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By

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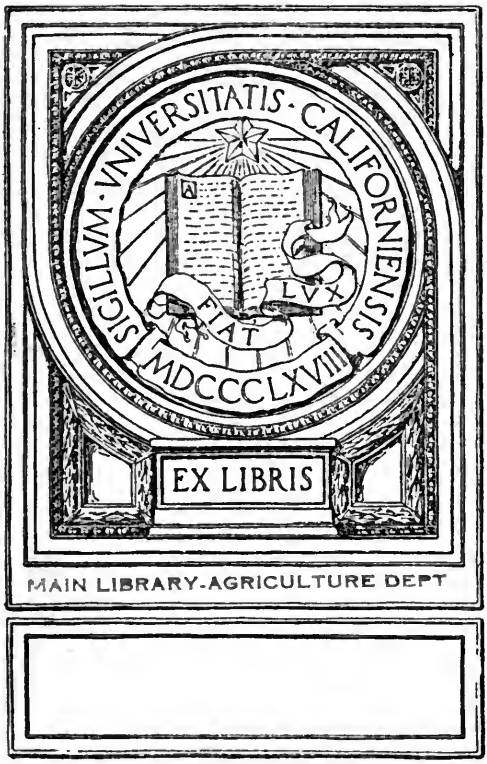


Notes on Some Wild Forms and Species of Tuber-bearing Solanums.

By ARTHUR W. SUTTON, F.L.S., V.M.H.

In 1883, Mr. J. G. Baker, F.R.S., F.L.S., at the suggestion of the late Lord Cathcart, made a study of the various species of tuber-bearing Solanums, the results of which were embodied in a paper presented to the Society on January 17th, 1884.*

Lord Cathcart was interested chiefly in the discovery of some wild species of tuber-bearing *Solanum* which could be utilised for crossing with the commonly cultivated potato, in the hope of obtaining new forms capable of resisting the attacks of potato-disease fungus, *Phytophthora infestans*.

It was concluded that *Solanum Maglia* of Schlechtendahl, generally known as Darwin's potato, afforded the best prospect of success in the direction, since this species does not appear to suffer from the disease in its indigenous habitat in the low-lying swampy soil of the Chonos Archipelago, whereas the ordinary potato is practically destroyed by the fungus on wet soils in damp seasons.

On August 6th, 1886, I obtained tubers of *Solanum Maglia* from a plant growing in the gardens at Kew, the tubers being dug up in the presence of Mr. Baker and myself.

(Plate **1**. Flowers, foliage, &c., of *Solanum Maglia*, Schlecht., drawn from living specimens grown at Reading.)—This species, so far as my experience goes, does not produce fertile seeds when pollinated with its own pollen: although it blooms very freely, the flowers drop off prematurely. Many hundreds of attempts were made to fertilize *Maglia* flowers with the pollen from cultivated potatoes, but in one instance only was a hybrid seedling obtained, the latter being the produce of a cross made in July, 1887.

The hybrid, which has been cultivated continuously during the last 20 years, has smooth tubers nearly white in skin (the tubers of *Solanum Maglia* are a dull, dark purple colour), with leaflets more pointed than those of cultivated potatoes.

In addition to experiments with *Solanum Maglia*, crosses were attempted with *Solanum Jamesii*, but from none of these were seedlings obtained.

Resembling *Solanum Maglia* in its general refusal to set "seed" either when pollinated with its own pollen or with that from other species, is *Solanum Commersonii* of Dunal.

(Plate **2**. *Solanum Commersonii*, Dun., white-flowered form, foliage, flowers, &c.)—Two forms of this species are known; one bearing lilac flowers and corresponding both in this and in all other respects with Dunal's description, and the other very similar to it but bearing white flowers. In both forms the jessamine-like scent of the flowers is very noticeable. Of the violet-flowered form I have had very many tubers collected in a wild state in Uruguay, and Professor Archeavaleta of Montevideo assures me that there is no other form to be found in a wild state

* See Journ. Linn. Soc., Bot. vol. xx. (1886) pp. 489–507.

in Uruguay. There is, however, reason to think that the white-flowered variety was introduced into France from Uruguay by a Colonel Robido in the year 1895. Many attempted pollinations were made with both varieties, but only one weak seedling from each has been obtained.

In 1901 M. Labergerie, of Verrières, Vienne, stated that some of the tubers of *Solanum Commersonii* (white-flowering type), which had been given him in the spring of that year by Professor Heckel of Marseilles, had given rise to a new variety by "sporting" or bud variation. The supposed new plant was named by M. Labergerie "*Solanum Commersonii* 'Violet.'" (Plate **3**. "*Solanum Commersonii* 'Violet,'" Labergerie, foliage, flowers, &c.).

Much controversy has arisen in regard to it, since it differs entirely from *Solanum Commersonii* in the character of its tuber, foliage, flower, and habit of growth, as well as in the form and size of its pollen-grains. On account of the very close resemblance in all its morphological features to the variety of the cultivated potato known on the Continent as Paulsen's "Blue Giant" (Plate **4**. Paulsen's "Blue Giant" Potato, foliage, flowers, &c.), it has been concluded by most investigators who have grown the so-called "sport" and the latter variety side by side in the same soil, that a stray tuber of the "Blue Giant" must have found its way accidentally into the plantations of *Solanum Commersonii* in M. Labergerie's garden.

(Plate **5**. *Solanum Commersonii*, Dun., flowers, tubers, &c. Plate **6**. "*Solanum Commersonii* 'Violet,'" Labergerie, flowers, tubers, &c. Plate **7**. Paulsen's "Blue Giant" Potato, flowers, tubers, &c.)—On reference to Plate **2** it will be noticed that the seed-berries are distinctly cordiform in shape, much more so than is seen in any other tuber-bearing *Solanum*, the usual form of berry in the wild species being round or slightly oval, and in almost all the cultivated potatoes distinctly round. The pollen-grains shown on Plate **2** are entirely regular and elliptical in form. In both these respects true *Solanum Commersonii* differs greatly from the "sport" supposed to have been derived from it, as will be seen on reference to Plate **3**.

A comparison between Plates **5** and **6** will show not only the relative form and size of the tubers in *Solanum Commersonii* and in the presumed sport, but also the fact that the tubers of the former (see Plate **5**), as in the case of nearly all other wild species, are borne at the extremity of long underground stolons, whereas the tubers of the "sport," like all cultivated potatoes, are produced close to the base of the stem. A further comparison between Plates **3** and **4** will show the complete similarity which exists between the pollen-grains of the supposed sport and Paulsen's "Blue Giant," and also between the seed-berries of these two. A comparison of the hairs on the tips of the petals on Plates **5**, **6** and **7** is also suggestive. It will also be seen on comparing Plates **6** and **7** that the tubers of the supposed sport and Paulsen's "Blue Giant" correspond in all respects.

Besides *Solanum Maglia* and *Solanum Commersonii*, I have had the following wild species under observation and experiment at Reading :—

1. Two distinct forms of *Solanum tuberosum* sent me by Mr. Stuart, of the Vermont Experiment Station, U.S.A. One of them, collected in Mexico, Mr. Stuart considered to be a practically unaltered ancestral form of *Solanum tuberosum*.

(Plate **8**. *Solanum tuberosum*, Linn., var.)—The chief points of interest in this plate are :—

(*a*) The regular and elliptical form of pollen-grains.

(*b*) The wheel-shaped corolla, in contrast with the star-shaped corolla of *Solanum Commersonii* (Plate **5**). This wheel-shaped corolla is also seen in *Solanum Maglia* (Plate **1**), in *Solanum etuberosum* (Plate **9**), and almost universally in the cultivated potatoes.

(*c*) The round form of the seed-berry, in contrast with the cordiform seed-berries of *Solanum Commersonii* (Plate **2**).

2. *Solanum polyadenium*, Greenman, also from Mr. Stuart. This species is one of the most distinct of all wild tuber-bearing Solanums with which I am acquainted, the leaves and stems being covered with a dense coat of hairs, and emitting a strong scent somewhat resembling that of Feverfew, *Pyrethrum Parthenium*, Sm.

3. *Solanum verrucosum*, Schlecht.

4. *Solanum tuberosum*, var. *boreale* (=*Solanum Fendleri*, A. Gray), from Arizona. The latter was sent to me by the Rev. J. Aikman Paton, of Castle Kennedy, Scotland.

5. *Solanum etuberosum*, Lindley. (Plate **9**.)

The five last mentioned wild species, except *Solanum etuberosum*, flower freely, and produce fruits containing an abundance of seeds. The plants raised from seed of these wild species (excepting only *Solanum etuberosum*) exhibit no variation whatever from the parents or among themselves, even when the seeds are taken from plants allowed to flower in close proximity to other species. Seedlings, however, of the commonly cultivated potatoes differ very widely from each other, those raised from the seed-berry or fruit generally exhibiting extensive variation in foliage, colour of tuber, and in habit of growth.

I find that the pollen-grains of all these wild species are of one particular shape, namely oval or elliptical, whereas the pollen-grains of all the cultivated potatoes which I have examined are very irregular in form and size, and possibly degenerate. This fact is clearly illustrated on Plate **12**.

One of the forms or species which has proved of great interest, and which on account of its remarkable exemption from disease may become of economic value, is *Solanum etuberosum*, Lindley. This name was given by Lindley in 1834 to a tuberless *Solanum*, which he states was obtained from Chile some years previously by the Horticultural Society. He described it as exceedingly like the ordinary potato, *Solanum tuberosum*, Linn., in all its characters, except that it possesses thickened rhizomes devoid of definite tubers, and the calyx and flower-stalks are smooth instead of hairy.

It may be remarked here that if Lindley's plant of *Solanum etuberosum* produced no tubers, it would have been difficult to propagate it except from seed; and judging by the behaviour of the plants I have experimented with, it is not likely that Lindley's plants reproduced themselves from seed, for two reasons: 1st, that seed-berries are very rarely formed, and 2nd, when formed the seedlings resulting therefrom differ so markedly from the parent stock. It may be suggested that the *Solanum etuberosum* when growing in the wild state, the tubers, of course, not being lifted from year to year and replanted, might produce tubers so small

as to be mistaken for "thickened rhizomes devoid of definite tubers,"—or that possibly the plants which Lindley examined may not have been fully developed, in which case the tubers would not yet have been formed.

The examples of *Solanum etuberosum* which I possess came originally from the Botanic Gardens, Edinburgh, in March, 1887, through Mr. Lindsay, and again from the same stock in 1897 from Dr. Bayley Balfour. They produced at first small tubers about the size of walnuts, and the calyces are hispid; in other respects the plants are similar to the type specimen described by Lindley.

Solanum etuberosum has been grown continuously for more than twenty years in the Trial Grounds at Reading. During that time no variation has occurred in the characters of the foliage or flowers of the plants. The tubers have also retained their original form and colour with the exception of an increase in size.

Up to 1906 the plants had never been seen to bear fruits, but in that year a single berry was found in the centre of the plantation and allowed to ripen. Whether this was the product of self-fertilization or the result of a cross with some other *Solanum* growing near, it is impossible to say.

The seeds taken from this fruit were sown, and during the past season (1907) twenty young plants were raised. None of these resemble the parent form very closely, but they exhibit the same variation that is met with among seedlings of the cultivated potato.

The tubers of the parent *Solanum etuberosum* are white in the skin and flesh, and after twenty years of garden culture average about $1\frac{1}{2}$ inches in diameter. Those of the seedlings, however, vary very much in size, some being already as large as cultivated potatoes: they are also very varied in colour of skin, some being white, others dark purple, pale blue, or rose-white; one seedling has given tubers the flesh of which is deep purple and the skin almost black, characters which are met with in some of the cultivated varieties now growing in Chile.

The pollen-grains of the parent are elliptical like those of all wild species, and the seed-berries are round or slightly oval, but are covered somewhat closely with distinct white spots, in which they differ from the fruits of all other wild types.

(Plate **10**. *Solanum etuberosum*, Lindl.—White-flowered seedling.)—I was only able to examine the pollen-grains of one of the twenty seedlings above referred to, and that happened to be a plant bearing white flowers. In this case the pollen-grains were regular and elliptical, and entirely similar in form to those of the parent.

N.B.—In order to avoid any doubt as to the parentage of the seedlings above described, several different blooms of *Solanum etuberosum* were artificially self-pollinated under controlled conditions in 1907. Ripe fruits were obtained from several flowers. Seedlings raised from these in 1908 exhibit the same variability in character of foliage and colour of the flowers as those obtained from the single berry collected in 1906, the male parent of which was uncertain, and they vary also in the form and colour of tuber.

Some of the plants raised from the same berry have white flowers, others lilac-coloured blooms.

The pollen-grains of the white-flowered plants of 1908, like the one white-flowering plant of 1907 already alluded to, are elliptical like those of the lilac-flowered parent, while those of the lilac-flowered seedling are irregular and polygonal in form, corresponding closely in these respects with pollen-grains of the cultivated potatoes. These are illustrated in Plate **12**, and on Plate **11** is figured one of the lilac-flowered seedlings raised by selfing flowers of *Solanum etuberosum* in 1907, with drawings of its irregular pollen-grains.

From the uniform character and shape of its pollen-grains, it would appear that *Solanum etuberosum* is a primitive specific form, since it agrees in this respect with admittedly wild species of tuber-bearing Solanums. Moreover, in the great variability of its seedlings it closely resembles the cultivated potato. These facts, I think, point to the conclusion that Lindley's *Solanum etuberosum* may probably be the parent form of the cultivated potato of to-day.

EXPLANATION OF THE PLATES.

The figures on the Plates were all drawn from specimens growing in the Reading Trial Grounds.

Plate 1.

Solanum Maglia, Schlecht.

A. Inflorescence and upper leaves, $\frac{1}{2}$.
B. Flower showing anthers, × 2.
C. Flower showing calyx, × 2.
D. Flower, side view × 2, showing cleft stigma.
E. Flower section, × 2, showing cleft stigma.
F, G, H. Cymes with flowers removed, $\frac{1}{2}$.
J. Largest leaf on examples examined, $\frac{1}{2}$.
K. Pollen, × 300.

Plate 2.

Solanum Commersonii, Dun. (White-flowered form.)

A. Inflorescence and upper leaves, large lower leaf behind, $\frac{1}{2}$.
B. Cymes with flowers removed, $\frac{1}{2}$.
C. Flower-bud, × 2.
D. Hairs from tips of petals, × 50.
E. Hairs from limb of corolla, × 50.
F. Pollen, × 300.
G. Self-fertilized berries, $\frac{1}{2}$.
H. Seed, × 2.
J. Cross-fertilized berries, $\frac{1}{2}$.
K. Sections of do., $\frac{1}{1}$.
L. Seed, × 2.

Plate 3.

"*Solanum Commersonii* 'Violet,'" Labergerie.

A. Inflorescence and upper leaves, large lower leaf behind, $\frac{1}{2}$.
B. Cyme with flowers removed, $\frac{1}{2}$.
C. Hairs from tips of petals, × 50.
D. Hairs from limb of corolla, × 50.
E. Pollen, × 300.
F. Berry, $\frac{1}{2}$.
G. Section of berry, $\frac{1}{1}$.
H. Seed, × 2.

Plate 4.

Paulsen's "Blue Giant" Potato.

A. Inflorescence and upper leaves, large lower leaf behind, $\frac{1}{2}$.
B. Cyme with flowers removed, $\frac{1}{2}$.
C. Hairs from tips of petals, × 50.
D. Hairs from limb of corolla, × 50.
E. Pollen, × 300.
F. Berry, $\frac{1}{2}$.
G. Section of berry, $\frac{1}{1}$.
H. Seed, × 2.

PLATE 5.

Solanum Commersonii, Dun. (White-flowered form.)

A. Flower from above, showing anthers, × 2.
B. Flower from below, showing calyx, × 2.
C. Flower, side view, part of corolla removed, × 2.
D. Flower section, × 2.
E, F, G. Tubers, ½.
H. Stolon cut at ++ showing distance from plant at which tubers are produced, ½.
J. Section of stolon at K, ¼.
K. Point of section shown at J.
L. External cells of tuber, × 60.

PLATE 6.

"*Solanum Commersonii* 'Violet,'" Labergerie.

A. Flower from above, showing anthers, × 2.
B. Flower from below, showing calyx, × 2.
C. Flower, side view, part of corolla removed, × 2.
D. Section of flower, × 2.
E, F, G. Tubers, ½.
H. External cells of tuber, × 60.

PLATE 7.

Paulsen's "Blue Giant" Potato.

A. Flower from above, showing anthers, × 2.
B. Flower from below, showing calyx, × 2.
C. Flower, side view, part of corolla removed, × 2.
D. Section of flower, × 2.
E, F, G. Tubers, ½.
H. External cells of tuber, × 60.

PLATE 8.

Solanum tuberosum, Linn., var.

A. Inflorescence and upper leaves, ½.
B. Flower showing anthers, × 2.
C. Flower showing calyx, × 2.
D. Flower, side view, × 2.
E. Flower section, × 2.
F. Pollen, × 300.
G. Cyme with berries, ½.
H. Berry, vertical and horizontal sections, ½.
J. Tubers, ½.

PLATE 9.

Solanum etuberosum, Lindl.

A. Inflorescence and upper leaves with large lower leaf, ½.
B. Flower showing anthers, × 2.
C. Flower showing calyx, × 2.
D. Flower, side view, × 2.
E. Flower section, × 2.
F. Bud, × 2.
G. Bud, × 2.
H. Berry, ½.
H¹. } White-spotted berries, ½.
H². }
J. Berry section, ½.
K. Pollen, × 300.
LL. Tubers, ½.

PLATE 10.

Solanum etuberosum, Lindl. (White-flowered Seedling.)

A. Inflorescence and upper leaves, large lower leaf behind, ½.
B. Flower showing anthers, × 2.
C. Flower showing calyx, × 2.
D. Flower, side view, × 2.
E. Flower section, × 2.
F. Cyme, with flowers removed, ½.
G. Pollen, × 300.

Plate 11.

Solanum etuberosum, Lindl. (Lilac-flowered Seedling.)

A. Inflorescence and upper leaves, $\frac{1}{2}$.
B. Flower showing anthers, × 2.
C. Flower showing calyx, × 2.
D. Flower, side view, × 2.
E. Flower section, × 2.
F, G, H. Cymes with flowers removed, $\frac{1}{2}$.
J. Pollen, × 300.

Plate 12.

Pollen of various Species of *Solanum*.

A, B, C. Figures representing the pollen-grains of *Solanum verrucosum*, *Solanum polyadenium*, and *Solanum tuberosum* respectively, each × 300. Although varying somewhat in size, the form in each case is regular and elliptical, and is typical of the pollen-grains of all the wild types I have examined.

D, E, F. Representing the pollen-grains of the cultivated potatoes "Up to Date," "Maincrop," and "Discovery" respectively, each × 300. There is little if any difference in the size of these three groups of pollen-grains, and in each case the form is irregular and polygonal, and thus typical of the pollen of all the cultivated potatoes I have examined.

G. Pollen-grains of *Solanum etuberosum*, × 300.

H. Pollen-grains of a seedling plant bearing white flowers raised from a berry produced in 1906. The form of pollen-grains still remains regular and elliptical. × 300.

I. Pollen-grains of a seedling plant bearing white flowers raised from a berry produced in 1907. The form of pollen-grains still remains regular and elliptical. × 300.

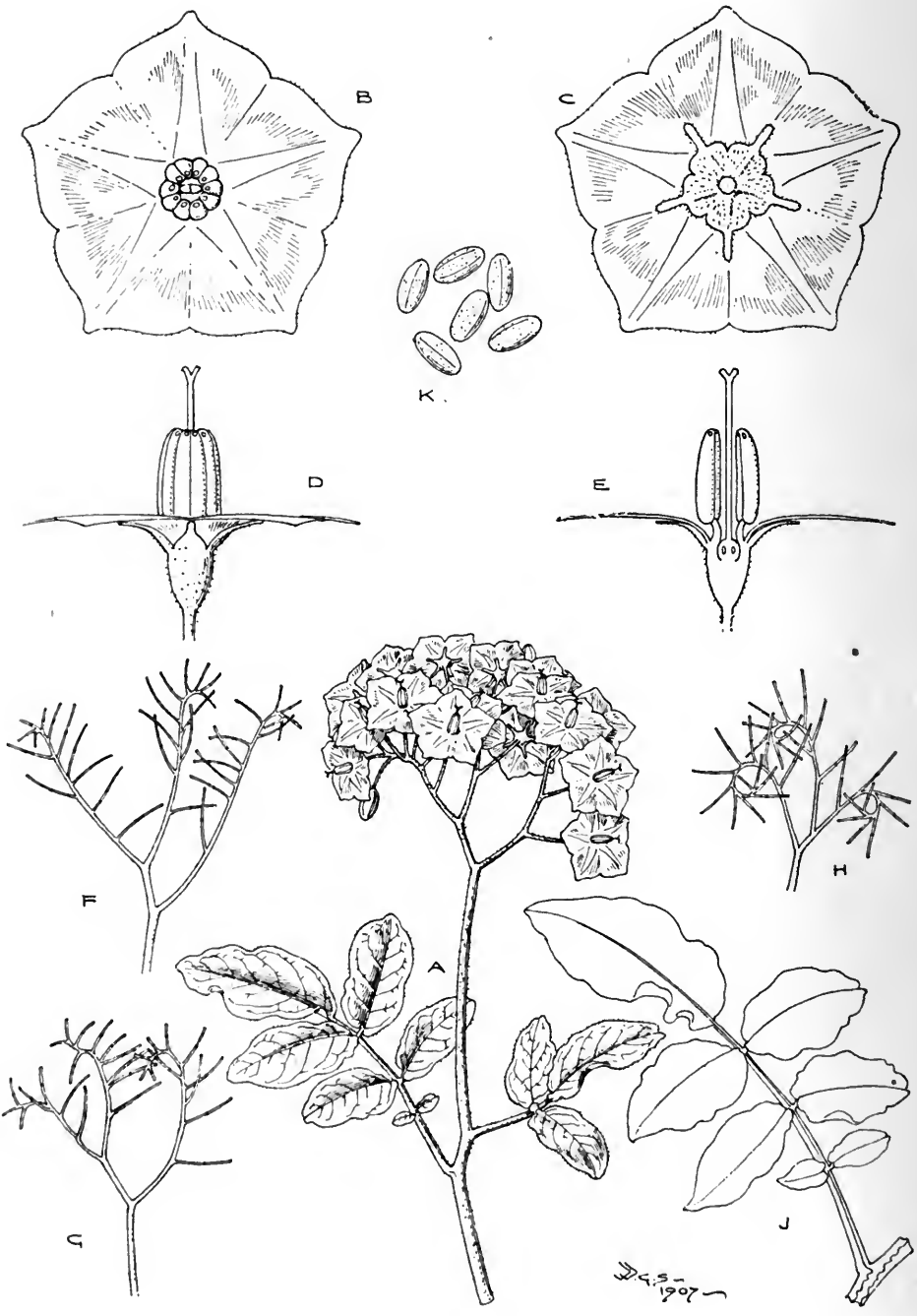
J, K, L. Pollen-grains of three seedling plants raised from berries produced in 1907, each bearing lilac flowers. The form of pollen-grains in each case is irregular and polygonal, corresponding to that of the cultivated potatoes. × 300.

All pollen-grains shown in I, J, K, and L, were in each case from the flowers artificially selfed under controlled conditions.

The seedling plants which gave the pollen-grains shown in I and J were raised from the same seed-berry.

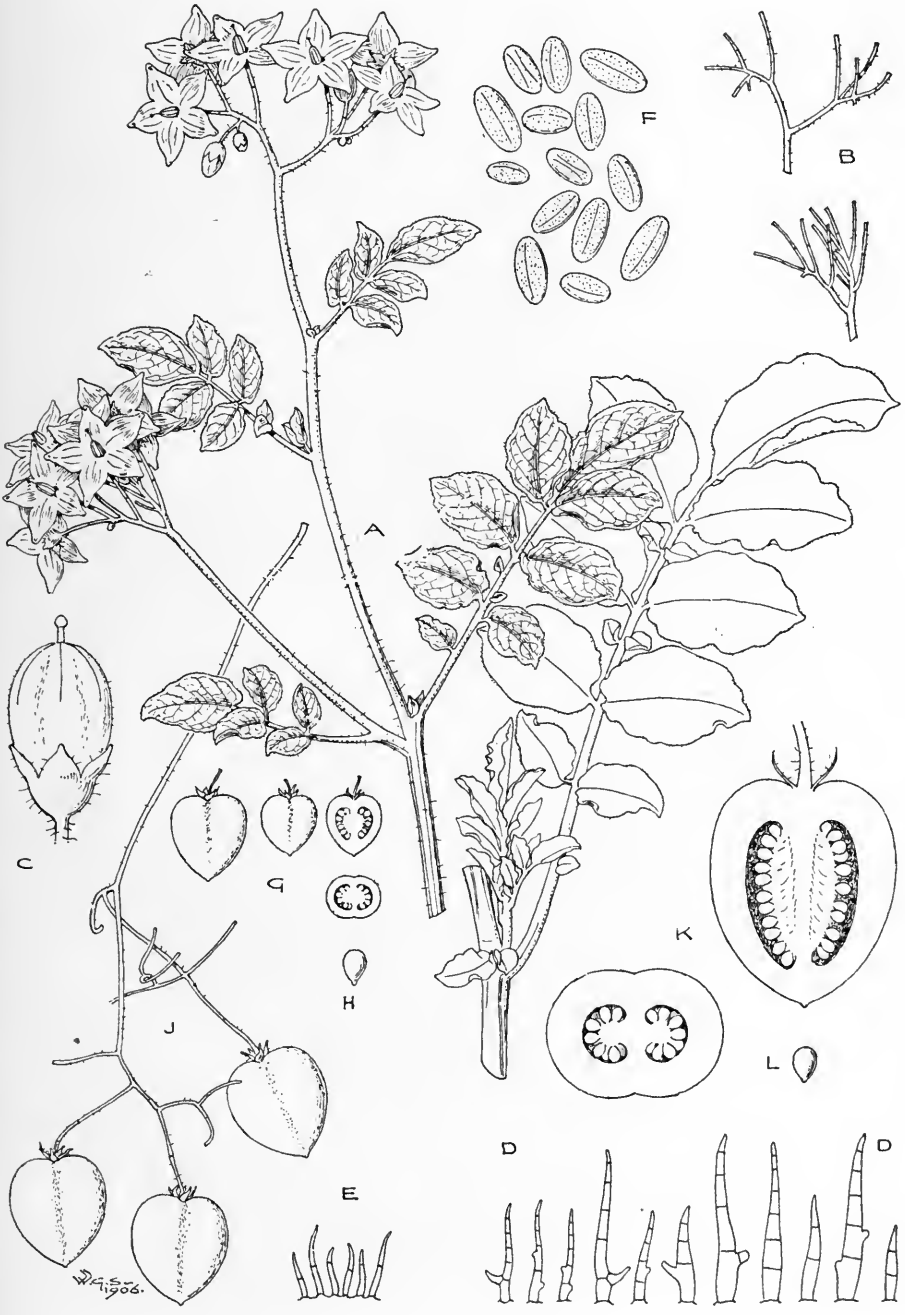
N.B.—The figures of pollen-grains in this Plate, and of those also shown in the preceding Plates, were drawn when the pollen-grains were dry.

PLATE 1.



SOLANUM MAGLIA, Schlecht.

PLATE 2.



SOLANUM COMMERSONII, Dun. (White-flowered form).

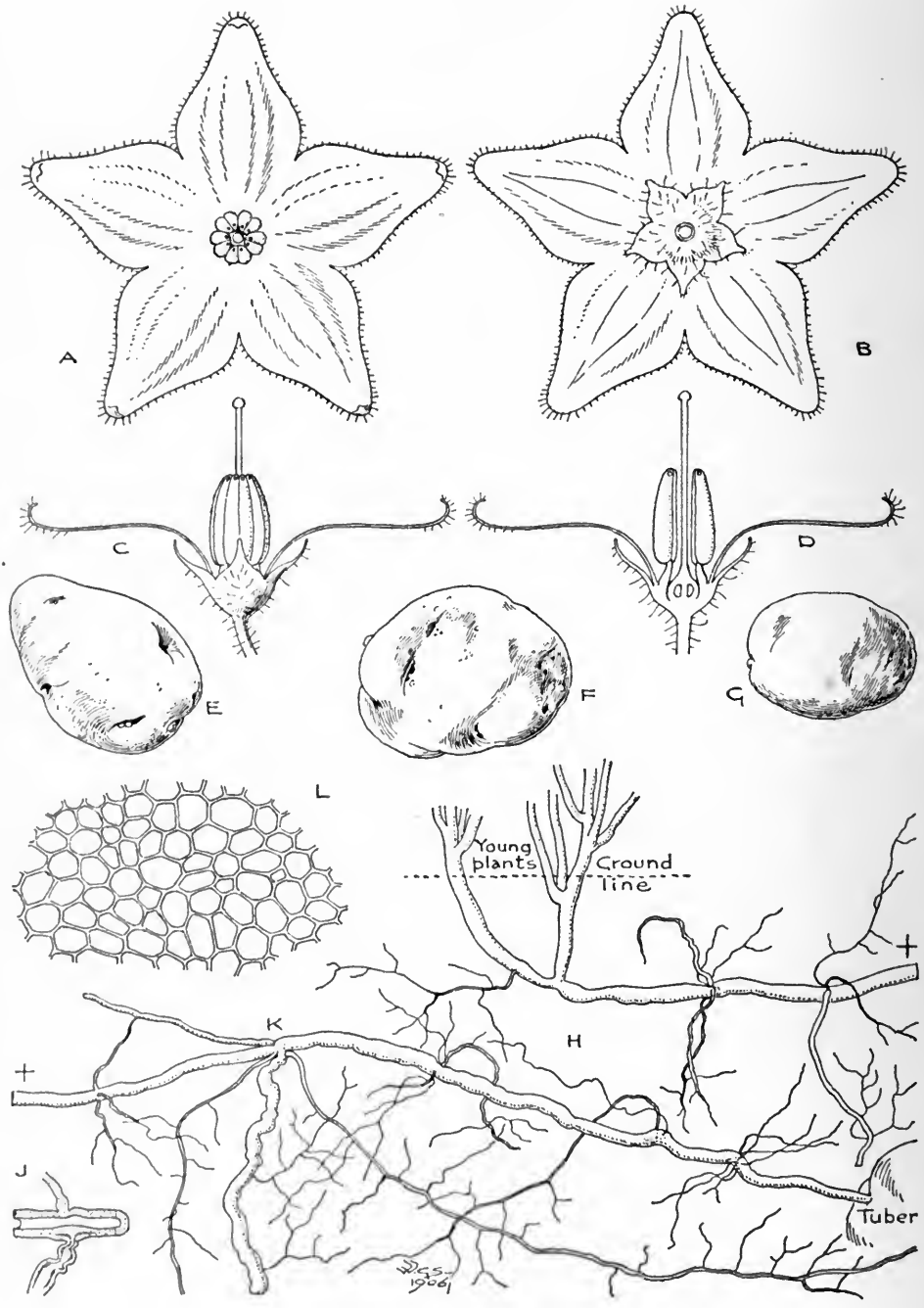
PLATE 3.

"SOLANUM COMMERSONII 'Violet'", Labergerie.

PLATE 4.

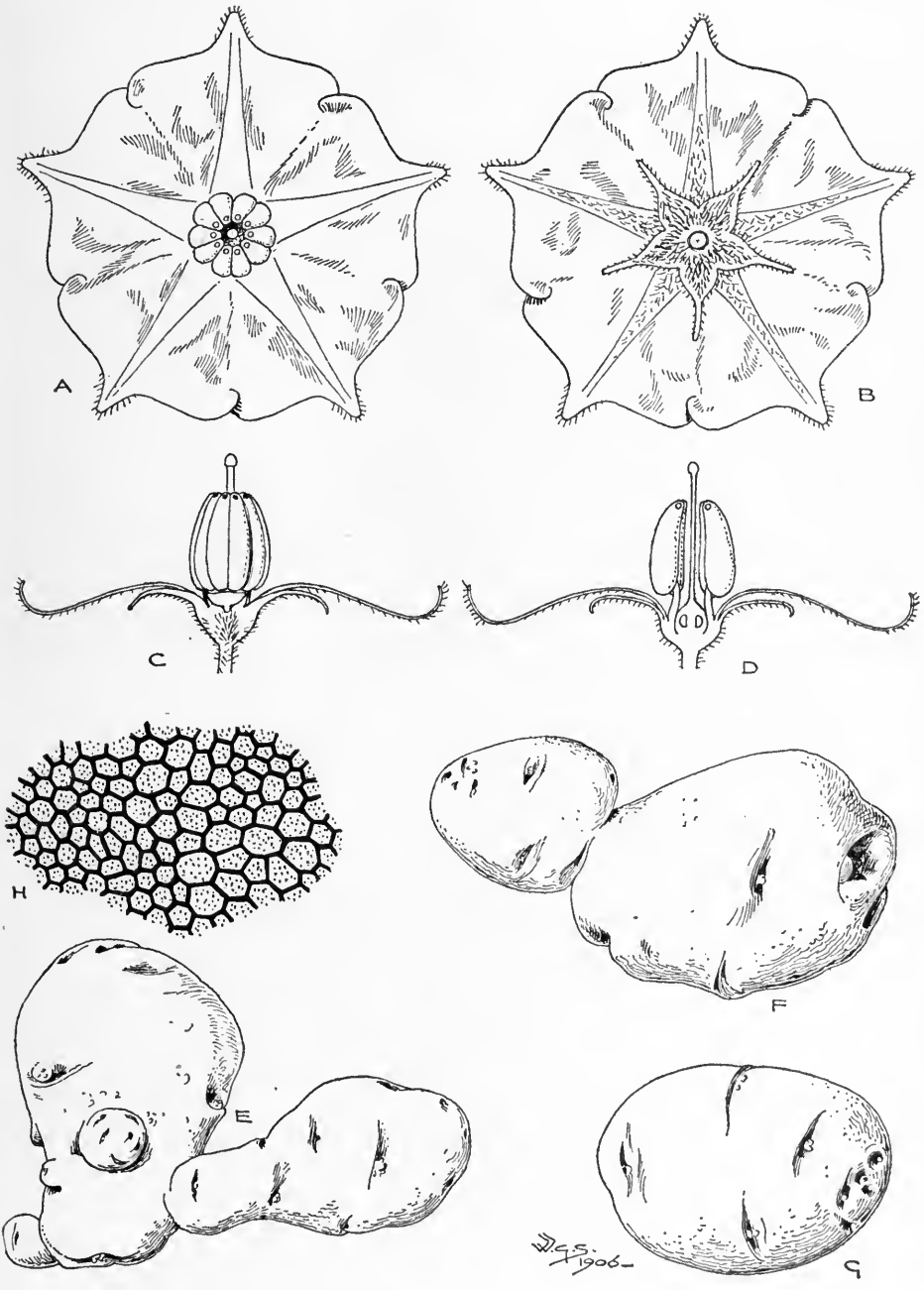
PAULSEN'S "BLUE GIANT" POTATO.

PLATE 5.



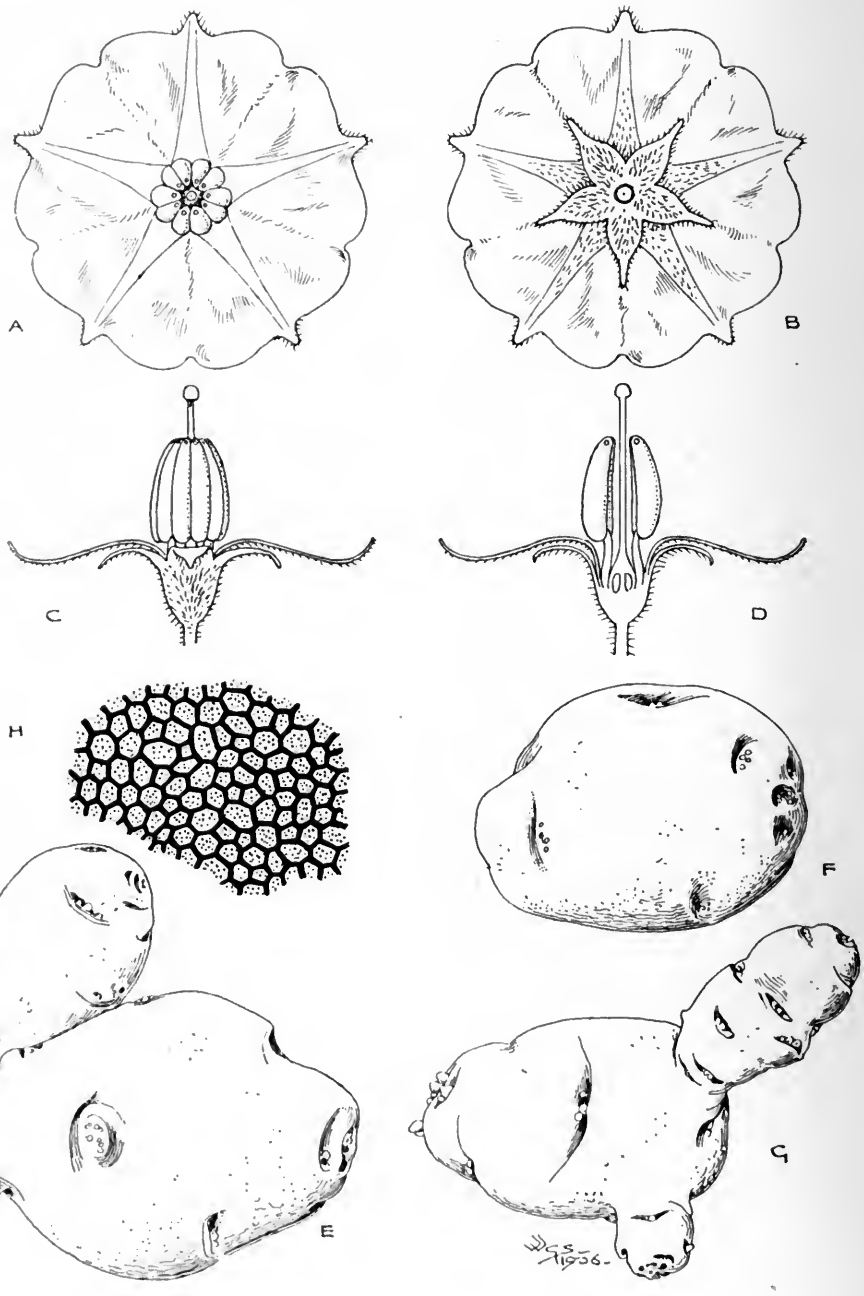
SOLANUM COMMERSONII, Dun. (White-flowered form).

PLATE 6.



"SOLANUM COMMERSONII 'Violet'", Labergerie.

PLATE 7.

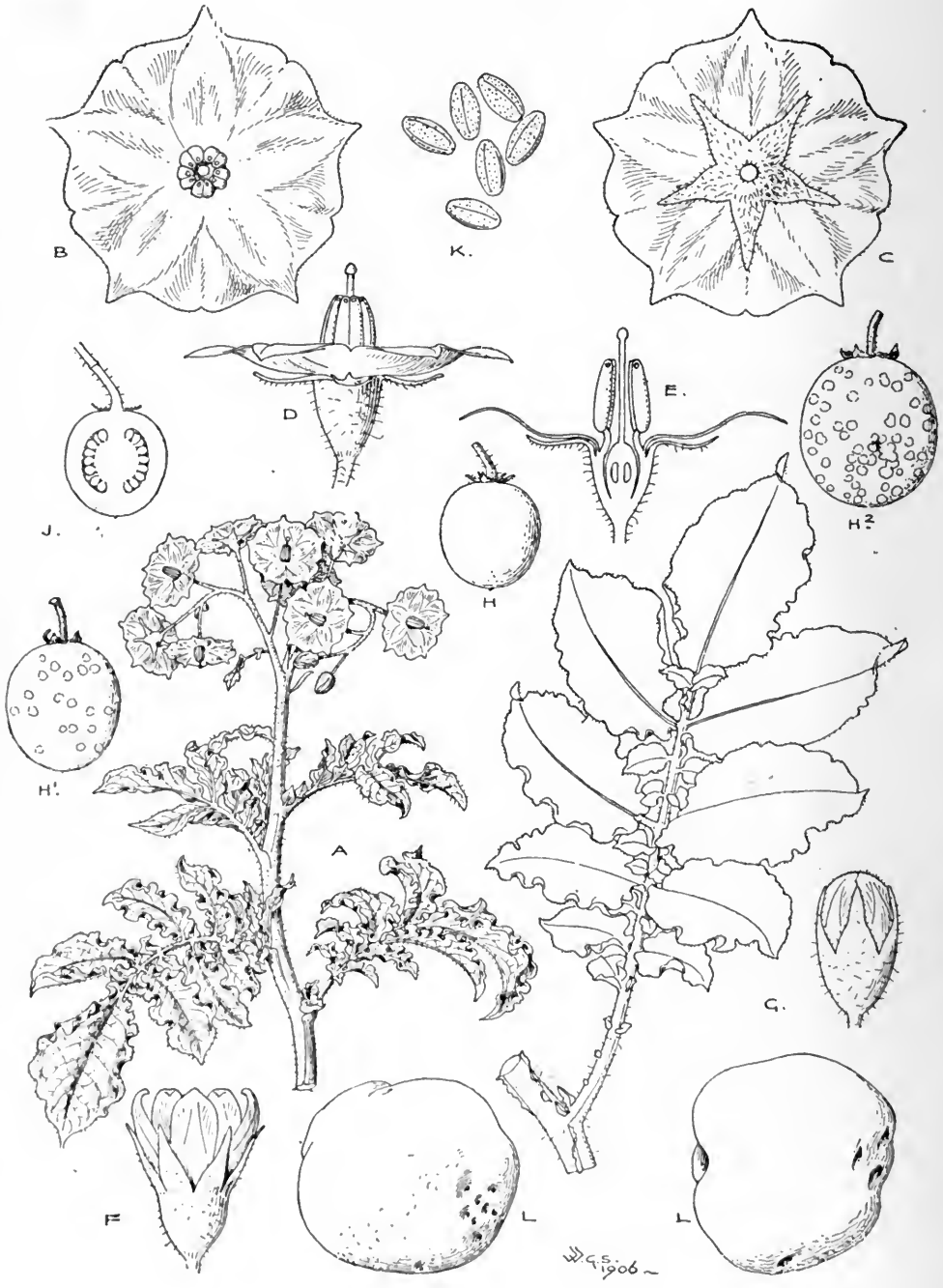


PAULSEN'S "BLUE GIANT" POTATO.

PLATE 8.

SOLANUM TUBEROSUM, Linn., var.

PLATE 9.

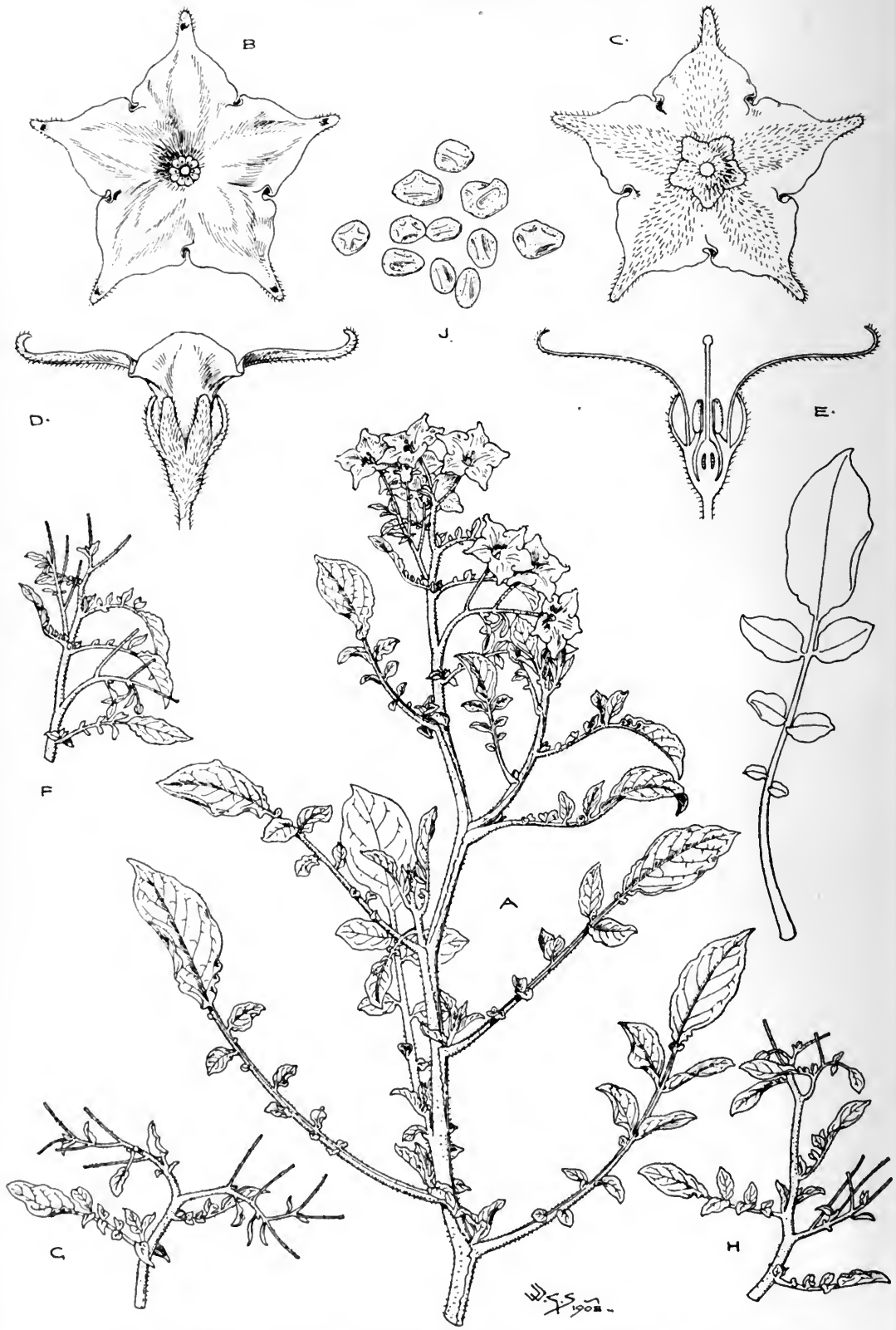


SOLANUM ETUBEROSUM, Lindl.

PLATE 10.

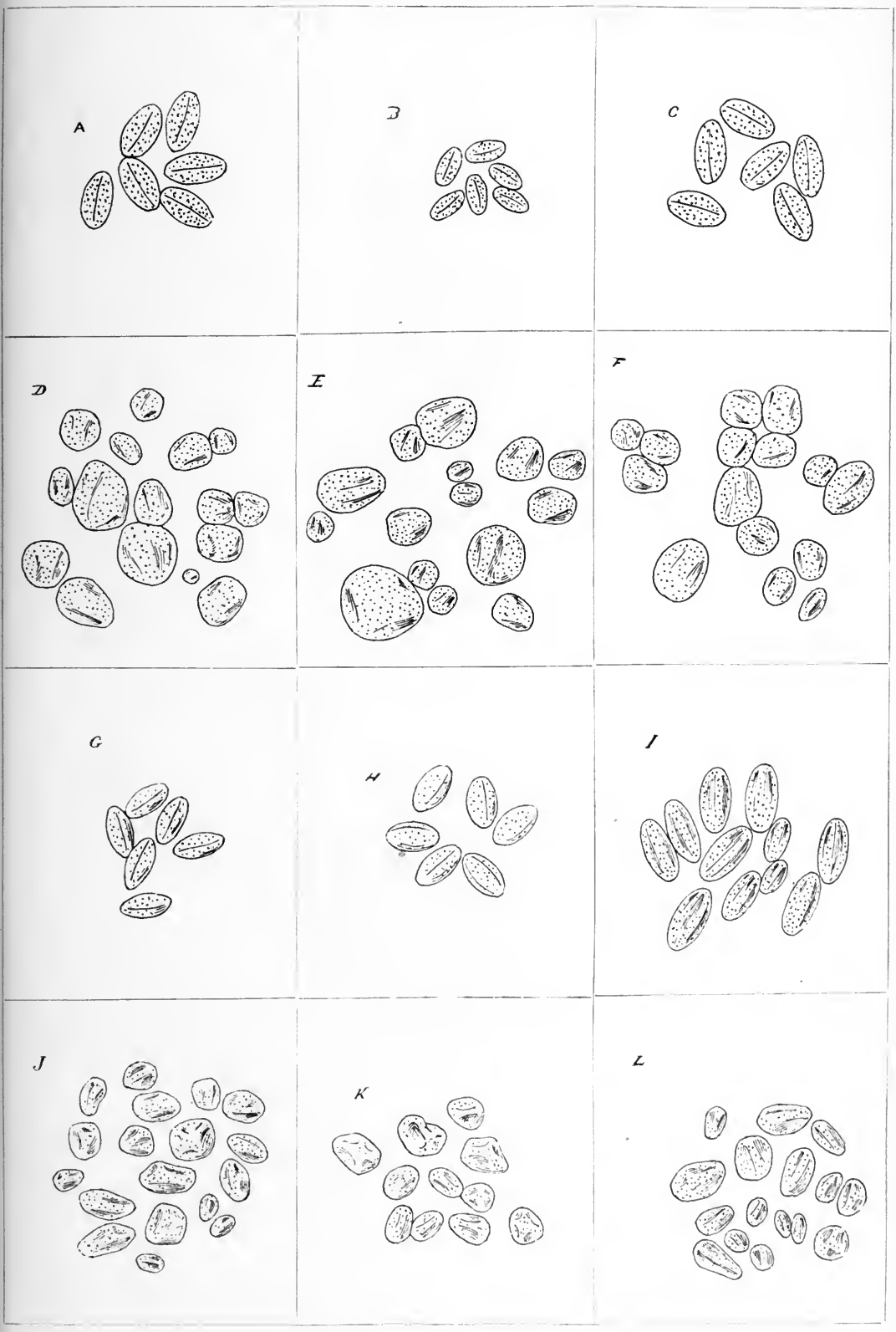
SOLANUM ETUBEROSUM, Lindl. (White-flowered Seedling).

PLATE 11.



SOLANUM ETUBEROSUM, Lindl. (Lilac-flowered Seedling).

PLATE 12.



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