100ft. Sporogonia not seen.

5.* Withypool and Exford, Exmoor. Tonehead, Brendon hills. Widcombe moor and Britty Common, Blackdowns.

6.* Downhead Common and North hill, Mendip (Parsons !). Failand (Roper !).

S. LARICINUM, Spruce. Very rare. Wet place, 1000ft.
5.* Ley hill (*teste* Wheldon).

SECTION III. TRUNCATA.

Similar to Section Subsecunda except that the stem has two to three layers of large superficial cells, the branches are straight and closely set, the border of the stem leaf is more pronounced, the leaves are truncate and the chlorophyllous cells are nearer to the outer surface.

S. RIGIDUM, Schp. Given in the *Census Catalogue* for V.C. 6, but the plant on which the record is based has been recently examined by the author, and also by Ingham, and it is *S. subsecundum* var. *viride*.
5.* Pinkery pond, Exmoor (var. *subsquarrosum*, W. *fide* Larter).

SECTION IV. SQUARROSA.

Stem with two to three layers of large superficial cells without fibres and pores. Stem-leaves large, broad at apex, without fibres and narrowly bordered. Branch-leaves usually more or less squarrose and with many large pores. Chlorophyllous cells inserted between the hyaline cells on the outer surface of the leaf.

S. SQUARROSUM, Pers. Infrequent in boggy places, sides of moorland streams, near boggy springs, and often in partially-shaded wet places in oak-woods. 500—1100ft. or higher. Sporogonia not seen.
First record for V.C. 5. *Census Catalogue* (Armitage. Exmoor).
5. Exmoor (Armitage). Cloutsham, 1100ft. Holford Combe.
6.* King's Warren near Brewham.

S. TERES, Angstr. Rare. Sporogonia not seen.
5.* Swampy place, 1100ft. Tonehead, Brendon hills.
var. *squarrosulum*, Warnst. Rare. Sporogonia not seen.
5.* Boggy place, 1000ft. Pennycomb water near Exford (*teste* Ingham).

SECTION V. ACUTIFOLIA.

Plants usually slender. Stem with two to three superficial layers of large cells which are without fibres but sometimes have a few pores. Stem leaves small, widened at base, and with a broad border of narrow cells below, obtuse at apices. Branch leaves ovate to lanceolate and narrow at apices, the chlorophyllous cells inserted between the hyaline cells on the inner surface, the pores usually numerous. *S. molle*, which perhaps is better placed in a section of its own, has a narrow border to the stem leaves which are larger and widened in their middle portions.

S. ACUTIFOLIUM, Ehrh. The type is infrequent being much less common than some of its varieties. Boggy places and pools. 300—1500ft. Sporogonia frequent.

First records. *Census Catalogue*, on the authority of Waterfall.

5. Exmoor (Waterfall). Cutcombe, Badgworthy, Exmoor. Treborough, Brendon hills. Blagdon hill and Widcombe moor, Blackdowns.

6. Black Down (c. fr. Roper !). Burrington Combe (c. fr. Roper !). Berkley and Gare hill (Parsons). King's Warren near Brewham.

var. *subnitens*, Dixon (Figs. 1 and 2). The commonest variety of *S. acutifolium* and one of the commonest Sphagna in Somerset. Sporogonia common. Bogs and wet peaty places on moors, occasionally in the wet open places of oak or oak-hazel woods.

First records. *Census Catalogue*, 1907, on the authorities of plants collected by Armitage on Exmoor (1894), and by Parsons on Downhead Common (1881). In the Leipner collection of mosses in the Bristol Museum there is a specimen of this plant. It is labelled *S. cymbifolium*, and was collected near Glastonbury about 1868.

var. *rubellum*, Russ. On moors. Not uncommon, 350 1000ft. or higher.

5.* Chard Common (wet heath, *teste* Wheldon). Winsford hill (1000ft.). Quantocks, Widcombe moor.

var. *gracile*, Russ. Recorded in the *Census Catalogue* for 5, but I cannot trace the specimen.

var. *quinquefarium*, Lindb. This is another common member of the *acutifolia* group. It often forms large cushions by the sides of streams in oak-woods and is frequently found in much drier places than any of its allies. Sporogonia rare. 300—1600ft.

First record for V.C. 5. *Moss Exchange Club Report*, 1914; specimen collected by the author in Horner woods.

5.* Dunkery, Horner woods, etc., Exmoor. Quantocks. Brendons. Haddeo valley. Blackdowns. Treborough (c. fr.).

6.* King's Warren near Brewham.

S. GIRGENSOHNII, Russ.

5.* Boggy place in hollow of heath, 600—700ft., Blagdon hill, Blackdowns (*teste* Ingham).

var. *gracilescens*, Grav.

5.* Some of the plants from Blagdon hill are referable to this variety or form.

S. FIMBRIATUM, Wils. The only claim to include this rests on a plant from a moist bank (700ft.) in Hodder's Combe V.C. 5. In my notes it is placed under form *compactum*, W., but the specimen has been lost.

S. MOLLE, Sull. Rare. Near moorland streams. No sporogonia seen.

5.* Cold Harbour, Treborough (1000ft.)

var. *tenerum*, Braithw. Very rare.

5.* Moist bank, Hodder's Combe, Quantocks (700ft.)

SECTION VI. CUSPIDATA.

Stem with superficial cells usually not well differentiated from the inner cells, without fibres or pores. Stem leaves obtuse, usually small and with broad border of narrow cells below. Branch leaves ovate to lanceolate, when dry usually undulate or crisped, narrowed above, with pores few or small; chlorophyllous cells free on the outer surface. *S. tenellum* does

not agree in all these characters with the other members of the group and perhaps is better placed in a group of its own.

S. INTERMEDIUM, Hoffm. Common in boggy and wet places on the heaths. 300—1200ft. or higher. Sporogonia not seen.

First record for V.C. 5. *Census Catalogue*, 1907, on the authority of a plant collected by Armitage on Exmoor.

5. Common on all the Sphagnum areas.

6.* Black Down, North hill (Roper !), Mendip. King's Warren.

var. *pulchrum*, Lindb. Wet boggy places. Rare.

First record for V.C. 5. *Moss Exchange Report*, 1915, specimen collected by the author from Blagdon hill in 1913.

5.* Blagdon hill and Widcombe moor, Blackdowns.

S. CUSPIDATUM, Ehrh. Rare.

5.* Sides of moorland pools, Dunkery, 1600ft. The Chains, Exmoor (*fide* Larter).

6. Recorded in the *Census Catalogue*. I have recently had an opportunity to examine the plant on which the record probably rests and it is *S. intermedium*.

var. *falcatum*, Russ.

5.* Bog pools, Dunkery, 1600ft.

var. *plumosum*, Nees and Hornsch. Completely immersed.

5.* Near Porlock, on Exmoor, 1000ft., in pool.

var. *serratum*, L. & J. Immersed.

5.* Dunkery, 1600ft., in bog pool with *Gymnocolea inflata* f. *natans*.

S. TENELLUM, Ehrh. This plant is recorded for V.C. 6 in the *Census Catalogue* but I have recently been able to examine the specimen on which the record is based, and it is *S. auriculatum*. This name has been confirmed by Wheldon.

SPHAGNA ACCORDING TO THE WARNSTORFIAN SYSTEM.

S. CYMBIFOLIUM, (Ehrh.) W. See *S. cymbifolium*, p. 177.
The colour-varieties *glaucescens*, W., and *fusco-flavescens*, (R.) W. are very common; *glauco-flavescens*, (R.) W., *glauco-pallens*, W., *fusco-pallens*, W., and *flavo-glaucescens*, (R.) W., are frequent; *fusco-rubescens*, W., and *fusco-glaucescens*, W., and *fuscescens*, W., are occasionally found.

S. PAPILLOSUM, Lindb.
var. *normale*, W. See *S. papillosum*, p. 178.
forma *conferta*, (Lindb.) W. = *S. papillosum* var. *confertum*, p. 178.
var. *sublaeve*, Limpr. = *S. papillosum* var. *sublaeve*, p. 178.

S. COMPACTUM, D.C. = *S. rigida*, p. 180.

S. SQUARROSUM, Pers.
var. *spectabile*, Russ. See *S. squarrosum*, p. 180.

S. TERES, (Schp.) Angstr.
var. *imbricatum*, W. See *S. teres*, p. 180.
var. *squarrosulum*, (Lesq.) W. =var. *squarrosulum*, p. 180.

S. CUSPIDATUM, (Ehrh.) W.
var. *falcatum*, Russ. = var. *falcatum*, p. 183.
var. *submersum*, Schp. See *S. cuspidatum*, p. 183.
var. *plumosum*, Bry. germ. = var. *plumosum*, p. 183.

S. TRINITENSE, C.M. See *S. cuspidatum* var. *serratum*, p. 183.

S. PULCHRUM, (Lindb.) W. = *S. intermedium* var. *pulchrum*, p. 183.

S. RECURVUM, (P.B.) W. See *S. intermedium*, p. 183.
var. *mucronatum*, (Russ.) W. Common. 300—1000ft. or higher.
5.* Chard Common. Ley hill, Exmoor, etc.
6.* King's Warren. North hill (Roper!), etc.
var. *amblyphyllum*, (Russ.) W. Common. 600—1200ft. or higher.
5.* Leigh hill and Widcombe moor, Blackdowns. Tonehead and Treborough, Brendons. Winsford hill.
6.* King's Warren.

S. MOLLUSCUM, Bruch. = *S. tenellum*, p. 183.

S. FIMBRIATUM, Wils.

var. *tenue*, Grav. See *S. fimbriatum*, p. 182.

S. GIRGENSOHNII, Russ. = *S. girgensohnii*, p. 182.

var. *gracilescens*, Grav. See p. 182.

S. WARNSTORFII, Russ. = *S. acutifolium* var. *gracile*, p. 182.

S. RUBELLUM, Wils. = *S. acutifolium* var. *rubellum*, p. 181.

Colour-variety *purpurascens*, W., Chard Common (5).

S. QUINQUEFARIUM, (Lindb.) W. = *S. acutifolium* var. *quinquefarium*, p. 181.

Colour-varieties *pallido-viride*, W. very common; *virescens*, W. common; *pallescens*, W. and *roseum*, W. frequent.

S. SUBNITENS, R. & W. = *S. acutifolium* var. *subnitens*, p. 181.

Colour-varieties *flavo-rubellum*, W., *versicolor*, W., *violascens*, W. are common; *pallescens*, W. is frequent; *flavescens*, W., *purpurascens*, W., *obscurum*, W., and *griseum*, W. are infrequent.

S. ACUTIFOLIUM, (Ehrh.) R. & W. See *S. acutifolium* type, p. 181.

Colour-varieties *pallescens*, W., *viride*, W., *roseum*, W., *rubrum*, W., *flavo-rubellum*, W., *obscurum*, W., and *versicolor*, W., have been found in the county.

S. MOLLE, Sull.

var. *pulchellum*, W. See *S. molle*, p. 182.

var. *tenerum*, Braithw. = var. *tenerum*, p. 182.

S. CONTORTUM, Schultz. = *S. laricinum*, p. 180.

S. SUBSECUNDUM, (Nees.) Limpr. The *subsecunda* group is a difficult one in which to correlate the two systems and it is impossible to place exactly the Warnstorfian species as varieties equivalent to them in the earlier system; only general statements can be made. All the plants belonging to the Warnstorfian *S. subsecundum* can be placed under *S. subsecundum*, Nees. Wet boggy places. Rare. 300—1000ft.

First record "*A Somerset Heath and its Bryophytic Zonation*," W. Watson, *New Phytologist*, 1915.

5.* Chard Common. Leigh hill and Castle Neroche, Blackdowns.

6.* Near Cogley wood.

S. INUNDATUM, (Russ.) W. This species, like the last, has many pores on the outer surface of the branch-leaf and few on the inner, but has larger stem-leaves with the hyaline cells mostly divided and fibrose. Many plants belonging to it, would be placed with *S. subsecundum* var. *contortum*, but others would have to be placed under var. *viride* or the type of the Neesian species, unless the Warnstorfian *S. subsecundum* is extended to embrace some plants with leaves longer than 1mm. Frequent by stream-sides and bogs, often more or less submerged. 300—1000ft. or higher.

5.* Quantock Combes. Blackdowns. Tonehead, Brendons. Chard Common. Selworthy. Ley hill and Winsford hill (c. fr.), Exmoor.

6.* Black Down and Downhead Common, Mendip. Kingsettle hill.

S. AURICULATUM, Schp. Many plants of this species are referable to the var. *viride*, p. 179, but there is no exact correspondence in the two nomenclatures. The pores are similar to the two preceding species, but the stem-leaves are much larger and narrowed at the base. Rare. In very wet peaty places, often submerged. 300—1100ft.

5.* Exford, Winsford hill, Britty Common, Castle Neroche (*teste* Sherrin).

6.* Longleat. North hill, Mendip (*teste* Wheldon). Black Down, Mendip.

S. CRASSICLADUM, W. Usually belong to var. *turgidum* or var. *viride* of the other system. In ditches, streams, and moorland pools, usually completely submerged. Infrequent. 300—1200ft. Sporogonia rare.

5.* Winsford hill. Withypool. Quantock Combes. Tonehead, Brendon hills. Castle Neroche. Ley hill, Porlock.

6.* Beacon hill, Mendip. Failand.

S. RUFESCENS, (Bry. germ.) Limpr. The most common member of the *subsecunda* group and mostly to be placed under var. *contortum* of the other system. It is also the most variable both in its characters and habitat, usually submerged or in wet places. Very common in all the

Sphagnum areas. Sporogonia occasionally found. 300—1500ft.

5.* First record in "*A Somerset Heath and its Bryophytic Zonation*," W. Watson, *New Phytologist*, 1915.

6. First record in the *Census Catalogue*, 1907, from a specimen collected by Parsons at Downhead Common and submitted to Ingham.

var. *aquatile*, W. Submerged. Rare.

5.* Winsford hill. Quantock Combe.

S. OBESUM, (Wils.) W. See *S. subsecundum* var. *obesum*, p. 179, as all the plants recorded under that variety belong to this Warnstorfian species.

In the preparation of the above lists hundreds of plants from different parts of Somerset have been examined microscopically, and in many critical cases have been passed on for other bryologists to examine.

Very little work had been done on the Sphagna of Somerset till the author began his investigations ; there is not a single Sphagnum mentioned in the Victoria History of the county, only thirteen species and varieties (with one extra Warnstorfian species) are given in the *Census Catalogue of British Mosses*, 1907, and two of these were cases of mistaken identity, and the only other references to Sphagna species were found in the publications mentioned in the list, which now shows thirty-two (and eight additional Warnstorfian) species or varieties.

For the adjoining counties of Devon, Gloucester, Dorset and Wiltshire eight (with four additional Warnstorfian), five (with one additional Warnstorfian), sixteen (with two additional Warnstorfian), nine species or varieties are respectively recorded in the *Moss Census Catalogue*, but the list in the case of Gloucestershire has been extended to eleven (with five additional Warnstorfian) species and varieties by H. H. Knight, in *The Mosses of Gloucestershire*. The rarer species or varieties recorded for Somerset are *S. teres* and its var. *squarrosulum*, *S. molle* and its var. *tenerum*, *S. acutifolium* var. *gracile* (a doubtful record), *S. girgensohnii*, *S. inter-*

medium var. *pulchrum*, *S. cuspidatum* var. *serratum*, *S. subsecundum* type and its vars. *obesum* and *viride*, whilst the common or widely distributed species *S. medium*, *S. rigidum* and *S. tenellum* have not as yet been seen by me from the county.

S. girgensohnii var. *gracilescens* has, so far as I am aware, not been previously recorded for the British Isles.

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It is much to be regretted that the two latter bryologists did not live to see the publication of the list of Sphagna to which they had contributed.