Yasuhiko Asahina*: Lichenologische Notizen (§ 99)


Usnea is the unique genus among lichens, which has highly developed and well differentiated cortex, medulla and axis. The mutual breadth of of medulla and axis, together with their contexture and color make important items in characterizing an Usnea species. In older literatures we find such expressions as “axis tenuis,” “medulla crassa” etc., without giving any standard.

Motyka¹ gave in his eminent work numerical values of cortex, medulla and axis of each species. But these figures are of little value, unless the exact position in the thallus was definitely mentioned. Motyka recommends to cut the branch at the upper portion from the middle of the thallus. Steiner²) seems to be the first, who utilized the thickness of the cortex to systematize Usneae. But his method was not further developed by the subsequent lichenologists.

Instead of giving arbitrary numerical values I propose to use their ratio, which I call “RS” (abbreviated from “Ratio stratorum”), taking the thickness of the cortex as unit. Let c, m and a be the thickness of cortex, medulla and axis of a section respectively, then

\[ RS \text{ of this species} = \frac{c}{m} : \frac{a}{c}. \]

By the calculation of RS value we may add another important factor in identifying Usnea species.

In many species the RS values of the same branch, except undermost and apical parts, are almost constant throughout the total length. At least this is the case with species of regularly attenuate stems and branches.

In case of inflated thalli the RS values show notable fluctuation according to the position of the section, so that it must be more accurately defined whether the section was made at the most thickened point or at a regularly

¹) Lichenenum Generis Usnea Studium Monographicum, pars systematica.
²) Ibid., pars generalis, p. (158).

* 資源科学研究所. Research Institute for Natural Resources, Shinjuku-ku, Tokyo.
attenuate region of the thallus. Under these limitations every individual of
one and the same species shows almost approximate RS values. However
the cortical layers of various Usnea species are very often uneven, the axes
are deformed and eccentrically situated in the medullae. To adjust such
irregularities an average thickness of each layer is calculated in following
way.

A section of thallus is immersed in glycerine-alcohol-water (1: 1: 1) and
gently warmed to drive air bubbles. Then measure the thickness of each
layer along two crossed diameters (Fig. 1) and find the arithmetical means
of these data:

\[ c = \frac{1}{4} (c_1 + c_2 + c_3 + c_4), \]
\[ m = \frac{1}{4} (m_1 + m_2 + m_3 + m_4), \]
\[ a = \frac{1}{2} (a_1 + a_2). \]

Graphic Expression of "RS."

To compare several RS values of the same or different species, it is
more convenient to use their graphs instead of numerical values. Let the
RS of a section be 1: 4.2: 3.6. Draw a horizontal straight line oX, which is
called the base line (Fig. 2). Take three points a, m, and c on it, so that
oa = 1/2 \times 3.6, am = 4.2 and mc = 1. The straight line oc itself is the simplest
graph of this RS, because therewith we are able to reconstruct the section
virtually as it is shown in the underside of the base line oX. Practically I
adopt another method. Draw aA (=3.6), mM (=4.2) and cC (=1) perpendi-

Fig. 1

Fig. 2
cular to oX. Join A and M, M and C, A and C. The straight line AC meets with oX at P. I call the triangle AMC the graph of $RS=1:4.2:3.6$ with respect to the base line oX. The acute angle $\theta$ at P varies in corelation with the thickness of cortex, medulla and axis. When a and c remain const-
stant, then the greater $m$, the smaller becomes $\theta$ and vice versa. If the point M lies on the outside of the line AC as in the case of Fig. 2, the

![Diagram of graph AMC with triangle ABC](image)

Fig. 3

Fig. 4

graph is said to be of exterior type, which is always the case with species of broad medulla. On the other hand, if the point M lies within AC, the graph is called interior. All species with narrow medulla belong to this class. Fig. 3 demonstrates the $RS=1:2:5$, $\theta=ca\,54^\circ$. When $RS=1:2:4$, then the point M lies on the straight line AC, $\theta$ being equal to $45^\circ$. (Fig 4). Also three points A, M and and C of the graph of $RS=1:2.3:5$ lie practically on the straight line AC, $\theta$ being ca $50^\circ$. Generally speaking, if the diameter of axis is less than double breadth of medulla, the graphs become decidedly exterior. On the contrary, if the diameter of axis is greater than or equal to double breadth of medulla, the graphs belong partly to interior, partly to exterior type. In the latter case the point M lies very near to the line AC. As a special case it may occur that the point M lies on the line AC. I have not yet met cases, in which the diameter of axis is less than the breadth of cortex. Also $RS\,1:1:1$, if really exists, may be an extraordinary case, as the line AMC is parallel to the base line.
One may raise an objection to the RS method, that I have treated the plastic tissue of lichen too much mechanically. Indeed, RS value of a species is not strictly constant and RS alone can give no ultimate decision. Nevertheless I am quite convinced that by the measurement of the RS values we can secure more accurate perception of the thallus of Usnea in question, excluding any absurd determination.

Examples

1. **Usnea hirta** (L.) Wigg.

This species is characterized by its comparatively thin cortex and broader medulla. The graphs of RS values are all of exterior type.

Specimen 1: Flora Danica, Sjælland—leg. M. S. Christiansen (no. 8125).
- $c: m: a=57: 197: 279$. $RS=1: 3.4: 4.8$. $\theta=41^\circ$.

- $c: m: a=72: 270: 390$. $RS=1: 3.8: 5.4$. $\theta=43^\circ$.

- $c: m: a=37: 345: 270$. $RS=1: 8.1: 7.3$. $\theta=35^\circ$.

Specimen 4: Plantae helveticae, Oberengadin—leg. E. Vayhinger.

**Usnea hirta** ssp. *villosa* (Ach.) Mot. apud Motyka, Monogr., p. 96:
- $c: m: a=80: 250: 220$. $RS=1: 3.1: 2.75$. $\theta=26^\circ$.

**Usnea hirta** ssp. *helvetica* (Ach.) Mot. apud Motyka, Monogr., p. 100:

2. **Usnea sorediifera** (Auctor.) Mot.

When the characteristic soralia are not sufficiently developed, this species is often mistaken with *U. comosa*, from which may be easily distinguished by the thinner cortex and broader medulla. The graphs of RS are all of exterior type.

- $c: m: a=65: 229: 262$. $RS=1: 3.5: 4$. $\theta=34^\circ$.

- $c: m: a=41: 164: 213$. $RS=1: 4: 5.2$. $\theta=40^\circ$.

3) To save space I abandoned to attach the graphs. The readers will easily reproduce them and be convinced of their utility.

c: m: a = 50: 270: 344. \( RS = 1: 5.4: 6.8 \).

\( \theta = 44^\circ \).

Usnea soredilfera (Auctor.) Mot. apud Motyka, Monogr., p. 287:

c: m: a = 60: 220: 180. \( RS = 1: 3.67: 3 \).

\( \theta = 24^\circ \).

3. Usnea comosa (Ach.) Röhl.

This species has comparatively thin medulla, which is hardly twice so thick as cortex and much thicker axis, so that the graphs of RS values are in general of interior type. Sometimes the graph appears as exterior type, then the point M lies very near to the line AC. Very often the points A, M and C lie on a straight line.

Specimen 8: Flora Danica\(^4\), Sjaelland—leg. M. S. Christiansen (10431, K+).

c: m: a = 69: 104: 580. \( RS = 1: 1.5: 8.4 \).

\( \theta = 72^\circ \).


c: m: a = 100: 164: 416. \( RS = 1: 1.64: 4.16 \).

\( \theta = 50^\circ \).

Specimen 10: Flora Danica, Jylland—leg. M. S. Christiansen (8528, K+).

c: m: a = 75: 150: 477. \( RS = 1: 2: 6.4 \).

\( \theta = 61^\circ \).

Specimen 11: Flora Danica, Jylland—leg. M. S. Christiansen (8528 p.p., K-).

c: m: a = 81: 212: 335. \( RS = 1: 2.6: 4.1 \).

\( \theta = 42^\circ \). (exterior).

Specimen 12: an admixed individual in Kryptog. Exsicc. Vindob. 2768 (sub U. dasypoga, K-).

c: m: a = 132: 245: 530. \( RS = 1: 2.3: 5 \).

\( \theta = 50^\circ \). A, M, C on a straight line.

c: m: a = 131: 115: 610. \( RS = 1: 0.88: 4.4 \).

\( \theta = 62^\circ \).


c: m: a = 90: 120: 575. \( RS = 1: 1.3: 6.4 \).

\( \theta = 66^\circ \).


c: m: a = 68: 137: 285. \( RS = 1: 2: 4 \).

\( \theta = 45^\circ \). A, M, C on a straight line).

\(^4\) Mr. Christiansen was kind enough to send me these Danish lichens, for which I thank him here again. The reaction K+ of U. comosa is due to the presence of thamnolic acid. Those specimens (K-) contained squamatic acid.
Usnea comosa (Ach.) Röhl. apud Motyka, Monogr., p. 265:

Usnea comosa ssp. similis Mot. apud Motyka, Monogr., p. 270:
c: m: a=70: 150: 300. RS=1: 2.1: 4.3. θ=46°.

Usnea comosa ssp. glaucina Mot. apud Motyka, Monogr., p. 274:

4. Usnea rubescens Stirt.

With respect to the RS values this species show almost identical numbers with those of Usnea rubicunda Stirt. But they are distinctly separated by the mode of ramification and chemical reaction.


Specimen 16: Arashiyama, prope Kyoto, Japan—leg. Y. Asahina.
c: m: a=123: 196: 360. RS=1: 1.6: 2.95. θ=38°.

Specimen 17: Mt. Arisan, Formosa—leg. Y. Asahina.
c: m: a=120: 200: 400. RS=1: 1.66: 3.33. θ=42°.

Usnea rubescens Stirt. apud Motyka, Monogr., p. 347:
c: m: a=90: 140: 300. RS=1: 1.55: 3.33. θ=42°.

5. Usnea rubicunda Stirt.


Specimen 19: Minoo, Prov. Settu, Japan—leg. N. Ui.

Specimen 20: Mt. Arisan, Formosa—leg. Y. Asahina.
(middle) c: m: a=131: 238: 377. RS=1: 1.8: 2.88. θ=36°.
(upper p.) c: m: a=65: 130: 237. RS=1: 2: 3.65. θ=42°.

Usnea rubicunda Stirt. apud Motyka, Monogr., p. 430:
c: m: a=180: 150: 350. RS=1: 0.83: 1.95. θ=27°.

This value seems to be an extraordinary one—the axis is too small in proportion to the cortex.

6. Usnea aciculifera Wain.

One of the most common Usneae in Japan, having almost regularly cylindrical and gradually attenuate branches. Graphs of its RS values are in
general narrow triangles, whose vertices M lying very near to the side AC.

(middle) c: m: a = 65: 262: 450. $RS = 1: 4: 6.7$. $\theta = 49^\circ$.
(upper p.) c: m: a = 41: 130: 340. $RS = 1: 3.2: 7.4$. $\theta = 57^\circ$.

Specimen 22: Subashiri, Mt. Fuji, Japan—leg. Y. Asahina (114).
c: m: a = 84: 147: 327. $RS = 1: 3.2: 7.4$. $\theta = 57^\circ$.

Specimen 23: Yamanaka, Mt. Fuji, Japan—leg. Y. Asahina (1405).
c: m: a = 49: 130: 300. $RS = 1: 2.6: 6.0$. $\theta = 54^\circ$.

c: m: a = 85: 164: 458. $RS = 1: 2: 5.5$. $\theta = 57^\circ$.

*Usnea aciculifera* Wain. apud Motyka, Monogr., p. 323:
c: m: a = 40: 150: 250. $RS = 1: 2.6: 6.3$. $\theta = 55^\circ$.

今回筆者は *Usnea* 類の記載に当り形態的の一要素として枝条の横断面に於ける皮層，
隣接及び中軸の幅の比を皮層の厚さを単位として示すことを提案する。従来の種の記載
は従って粗略で“幅広い” とか “中軸狭細い” と云う不確定な，標準のない抽象
的の表現をして居る。又分々皮，鱗，軸の実際の数値を考えて居る場合でも其の切断場
所が不明では比較することができない。今或る枝の直角断面に於ける皮，鱗，軸の数値
（μ 単位）を夫々 c, m, a とすれば全体を c で除したものの比 （之を RS と云う）
を計算する:

$$RS = 1: m/c: a/c.$$  

但し *Usnea* 類の内には皮層の厚さが甚しく不同であるもの少からず又中軸の断面も正
円ではなく且つ鱗の中に偏在して居るので軸の中心を通る略直角に交叉する両直径に沿
うて測定し其の平均値を用ることにした。

勿論此の RS が或種の標微である為には，同一の種であればどの個体のどの部分を
切っても同一の RS を示さなければならない。かかる数学者的正確を変化の多い地衣類で
要求するのは無理なことで或る範囲の動揺を考慮すれば形態的の一要素として利用す
ことができる。今迄の経験では *Usnea* 類の中でも茎条が基部から先端迄殆ど同様形を
なし漸次するものでは可なり恒一の RS を与える。又枝条が中央部又は先の方で膨脹
（inflate）し鱗が比較的広いものでは断面の場所によって著しい動揺があるがこの場合
でも其の断面の場所を限定すれば互に比較できる。猶此の RS 値を同示することは
多くの標本の RS を連に比較することができる。筆者の今回の考察は植物鑑定に際し
隣接塩液等特殊ある“勘”なるものを追放する意図に出ても事である。"勘" と
ば熟練によって得た概念で，正しき結論に達する端緒には違いないが勘の持主のみ
に通用するもので他人から見れば独断以外の何者でもない。科学的には是非客観的証拠
の裏付けで他人を納得せしめなければならない。