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T. F. Allen's Collection of Characeae in Herbarium of Algology, Natural History Museum and Institute, Chiba (CBM), Japan

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Abstract Characeae Japonicae Exsiccatae by T. F. Allen (1895) preserved in the Herbarium of Algology, Natural History Museum and Institute, Chiba (CBM), Japan, which consist of 1 species and 3 varieties in *Chara* and 9 species and 1 form in *Nitella*. Especially, of those, *Nitella japonica* Allen, *N. orientalis* Allen, *N. pulchella* Allen, *N, psucicostata* Allen and *N. sublucens* Allen are important specimens following the type material of species which is described as new species in Japan by T.F.Allen. These authentic specimens are essential for taxonomy of Characeae in Japan, as standard specimens.

Key words: Characeae Japonicae Exsiccatae, T. F. Allen, taxonomy, Characeae, *Nitella, Chara,* Japan, CBM.

Characeae Japonicae Exsiccatae

Characeae Japonicae Exsiccatae (Allen, 1895) deposited in the Herbarium, Natural History Museum and Institute, Chiba (CBM), Japan, which consist of *Chara fragilis* Desv., 2 specimens of *Chara gymnopitys* A.Braun var. "*alpha*", A.Braun, 2 specimens of *Nitella coronata* Ziz., 2 specimens of *Nitella japonica* Allen, *Nitella orientalis* Allen, *Nitella pulchellan* Allen, *Nitella paucicostata* Allen, *Nitella pulchella* Allen, *Nitella sublucens* Allen and *Nitella oligospira* A.Braun. Especially, of those, *Nitella japonica* Allen, *N. orientalis* Allen, *N. pulchella* Allen, *N. psucicostata* Allen and *N. sublucens* Allen are important specimens following the type material of species which is described as new species in Japan by T. F. Allen (1894, 1895). This exsiccata is on eternal loan from the University Museum, the University of Tokyo (TI). These specimens are essential for taxonomy of Characeae in Japan, as standard specimens. Each taxon identified by T. F. Allen in the list are enumerated (Table 1).

Taxonomy of Charophytes

Charophytes (Charophyceae, Charales) are among the largest and most structurally complex of the green algae. The main axis have, at intervale, whorls of short lateral branchlets so that the plants bear a superficial resemblance to *Equisetum*.

In 77 A.D. Pliny the Elder (Plinius 23-79 A.D.) in "Historie Naturalis" assinged the green alga *Chara* to the land plants as an aquatic horse-tail (Plinius, 1741). Since then systematic position of *Chara* and related algae within the plants has been controversial.

Linnaeus (1753) included four species of Charophyta in a single genus, *Chara*, in his "*Species Plantarum*", namely, *C. tomentosa, C. vulgaris, C. hispida* and *C. flexilis*, and these names are unchanged today, except that *C. flexilis* is now in *Nitella*. After that there are new genera, species, varieties and forms, at present totalling over 300 taxa in the world, on the taxonomic limits of the Linnean species (Wood, 1962; Wood and Imahori, 1964, 1965; John and Moore, 1987).

During the 19th century, five additional genera were recognized, *Nitella* (Agard, 1824), *Lychnothamunus* (Ruprecht, 1845), *Tolypella* (A. Braun, 1849), *Lamprothamunus* (A. Braun, 1882) and *Nitellopsis* (Hy, 1889). In 1916, J. Groves substituted the name *Lamprothamnium* for *Lamprothamnus* as the latter had been used for a genus of Rubiaceae. Representatives of all these genera are found in Japan without *Lychnothamunus* and *Tolypella*.

20 years later, Karsten *et al.* (1936) recognized a common ancestry of the green plants (*i.e.*, Chlorophyceae, Bryophyta and Pteridophyta), but Characeae and Conjugatophyceae were still excluded from the green algae (Volker *et al.*, 1997).

It is now generally accepted that these genera make up a highly specialized family, Characeae, within the Chlorophyta, although their position in relation to other green algae, this group have treated as a

Table 1. List of specimens of Characeae Japonicae Exsiccatae (T. F. Allen, 1895), (1) the number of specimens in Characeae Japonicae Exsiccatae (2) the scientific name (3) the collection site (4) the plate number.

Allen's No.	Scientific name	Collection site	Plate number
1	*Chara fragilis* Desv.	Province Tokio	No.1
2	*Nitella coronata* Ziz.	Province Mikawa	No.2
3	*Nitella coronata* Ziz.	Province Tokio	No.3
4	*Nitella Japonica* Allen	Province Tokio	No.4
7	*Nitella orientalis* Allen	District of Toyohashi, and Province Ise	No.5
8	*Nitella pulchellan* Allen	Province Ise, District Yamakami, pond Kaida-ike	No.6
9	*Nitella Japonica* Allen	Ise,Yamagami	No.7
10	*Chara gymnopitys* A.Braun var. *"alpha"* A.Braun	Province Mikawa Tennu pond, Toyohashi	No.8
11	*Chara gymnopitys* A.Braun var. *"alpha"* A.Braun	Province Tokio, Shinbashi pond	No.9
12	*Nitella paucicostata* Allen	Province Tokio	No.10
14	*Nitella pulchella* Allen	Province Mikawa, Tennu poid, Toyohashi and Province Tokio Shinbashi pond	No.11
16	*Nitella sublucens* Allen	Province Sagami, Localty Koduz	No.12
17	*Nitella oligospira* A.Braun	Province Mikawa, Seishin pond	No.13

separate division as Charophyta. But Mattox and Stewart (1984) suggests that the Chlorophyta should be divided into two classes, the Chlorophyceae and the Charophyceae, the second class organizing the restwhile members of the Chlorophyceae such as Charales, Chlorokybales, Coleochaetales, Klebsormidales and Zygnematales. The term Charophyte or stonewort is used as a common-name for the members of the family Characeae, which is divided into two tribes, Charaeae (*Chara, Lamprothamnium, Lychnothamunus, Nitellopsis*) and Nitelleae (*Nitella, Tolypella*).

In history of taxonomy of Japanese Characeae, Kotaro Saida (1887) firstly described 2 species of *Chara* (*Chara braunii* Gmelin, *C. foetida* Braun) and 5 species of *Nitella* (*N. flexilis* Agardh, *N. gracilis* (= *Tolypella gracilis*) Agardh, *N. opaca* Agardh, *N. tenuissima* Kuetzing, *N. translucens* Agardh) and T. F. Allen (1894, 1895, 1898) described 3 species of *Chara* (*C. coronata* Ziz. (= *C. braunii*), *C. fragilis* Desv. (= *C. globularis* Thuiller), *C. gymnopitys* A. Br. var. *'alpha'* A. Br.) and 17 species, 2 varieties and 4 forms of *Nitella* (*N. expansa* Allen, *N. gracillima* Allen, *N. japonica* Allen, *N. oliogospira* A. Br., *N. orientalis* Allen, *N. mucronata* Miq. var. *tenuior* A. Br., *N. multipartita* Allen, *N. multipartita* Allen form. *intermedia* Allen, *N. multipartita* Allen form. *subsrecta* Allen, *N. multipartita* Allen form. *transiliforma* Allen, *N. pseudoflabellata* A. Br., *N. pseudoflabellata* A. Br. form. *testaglabra* Allen, *N. pseudoflabellata* A. Br. var. *imeprialis* Allen, *N. pseudoflabellata* A. Br. var. *ramuscula* Allen, *N. paucicostata* Allen, *N. pulchella* Allen, *N. rigida* Allen, *N. saitoiana* Allen, *N. subglomerata* A. Br. var. *japonica* Allen, *N. sublucens* Allen, *N. tanakaiana* Allen) from Japan, on the basis of specimens collected by Kenzo Saito and Yoshio Tanaka. Of those, 12 species, 2 varieties and 4 forms were new to science, and 4 species and 1 varieties were new to Japan. As a results of his study, Characeae Japonicae Exsiccatae, which consist of 17 specimens, 1 species and 2 varieties of *Chara* and 7 species and 2 varieties of *Nitella*, has distributed to several Europe herbarium such as the British Museum (Natural History) and Tokyo Imperial University (Japan).

Tomitaro Makino (1929) had called attention to the study of Characeae of Japan on T. F. Allen's reports. (1894, 1895, 1898) Then Walter Migula (1935) described 3 species of *Chara* and 8 species and 1 form of *Nitella* on specimens collected by Shigeru Miki. Of those, *N. dimorpha* Migula and *N. polyglochin* A. Br. form. *japonica* Migula were new to science, and *N. acuminata* A. Br., *N. dispersa* A. Br., *N. flaccida* A. Br., *N. hyalina* A. Br. and *N. polyglochin* A. Br. form. *japonica* Migula were new to Japan. After that Hideo Morioka (1940, 1941a, 1941b) reported 5 species of *Chara* and 11 species of *Nitella*. Of those, 7 species (*N. coreana* Morioka collected in Korea, *N. fallosa* Morioka, *N. gracilens* Morioka, *N. moniliformis* Morioka, *N. musashiensis* Morioka, *N. spiciformis* Morioka, *N.*

sublucens Morioka) were new to science and 3 species (*C. corallina* Willdenow, *C. benthamii* A. Br., *C. zeylanica* Willdenow) were new to Japan. Afterwards, Kozo Imahori (1964) described 8 species of *Chara* and 47 species of *Nitella* containing 14 species as new to science (*N. allenii* Imahori, *N. axilliformis* Imahori, *N. crispa* Imahori, *N. erecta* Imahori, *N. horikawae* Imahori, *N. inversa* Imahori, *N. pusilla* Imahori, *N. robusta* Imahori, *N. sejuncta* Imahori, *N. shinii* Imahori, *N. spinosa* Iamahori, *N. stabilis* Imahori, *N. stricta* Imahori, *N. tuyamae* Imahori). Then Hideo Kasaki (1964) reported 5 species, 7 varieties and 1 subspecies of *Chara*, 21 species and 35 varieties of *Nitella*, 1 species of *Nitelopsis* and 1 species of *Lamprotamnium*. Of those, 4 varieties and 1 form are new to science (*N. flexilis* var. *flexilis* Kasaki, *N. shinii* var. *graciliformis* Kasaki, *N. pseudoflabellata* form. *macrophylla* Kasaki, *C. benthamii* var. *longicorollata* Kasaki, *C. benthamii* var. *brevibracteata* Kasaki and *C. globularis* var. *hakonensis* Kasaki). Kozo Imahori and Hideo Kasaki (1977) reviewed Japanese species of Charophyte with 4 genera (*Chara, Lamprothamnium, Nitella, Nitellopsis*), 26 species, 42 varieties and 1 subspecies.

With the development and broader application of molecular genetic techniques, the number of investigations increased especially in the late 1990s. McCourt *et al.* (1999) investigated systematic relations between Charophytes by analyzing the chlororplast-encode large subunits of the Rubisco-gene (rbcL) in recent as well as extinct species, whereas Meiers *et al.* (1999) studied the relationships between the subsections of the genus *Chara* by means of small subunit (18S) of the ribosomal DNA gene. McCourt *et al.*, (1999) could prove the monophyletic origin of the tribe Characeae. After that rbcL-based data segeregated *Lamprotamnium* from *Chara* (McCourt *et al.*, 1999), whereas an 18S-rDNA analysis placed *Lamprotamnium* within from *Chara* (Meiers *et al.*, 1999). Furthermore investigation on the intra-species level, either by AFLP (Mannschreck *et al.*, 2002) or by microsatellite analysis (Schaible, 1999), a tool especially valuable for discrimination between ecotypes and morphological acclimination, have become a field of increasing interest. Recently taxonomic reexamination has been done by comparative morphology and multiple DNA marker analysis (Sakayama *et al.*, 2005).

Under these circumstances, it is still necessary to study morphologically species of Charophyte on type methods (McNeil *et al.*, 2006). The specimens of "Characeae Japonicae Exsiccatae (Allen, 1895)" is essential voucher specimens in taxonomy of Charophyte in Japan.

Acknowledgements

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千葉県立中央博物館・藻類標本室（CBM）が保管する日本産シャジクモ科・T. F. Allen（1895）コレクション

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日本産シャジクモ科エキシカータ（T. F. Allen, 1895）を千葉県立中央博物館・藻類標本室（CBM）が保管している．当標本群は，シャジクモ属 1 種 3 変種，フラスコモ属 9 種 1 品種からなる．特に，*Nitella japonica* Allen, *N. orientalis* Allen, *N. pulchella* Allen, *N. psucicostata* Allen そして *N. sublucens* Allen の標本は，日本を基準産地として T. F. Allen が原記載した種の基準標本に準じる証拠標本であり，日本におけるシャジクモ科の分類学的な研究のための重要参照標本である．

Explanation of Plates (1－13)

(habitus with an original label)

Plate 1 : No. 1 *Chara fragilis* Desv.

Plate 2 : No. 2 *Nitella coronata* Ziz.

Plate 3 : No. 3 *Nitella coronata* Ziz.

Plate 4 : No. 4 *Nitella japonica* Allen

Plate 5 : No. 7 *Nitella orientalis* Allen

Plate 6 : No. 8 *Nitella pulchellan* Allen

Plate 7 : No. 9 *Nitella japonica* Allen

Plate 8 : No. 10 *Chara gymnopitys* A.Braun var. *"alpha"* A.Braun

Plate 9 : No. 11 *Chara gymnopitys* A.Braun var. *"alpha"* A.Braun

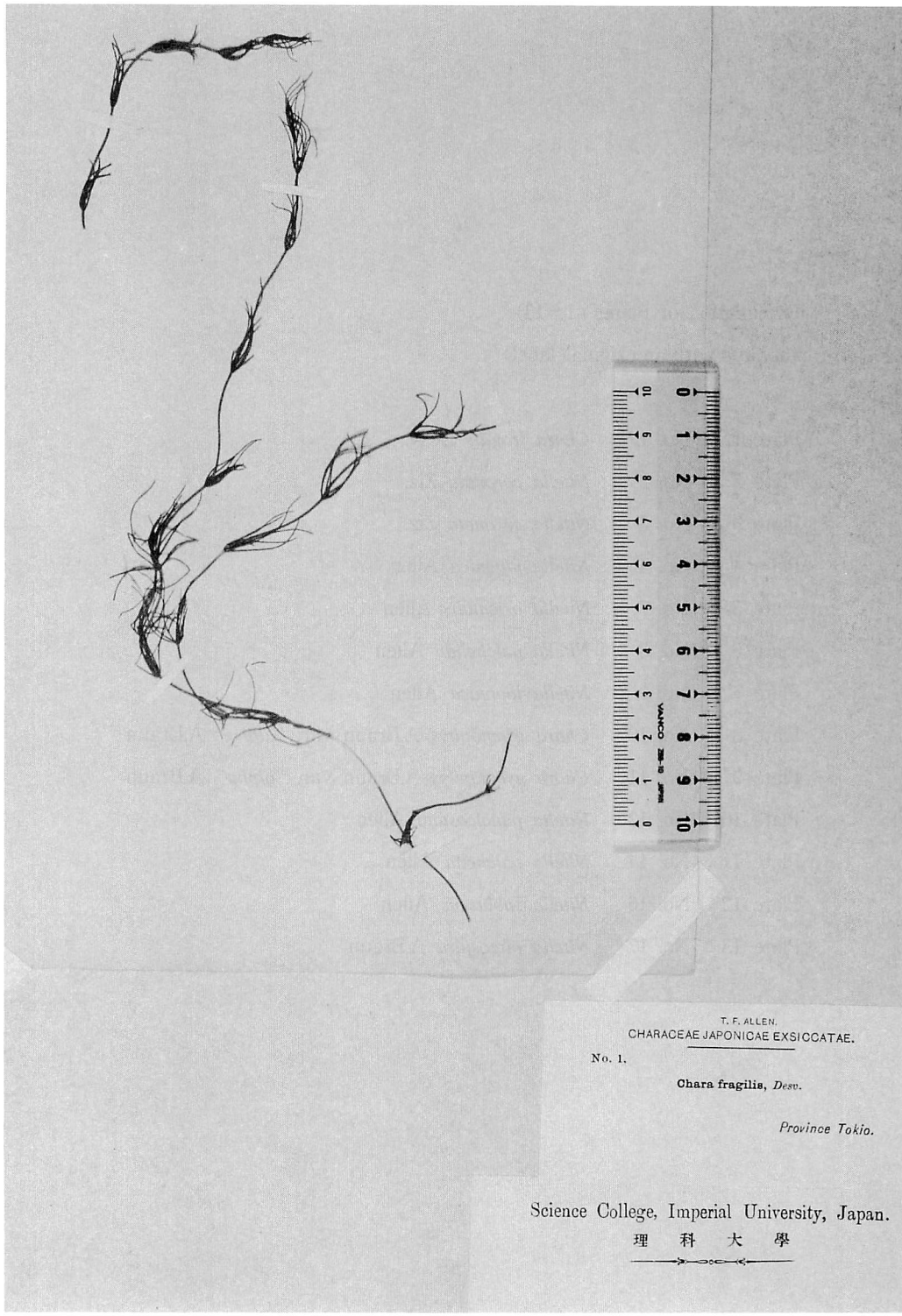
Plate 10 : No. 12 *Nitella paucicostata* Allen

Plate 11 : No. 14 *Nitella pulchella* Allen

Plate 12 : No. 16 *Nitella sublucens* Allen

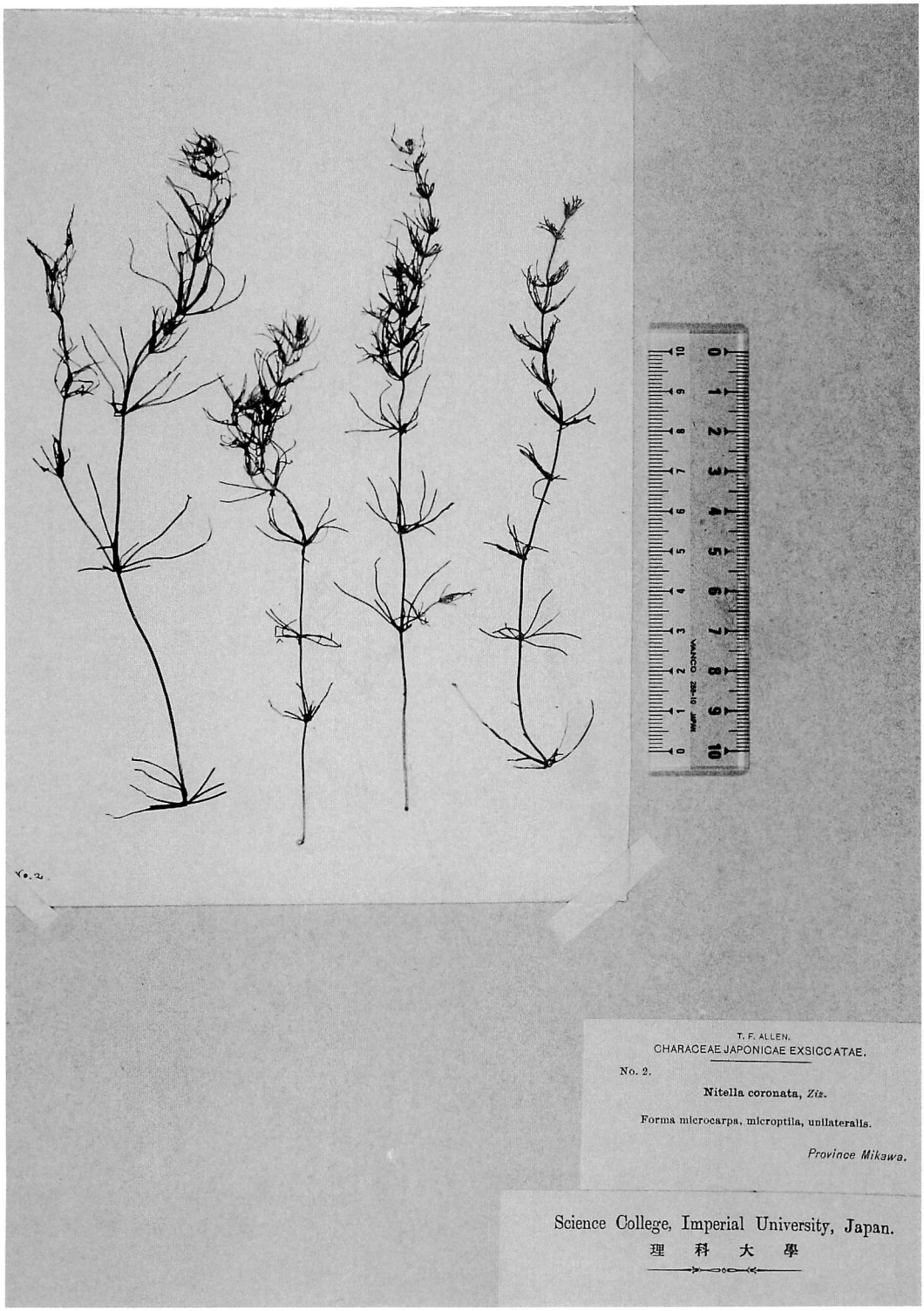
Plate 13 : No. 17 *Nitella oligospira* A.Braun

Plate 1



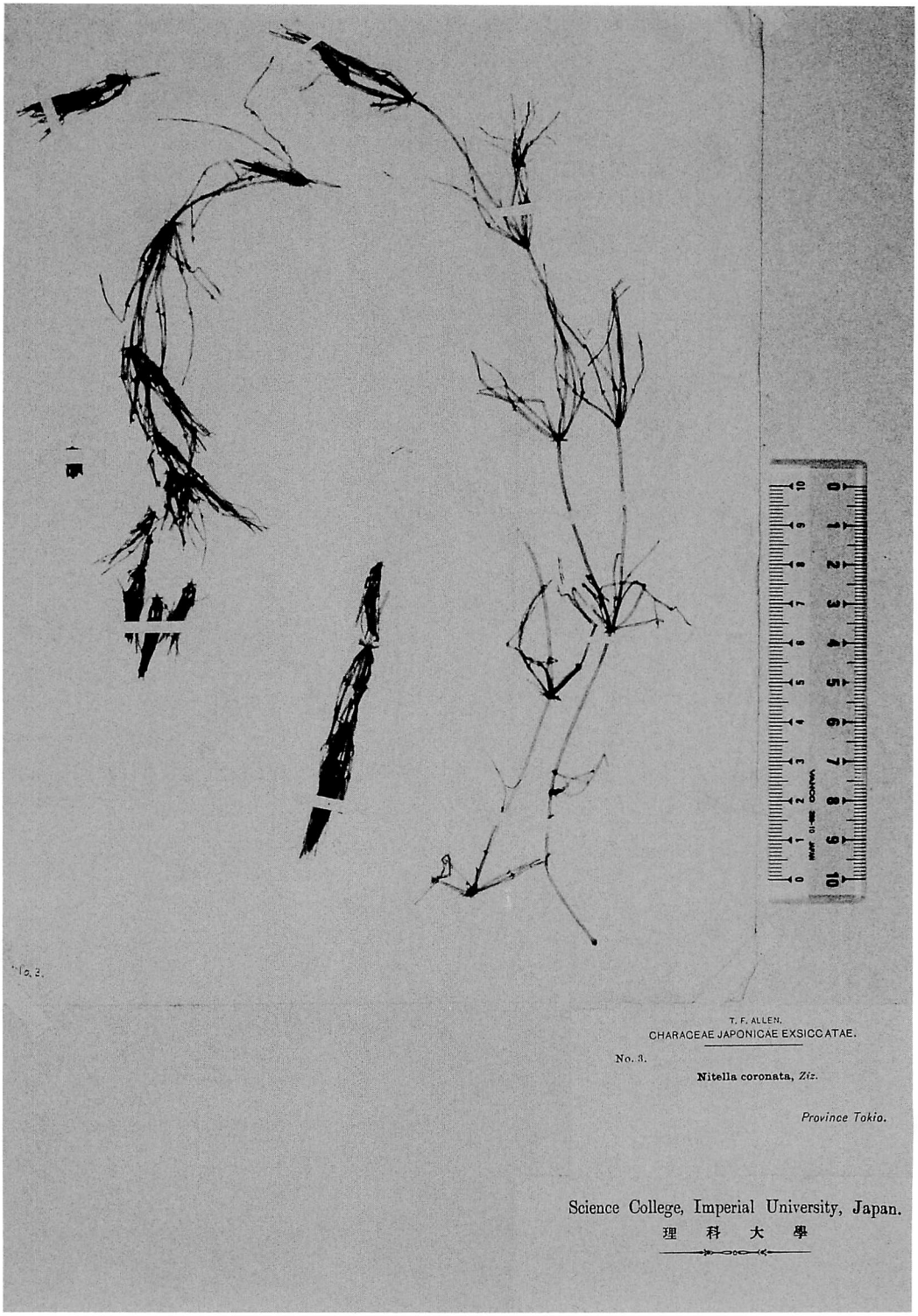
No. 1 *Chara fragilis* Desv.

Plate 2



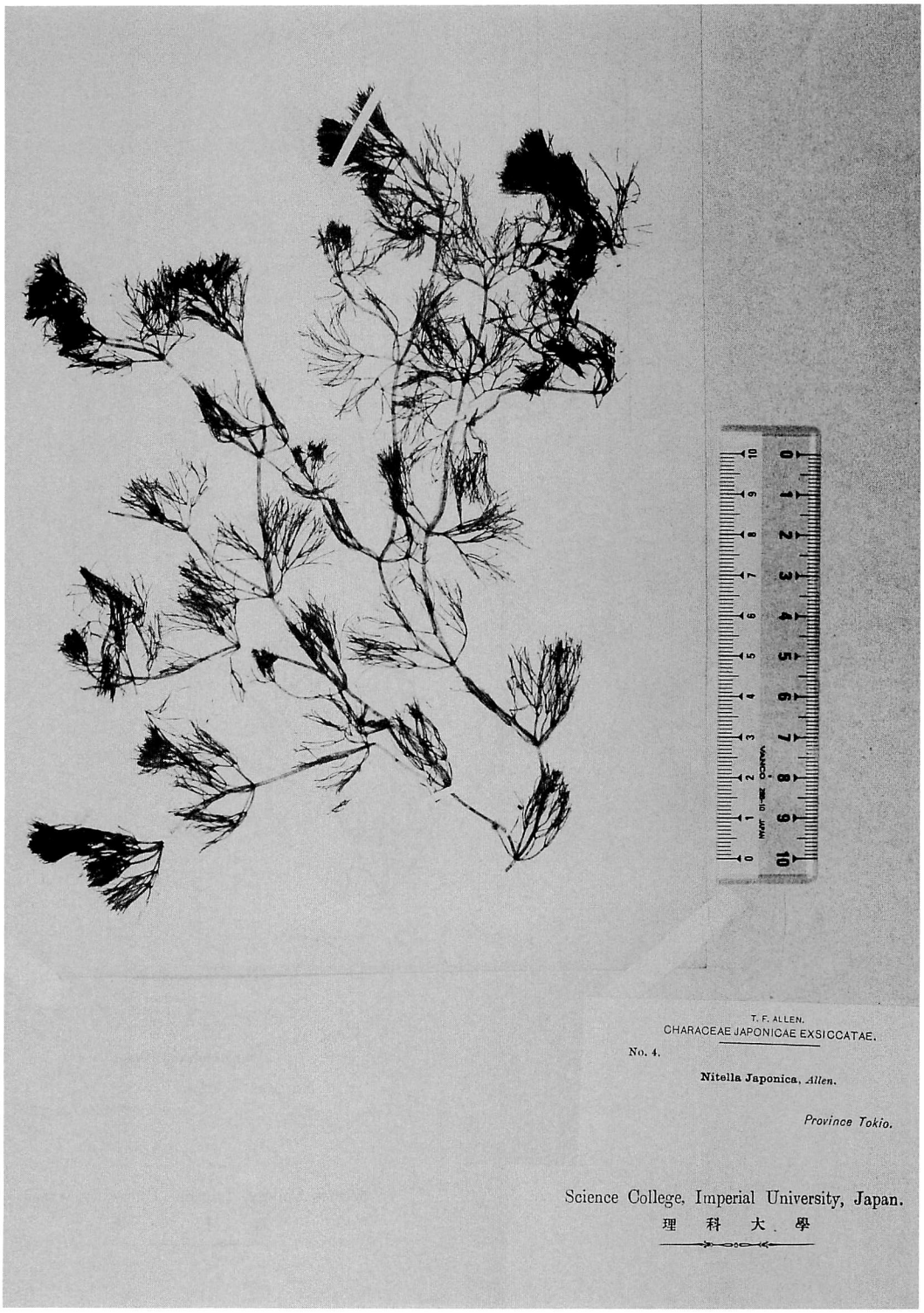
No. 2 *Nitella coronata* Ziz.

Plate 3



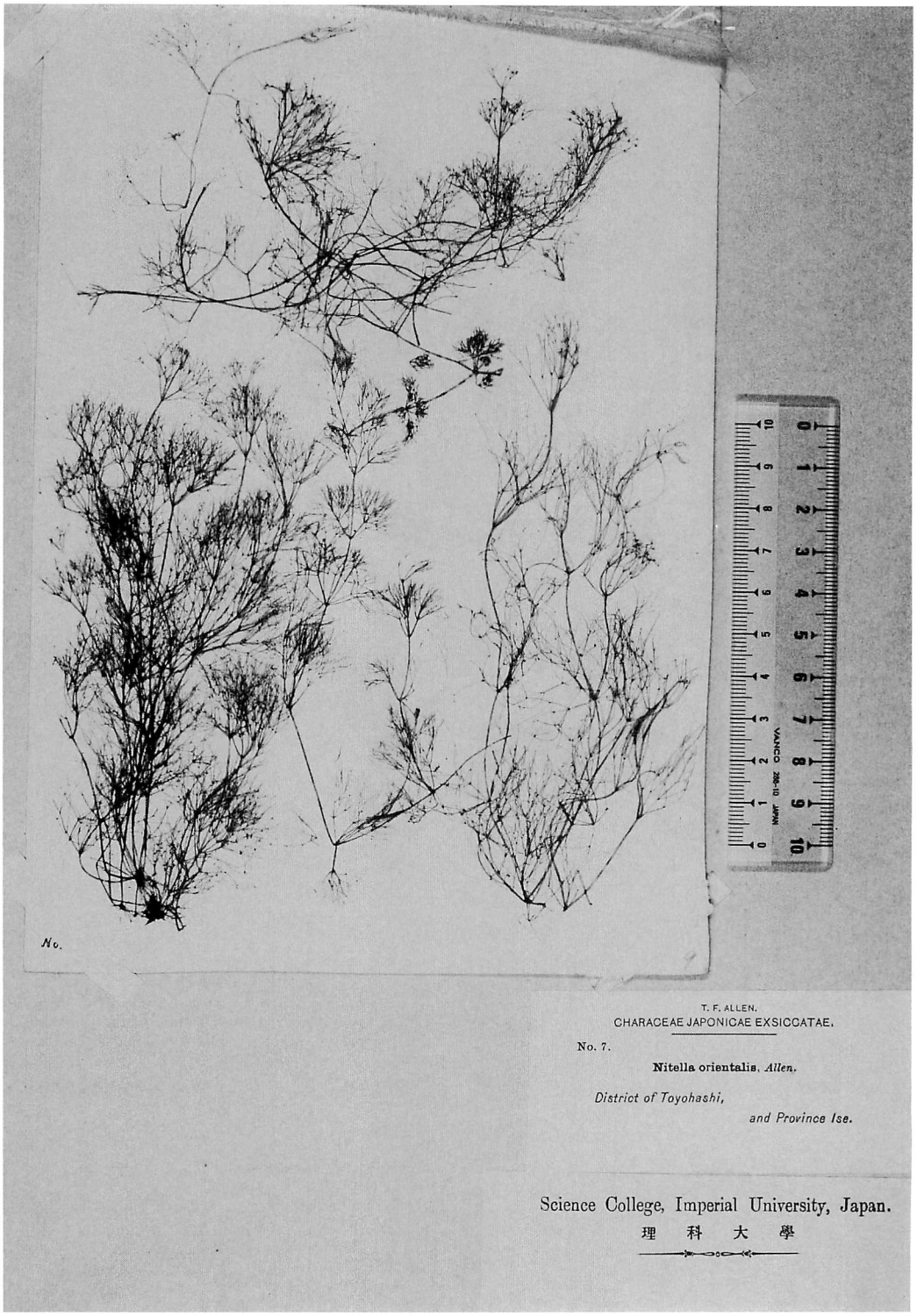
No. 3 *Nitella coronata* Ziz.

Plate 4



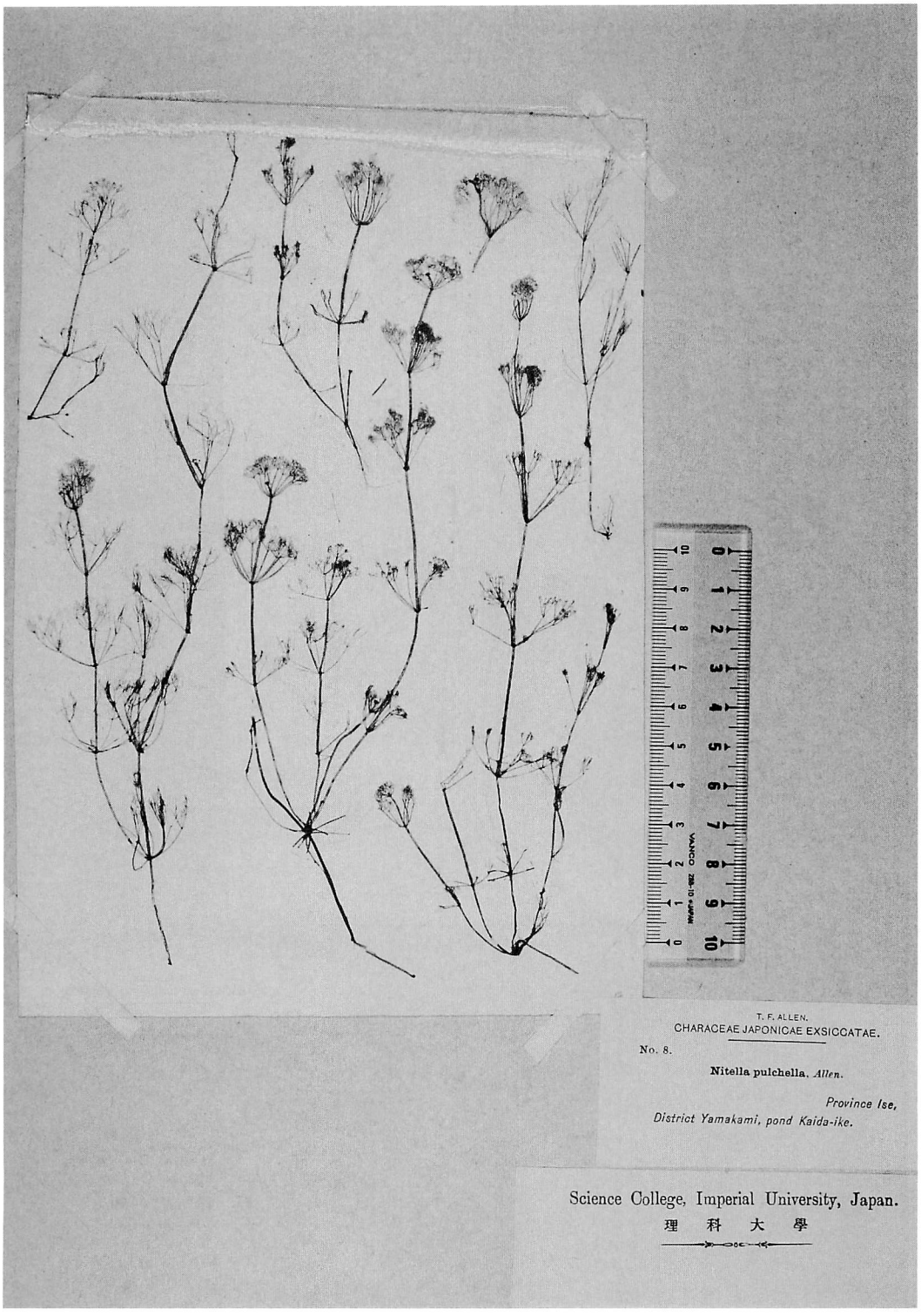
No. 4 *Nitella japonica* Allen

Plate 5



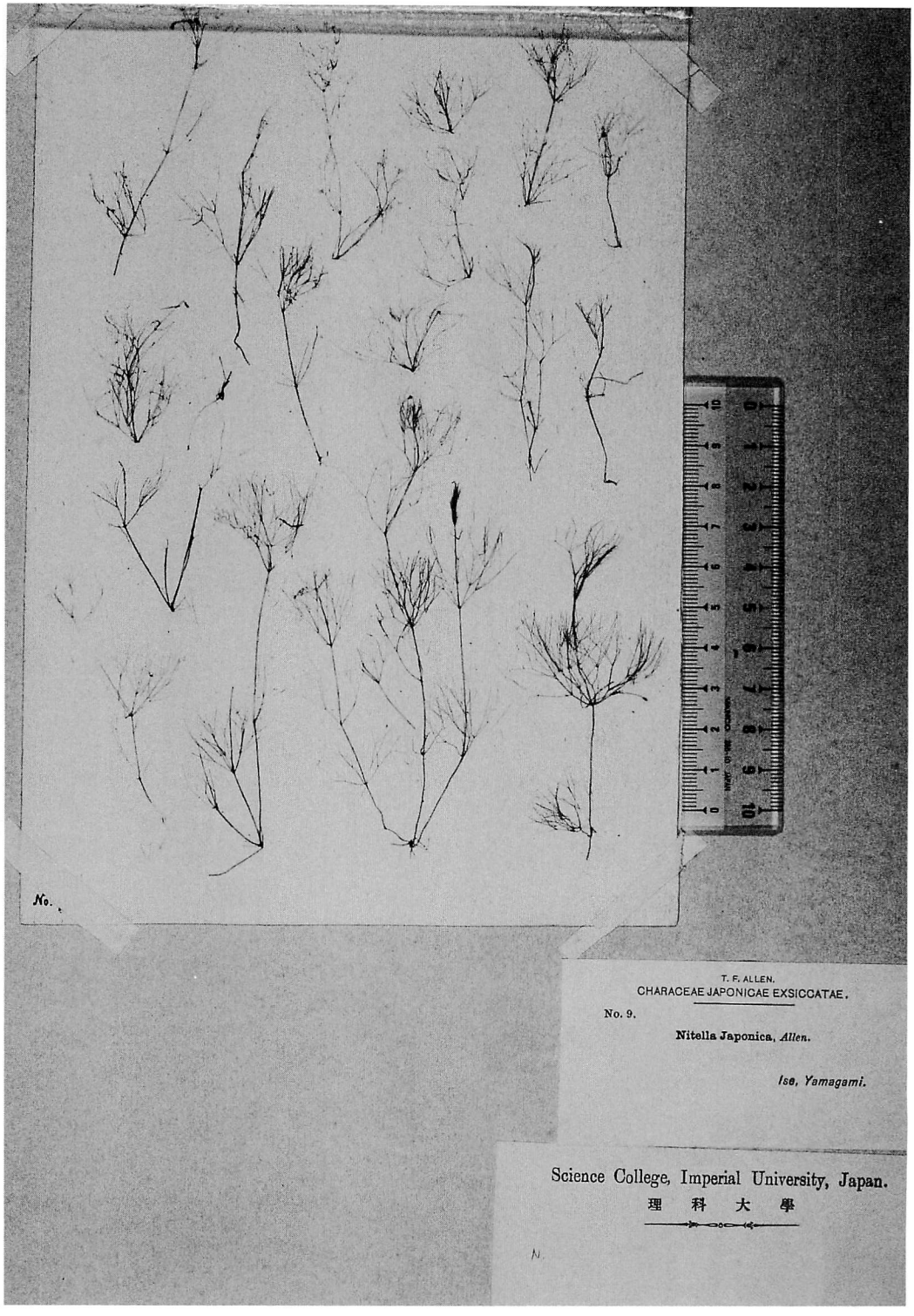
No. 7 *Nitella orientalis* Allen

Plate 6



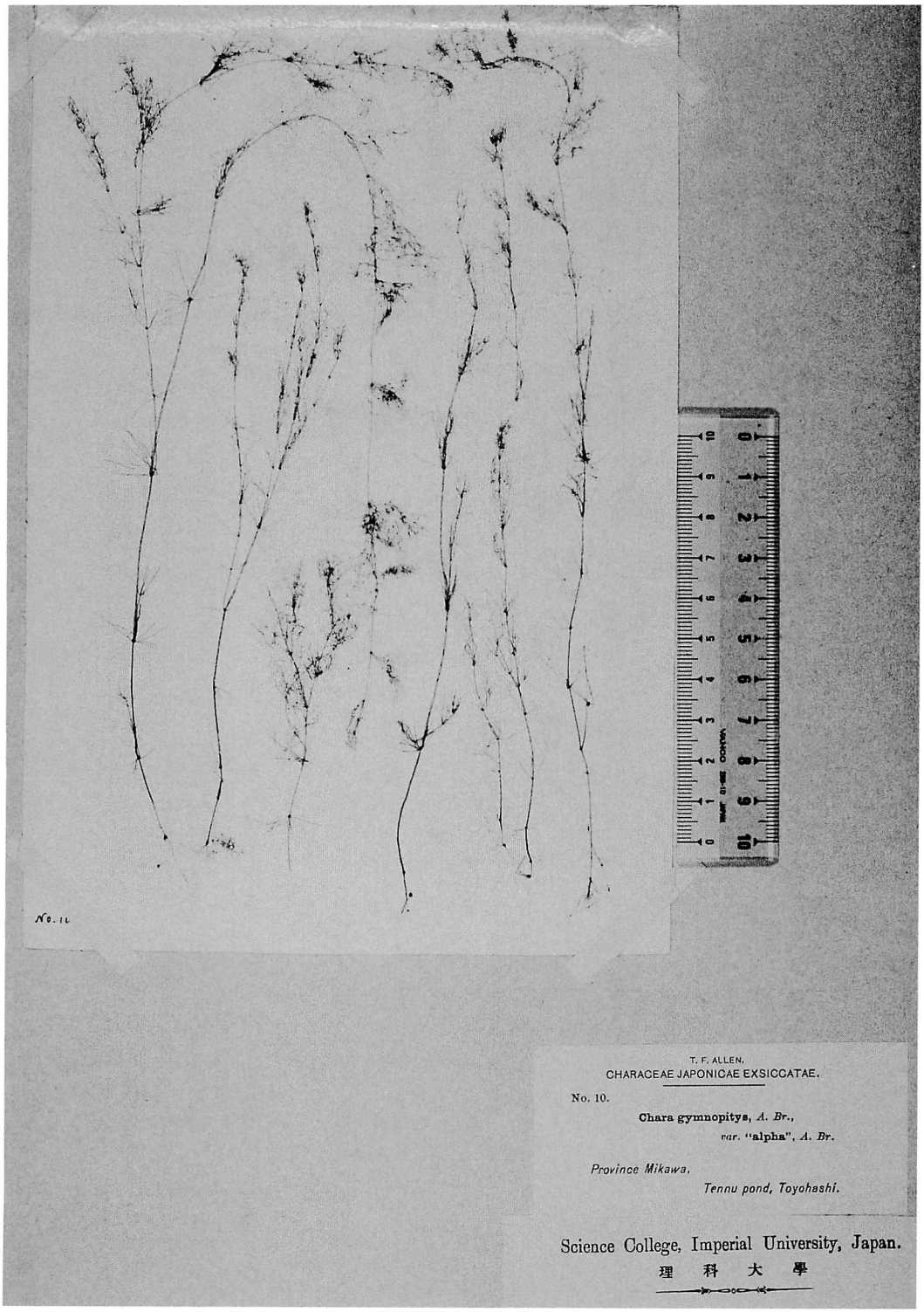
No. 8 *Nitella pulchellan* Allen

Plate 7



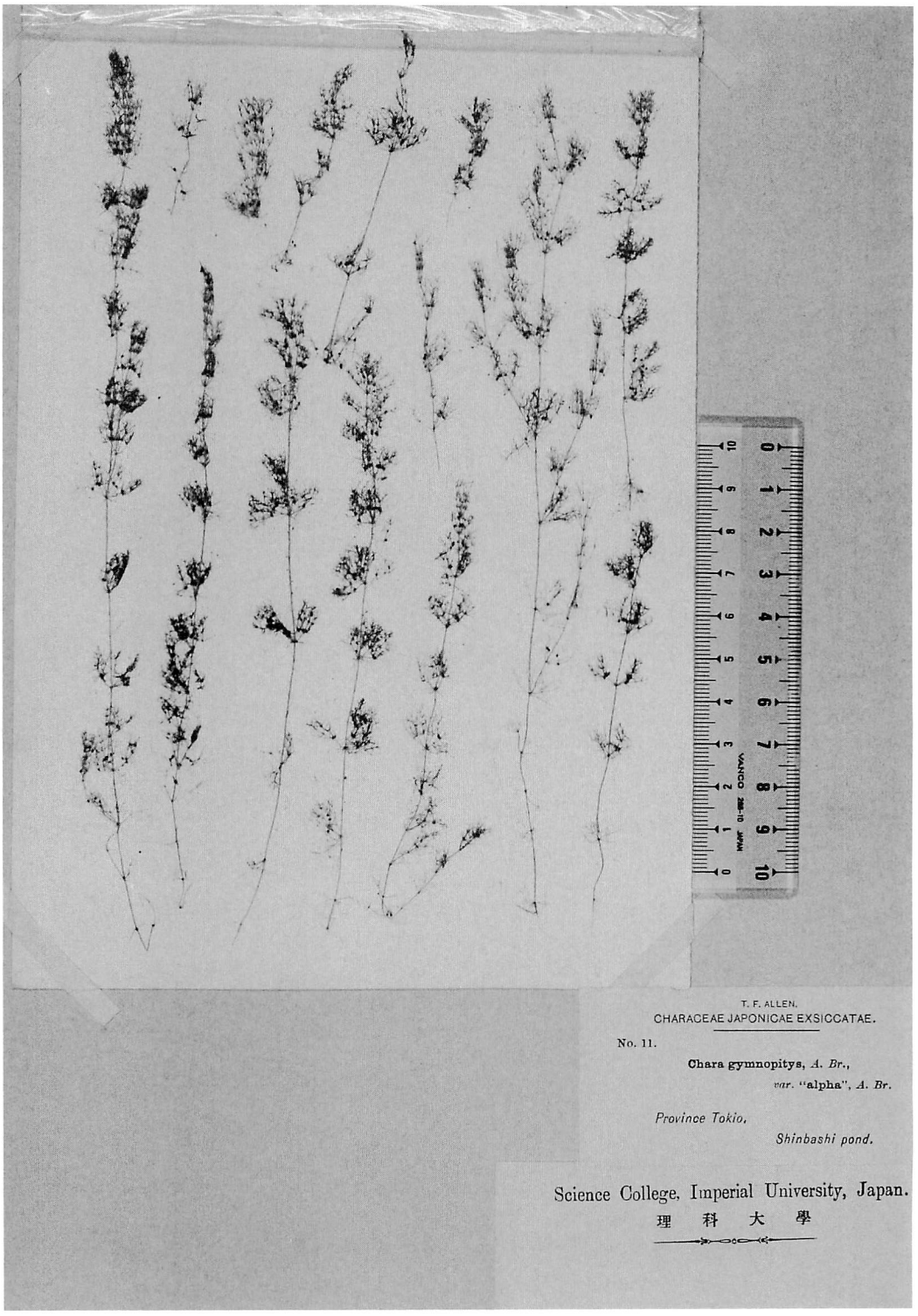
No. 9 *Nitella japonica* Allen

Plate 8



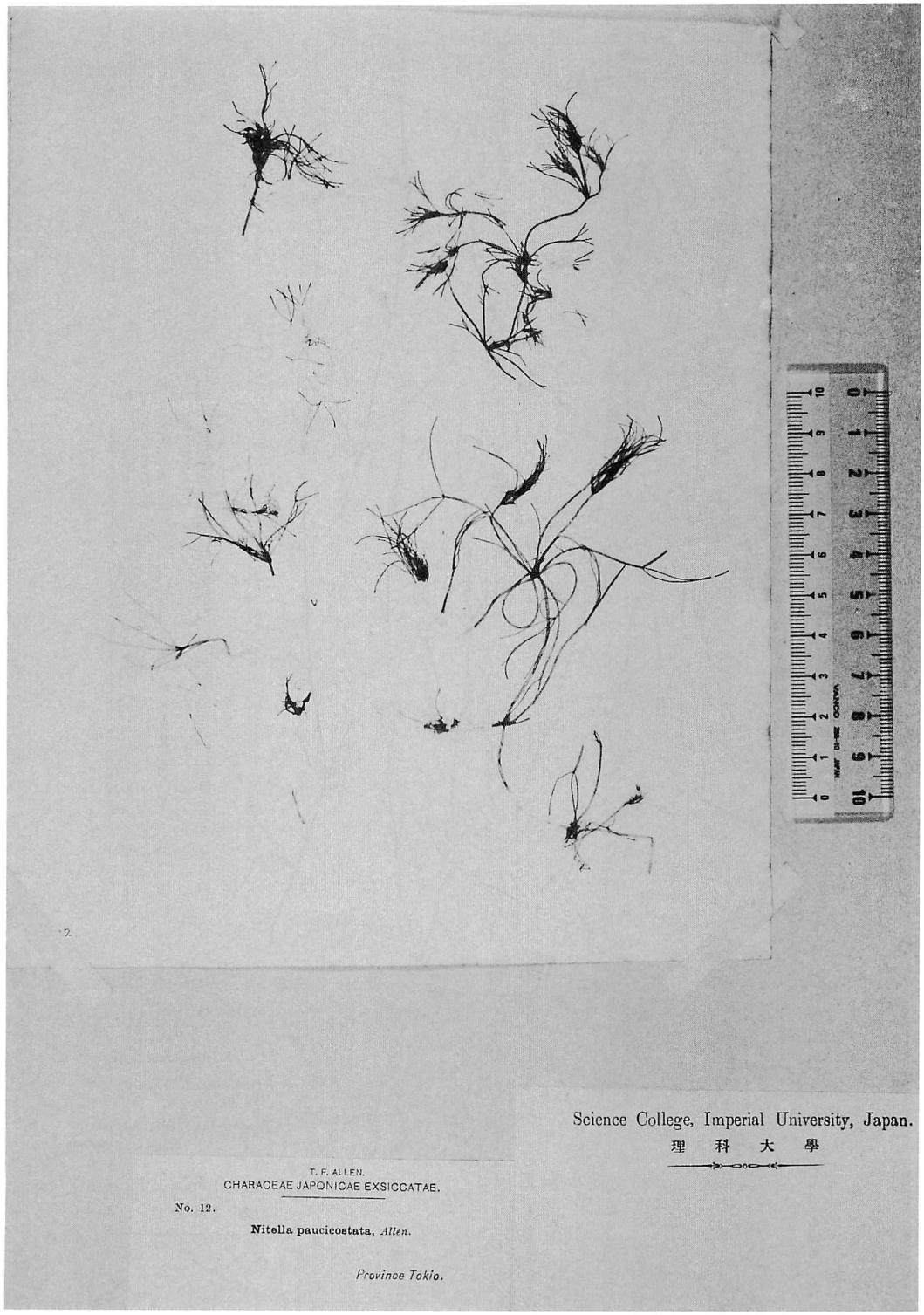
No. 10 *Chara gymnopitys* A.Braun var. "*alpha*" A.Braun

Plate 9



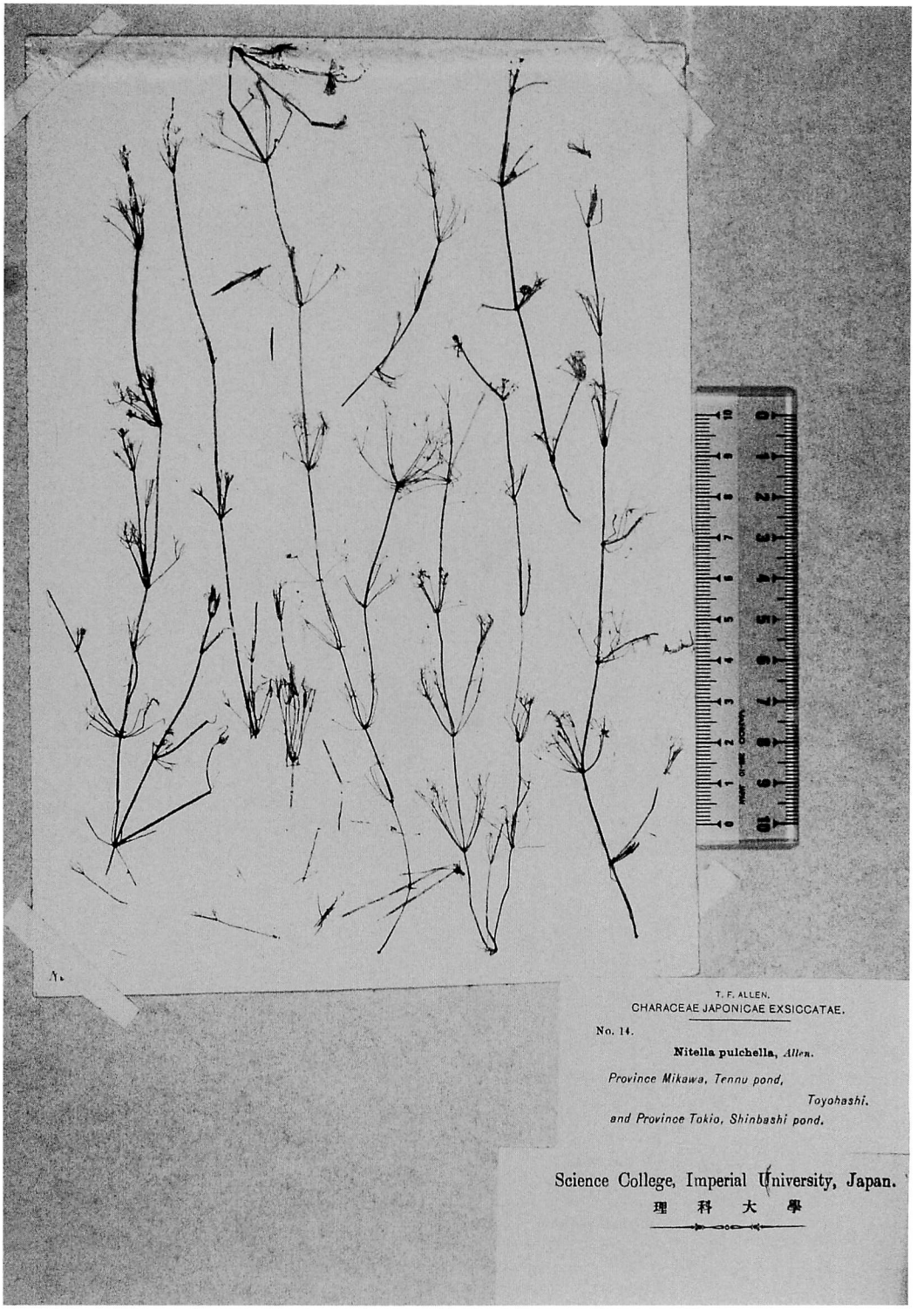
No. 11 *Chara gymnopitys* A.Braun var. "*alpha*" A.Braun

Plate 10



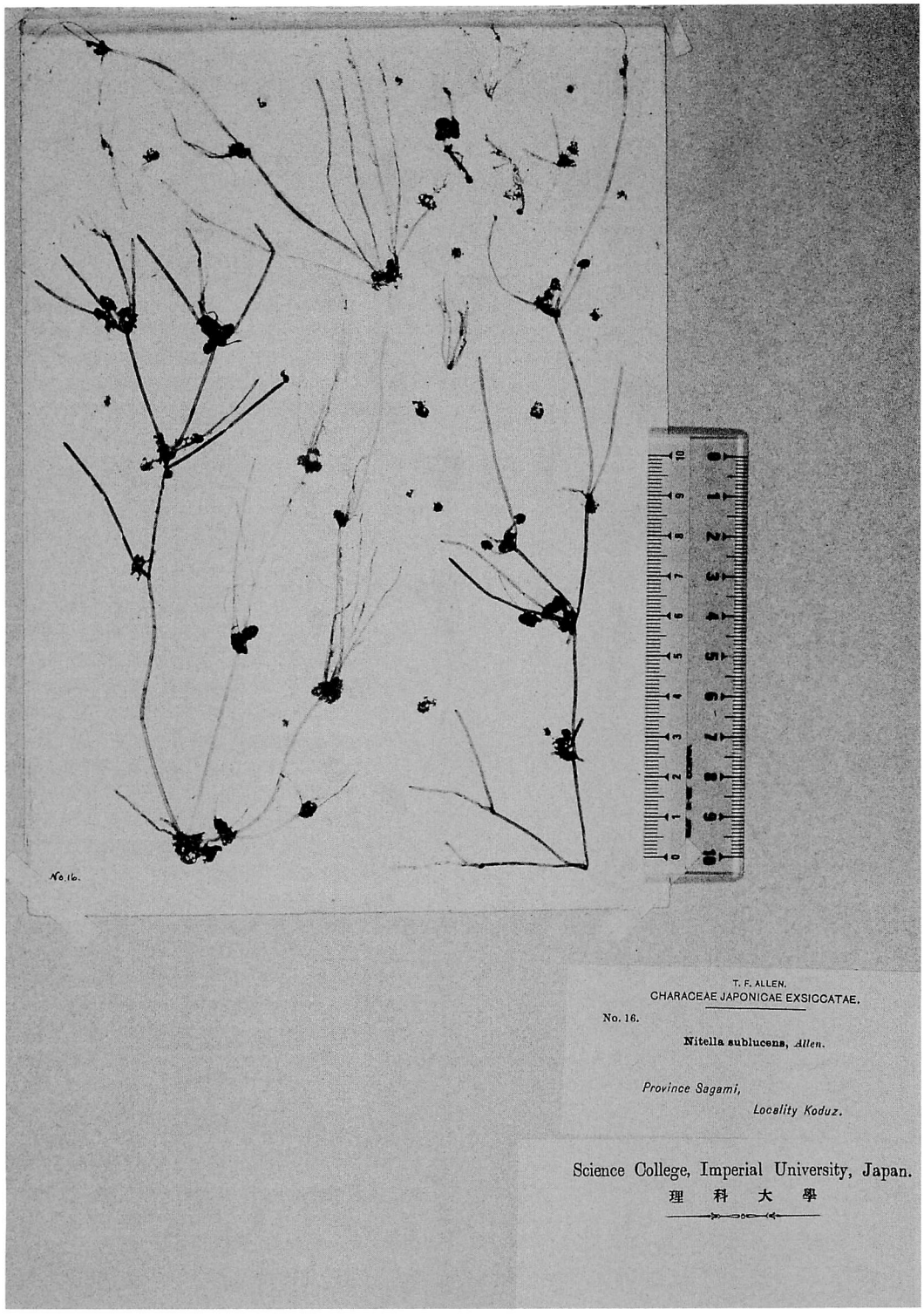
No. 12 *Nitella paucicostata* Allen

Plate 11



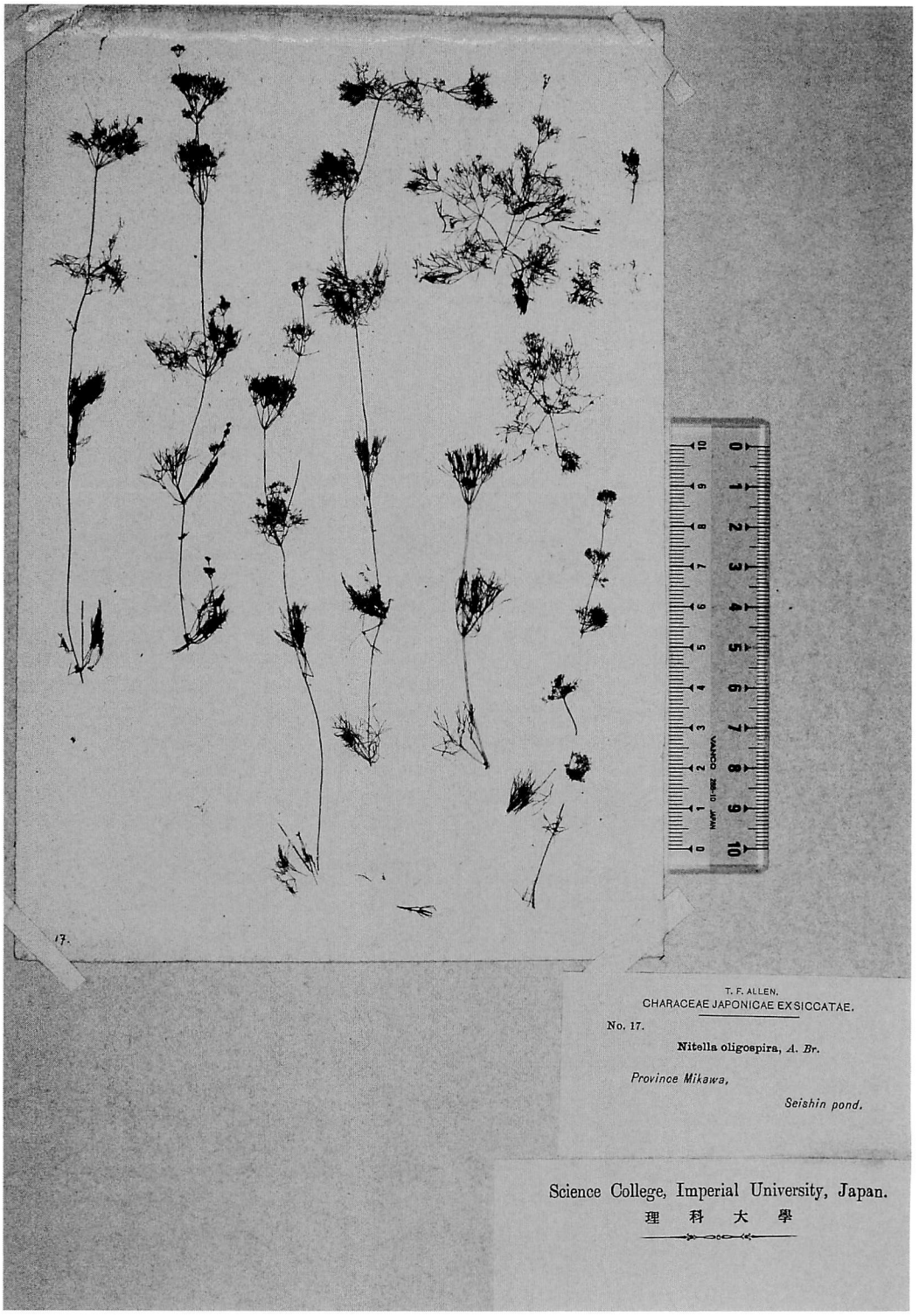
No. 14 *Nitella pulchella* Allen

Plate 12



No. 16 *Nitella sublucens* Allen

Plate 13



No. 17 *Nitella oligospira* A. Braun