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Taiwania cryptomerioides Hayata.

On *Taiwania* and its affinity to other genera.

By

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(With Plate I.)

In the Journal of the Linnean Society of London, 1906, I wrote an account of a new genus, *Taiwania*,¹⁾ of Coniferae from the Island of Formosa. At that time, I had but a few dry branches with cones, which was, as I have ascertained afterwards, occasionally picked up under a large trunk of this interesting Conifer. I was not, therefore, able to give any account about its histological character, even as much as is requisite in order to systematize the genus. Nor could I supply any notes about its general appearance. It has long been my desire to secure some alcoholic material for its histological study, and, if possible, to get a photograph of the whole plant, to complete my former description. The habitat of this Conifer is by no means easily accessible, owing to the high elevation and to a deep valley where one can only recognize the tree from the ridge above by its peculiar branching and the colour of its trunk. Fortunately, however, through the kindness of Mr. N. KONISHI, I was able to secure what I have been longing after.

In this paper I have endeavoured to make some remarks on the histology of the leaf, and the description of the whole plant, in addition to my former paper. I will also try to say a few words on the affinity of this genus and other genera.

¹⁾ B. HAYATA :—On *Taiwania*, a New Genus of Coniferae from the Island of Formosa, in Journ. Linn. Soc. Vol. XXXII. pp. 330–332, Pl. 16, and M. T. MASTERS :—On Chinese Conifers, in Journ. Linn. Soc. Vol. XXXII. p. 424.

Before I go further, I had better pause a little while to consider once more about this interesting genus in order to get a clear conception of it. As repetition may be considered allowable here, I trust I may be excused if I quote the following description from my former paper.

Taiwania¹⁾ HAYATA.

Flores monoici? ♂.....♀. Strobilus subglobosus, bracteis minutissimis; squamæ multiseriatæ laxiuscule spiraliter imbricatæ parum induratae apice squarroso-patentes persistentes obovatæ apice leviter mucronatæ basi cuneatæ. Semina ad medium squamarum fertilium 2 reversa oblonga, testa coriacea duriuscula, ala angusta cincta; embryo 2-cotyledoneus.—Arbor sempervirens dense foliata, ramis patentibus. Folia squamæformia spiraliter conferta adnato-decurrentia, in ramis vegetis anguste lineari-falcata incurvo-erecta 4-gona, angulo dorsali prominente. Strobilus terminalis.

Taiwania cryptomerioides HAYATA. Arbor. Folia polymorpha, rami adulti squamæformia triangularia breviter acuta carinata 5 mm. longa, 3 mm. lata per totam fere faciem ramo adnata; ramuli superioris falcato-incurva decurrentia 6 mm. longa, 3 mm. lata; rami vegeti aceroso-linearia latere compressa superne et subtus carinata, rhombeo-tetragona in sectione, 15 mm. longa. Strobilus subglobosus, 10–13 mm. longus, squamis numerosis 15, parum induratis margine tenuibus, apice mucronatis obcordatis vel obconicis 8 mm. longis, 5 mm. latis, basi additis bracteis minutissimis, squamis inferioribus vacuis minoribus. Semina oblonga cum alis 6 mm. in longitudine, alis utrinque sinuatis; albumen carnosum; embryo oblongus, 2½ mm. longus; cotyledones 2, planæ.

Hab. Ushōkō, Shōrinzan, Rinkiho, ad pedem montis Morison ad 6000 ped. alt., leg. N. KONISHI (Feb. anno 1904); Kagi: Arisan, leg. N. KONISHI (Oct. anno 1906.); et ad 7500

¹⁾ I called this genus *Taiwanites* provisionally, which name is, however, suppressed in favour of the permanent name *Taiwania*.—See Gard. Chronic. 3 series, No. 3403 (1906) p. 135.

ped. alt., leg. T. KAWAKAMI et U. MORI, (Oct. anno 1906); Taitō: Taironkōsha, ad 8000 ped. alt., leg. U. MORI, (Nov. anno 1906).

A few lines here should be devoted to the description of the locality and of the whole tree. The accompanying photo-

graph will give some fair idea of the habit of this plant. As was reported by Mr. N. KONISHI, the plant grows in the jungle

on a high elevation with other Conifers, such as *Picea*, *Abies* and *Chamæcyparis*. The climate there, it is said, is pretty cool all the year through. In a deep valley, each standing solitary here and there, these trees attain a considerable height of more than fifty metres, and a diameter of about two metres; showing their bare trunks from far off, stretching their clustered foliage towards the apex of the branches. The stem is quite branchless from the base up to the middle to the height of about twenty metres. Together with its branches, it describes an outline of a conical or rather a cylindrical form. Its habit bears much resemblance to *Cryptomeria*, but has more clustered branchlets and foliage towards the end of the branches. It grows in rather wet places, as is the case with *Cryptomeria*. The foliage too is very much like that of *Cryptomeria*, but a little shorter in *Taiwania*.

Thus far the two closely resemble each other in the sterile branches. I had myself, perhaps like everybody on the spot, long made the error of thinking that *Cryptomeria* was found in Formosa, until I first examined the cone of the plant. On glancing over that singular cone, I was at once surprised to find that the new plant must no longer be regarded as belonging to *Cryptomeria*, nor does it seem to be assignable to any known genus. Studying the plant more carefully, I ascertained that the plant should fall into the family of Taxodiineæ.¹⁾ Further on I proceeded to find out to what genus it comes nearest, and, if possible, to establish clearly its relation to other forms. It has but one kind of shoots, and, therefore, this no longer comes to *Scidopitys*. The seed is reversed, by which this differs from *Cryptomeria*, *Taxodium* und *Glyptostrobus*. As far as my knowledge extends, the plant comes nearest to *Cunninghamia* in the structure of its cones, as seen in the arrangement of the seminiferous scales, in the presence of the minute bract,²⁾ in the attachment and position of the

¹⁾ ENGL. und PRANTL:—Nat. Pfl.-fam. II.-1, p. 84.

²⁾ *Cunninghamia* is described as "Bractee distinctæ nullæ" or "Bractee nullæ" in SIEB. et ZUCC. Fl. Jap. II. pp. 6 et 8" and in "G. GORDON, The Pinetum, p. 76," as "without bracts." But I convinced myself that there is often, if not always, a minute bract at the base of each scale.

ovules, and the shape of the seed, wing, albumen and embryo. But it differs from that genus in the absence of the secondary squama and in the number of the ovules (two in each scale). These two points and the even more strikingly different habit of the plant do not allow me to place it in *Cunninghamia*. On this occasion, I thought whether I had not better regard the plant as representing a new genus, *Taiwania*.¹⁾ This was a difficult question for me to decide myself. I therefore sent this specimen to Dr. M. T. MASTERS of the Linnean Society, together with its description and figure, and asked him if I might not be justified in making a new genus for this new plant. In reply to my inquiry, that gentleman assured me that he agreed with me on the matter. He also pointed out that the foliage of this plant reminds one of that of *Cryptomeria* but still more of *Arthrotaxis*, and the cone is very like that of *Tsuga*. On his kind suggestion, I proceeded to examine *Arthrotaxis* with the utmost care, and found that it resembles *Taiwania* very closely, but differs from it in the form of the cone, and still more in the general aspect.

Arthrotaxis is Cupressus-like in its general form, as far as I can learn from plates,²⁾ while *Taiwania* is not Cupressus-like, but *Cryptomeria*-like. I am sorry that I have not ever seen any specimen of *Arthrotaxis*; but I do not think that my conception of *Arthrotaxis* acquired from plates can be widely different from that obtained through studying specimen plants.

As has been stated above, *Cunninghamia*, *Arthrotaxis*, *Cryptomeria* and *Taiwania* resemble in this point or that. The question we are going to solve, is, which two of the preceding three genera should *Taiwania* be inserted in? Summarizing all the above accounts, we see that *Taiwania* comes nearest to *Cunninghamia* in the form of its cones, while on one side it resembles *Arthrotaxis* in its foliage, and on the other it shows a close kinship to *Cryptomeria* in its habit.

¹⁾ My paper on this new genus was read before the Linnean Society, 5th, April, 1906.

²⁾ HOOKER:—Icones Plantarum, t. 559, and ENGL. et PRANTL.:—Nat. Pfl.-fam. II.-1, p. 89, Fig. 59.

It should be granted that most stress should be put upon the form of the cone, in systematizing Conifers. *Taiwania*, therefore, should be assigned the next place to *Cunninghamia*. As *Arthrotaxis* bears some resemblance to *Taiwania* in the form of its cones and leaves, it should be put next to *Taiwania*. After considering all these cases, I was, at last, forced to the conclusion that *Taiwania* should be placed between *Cunninghamia* and *Arthrotaxis*.

So much as to the external relation of *Taiwania* to other genera. Lastly, a few lines should be given to the consideration of the histology of this genus. I do not think, however, that I should dwell upon its particular anatomy, nor will I enter upon the phylogenical study of the organs. On this occasion, I must be content to examine whether or not the above conclusion will hold good about its histological relation.

I will here take the leaf for my study. As shown in Plate I, Fig. 14, the leaf of *Taiwania* is rhomboidal in its outline with two acute edges on both sides, and round surfaces above and below. The epidermis (ep), as seen in many Conifers, has a well-thickened wall, and under it the hypodermis (hy) is equally well developed lying in a single layer. But in some portion of the surface (st) where a great number of stomata are scattered, the hypodermal layers are generally omitted. Internally, the chlorophyll-parenchyma is equally arranged all round the surface; but it becomes looser towards the centre. The vascular bundle and resin canal are generally seen in the centre. In both sides of the medial bundle, there are clearly seen transfusion tissues, that peculiarity of Conifer leaves. The tissue consists of tracheids with bordered pits and beams.

I shall try to compare these histological points with those of *Cunninghamia*. In the leaves of *Cunninghamia*, the hypodermis is most developed and sometimes sclerenchymatous fibres are seen scattered within the parenchyma, which is entirely absent in *Taiwania*. Now come to *Cryptomeria*, and we see the hypodermis is the least developed. In this respect, *Taiwania*

1) DE BARY;—Comparative Anatomy of the Phanerogams and Ferns p. 381.

lies between the other two. Further, the transfusion tissue is most developed in *Cunninghamia*, but it is the least in *Cryptomeria*. Referring to this tissue too, we see that *Taiwania* is the intermediate of the other two.

What about *Arthrotaxis* then? I can only repeat my regret that I have not any specimen of *Arthrotaxis* for anatomy, and, therefore, cannot experimentally examine its histological character. But we have seen that the external relation of the three genera of *Cunninghamia*, *Taiwania* and *Cryptomeria*, is proved to be true in their internal. In like manner, we may very reasonably infer that what has been stated about the three genera *Cunninghamia*, *Taiwania* and *Arthrotaxis* in their external form will hold good in their histology. We have no room to doubt that *Arthrotaxis* must come nearer to *Taiwania* in its histology than *Cryptomeria* comes, just as it does in its external structure.

Upon considering all the above cases, I was led to the conclusion that *Taiwania* must be placed between *Cunninghamia* and *Arthrotaxis*.

In conclusion, I must express my hearty thanks to Prof. J. MATSUMURA under whose supervision this work has been carried out. Thanks are also due to Prof. K. FUJII and Mr. T. MAKINO, for their valuable advice. Nor should I forget to tender my cordial gratitude to Dr. M. T. MASTERS of the Linnean Society who has kindly aided my investigations by many helpful suggestions. Lastly, I feel bound to express my sincere thanks to Messrs. T. TAWAKAMI and N. KONISHI who have generously put their valuable materials at my disposal.

Explanation of Plate I.

- Fig. 1. Fragment of a branch, natural size.
„ 2. Fragment of a young branch, natural size.
„ 3. Leaves from a fertile branch.
„ 4. Leaf from a young sterile branch.
„ 5. Scales of the cone with minute bracts at the base.
„ 6. Scale seen from within, showing two winged seeds.
„ 7. Scale showing two winged seeds, one partially hidden behind the other.
„ 8. Scale from the inner side, seeds taken off, showing the traces where the seeds were attached.
„ 9. Scale of a young cone with two abortive ovules.
„ 10. Ovule showing its reversed position.
„ 11. Seed.
„ 12. Albumen.
„ 13. Embryo.
„ 14. Transverse section of a leaf, (of a adult branch).
„ 15. A portion of the upper surface.
„ 16. A central portion with the median bundle.
„ 17. Tracheid with bordered pits of the transfusion tissue.
„ 18. A portion of the under surface.
- { ep=epidermis; hy=hypodermis; ch=chlorophyll-parenchyma; }
{ xy=xylem; tr=transfusion tissue; ph=phloëm; res=resin canal. }
- (Figs. 3-18 enlarged).
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