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ON THE

POTAMOGETONS

BY

J. O. HAGSTRÖM

WITH 119 FIGURES IN THE TEXT

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I have been addling my brain and straining my eyes over a set of ignoble Pond-weeds (alias Potamogeton) trying to find the difference there should be 'Twixt tweedledum and tweedledee, for all of which I suppose nobody will thank me, and I shall get no fee. Indeed, few would see the least sense in devoting so much time to a set of vile little weeds. But I could not slight them. The Creator seems to have bestowed as much pains on them, if we use such a word, as upon more conspicuous things, so I do not see why I should not try to study them out.»

ASA GRAY.

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It was in the year 1891 that I commenced studying the aquatic plants. At first indulging in the small *Callitriches*, I later took to the greater and by far more interesting genus *Potamogeton*. Concurrently with the most necessary observations in nature I was favoured with having access to the considerable collections of the late Dr. G. TISELIUS and the also deceased chemist J. BAAGÖE. By the kindness of the latter I succeeded in getting into correspondence with several foreign botanical institutions. For the access to the Swedish museums I am greatly indebted to the favour of their benevolent directors and assistants who, moreover, have most kindly rendered accessible to me all desirable literature. And at the Bot. Museums of the universities of Christiania and Copenhagen I have met with the same benevolence and complaisance, for which all I herewith am saying my best thanks. I am especially under great obligation to Prof., Ph. D. C. LINDMAN, Stockholm. Without his powerful assistance and instructive advice the present work had scarcely been published.

To my appreciated friends, Director FR. FANT, at Hall, and Barrister B. LAGERWALL, at Drottningholm, as well as to Ph. D. F. KEMPE, of Stockholm, and Ph. D. I. LAGERWALL and Mrs. I. LAGERWALL, of Stockholm, I herewith offer my sincerest thanks for their encouragement and the valuable aid they have rendered to me.

Lastly I render my most respectful thanks to Miss HEDVIG SVENSSON, of Stockholm, who has kindly assisted with the time-wasting proofreading.

The Swedish museums contain important collections of *Potamogetons*. Thus an abundant material is deposited in the Natural History Museum at Stockholm (Riksmusei Botaniska Afdelning). It possesses collections that have belonged to P. BEURLING, P. A. BORÉN, R. F. FRISTEDT, JOH. LANGE, L. L. LÆSTADIUS, E. F. NOLTE, C. F. NYMAN, C. M. NYMAN, H. F. G. STRÖMFELT, K. FR. THEDENIUS, G. TISELIUS, J. ÅNGSTRÖM, and many others. In Upsala there are a great many interesting forms from the herbaria of M. M. FLODERUS, ELIAS FRIES, T. M. FRIES, C. J. HARTMAN, R. HARTMAN, L. L. LÆSTADIUS, C. O. SCHLYTER, E. TUCKERMAN, P. J. ZETTERSTEDT and G. WAHLENBERG, among others. The Botanical Institution of the University of Lund has collections brought together by J. G. AGARDH, M. VON DÜBEN, F. ELMQVIST etc. In the museum of Gothenburg we find the herbaria of

C. J. LINDBERG and E. TRANA. The splendid work of Dr. G. TISELIUS, *Potamogetones suecici exsiccati*, is to be found at Stockholm, Upsala, Lund and Gothenburg, and at the three places first mentioned you will also find E. FRIES's *Herbarium Normale*.

On dividing all the species of this genus in the following twenty-six subsections or groups I have considered their morphologic, as well as their biological and anatomical characters.

No doubt the fructification is of the greatest importance for indicating the affinity. The pistils and stigmata, however, are as yet little studied. As to the ripe fruit, it is true, the keels and outgrowths are mostly described, but sometimes there is no difference made between false and true keels. The curvature of the embryo establishes a close relation between *P. Nuttallii* and *Euhybridii*.

As regards the leaves, the principal interest is attached to the submersed ones, especially to their margin, if smooth or rough, their apex, and the nervature. But the form of the basis and the extent of the lacunar system must also be kept in view. Obversely the absence or presence of floating leaves is of much less importance in fixing the relationship. Several species, typically provided with floating leaves, are able to dispense with them under certain circumstances. Some others, in which they are commonly wanting, occasionally supply themselves with a sort of leaves as to structure presenting an intergradation between true floating leaves and submersed leaves: more lacunous, often furnished with scattered stomata, and with an obvious tendency to form an expanded blade, in the cases when the submersed leaves are narrowly linear. Their biological function is twofold: to serve at the same time as submersed leaves (water-leaves) and as a sort of aerial leaves (air-leaves). For this reason I am inclined to term them amphibial leaves (*folia amphibia*). Yet I do not intend to say (with NOLTE) that all submersed species are able to produce coriaceous or subcoriaceous leaves. Submersed species in proper sense are really to be found and in them you as a rule look in vain for stomata or other characteristics of floating leaves. Such species are *P. lucens*, *P. perfoliatus*, *prælongus* etc. C. SAUVAGEAU in his paper *Sur les feuilles de quelques monocot. aquatiques*, p. 270—271, certainly mentions stomata in *P. lucens*, but most of his »*lucens*» seems to have been *P. coloratus* (»la variété non mucronée»).

Hybrids of wholly submersed species with coriaceous-leaved species are often provided with those amphibial leaves, a fact which affords a good help in studying several difficult forms. Besides, they occur in the region between the true water-leaves and the air-leaves in species with floating coriaceous leaves.

The leaf-sheaths and ligules are also significant in pointing out the affinity. Especially we must set weight upon if they are open or connate, but also other conditions lay hold on our attention much more than has hitherto been the case.

The affinity between groups and forms is further manifested in the form and internal structure of the stem. Nearly allied forms have the same or similar anatomical characters. Especially the cells constituting the peculiar endodermis seem to be most prominent in importance. Three types can be conveniently distinguished: cells without incrassate walls (= thinwalled *o*-cells), cells inside with round about

stratified cellulosa layers (= thickwalled *o*-cells), and finally cells with unilateral incrassation (= *u*-cells). Yet the degree of incrassation very much depends on the age of the plant, wherefore it is most clearly observed in fruiting individuals. Besides there are several varieties of the latter two celltypes, some of them due to alteration of the form of the cell-room, which varies from broadly rounded to narrowly oval, especially in the *u*-cells. *P. lucens* offers example of the first-mentioned broad *u*-cells, while the *P. gramineus* has the compressed form of those cells.

Species are met with having the *u*-endodermis not fully developed, but with a tendency to form *u*-cells. Such an interesting species, for instance, is *P. polygonifolius* and several others. These species have a pure *o*-endodermis at the nodes. But at a very little distance from the node the onesided incrassation gradually comes in and always in the corners of the central axis outside the vascular bundles, where also the supply is by far more necessary than in the sinus close by, in which on the contrary thinwalled communicating cells are required. The evolution consequently shows that species with an *o*-endodermis are more primitive than those provided with a *u*-endodermis, and that the anatomical conditions of the stem in their more advanced state are to be found towards the middle of an internode, whereas the more primaeval state may be studied in the very node.

P. Robbinsii furnishes another example of a mixed endodermis, which we will consider when in the dissertation we arrive at this species. It is composed by both thinwalled and stratified cells. — On taking a review of the genus you accordingly will find five (or six) essentially different kinds of endodermises.

A. Uniform endodermises:

1. Non-stratified *o*-endodermis.
2. Stratified *o*-endodermis.
3. *U*-endodermis, with two modifications:
common *u*-type, cells with round or broadly rounded cross-cut form, and
gramineus-type with laterally compressed cells and narrower lumen.

B. Mixed endodermises:

4. *O—U*-endodermis: a *u*-end. with *o*-cells at intervals or faintly developed *u*-cells.
5. *O—O*-endodermis, with *o*-cells of different kinds.

The endodermis encloses the central axis, which principally consists of pith, vascular bundles chiefly belonging to the leaves and often also a strengthening tissue. These mechanical cells most frequently follow along the endodermis as a more or less complete layer and sometimes form moreover an intermediate stratum between the two median bundles as well as between the lateral bundles and the median ones, by which a fusion of bundles is prevented. Finally they appear as more or less strong open sheaths round the vascular bundles, thus constituting a sclerenchymatous stele. Non-sclerenchymatous species are more or less fully destitute of particular mechanical cells in the pith.

The topography of the stele chiefly depends on the arrangement of the bundles. These namely behave in some species or groups in a dissimilar way to what is the fact in others. A fusion of bundles frequently takes place according to a certain

scheme. A cross-section of the stele exhibits three separate parts or areas: a median area and two lateral ones. A fusion of bundles can take place with the median bundles as well as with the lateral ones. In the median area there are four bundles originally, of which three form a group belonging to the internode next above, and the fourth, the opposite bundle, belongs to the leaf next above. The first and commonest mode of fusion consists in the three bundles first mentioned, or the so-called trio (CHRYSLER), uniting with each other into a compound bundle with three phloem parts, or into a bundle with a single phloem portion, a trio-bundle, in both cases with a common xylem cavity. The third stage finally comes about when the trio-bundle unite with the opposite bundle forming a compound median bundle with two phloem parts but a common xylem cavity in the centre. This central canal is very constant and characteristic to many species, for inst. *P. gramineus*. In some species the two median bundles run separately at the very base of the stem, unite a couple of internodes above the bottom thus forming the typical characteristic up to the internodes next below the primary spike, where they again separate running lastly as a trio-bundle with its opposite bundle. In order to learn the characteristic fusion you therefore should take the crosscut of an internode situated rather far from the primary spike or at least a couple of internodes beneath it.

The lateral vascular bundles also frequently coalesce with the single bundle belonging to the leaf, the foliar bundle. Or the cauline bundles quite fail for want of space at the side of the foliar one, or they are not required for the life of the plant. In these cases of fusion or development there exist only two lateral xylem canals, one on either side. The last stage of fusion enters, when the lateral foliar bundles unite with the median foliar bundles thus forming a single compound bundle with four phloem parts and one xylem cavity running in the centre. The crosscut-form of such a stele becomes circular or nearly so.

As to the anatomical conditions of the stele in general, the disposition of the fibro-vascular bundles and the crosscut-form of it we thus observe the following six stages:

A. Lateral bundles free, 2—4 (5) in number on each side.

1. The prototypic diagram: four median bundles. Fig. 1, *A—B*.
2. The trio-type diagram: a compound trio-bundle and an opposite bundle, thus two median xylem canals, a frequently occurring case. Fig. 1, *C*.
3. The eight-bundled diagram: usually six lateral and always two median bundles, each with a single phloem part looking at the endodermis. Fig. 1, *D*.

B. Lateral bundles only two, one on each side viz. the foliar bundle.

4. The four-bundled diagram: two median and two lateral bundles, the first mentioned often separated by a partition wall of mechanic cells. Fig. 1, *E*.
5. The oblong diagram has two lateral bundles and one compound median bundle, consequently three xylem canals often separated by a mechanic tissue. Common to a plurality of species. Fig. 1, *F—H*.
6. The circular diagram characterized by a large compound bundle with four phloem parts occupying nearly the whole tube. In many species with a filiform stem like that of *P. panormitanus*, *trichoides* and so on. Fig. 1, *K—L*.

Modifications of these types occur. In *P. Robbinsii*, for instance, we meet with a by-form of the prototype caused by the particular compressed form of the stem. See the account of this species and the Fig. 19.

P. lucens, the stele diagram of which properly belongs to the oblong type, like that of *P. gramineus*, varies on account of the plant's being partly a sclerenchymatous species partly a coarse-grown form, which is in need of special cauline vascular bundles. Accordingly you will sometimes find a couple of cauline bundles in the lateral areas at the same time as the dissolution of the xylem of the two median bundles is incomplete and a more or less thin partition between them is left in the central cavity. But the typical state is three large canals along the axial diameter of the diagram.

An anatomical stem-diagram, of which is spoken in this paper, means a sketch of the stem-anatomy such as it appears in a cross-section at about the middle of an internode a few internodes beneath the primary spike. The constituents of this diagram are the following parts: 1) epidermis, 2) its strengthening stratum or the subepidermal bark-layer, which rather improperly may be called hypoderma,¹ 3) accidentally existing subepidermal (pseudo-hypodermal) bast bundles or strands,

Fig. 1. Different types of stele-diagrams. A—B, The prototypic diagram, *P. praelongus* WULF. B, *P. linguatus* HAGSTR., the median bundles and the interjacent sclerenchyma. C, The trio-diagram, *P. nodosus* POIR., median bundles, showing the disposition of the phloem, 1, in three parts, 2, in two parts. D, The eight-bundled diagram, *P. vaginatus* TURCZ. E, The four-bundled diagram, *P. Cheesemanii* BENN. F—H, The oblong type of diagram; F, *P. obtusifolius* M. & K.; G, *P. confervoides* RCHB. H, *P. lucens* L., 1, typical form, 2, instance with a more primeval state. I—L, The circular diagram, K, *P. rutilus* WOLFG. I, from an internode at the middle of the plant; 2, from the internode next below the primary spike, showing the spreading again of the lateral bundles from the median ones. L, *P. foliosus* RAR. showing the central stele laterally somewhat compressed. All ca. ⁹0. — m, median bundles, l, lateral bundles, fb, foliar bundles, c, cauline bundles, ctr, opposite bundle, tr, the trio dissolved or fused to a compound bundle, scl, sclerenchyma, p, pith, x, xylem canals; the chequered parts represent the phloem of the bundles; end, endodermis.

¹ According to the exposition of the hypoderma by some authors (for inst. E. STRASSBURGER, Das kleine bot. Pract. (1893) 66—67) I use this term for the stratum concerned as its chief function evidently is to strengthen the epidermis. Otherwise it should be termed pseudo-hypoderma.

4) interlacunar bark-parenchyma and 5) its occasional strands, 6) endodermis and 7) the central cylinder with its vascular bundles and channels, the latter originating in a more or less dissolved xylem, and eventual mechanical system.

The epidermis consists sometimes of small cells sometimes of wide ones, round—squarish—oval in crosscut-form, usually many times longer than their width, but at times, to facilitate their mechanical function, much abbreviated almost cubic, for instance in the *P. vaginatus*, fig. 12, *D*.

The hypoderma (pseudo-hyp.) sometimes occurs one-celled, sometimes 2—4-celled, see fig. 116, *D*, occasionally it is wholly wanting. In this case the very epidermis-cells are usually bigger, their crosscut-form oval with the radial axis longer than the tangential.

Subepidermally occurs often — though it be as frequently lacking — a more or less complete circle of more or less strong bastbundles situated in the angles where lacunar septæ join the epidermis or its corroborating stratum.

The cortical lacunæ are mostly widest in the subepidermal circle, but occasionally their greatest widening appears in the circle next to it. As the lacunæ of each circle have almost the same width or lumen, the cortical vascular- and bast-bundles also show a circular arrangement (in one or a few more or less complete circles).

Owing to the fact that the outer circle of those interlacunar bundles originate in the bundles of the sheaths and ligules (see the fig. 88, *vbic*) this circle should be named the ligular circle. It is natural that the ligular circle is composed by a greater or less number of strands at different levels of the stem as the sheaths and ligules are of different thickness and length according to their place on the stem. The *Coleogeton*-species are usually provided with stout basal sheaths.

According to the above said you will find the most advanced, constant and typical anatomical conditions prevailing at about the middle of the spike-bearing shoot, from which level thus the crosscut for systematic purpose is to be taken.

The anatomy of the rhizome is rather uniform throughout the whole genus. The difference chiefly pertains to the character of sclerenchymatous or non-sclerenchymatous species and the degree of coalescence of the central vascular bundles. The form of the rhizome is also nearly the same, namely terete or at least nearly so even in species with compressed or bicanaliculate stem. In order to show that interesting fact I have figured cross-sections of *P. crispus* and *P. acutifolius*, see figs. 22, *A* and 26, *B*!

As to the peduncle there is an essential difference between the *Coleogeton*-species and the species of the subgenus *Eupotamogeton* in the former being furnished with an endodermis, the latter, again, lacking this organ. On *P. trichoides* and *foliosus*, vide the descriptions! Within the *Eupotamogeton*-species the peduncles sometimes offer differences in form, in general, and crosscut-form, but also as to some anatomical facts, for instance the absence or presence of subepidermal strands in some groups especially in the *Pusilli*. The arrangement of the bundles is also noteworthy in many species. The more or less prominent stiffness of the peduncles of the *Eupot.*-species is caused by the bundles spreading and becoming surrounded by strong bast sheaths,

by their always having a pseudo-hypoderma even in species lacking it in the stem, and finally by the channels of the cortex increasing in number but decreasing in width which process causes the well known incrassation of the organ. By this rigidity of the peduncles the plant is able to lift the spikes over the surface of water for the pollination. Thus we have here a biological adaption causing me to say some words of the biological facts employable for distinguishing the species.

I have already spoken of the adaption of some leaves for a double life. Another important fact is the adaption for different levels of water. In this respect some species prolong the internodes next below the primary spike, seldom the peduncle also, others, again, prolong the stem by branches from the topmost two leaves, the first involucreal leaves, and then produce, often dichotomously, branches of several different ranks. Instances of the first-mentioned way are *P. lucens*, *P. panormitanus* and others. *P. foliosus*, *pusillus*, *densus* etc., on the contrary, use the latter way. — Each species has also its own way of producing the greatest number of spikes from which it rarely or not at all deviates. Some species give off long branches from the basal or lower axils each terminating itself by a spike and a short or two spike-bearing branches of the first rank from the base of the primary spike, fig 2, *A* (*A*-type). The other way consists in developing a rich rosette of spikes on short branches of 1st—5th rank above the primary spike, with or without the power of producing the above-said long spike-bearing basal branches, fig. 2, *B* (*B*-type). A third way is to produce shorter branches from the axils next below the primary spike together with or without the mode of branching characteristic to *P. vaginatus*, vide p. 10!, fig. 2, *C* (*C*-type). Other species, again, like *P. perfoliatus* etc., form the above mentioned toprosette, often dichotomously, to a bushy tuft of rather long spiciferous branches of as far as the fifth or sixth rank sometimes together with spike-bearing branches from the axils beneath the tops-pike, *D*-type, fig. 2, *D*.

Beside the development of fruits most *Potamogeton*-species have an effective vehicle for the propagation and spreading in their turios, which also serve as a resting-stage during the unfavourable season. Therefore these organs are mostly called either propagating-buds or winter buds (hibernating-buds). They appear either as subterranean organs on the rhizome or as cauline ones on the leafy shoot, in which case they shed and at least sink to the bottom. They are tops of rhizomes and branches which have been metamorphosed and with their scales and leaves adapted to depositories for starch, or they are wholly transformed short branches. Sometimes a single sort of them occurs, sometimes again principally one sort, sometimes finally all sorts together in a single species. In some species no such turios at all are observed. In some groups especially in the *Pusilli*, they are of a prominent importance for recognizing the species and hybrids often habitually similar among themselves.

Another adaption are the arrangements in the stems and leaves for the purpose of resisting the impetus of the waves and the current of water. The short epidermis-cells, the mechanical tissue especially in the border and along the midnerve, the wavy shape of the margins, the canaliculate shape of the tip, the linear or narrow form of the lamina and the lubricity of the surface are the chief expedients

to prevent the leaves to be pulled to pieces. The arrangements of the stem principally consist in anatomical facts:

Fig. 2. Schematic delineation of the different ways of spike-production. See the text!

1) Adaption of the epidermis-cells in being very narrow with maintaining of the usual length or being very short almost cubic with keeping of the width. In general the epidermis cells are 3—6 times the width.

2) Generation of a pseudo-hypoderma. In some species it appears one-layered (*P. perfoliatus*, *P. pulcher* etc.), in others two-layered (*P. praelongus*, *P. ochreatus* etc.), in one species even three- (2—4) layered: *P. linguatus*.

3) Developement of particular lists in the angles where the partition-walls join the epidermis or hypoderma. A usual fact.

4) Developement of particular thin or strong subepidermal or subhypodermal (*P. praelongus*) bast bundles. A very important distinctive mark.

5) Evolution of a system of mechanical strands and tissues both in the bark and the central cylinder, the endodermis included, too.

6) Evolution of a plurality of air-channels by decreasing of their lumen; occasionally in non-sclerenchymatous species. In this case a multitude of longitudinal walls in the bark afford the same strength to a plant as the mechanic strands give to another.

The groups thus established have been distributed on five sections. When, however, such a significance as has hitherto been ascribed to the floating leaves cannot be attributed to them, I have been obliged to disapprove of the old division *Heterophylli*, *Homophylli* etc., and the modifications of it made by later authors. Here the behaviour of the leaf-sheaths and ligules offers itself as a convenient principle of division. On the peculiarity of *P. densus*, see under *Laterales*!

Vernation forms a distinctive mark within the extensive section IV *Axillares*.

The subsection *Pusilli* may conveniently be divided into two series: *Connati* and *Convoluti* according as the ligules are connate or open, which fact has hitherto not been observed at all.

The anatomical conditions play such an important part in the *Amplifolii* as to divide them in a sclerenchymatous and a non-sclerenchymatous series.

Hybrids are not rare in this genus, but the successful study of them is comparatively new.

All hitherto exactly known *Potamogeton*-hybrids have proved to be very sterile. But, strange to say, the sterility also occurs, although rarely, in genuine species. No one can suspect *P. Robbinsii* to be a hybrid of any known species, nevertheless it seldom is to be found fruiting. To this is to add that species commonly fruiting freely, occasionally, by adverse conditions appear fruitless. In herbaria such forms are often met with and have sometimes been considered as hybrids. This is the case with some broad-leaved forms of *P. gramineus*, viz. *P. gram.* var. *fluvialis*, f. *Wolfgangii* et f. *septentrionalis*, that in Herb. Stockholm have been taken for and in HARTMAN, Handbok i Skandinaviens Flora, ed. 12, 1889, described as » $\times P. alpina \times graminea$ var. *graminifolia* (?)». The genuine *P. alpinus \times gramineus* is somewhat later detected and described (see below).

According to my experience, in most cases an exact judgment is nearly quite impossible except by means of the anatomy. This makes it necessary to have each species even anatomically examined and described.

Concerning the very possibility of hybridization I will remark that it seems not to occur between species with different stigmatic papillæ. Thus no hybrids are observed between *Coleogeton*- and *Eupotamogeton*-species. On the contrary it is not rendered impossible by the differences in form and size of the pollengrains. An evident proof of it is the hybrid *P. nitens*. One of its parents, *P. gramineus*, has small oval pollengrains, the other again, *P. perfoliatus*, has spheric and conspicuously larger grains. In this case it is surprising, that when the hybrid eventually produces fertile pollen, we see part of it evolved to the *gramineus*-type, another part to the *perfoliatus*-type. But sometimes one or the other species is exclusively prevailing.

As I already in 1901 and 1908 have given a partly new interpretation of *P. Zizii* and *P. nitens*, as hybrids and not genuine species, and established some new hybrids, and on the following pages am going to present several others, it may be necessary to give an account of the principles I have followed in establishing all those forms.

The hybrid forms mostly present a pollen to the greatest part unfit and sterile and deformed stigmata. Accordingly no fruits can generally be produced, or the fruiting faculty is at least considerably reduced. In very rare instances, for example in *P. gramineus \times lucens* (*P. Zizii* M. & K.) the development of fruit seems to be almost normal. But it is not yet made out, if such individuals through several generations are able to keep their existence and multiply themselves by seeding. This is probably not the case since those forms appear only locally. In many cases, besides, an abundant evolution of fruit in this hybrid and in the hybrid *P. nitens* is only seeming as most fruits are obviously lacking adult and fertile embryo.

The hybrids further lack a distribution area of their own. They accompany two species and appear sporadically in their distribution area, less often pretty com-

monly. The latter is the case with *P. gramineus* $\times$ *perfoliatus* (*P. nitens* WEB.) frequently occurring at the stations where its parents grow together at least in the Scandinavian countries. That we here, in general, have to do with as many crosses as we have stations is clear from the slight fertility mostly much reduced or quite failing, as well as from the fact that one form is not like the other, i. e. the specimens of each station are isolated and independent. In Sweden *P. Zizii* follows *P. gramineus* and *P. lucens* to the north, but does not appear beyond the 63^d parallell, where *P. lucens* has its northern limit. *P. nitens*, again, proceeds northward as far as its two parent-species spread and accompany one another. The same is the case as to the hybrid *P. gramineus* $\times$ *natans*.

The correct determination of the hybrids of this genus has proved very difficult. It belongs indeed to the most intricate problems of the *Potamogeton*-study and presupposes a thorough knowledge of each genuine species and a careful attention to each detail. Instances can nevertheless occur when one of the parents is recognizable at the first glance, but the more the other partner in such a case uses to conceal itself owing to its appearance in the fructification. And the difficulties increase when the parent-species have similar styles and stigmata or the malformation of these organs is so great that their true shape is not distinguishable. Then we try to get notice of among which species the form was found growing. Too great a weight, however, must not be set on this circumstance. It has been proved that the hybrid *Potamogeton*-forms can abide at the place where they have arisen for long spaces of time, while at last both the parents or either has become extinct and other species have occupied their place. Spikes, buds and turios can also be conveyed by waves and current far distances from their native place. It has happened that in a small river or on a spot very much retrenched four or five different hybrids partly entangled in one another have been met with. For instance in Gudenaa at Kongensbro in Jutland. From there I have, in my own herbarium, *P. gramineus* $\times$ *natans*, *crispus* $\times$ *prælongus*, *lucens* $\times$ *perfoliatus*, *lucens* $\times$ *prælongus* and *lucens* $\times$ *nodosus*. *P. nodosus* itself is at present gone out in Jutland. — At all events the distribution areas of the hybrids must now coincide or must once have been, at least partly, coinciding with those of their parents.

The hybrids must be studied according as Nature produces them. Cultivation and experiments in hybridization may not lead to great results as to the solution of this intricate question. A thorough study of the specimens already exactly known as to their origin is much more profitable for the purpose of a correct identifying of others. Rather soon you will learn in which way the one or the other species makes itself prevalent to its compartner, and to recognize the so-called intermediate properties.

Properties not occurring in the supposed parents cannot appear in their cross-breed. Thus, for instance, *P. Billupsii* FRYER cannot be the hybrid »*coloratus* $\times$ *Zizii*» on account of the long petioles of the hybrid. The two parent-species, namely, have short petioles. *P. lanceolatus* SM. cannot be as it has been supposed (BENNETT, FRYER, ASCHERSON, GRAEBNER), either »*gramineus* $\times$ *mucronatus*» or »*heterophyllus*

× *pusillus* FRYER, 1907, because of the rounded apexes of the submersed leaves, which are extraneous to *P. gramineus* as well as to *mucronatus* (Friesii) and *pusillus*. See the figs. 37, D, 55, A and 102, H—L, and cf. fig. 68, A!

As above said the anatomical conditions are of a prominent significance and likewise the turios, styles and stigmata and non-adult specimens without spikes (and turios), as they sometimes are met with in herbaria, are often or mostly not recognizable, and many a form already distributed as a certain hybrid need be reconsidered.

For every uniform cross-breed, be it a produce of one or more crossings performed at different places I use the term of form. Such nearly like specimens are comprised into a series signed α , β etc., corresponding to the variations of common species, an arrangement already used by me in NEUMAN & AHLFVENGREN, Sveriges Flora, 1901.

Subgenus A. *Coleogeton* (REICHENB.) RAUNKIÆR.

Potamogeton LINN. a. *Coleogeton* REICHENBACH, Icones floræ Germanicæ et Helv. etc. VII, 1845, 10. — Subgenus *Coleogeton* RAUNKIÆR, De danske Blomsterplanter Naturhistorie I: 1, 1896, 108.

Caulis teres vel subteres, ramosissimus—ramosus—subsimpler. *Folia* uniformia angustissime linearia ± canaliculata submersa, per totam latitudinem lacunis seu canalibus longitudinaliter perfossa, marginibus semper lævia, semper vaginata. *Spica* deflorata interrupta. *Stigma* papillosum papillis majoribus. — *Caulis*, pedunculus rachisque flexiles, endodermide instructi. *Fasciculi* libriformes caulini ± numerosi semper adsunt saltem in parte inferiore caulis. — *Hybernacula* (turiones) subterranea i. e. in rhizomate affixa. Ex *gemma* foliorum floralium superior est debilior. *Pollinatio* per aquam.

REICHENBACH, as already MERTENS & KOCH, equals a. *Coleogeton* with b. *Chloëgeton* and c. *Antiphyllögeton* etc. RAUNKIÆR in his Anatomical Potamogeton-Studies, 1903, 261, refers his *P. Robbinsii*-group to the subgenus *Coleogeton* for the sake of the sheaths, but this group associates naturally with the subgenus *Eupotamogeton*.

The subgenus may be divided into two sections: *Connati* and *Convoluti*.

Sectio I. *Connati* HAGSTR.

Folia fragiliora, fasciculis libriformibus carentia, plerumque trinervia, nervis ut solet tenuibus, lateralibus subepidermaliter in marginibus sitis. *Vaginæ* badeo-marginatæ, juniores integræ, hoc est in parte inferiore marginibus connatæ, plicatæ. — *Fasciculi* libriformes corticales pauci. — *Pollinatio* probabiliter in omnibus sub aqua locum habet.

To this section belong species generally of slender growth and poor in mechanical tissue in stem and leaves. Nor do any other anatomical facts afford any more

important distinguishing marks employable to the systematist. Especially the stem-anatomy is rather uniform.

Five species are known which should be divided in two subsections.

Subsectio 1. Filiformes HAGSTR.

Fructus rostro brevissimo verrucæformi.

P. filiformis PERSOON, Syn. plant. I. (1805), 152.

P. setaceus SCHUM., Enum. plant. Sæll. I, 1801, 51 (non L.). — *P. borealis* RAFIN. in Med. Reposit. 1808, 354? — *P. maritimus* POHL, Tent. Fl. Bohem. I, 1810, 159 ex GRAEBNER, Potamog. in ENGLER, Pflanzenr. IV, 11, 1907, 126.¹ — *P. fasciculatus* WOLFG. in J. A. et J. H. SCHULTES, Mant. in vol. III syst. veg. 1827, 364—365. — *P. marinus* L. ex FR., Novitiæ Fl. suec. 1828, 54. — *P. salinus* SCHUR, Phytogr. Fragm. CII, in Österr. Bot. Zeitschr. n. 9, 1870, 280 (nomen solum). — *P. capillaceus* MOERCK, Herb. Mus. Brit. 1821 ex AR. BENN. in Journ. of Bot. 1890, 301 (nomen solum). — Figs. 3 and 4.

The expression of *P. Bocconi*, that LINNÉ is said to have used, though not in the Öländska och Gotl. Resan 1745, 221, must not be understood as a species-name but only as a reference to the Fig. 5. tab. 20 in BOCCONE, Icones et descr. etc. and is an abbreviation instead of »*Potamogeton pusillum fluitans Bocconi*».

By the authority of Prof. E. FRIES the name *marinus* has been employed quite up to our days (HARTMAN, Handb. 1879; RICHTER, Pl. eur. 1890). Before FRIES it was applied to some forms of *P. pectinatus* (LINNÉ, ROTH, SCHUMACHER, *Flora Danica*, LAMARCK & DE CANDOLLE, SMITH, HARTMAN, WAHLENBERG and others) or to forms belonging both to *pectinatus* and *filiformis* (ALLIONIUS, Fl. pedem. ex synon.).

P. filiformis has often been mixed up with *P. pectinatus* and considered as a variety or subspecies of it (HOOKER, Stud. fl. Brit. Isl. 1878). Even as late as in 1894 K. SCHUMANN hesitatingly designates it as a distinct species (Flora brasil. III, 3, 696) and P. GRAEBNER comprehends *pectinatus*, *vaginatus*, *amblyophyllus*, *filiformis* and *pamiricus* to a species collective »*P. pectinatus*» (Potamog. 1907, 121); so still in the Synopsis mitteleur. Fl. 1913, 538. G. FISCHER certainly separates it from *P. pectinatus*, but regards it together with *P. juncifolius* as subspecies of a collective species »*marinus* autt.» (Die bayer. Potamog. 1907, 130).

No doubt *P. filiformis* is an independent species and well distinguished from *P. pectinatus*. Beside the differences mentioned by S. ALMQUIST, G. FISCHER and others, the most important of which, of course, pertain to the style and stigma (fig. 3, A), the fruit, the small perianth-leaves and the inflorescence, the dark-bordered connate sheaths (fig. 3, B) and obtuse leaves (fig. 3, E-H), we must also observe that the pollen grains are smaller and the hybrids of the two species always sterile.

¹ Yet it is uncertain if *P. filiformis* is here concerned. The name may have been adopted after PLUKENETH description in Almagestum botanicum 1696: *P. maritimum ramosissimum* etc. or it may simply be a misprint.

To this may also be added biological and anatomical differences.

The matter with the turios stands thus: As to their nature they are rhizomatic. A turio (Fig. 3, *C, D*) consists of two (or rarely three) generations of shoots in budstate. The third and fourth internodes of the first generation swell to an oblong form and likewise the first to the fourth internodes of the second generation while a concretion, indicated by a dotted line (in *D*), partly takes place between the third internode of the first generation and the first internode of the second generation, the whole only about 15 mm in length. *P. vaginatus* behaves in quite like manner (fig. 11, *E*), whereas *P. pectinatus* has its own way (fig. 15, *A*).

The spike-bearing branches behave as is shown in the fig. 2, *A* and the stem seldom prolongs itself by spike-bearing branches from the involucre leaf-axils.

On the way of ramification see HAGSTRÖM in NEUMAN and AHLFVENGREN, Sveriges Fl. 1901, 793. Each leaf-sheath clasps a single branch.

Anatomy. The epidermis of the stem consists of very long and narrow cells in contradistinction to *P. vaginatus* (the main-form) with very short almost cubic epidermis-cells. The statement of C. W. FONTELL (Beiträge anat. Baues Pot. 1909, 27): — »Die Epidermiszellen in verschiedenen Teilen des Stammes wie bei *P. vaginatus*»

etc. is misleading, evidently depending on an incomplete investigation, the author having only observed the cells in transverse section. They are inside covered with an one-layered pseudo-hypoderma, at the base of the stem rarely two-layered. Inside the epidermis occur a few (2—4) circles of lacunæ or air-channels, the wider outward, the narrower inward as usual. The inmost bark-part consists of one or a few layers of cells placed close to each other and along the endodermis as usual. The endodermis consists of faint u-cells. Between the corner-cells of the air-channels the cortical (vaginal) strands are drawn forth, at the basis of the stem forming a circle of 6—8 (10) strands, higher up of only 4—2—0 strands. In the peduncle and rachis they have entirely disappeared. The central cylinder has a rounded crosscut-form of the four-bundled type, basally in the stem passing into an eight-bundled arrangement. The

Fig. 3. *P. filiformis* PERS. *A*, Pistil, lateral view, $\frac{1}{2}$; stigma horizontally extended over the whole surface of the style. *B*, Transverse section of a very young leafsheath at base showing three vascular bundles, the midrib, *a*, and the lateral nerves *b-b* (corresponding to *a* and *b-b* in the next figure) and four mechanical strands; *l*, airchannels, *p*, plicate part finally bursting, $\frac{1}{5}$. *C*, Turio $\frac{1}{2}$. *D*, The same, $\frac{3}{4}$, deprived of its scales and their places signed with *f*, prophyllum and *sl*, scale-leaves; *I*, *II*, first and second generation; *1*, *2*, *3*, *4*, different internodes of these generations. *E-H*, Different forms of the leaf-apex showing the midnerve, the thin marginal nerves and the cross-walls of the lacunæ, $\frac{1}{10}$. *E*, common form. *F*, common form tipped with a very faint wart. *G*, var. *Macounii* MOR. *H*, var. *rivicolus* HAGSTR. and *tibetanus* HAGSTR.

central cylinder of the peduncle exhibits the same structure as the upper portion of the stem, but the lateral bundles are often still more reduced or have disappeared.

The anatomy of the leaf (fig. 4, *D*) exhibits a median vascular bundle surrounded by small air-channels, on either side of which one always meets with a row of wider lacunæ and subepidermally a faint bundle in the very margin, the leaves accordingly being three-nerved, although to the naked eye only one-nerved. The so-called cross-veins are the extremely thin cross-walls of the lacunæ.

The species varies rather much, though considerably less than *P. pectinatus*. The upper part of the style (not the stigma) grows often in this species and in *P. strictus* somewhat protracted backwards forming a little beak. The fruit of the usual

Fig. 4. *P. filiformis* PERS., *A*, Transverse section of stem, upper part, showing two barkbundles (*str*), central stele outlined, ϵ_1^0 . *B*, Transverse section of central cylinder, more enlarged (outlined) exhibiting two median bundles and two lateral ones, *a*, *b-b* corresponding to *a*, *b-b* in the cross-section of the leaf (below) and of the sheath (fig. 3, *B*). *C*, Transverse section of the peduncle with four bundles (outlined). *D*, Transverse section of a stem-leaf middle part, ϵ_1^0 . *E*, Longitudinal section of the epidermis of the stem, ϵ_1^0 . *F*, Longitudinal section of leaf-epidermis, ϵ_1^0 . *ep*, epidermis, *hp*, pseudo-hypodermis, in the stem one-layered, in the leaf two-layered, *l*, lacunæ, *x*, xylem-canals, *p*, pith, *end*, endodermis, *sept*, cross-walls of the lacunæ consisting of very thin stellate cells, *ho*, longitudinal walls *cc*, stele.

Baltic form as well as of most forms both from brackish and fresh water is small, but there also occur large-fruited forms especially on calcareous mud (formæ *megacarpæ*, *P. pycnostegus* KIHLM.), in which the walls of the very stone grow thicker than they usually do. But the shape of the lid and the ventral part is unaltered. The lid is always rounded on the back, of about the same form drawn in the fig. 116, *H*. The leaf-width varies slightly from 0,5–1 mm and the sheaths hold commonly 5–15 mm in length. The different habit of the specimens mostly depends on the variations in length of the internodes and peduncles.

Synopsis of the forms and varieties.

I. Narrow-leaved forms. Stem-leaves usually 0,5–0,75 mm broad.

1. *f. vulgaris* TISELIUS, Potamog. Suec. exs. fasc. III, 1897 n. 111–112: — The common Baltic form which also occurs in many other currents of water; usually of low growth (10–15 cm.) but with elongated peduncle (± 10 cm), small-fruited; to be considered as the typical form of the species. — Fig. 3, *E*.

2. *f. luxuriosus* HAGSTR., Potamog. in NEUMAN, Sveriges Flora 1901, 794: — Ca. 30 cm altus, foliis longissimis 0,5 mm latis, spicas valde superantibus. — On ground rich in nourishment.

This form is met with in Sweden, the vicinity of Stockholm: Vermdö, Vikings-hill, 1897, HAGSTRÖM. — *Lapponia rossica*, Varsugæ, Tschawanga in aqua dulci, 89, KIHLMAN (hb. Stockholm.), very like *f. alpinus* BL. — North America, Riv. St. Mary, Mich., U. S. A., 82, MORONG (hb. Stockholm).

3. f. *major* TISEL., l. c., fasc. III, 1897, n. 114—115. — A form *vulgaris* with more protracted internodes and often large-fruited.

In the Swedish herbaria this form occurs from the following places: *Sweden*, *Smoland*, Loftahammar 87, MONTELIN 91, FLODERUS (hb. Uppsal.), *Westgothia*, Barne-sjön, 81, NORDSTEDT (hb. Lund.), *Jemtland*, Refsundssjön, Märlgåviken, 84, TISELIUS (hb. Stockholm., Uppsal., Lund., Gotenb.), Frösön, 70, LENSTRÖM (hb. Uppsal. et Lund.); Mattmar, Drafsjön, 58, BEHM (hb. Lund.). — *Iceland*, Myvatn, 76, GRÖNLUND (hb. Uppsal.). — *Scotland*, Caithness, 85, GRANT (hb. Stockholm.). — *Switzerland*, Entre Ponte et Bevers, 73, BROWN (hb. Uppsal.). — *France*, Hautes-Alpes Lac du Pontet, 94, Vieux (hb. Lund.). — *Italy*, In lacubus subalpestris, D:r FACCHINI (hb. Uppsal.).

4. f. *linipes* HAGSTR. Potamog. from Asia in Bot. Not. 1905, 142: — *Caulis* elongatus internodiis summis 10—15 cm.; *Pedunculus* 25—30 cm longus.

Hitherto only known from *Asia*, Tibet, D:r S. HEDIN (hb. Univ. Stockholm.) and *Norway*, Senjen, 10, Notö (hb. Christian.), as far as one metre high.

5. f. *fasciculatus* (WOLFG.) HAGSTR., Potamogeton in NEUMAN, Sveriges Fl., 1901, 794. Cfr TISEL., l. c. fasc. III, 1897, n. 113 et 116. — *P. fasciculatus* WOLFG. in SCHULTES, Mantissa in vol. III etc. 1827, 364: — Humilissimus, pedunculis folia subæquantibus.

In shallow water at several places in *Sweden* (hb. Stockholm, Uppsal., Lund., Gotenb.) and *Norway* (hb. Uppsal.).

6. f. *crinisimilis* n. f. — Planta tenuissima, flexuosa, ramosissima, crinisimilis, 10—25 cm alta, internodiis brevissimis (inferne 3—5 mm), pedunculis 6—9 cm longis, paulo superantibus.

A very delicate plant, like a tuft of hair. It occurs in *Sweden*, *Scania*, Cim-brishamn, 67, TULLBERG (hb. Lund.); common in the *Lake Vetter* (hb. Stockholm., Uppsal., Lund., Gotenb.); *Bahusia*, Otterön (hb. Lund.); *Gestrikland*, Gefle at Orarne (hb. Stockholm.). — *Norway*, Næsseby, 64, HENSCHEN (hb. Uppsal.).

7. f. *polaris* n. f. — Vaginæ longiores (ad 25 mm), ceterum ut f. *vulgaris*.

Distribution. *Norway*, Nordland (hb. Uppsal.). — *Greenland*, Maneetsok, 83, Berlin (hb. Uppsal. et Lund.), Disco near Narsak, 71, FRIES (hb. Uppsal.). — *Italy*, Piemont, Hohenacker (hb. Uppsal.), Lac du Mont Cenis, Jordan (hb. Uppsal.).

8. f. *alpinus* BLYTT, Norges Flora I, 1861, 370: — *Folia* elongata, anguste linearia subparallelo-patentia. *Flores* minimi, fructus subglobosi. Ex BLYTT et specimenibus dovrensibus.

The distinguishing feature of this form or variety are the narrow (0,25—0,50 mm) leaves, arcuately rising from the sheaths. Against the description of BLYTT it has hitherto in the literature incorrectly been assumed to be and described as a tall form with broad leaves etc. and confounded with *P. pectinatus* and the hybrid *P. suecicus*.

From *Sweden* I have not been able to get the typical plant, but something like this form is found at Skellefteå (hb. Stockholm.). — *Norway*, Ost-Finm. Varanger, 64, FRIES (hb. Stockholm. et Uppsal.); Tana-elv between Seida and upper Fingervandet, 58, SOMMERFELT (hb. Stockholm. et Uppsal.); Saltö, Lillevaten, SOM-

MERFELT (hb. Uppsal.); Dovre, Todalen, 81, STRÖM (hb. Uppsal.); Dovre, Goverlivandet, 65, FALCK (hb. Lund.), Jerkind, 1837, LINDBLOM (hb. Christian.), Karasjok, 13, O. DAHL (hb. Christian.).

II. Broad-leaved forms.

Var. β . *Macounii* MORONG, in MACOUN's Cat. Canad. Pl. IV. 1888, 88. — In this form the lower leaves reach a breadth of 1,5 mm, the upper ones and the branch-leaves a little narrower, $\frac{3}{4}$ —1 mm, apex rounded (Fig. 3, G) and of nearly the same width as the middle part. Internodes and the peduncles short (the latter only 10—20 mm), spike dense-flowered. Stem often elongated with a very short spike-bearing branch. Sheaths, ramification, fruit, anatomy etc. seem not to diverge from the main-form. Through its often bushy habit and the short peduncle this variety much reminds of the f. *fasciculatus* but differs by the broad leaves and dense spikes. — It belongs to the prairie-region of *Canada*, but a similar form with the usual narrow leaves has been gathered by S. ALMQUIST in shallow water at Gälön in Södermanland, *Sweden*, 1888 (hb. Uppsal.): Mature spike dense, peduncle 5—10 mm. An interesting connecting form.

An authentic *P. filiformis* var. *Macounii* MOR., coll. MORONG, lies in hb. Stockholm. — Fig. 3, G.

Var. γ . *occidentalis* ROBBINS, Bot. King's Explor. etc. 1871, 339. — Resembles the next foregoing, but has longer peduncles. These two varieties are properly American types and by Dr P. A. RYDBERG held for a distinct new species, *P. interior*, yet after my opinion without sufficient grounds. Neither pistils nor fruits differ in any essential respects from the type, f. *vulgaris* TIS., and the anatomy is also the above described and figured.

Var. δ . *Kihlmanii* n. var. — *Caulis* elongatus, 20—30 cm; *folia* breviuscula, 0,5—0,75 mm lata, vaginis brevibus ($\pm$ 10 mm), latis, griseo-marginatis; *pedunculus* elongatus (100 mm); *fructus* magni. — *P. pycnostegus* KIHLM. in Herb. Upsal.

This var. differs from the f. *major* TIS. through the rather broad leaves, short sheaths with greyish margins and always large, thick-shelled fruits. On account of these somewhat bigger fruits it was by Dr A. O. KIHLMAN looked upon as a separate species, but large-fruited forms are met with in almost all species.

It occurs in *Sweden* on lime-ground viz. *Jemtland*, Sundsjön, 56, KROK (hb. Stockh. et Uppsal.); *Gothland*, Klintehamn in the river, 61, NYMAN (hb. Stockholm.).

Var. ϵ . *rivicolus* HAGSTR., Potamog. in NEUMAN, Sveriges Flora, 1901, 794. — Differt a typo foliis latioribus (0,75—1 mm) fusco-viridibus, pedunculo folia vix superante, fructu ut plurimum majore. — Fig. 3, H.

This form or variety is usually megacarp, but occurs also microcarp, in habit rather like f. *luxuriosus*, but with broader leaves, maintaining their width into the apex, by which it comes near to the following variety.

Distribution. *Sweden*, *Gothland*, Gothemsån, 94, JOHANSSON (hb. Stockh.), Klintehamn, 61, THEDENIUS, 82, ANDERSSON, 88, JOHANSSON, 91, BOLIN (hb. Stockholm., Uppsal., Lund.), Hau träsk, 55, STENHAMMAR et FLODERUS (hb. Stockh. et Uppsal.), Kyllgårdsåns utlopp, 52, Westöö, 53, Lth, 59, SANDEEN (hb. Uppsal.,

Lund., Gotenb.), Klinte, 72, ZETTERSTEDT (hb. Uppsal., et Lund.); *Öland*, Alvaret, Resum, 03, WITTE (hb. Uppsal.); *Smoland*, Västervik, Gränsö, 63, C. F. W. (hb. Stockh.) *Westgothia*, Floby, 93, STENHOLM (hb. Lund.). — *Norway*, Jæderen, 84, MURBECK (hb. Stockholm. et Uppsal.), Laurgård, 68, NORDSTEDT (hb. Lund.), Porsanger and several other stations (hb. Christian.). — *Denmark*, Jyll., Ravnstorp aa, Viborg, 70, NIELSEN (hb. Uppsal.). — *Switzerland*, Lac Domène, Alpensee im Canton Freiburg, Dr LAGGER (hb. Uppsal.). — *Bavaria*, in rivulo Ramsach prope Murnau, 05, G. FISCHER (hb. Stockh.), by FISCHER labelled: »*Potamog. juncifolius* KERN.».

Var. ζ . *tibetanus* HAGSTR., *Potamog.* from Asia in Bot. Not. 1905, 124: — *Folia* linearia ($\frac{3}{4}$ —1 mm), æquali fere latitudine usque ad apicem, apice breviter rotundata vel sæpe triangularia; vaginæ 20—35 mm longæ. — Very much like the preceding var. but with longer sheaths. Anatomy of the stem is the same. Fruit as usual.

Occurs in *Asia*, N. Tibet, Upper Kum-Köll, Dr. S. HEDIN (hb. Univers. Stockholm.), Tibet occ., THOMSON (hb. Stockholm.). — The form, mentioned by J. BAAGÖE in *Potamog.* from Asia-media, 1903, 183, n. 11 from Pamir, Bulung Kul, alt. 3,800 m, is also the present variety. — Fig. 4, H.

P. filiformis seems to be principally an alpine and northern species. After the glacial period it evidently has spread northward from especially three sources: 1) The German Jura through Germany to the Baltic and surrounding countries, and northwestward to England, Shetland etc., Faroe Islands, Norway (to Magerö, hb. Christian.), Iceland. 2) High-Asia, how far to the north (northwest and northeast) is not fully explored. The author has seen specimens from Siberia, Vorogov in Yeniseivalley at 61° n. lat, coll. by M. BRENNER (hb. Stockholm.). 3) Rocky Mountains to Wyoming and Nevada (var. *occidentalis* ROBB.) — Northeastern United States and Canada—West-Greenland to Disco Island, near Narsak, 71, FRIES (hb. Uppsal.), and Omenak Fjord, Ikerasak (ca. 71°), 92, VANHÖFFEN (hb. Hauniense), probably the most northern place hitherto known.

To the south of the line of The Pyrenees—The Alpes—Himalaya it seems not to have spread. At least we know of no sure statements. The report of Australian habitats may need further confirmation. But that line coincides nearly with the year-isotherm for + 15° C., and it is rather certain that the species does not surpass this line in America either. Thus we should have its occurrence between the year-isotherm of + 15° and — 5° (Omenak) to 8°, in Siberia up to — 10° C or more.

As to *Sweden* it is not very rare in bays along the Baltic coast. — In fresh water it occurs chiefly on calcareous ground. (Gothland: Tingstäde, Öland, Scania, Ostrogothia: Lake Vetter, Westgothia, Upland: Lake Mælar, etc., Jemtland and Lapland: Barrseleavan). The museums include a great deal of material from all these counties. — On the west coast of Sweden it is found only at Otterön in Bahusia (immigrated from Norway?).

Finally I will point out the biological conformity that is to be found between the most northern forms in Greenland and the forms in the Alps and High-Asia (Thibet), namely the longer sheaths (f. *polaris* and f. *tibetanus*), evidently an adaption to colder water.

P. filiformis PERS. × **pectinatus** L. Ex ALMQUIST, Om gruppen Ligulatæ Fr. af sl. Pot. in Bot. Not. 1889, n. 2, 62. — *P. suecicus* RICHT., Pl. Eur. I, 1890, 15 (nomen solum).

Undeniably this hybrid is among the more difficult ones to determine correctly. In the sterility certainly we have a good clew yet a strict attention is necessary, since *P. pectinatus* also sometimes appears more or less failing in the evolution of fruits, dependent, as I think, on the often observed deformity of the stigmata. On the contrary the pollen always seems well-shaped and richly developed in this species, whereas the hybrid always exhibits all grains or at least the greatest part of them deformed. When sometimes one or a few fruits are brought to maturity they hold the middle size between the two parents, but as far as it is now explored, always with deformed embryo. The spikes consist sometimes of 3—4 small-flowered often closely placed verticils, sometimes of 4—5 verticils, usually with a little larger perianths, i. e. upon the whole more *pectinatus*-like. Stem commonly very thin and *filiformis*-like with 2—3 bundles in the middle internodes, but often toward the base a little thicker and with much stronger leaf-sheaths, whereby its connexion with *P. pectinatus* conspicuously appears, more seldom of tall and luxuriant growth reminding of a river-form of *pectinatus* and in this case with more cortical strands, but also with more elongated leaves and more intensive green colour than in *P. pectinatus*. The leaves ordinarily are more or less obtuse (*filif.*-like), but forms with subacute or cuspidate leaves now and then occur. Sheaths more seldom long and *pectinatus*-like, often shorter and darkbordered, reminding of *P. filiformis*.

As many different forms occur, it seems necessary and convenient to group them into series. According to the shape of the leaf-apex we shall have four groups:

α. **Acutus**: — Folia sensim attenuata ± acuta.

Forms of this series are not by their leaf-apexes distinguishable from *P. pectinatus*.

β. **Intermedius**: — Folia sensim attenuata ± obtusa.

Forms belonging hereto are in every respect the most intermediate of all. The apex is tapering but commonly rather obtuse.

γ. **Cuspidatus**: — Folia ± cuspidata aut obtusa cum mucrone saltem pro magna parte.

In habit these forms may be more *pectinatus*-like, or approaching very much to *P. filiformis*.

δ. **Obtusus**: — Folia obtusa ± lata, longa vaginis longis.

Conspectus formarum.

α. **Acutus** HAGSTR.

1. f. **holmiensis** n. f. — *Caulis* tenuissimus, internodiis elongatis (80—100 mm.); *folia* angustissima (0,5—0,25 mm) elongata (ca. 100 mm) sensim attenuata, vaginis

brevibus, superne 10—15 mm, inferne 20 mm viridiusculis; *pedunculus* elongatus; *spica* 2—4 (5)-verticillata parviflora.

This form is extremely like *P. pectinatus* f. *laxus* TIS. It has been collected by Dr G. TISELIUS at Stockholm 1896 (hb. Upsal.) and by him looked upon as a »f. *laxus*».

2. f. *gevaliensis* n. f. — Longitudo foliorum et structura, color vaginarum, stylus et stigma ut in *P. filiformi*; *pedunculus* autem brevior, *spica* 4—5-verticillata, verticillis approximatis; sterilis.

Habitat: Sweden, Gefle, in a ditch, 1818 (hb. Stockholm.), Gefle ballast-quay, 87, ZETTERSTRÖM (hb. Stockholm., Uppsal., Lund.).

β. *Intermedius* HAGSTR.

3. f. *Hartmanii* n. f. — *Caulis* 25—40 cm altus badeo-viridis, inferne crassiusculus. *Folia* ± angusta, 5—10 cm longa, vaginis brevibus, superioribus 15—20 mm, inferioribus 20—30 mm sæpe crassiusculis ut in *P. pectinato*, fuscoviridibus vel ± albido-marginatis præsertim inferioribus. *Spica* vulgo 4—5-verticillata, semper sterilis.

Distribution. Sweden, *Gestrikland*, Gefle, Orarne, 35, hb. Hn. (hb. Uppsal.), Iggö, 97, ARNELL (hb. Uppsal.). — *Uppland*, Länna, Furusund, 96, TISELIUS (hb. Stockholm., Uppsal., Lund., Gotenb.) is n. 119 in TISEL., Pot. suec. exs. III; Norrtelje, H. & D. TISELIUS (hb. Uppsal.). n. 119 in d:o. — *Sudermania*, Österhaninge Gälön, 87, ALMQUIST (hb. Stockholm. the plant mentioned in ALMQU. Bot. Not. 1889), 90, RIBBING (hb. Uppsal.), Järna, Ängsholmen, 81, 82, SANDÉN (hb. Uppsal., Lund.), Hallsfjärden, 93, HAGSTRÖM (hb. Stockholm.). — *Ostrogothia* Jonsberg, in several places (Ölskär, Yttre Högsjär, Gubbholmen) coll. ELMQUIST, STENHAMMAR, HAMMARSTEN (Lönö) (hb. Stockholm., Uppsal., Lund.). — *Smoland*, Lofta, Lerboholms sufferance-wharf (hb. Stockholm.) on the same page as *P. filif.* and *pectin.*, evidently collected at the same time; Västervik, 63, HOLMSTRÖM & LYTTKENS (hb. Lund.). — *Öland*, Björnudden, 83, NORDSTEDT (hb. Lund.). — *Gothland*, Kapellhamn. — *Denmark*, Suså, 99, BAAGÖE (hb. Stockholm.), more slender and elongated (river-form).

4. f. *abundans* n. f. — *Caulis* altus ramosior; *folia* longa, vaginis longis.

Distribution. Sweden, *Ostrogothia*, Jonsberg, Yttre Högsjär, 80, ELMQUIST (hb. Lund.). — *Iceland*, Laxå, Husavik, 99, GUDJONSON (hb. Stockholm.); Myvatn, 76, GRÖNLUND (hb. Uppsal.). On the same page a specimen of *P. filiformis* f. *major* TIS. and one specimen of *P. pectinatus* L., apparently collected at the same place and parents to the hybrid plant. N. Amer., Sault Ste Marie, Mich. 81, HILL (hb. Haun.).

γ. *Cuspidatus* HAGSTR.

5. f. *ysanensis* n. f. — *Caulis* tenuissimus, internodiis elongatis; *folia* angustissima, pulchre cuspidata, vaginis fuscis, brevibus; *stylus* ut in *P. pectinato*.

This form is much like the *P. pectinatus* var. *ungulatus* HAGSTR. (see under *P. pect.*!) as to the leaf-apex. However, the half of the pollen-grains are deformed and the well-shaped grains smaller and of another form than in *P. pectinatus*. In this species the grains are always more or less conspicuously oblong, in the present form they are almost completely spheric. The diminution of the grains (influenced by *P. filif.*) has been made at the expence of the length. —

Habitat: Sweden, Blekinge, Ysane, coll. by SÖDERLUND, 1886 (hb. Lund.).

6. f. *alandicus* n. f. — *Staturâ humili, internodiis brevissimis; præterea ut in præcedente.*

Habitat, Finland, Alandia, Saggö, 97, SERNANDER & OLSSON (hb. Uppsal.).

7. f. *Wahlenbergii* n. f. — *Caulis elongatus habitu P. pectinati. Folia fusco-viridia 100 × 0,75–1 mm vaginis badeo-marginatis ± 20 mm longis, junioribus integris (P. filif.). Pedunculus 4–5 cm; spica 3–4-verticillata verticillis approximatis, parviflora; stylus ut in P. filiformi; sterilis.*

The apex of the leaves is abruptly formed to a short, sometimes only verrucose, subobtuse point. From the upper leaf-axils (more exactly expressed, from the basal scales of the primary upper branches) there often grow out rhizomatic shoots just as in *P. pectinatus*, though of slender structure, an occurrence often met with in other forms of this hybrid for instance in f. *Hartmanii* and f. *Kernerii*, see below. Through those rhizomes and their turios the plant, though sterile, has an excellent mode of spreading over vast regions. In *P. filiformis* we have scarcely observed such rhizomes in the leaf-region.

As to the stem-structure it may be remarked that also in this form 2–3 strands occur in the cortex at the middle of the stem. Forma *Wahlenbergii* is a very instructive form since the two parent-species most evidently appear in it and both, so to say, contest one with the other to put forth their peculiarities.

Distribution. Sweden, Uppland, Fyris at Ulfva, WAHLENBERG (hb. Stockholm., Uppsal.). A similar form is coll. in Norway, Jæderen 75, BRYHN (hb. Christian.).

2. Obtusus HAGSTR.

8. f. *Kernerii* n. nom. — *P. juncifolius* KERNER ap. FRITSCH in Verhandl. K. K. Zool.-bot. Gesellsch. in Wien, Wien 1896, 364–366. — Fig. 5.

This form is for the first time gathered by Prof. A. KERNER v. MARILAUN at Giessen, Innsbruck, in the year 1866; later also found in cold rivulets at Egerdach (common) and Seefeld (Innsbruck).

In his herbarium KERNER has labelled the plant *P. juncifolius* remarking that the fruit by its slight size and low beak associates the plant with *P. marinus* L. (= *filif.* PERS.) and that in habit it is like *P. zosteraceus* FR. D:r G. TISELIUS (in Bot. Not. 1884, 91–92) and AR. BENNET (in Flora exsicc. Austro-Hung.) held it at first to be *P. flabellatus* BAB. TISELIUS has later on defined it to be a distinct species. He observes, that the fruits are few in number and closely resembling those of *P. vaginatus*, that the leaves are of equal width up to the obtuse apex etc.

FRITSCH notes, that it is not identic with *P. flabellatus* according to FRYER's description. C. RAUNKIÆR (Danske Blomsterpl. Naturhist. 1896, 73) is in doubt of its specific rank and rather puts it near to *P. filiformis* v. *alpinus* BL. In this G. FISCHER (Bayer. Potamog. 1907, 130) also agrees, making of the two (regarded as subspecies) a collective species »*P. marinus* autt.» On the misconception of v. *alpinus* BL., see p. 17.

Many years ago I have come to the opinion below expressed about these plants and in order to get the question critically elucidated I had written to Prof. P. GRAEBNER before the publishing of his *Potamogeton*-monography. Meanwhile I have been misunderstood. He has considered it to be about a plant, here below referred to *P. strictus*, whereas I had the European plant *P. juncifolius* in view (P. GRAEBNER, in Pflanzenr. 1907, 124, 162).

The facts which, as it seems to me, decidedly prove its hybrid origin are 1) the sporadic occurrence. Beside the first named locality it seems to occur in but two more places: Kongeaa and Skalsaa in Jutland. Moreover the specimens from these three stations (Innsbruck, Kongeaa and Skalsaa) are not quite identic, although they may be brought without inconvenience under the same denomination. 2) The abundantly developed vegetative system with rhizomas and turios in fellowship with a very rare occurrence of fruits. This characteristic has also made G. FISCHER

think of a hybrid origin. Later, after finding freely fruiting individuals at Murnau he has attributed the sterility to swiftly running water. But if this might sometimes be disadvantageous to the fertilization, we cannot from this fact explain either that the few developed fruits after examination always seem to have impotent embryo nor the sterility of the pollengrains. The fruiting plant of Murnau I have seen (hb. Stockh., see above! p. 19) is *P. filiformis* PERS. var. *rivicolus* HAGSTR. Finally 3) this plant is wanting original characters. All its characters belong either to *P. filiformis* or to *P. pectinatus*. Of the latter we are reminded by the numerous internodes and their length, the thickness of the stem and branches with abundant evolution of vascular- and bast-bundles in the cortex, particularly in the Kongeaa-plant, the width of the leaves and the length of the sheaths sometimes but rarely also the leaf-apex, that I, after seeking assiduously, really once have found provided with a little wart or slight cuspid (specimens from Giessen coll. by SARNTHEIM, hb. Lund.), the 4—6 verticils of the spikes with comparatively short intervals and, further, with respect to the anatomy of the stem, the endormis composed of strong one-sidedly thickened *u*-cells. We are, on the contrary, reminded of *P. filiformis*

Fig. 5. $\times$ *P. suecicus* f. *Kernerii* HAGSTR. A, Leaf-apex, common shape, $\frac{2}{3}$. B, Leaf-apex, *pectinatus*-shaped, $\frac{2}{3}$ (material from Giessen, leg. SARNTHEIM). C, Transverse section of a leaf, $\frac{5}{1}$, a the midrib surrounded by small lacunae, b, marginal nerves, l, the large channel-row (materials from Giessen).

by the colour of the leaves, their fragility and apexes (in general), the colour and structure of the sheaths and their quality of being connate when young, and the mode of branching with only one branch in each axil. Finally the pollengrains, style and stigma belong to *P. filiformis*, to which may be added that the fruit when developed is intermediate or often hardly larger than in a macrocarp *P. filiformis*. The central cylinder of the stem is rather slightly differed from that of the just mentioned species.

Distribution. Denmark, Jutland, Kongeaa, 96, BAAGÖE (hb. Stockholm.). — *Tirolia* sept. in rivo Giessen, HELLWEGE (hb. Lund.), ZIMMETER et ZARNTHEIM (hb. Lund.), Innsbruck in Giessen, 83, TISELIUS (hb. Stockholm. et Uppsal.). In lacu »Pillersee» ad St. Ulrich 834 m s. m., 10, KELLER (hb. Stockholm.).

***P. filiformis* PERS. × *vaginatus* TURCZ.** — *P. vaginatus* × *filiformis* ex FONTELL, Von ein. Potam. Hybriden 1902, 2. — *P. filiformis* × *vaginatus* ex FONTELL, Beitr. Anatom. Bau Pot.-Art. 1909, 30. — *P. jennicus* HAGSTR.

This bastard has a greyish tone of colour that points to *P. vaginatus* as the one of the parents. This parentage is confirmed by the richer ramification, thus differing from × *P. suecicus*, in which the evolution of branches more agrees with *P. filiformis* and the colour moreover inclines to brown or green. It differs from *P. pectinatus* × *vaginatus*, the more slender forms of which it bears strong resemblance to, through the slender, only at the base somewhat thicker stem, the usually shorter weaker basal sheaths, the always obtuse, narrow and often longer, upwards less tapering leaves and a less number of cortical strands in the stem, commonly 6—8 in one circle at the middle internodes. For the rest the sheaths are intermediate, but even when very young open as in *P. vaginatus*; ligules as in *P. filiformis*, but more persistent and of stronger structure, leaves elongated and narrowly linear, peduncles thin and more elongated, spikes of four verticils or more. A cross-section of the stem shows a central cylinder with four lysigene channels, an endodermis of typical *u*-cells and usually a few narrower air-cells among the wider in the uttermost circle. The leaf-structure is more like that of *P. vaginatus* than of *P. filiformis*, and the marginal nerves retire more or less from the border just as in that. In the peduncle the four central vascular bundles appear conspicuously, and in the whole the hybrid in its hitherto known forms approaches more the *P. vaginatus* than the *P. filiformis*. The slenderness, the thin elongate peduncle and intermediate mode of branching makes it at the first glance rather easily recognizable.

Distribution. Sweden, West-Bothnia, Löfånger, 1870, L. ANDERSSON (hb. J. O. HAGSTRÖM). — Finland, Ostrob. bor., Karlö, 84, SANDMAN (hb. Uppsal.). The third locality is Pedersöre, Ostrob. med., coll. C. W. FONTELL 1901.

A plant from Canada. Winipeg Valley, 1859, E. BOURGEOU (hb. Stockholm), labelled »Pallisers Brit. N. Am. Expl. Expedition. *P. pectinatus* var.» I as well refer to this hybrid. According to A. O. KIHLMAN (in Meddel. Soc. Fauna et Fl. fenn. 1888, 113) *P. vaginatus* is said to have been collected by BOURGEOU, on the Expedition of PALLISER in 1858 in Saskatschavan and communicated as *P. pectinatus*

L. (probably to the Museum of St. Petersburg) and MACOUN's Catalogue Canad. Plants 1888 records it from Buffalo Lake, lat. 56°. It is thus testified, that *P. vaginatus*, or a form of it, occurs in Canada (see under *P. vagin.*). *P. filiformis* also is growing there, and the Winipeg-plant really has much, that reminds of the two species: stem rather thick but the ramification as in *P. filiformis*; leaves narrow, blunt, greyish-green; sheaths short, 15—20 mm, but rather dark and of strong structure, ligules persistent, even in the basal sheaths; peduncle short (— 60 mm) as in *P. vaginatus* with almost overtopping leaves; spike of 4—6 approximate verticils. This form should be called f. *brevipes* n. f.: ped. brev. — Another form, coll. by Low at Fort Chimo, Labrador (hb. Haun.), with very long leaves and peduncles, I would name f. *longipes* n. f.: ped. longiss.

P. pamiricus BAAGÖE.

Potamogetonaceæ from Asia-media in Vidensk. Medd. fra den naturhist. Forening. Kjöbenhavn 1903, 182. — Fig. 6.

In his dissertation (p. 183) BAAGÖE has mixed up two different species. The same is the case with his assigning of names in the Museums of Lund and Copenhagen. The plant, gathered by O. PAULSEN in Pamir and named *P. pamiricus* is quite another than that collected by ROBOROWSKY in Kuen-Luen. This one has been found to be a beautiful, distinct, new species separated from *P. pamiricus*, which is very nearly allied to *P. filiformis* and scarcely specifically separated from it. The description of BAAGÖE meanwhile refers to PAULSEN's plant from Pamir and the name *pamiricus* consequently is to be kept for this form. A plant from Thibet (hb. Lund. et Haun.), gathered by T. THOMSON and determined by BAAGÖE, pretty well corresponds to the description except a couple of measure-notes. Stem about 0,5 m high, the basal internodes also elongated (4—8 cm); leaves as to length and width, apex and nervature like a broad-leaved *P. filiformis* (the Pamirplant, too, seemed to me to have 3-nerved leaves, BAAGÖE's description: 3—5-nerved, counting also the longitudinal lacunar walls?). The sheaths of the Thomson plant are 10—25 mm in length, those of the Paulsen plant somewhat longer, especially the basal ones. Peduncle 3—4 cm, spike 3-verticilled, flowering 10—20 mm long. Ripe fruit not seen.

A transverse section of the Thomson plant showed a central cylinder with one wide air-channel, a *u*-endodermis and three to four cortical strands. ROBOROWSKY's plant will be described farther below.

Distribution. Asia, Tibet occ., 12—15,000', T. THOMSON (hb. Lund.). BAAGÖE has given to the Mus. of Lund a »*P. pamiricus*» labelled: »Asien. Pamir. In stagnis prope lacu Kara-Kul, 1890. Ove Paulsen», yet evidently originating from another place.

Fig. 6. *P. pamiricus* BAAGÖE. Leaf-apex, $\frac{3}{4}$ °. Lacunar walls and marginal bundles visible.

P. strictus PHIL. Florula atacamensis, 1860, 50.

P. aulacophyllus SCHUMANN in Fl. brasil. III. 3, 1894, 696. — Fig. 7, A—B.

This species also comes very near to *P. filiformis*. As to style, stigma and ripe fruit it may hardly be discerned from it. The way of branching, likewise, is also the same: every sheath embraces but one branch.

The low-grown form, being only 9—13 cm high, is to be considered as main-form. It has comparatively short (3—6 cm) leaves and short sheaths. Leaves usu-

Fig. 7. A—B, *P. strictus* PHIL., C—D, *P. strictus* PHIL. var. *magellanicus* HAGSTR. A, Apex of a stem-leaf, $\frac{2}{1}^0$, the bottoms and walls of the lacunæ visible. B, Transverse section of a stem-leaf (middle part), $\frac{2}{1}^0$, $\frac{2}{1}^0$, vascular bundle of the midrib, $\frac{2}{1}^0$, lateral bundles, $\frac{2}{1}^0$. C, Transverse section of a stem-leaf, middle part, $\frac{2}{1}^0$, $\frac{2}{1}^0$, $\frac{2}{1}^0$, as in B, $\frac{2}{1}^0$, marginal bastbundles, $\frac{2}{1}^0$. D, apex of a stem-leaf of v. *magell.*, $\frac{2}{1}^0$, bottoms and walls of the lacunæ visible.

ally a little over 1 mm broad, of the same width up to the rounded apex, canaliculate and obtusely keeled, 3-nerved, the lateral nerves being a little more removed from the margin than in *P. filiformis*. Ligules truncate or subretuse. A cross-section of the leaf presents very seldom a faint subepidermal strand which, again, always is to be found in the variety described below. The peduncles are short, 2.5—4 (— 6—7) cm, also the spikes that consist of 3—4 approximated verticils.

Anatomy of stem: The Philipian specimens of Atacama exhibit the following peculiarities: Epidermis of long narrow cells, inside strengthened by an one-celled pseudo-hypoderma along which appears a circle of large-roomed lacunæ, evidently wider than in *P. filiformis*, whereon follow 2—3 circles of narrower lacunæ. Three

vascular bundles appear in this lacunar tissue. Inward the cortex is confined by a *u*-endodermis. The central cylinder is four-bundled just as in *P. filiformis* which does not very distinctly differ from it. Cf. fig. 2!

Distribution. *Chile*, Desert. Atacama, 84, PHILIPPI (hb. Stockholm.), of very low growth; *Argentina*, Jujuy, 01, FRIES (hb. Stockholm.), 4,300 m s. m. *Patagonia*, territ. Sta Cruz, 09, SKOTTSBERG.

Var. *magellanicus* n. var.

Caulis 30—50 cm altus, internodiis inferioribus 4—5 cm, superioribus 6—7 cm, subteres, flexilis, ramosus, ramificatione ut in *P. filiformi*. *Folia* badeo- vel fusco-viridia ± canaliculata rotundato-obtusa ± rotundato-carinata, 3-nervia, vaginis badeo-marginatis ± 30 mm (iis ad folia flor. 20 mm) longis, ligulis 15 mm retusis membranaceis, folia caulina infima 2 mm, superiora 2—1,75 mm lata, 100 mm longa, ramea summa 100—150 mm longa vaginis 30—50 mm longis. *Pedunculus* 80 mm; spica florens 10—15 mm, fructifera 35 mm, 4—6-verticillata. *Stylus* brevis, stigma humile rotundatum. *Pollen* sphæroideum. Fructus iis formæ primariæ similes. — Fig. 7, C—D.

The variety differs from the type by its higher stature, stouter stem, below 2 mm in diam., broader leaves, longer, and broader sheaths. Flowers somewhat larger than for instance in *P. filiformis*, leaves more conspicuously keeled than in the type having a bast-bundle subepidermally in the margins (fig. 7, C, *skl.*). The stem has a circle of 6—8 bast- and vascular bundles in the cortex, a 2-layered pseudo-hypoderma and no subepidermal strands. Central cylinder terete with 4 cavities (4—8-bundled).

Just as the typical form is extremely like *P. filiformis*, the variety also is similar to × *P. suecicus* f. *Kernerii* m. and was accordingly at first determined by me as *P. juncifolius* when this plant was considered a true species. It can, however, even without fruit, easily be distinguished from the hybrid through the more uniform leaves, the topmost leaves scarcely being narrower than the basal ones. The leaves taper very slightly towards the tip and appear more lacunous, the lacunæ being shorter and their bottoms more approached to each other which appears to the naked eye, when the leaf is held against the light. The transverse section of a leaf shows also, that the leaf is more canaliculate and faintly keeled, to which may be added that the lateral nerves are more removed from the margins, each being provided with a microscopical bast-bundle. Pollen spheric, of large grains (or of middle size).

Distribution. *S. America*: Tierra del Fuego septentr., Gente Grande, 96, P. DUSÉN n. 280 Pl. in regione Magellanico lectæ (hb. Uppsal.); Territorio Chubut, Lat. S. 44° 0', Long. W. 70° 30', rivulet 02, HÖGBERG (hb. Stockh.).

P. rostratus n. sp.

Caulis humilis a basi ramosus filiformis badeus, internodiis mediis longioribus. *Folia* angustissime linearia viridia vel fuscoviridia loculosa 3-nervia, nervo laterali in margine situ ut in *P. filiformi*, brevissime subacuta vel subcuspidata, canaliculata,

apice sæpe recurvata, caulina omnia æquilata, $50 \times 0,8 - 1$ mm, vaginis 15 mm (summis 8 mm) longis, ramea angustiora (0,75 mm), superne paulo longiora, vaginis 20 mm longis. *Vaginæ* badeo-marginatæ juniores integræ ligulis membranaceis 5—8 mm longis. *Pedunculus* brevis (sub anthesi); spica florens brevis (10 mm) 8-flora, floribus minoribus. *Pollen* ovale magnitudine media. *Stylus* brevis, stigmatum humili, postice in rostrum breve protracto; fructus non visus. — Fig. 8.

Anatomy of the stem: Epidermis-cells elongated and rather wide, almost of the same width as the bark-cells supporting it (hypoderma). Endodermis-cells almost insensibly thickened (faint *u*-cells). The strands of the cortex and the central cylinder as in *P. filiformis*, from which the anatomy but little differs. The leaf-anatomy also corresponds nearly to that species. Consequently there are two rows of larger

Fig. 8. *P. rostratus* HAGSTR. A, Apex of a stem-leaf, $\frac{2}{3}$; B Apex of a branch-leaf, $\frac{2}{3}$, the cross-lines represent the bottoms of the lacunæ, a, b, See C! C, Transverse-section of a leaf (middle part); a, b, vascular bundles (nerves), $\frac{1}{4}$; D, Pistil from the side, $\frac{1}{8}$; E, Stigma (more enlarged) seen from above.

lacunæ on each side of the small lacunæ round the mid-bundle. Seldom someone or other of these greater lacunæ is longitudinally divided into two (fig. 8, C, to the right!). Towards the leaf-apex the channel-bottoms are scarcely visible outside. The marginal nerves run subepidermally only a couple of cell-layers from the epidermis, and join the mid-bundle quite in the utmost tip (fig. 8, A, B).

This description is made after a single little flowering specimen and, of course, the statement of the length of the peduncle, spike and of the whole plant wants to be completed by further researches. Nevertheless it is even without fruit easily recognizable from the slightly recurved leaf-apex, that in its form much reminds of *P. pectinatus*, and from the stigma protracted backwards in a little beak as in *P. recurvatus* m., thus combining in an interesting way different groups of the subgenus *Coleogeton*. The connate sheaths, the ramification and other characters yet show its close relation to *P. filiformis*, the group of which it completes by the acute leaves, whereas the other species have obtuse leaves.

Distribution, Asia. Mongolia bor. Desertum a Thian Schan boream versus, 1877, POTANIN (hb. Stockholm.).

Subsectio 2. Amblyophylli HAGSTR.

Fructus rostro acuto subincurvato.***P. amblyophyllus* MEYER.**

Verzeichniss der von dem Herrn Dr. KOLENATI in dem mittl. Theile des Caucasus etc. ges. Pfl., — in Beitr. zu Pflanzenkunde des russ. Reiches. St. Petersburg, 1849, 10. — Fig. 9.

Fig. 9. *P. amblyophyllus* MEY. A, B, Tops of branch-leaves showing the different form of the apex, the lacunæ and the way in which the lateral nerves join the midnerve in the apex, $\frac{2}{3}$; C, Peduncle and spike (nat. size); D, Fruit from the side, $a \times 4,3$, $b \times 3,5$. E, Fruit, cross-section, $\frac{2}{3}$, a, back, b ventral side, $\frac{2}{3}$.

Certainly MEYER's latin description is very extensive yet not quite exhaustive, wherefore I think it proper to complete it, the more so as I have had occasion to examine the very original specimen collected by Dr. KOLENATI at Kasbek, now preserved in the St. Petersburg museum.

Stem 20—30 cm high with short internodes of equal length richly branched, in each leaf-axil only one branch with very short internodes, secondary branches wanting. *Stem-leaves* linear, ± 1 mm broad, fragile, lacunous (no whole stem-leaves are preserved on the material and the basal leaves are quite wanting) with sheaths 15 mm in length or somewhat longer in the lower part. *Branch-leaves* linear, short, 50—60 mm, 3-nerved, the lateral nerves running in the very margin as in *P. filiformis*, apex roundly obtuse; sheaths of the branch-leaves brown, short. Young *ligules* 8—10 mm in length, subretuse, their frontfield faintly nerved. *Peduncle* filiform, 5—7 cm. *Spike* of 5—6 (or possibly more) whorls, the basal one a little retired, the others more approached to each other, the whole ca. 30 mm in length. *Pollen* and

pistil unknown. *Fruit* extremely characteristic, with well-developed distinctly inward-turned, acute rostrum, convexe sides, and rounded back without keel, 3,5 mm long and 2 mm broad.

The transverse-section of a leaf shows a structure nearly quite the same as in *P. filiformis*. The lateral nerves run subepidermally. The bottoms of the lacunæ appear to the naked eye as »cross-nerves» (*venis crassiusculis transversis*: MEY.). The stem-anatomy scarcely exhibits any difference from *P. filiformis*. The cortical parenchyma has two strands or vascular bundles, the endodermis consists of *u*-cells, bundles of the central cylinder arranged *filiformis*-like in 2—4 areas with the same number of cavities. But if anatomically scarcely separated from *P. filiformis*, it easily differs from this and allied forms by the mode of branching, the very short internodes of the branches, the subretuse ligules, and the fruit. Probably because of the rostrated fruit MEYER says, »proxime ad *P. pectinatum* accedit», and GRAEBNER considers it as *proles* under that species, whereas BAAGÖE correctly puts it nearer to *P. filiformis*, with which the sheaths undoubtedly connect it. In fact *P. amblyophyllus* is a very beautiful and interesting species within this section, analogous with *P. pectinatus* in the following.

Distribution. *Asia*, China borealis prov. Kansu orientalis, 1885, G. N. POTANIN (hb. Stockholm.). Thus we have this species from the Caucasus and eastward probably as far as the Pacific.

The five species treated of above have been found to be both morphologically and in their biological and anatomical conditions nearly allied to each other, and the same can also be said of the species of the next section.

Sectio II. *Convoluti* HAGSTR.

Folia firmiora, fasciculis libriformibus subepidermalibus non solum in marginibus sed etiam in medio instructa, 3—5(7)-nervia. *Vaginæ* sæpe albido-marginatæ semper fissæ et in parte inferiore subconvolutæ. *Fasciculi caulini* libriformes corticales numerosi, præsertim in inferiore caulis parte. *Pollinatio* in superficie, ut videtur, aquæ fit.

All the species belonging hereto are rich in sclerenchymatous tissue and endowed with open leaf-sheaths, which are subconvolute. They should be described under two subsections with regard chiefly to the fruit.

Subsectio 3. *Vaginati* HAGSTR.

Fructus rostro humili verrucæformi.

P. subretusus n. sp.

Rhizoma gracile. *Caulis* badeus filiformis tenuissimus teres elatus, internodiis inferioribus brevibus, sequentibus sensim longioribus, summo pedunculi fere longitu-

dine, ramosus ita ut nulla vagina foliorum caulorum duos ramos primæ et secundæ ordinis $\pm$ evolutos non amplectat, ramis summis spicam sæpe superantibus. *Folia* fusco-viridia tenuia subplana 3(5)-nervia striata angustissime linearia (0,5—1 mm), inferiora breviora, superiora sensim in longitudine crescentia (ca. 10 cm), omnia obtusa apice præsertim in floralibus subretusa. *Vaginæ* badeo- vel fusco-virides badeo-marginatæ fissæ subelongatæ, summæ 2—3(4) cm longæ, ligulis tenuibus 7—10 mm longis. *Pedunculus* tenuissimus teres flexilis 10—15 cm longus. *Spica* 6—7—(8)-verticillata fructifera 35 mm longa internodiis brevibus æquilongis (ut in *P. vaginato*). *Stylus* subnullus, stigmate rotundato, in fructibus verrucellæ simili persistente. *Fructus*

Fig. 10. *P. subretusus* HAGSTR. A, Top of an involucre leaf, showing the course of the small superficial nerves (mechanical strands) and the way in which the lateral nerves join the midrib, $\frac{2}{3}$. B, Transverse section of a stem-leaf (middle part) a, b—b, chief nerves, str, subepidermal strands, l, lacunæ, $\frac{2}{3}$. C, Transverse section of the stem's axial stele (4-bundled diagram), a, two bigger median bundles with intercellular channels (x), b, lateral bundles, $\frac{2}{3}$. D, Spike, $\frac{1}{2}$. E, Fruit with the slight, persisting stigma, lateral view, $\frac{1}{2}$. F, Fruit, crosscut-form.

maturus 2,5 mm longus 1,5 mm latus, oblique obovatus, lateribus planis vel subconvexis, dorso bisulcatus, stigmate subfaciali. — Fig. 10.

The epidermis of the stem consists of long, narrow cells; inside there are a few circles of air-channels, the larger outward, the narrower inward, as usual. Five to six ligular strands have been observed in the cortex grouped, as usual, into one circle in the angles of the channel-walls. Endodermis of *u*-cells, though not very much thickened and inside this a complexure of vascular bundles in four groups (four-bundled) with two (1—4) wide intercellular channels. The crosscut-form of the central cylinder a little compressed with mechanical tissue only along the endodermis.

If already the rather numerous cortical strands of the stem suggest affinity to the species of this section, the leaf-structure shows much more conspicuously such an affinity. Beside the very strong marginal nerves there are between these and the middle nerve subepidermally two or three (dependent on the leaf-width) mecha-

nical strands both on the upper and lower surface and in addition 1—2 over the midrib (fig. 10, *B*). In this manner the leaves become a little striate. Counting also these faint nerves, the leaves appear 7—9-ribbed.

The verticils closely placed at regular intervals suggest in this species an obvious affinity to *P. vaginatus*. The characteristic apex of the involucre leaves resembling that of the *Callitriche vernalis* (possibly only a secondary formation) and the bifurcate fruit make it easily distinguishable from all the other Coleogetons.

Distribution. *Siberia*, Yenisei, Nikandrovskij-island, 1876, M. BRENNER (hb.

Fig. 11. *P. vaginatus* TURCZ. *A*, Top of a stem-leaf, cf. the next fig. *E*!, $\frac{1}{2}$. *B*, and *C*, Tops of branch-leaves, $\frac{1}{2}$. *D*, Leaf-axil and ramification (natural size, but for better illustration somewhat schematized), *a*, main-shoot beneath the middle, *b*, leaf with sheath and ligule (*c*) clasping the basal parts of four evolved branches of 1st to 4th rank (*1*, *2*, *3*, *4*) and a small bud (*5*) of 5th rank, *f*, prophyllum, *l*, scale-leaves, from which the branches *2*, *3*, *4*, *5* grow out, the youngest ones therefore always turning towards the leaf *b*. The internode next above the scale much elongated (*i*¹ of the branch *1* and so on). The two internodes of each branch beneath it, on the contrary, extremely abbreviated, all taken together forming a sympodium of only a few mm in length (much shorter, thus, than in the figure) included within the basal part of the sheath. *E*, Hibernating turio, nat. size; explanation, see the text and the explanation of the turio of *P. filiformis* PERS., p. 15.

Uppsal.), and Malo Briochovskij island, 1876, SAHLBERG (hb. Stockh.). The latter island is situated on 70° 50' N. L., and *P. subretusus* therefore seems to be the most northern *Potamogeton*-species of the world (see under the following!).

P. vaginatus TURCZANINOW.

Flora Baicalensi-Dahurica, — in Bull. Soc. Imp. des naturalistes de Moscou 1854, T. XXVII. 2^d partie, p. 66. — Cfr KIHLMAN, *Pot. vaginatus* TURCZ., ny för Europas Flora, — in Meddelanden af Soc. Fauna et Fl. fenn. 14. 1888, 111—115. — Fig. 11 and 12.

TURCZANINOW's description of this species scarcely contains anything that would well distinguish it from its congenates, for instance *P. pectinatus*. Even a characteristic not occurring in the plant named *P. vaginatus* is mentioned when the author writes, »foliis omnibus submersis etc. acutis trinerviis». As to *P. pectinatus* it is said, »foliis etc. acutis uninerviis». Subsequently TURCZANINOW considers the leaf-apex of the two species to be conform, whereas the nervature is held to be another. KIHLMAN who quotes incorrectly the original diagnosis (*acute trinerviis* instead of *acutis trinerviis*), has afterwards given the correct description of the leaves (1888). Nevertheless it is incomprehensible to me that such a sagacious observer as TURCZANINOW should consider the leaves as acute, while they are, at least the stem-leaves, even to the naked eye conspicuously obtuse; and the suspicion has cropped up that the form alluded to might have been something else. No specimen determined by the author himself has come under my eyes, but KIHLMAN asserts having seen one, which he states to be congruent to our Bothnian species, and I myself have seen our *vaginatus* from the province »Irkutsk, distr. Balagansk ad pag. Bashejewsky». I therefore let the name stand in the adopted sense. Its rank of a distinct species, however, has been contested by ASCHERSON and GRAEBNER (Synopsis mitteleur. Flora 1897). Ten years later Prof. GRAEBNER maintains his opinion in treating this species as a var. β of *P. pectinatus*. In the Synopsis of the year 1913 again, he regards it as a *proles* of the subspecies *P. juncifolius* KERN. now correctly separated from the *P. interruptus* KIT. which is maintained under *P. pectinatus*.

After the reintroduction of the species into the literature the Swedish authors S. ALMQUIST in HARTM., Handb. Skand. Fl., 1889, and J. O. HAGSTRÖM in NEUMAN, Sveriges Fl., 1901, have correctly described it and pointed out its peculiarities in contradistinction to its kindred species even as to the turios.

G. FISCHER has lately (Bayer. Pot., 1907, and in FEDDE, Repertorium, 1914) translated the Swedish text into latin, but influenced by a certain Bodensee-plant, BAUMANN's »Winterkraut», he has also made some inaccurate additions spoiling the whole.

The German plants referred to cannot be *P. vaginatus* TURCZ., the distribution of which in Europe does not extend southwards beyond the 60th parallel. — Specimens collected in Switzerland (Lac Lemman 1896, WILCZEK. Det. BENNET. — Bodensee: *P. vag.* var. *helveticus* FISCH.) and considered to be *P. vaginatus* are also nothing but *pectinatus*-forms. And so is the case concerning the German specimens.

P. vaginatus is an excellent and distinct species and though more allied to *P. pectinatus* than to *filiformis* or *amblyophyllus*, yet it is extremely well distinguished from them by the stiff and ample sheaths, retuse young ligules, short, obtuse stem-leaves, the basal leaves of equal length to the upper ones, the often greyish-brown colour in sheaths and leaves, the characteristic mode of branching (see the fig. 11, D!), the short internodes of the spike, all of nearly equal length, numerous verticils, inconspicuous style with horizontal stigma, the fruit of median size and the anatomy of stem and leaves.

Besides, the turios differ from those of *P. pectinatus* while they as to their nature are congruent with those of *P. filiformis*.

Late in autumn they are formed at the end of the rhizome (fig. 11, *E*, *a*) and consist of the 3 (or 2) last generations (I, II, III) of it together with their shoots in bud-state. The third and fourth internodes of the generation *I* swell to an oblong form, and the four first ones of *II* likewise.

In the meantime a concretion takes place just as in *P. filiformis* and the whole turio holds a length of about 4—5 cm (cfr. HAGSTRÖM, Potamog. in NEUMAN, Sveriges Fl. 1901, 793, where we have the very first mention of these buds). C. W. FONTELL, in his researches, has happened to find a locality, where the species is vegetating throughout the winter, and from this he has precipitately drawn the conclusion, that no winter-buds are to be found: — Eigentliche Winterknospen finden sich nicht (Beiträge etc. 1909, 15).

I have never observed that in this species the stem elongates itself with spiciferous branches from the base of the peduncle, as often does *P. pectinatus*. Otherwise the spiciferous branches are arranged after the type *C*, Fig. 2. Concerning the ramification I refer to the figure 11, *D*.

Anatomy of the stem: Epidermis-cells very short, nearly cubic; inside the epidermis there is a layer of 1—2 cells and 5—6 (7) circles of lacunæ, the larger ones outward, the narrower inward. Nearest to epidermis a few small cells are also met with alternating with the larger ones. In the cortex occur, dependent upon the height on the plant at which the cuts are placed, five (basal part) or four (the middle) circles of numerous vascular- and bast-bundles, by which the stem becomes very strong and tough, able to support the abundant growth of branches. In an individual of medium size the author has, in a section from the middle part of the stem, counted 60 such strands, of which 40—45 evidently possess no vessels and only serve as mechanical tissue. The endodermis consists of strong *u*-cells of the common broad type and is, moreover, on the inner side strengthened by a layer of bast-cells. The vascular bundles of the stele are disposed after the eight-bundled type in three groups, a median one with two bundles, and two lateral ones with three more or less conspicuous bundles each. The median bundles form one air-channel each, laterally there are at least two wide channels, sometimes even more, and in the basal internodes usually eight. The cells of the pith often have thickened walls and the bundles are always surrounded by mechanical celles (bast-sheaths).

The central axis of the peduncle has the same structure as that of the middle or upper internodes of the leafy shoot, and in the peduncle there is also to be observed a circle of cortical strands, so far as known not met with in any other species of the subgenus. *P. vag.* accordingly proves to be a genuine sclerenchymatous species, whereas *P. filiformis* is a non-sclerenchymatous plant.

A leaf in cross-section presents a lacunar system chiefly in accordance with that of *P. pectinatus* and exhibiting more or less complicated variations corresponding to the width and thickness of the blade. Peculiar to this species is that the lateral nerves (fig. 12, *E*, *n*¹) run at a considerable distance from the border. Be-

tween these chief lateral nerves and the border at equal distance from both appear in broad or middle-sized leaves small secondary nerves (vascular bundles), the leaves thus becoming five-nerved (fig. 12, *E*, n^2). These faint nerves, however, can scarcely be perceived with the usual magnifying glass, and the leaves therefore look three-nerved. The space between the primary lateral nerve and the margin presents a light appearance on account of the interjacent marginal lacunæ, see the fig.! Between the midrib and chief lateral nerves in the upper and lower surface, occur subepidermally 1—4 bast-bundles (fig. 12, *E*, *str.*) and occasionally a subepidermal strand in the very border with another also farther in (fig. 12, *E**). Such mechanical strands, however, are never to be found between the chief lateral nerve (n^1) and the secondary ones (n^2), even in the broadest leaves. In the ordinary »3-nerved» leaves of *P. pectinatus* the primary lateral nerve runs much nearer to the margin and the secondary nerve or bast-bundle (fig. 16, *D*, *str.*) almost subepidermally at a distance of 2—3 cell-layers from the marginal epidermis, wherefore it cannot be perceived at all by a usual magnifying glass. On close examination these two species can easily be distinguished from each other by the leaf-structure. On the other hand the leaves exhibit closer anatomical relations to *P. subretusus* and *recurvatus* than to *P. pectinatus*.

Another essential characteristic in the anatomy is the above mentioned short cubic epidermis-cells (fig. 12, *D*), of great importance especially in studying the hybrids. The epidermis-cells of the peduncle are somewhat more elongated, about three times as long as broad. The epidermis-cells of the stem, on the other hand, are constantly short even in the most stretched internodes. Through this anatomical structure the stem obtains a most considerable strength.

An examination of the anatomy of the turios proves that in them all the cauline arrangements for mechanical purposes are totally absent: 1) Epidermis-cells considerably longer; 2) The cortex is without the regular square channels and their bast-bundles. Only the vascular bundles are left. 3) Bark-cells very thin-walled and cylindric, not square-formed, with tapering ends and with wider or narrower interspaces corresponding to the stem-lacune. 4) Endoderm-cells not at all or but slightly thickened, and 5) the pith deprived of mechanical elements.

The species does not vary much. A slender form is by TISELIUS named *f. tenuior*.

Fig. 12. *P. vaginatus* TURCZ. A, B, Transverse section of the central stele, lower part of the stem, from two different individuals showing the form and the arrangement of the bundles (hatched parts) and xylem-channels (X), eight-bundled diagrams, ca. $\frac{1}{10}$. C, Stele-diagram of the peduncle, showing the same parts as in A and B, $\frac{1}{10}$. D, Epidermis of the stem, longitudinal and tangential section, $\frac{1}{10}$. E, Transverse section of a stem-leaf, middle part, showing the position of the five nerves of the figure 11, A (hatched), the small subepidermal strands (*str*) and the lacunar system (*l*); * signifies the places for rarely appearing strands, n^1 , n^2 lateral nerves, $\frac{1}{10}$.

The Canadian *vaginatus* constitutes a peculiar race:

V. canadensis n. var. — *Ligula* paulo nervosior. *Fructus* latior, 2,3—2,5 mm (in statu sicco), margine ventrali recto. — *Anatomia* caulis: cellulæ epidermidis elongatæ.

The ligule has the same form with subretuse apex and the same length as in the main-form, but is endowed with stronger nerves, by which, after the ligule has decayed, the upper margin of the sheath gets another appearance than in the primary form.

This variety stands to the main-form almost as the v. *Macouni* of *P. filiformis* to the main-form of this species. It is unlike inasmuch as the stem-anatomy also deviates by its stretched epidermis-cells, and it may perhaps be necessary to separate it as a distinct species *P. canadensis*, which I leave to future decision.

The specimens examined are collected by ASA GRAY, named *P. pectinatus* L., mentioned in A. O. KIHLMAN, *Pot. vag.*, in Medd. Soc. pro Fauna et Fl. fenn. 1888, 113, and by MACOUN, near Banff in Alberta, Canada, 1891, named *P. pectinatus* L., both preserved in the Univ. Mus., Christiania. Cypress Lake, Assiniboia, 95, MACOUN (hb. Haun.).

Distribution. Sweden, West-Bothnia, Haparanda, 87, HAMMARÉN (hb. Uppsal., Lund.), Skellefteå, Bäckfors, 75, MELANDER (hb. Stockholm., Uppsal.), Piteå, Bredskär, 69, LUNDBERG (hb. Uppsal.), Piteå, Recknön, 66, LUNDSTRÖM (hb. Lund.), Umeå, Tafle Skärgård, 89, ANDERSSON (hb. Uppsal.), Bygdeå, Ratan, 68, BERGHOLM (hb. Stockh., Uppsal., Gotenb.), 1901, FAHLANDER (hb. Lund.). — *Angermania*, Nora, Grönvik, 56, FRISTEDT & LÆSTADIUS (hb. Stockholm.), Själevad, 96, BLOMQVIST & LUNDBERG (hb. Stockh., Uppsal.), Hernösand, 99, TISELIUS (hb. Uppsal.). — *Medelpad*, Tynderö, 88, NEUMAN (hb. Stockholm., Uppsal., Lund.), 91, EDVALL (hb. Uppsal., Lund., Gotenb.), 98, LIDHOLM (hb. Uppsal.). — *Environs of Stockholm*, Stora Värtan, 46, J. E. W—M (hb. Stockh.), Värmdön, Rörsundsvik, 88 & 96, TISELIUS (hb. Uppsal., Lund., Got.), f. *tenuior*, Ulfsundasjön, 90, ÖSTLING (hb. Stockh.), in fresh water.

Rörsundsvik at Stockholm is the most southern station on the Swedish coast, 59° 19' N. Lat. In Finland this species does not descend along the coast southward farther than to 63° 30'. No specimen having been found between Stockholm and Tynderö, the former place is to be considered as outside the proper distribution-area, which may be reckoned to extend from 62° 30' northward. Following the year-isotherm of this district of the Bothnian Gulf eastward, we arrive at the neighbourhood of Lake Baikal (Irkutsk—Selenginsk), see p. 33, above, and at Kamtschatka—Aleutian Islands—South Canada. It is therefore probable that the Turczaninowian habitat, Selenginsk, belongs to the south boundary line of the species, which may fairly coincide with the year-isotherm for +2°C. The particular distribution territory of *P. vaginatus* may be the large river-district of North Asia or the vast forest territory of Siberia and northward up to the arctic regions (Tolstoi nos, Yenisei-valley, 1876, BRENNER, hb. Stockholm). From there it has spread eastward and westward as is stated above.

This supposition is confirmed by the records of the vegetation of Yenisei-valley

in N. J. SCHEUTZ, *Plantæ vasc. jenseenses* etc. 1888. Here the author states that »*P. pectinatus*» was gathered by the Swedish Yenisei-Expedition 1876—1877 in the forest territory at several stations (Yeniseisk, and so on, northward), in subarctic territory two stations, and in territorium arcticum in several places as far as Nikandrovskij-island and Tolstoi-nos to the north of the 70th° N. L., where specimens many feet long were thrown up on the shore.

Part of the material collected is *P. subretusus*, but another part, especially these gigantic examples are made up of *P. vaginatus*, although they were all classified by SCHEUTZ, to whom as to other Swedish botanists this species at that time was not yet known, as *P. pectinatus*.

The two latter species accompany each other in the Yenisei-valley as far as the mouth of the river. In general both occur together in Asia in a region of varying width, but *P. pectinatus* spreads southward, whereas *P. vaginatus* extends its domaine towards the north until meeting with the *P. subretusus*, which evidently is an inhabitant of the Tundra-lakes and estuaries of Arctic Siberia.

At the Swedish coasts *P. vaginatus* therefore has arrived as an immigrant from the east by Finland, whereas *P. pectinatus*, again, undoubtedly has immigrated from the south. Having arrived at the Baltic very early after the ice-period as is proved by the discovery of its fossil fruits, *P. pectinatus* must be considered to have long ago reached its northern limit which is, in the Bothnian Gulf, the 64th° N. L., but in Siberia a few degrees more on account of the high summer warmth of those regions (at the mouth of the river Yenisei, for instance, according to SCHEUTZ, ca. 20° C. and above).

As to the distribution of *P. vaginatus* farther westward, AR. BENNETT records the species from Shetland (1887, W. H. BEEBY, see the Journ. of Bot., 1907, 192!). I am not fully convinced of the correctness of this statement. If it were true it would be extraordinary that the species has not been found either in Norway, or in the great lakes of Swedish Lapland, or in Iceland and Greenland. Consequently it should have been brought direct from Canada or the Bothnian Gulf to Shetland! And again, Shetland, with an annual isotherm of about + 7° C is situated too far to the south of the boundary line of the species. Finally, there are in the article referred to other mistakes concerning the distribution of the species in question, wherefore I suppose that closer researches on the Shetland *vaginatus*-plants should be necessary.

***P. recurvatus* n. sp.**

Caulis teres, superne (et a basi?) ramosus metralis, internodiis ut in præcedente, 6—12 cm longis, supremo sæpius infrajectibus longiore (ad 12 cm). *Folia* anguste linearia (1—1,5 mm) trinervia substriata canaliculata obtusa, apice ut plurimum recurvata, longissima, inferiora verisimiliter ad 50 cm longa, vaginis ad 14 cm longis et ligulis albidis 15—23 mm longis, superiora sensim in longitudine decrescentia, suprema (folia floralia) 5—12 cm longa, vaginis 7—15 mm longis. *Vaginæ* tenues

sed validæ, persistentes semper fissæ badeo-virides, ut ligulæ marginibus albidis nitidis. *Pedunculus* brevis, 25—35 mm longus. *Spica* 20 mm longa, 4—5-verticillata, interstitiis brevibus. *Stylus* brevis stigmatibus ovali, postice in rostellum in fructu maturo sæpe persistens protracto. *Fructus* maturus oblique obovatus 3 mm longus 2 mm latus, siccus subcarinatus in vivo verisimiliter dorso rotundatus, rostro brevi apicali v. subapicali. — Fig. 13.

Anatomy of the stem and leaves: The central cylinder and endodermis of the stem chiefly as in the precedent species, yet the lateral bundles are often reduced so that the original three bundles fuse into one single bundle by which the stele becomes four-bundled. The epidermis consists of very long and narrow cells, about ten times as long as the width. Inside it is covered with a single stratum of cells wherein occasionally occur fainter bast-bundles, peculiar to this species, though a tendency hereto is observed also in *P. vaginatus*.

Fig. 13. *P. recurvatus* HAGSTR., A, Transverse section of the stem, middle part, anatomical diagram, $\frac{1}{10}$. B, Longitudinal section of the stem-epidermis, $\frac{1}{10}$. C, Transverse section of a narrow leaf, $\frac{1}{10}$. D, Transverse section of a stem-leaf, middle part, showing the lacunar system; three vascular bundles, a, b-b; two strong marginal bast bundles, and seven strong superficial ones, $\frac{1}{10}$. ep, epidermis, hp, pseudo-hypodermis, in the stem one-layered, in the leaf two-layered, l, lacunæ, x, xylem canals, end, endodermis, cc, stele. Vascular bundles hatched. * Eventually occurring subepidermal bast bundles.

nearer to the borders separated from the marginal epidermis by 4—5 cell-strata, in the broader leaves. In the very border towards the upper surface either immediately up to the epidermis or separated from it by a single cell-layer there appears a very strong bast-cell-bundle, and subepidemally in the upper surface 2—3 and in the lower surface 3—4 strong bast-bundles.

It is this plant that has at least in some degree, for instance respecting some measure statements, influenced the description of *P. pamiricus*. I am induced to think so, as in the Museums it is mistaken by BAAGÖE himself for the Pamir plant of PAULSEN, and the author has expressly reckoned the plant collected by ROBOWSKY in 1894 in Kuen-Luen, which is *P. recurvatus* m., to his *P. pamiricus*.

In the lacunar part, besides, there is a circle of about 10—15 strands, or fewer in very thin stems, sometimes an indication of a second circle. The epidermis of the leaf consists of small cubic cells just as in all the other species of the subgenus. The arrangement of the lacunar system does not differ essentially from that of *P. vaginatus* as a comparison of the two figures (12 E and 13 D) will show. Three vascular bundles occur, a median one forming the midrib and two lateral ones

Nevertheless it is easily distinguishable both from this species and from all the others by its very long lower stem-leaves with their long sheaths the margins of which are white-green and shiny. The leaves are canaliculate and recurved in the top, always three-nerved and with strong margins. Young ligules short and obtuse. By the peculiar stigma, backwards forming a little beak, it appears as a parallel-form to *P. rostratus* of the percedent section, with which in other respects it has but little affinity. The fruit resembles, at a quick glance, that of *P. pectinatus*. However, partly it is a little smaller and comparatively thicker, partly it has the ventral convexity higher up towards the top, finally it has a very short obtuse rostrum with usually remaining stigma, whereas the rostrum of *pectinatus* is more elongated, faintly recurved and subacute.

In its youngest state, being only some centimeters in height or so, it bears an extreme resemblance to *P. filiformis* by the elongated obtuse leaves. Such small samples collected by Dr. S. HEDIN in *Thibet* are stored in the herbarium of the University of Stockholm and some years ago fallaciously determined by me as *P. filiformis* which I am now correcting. It is to be regretted that we never arrive at the truth but through some mistake or another.

Distribution. *High-Asia*, a specimen (hb. Lund.) probably from Kuen-Luen, but labelled by J. BAAGÖE as collected by OVE PAULSEN in Pamir. *Thibet*, see above. Tschatyr-kul, 11,000'—12,000', 03, W. LIPSKY (hb. Haun.). — Probably some ›*pectinatus*›-forms from China and Japan also might be reckoned here.

Fig. 14. *P. recurvatus* HAGSTR. A, Top of a stem leaf in natural position, $\frac{1}{2}$. B, Top of a stem-leaf showing the form of the apex and the course of the nerves, $\frac{2}{3}$. C, Top of a branch leaf, $\frac{2}{3}$. D, Pistil, lateral view, a, stigma, $\frac{1}{2}$. E, Fruit, lateral view, $\frac{1}{2}$.

Subsectio 4. *Pectinati* (FRIES) HAGSTR.

Fructus rostro faciali $\pm$ protracto recurvatulo.

P. pectinatus L.

Species plantarum, 1753, 127. — *P. marinus* L., l. c. — *P. striatus* RUIZ & PAVON, Fl. peruv. etc. I, 1798, 70, tab. 106, b. — *P. interruptus* KITAIBEL in SCHULTES, Österr. Fl. ed. 2, I, 1814, 328. — *P. angustissimus* KUNTH, Nova gen. et sp. I, 1815, 370. — *P. tenuifolius* KUNTH, l. c. — *P. Vaillantii* ROEMER et SCHULTES, Systema veg. III, 1818, 514. — *P. caricifolius* WILLDENOW in SCHULTES, Mantissa in vol. III etc. 1827, 367. — *P. zosteraceus* FRIES, Novitiæ Fl. Suec. ed. 2, 1828. 51. —

P. drupaceus LANG, Fragmente etc. in Flora II, 1846, 476. — *P. flabellatus* BABINGTON, Manual of Brit. Bot. ed. 3, 1851, 343. — *P. vaginalis* FISCHER, Verzeichn. Gef. pfl. Neuorpomm. 1861, 40. — *P. filicaulis* SCHUR, Enumeratio pl. transsilv. 1866, 633. — *P. latifolius* MORONG, Najadaceæ of N. Amer. 1893, 52, tab. 59. — Figg. 15, 16, 17, 18.

»*P. pectinatum* — — — Habitat in Europæ fossis & paludibus» LINNÉ l. c. This species is not mentioned in his travels nor does he record any Swedish station in his Flora Suecica. It is therefore likely LINNÉ had not studied the species in nature but had seen only herbarium samples fixed on a paper (»foliis — — — parallelis»). At any rate, he has had a fresh-water plant in view.

P. marinus L., again, is the plant LINNÉ on his Gothland travel observed in brackish water outside the estuary of Gothum-rivulet. It is most completely described of all *Potamogeton*-species. From the account of the journey we cite (p. 221): — Gothum-åen — — — Örterna här på orten voro besynnerligen kring Gothum-Elfven desse, Hedera — — — Pyrola — — — Anthericum — — — Linnæa; Nymphæa alba & lutea; Alisma; Chara caulibus aculeatis; Potamogeton pusillum fluitans Bocc. hvars caulis var ramosissimus; foliis alternis, lineari-subulatis, angustissimis; ad ramificationes vero caulis notatiis; stipulis latis, amplexicaulibus, e quarum dorso folia solitaria. And from Flora suecica ed. 2: — Folia stipulis ipsis insident in hac specie, nec stipulæ distinctæ in alis foliorum, uti reliquis. Consequently *P. marinus* is a plant with abundant and prominent ramification, rich in stem-leaves that are acute and endowed with prominent, amplexicaul, broad sheaths etc. which just coincides with *P. pectinatus* but not with *filiformis* PERS. The fact that LINNÉ has twice described the same species is easily accounted for by the above said. E. FRIES, again, evidently thinks less of the description than of his gathering the *P. filiformis* at the Linnean station for *P. marinus*: — locoque ab ipso accurate indicato hic, et nullus alius similis, quotannis colligitur (Summa Veg. p. 216). But, of course, both the species have grown at the same place.

P. striatus, to which *P. australis* PHIL. might be a synonym, I consider to be a variety of *P. pectinatus*. Neither the original description, nor descriptions given by different authors after the original specimens, nor specimens from South America examined by me seem to me to be specifically separated from *P. pectinatus*. The fruit is not smaller than this species often has (microcarp forms). Leaves and sheaths nearly coincide with »*P. zosteraceus*». The broadest leaves certainly attain to a width of 5 mm, but also European forms are met with reaching this measure. The anatomy of the stem and leaves does not differ in any essential point. At all events, it is sure that the Sprucean specimens (n. 5886) from the Ecuador Andes, in the Natural History Museum of Stockholm (Riksmuseum) are nothing else than a form of *pectinatus*.

P. zosteraceus FR. is still in 1907 by G. FISCHER considered as a proper species yet without any real motives for such a statement, nor could they ever be presented.

P. flabellatus BAB. may nowadays by all investigators be acknowledged as a *pectinatus*-form.

Common characteristics of the numberless forms of this species (das Chamäleon unter den Laichkrautarten: E. BAUMANN) are the elongate, sharp points of the youngest leaves of the sterile short-branches, the cuspidate involucral leaves with a more or less conspicuous mucro, the more or less broad, light (whitish—pale-green—whitebrown) membranous border of the sheaths, the large, oblong-shaped or ovoid (rarely almost spheric) pollengrains, the more or less conspicuous styles with sloping stigmas, and the more or less large (3—4,5 mm × 2—3 mm) fruits, whereto is to be added the way of branching (fig. 15, B) and producing its spikes,

Fig. 15. *P. pectinatus* L. A, Hibernating rhizomatic turio (nat. size), deprived of its basal scales; f, prophyllum, sl, scale-leaves, I, II, III, the different generations of the turio, 1, 2, 3, 4, 5, 6, their different internodes. The dotted lines indicate the places for concretion of internodes. The 3d and 4th internode of the different generations partake in forming the bulbs, cf. fig. 3, C, D! B, Ramification, somewhat schematized, 1, a, mainshoot, b, leaf with sheath and ligule (d), clasping the basal parts of 3 evolved branches (1, 2, 3), f, prophyllum, l', l'', scale-leaves, c, first laminated leaf of the branch 1. The first three internodes of this branch are commonly very short, together only about one mm. Or only the first two internodes are short (about 1 mm) and the third one elongated, the sheath therefore clasping only two branches, or, if l' is sterile, one single branch. From the scale l'' occasionally springs a rhizome; f is always sterile, cf. Fig. 11, D. C, Transverse section of young sheath, basal portion, showing the site of the free borders, a, b, as in Fig. 3, B, 4^o. D, Pistil, lateral view showing the free beak of the style, 1^o. E, Stigma, and the just mentioned beak, from above, more enlarged.

after the type C (Fig. 2) except in the f. *geminatus* m., see below, p. 51. On the systematic importance of the turios, Fig. 15, A, see HAGSTRÖM, Potamogeton in NEUMAN, Sveriges Flora 1901, 794! On the anatomical facts, see below, Fig. 16!

Concerning the *leaf-width* it may be remarked that the leaves of the main-shoot are always broader than the branch-leaves, and the lower leaves of a shoot also broader than the upper ones. — Different statements are to be found about the *fruit-form*, some authors (CHAMISSO, E. FRIES, GUSSONE, and others) describing it as keeled on the back, others, for instance, GRENIER, MARSSON, MORONG, KIHLMAN, VUYCK, as without keel, others finally (ASCHERSON and GRAEBNER) as keeled or unkeeled. The cover of the putamen is always rounded without keel and the flesh

also has the same curvature, but in *dried* state false keels are often formed both dorsally and laterally.

The epidermis-cells of the *stem* always consist of long narrow cells which here, as in all the *Coleogeton*-species, increase somewhat in length in the peduncle. The pseudo-

Fig. 16. *P. pectinatus* L. A, B, C, Anatomical diagram of the central cylinder, different individuals, serving to show the chief types of the arrangement of bundles and channels, ca. $\frac{5}{16}$; A, from the basal part, four-bundled, $\frac{5}{16}$; B, from the middle of the stem, oblong type, $\frac{3}{16}$; C, from the uppermost internode, next to the peduncle, more enlarged, oblong type compressed; letters as in fig. 1. D—H, Transverse sections of leaves showing the arrangement of nerves and the lacunar system of leaves of different width; D, Leaf of about 1—2 mm in width; E, Leaf of var. *zosteraceus* (Fr.), $\frac{3}{16}$; F, Stem-leaf of var. *striatus* (R. & P.), from Jujuy and Padaguel, S. America, and a broad-leaved specimen from Trendå in Denmark, $\frac{3}{16}$; G, Narrower leaf, $\frac{1}{16}$; H, var. *mongolicus* BENN., Epidermis without pseudohypodermis, $\frac{5}{16}$. Letters, see the text!

tely, the four-bundled type having thus returned.

The *leaves* usually present three vascular bundles, m , n^1 fig. 16, D, E, G; and the lateral bundles run considerably nearer to the border than to the midrib. Broad leaves contain two pairs of lateral nerves arranged as is shown in the fig. 16, F, n^1 , n^2 . A reduced condition, again, is to be found in extremely narrow leaves, fig. 16, H. Subepidermally there occurs nearly always at the margin a weak bast-bundle which

hypodermis usually consists of a two-celled layer in the basal internodes, in the upper ones it is one-celled. Interlacunarily there always occurs the vaginal circle of more (basally) or fewer (upwards) vascular and fibrous bundles. In most cases there are at the middle of the stem 6—12 bundles, and in the top internode as a rule 4 bundles. In the peduncle, on the other hand, they are without exception absent. The endodermis of spike-bearing specimens always consists of well developed *u*-cells of the broad type. Crosscut-form of the stele oblong at the base of the stem, more roundish or circular in the top, fig. 16, A, B, C. The bundles of the stele are arranged into three groups as usual, the median one with two separate bundles (basally), thus four-bundledly, or two fused bundles (upwards), the oblong type. In the top of the stem and especially in the peduncle, the laterally situated bundles grow more reduced and often seem to be grouped round a common xylem cavity (circular diagram-type). In the rachis the four bundles again run separa-

is laminar in its character (cf. the fig. 17), but no subepidermal, vaginal strands are met with in this species which, thus, is less sclerenchymatous than the three next in advance. The pseudo-hypodermal stratum is usually two-layered, very seldom entirely lacking (fig. 16, *H*).

The process of the outgrowth of the leaf-blade and its detaching from the sheath is shown by the three drawings below of serial sections from a stem-leaf. *A*, is a transverse section of the sheath at the middle, *m*, *b—b*, vascular bundles (*m* = mid-rib), *str*, bastbundles, *l*, lacunæ. *B*, the same sheath, transv. sect. through the very point of insertion of the lamina. The dotted (+++) line represents the line of demarcation between the lamina and the ligule. The middle vascular bundle has bent into the lamina, and, after forking, the lateral bundle (*b*) to the left has sent a branch into the leaf (*n'*). The mechanical bundles to the left have entered the intercarinal part of the ligule. To the right the process has not advanced so far as on the opposite side. *C*, the process is performed, lamina and ligule perfectly disjoined. All the mechanical strands have entered the ligule save one which has remained in its original place, but will soon disappear in the leaf. No marginal strand is yet to be found. They are formed a little later. Thus we have found 1) that the middle bundle of the sheath bends into the blade, 2) that each of the lateral bundles (*b—b*) gives off a branch to the blade which forms the lateral vascular bundle (*n'*) of the leaves, 3) that the vaginal strands bend into the ligule, but that one may occasionally continue into the lamina, where it, however, soon disappears (cf. fig. 16!), 4) that the ligule is at the base strongly two-ridged with a vascular bundle in either ridge, 5) that the ligule is a so-called axillary ligule according to the terminology of COLOMB, and 6) that the faint marginal bast-bundle of the leaf (Fig. 16, *str*) is laminar in its character.

P. pectinatus is a somewhat more southern plant than *P. filiformis*. Its north limit seems, over vast ranges of Europe and America, Japan and China, to coincide with the year-isotherm of about + 1° (0°) C., but in Siberia the boundary line makes a considerable curve, at least in the Yenesei-valley with high summer-warmth (at the river-mouth as far as 20—21° C.: SCHEUTZ), and the species is observed much

Fig. 17. *P. pectinatus* L. The outgrowth of the blade and its detaching from the sheath and the origin of the axillary ligule. *A*, *B*, *C*, $\times 30$. Explanation in the text above. *D*, Adult ligule, $\frac{1}{2}$, *b—b*, vascular bundles of ridges.

farther to the north, for instance at Nikandrowsky ostrov, 70° 20' n. L. (coll. LUNDSTRÖM, 75, ARNELL, 76, hb. Stockholm.). From this boundary it spreads southwards through all parts of the world, its distribution consequently being universal and surpassing all the other species of the genus.

It is evident that a species, appearing under so different climatic conditions, arctically (see above!) and equatorially (for instance in the Albert Edward Lake,

Africa, coll. R. E. FRIES, 1912, hb. Upps.), and occurring both in salt and fresh water, at the shores of the sea and in small lakes, in rivers and rivulets, on muddy, fat ground and barren, sandy, clay bottom, must, of course, be met with in many different varieties or forms. Thus we find forms with horse-hair-like stems and leaves and, again, stems 2 mm in diameter at the base and with 5 mm broad stem-leaves and numberless transition forms between those extremities; with short and long sheaths (at most 50 mm); with large (4.5×3 mm) and smaller (3×2 mm) fruits (megacarp and microcarp forms).

Of all the variations of this species I have observed, none seems to be more significant or of a greater systematic value than the different forms of the leaf-apex, of which the figure beside should give an idea. The body of the forms should be

Fig. 18. *P. pectinatus* L. Different forms of the leaf-apex. A, B, C, D, var. *diffusus* m. $\frac{1}{1}$. E, F, G, var. *ungulatus* m. $\frac{1}{1}$. H, var. *striatus* (R. & P), $\frac{6}{1}$. K, Middle portion of H, showing the nerves and lacunæ, $\frac{6}{1}$; L, var. *diffusus*, m. $\frac{1}{1}$. A, basal stem-leaf, B, from the middle of the stem, C, involueral leaf, D, branch-leaf; E, leaf from the middle of the stem, F, involueral leaf, G, basal leaf of a short branch; H, top of a stem-leaf, material from Jujuy, South America. K, Middle portion of this leaf showing the position of vascular bundles, strands and lacunar walls, cf. fig. 16, F! L, top of a basal stemleaf with the position of nerves and lacunæ visible.

divided into the two varieties established here below, according as their leaf-apex is endowed with a conspicuous mucro or more slowly tapered.

The somewhat peculiar v. *mongolicus* A. BENN. ought to be kept, and likewise the *P. zosteraceus* FRIES and *P. striatus* R. & P. All the other innumerable variations should after my opinion be considered only as rather accidental and insignificant forms of inferior value.

The following arrangement of the forms of *P. pectinatus* is only an attempt to put in order the great multitude of forms which I have had an opportunity to examine.

The varieties *zosteraceus* and *striatus* have broad stem-leaves with 3—7 nerves, all the other have narrower stem-leaves, with 3 nerves, the thin marginal strands not included.

Var. **ungulatus** n. var.

Folia caulina superiora ca. 1 mm lata vel plerumque angustiora, inferiora vel infima 1—2 (0,5—2,5) mm lata, plerumque 50—60 mm longa et fusco-viridia; *apices* foliorum caulinarum et ramorum spiciferorum (saltem in partibus superioribus) etiam foliorum ramulorum in inferioribus partibus rotundati cum mucrone unguiformi vel abrupte cuspidati; *vaginæ* plerumque angustiores et rigidiores. — Fig. 18, E—G.

Distribution: Sweden, Scania, several stations e. g. Malmö, 50, NORDQVIST (hb. Stockh.) Lomma, 51, G. LÖFVENSKIÖLD, 66, EURÉN (hb. Lund.), Malmö, 67, A. TULLBERG (hb. Lund.), Esperöd, hb. Z:DT (hb. Lund.), Landskrona (hb. Lund.) transition forms; between Engelholm and Vegeholm in pits at the shore, 1812, hb. E. FRIES (hb. Uppsal.) *scoparius*-like; Kjefflinge, 1840, hb. E. FRIES (hb. Uppsal.) *scoparius*-like. — Bleking, Karlskrona, 60, H. LÜBECK (hb. Lund.), 61, FORELIUS (hb. Uppsal.) transition form. — Smoland, Kalmar, Björnö, 63, TISELIUS (hb. Uppsal.), Västervik, 64, C. M. NYMAN (hb. Stockholm.), 63, A. & E. CARLSSON (hb. Gotenb.). — Ostrogothia, Häradsskär 63, A. & E. CARLSSON (hb. Uppsal. et Lund.), transition forms. — Stockholm, Karlberg, 24, Z:DT (hb. Lund.). — Uppland, Norrtelje, Sandviken, 63, HYBBINETTE (hb. Gotenb.). — Gothland, Skälsö 52, KINDBERG (hb. Uppsal.), 55, JONSSON (hb. Gotenb.), Histilles 52, KINDBERG (hb. Uppsal.) all are transition forms. — Öland, Grankalleviken, 83, NORDSTEDT (hb. Lund.). — Halland, Onsala, 64, TRANA (hb. Gotenb.), *scoparius*-like. — Bohusia, Marstrand, 88, LALIN, 89, JOSEPHSON, 90, JOHNSSON (hb. Uppsal., Lund.) typical form, Koön, 90, FRIES (hb. Lund.) Tofta, LINDBERG (hb. Gotenb.) transition form.

Norway, Kristiania, 62, MOE (hb. Stockholm.), transition form. — Denmark, Flaskekroen, 64, Baagöe, Möen, Ulfshale strand 82, 84 HENNINGSSEN, Fyen 51, Bornholm (all in hb. Lund.), Köpenhamn (hb. Uppsal.). — Germany, Danzig, 74, BÄNITZ (hb. Gotenb.) transition f., Bavaria, 49, CLASON (hb. Stockholm.), Appeln, WIMMER (hb. Uppsal.), Augustenburg, NOLTE (hb. Stockholm.). — England, Wallasay, Cheshire 86, LOMAX (hb. Stockholm., Uppsal., Lund.). — Russia, Esthonia pr Reval 1847, Kühlewein (hb. Uppsal.). — France, Vendée, PONTARLIER (hb. Uppsal.). — Spain, Ojos del Guadiana, 83, NILSSON (hb. Uppsal.).

Africa, Cape, reg. occ. Krude Rivier, 96, SCHLECHTER (hb. Stockholm.). — S. America, Argentina, 73, HIERONYMUS (hb. Uppsal.), Bolivia, Taxara, 02, FRIES (hb. Uppsal.) aberrant form. — Australia, Nov. Holl. austr., MÜLLER (hb. Lund.).

Of this in its typical shape very beautiful variety the following more aberrant forms may be distinguished:

f. *acerosus* n. f. — *Folia* caulina rameaque brevissima, 10—20 mm longa.

Leaves and sheaths almost equal in length. Is noticed from Sweden, Bleking, Nättraby, 59, PETTERSSON (hb. Lund.)

f. *devestitus* n. f. — *Folia* breviora. Ramuli 2:æ et 3:æ ordinis vix evoluti.

On account of the short leaves and the absence of short branches this form presents a very bare appearance.

Distribution: Sweden, Scania Kullen (hb. Lund.). — Gothland, Bogevis, 82, ANDERSSON (hb. Lund.)

f. *brachypus* n. f. — Differt a typo pedunculis brevissimis, 10—30 mm.

Distribution. S. America: »Andes Ecuadorenses 1857—59, R. SPRUCE, N. 5886 (hb. Lund.), a narrow-leaved »P. striatus», see p. 52. — Besides in hb. Stockholm. and Uppsal., labelled: »L. Kralik, Pl. Cuneatanæ n. 136 et 395».

f. *coronatus* HAGSTR., Potamog. from As., in Bot. Not. 1905, 141: — *Spica* sæpius multiverticillata (vertic. 5—8), *fructus* minor, 3 mm × 2 mm.

Distribution: High-Asia: »Muntjokk-ott 23 Juni Mapiek-köll» (hb. Stockholm. Univ.)

f. *subæquabilis* n. f. — *Folia* latiora, ramea et caulinea subæqualia.

A rather broad-leaved form, with slight difference in width between branch-leaves and stem-leaves. Recorded from England, River Leen, MITCHELL (hb. Uppsal.) and from India, Panjab, THOMSON (hb. Stockholm. and Uppsal.)

f. *trichophyllus* n. f. — *Caulis* tenuissimus, foliis trichoideis.

Distribution: Spain, Iviza, CAMBERFEDER (hb. Stockholm.). — Italy, Palermo, TODARO (hb. Stockholm.). Besides in hb. Stockholm. labelled: »L. Kralik, Pl. Cuneatanæ. N. 136, 1852 and 395».

f. *latiusculus* n. f. — *Folia* præsertim inferiora latiora ca. 2 mm lata.

Distribution: Sweden, Stockholm, 59, ZETTERSTEDT (hb. Uppsal.). — Denmark, Omö, 64, NIELSEN (hb. Uppsal.). — England, Benwick, Cambs. 85, FRYER (hb. Stockholm.).

Var. *diffusus* n. var.

Ramosior et plerumpue colore lætiore præter formas flumineas. *Folia* omnia ramulorum sensim attenuata acuta; caulinea inferiora, 0,5—ca. 2 mm lata, obtusa cum mucrone minimo verrucæformi, media apice attenuata subacuta, summa angustiora apice ± conspicue mucronata. — Fig. 18, A, B, C, D, L.

This variety has usually a lighter brown colour except the river-forms, that are of a darker green. It is easily recognizable on the leaf-apex gradually tapering to a keen point. The involucre and basal stem-leaves, however, always have their fixed form.

V. *diffusus* is by far the most usual and widest spread form. In the Baltic it can be considered as common, farther northwards it is more sparingly met with in the south part of the Bothnian Gulf to »Kvarken». In the northern section of the Gulf it is only recorded from Ratan, Sweden, under the 64:th N. L., and from Jakobstad, Finland (C. W. FONTELL, Beiträge etc. 1909, 4) a little more southwards. To the north of the 64:th parallel it is not known to me, but S. ALMQUIST (HARTM.

Fl. 1889, 56) records it from Skellefteå, too. At all events, we have its proper distribution area to the south of this latitude. As regards its occurrence in Swedish fresh water the Museums suggest that it appears in *Scania*, Trelleborgs å, hb. Ag (hb. Lund.), Höjeå at Lund, 49, Z. (hb. Lund.), Börringesjö, hb. DÜBEN (hb. Lund.), Råbelöfsjön, 86, NILSSON (hb. Lund.); *Smoland* Skärstad, 86, RENDAL (hb. Lund.), Munksjön, 09, EKMAN (hb. FRÖDING); *Westgothia*, Ösan, 81, HULTH (hb. Uppsal.), Aspösjön, 64, NORDSTEDT (hb. Uppsal.), N. Ving, 05 (hb. ALM), Ulricehamn, 46 (hb. WESTERLUND); *Ostrogothia*, Tåkern, 43 (hb. Uppsal.), Vadstena in a rivulet near STARBY (hb. Stockholm.); *Sudermannia*, Sparreholm, NYMAN (hb. Stockholm.), Vårdinge, Sjögård, 94, TRÄGÅRDH (hb. Uppsal.); *Uppland*, Mälaren, several stations: Kongshamn 1797 (hb. Uppsal.), Sigtuna, 89, FLODERUS (hb. Stockholm.) etc., Fysingen, 95, TISELIUS (hb. Stockholm. and Uppsal.), Valloxen, 84, TISELIUS (Stockholm. and Uppsal.), Uppsala Björkby, 66, ÄHRLING (hb. Uppsal.), Fyris 1859, ZETTERSTEDT (hb. Uppsal.), Ulfva, 66, TISELIUS (hb. Stockholm.) etc. S. ALMQUIST (l. c.) also records it from Silfberg in *Dalecarlia* ca. 60° 20' Lat., thus not so far towards the north as in the Gulf of Bothnia. On the other hand *P. filiformis* proceeds to Jemtland and Lapland! A good deal of materials, especially from the Baltic, is deposited in the Museums referred to.

A great many forms belonging to this variety are distinguishable:

f. *laxus* TISEL., Potam. suec. exsicc., fasc. III, 1897, n. 120—122: — *Caulis* filiformis tenuior, superne internodiis brevissimis; pedunculus sæpe brevior.

Distribution: *Sweden*, rather common, recorded from Gefle (hb. Lund.) and southward along the Uppland coast and from the Lake Mælar, Sudermannia, Ostrogothia and Smoland. — *Russia*, Sarepta, 85, BECKER (hb. Uppsal.). — *England*, Hedge Court Mill Pond, Surrey, 83, BEEBY (hb. Stockholm.), Chatteris, Cambs., 84, FRYER (hb. Uppsal.). — *Germany* at several places in Brandenburg, Sachsen etc. — *Tirolia* austr. (hb. Lund.). — *Italy*, Trento, Sardagna (hb. Uppsal.).

f. *submarinus* FRIES, Novitiæ Fl. suec. 1828, 53: — »Caule capillari inferne nudo, fol. subdistantibus, ultimis subternis approximatis capillaceis, pedunculo brevissimo unico seminum verticillo capitato.»

According to the description this form coincides with f. *laxus* except as to the spike, which is capitate. It is said to occur »in aquis salsis vadosis», but I must confess that I never saw this form. In »hb. E. FRIES», at Uppsala, I have found a plant from *Westbothnia*, Nordmalingsfjärden, 1864 coll. by LÆSTADIUS and labelled »*Potamogeton pectinatus* L. — *submarinus* FR.», however not by FRIES himself, but this was found to be the common form of *P. filiformis* with spike and peduncle evolved in the usual mode. Thus it cannot be the original plant of FRIES. Most likely f. *submarinus* FR. is a f. *laxus* with deformed spikes. In Summa Veg. 1846, FRIES does not mention it more.

f. *glaucescens* CHAM. et SCHL., in Linnæa, 1827, 165: — »capillaceus, 1—1 ½ ped., ramosissimus. Vaginæ margine valde albo-scariosæ nec amplæ, 7 circ. lin. longæ. Folia tenuissima, densissima, capillacea 1 ½—2 poll. longa.»

This form comes near to f. *laxus* TIS., but is more richly branched and with

finer, hairlike leaves. Absent in our Museums it seems, however, to be rather common southward. P. GRAEBNER states: »nicht selten» (Synopsis etc. 1913, 540).

f. *ostiarius* n. f. — *Caulis* fere capillaceus; *folia* elongata, 1 mm circ. lata; *vaginae* longissimæ (ad 50 mm).

This form is noticeable for its long leaves and sheaths; we suppose a local adaption to the outlets of great rivers, since it is observed in *India*, »Gangetic Delta, Province Bahár, River Gandak near Patna, 1857. Schlagintweit n:o 12981» (hb. Stockholm.) and in the estuary of *Yenisei* (coll. BRENNER, LUNDSTRÖM, and ARNELL 1875—1876, hb. Stockholm.).

f. *protensus* WALLR., Sched. crit. 1822, 67. — *P. pectinatus* var. *C. vulgaris* CHAM. et SCHL. l. c. 1827, 165.

Undoubtedly the most common form of all. WALLROTH records it only from rivers, but it is also met with in lakes and along the coast of the sea and elsewhere. It is characterized by the stretched internodes and debile leaves (»foliis debilibus»), and may be considered as a deep-water form.

f. *longipedunculatus* TISEL., Pot. suec. exsicc. III, 1897, n. 131: — *Pedunculus* longissimus, 25—50 cm. *Spica* internodio infimo 30—50 mm longo. Ceterum ut in præcedente.

A strongly marked deep-water form adapted to lakes, observed in *Sweden* in the Baltic Sea at several places, for instance Uppland, Grisslehamn, 83, HEDLUND (hb. Uppsal.), Värmdö, 90, THEDENIUS (hb. Lund.), Stockholm, Saltsjöbaden, 04, KJELLBERG (hb. Lund.), Sudermania, Dalarö, 83 TISELIUS (hb. Stockholm., Uppsal., Gotenb.).

f. *spissus* TISEL., Pot. suec. exsicc. III, 1897, 127: — *Caulis* a basi usque ad pedunculum ramosissimus. *Folia* inferiora caulina sæpe magis quam 1 mm lata.

Shallow-water form on muddy ground. Seen only from the original station, at *Stockholm*, Värmdön, Bo, 91, TISELIUS (hb. Stockholm., Uppsal., Lund., Gotenb.).

f. *scoparius* WALLR., Sched. crit. 1822, 67: — »Caulibus prælongis — — — superne in ramulos scopæformes polyphyllous expansis» etc.

This form is also a modification belonging to shallow water, where the upper internodes grow very short. The form is by many authors considered to be the true *P. pectinatus* L. It is very likely so, though it may be supposed that LINNÉ's material may have been very scanty, since he had not observed the leaf sheaths.

The Museums contain this form from several stations, among others: Warwick, *England*, coll. by BABINGTON and by him labelled: *P. flabellatus* (hb. Uppsal.).

f. *subdrupaceus* FISCHER, Die bayer. Potamog. 1907, 125: — A form *scoparius* but with more conspicuous rostrum on the ripe fruit. A specimen from »Bayern, Bamberg, 02, G. FISCHER» is preserved in hb. Stockholm. and by the author himself labelled »v. *scoparius* WALLR. f. *subdrupaceus* FISCHER».

f. *interruptus* (KIT.) ASCH. — *P. interruptus* KITAIBEL in SCHULTES, Oesterreichs Flora 1814, 328. — *P. pectinatus* b) *interruptus* (KIT.) ASCHERSON, Fl. Prov. Brand. 1864, 666. — *P. flabellatus* BABINGTON, Manual Brit. Bot. 1851, 343. — *P. vaginalis* FISCHER, Verzeichn. Gef. pfl. Neuorp. 1861, 40 ex MARSSON, Fl. von Neu-Vorpomm.

1869, 495. -- According to the original description J. A. SCHULTES meant a plant with rather broad and elongated leaves and conspicuously interrupted spikes (»Die Blumen in entfernt stehenden Querlen»). Such forms f. *pinguis* TIS., l. c. n. 128, and f. *zosteroides* FISCHER, l. c., 125, also seem to be. — F. *incrustedatus* TIS., l. c. n. 128, I place here, though with some doubt. By its broader basal leaves it forms a transition to the var. *zosteraceus* FR.

Distribution: Sweden, Uppland »sjön vid Kongshamn 1797» (hb. Uppsal.); »Fyris juxta Upsaliam 1859, ZETTERSTEDT» (hb. Uppsal.); Sudermania, Västerlång, Tunsäter, 96, TORSSANDER (hb. Stockholm., Uppsal., Lund., Gotenb.). — England, »Hull, Yorkshire, 7 sept. 1853, From CHARLES C. BABINGTON (Cambridge)» (hb. Uppsal.), by BABINGTON himself labelled *P. flabellatus*. This is without doubt the true *P. flabellatus*: of high growth, upper internodes 50 mm long, lower ones longer, sheaths rather long, lower stem-leaves rather broad, upper ones narrower, branch-leaves very narrow. Fruit large, of usual form, without prominent keel. — Stoke Heath, Warwickshire 1855. T. KIRK (hb. Lund.). — Germany, Bavaria, Bamberg, 02, FISCHER (hb. Stockholm.).

f. *dichotomus* WALLR., Sched. crit. 1822, 67. — *P. Vaillantii* ROEM. & SCHULT. Syst. veg. III, 1818, 514. — Distinguished from the preceding only by the shorter and more dense spikes: spica pauciflora, WALLR. The peduncle also seems to be shorter than in general. I have seen specimens from Denmark »Jordbroå, 97, J. BAAGÖE» (hb. Stockholm.) and »Nipså, 99, J. BAAGÖE» (hb. Stockholm.).

f. *sublatifolius* n. f. — *Folia* inferiora latiora (circa 2 mm); vaginæ ut in var. *zosteracea*.

This form resembles var. *zosteraceus* in everything except the upper leaves which are narrower: thus more like the usual form as to the upper part of the stem; as to the basis, again, just like v. *zosteraceus*. The same is the case with the following, f. *notabilis*, besides being microcarp.

Distribution: Sweden, Medelpad, Tynderö, 06, (hb. Uppsal., Lund.); Uppland, Rådmansö, 87, HALLSTEN (hb. Uppsal.), Edbovik, 37, SILFVERSTOLPE (hb. Stockholm.), »sundet mellan Ingarö och Värmdö, 51, V. B.» (hb. Uppsal.); Stockholm, Laduviken, 47, NYMAN (hb. Stockholm.); Sudermania, Gålön, 50, BJÖRNSTRÖM (hb. Stockholm., Uppsal.), Österhaninge, 87, ALMQVIST (hb. Stockholm.), passing over into pure v. *zosteraceus*; Utön 96, TISELIUS (hb. Gotenb.) among true v. *zost.*, see below! Ostrogothia, Kvarsebo, Sättersholmen, 84, STRÖMFELT (hb. Stockholm.), St. Annæ, Aspöja, 84, ELMQVIST (hb. Stockholm.); Smoland, Tryserum, 81, ELMQVIST (hb. Lund.).

Norway, Kristiania, hb. E. FRIES, Blytt n. 72. (hb. Uppsal.).

f. *notabilis* TISEL., Potamog. succ. exsicc. III, 1897 n. 133: — Fructus minores, ceterum ut f. *sublatifolius*.

Being microcarp this form corresponds to f. *coronatus* of var. *ungulatus*. I can record it only from the original locality: Sweden, Uppland, Bay of Norrtelje, 82, TISELIUS (hb. Stockholm., Uppsal., Lund. and Gotenb.).

f. *ulvensis* n. f. — *Folia* brevia, 30—40 mm longa.

Var. *diffusus* has in general rather long leaves. This form, however, shows that sometimes short-leaved specimens also occur. It is gathered by Dr. G. TISELIUS at Ulva near Uppsala 1866 (hb. Stockholm.) and at Björkby (Uppsala), 66, ÄHR-LING (hb. Uppsal.). A similar plant is observed at Jonsberg (Ostrogothia), 80 (hb. Uppsal., Lund.) and »in Flusse Bystrzyen», *Poland* 84 (hb. Lund.). — It may be considered a parallel-form of var. *ungulatus* f. *acerosus*.

Var. *mongolicus* AR. BENNETT.

Notes on Potamogeton in the Journ. of Bot. 1894, 203—204: — *Caulis* capillaceus; *folia* læte viridia setacea uninervia; *pedunculus* longissimus (ad 250 mm); *spica* brevis triverticillata; microcarpus. Ex A. BENN. et specim. PRZEWALSKI. — Fig. 16, *H*.

This variety comes nearest to v. *diffusus* f. *laxus* or *glaucescens* by the capillaceous stem and leaves, the apex of which is also like that of var. *diffusus*, but differs by the lighter green colour, one-nerved leaves without hypoderma, long peduncles and small spikes. One could almost consider it to be a separate species, but further researches are required for full certainty. The plant originates from Asia, Mongolia occ., where it is collected by N. M. PRZEWALSKI in 1871 (hb. Stockholm.). True *P. pectinatus* is gathered in Mongolia media 1886 by POTANIN (hb. Stockholm.), also this microcarp.

Var. *zosteraceus* (FR.).

P. zosteraceus FRIES, Nov. Fl. suec. 1828, 51. — *P. pectinatus* f. *zosteraceus* (FR.) ALMQUIST in HARTMAN'S Handb. Skand. Fl. 1889, 56. — *P. pectinatus* var? *latifolius* ROBBINS, Bot. King's Expedition, 1871, 338 ex MORONG, Najadaceæ 1893, t. LIX: — *Caulis* internodiis elongatis. *Folia* caulina inferiora et superiora lata (resp. ca. 3 et 2 mm), 3(—5)-nervia obtusiuscula cum mucrone, vaginis laxis brevibus, 15—20 (25) mm. *Pedunculi* longissimi. — Sec. cl. Auct. et specimina Hartmaniana.

The typical Hartmanian specimens from Utön, »in extimis Sudermanniæ maritimis» (hb. Uppsal.) is a deep-water form with few branches developed in the upper part of the stem. The leaves are comparatively broad as well in the upper part of the stem, and their sheaths are obviously broad, short, and enlarged, and with thin, broad, grayish, membranous margins. Its habitat seems to be in the northern part of the Baltic. But also the N. American plant from Nevada and California may be congruent with our Baltic plant judging from the drawing of it made by Rev. TH. MORONG in his Najadaceæ. On the other hand the German specimens, v. *zosteraceus* CASP., v. *fluviatilis* SCHÜBL., v. *luxurians* DÖLL, are very likely not identic with the plant here spoken of, but to be referred to f. *interruptus* or to f. *dichotomus*.

In shallow water it behaves as var. *diffusus* upwards branching more richly, and well corresponding to f. *scoparius*. This form should be called f. *ramulosus*.

f. *ramulosus* n. f. — Ramosior præsertim in parte superiore. Apices foliorum caulinatorum subelongati ± acuti.

Distribution of v. *zosteraceus*: Sweden, Angermania, Säbrå, 66, ARNELL (hb. Uppsal., Lund., Gotenb.), f. *ramulosus*; Nora, 56, FRISTEDT (hb. Uppsal.); Hernösand, 56, FRISTEDT (hb. Stockholm.). Medelpad, Tynderö, 85, NEUMAN (hb. Uppsal., Lund.), f. *ramulosus*. — Helsingland, Stocka såg, 91, SANDAHL (hb. Stockholm., Uppsal. et Lund.), f. *ramulosus* and transition forms to var. *diffusus* f. *scoparius*. — Gestrikland, Gefle at Utnåra etc., 33, THEDENIUS and others (hb. Uppsal.), ff. *ramulosus* and *scoparius*. — Uppland, Rådmansö, 10 (hb. Stockholm.), f. *ramulosus*; Ljusterön and many other places (hb. Stockholm., Uppsal., Lund., Gotenb.), typical forms. — Stockholm, several stations (hb. Uppsal.). — Sudermania, Sandemar, 59, THEDENIUS (hb. Stockholm.), Österhaninge, Fjellong, 53, BJÖRNSTRÖM (hb. Stockholm., Uppsal., Lund. et Gotenb.), Utö, leg. HARTMAN, ÄHRLING and others (hb. Stockholm., Uppsal., Lund. et Gotenb.), Oxelösund, 00, LAGERWALL (hb. Lund.), f. *ramulosus*. — Ostrogothia, Dagsberg, Beteby, 67, WESTERLUND (hb. Uppsal. et Gotenb.), f. *ramulosus*.

Finland, Regio Aboensis, 81, HOLLMÉN (hb. Stockholm., Lund.).

Var. *striatus* (RUIZ & PAV.).

P. striatus RUIZ et PAVON, Fl. peruviana 1798, 70, t. 106: — *Folia* inferiora sæpe latiora (2—5 mm), 3—5(7)-nervia; *pedunculus* brevior; fructus minor. Ceterum ut var. *zost.* Figg. 16, *F*; 18, *H*, *K*.

Basal stem-leaves of this variety often broader than in the foregoing, but their shape and sheaths are alike for the rest. Without ripe fruit this plant would be difficult to distinguish from var. *zosteraceus* f. *ramulosus*, which form, besides, also sometimes appears microcarp and with shorter peduncles (see L. M. NEUMAN, Några kritiska o. sällsynta växter 1888, 23—25!). FRIES says also of his *zosteraceus*, »Sequenti (*P. pectinato*) utique affinis l. forsan magis *P. striato*» (Nov. 1828, 51). Leaves are described as »longitudinaliter striata» and the stem is also recorded as »*striatus*», but the anatomy of both stem and leaves completely coincides with that of *P. pectinatus*. The striation of the leaves originates in the channel walls and not in a mechanical tissue. The form of the pistil and fruit does not differ from *P. pectinatus*. The single remaining quality, therefore, would be the constant smallness of the fruit, 3 × 2 mm. »*P. striatus*» is an interesting small-fruited and usually broad-leaved South-American race of *P. pectinatus* nearly as »*P. canadensis*» is a North-American race of *P. vaginatus* (p. 36).

A peculiar difference as to the ramification presents the following form.

f. *geminatus* n. f. — Caulis per ramulos 1:æ—tertiæ ordinis ex axillis foliorum floralium valde prolongatus.

This mode of branching dichotomously from the primary involucreal leaves I never saw in any other variety or form of the species. In general, only the inferior bud of the two at the base of the peduncle becomes evolute and furnished with a single spike. In *f. geminatus* on the contrary the stem becomes forkedly branched by spiciferous branches of 1st to 3rd rank, considerably surpassing the primary peduncle, which here is 60—70 mm long, thus a way of prolonging the stem which answers to the type *D*, Fig. 2. For the rest the form is normal.

Distribution of var. striatus: *S. America*, Chili, Lacus Pudaguel, 82, PHILIPPI (hb. Stockholm.). — Argentina, Jujuy, Laguna de Sansal, 01, FRIES, n. 424 (hb. Stockholm.), Casa Bamba, Sierra Chica de Cordoba, 09, STUCKERT (hb. Haun.), *P. dissimilis* AR. BENN., authentic. — Bolivia, Gran Chaco, Caiza, 02, FRIES, n. 1575 (hb. Stockholm.), *f. geminatus*. — Ecuador, in Andibus, 1857—59, Spruce n. 5886 (hb. Stockholm.), *f. geminatus*. — Peru, Callao, 23 (hb. Christ. »dedit J. SYME«).

***P. pectinatus* L. × *vaginatus* TURCZ.**

P. vaginatus × *pectinatus* ex FONTELL, Von enig. Potam. Hybriden, 1902, 2. — *P. pectinatus* × *vaginatus* ex FONTELL, Beitr. Anatom. Bau Pot.-Art. 1909, 23. — *P. bottnicus* HAGSTR.

Just as in the hybrid *P. fennicus* the grayish colour of this plant alludes to a certain connexion with *P. vaginatus*, which fact, moreover, is ascertained by the usually short, obtuse stem-leaves. Branch-leaves longer and narrower, but even these commonly obtuse, though towards the apex more conspicuously tapering than in *P. vaginatus*, someone or other acute or cuspidate as in *P. pectinatus*. Sheaths and ligules intermediate. Ramification often as in *P. pectinatus*. The stem-anatomy shows an influence from *P. vaginatus* by the presence of numerous vascular- and bast-bundles in the bark. The central stele sometimes coincides with that of *P. pectinatus*, sometimes almost with that of *P. vaginatus*. The evolution of the spikes seems to draw near *P. pectinatus*, but is very much defective.

This hybrid is first discovered by C. W. FONTELL in the neighbourhood of Jakobstad, *Finland*. From the *Swedish* coast of the Bothnian Gulf I know it from two stations: the sound at Tynderö in *Medelpad* (near Sundsvall) and at Hernösand in *Angermania*. Besides a plant from Suopohja, *Russian Karelia* (hb. Helsingfors, Finland) might also be this hybrid (or *P. fennicus*). More stations are not hitherto known.

The characteristics of all those are that the leaves for the most part are more or less obtuse and more or less destitute of the light marginal border of *P. vaginatus*, that the ligule of the lower leaves are persistent and somewhat elongated, further the numerous cortical strands of the stem and the more or less defective or deformed fructifications. From × *P. fennicus* it differs in the coarser growth, more abundant ramification, larger sheaths, broader leaves and more numerous bundles in the bark of the stem.

Distribution: *Sweden*, Angermania »ad oppidum Hernösand freto australi», 99 TISELIUS (hb. Stockholm.), labelled *P. vaginatus*. — *Finland* (and *Russia*) see above!

To the section *Convoluti* (Subsect. *Vaginati*?) might also belong *P. Livingstonei* AR. BENN., the leaf-apex of which, fructifications, and anatomy are not yet described. — A very strange »*P. pectinatus*» is recorded from Florida with »drupelets cochleate, barely fleshy, 1,5 mm long, 3-keeled on the back, crestless, but with 4–5 teeth» (SMALL, Flora south-east. U. States 1903, 39).

P. dissimilis AR. BENN., of S. America, is *P. pectinatus* var. *striatus*, according to authentic spec. from Casa Bamba. »Stipulæ adnatæ ad 5 cm longæ» probably bears upon the sheath and ligule together. Leaves are said to be very long, »4,35 dm», evidently a misprint; the form is congruent with the Jujuyplant of Argentine.

Subgenus B. **Eupotamogeton** RAUNK.

De danske Blomsterplanters Naturhist. I: 1, 1896, 34, 108. (See p. 13!)

Caulis teres—subteres v. compressus—bicanaliculatus, ramosus—simplex. *Folia* uniformia linearia plana—lanceolata ± undulata, semper submersa, vel bi—triformia: 1:o submersa plana vel margine ± undulata, membranacea, canalibus internis, ut in præcedente, ad costam mediam vel ad nervos principales sitis, vel semiteretia rigida ± canaliculata, canalibus ut in *Coleogetonibus*, 2:o fluitantia ± coriacea loculosa integerrima, omnia rarius vaginata ligulata vel ut plurimum evaginata ligulis axillaribus vaginantibus vel lateralibus. *Spica* deflorata densa v. subinterrupta rachide rigida. *Stigma* papillis minoribus. — *Caulis* endodermide instructus, ± flexilis, pedunculus eam desinens ± rigidus. — *Hybernacula* (turiones) subterranea rhizomatica vel supraterranea caulina. — *Gemma superior* caulis ut plurimum subjectâ validior. *Pollinatio* per ventum.

As to the function of the endodermis different views have been taken, see H. SCHENCK, Anat. p. 52! Comparing the species of this and the precedent subgenus, however, it stands clear that, beside the common purpose of effecting resistance against the impetus of the waves, its chief function is to make the stem and peduncle flexible. Such peduncles that are rigid and rise over the water-surface always lack an endodermis and spread the bundles more or less in the cortex.

Sectio III. **Adnati** HAGSTR.

Caulis compressus—bicanaliculatus. *Folia* uniformia, linearia plana ± nervosa serrata vaginata canalibus ad costam mediam instructa. *Præfoliatio* adplicata. Ramorum apices in *hybernacula* transformantur.

Subsectio 5. **Serrulati** HAGSTR.

Characteres: vide supra! — C. RAUNKIÆR's opinion of this group, see p. 13!

To this group belong but two species, constituting an interesting and signi-

ficant connective link between the Coleogetons and Eupotamogetons. Yet it decidedly belongs to the latter and can be considered as nearly allied to *P. crispus* and *zosterifolius*. It shows the near relationship existing between the two main groups of the genus and proves by this, that the primary types of the genus have been submerged forms with sheathing leaves. *P. densus*, another single, remaining species of an isolated section, is a similar evidence as to the ligule, originally being divided into two lateral stipules.

***P. Robbinsii* OAKES.**

In Hovey's Magazine, 7, 1841, 180. — Fig. 19, 20.

This species rarely fruits and the fruit ripens late, in september—october according to Rev. E. HILL, Fl. of the White Lake Region (Bot. Gaz. 1900, 429). However, it can easily be distinguished from any other species by the vegetative organs. The stem is recorded (HILL, l. c.) to reach a length up to six feet. It is compressed and bicanaliculate as in *P. crispus*. The furrows especially appear in the peduncle. The stem is branched and elongates from the floral leaves by branches of 1st—3rd rank. Spiciferous branches are often to be found in the axils next to the primary spike in the way figured as the type *C*, fig. 2, the plant thus being very rich in spikes. The nervature of the leaves reminds much of that of *P. zosterifolius*. The rounded leaf-base is also mutual. The involucral leaves, again, remind of some Pusilloids by a sometimes occurring slight differentiation between blade and petiole. The perianths are almost circular, concave with short petioles. Style short with a rounded stigma. Fruit more conspicuously petioled than in other species and sharply keeled.

The pollen of the species exhibits a very strange character in behaving as that of a bastard. The grains, namely, are rather unequal as to their size, commonly of middle size, and mostly sterile. However, it cannot be a hybrid between any modern species. Might not the sterile pollen and the scanty fruiting possibly suggest a survivor from times climatically more favorable to it than the present one? Might we not here have before us a dying species, now-a-days maintaining itself principally in a vegetative way? It is likely to be so as regards its area of north-eastern distribution, where it is an immigrant from the time after the glacial period. Its original habitation is the western states of N. America and there we shall certainly find it bears freely fruit. But its distribution and behaviour there is very little known. American botanists should elucidate this question, also of importance geologically.

Anatomy. The anatomical facts show that *P. Robbinsii*, like the following, is a decidedly sclerenchymatous plant. — The epidermis of the stem consists of narrow cells, 4—6 times as long as they are broad. Inside it we observe just as in the following groups a more or less complete circle of mechanical strands and, besides, interlacunarly a few cauline strands on each side of the stele (fig. 19, *B*, *cs*). This exhibits three well separated portions, the two lateral ones formed by 2—3 ± fused

bundles, and the median one consisting of 1) a trio of bundles (the bundle-trio), the middle bundle of which is compressed, with sieve tubes toward the sides, and the others smaller or often wanting, and 2) a likewise compressed opposite bundle, the xylem channel of which fuses with that of the main bundle of the trio. Between the median and lateral areas and between the endodermis and the trio's main-bundle and the opposite bundle there are important portions of mechanical cells. The whole is surrounded by an *O—O*-endodermis, the cells of which have three different degrees of thickness. The strongest cells are situated outside the lateral bundle-groups, the second strongest outside the median group. Other cells are thin-walled, combining cells (fig. 19 *C*, *z*). In the peduncle the cortical strands are entirely lacking and the vascular bundles are four, two median and two lateral ones, fig. 20, *C*.

The anatomy of the leaf presents on the upper surface an epidermis of very large-roomed cells, at short intervals interrupted by narrow ribbons of very small cells (fig. 19, *G*), within which more or less strong bundles of bast-cells are running. All these strands make the leaves many-nerved and finely striate. The vascular bundles are seven at the base of the leaf, at the middle usually five. The marginal bast-bundle is very strong. By all that, the leaves grow very durable and well able to endure unfavourable conditions.

The tops of the branches are transformed into turios in the same way as in *P. zosterifolius* and others, which endure the winter well and abundantly propagate the species.

Distribution. In the Swedish Museums specimens occur from *N. America*: *U. States*, *N. Angl.* leg. E. TUCKERMAN (hb. Uppsal.); *Massachusetts*, leg. MORONG (hb. Stockholm.), *Connecticut*, leg. MORONG (hb. Stockholm.), *Minnesota*, leg. TAYLOR (hb. Stockholm.). No specimen from the *Western States*. *Canada*, *Plevna*, *Ont.* 02, FOWLER (hb. Stockholm.), *Vancouver Isl.*, 87, Macoun (hb. Christian. et Haun.).

Fig. 19. *P. Robbinsii* OAKES. *A*, Pistils, *a*, *b*, lateral view, *c*, stigma from above, *d*, pistil from behind, $\frac{1}{10}$; *B*, Anatomical stem-diagram, *str*, subepidermal strands, *cs*, cauline strands, $\frac{4}{1}$; *C*, Stele-diagram (more enlarged), *ctr*, median opposite bundle, *tr*, bundle-trio, *z*, thin-walled endodermis cells; *D*, Epidermis of the stem, longitudinal section, $\frac{6}{10}$; *E*, Transverse section of leaf (the one half), *m*, midrib, *n'*, *n''*, lateral nerves, *skl*, mechanical strands, ca. $\frac{6}{10}$; *F*, Transverse sect. middle part, of a leaf at the middle, more enlarged, ca. $\frac{6}{10}$; *us*, upper surface, *ls*, lower surface; *G*, Longitudinal section of the epidermis at *F*, *x*; *H*, Longitudinal section of the epidermis of lower surface.

P. Maackianus AR. BENNET.

Notes on Potamogeton, — in The Journ. of Bot. 1904, 74. — *P. serrulatus* REGEL et MAACK, in REGEL, Tent. Fl. Ussur. 1861, 153. — *P. Robbinsii* OAKES var. *japonicus* AR. BENN. Notes on Japan. Potamog. in Bull. de l'Herbier Boiss. 1896, 546, 549. — Fig. 20, D, E, F.

Dr. P. GRAEBNER in his Potamogeton monograph (1907 p. 108) says, »Af-

finitas speciei mihi valde dubia est; probabiliter melius subsectionem propriam constituit; ex cl. A. BENNETT in litt. melius prope *P. Robbinsii* ponenda est.» Nevertheless he puts it near to *P. obtusifolius* M. & K. The opinion of AR. BENNETT, however, is quite correct, since the species presents the most obvious resemblance to *P. Robbinsii*, both morphologically and anatomically. To the above stated common characters we add: The anatomical diagram of the stem is the same, except that the interlacunar strands are absent and the lateral groups of bundles in the stele more reduced. But the endodermis is entirely alike in both species. In the peduncle *P. Maackianus* has a circle of subepidermal strands and besides more vascular- and bast-bundles (fig. 20, F). On the contrary, the number of the schlerenchymatous strands of the leaf is considerably limited. To the morphologic differences belongs, among

Fig. 20, A, B, C, *P. Robbinsii* OAKES, A, Leaf, $\times 2.5$; B, Top of a leaf, $\frac{2}{1}^5$; C Transverse section of peduncle, showing the shape and the disposition of the bundles, $\frac{2}{1}^6$. — D, E, F, *P. Maackianus* BENN. D, Leaf, $\times 2.5$; E, Top of a leaf, $\frac{1}{1}^3$; F, Cross section of peduncle, showing the subepidermal strands (str) and lacunar bundles (hatched), $\frac{4}{1}^9$; m, n', n'', skl = Fig. 19.

others, that the leaves are of the same width throughout their whole length, the top abruptly cuspidate forming a broad, obtuse apex, the denticulation abating towards the base, that the stem is compressed but scarcely bicanaliculate, the cross-cut form of the peduncle oval or oblong etc. Fruit seldom seen.

Distribution. Japan, Hakone. SIEBOLD it. sec. 1859—63 (hb. Stockholm.). The species obviously has its distribution area in East-Asia: Japan, Corea and adjacent districts, thus constituting, by its near affinity with the foregoing species, an interesting combining link of the floras of both sides of the Pacific.

P. Maackianus is said to hybridize with *P. compressus* (GRAEBNER, Potamog., 1907, 165), but I have not seen the plant referred to (FAURIE, Japanese pl. 10370), and with *P. malaianus* MIQ. (AR. BENNETT, Philippine Journ., 1914, 342) in the Lake Lanao, Mindanao, 1906, leg. MARY STRONG CLEMENS. On a sheet of this plant preserved in Copenhagen (Bot. Mus. University), two forms are present: 1) *P. nipponicus* MAK. and 2) The new form named *P. philippinensis* AR. BENN. The stem of this plant is terete and the anatomical diagram of it is: epid. + one-layered pseudohyp. + subepid. str. + ligular str. + O-O-end. + CC of eight-bundled type. Leaves serrulate lance-linear, $65 \times 5-6$ mm, with a protracted *malaianus*-like, sharp cusp, base sessile, sheathing like *P. Maackianus*, the longitudinal 4-6 lateral nerves running like those of *P. mal.*, but the cross-veins not so densely placed as in this one. Besides, the thin, longitudinally interjacent, mechanical strands of *P. Maackianus* are absent. — The author seems to have confounded these two forms when writing: — Lower leaves — — — 8 to 15 mm wide. etc. It is the narrow-leaved form that ought to bear the new name.

Sectio IV. **Axillares** HAGSTR.

Caulis compressus $\pm$ bicanaliculatus vel subteres—teres. *Folia* sessilia vel $\pm$ petiolata, serrata—serrulata—integerrima, ligulata, ligulis in ochream fissam vel rarius integram connatis. *Præfoliatio* adplicata (subsect. 6-13), involuta (subsect. 14-23) vel convoluta (subsect. 24-25). *Hybernacula* rhizomatica vel caulina.

To this section belongs the bulk of the Potamogetons and it is evident, that the evolution of the genus has gone this way. We take the youngest types to be the forms with involute præfoliation with a few exceptions having floating leaves. These species derive their origin partly from the submerged narrow-leaved, partly from the submerged broad-leaved forms, between which the difference is not very prominent indeed. In this section hybridization is rather common, by which the evolution may be said to be in process.

Subsectio 6. **Crispi** WALLMAN.

In LILJEBLAD, Utkast till en svensk Flora 1816, 706. — *Batrachoseris* IRMISCH, Über einige Arten etc. 1858, 17.

Caulis compressus bicanaliculatus. *Folia* late linearia serrata. *Ligulæ* emarginatæ. *Pistillum* stylo conspicuo, stigmatæ ovali oblique affixo. *Fructus* $\pm$ longe rostratus.

This group is richly provided with both rhizomes and cauline propagating buds. Only one species is known. *P. Chamissoi* AR. BENN. must be ranked under the *Lucentes*.

P. crispus L.

Species plantarum 1753, 126. — *P. serratus* L. l. c. — *P. crenulatus* DON, Prodrum Fl. Nepal. 1902—3, 22. — *P. tuberosus* ROXBURGH, Hortus beng. 1814, 12. — *P. serrulatus* SCHRADER ap. OPIZ, Flora V, 1822, 227. — *P. crispatus* WALLMAN ap. FRIES, Nov. fl. Suec. 1828, 43. — *P. lactucaceus* MONTAND., Guide Bot. 1868, 305. — Huc etiam species Gandogerianæ pertinent: *P. hungaricus*, *P. rubricans*, *P. pallidior*, *P. Hohenackeri*, *P. Notarisii*, *P. leptophyllus*, *P. rubrinævus*, *P. macrorrhyncus* et *P. austriacus* GANDOG., Pugillus plant. nov. etc. in Österr. Bot. Zeitschr. 1881, 43—44. — Fig. 21, 22, 24, A.

Fig. 21. *P. crispus* L. A, B, C, Tops of stem-leaves of the var. *obtusifolius* FIEB. (slightly enlarged); D, Upper part of a stem-leaf of v. *acutifolius* FIEB. (slightly enlarged); E, Pistil, lateral view, a, the point where it is fixed at the receptacle, st, stigma, $\frac{1}{2}$; F, Longitudinal section of the receptacle (a) with two fruits showing the point of concretion (p), b, rostrum, c, dorsal keel with a basal horn-like boss, $\frac{1}{4}$; G, Figure showing the relative size of the pollen-grains of, a, *P. crispus*, b, *P. perfoliatus* and *praelongus*, c, *P. pusillus*; H, Diagram of the stem's axial cylinder, k, bundles, tr, bundle trio, ctr, opposite bundle, lb, lateral bundles, p, pith; I, Transverse section of the middle lacunar part of a leaf (upper part near the middle), m, midrib, $\frac{1}{2}$; J, Part of the leaf margin with 2 teeth each ending in a greater top-cell, a (enlarged); K, Transverse section of leaf margin, us, upper surface, ls, lower surface, b, a faint marginal strand, $\frac{1}{10}$.

the leaf, a fact observed in *P. ochreatus* also.

The style is elongated and the oval stigma fixed obliquely. By this fact the present species and group is distinguished from its relatives; also by the ovaries, which at first isolated from each other grow a little together below, when ripening to fruit and increasing simultaneously their receptacle. The rostrum, in fresh state being conic and erect, curves itself more or less backwards, when drying, by the dorsal spongy parts of it shrinking more than the inside. The dorsal keel ends in

The furrowed stem and serrulate leaves connect this plant with the precedent group. An abundant evolution of hibernating and propagating cauline buds characterizes this species as well as the foregoing and next-following groups. The air-channels of the leaf, in the upper part 1—2 on each side of the midrib, increase in number toward the base, forming there a broad area of 4—5 rows on each side. One or two pairs of lateral nerves are running rather near the margin, by which the species exhibits affinity with the Pusilloids especially *P. obtusifolius*. The ligule is often at its base slightly grown together with

a more or less prominent boss. Endocarp thick-walled, epicarp thin, lid narrow, prominently keeled. Peduncle lacking the furrows has an oval crosscut form.

Respecting the stem-anatomy *P. crispus* is perfectly lacking interlacunar and subepidermal strands but the epidermis, in compensation, is endowed with a one-celled pseudohypodermal stratum. Endodermis of *O*-cells, vascular bundles of the stele arranged chiefly as in the following groups. The leaves are also lacking mechanical strands except in the margins, where a faint strand is present. Thus *P. crispus* is a genuine non-schlerenchymatous species. The epidermis-cells of the upper surface of the leaves are not so deep, radially seen, as those of *P. Robbinsii* and the same is the case with the next following groups.

The rhizome has not the same cross-cut form as the stem, but a nearly circular or faintly oblong one, which, besides, seems to be characteristic of the rhizomes of all species. The epidermis-cells are longer, about 4–10 times the width; in the stem, to mechanical purpose, only 2–4 times (fig. 22, *C*, *D*). The air channels are reduced both in size and number. The bundles of the stele are separated, and beside this there are three lateral ones on each side. The endodermis-cells are weaker like all mechanical dispositions for the rest. But these arrangements return also regularly in the rhizomes in general. The compression of the leafy shoot in this and other species is therefore an evident arrangement for mechanical purposes by making all parts more flexible and pliant in the water. The enlarged, rounded borders of the stem and branches of this and other species, again, make the plant float more easily by their being pierced by larger air-filled channels. The fusion or reduction of the lateral bundles of the stele of the stem evidently depends on the necessity of making place in the strongly compressed stem for the essential, lacunar system situated semicircularly round the lateral edges of the stele, fig. 22 *B*. If the channel-system is reduced, as in the rhizomes, or sufficient space can otherwise be obtained you will find a plurality of free, lateral bundles in the central axis.

According to FIEBER (Potam. Böhm. 1838 p. 32) the variations of this species can be classified into two varieties characterized by a pointed or obtuse leaf apex:

Var. *acutifolius*, and Var. *obtusifolius*. — The latter is *P. crispus* α *genuinus* REICHB., Icones 1845, 18, and *P. crispus* f. *typicus* TISELIUS, Pot. suec. exsicc. fasc. II, 1895. It is the commonest in the Swedish collections. The former is much rarer, recorded from *Sweden* at following stations: *Scania*, between Skanör and Trelle-

Fig. 22. *P. crispus* L. A, Transverse section of the rhizome, $\frac{2}{1}$, showing the central cylinder (cc), the lacunar system (l) and the terete form, B, Transv. section of the stem, $\frac{2}{1}$, showing the same. C, Longitudinal section of the epidermis of the rhizome, $\frac{6}{1}$, and D, of the stem, $\frac{6}{1}$.

borg, 84, WITTROCK (hb. Stockholm.), Malmö, Husie, 65, BRORSON (hb. Uppsal. et Lund.), Björka, Kropp, 64, HULTBERG (hb. Lund.), f. *longifolius* FIEB., Ousbyholm, hb. Düben (hb. Lund.), narrow-leaved form, between Reng and Maglarp, 84, NILSSON (hb. Lund.); *Uppland*, Uppsala, WIESLANDER (hb. Lund.). — *Russia*, Livland, Riga, 82, CEDERWALD (hb. Stockholm.).

Other forms are:

Var. **cornutus** LINTON in The Journ. Bot. 1894, 186. — *P. macrorrhyncus* GANDOG. l. c., p. p. — *P. crispus* L. var. *macrorrh.* (GDGR) ASCH. & GRAEBN., Syn. 1897, 336: — A form with the most elongated rostrum: »The spur stands out $\frac{1}{20}$ in. from the surface of the drupelet, in the dried specimens.» (LINTON).

The length, width, and crispness of the leaves vary. Thus FIEBER discerns in *v. acutifolius* two forms:

f. *vulgaris*: Leaves about 5 cm long, and f. *longifolius*: Leaves more elongated.

Var. *obtusifolius* also sometimes has elongated leaves: thus a *forma elongatus*.

The same variety, besides, occurs narrow-leaved, f. *angustifolius* FIEB, and broad-leaved, f. *latifolius* FIEB. The former is recorded from *Sweden*, Scania, Högånäs, hb. AG. (hb. Lund.) and from *Ind. or.* HOOKER & THOMSON (hb. Stockholm. et Lund.); *Japan*, Tokio, YATABE (hb. Uppsal.).

Var. **sinuatus** FRIES, Nov. Fl. suec. 1828, 43, has the crispest leaves and is besides densely foliated. Two typical examples of this are deposited in the Museum of Uppsala, both from *Sweden*, Smoland: one from Misterhult lake, labelled hb. HARTMAN, and the other from Hemsjön, 1824, E. FRIES, labelled: »*P. crispus* v. *crispatus* WALLM.».

Var. **najadoides** GRAEBNER in ENGLER, Pflanzenr. IV: 11, 1907, 100: — Leaves very crisp, narrow and more removed from each other.

Var. **planifolius** MEYER, Chloris han. 1836, 523: — »Flachblättriges Laichkraut». *P. crispus* γ *serrulatus* (SCHRADER) REICHB., Icones 1845, 18. — *P. crispus* v. *phialensis* POST, Bull. Herb. Boiss. I, 1893, 409? (form with very faint denticulation). —

Var. **alatus** ZAPALOWICZ might be nothing else than the usual form, see the fig. 21, *F*.

f. *humilis* DUMORTIER, Fl. belg. 1827, 163 is individuals of low growth and f. *gemmifer* REICHB., l. c., individuals with buds (turios).

Distribution. As to *Sweden* *P. crispus* is a southern or south-east species. The most northern outposts of it occur at Hedesunda in *Gestricia*, 60° 30' N Lat.; at Kärbo, 55, CEDERSTRÄHLE (hb. Uppsal.) and Ångsjön, 54, CEDERSTRÄHLE (hb. Stockholm.) in *Westmania*; at Götlunda, 58, BLOMBERG (hb. Lund. et Gotenb.) in *Nericia*; in Kolungen near Mellerud, *Dalia*, 84, FRYXELL (hb. Stockholm.) and at Kongälf (hb. Lund. et Gotenb.) in *Bahusia*. — In *Norway* it is recorded from Ringerike. Its most northern limit in the Scandinavian Peninsula, therefore, is a line going from Hedesunda to Örebro and Mellerud in Sweden, to Ringerike, ca. 60° N. Lat., in Norway, nearly corresponding to the year isotherm of + 4° C. It is probable it does not surpass this line in general. In *Siberia*, however, it goes as far to the

North as to Yeniseisk 58° 20' N. Lat. where it is gathered by H. W. ARNELL in 1876. (see SCHEUTZ, Pl. vasc. jenisei. p. 163! hb. Stockholm.) with a year isotherm of about — 4° C. Such a curve towards the north in these regions may belong to several other species of about the same northern limit, undoubtedly dependent on the comparatively high summer temperature (July isotherm + 20° C). From this northern limit it seems to spread in *Europe* and *Asia*, through *Africa*: Egypt, Syene, KOTSCHY (hb. Stockholm. et Uppsal.), var. *obtusifolius* f. *angustifolius* FIEB. Natal, in rivulo Umschlangwe pr. Phoenix, 93, R. SCHLECHTER N:o 3122 (hb. Zürich. et Stockholm.) (see also AR. BENNETT in Flora trop. Afr. VIII: 2, 1901!), and *Australia*. The distribution in *N. America* is little known. Arizona is mentioned; also Canada. In our Museums specimens are found from Delaware, COMMONS (hb. Stockholm.) and Massachusetts, ARLINGTON, coll. MORONG (hb. Stockholm.). From *Central America* and *South America* it is not recorded.

P. crispus L. × *perfoliatus* L.

FRYER, On a new Brit. Potamog., in The Journ. of Bot. 1891, 289 tab. 313. — *P. undulatus* v. *Cooperi* FRYER; *P. Coopéri* FRYER, l. c. 290. — *P. cymatodes* ASCH. et GRAEBN., Synops. mitt. Fl. I, 1897, 337. — *P. cymbifolius* FISCHER, Beitrag zur Kenntn. bayer. Pot. in Mitteil. n:o 31 d. bayer. Bot. Ges. 1904, 366.

Of this hybrid I have seen four forms which can be classified into two series, one with the leaf serrature *crispus*-like with real incisions in the margin (Fig. 21, *L*), the other *perfoliatus*-like with one-celled denticles on the margin (Fig. 117). The ASCHERSON—GRAEBNER arrangement is more vague and difficult to understand and apply.

Stem always compressed and more or less double-furrowed as all the *crispus*-bastards. Leaves always provided with teeth or denticles, 7—many-nerved, broad or narrower, short or more elongate; leaf-apex obtuse and always more or less gutter-shaped and *perfoliatus*-like. Nerve-spaces either short as in *P. crispus*, or somewhat longer as in the other parent-species. Ligules always very deciduous.

The *stem-anatomy* has three singularities: 1) Endodermis always of *O*-cells; 2) Cortical bastbundles either entirely wanting or seldom represented by one or two interlacunar strands with a disposition for running subepidermally (an inheritance from *P. perfol.*); 3) Along the epidermis there never appears more than a single i. e. one-celled layer of bark-cells. By these anatomical facts this hybrid can easily be distinguished from the very similar hybrid *P. undulatus*, where the stem is always much influenced by *P. praelongus*, and therefore has: 1) an endodermis of more or less conspicuous *U*-cells, 2) the subepidermal bark-layer two-celled at least in several places, and 3) vascular and bast-bundles in the bark at least in one well developed interlacunar circle, but on the other hand scarcely any subepidermal strand, thus an arrangement in opposite direction to the foregoing hybrid or from epidermis towards the central axis.

Conspectus formarum:

α. **Serrulatus:** — Folia serrulata, in margine iis *P. perfoliati* similia.

f. eu-Coopéri GRAEBNER, Potamog. in ENGLER, Pflanzenr. IV: 11, 1907, 134. — *P. undulatus* var. *Cooperi* FRYER l. c., tab. 313.

Stem-leaves broad and elongated, usually 60—70 mm long by 20—30 mm in width. A single station known: *England*, Leicestershire: Canal Loughborough. This plant might possibly be *P. crisp.* × *præl.*

f. **Jacksonii** (LEES). — *P. perfoliatus* var. *Jacksoni* LEES in The Bot. Record Club Report 1880, 150. — *P. undulatus* (*crispus* × *perfoliatus*) var. *Jacksoni* (LEES) FRYER, l. c. 290—291: — Stem-leaves commonly of the size $\frac{50}{13}$ mm (45—60 × 13—20). In habit often very like *P. perfoliatus* L.

Distribution. *England*, Chester, River Dee, 91, BILLUPS (hb. Stockholm.), Cambridgeshire, Parsonware Drove, Benwick, 92, BILLUPS & FRYER (hb. Stockholm.).

f. **scoticus** n. f. — Folia anguste ovato-lanceolata. — Stem-leaves narrower and comparatively more elongated than in the precedent and following forms, 50—80 × 6—13 mm.

Distribution. *Scotland*, Stirlingshire, Union Canal supra Falkirk, 94, STIRLING & KIDSTON (hb. Stockholm. et Lund.).

β. **Serratus:** — Folia serrato-dentata.

f. **Fischeri** n. f. — Folia caulina ca. 20—25 mm longa, 10—12 mm lata. — *P. cymbifolius* FISCHER, l. c.

FISCHER parts his *P. cymbif.* into two forms: f. *subperfoliatus* and f. *subcrispus* yet without stating the separating differences. All materials from Ebing I have seen are uniform and I propose to name the form after its meritorious discoverer Dr. G. FISCHER, Professor in Bamberg.

Distribution. *Germany*, Bavaria, Mainaltung bei Ebing, 02, FISCHER (hb. Stockholm.).

Real *P. Cooperi* is besides observed by us from Gudenå in *Denmark* (hb. BAAGÖE).

***P. crispus* L. × *prælongus* WULF.**

Ex CASPARY, Bericht etc. in Schriften Phys. Ök. Ges. Königsberg 1878, 96—98. — *P. undulatus* WOLFG. in J. A. & J. H. SCHULTES, Mantissa in vol. tert. etc. 1827, 360, ex RAUNKIÆR, Danske Blomsterpl. I, 1896, 104.

This hybrid can easily be distinguished both from the preceding bastard and from the parent-species in the bicanaliculate stem and the even leaf-margin. At least hitherto very few individuals of it have been discovered with rudimentary serrature. The author has seen a single specimen from Langer See of West-Prussia. On such individuals those dental rudiments, at all events, can be observed only in very young leaves as they very soon disappear. On the contrary the leaf margin often appears

sinuated by which an influence from *P. crispus* can be perceived. The ligules, however, are more persistent and longer than in *P. Cooperi* and the leaf-apex of another shape. To this come the above mentioned characters of stem-anatomy and consequently there are no greater difficulties to discern the two hybrids from each other.

Finally it should be observed that the unequal size of the pollen-grains does not prevent the crossing between the two species (fig. 21, G).

Although found in very many places the hybrid appears rather uniform in characters. The variations mostly refer to the leaf width. Usually the stem-leaves are 15—20 mm broad. This form I have called:

f. *typicus* n. f. — Folia ad 15—20 mm lata.

Another form with broader leaves is found in the »See von Kutzborn», East Prussia, and could be named

f. *latus* n. f. — Folia ad 40 mm lata.

Other individuals again have narrow and more elongated leaves. In several herbaria I have labelled such ones

f. *concinus* n. f. — Folia sat elongata, ca. 12—14 mm lata. —

A rather peculiar plant collected by Dr. MAGNIN in 1895 at »Leyre, La Mothe» in France, evidently belongs to the hybrid *P. undulatus*. It resembles very much f. *concinus* but with a little more tapered leaf-base and much more numerous nerves anastomosing in the apex as in *P. praelongus*. The stem-anatomy cannot be derived from any other combination than *P. crispus* × *praelongus*. It may be named:

f. *nervosior* n. f. — Folia multinervia ut in *P. praelongo*. —

Fig. 23.

This find is most interesting, since *P. praelongus* is not hitherto recorded from south-western France. Perhaps the plant is mislabelled originating in fact from East France.

Distribution. Denmark, Varming Sö, 00, BAAGÖE (hb. Stockholm.), Nibså, 97, BAAGÖE (hb. Stockholm.), Gudenå, 95, 99, BAAGÖE (hb. Stockholm., Uppsal. et Lund.), Kongeå, 96, BAAGÖE (hb. Lund.). — Lithuania, Vilna, WOLFGANG (hb. Stockholm.), Vilna, HORANINOW (hb. Uppsal.). — Besides those from West- and East-Prussia the writer has seen specimens of this hybrid from »Gerdau unweit Ülzen», Hanover; and AR. BENNETT records it from Stirlingshire in Scotland near the localities for × *P. Cooperi* and × *P. Bennettii*, thus three *crispus*-hybrids growing on a limited area.

P. crispus L. × *pusillus* L.

P. Bennettii FRYER Notes etc. in The Journ. of Bot. 1895, 1; t. 348. — Fig. 24.

A. FRYER considers this plant to be *P. crispus* × *obtusifolius*. Three facts, however, decidedly stand in opposition to this hypothesis and support the above

Fig. 23. *P. undulatus* WOLFG. f. *nervosior* HAGSTR. Top of a stem leaf, $\frac{3}{4}$, showing the form and nervature.

signed combination: 1) The filiform stem has not the strongly compressed shape that has *P. obtusifolius*. The cross-cut form and anatomical diagram (fig. 24, B) evidently is intermediate between *P. pusillus* and *crispus*. Evidence for the latter are the two furrows, the subepidermal strands reduced in number and the bundle-trio (fig. 24, B, tr) of the central stele; for the former, again, the rounded form of the stem and of the central axis, and the few subepidermal bast-bundles. To these decisive facts come (2) the narrow stem-leaves, and (3) the small turios intermediate

between *crispus* and *pusillus*, not between the former and *obtusifolius*, the buds of which are larger than those of *P. Bennettii*, a fact that otherwise ought to be the very inverse.

The specimens examined are labelled: »STIRLING V. Co. 86. Wood Pond: Grangemouth. Aug. 24. 1894. R. KIDSTON & COL. STIRLING. A. F. n. 3001» (hb. J. BAAGÖE). Thus originating from an exceedingly interesting *Potamogeton*-region of Scotland. — It is not known to me if *P. concinnitus* AR. BENN. (*crisp.* × *pus.*? ex AR. BENN.) is the same hybrid as the STIRLING plant or not.

Fig. 24. A, *P. crispus* L., Cross section of the stem, $\frac{4}{1}$; B, *P. Bennettii* FRYER, Cross section of the stem, $\frac{4}{1}$; C, Cross section of *P. pusillus* L., $\frac{5}{1}$, and D, Cross section of *P. obtusifolius*, $\frac{4}{1}$. x, intercellular channels, l, lacunæ, str, strands; E, *P. Bennettii* FRYER, Top of a stemleaf, $\frac{4}{1}$.

Subsectio 7. *Compressi* (FRIES Nov.) HAGSTR.

Caulis valde compressus.

Folia anguste linearia integerrima multinervia, basi late rotundata, apice acutissime cuspi-

data. *Ligulæ* semper fissæ, in spatio intermedio multinerviæ. *Pistillum* stylo brevissimo, stigmathe ovali-oblongo. *Fructus* dorso sæpe rugosus.

This group is characterized by the short style and oval stigmas covering the whole upper surface of the style. By this it closely joins the *Monogyni m.* (below), whereas the strongly compressed stem unites it with the *Crispi*. Anatomically it differs from all the contiguous groups by the strong, marginal, cauline strands being provided with vessels, Fig. 26 A, a, D, a. The abundance of the foliar schlerenchyma

connects it with the *Ochreati*, with which it besides has the round leaf-base in common. The front-field of the ligules 25—30-fibrous reminding also of the *Ochreati*.

The evolution of rhizomes of this and some following groups is very inconsiderable and often quite failing.

P. zosterifolius SCHUM.

Enumer. pl. Sæll. I, 1801, 50. — *P. complanatus* WILLD., Magaz. Ges. der naturforsch. Freunde Berlin, V, 1809, 297. — *P. laticaulis* WAHLENBERG, Fl. suecica I, 1824, 107. — *P. cuspidatus* SCHRAD., ap. SMITH Engl. Fl. I, 1824, 234, ex CHAMISSO. — *P. zosterophyllus* DUMORTIER, Fl. belg. 1827, 164. — *P. compressus* L. ap. FRIES, Nov. Fl. suec. 1828, 44—46. — *P. carinatus* KUPFFER ap. VON ZUR MÜHLEN, Die Potamogetonen des Ostbaltikums in Korr. Bl. Nat. Ver. Riga, 1906, 164. — Figs. 25, 26.

According to P. J. BEURLING, Syn. 1853, 89, the Wahlenbergian name refers to *P. zosterif.* For this the fact also pleads that the just mentioned species appears in several examples in the herbarium of Prof. WAHLENBERG (hb. Uppsäl.) while *P. acutifolius* is wanting.

Although I have not seen and examined the original *P. carinatus* KUPFFER, I consider it, according to the description, to be the species of SCHUMACHER. A new species is not to be thought of. Nor can it be a bastard, since the pollen is well developed (*pollen optime evolutum*). Nor can it be a variety of *P. acutifolius* which is neither many-flowered nor has elongated peduncles as *P. carinatus* is said to have.

The anatomical structure of the stem and leaf is showed by the figs. 25 and 26. The peduncle (Fig. 25) has scattered subepidermal bast-bundles, in some individuals rather numerous, in others very few. The number also decreases towards the spike, thus the basal cross section showing more strands than the upper one. The median vascular bundles vary in number from 2 to 4, the latter number when fruiting richly, the former in case of spare fruit. The abortive form (see below!) never exhibits more than two median bundles, the phloem part of which seems to have been transformed into mechanical tissue.¹ The bundles of the stem, again, are all normal. The lateral bundles of the peduncle are always two, one on either side of the middle ones, more or less approaching to the borders of the peduncle. In the abortive form the lateral bundles also exhibit an abnormal appearance. Herein I see the natural cause of the reduced ability of stretching the peduncles, of the reduced number of flowers, and of the incapacity of full development of the floral parts of this form.

G. FISCHER has distinguished following forms of this species: f. *major*, of high growth and with long leaves (= f. *major* ZAPALOWICZ, Consp., 1906). To this belongs a barren form which TISELIUS (Pot. suec. exs. II, 1895, n. 97) has named f. *magnus*.

¹ For want of fresh material the researches of this strange fact are not finished.

Further, f. *minor*, with short internodes and small leaves; f. *latifolius*, broad-leaved; f. *angustifolius*, narrow-leaved; f. *cuspidatus* with elongated, finely cuspidate leaves. Probably he means a form called by J. BAAGÖE (in some herbaria) »f. *cuspidata*» which on closer investigation has turned into the $\times$ *P. bambergensis*; f. *selenocarpus*, fruit inside with a basal boss as in *P. acutifolius*. It may be added that a micro-carp form is also found.

A form hitherto not studied is the above mentioned abortive form, f. *abortivus* m. It has always abbreviated peduncles (15—25 mm), undeveloped spikes with only 5—7 verticils and barren flower parts. It behaves completely as a bastard and it is not impossible that the properties just now mentioned may derive their origin from *P. acutifolius*. If this were the case the reduced number of the middle vascular bundles of the peduncle also would be satisfactorily explained. In the vegetative parts, however, no influence from *P. acutifolius* can be traced, but it is possible, that future researches here also may discover what we at present are unable to discern.

I have seen distinct examples of this interesting plant from *Sweden*, *Uppland* in the following small lakes or water currents: Metsjön in Fasterna, 82, TISELIUS (hb. Stockholm. et Uppsal.), Sparren in the parish of Närtuna, 93, TISELIUS (hb. Stockholm. et Uppsal.), Valloxen 82, TISELIUS (hb. Stockholm. et Uppsal.), Heder-viken, 58, TISELIUS (hb. Uppsal. et Lund.), Bergshamra in Kyrksjön, 78, LÖFGREN (hb. Lund.), Skeboån, 67, MOSÉN (hb. Uppsal., Lund. et Gotenb.). — *Sudermania*, for instance in Bränningeträsk near Södertelje, and in Tumba kvarnsjö. On the occurrence of the supposed parent-species in those regions, see below!

But a similar plant is also collected in *Scotland* by BABINGTON (hb. Stockholm. et Uppsal.), where *P. acutifolius* is not now met with. Nevertheless it is possible that it has occurred there in olden times.

P. zosterifolius has an amphigeian distribution. *Sweden* northwards to east *Jemtland*, Barrsjön, 81, TISELIUS (hb. Stockholm., Uppsal. et Lund.), f. *major*, and south *Angermania*, Gudmundrå at Frånö, 70, SJÖSTEDT (hb. Stockholm.) ca. 63° N. L. To the south of this point it has an eastern distribution through *Medelpad*, Selånger near Sundsvall, 24, LÆSTADIUS and others (hb. Stockholm., Uppsal. and Lund.), f. *angustifolius*, fruiting; *Gestricia*, Trösken at Gefle, 65, THEEL and others (hb. Stockholm., Uppsal. et Lund.); *Uppland*, many stations, for instance Norrsjön at Blad-åker, 02, RINGSSELLE (hb. Uppsal. et Lund.), Lomaren at Norrtelje, 80, HEDLUND (hb. Uppsal.), Sättrasjön at Uppsala, 28, WAHLENBERG (hb. Uppsal.), Ekebysjön, 18, WAHLENBERG (hb. Uppsal.), Fyrisån, 28, WAHLENBERG (hb. Uppsal.); *Westmanland*, Köpingsån, 48, »LHTR» (hb. Uppsal.); *Sudermania*, many stations, for instance at Stockholm, collected by NYMAN, HARTMAN, THEDENIUS and others (hb. Stockholm., Uppsal. et Lund.), Nyköping, 51, FRISTEDT (hb. Stockholm.), Eskilstuna, 83, PEHRSSON (hb. Lund.), Årdala, 50, FRISTEDT (hb. Uppsal.) etc.; *Nericia*, Igeln in the parish of Sköllersta, 70, HARTMAN (hb. Uppsal.), at Örebro, 69, HARTMAN and later many others (hb. Uppsal. et Lund.); *Ostrogothia*, Norrköping, 56, HAMMARSTEN and others (hb. Uppsal.), Himmelstalund, 67, ELMQVIST (hb. Lund.), Söderköping, 49, »LBG» (hb. Uppsal.), Linköping, 24, FRIES (hb. Uppsal.), Skrukeby and Svinstad,

EKEROTH and others (hb. Stockholm., Uppsal. et Lund.); *West-Gothia*, Dinstorpsjön in Sandhem, 87, NORSTEDT (hb. Uppsal. et Lund.), Vartofta, 92, MALMGREN (hb. Uppsal.); also in east *Smoland* according to S. ALMQUIST; *Scania*, many places, collected by AGARDH, THEDENIUS and many others (hb. Stockholm., Uppsal. et Lund.). Westward it is misreported from Ätran in *Halland* by E. FRIES in his *Flora Hallandica*. *P. compressus* Fl. Hall. = *P. obtusifolius* M. & K. (see under this species!).

Norway, Christiania, 45, BLYTT (hb. Stockholm. et Uppsal.). — The scandinavian occurrence of *P. zosterifolius*, therefore, seems to coincide nearly with that of *P. crispus*. The difference is that the former appears a little more towards the north than the latter. The northern limit may be the year-isotherm of $+3^{\circ}$ or $+2^{\circ}$ C. — In *Finland* it is met with in Lakkola, 53, VIKLANDER (hb. Uppsal.), in Karelia austr., 80, OLSONI and others (hb. Stockholm. et Uppsal.), in Karelia oneg., 63, SIMMONS (hb. Uppsal.).

Asia, south part of Baikal, 55, RADDE (hb. Stockholm.). *Japan*, Sorachi, 98, FAURIE. *N. America*, Canada (hb. Uppsal.).

From this northern limit it seems to spread through the old and new world to the year-isotherm of about $+12^{\circ}$ C. In the Swedish Museums specimens occur from the *United States*: Wisconsin (hb. Uppsal.), Minnesota (hb. Stockholm.), Michigan (hb. Stockholm.), f. *selenocarpus*, and Massachusetts (hb. Stockholm.). — *Europe*, from many stations in *Denmark* and *Germany* (hb. Stockholm., Uppsal., Lund. et Gothenb.); *Belgium*, Westerloo, 66, HÆSENDONCK (hb. Lund.); *Switzerland*, Neuchâtel, Lac d'Etalières, 69, TRIPET (hb. Uppsal. et Lund.); *Poland*, Lithuania, 98, DYBOWSKI (hb. Stockholm.).

P. acutifolius LINK.

In ROEMER & SCHULTES, *Systema vegetabilium*, III, 1818, 513. — *P. cuspidatus* SCHRADER in SMITH, *Engl. Fl.* I, 1824, 234. — Fig. 25, 26, 27.

A noticeable peculiarity characterizes the genus *Potamogeton* in the manner that nearly allied species often appear in pairs. This is the case with *P. Robbinsii* and *P. Maackianus* treated of above. The same is to be stated of *P. polygonifolius* and *coloratus*, *P. gramimus* and *lucens*, *P. polygonus* and *Ulei*. *P. zosterifolius* and *acutifolius* also exhibit very great conformity with each other. Therefore some authors consider the latter to be a variety of the former (thus already SCHULTES in *Mant.* III 1827), others look upon it as a subspecies or at least a dubious species. However the fact may be explained, to me *P. acutifolius* nevertheless seems well to defend its rank as a true species. This results both from a comparative examination of the two species and from the fact that the cross-breed is entirely sterile. As to the fructification the difference at first glance is not very obvious. The ripe fruit of *P. acutifolius* very seldom lacks the basal boss inside, which in *P. zosterifolius* again is the normal condition. By this the fruit of the former generally appears broader than that of the latter (cf. CHAMISSO's description in *Linnaea* 1827!). Both fruit-forms, however, occur in *P. zosterifolius* and even sometimes in the same

individual or in the same spike. This fact shows that the boss spoken of belongs to the species as a disposition, although it more seldom arrives at its full development. This, again, seems partly to depend on the room in each case. Where, in a flower, all the four pistils have grown into fruit, the boss is lacking; if only one nutlet be met with the boss is present. Partly it may depend on the fact making

the fruit microcarp or causing the partial failure of fruit, viz. the reduction of numbers of the median vascular bundles of the peduncle. In *P. acutifolius*, moreover, the rostrum is more facial than in *P. zosterifolius*, where it generally is more apically situated. The two species can thus often, but by no means always, be distinguished by the ripe fruit.

In *P. zosterifolius* the topmost part of the style is somewhat protracted backwards, which I have not observed in the parallel species. The stigma, therefore, is also more elongated in the former than in the latter. The pollen-grains of *P. zosterifolius* are always considerably larger than those of *P. acutifolius*. The form of the perianths has not the constancy authorizing a specific difference to be founded on it. Generally these organs have but little systematic value. The number of the verticils never surmounts four in *P. acutifolius*, generally they are three, sometimes only two, in the other species they are 7 to 9 (12). On the abor-

Fig. 25. A, B, C, *P. zosterifolius* SCHUM. D—G, *P. acutifolius* LINK. — A, Transverse section of a stem-leaf a little beneath the middle, $\frac{3}{8}$; B, Transverse sect. of peduncle, showing three median vascular bundles, $\frac{1}{2}$; C, Pistil, a, side-view, b, stigma from above, c, style from the back ($\times 8$). — D, Transverse sect. of a stem-leaf somewhat beneath the middle, $\frac{3}{8}$; E, Transverse sect. of peduncle showing the two median vascular bundles, $\frac{1}{2}$; F, Pistil, a, side-view, b, stigma from above ($\times 8$); G, Stamen with reduced perianth, a, from within, b, outer sight, $\frac{1}{2}$. — m, mid nerve, n', n'', lateral nerves, l, lacunar system, ls, lower surface, str, mechanical bundles (marginal strand of 50—80 cells), vb, vascular bundles.

tive form, see above! Another peculiarity as to the *P. acutifolius* is that usually three pistils and the two outer stamens (sometimes also one of the inner ones) of each flower fail, the blade of the perianths also being much reduced as to size and of another form (see the fig. 25, G). This peculiarity unites this group closely to the group of *P. trichoides*. In *P. zosterifolius* also such a reduction of the number

of the pistils is met with though not so regularly. Finally the fullgrown peduncle of typical *P. zosterifolius* is more elongated, usually 3—6 cm (2,5—11), in *P. acutifolius* on the other hand always short, usually about 10 mm (5—23). In both species the crosscut form is alike. The median vascular bundles of *P. zosterifolius* 2—4, those of *P. acutifolius* always only two.

The greatest differences are to be found in the stem, the leaves and turios. The crosscut-form of the stem is shown by the fig. 26, A. The epidermis-cells of *P. zosterifolius* are constantly short, 1,5—3 times as long as they are broad, those of *P. acutifolius* again constantly long, 4—6 times (or more) longer than broad, fig. 26, C, D. The stem of both species is often faintly bicanaliculate, by which these, like many of the following species, exhibit relationship to *P. crispus*. As in this species the furrows disappear in the peduncle.

Proportionally the leaves of *P. zosterif.* are longer than those of *P. acutifolius*, the involucral ones of that being 60—90 mm, and of this 30—60 mm. In *P. acutifolius* the central lacunar part of the leaves occupies the space between the two lateral nerves in the lower half or third part of the leaf, in *P. zostif.* only in the mere basal part. In that the lacunæ are more square and low, in this of a more rectangular crosscut form and the lacunar part thus more elevated over the lower surface of the leaf (fig. 25, A, D).

In anatomical respect the leaves are essentially of the same structure except that *P. zosterifolius* always has two lateral vascular bundles, whereas *P. acutifolius* has only one bundle on either side, this consequently being »3-nerved» and that »5-nerved». In both species numerous subepidermal bast bundles are met with, the marginal ones being very strong. As to the leaf-apex these species hardly can be distinguished from each other, though *P. acutifolius* usually has more elongated cusp and free nerve-tops.

The turios of *P. acutifolius* are thinner and their inner leaves not at all, or but little, protruding over the sheaths. In the other species, again, the buds are

Fig. 26. A, B, C, *P. acutifolius* LINK. D, E, *P. zosterifolius* SCHUM. — A, Transverse section of the stem, $\frac{1}{10}$; the dotted line indicates the occasionally occurring depression by which the stem becomes narrowly double furrowed. B, Transverse sect. of the rhizome, $\frac{1}{10}$. Obs! the terete form! C, Longitudinal section of the stem-epidermis, $\frac{1}{10}$. — D, Longitudinal sect. of the epidermis of the stem, $\frac{1}{10}$. E, Transverse sect. of the stem, $\frac{1}{10}$; the dotted lines, see A!

thicker, their leaves broader, and the inner leaves always more or less (± 10 mm) surpassing the others with free tops. The apices of these leaves of both species roundish, or in *P. zosterifolius* truncate, with a very short point.

P. acutifolius has the most flattened stem of all species hitherto known. The rhizome, however, is even in this species almost terete (fig. 26, *B*). The epidermis somewhat wider than those of the stem, the cortical lacunæ smaller and the endodermis and subepidermal bastcells more thinwalled than in the stem (= reduced floating apparatus and mechanical system).

Fig. 27. *P. acutifolius* LINK. Explanation, see the text.

A lateral vascular bundle of the central cylinder (to the right in fig.) is sending its vessels to form the lateral nerve (n') of the leaf. A dotted line indicates the line of demarcation between the stem and the leaf. *Oc*, oil-cells, *cc*, central axis. $\frac{3}{4}$. *B*, section immediately above *A*, showing a further progression of development, the two lateral bundles and the opposite bundle of the stele having curved outward in order to enter the leaf as its three nerves ($\times-\times-\times$); the dotted line indicates the line of demarcation between the leaf and ligule, and between the ligule and the stem, which now is deprived of its mechanical strands. *C*, The development more advanced, the borders of the leaf and ligule detached from each other and from the stem, beginning of a branch in the leaf axil is indicated by a dotted line (*br*). *D*, The

For the purpose of showing the coherence partly between the stem, ligule and leaf, partly between the vascular and bast-bundles of the stem, ligule and leaves I have figured four serial transverse sections through a node of a young shoot. Fig. 27, *A*, represents a transverse section of the stem through the point from where the leaf is growing forth. The border strands of the stem have unite into a bigger strand on either side (*bstr*), which by partition gives rise to the marginal strands of the ligule and leaf (*B*, *bstr*). The subepidermal strands of the stem (*str*) have moved somewhat inwards from the epidermis, and the lacunar system has become reduced consisting now principally of small rounded rooms (*l*). A

ligule is free from the stem being still destitute of mechanical strands; intervaginal scales (*i*), ca. ten in number, formed in the space between as secretion organs (oil reservoirs). Leaf and ligule still cohering by a narrow cell-tissue, but the little branch free. The mechanical strands of the front-field of the ligule and the inside (= upper surface) of the leaf are developing. *bf*, back-field of the ligule, showing the line of demarcation (dotted) between the borders of the ligule. *m*, midbundle, *n'* lateral bundles, *ustr*, strands of the lower surface of the leaf. *E*, Transverse section of the adult ligule; *ic*, intercarinal part (= front-field) showing 25 bast-strands, *r—r* the two ridges.

From what is said above it will be clear that the middle vascular bundle of the leaf first enters the stem and forms the opposite bundle of the central axis, then the lateral bundles of the leaf enter the stem and central axis and form the lateral bundles of central stele (foliar bundles, see fig. 2), further that the subepidermal strands of the stem are the same as in the lower surface of the leaf and in the back-field of the ligule, that the stem is deprived of its subepidermal strands at the point of the ligule's disjoining from it, and, finally, that the mechanical strands of the front-field of the ligule and of the upper surface of the leaf are born within these organs and accordingly of a considerable systematic value. — The correspondence with the ligule of *P. pectinatus* (and its relatives) and *P. acutifolius* (and allied), and the differences between them will immediately appear on a comparison between the figs. 17 and 27.

The species does not vary very much. FIEBER has called individuals with lower growth shorter and narrower leaves β *minor*. The mainform is α *major*.

Besides, FISCHER has distinguished a form *latifolius* (probably = α *major* FIEB.), *f. angustifolius* (= β *minor* FIEB.), and *f. mucronatus*, leaves with a short cusp. Dependent on the fruit-form he distinguishes between *f. liocarpus*, without, and *f. condylocarpus* with a tuberos keel on the back.

Distribution. Sweden. Scania, several stations, for inst. Lund (hb. Stockholm., Uppsal. et Lund.), Öja, 98, NEUMAN (hb. Uppsal.), Svartskylle lake, 23, E. FRIES, »ubi prima vice pro Fl. suec. novum agnovi» (hb. Uppsal.). Ostrogothia, Rochella lake, 1/2 mile from Linköping 1812, hb. AG. (= AGARDH) (hb. Lund.) distinguished as a new species but without name; Borg, 62, WESTLING and others (hb. Stockholm., Uppsal. et Gotenb.), Ö. Eneby, 83, LÖNNBERG (hb. Stockholm., Uppsal. et Lund.), Svinstad, EKEROTH (hb. Uppsal. et Lund.), Ö. Skrukeby, EKEROTH (hb. Uppsal. et Lund.), Häradsdhammar, Lundby, 40, TRÄSKMAN (hb. Uppsal.), Norrköping, Himmelstalund, 41, WIEDE (hb. Uppsal.); Sudermania and Stockholm, several stations, for inst. at Stockholm, Klara lake, 34, W—M (hb. Stockholm.), at Nyköping, 84, SEDERHOLM (hb. Lund.), at Nyby, 99, v. PORAT (hb. Uppsal.), Öja, St. Sundby, 81, ÖSTRÖM (hb. Lund.); Nericia, Örebro, to the north of the town, 64, C. HN and others (hb. Stockholm., Uppsal., Lund. et Gotenb.), Hjelsta, 95, BÅGENHOLM (hb. Uppsal.), Hjälmaren in the bay of Järnäs, 75, R. HN. (hb. Uppsal.), Glanshammar, Skäfvesund, 79, HN (hb. Uppsal.). The most northern locality of Sweden is at Örbyhus in Vendel lake, 60° 12' N. L., where it is collected by G. A. FRÖMAN in 1882 (hb. A. FRÖDING). A station in Medelpad, Selånger, 62° 25' (1890

coll. J. A. HOLM) is misreported by E. COLLINDER, Medelpads Flora, 1909, 179. The plant referred to is *P. zosterifolius*, which has spread more northwardly (see p. 66). On the west coast a single station is recorded, viz. *Gothenburg*, 53, KROK, LINDBERG and many others in later times (hb. Stockholm., Uppsal., Lund. et Gothenb.).

The statement from *Norway* (Skien) BLYTT, Norges Flora I, 1861, 368, is a mistake instead of *P. mucronatus* (see under that species!) according to BLYTT's

examples as well as A. BLYTT, Norges Flora I, 1902, 49. The northern limit of *P. acutifolius* in the Scandinavian Peninsula thus runs from Örbyhus (*Uppland*) to Örebro (*Nericia*) and Gothenburg. The species, however, does not appear equally scattered over the whole area to the south of this line, but in three isolated small districts: 1) a western one: Gothenburg, 2) a south area: Scania with south Halland, and 3) a northern, larger district. The stations within this last one, strange to say, seem to be situated on the old bottom of the Litorina Sea. Hence we might perhaps suppose *P. acutifolius* to be a rather recent plant-immigrant to Sweden.

Extra-scandinavian stations:

Denmark, near Copenhagen etc. (hb. Stockholm., Uppsal. et Lund.).

— *Germany*, several places (hb. Stockholm., Uppsal. et Lund.).

— *France*, several places (hb. Stockholm., Uppsal. et Lund.).

Fig. 28. A—E, *P. sudermanicus* HAGSTR., F, *P. pusillus* L. — A, Basal portion of a stem-leaf, $\frac{1}{2}$; B, Transverse section of a stem-leaf at the middle, $\frac{1}{2}$, *m*, midvein, *n'*, lateral nerves, *l*, lacunar system, *str*, mechanical strands, the marginal bundle very strong; C, Transverse sect. of the stem, $\frac{1}{2}$, *cc*, central axis, *str*, subepidermal strands; D, Longitudinal section of the epidermis, $\frac{1}{2}$; E, Transverse sect. of the peduncle, $\frac{1}{2}$, showing two median (*vb*) and two lateral vascular bundles and a single subepidermal bast-bundle. — F, Basal parts of stem-leaves, *a*, subpetioled, *b*, sessile, $\frac{1}{2}$.

From those countries as a centrum it seems to have spread to *Bohemia*, in lacu Záklici, VELENOVSKY (hb. Lund.), *Transylvania* prope Baumgart, Dr. SCHUR (hb. Stockholm.), *Belgium* (hb. Uppsal.) and *England*, Middlesex, LINTON (hb. Uppsal.), Norfolk, 87, BENNETT (hb. Stockholm. et Uppsal.). It is also recorded from *Russia*, Plescau, and *Italy*, but I have not seen specimens from thence. Australian and Manchurian plants referred to *P. acutifolius* surely are something else.

P. acutifolius, thus, has a comparatively limited distribution-area, and is together with *P. coloratus* an almost exclusive European species.

P. acutifolius LINK × pusillus L. (P. sudermanicus n. hybr.).

Caulis ± compressus (vide fig. 28, C), statura *P. pusilli*. *Folia* parva ut in *P. pus.*, acuta, basi rotundata fere ut in *P. acutifolio*, nervatura fere intermedia. *Pedunculus* et spica ut in *P. acutif.* *Hybernacula* iis *P. pusilli* similia.

At a sudden glance this plant extremely resembles in habit *P. pusillus*. The collector has also held it to be so. Beside the habit and the smallness of all parts the turios also resemble those of *P. pusillus*. Further the lacunar part of the leaves with two large channels on either side of the midrib, at least in the lower half of the leaf, and the central cylinder of the stem are completely as in the species just now mentioned. On the other hand the basis and apex of the leaf have the same form as in *P. zosterifolius* and *P. acutifolius*, and the flattened stem, the abundant leaf-schlerenchyma, and the appearance of the ovary point in the same direction. The organs incontestably witnessing the last mentioned to be one of the parents are, above all, the two-whorled, small, head-like spikes, the very short (6—8 mm) peduncles, the short leaves and the comparatively long epidermis-cells of the stem (4—5 times as long as broad). The peduncle is as to form and anatomy intermediate; a single subepidermal bast-bundle is observed. Besides, I refer to the fig. 28, E.

The nervation of the leaves draws nearer to *P. acutifolius* than to *pusillus*. The marginal strands are very strong. Beside the lateral nerves there is a bast bundle between them and the median lacunar part, and besides, here and there, small, at places interrupted strands in the whole blade and a complete sclerenchyma in the lacunar part also. Numerous spikes are present, all entirely barren. No fertile pollen is found.

The plant is collected at the most northern border of the distribution area of *P. acutifolius* and probably belonging to the greatest rarities of the vegetable kingdom. I have named it after my beautiful native county *Sudermania*, where it has been gathered by Dr. C. J. HARTMAN. It is labelled »Rorvik prope Hjelmaren, aug. 1831. Hⁿ» (hb. Uppsal.) and it would be very interesting, if the locality could be found again by botanists living there.

P. acutifolius LINK × zosterifolius SCHUM.

P. bambergensis FISCHER, Die bayer. Potam. etc. 1907, 98, 21. — *P. zosterifolius* × *acutifolius* ex FISCHER, Beiträge etc. in Mitteil. bayer. bot. Ges. 1904, 377.

I have seen true specimens of this bastard from several places. Especially beautiful ones I have received from my friend B. LAGERWALL, at Drottningholm. Characters common to all hitherto known forms are the barren spikes, consisting of 5—6 verticils, and the short peduncles, 15—30, usually 18—23 mm. long. Sometimes a single nutlet ripens, but this is very rare. The turios are less thick or mas-

sive than in *P. zosterifolius*. Stem-leaves usually more like *P. acutifolius* as to their lacunar part. This form could be named

f. *mollifolius* n. f. — Pars foliorum lacunosa ut in *P. acutifolio*. —

Other individuals, as to the leaves more approaching *P. zosterifolius* with more prominent midrib and less expanded lacunar system could be called

f. *strictior* n. f. — Pars lacunosa folii magis ut in *P. zosterifolio*, folia ergo strictiora.

Stem usually thinner than in *P. zosterifolius* but in this case, again, as to the margins more *zosterifolius*-like.

On the supposed bastard origin of the *P. zosterif.* f. *abortivus*, see p. 66!

Distribution: Sweden, *Uppland*, at Stockholm, Brunnsviken, 55 CLEVE (hb. Stockholm.), poor material; same station, 90, HESSELMAN (hb. Stockholm.), Drottningholm, 07 LAGERWALL (hb. Stockholm), Sigtuna, Snörin, 80, FLODERUS (hb. Uppsal.); *Ostrogothia*, Svinstad, EKEROTH (hb. Uppsal.), Hb. Normale V, 79, labelled: *P. acutifolius*; but with *zosterifolius*-like nervation and intermediate spikes and peduncles (f. *strictior* HAGSTR.); *Scania*, Kristianstad, 57, OLSSON (hb. Gothenb.), 76, NILSSON, and 87 THEDENIUS (hb. Uppsal.).

Denmark, Hjulby mose, Fyen, 97, BAAGÖE (hb. Stockholm.). *Germany*, »Saxon. HÜBNER» (hb. Stockholm.) »Silesia, Vratislaviæ, Margarethendamm», 64, UECHTRITZ (hb. Stockholm.). Another plant from »Bischofswald, 80, UECHTRITZ» (hb. Lund.) is more doubtful. True *P. acutifolius* from Bischofswald is preserved in hb. Stockholm.

Subsectio 8. *Monogyni* HAGSTR.

Caulis teres filiformis. *Folia* angustissime linearia acutissima trinervia, basi apiceque attenuata. *Ligulae* semper fissae ut in præcedente, convolutæ, in spatio intermedio 3—5-nerviæ. *Pistillum* stylo brevissimo, stigmate ovali. *Fructus* sæpe dorso rugosus.

Only one species belongs to this group presenting close relationship to the next foregoing. Especially the style, stigma, and ripe fruit are conspicuously alike. The abundance of leaf-sclerenchyma is common to the three groups: *Compressi*, *Monogyni* and *Ochreati*.

P. trichoides CHAM. et SCHLECHT.

De plantis in exped. specul. Romanzoff. observ., in Linnæa II: 2, 1827, 175, t. IV, fig. 6. — *P. condylocarpus* TAUSCH in Flora XIX, 1836, 423. — *P. tuberculatus* TENORE et GUSSONE, Syll. Flora Neapol. App. V, 1842, 4, in Act. Soc. Borbonica di Napoli I, 430. — *P. monogynus* GAY, ap. COSSON et GERMAIN, supp. cat. rais. 1843, 89. — *P. danicus* GANDOGGER, Pugillus plant. nov., Österr. Bot. Ztschr., 1881, 18. — *P. perneglectus* GANDOGGER, l. c. — *P. orthorrhyncus* GANDOGGER, l. c. — *P. Bænitzi* GANDOGGER, l. c.? — *P. Phialæ* POST, Bull. Herb. Boiss. I, 1893, 409. — Fig. 29.

This species has been sometimes intermingled with *P. pusillus* L. and considered a variety of it (thus KUNTH, Enum. III, 1841, 137). Later authors have certainly thought it to be a proper species but included it with the *pusillus*-group as nearly related to that (thus RAUNKJÆR, Anat. Pot. Stud. 1903, FISCHER, GRÆBNER). ALMOVIST has (1889) put it together with *P. zosterif.* and *acutifolius*, indicating thereby a more correct view, although even he has held it to stand very near to *P. pusillus*, which ex ALMQVIST includes also *P. gracilis* FR. A closer observation of all parts of the plant shows that, respecting the fructifications, it stands very close to *P. acutifolius*, and as to the vegetative organs it draws extremely near to *P. rutilis*. But the ligules are open and by this property it reminds of the *Pusilli convoluti*. The structure of the ligule, again, is very like that of *P. javanicus*. Its distribution area coincides for the greater part with that of *P. acutifolius*, but expands much more southwards through Africa.

The stigma is depressed, oval, much wider than the upper surface of the style. Style very short, ovary broad, compressed. A ripe fruit in longitudinal section shows quite the same appearance as the fruit of *P. acutifolius*. The inside boss lies in the prolongation of the partition wall (see fig. 29, B). The flowers of the two species are also like in usually having barely one pistil.

The stem is nearly quite terete und built after the usual type with one circle of subepidermal bast bundles in the cortex, O-endodermis, and a single xylem cavity in the central cylinder denoting a fusion between the lateral and median vascular bundles as in *P. pusillus* and others with a circular stele diagram. — In the very thin peduncle the bundles run so near to each other that their bast-sheaths often fuse and form a pseudo-endodermis. The lateral bundles are often extremely reduced sometimes quite wanting. In the south-african form (see below!), however, two small lateral bundles appear conspicuously separated from the median ones as

Fig. 29. *P. trichoides* CH. & SCHL. A, Pistil, a, lateral view, c, from behind, b, stigma from above, $\frac{1}{4}$. B, Longitudinal sections of ripe fruits of different size and form, a, b, $\frac{5}{16}$. C, Transverse section of a stem-leaf, middle part, us, lower surface, l, lacunar system, str, bast-bundles, $\frac{1}{10}$. D, Basal portion of a stem-leaf, $\frac{2}{16}$. E, Top of the same, $\frac{2}{16}$. F, Top of an involucre leaf as it sometimes is met with, $\frac{2}{16}$. G, Innermost leaf of a turio, $\frac{8}{16}$. — m, midrib, n', lateral nerves.

is the case with several other nearly allied species. One or a couple of subepidermal strands can also be perceived in the peduncle. — *Epidermis-cells* always rather short, usually 2—4 times as long as they are broad.

The *leaves* are very narrow ($\frac{1}{4}$ — $\frac{3}{4}$ mm) always three-nerved and tapered at the base. Apex acute except in the involucral leaves, of which at least the topmost one usually has a more or less obtuse apex. The lacunar middle portion of the leaf is abundantly endowed with sclerenchyma. Its anatomy as seen in the fig. 29, *C*. The inner leaves of the *turios* hidden by the sheaths are very short, obtuse or roundish-obtuse, pointless, 7—8 in number, the outer or lower ones, 2—4 in number, are free, a little protruding, and in the basal part semiterete, by which they differ from the other branch-leaves.

The *ramification* of this species is usually very abundant. According to J. GAY very short rudimentary branches grow out from the axils, on which later on the longer branches are formed in an unlimited number as branches of the second rank while the rudimentary branch grows on. Those longer branches, however, are said to be found only on the side of the short branch turning to the stem, in the axils of the 2nd, 4th, 6th etc. leaf, whereas the 1st, 3rd, 5th etc. leaf are said to be barren. This explanation given in 1854 (see Bull. Soc. Bot. France of that year, p. 46 et seq.!) has as late as in 1907 been adopted by P. GRAEBNER. I cannot join this opinion. The mode of ramification of this species is fully concordant with that of *P. vaginatus* (vide fig. 11, *D*, pag. 32!) that is to say the branches are of the first, second, third etc. rank in relation to the main-axis, see also RAUNKIÆR, Danske Blomsterpl. 1896, p. 37—38!

Another character combining this species with the *Coleogeton*-species is that the strongest of the buds of the two involucral leaves is the lower one. Those buds do not, however, come to any rich evolution as for instance in *P. pusillus*, but the spike-production is generally accomplished with the primary spike. Nevertheless the species becomes very rich in spikes since the numerous branches beneath the primary spike are in general spiciferous according to the type *C*, Fig. 2. This peculiarity gives to the species a characteristic appearance among the other narrow-leaved species, corresponding to the state or aspect of *P. vaginatus* within the subgenus *Coleogeton*.

The species does not vary considerably. Some authors have distinguished varieties with three-nerved leaves, but the leaves are on closer examination always three-nerved. Such varieties as *Trimmeri* CASP. and *capillaris* FISCHER, recorded as three-nerved and by this fact separated from the main-form, are probably bastards. The species has, namely, a formerly not sufficiently observed tendency of crossing with a great many species, by which fact many aberrant forms get a satisfactory explanation.

The fruit, however, varies as to the development of bosses or protuberances the producing of which *P. trich.* is much inclined to. This peculiarity has, however, not any great systematic importance, as the same individual often shows fruits with an appearance different in this respect. CHAMISSE's description evidently refers to

a form with smooth fruits and the outline of it corresponds to the description. Thus the plain-fruited form, *liocarpus* ASCH. is to be held as the main-form of the species. The more common form, again, with protuberances especially on the middle keel is *P. condylocarpus* TAUSCH, that should be named *P. trichoides* var. *tuberculosis* REICHB. (1845). At last may be mentioned that GANDOGGER has constructed four different species (see above!) of which *P. Bænitzi* may comprehend *P. panormitanus* also (»costa media parum prominula» etc.), unless it does not refer exclusively to the form *minor* BIV. of *P. panorm.*

Distribution. In Sweden *P. trichoides* occurs only at Gothenburg, Gullbergsvass, 78, WINSLOW (hb. Stockholm., Uppsal., Lund.) and Kvillebäcken in Hisingen, 01, PALMÉR (hb. Uppsal. et Lund.), and at Lund in the new bot. garden, 75, TULLBERG (hb. Stockholm., Uppsal., Lund.): the so called *P. orthorrhyncus* GDGR.

Denmark, Falster, Stubberup, 73. MORTENSEN (hb. Uppsal. et Lund.): the so called *P. danicus* GDGER or var. *liocarpus* ASCH., i. e. the main-form; Sjælland, Næstved, 97, BAAGÖE and others (hb. Stockholm. Uppsal. et Lund.). — England, Surrey, 81, BEEBY (hb. Stockholm.), Norwich, BABINGTON (hb. Uppsal.). — France, Lyon, 50, GUINAUD (hb. Stockholm.), La Grolle, 77, PONTARLIER (hb. Uppsal.), Maine & Loire, 69, LE JOLI (hb. Lund.), Corbeil, 40, MAIRE (hb. Lund.). — Germany, Berlin, 83, SCHEPPIG and others (hb. Stockholm., Uppsal. et Lund.), Pommern, Wolgast, 66, ZABEL (hb. Uppsal., Lund.), Hamburg, SONDER (hb. Uppsal. et Gothenb.), Königsberg, Medenau, 74, BÆNITZ (hb. Uppsal. et Lund.), Aldenau, 75, BÆNITZ (hb. Gothenb.), Brandenburg, 67, GRANTZOW (hb. Stockholm.), Nürnberg, ELFSMAN (hb. Stockholm. et Lund.), Oberphalz, Gebenbach, 06, NIEBLER (hb. Stockholm.), part of the fruits with much elongated ventral tooth; ERLANGEN (hb. Stockholm.), Breslau, 62, UECHTRITZ (hb. Stockholm.), Breslau, Kleinburg, 78, BACHMAN (hb. Uppsal.), liocarp; Trachenberg, 89, SCHWARTZ (hb. Stockholm.), Sachsen, HÜBENER (hb. Stockholm.), Dresden, RABENHORST and others (hb. Stockholm.), labelled »*P. tuberculosis*»; Bavaria, in stagnis ad Gaustadt, Trabelsdorf, Vollmannsdorf prope Bamberg, 03—05, FISCHER (hb. Stockholm.). — Bohemia, Mühlhausen, 83, VELENOVSKY (hb. Stockholm.). — Spain, Aragonien, 63, WILLKOMM (hb. Uppsal.). — Italy, Piedmont, HOHENACKER (hb. Uppsal.), Naples, GOËS (hb. Lund.) Palermo, 49, TODARO (hb. Stockholm.), Lago di San Egedio, 48, RABENHORST (hb. Stockholm.), CESATI (hb. Lund.).

Africa, Port Natal, DREGE, »8800» (hb. Stockholm.).

P. trichoides CHAM. & SCHL. × **zosterifolius** SCHUM.

(*P. ripensis* BAAGÖE, Préparation des Hydrophytes etc. in Compte-rendu du Congrès int. Bot. Paris, 1900, 517, nomen solum.)

This hybrid which J. BAAGÖE has named *P. ripensis*, I have discerned and determined in his herbarium, already in 1899.¹ In doubt at first, if not *P. pusillus*

¹ Together with another hybrid, *P. alpinus* × *crispus* which BAAGÖE l. c. has called *P. venustus*, see under *P. alpin.*!

might be one of the parents beside *P. zosterif.*, I later on, after further minute examination, have got still more convinced of the accuracy of the above presumption.

Stem more or less flattened but not winged, crosscut-form oval, the longer axis about twice the shorter one. Central cylinder with one cavity, round which the phloem parts are grouped as in *P. trichoides*. Leaves narrowly linear, stem-leaves 1.5–1.75 mm, with somewhat broad base, sometimes long with *trichoides*-like apex, sometimes shorter with an apex more like *P. zosterifolius*. Stem-leaves 5-nerved and with strong bast-bundles in the lacunar part. Air-channels arranged as in *P. trichoides*. Turios as to shape and other conditions intermediate, inner leaves sometimes confined within the sheaths, sometimes a little protruding. The lower leaves resemble most those of *P. trichoides*. Peduncles elongate, 3–5 cm long, their anatomical structure intermediate: the two middle bundles in proximity to each other as in *P. trichoides*. Spike of four verticils, always barren. A single nearly ripe fruit, once found, looked very much like a *trichoides*-fruit. About 50 p. C. of the pollen is sterile, the rest consisting of bigger (*F. zosterif.*) or smaller (*P. trich.*) grains.

Two forms may be distinguished:

f. *apicatus* n. f. — *Folia* elongata, (10)–12–15 cm, in apicem acutissimum sensim attenuata.

f. *breviusculus* n. f. — *Folia* 6–8–(10) cm longa apice citius attenuata.

By the long leaves the former reminds of *P. zosterifolius*, the leaves nevertheless being narrower and the top unlike, the latter, again, of *P. trichoides* but has much broader leaves.

Distribution. Denmark, Varmingsö, 97, BAAGÖE (hb. Stockholm.), f. *apicatus*; Nibsa, 00, BAAGÖE (hb. Stockholm.), f. *breviusculus*. Both forms probably originate from the same crossing. More habitats are not yet known.

Subsectio 9. Ochreati GRAEBNER.

GRAEBNER, Potamog. in A. ENGLER, Das Pflanzenr. 1907, 100.

Caulis compressus internodiis ± elongatis, nodis annulatis. *Folia* multinervia obtusa vel mucronulata, basi rotundata, canalibus in medio perpaucis. Ligulæ fissæ, multinerviæ. *Pistillum* stylo conspicuo æquali, stigmate parvo. *Fructus* tricarinatus, sæpe rugosus.

This and the two following groups nearly associate with *Compressi* by the broad, rounded leaf-base and the richly developed sclerenchyma of the leaves and ligules, but differ by the style and stigma, that one more elongated, this one smaller and more rounded. The group is evidently nearest related to the *Polygoni*, also with elongated styles, though a little thickened upwards, and with a very rich lacunar system in the leaves. The present group also separates from all the following through the 1–3-celled hypodermatous layer in the stem anatomy. In this respect it seems to take the first place of all the narrow-leaved groups. — Hibernating buds are not known either in this group or in the two following ones.

P. ochreatus RAOUL.

Choix de plantes de la Nouvelle Zélande, — in *Annals des sciences nat* III, Bot. II, 1844, 117. — Fig. 30.

The description of RAOUL refers to a plant he had gathered in »la presque île de Banks» (Peninsula Banksiana in the south island). It has greyish-green leaves with very obtuse, almost truncate or even a little emarginate, canaliculate apex, seldom endowed with a nearly imperceptible blunt point (»foliis linearibus apice rotundatis truncatis v. emarginatis viridibus»: RAOUL); peduncles rather elongated, 30—100 mm; styles straight; stigma covering their upper surface.

Anatomically the stem is distinguished by the 2—3-celled pseudo-hypoderma along which a complete circle of mechanical strands are arranged, Fig. 30, A. Interlacunar bundles are wanting. The endodermis consists of *O*-cells and the central cylinder has a median channel and two lateral ones (oblong type). The subepidermal strands still appear in the peduncle but the endodermis has disappeared and the two median bundles run separately conducted by 2—6 likewise free lateral ones.

Habitat: N. Zeal., N. Isl., Wakato River, 84, CHEESEMAN (hb. Stockholm.). *Tasmania*, GUNN (hb. Uppsal.).

Distinguished from this, but probably of common origin a proper Australian race appears with repeatedly furcate ramification upwards according to the type *B* (fig. 2). Leaves more brownish, more tapered towards the top, in the branches always more or less cuspidate and usually with stronger mechanical strands than has the true *P. ochreatus*. The front-field of the ligules 17—18-fibrous. Besides the form has

Fig. 30. A—E. *P. ochreatus* RAOUL. A, Transverse section of the stem, $\frac{1}{4}$. B, Transverse sect. of the peduncle, a, median, b, lateral bundles, str, subepid. strands, $\frac{1}{4}$. C, Pistil, lateral view, $\frac{1}{4}$. D, Youngest and E, a little older leaf (top and main-nerves), $\frac{1}{4}$. F—K. *P. furcatus* HAGSTR. F, Transverse section of the peduncle, $\frac{2}{3}$. G, Transverse section of a stem-leaf, middle part, $\frac{7}{16}$. H, Tops of leaves, d and e, corresponding to D and E, $\frac{1}{4}$. I, Pistil, lateral view, $\frac{1}{4}$. K, Fruit, lateral view, $\frac{1}{4}$.

shorter peduncles (20—35 (60) mm) with only two (sometimes barely one) lateral vascular bundles (fig. 30, *F*), without subepidermal bast-bundles, longer and more curved styles and on the sides also rough or knobby fruits. They seem to stand in a similar relation to each other as for instance *P. zosterifolius* and *acutifolius*, or the south-american *P. polygonus* and *Ulei*. This form can in short be described thus:

***P. furcatus* n. species (vel subsp. *P. ochreatei*?)**

Caulis superne dichotome ramosus sæpe ramis 4^æ—5^æ ordinis. *Folia* perspicue cuspidata, fusco-viridia. *Stylus* elongatus subcurvatus. *Fructus* rotundatus, carinatus, lateribus et ventro rugosus, rostro apicale. — Anatomia, vide supra! — Fig. 30, *F—K*.

Distribution: *Australia* felix N. H. (hb. Stockholm.); unknown locality (hb. Lund.). Tia river near Walcha, N. S. W., 97, MAIDEN (hb. Bot. Gardens, Sydney).

Subsectio 10. **Polygoni** HAGSTR.

Caulis compressus vel teres, internodiis brevissimis, nodis sine annulo. *Folia* linearia multinervia, media in parte late loculosa, basi ± rotundata, in apicem acutum vel subobtusum sensim attenuata. *Ligulæ* apice rotundatæ semper fissæ. *Pistillum* stylo conspicuo incrassato, stigmate parvo. *Fructus* siccus tricarinatus, lateribus levis.

Hereto belonging species can scarcely be arranged together with any of the foregoing or following groups. The characteristic short internodes, the leaf- and stem-structure, and especially the incrassate styles undoubtedly make them form a separate group. The endodermis consists of *O*-cells as in all similar species.

***P. polygonus* CHAM. et SCHLECHT.**

De plantis in exped. specul. Romanzoff. obs. — in Linnæa II: 2, 1827, 184. Tab. IV, fig. 11. — Fig. 31.

The species is easy to recognize on the very short internodes, by which it has a certain exterior resemblance to *P. Robbinsii*.

The stem of this species, like that of the foregoing, is a little flattened and prolongs itself often by branches of different (1—4th) ranks from the uppermost leaf-axils. The epidermis-cells of the stem are rather long, about 4—6 times the width and supported by a one-celled stratum of bark-cells. Beside the usual subepidermal strands there is also a number of thin interlacunar strands laterally placed, by which this species (and the next following) differs from all the other narrow-leaved species hitherto known. The bundles of the central axis are very conspicuously separated in three groups, usually with two free bundles in either of the lateral groups, but sometimes fused into a compound bundle. Stele-diagram: a reduced trio-type. — In the peduncle the diagram shows numerous vasc. bundles and subepid. strands.

The peduncle, thus, exhibits a great difference from the other allied species in the more scattered arrangement of numerous vascular bundles and in the appearance of a few bast-bundles beside the here also present subepidermal strands. The length of the peduncle is usually 3—4 cm or about the same as that of the internode next beneath.

The leaf-base never tapers into a stalk, but is more or less broad and occupied by the lacunar part. From the middle the width of the leaf gradually narrow into a very elongated apex. The leaves are often somewhat asymmetrical and falcately curved to either side. The lacunar part of the leaf usually occupies the whole space between the two principal side-nerves from the middle to the base of the leaf. From the middle and upwards the number of the lacunæ decreases so that the very top has none. In the lacunar part the leaf has a full number of thin subepidermal strands both in the upper and lower surface. Such strands occur also at short intervals quite to the borders. The very border-sclerenchyma is extremely strong, usually consisting of about 75 cells each (see fig. 31 A). The front-field of the ligules 12—13-fibrous.

No varieties of this and the next following species have at present been found.

Distribution. Brazil, S. Paulo, Minas Geraes, 47, WIDEGREN and others (hb. Stockholm. et Uppsal.); Lagoa Santa, WARMING (hb. Stockholm.).

***P. pseudopolygonus* n. sp.**

Caulis compressus, $\pm$ ramosus, internodiis brevibus, 10—20 (30) mm longis. *Folia* linearia, basi rotundata, apice $\pm$ abrupte cuspidata modo fere *P. Berteroani* (fig. 46, B), caulina ca. $110 \times 6-7$ mm, multinervia ut in *P. polygoni* (fig. 31, A), nervis lateralibus principalibus ternis, secundum nervum medium usque ad apicem late lacunosa fere ut in fig. 53, A; ramea minora, 5-nervia. *Ligulæ* apice rotundatæ, fissæ, 11—15-nerviæ, ca. 15 mm longæ.

The specimens examined are collected in *Uruguay*, Cuarein, 01, by B. BERRO, (n:r 1564, hb. Haun.) and lack spikes. Possibly they may be of a hybrid origin or only a variety of *P. polygonus*. I have herewith wished to call attention to an interesting plant, which should be looked for and further studied.

The anatomy of the stem and leaves answers much to that of *P. polygonus*, but the central cylinder exhibits an evident prototypic arrangement of the median bundles, and this fact has caused me to distribute the plant as a distinct species.

***P. Ulei* SCHUMANN.**

Flora brasiliensis III. 3, 1894, 690. — Fig. 31.

This plant can easily be confounded with the precedent species. However, it is, even in its barren state, well distinguished from them. The stem is terete and its structure rather different. The epidermis-cells are shorter, the interlacunar strands

Fig. 31 A—C, *P. polygonus* CH. & SCHL. A, Transverse section of leaf below the middle, $\frac{1}{2}$, showing the lacunar system (*l*) and the bast-bundles; *str*, marginal strand; *m*, *n'*, nerves (vascular bundles); B, Pistil; *a*, lateral view, *b*, ventral view, $\frac{1}{2}$; C, Transverse section of the central axis of the stem, showing the bundles and their channels, $\frac{1}{2}$. — D—F, *P. Ulei* SCHUM. D, Transverse section of stem, showing the arrangement of the lacunar system, the subepidermal strands (*str*), and the vascular bundles of the central cylinder (*cc*), $\times$ occasionally occurring interlacunar bundle, $\frac{3}{4}$; E, Top of a stem-leaf, $\frac{1}{2}$; F, Transverse section of this leaf, at the middle, *m*, *n'*, *str*, as in A, $\frac{1}{2}$.

are either quite wanting or present in a very slight number. The crosscut-form of the central stele is rhomboid, which results from the median bundles running more separately than in general and the lateral ones being considerably reduced both in number and size, the stele thus presenting a four-bundled diagram. The leaves taper more abruptly into an apex, less acute by far than in *P. polygonus*.

The leaf is through its whole width and up to the very top intersected or replenished with narrow channels, the crosswalls of which are rather approximate, which makes it appear reticulate under the lens. Two vascular bundles run on either side of the main-rib and, between them, thin bast-bundles nearly as in the foregoing species, but the border-strand is considerably weaker. Ligules more durable, their front-field is 12—15 (17)-fibrous.

It should be observed, that my researches are made on young shoots from a creeping rhizome, the only materials hitherto accessible to me. Spike-bearing individuals may have the interlacunar sclerenchyma (the ligular bundles) a little more developed.

The species is figured in GRAEBNER, Potamog. ap. ENGLER, Pflanzenreich IV, 11, 1907, 105, f. 25 A (habit-figure); B, fruit, seems to me to be a *polygonus*-fruit, cfr. SCHUMANN, fruit 1.5 mm long etc. l. c!

Distribution. Brazil, Prov. Rio de Janeiro, Serra do Itatiaia, 2,460 m. s. m., 02, DUSÉN (hb. Stockholm.). — Leg. GLAZIOU, N. 6721; det. SCHUM. (hb. Haun.).

Subsectio 11. Oxyphylli HAGSTR.

Caulis $\pm$ compressus internodiis elongatis, nodis biglandulosis. *Folia* linearia multinervia acuta vel acute cuspidata basi $\pm$ rotundata. *Ligulae* fissae, multinerviae, apice rotundatae. *Pistillum* stylo brevi stigmate parvo. *Fructus* ovoidei leviter compressi (*P. oxyphyll.*).

This group occupies an intermediate position between the *Polygoni* and the *Pusilli*. It is like the latter as regards the styles and stigmas, but differs by the

nervation of leaves and ligules. It joins to the *Polygoni* (*Ochreati* and *Compressi*) by the leaf-base also, but differs by the structure of the peduncle, stem, and leaves.

The two species here below considered have the front-field of the stipular sheaths 10–15-fibrous, in this respect also keeping a medium position between the two groups mentioned above. If the *Oxyphylli* nevertheless be considered, on account of the styles and stigmas, to belong to the *Pusilli*, they must, however, form a separate series within this subsection. Their nearest relative among the *Pusilli* may be *P. orientalis* HAGSTR.

Assumably *P. sibiricus* AR. BENN., *P. manchuriensis* AR. BENN. and *P. Henningii* AR. BENN. are to be included with the *oxyphyllus*-group, and the distribution area of the group would thus be decidedly Asiatic.

P. oxyphyllus MIQUEL.

Annales Mus. Bot. Lugduni-Batav. III, 1867, 161. — Fig. 32.

Stem and peduncle compressed so that the crosscut-form becomes oval (2–3:1), the former sometimes slightly canaliculate, both of about the same thickness.

The anatomy is the one common to the body of the small-leaved species, but the epidermis-cells are comparatively broad, about 2–3 times as long as broad. The subepidermal bast-bundles are strong, but no pseudo-hypoderma has been observed. For the rest I refer to the fig. 32, D. The central axis shows the usual oblong diagram.

The two median vascular bundles run close to each other in the peduncle also, the lateral ones, again, more remotely. The small sclerenchymatous strands of the stem seem to disappear completely in the peduncle, which also reaches a length of only 2,5–5,5 cm. The internodes of the stem are in general 4–6 cm in length.

Fig. 32. *P. oxyphyllus* MIQ. A, a, basis and b top of a stem-leaf, $\frac{1}{1}^0$. B, Pistil, a, lateral view, b, from above, c, ventral view, $\frac{1}{1}^0$; C, Transverse section of a stem-leaf, showing the lacunar system (l), vascular bundles (m, n), and the mechanical strands (str), lower half, $\frac{1}{1}^0$; D, Transverse section of stem, cc, central axis, str, subepidermal strands, $\frac{5}{1}^0$; E, Transv. sect. of the peduncle, showing the lacunae (l) and vascular bundles (hatched), $\frac{5}{1}^0$.

The lacunar median part of the leaf consists of the usual small lacunæ round the median vascular bundle. On either side of those small channels, in the lower half of the leaf, run two rows of large lacunæ and thin bast-bundles in the conjunctions between the lacunar walls and the epidermis. On both sides of the lacunar part the small strands run at rather short intervals from each other as the fig. 32, *C*, shows looking outwardly like fine nerves. The var. *Fauriei* BENN. also has the same structure. The only difference is that the bast-bundles are considerably stronger, by which the leaf grows stiffer and more resistive.

Fig. 33. *P. subsibiricus* HAGSTR. *A*, Transverse section of a stem-leaf at the middle, $\frac{1}{2}$, *m*, mid-vein, *n'*, lateral vein, *str*, bast-bundles, *l*, lacunar system. *B*, Top of a stem-leaf, $\frac{1}{2}$. *C*, Ligule, $\frac{1}{2}$. *D*, Pistil, $\frac{1}{2}$. *E*, Transverse section of stem, $\frac{1}{2}$, *ep*, epidermis, *l*, lacunar system, *str*, subepidermal bast-bundles, *cc*, central axis.

The leaf-apex gradually tapers and exhibits an asymmetric form just as *P. polygonus* and others (Fig. 32, *A*, *b*). The base is somewhat rounded, sessile, not subpetioled. The style is short, but distinct, and a little incrassate upwards, as is the case in a good deal of species, and the stigma small, roundish-oval, not covering the whole upper surface of the style (Fig. 32, *B*). Pollen of small grains, spherical.

Distribution. Japan, Nippon prov. Nambu, 65, ICHONOSKI (hb. Stockholm.). It belongs to the easternmost Asia, how far to the south and north is not yet fully known.

P. subsibiricus n. sp.

Caulis ca. 5 dm altus, compressus ($\frac{2-3}{1}$) filiformis, 0.5–1 mm latus, parum ramosus, supra spicam pri-

mariam vix prolongatus ramis spiciferis, internodiis 3–7 cm longis. *Folia* anguste linearia, caulina ca. 2 mm lata, 40–60 mm longa; summa $\pm$ 40 mm longa, basi rotundata, apice cuspidata, 13–17-nervia vel ultra. *Ligulae* ca. 15 mm longæ, obtusæ, badiæ, basi glandulosæ, fissæ, in spatio intercarinali 10–13-nerviæ. *Pedunculus* compressus æqualis, 20–35 mm longus. *Spica* $\pm$ densa 3–4-verticillata. *Pistillum* stylo brevissimo, stigmate complanato rotundato expanso. *Pollen* parvum sphæroideum. Fructus non visus. — Fig. 33.

The anatomy of stem and peduncle is much the same as in the foregoing. The stem is provided with subepidermal bast-bundles and deprived of hypodermatic layer, in the peduncle the condition is the reversed: no strands but a 2-celled strengthening layer, which, beside the scattered position of the vascular bundles, makes the peduncle obviously thicker than the stem. In *P. oxyphyllus* the stem and peduncle

are of the same thickness. Epidermis-cells 4—5 times as long as broad; endodermis, lacunar system, and central stele just as in the coordinate.

Leaves with low midrib and slightly developed lacunar system in contradistinction to *P. sibiricus* BENN. possessing a broad median areolation-area. Bast-bundles and vascular bundles as the fig. shows. The chief lateral nerves join the midrib in the very apex especially in the involucral leaves, which are also a little more obtuse than the lower ones, but always lacking the lacunous structure, which is characteristic to part of the *Pusilli*.

The style is very short and the stigma expands over the border of the style.

The species differs from *P. sibiricus* BENN. by the stem being narrower, the ligules brown, the spike 6—8-florous, and by the absence of the leaf-areolation mentioned above. Fruit not seen.

The material examined originates from *Siberia*, Yenesei, Dudinka, 69° 35' n. lat, coll. H. W. ARNELL, 1876 (hb. Stockholm); Nikandrovskij ostrov, 70° 20' n. lat., in a small lake, 76 $\frac{1}{8}$ (flowering), ARNELL (hb. Stockholm.). *P. subsibiricus* may belong to the tundra-lakes of north-west Siberia, whereas *P. sibiricus* may have a more easterly distribution.

Subsectio 12. *Monticoli* HAGSTR.

Caulis teres v. subteres, pedunculis valde elongatis. *Folia* angustissime linearia, uninervia, læte viridia, in apicem tenuissimum subobtusum longissime attenuata, per totam latitudinem loculosa. *Ligulæ* fissæ, binerviæ, in spatio intercarinali enerviæ. *Pistillum* stylo brevi, stigmate parvo. *Fructus* subglobosus dorso carinatus, lateribus levis. Operculum angustum, carinatum.

Dr. C. RAUNKIÆR is the first that has established the »*P. confervoides*-group» (Anat. Pot. Stud., 268) because of the lack of subepidermal bast-bundles in the bark of the stem. Prof. P. GRAEBNER, again, has reunited the species with the *Pusilli*. The species, however, deserves its particular position not only because of the above remarked condition, but also on account of the stem-hypoderma, the structure of the leaves and ligules, the different central cylinder of the stem and peduncle, the fruit etc.

Its distribution-area is rather narrow: the north-east parts of the United States of America.

P. confervoides REICHENBACH.

Icones Floræ Germanicæ et Helveticæ etc. Vol. VII, 1845, 13. — *P. Tuckermani* ROBBINS ap. A. GRAY, Manual of the Bot. of the north. U. S., 1856, 434. — *P. monticolus* SCHWEINITZ ap. AR. BENN. in Ann. naturh. Hofmus. Wien, 1892, 292, nomen solum. — Fig. 1, G, 34.

As the *P. polygonus*, respecting the development of stem-sclerenchyma, forms

the pitch of all the small- and narrow-leaved species, so the *P. confervoides* goes to the contrary extremity by developing no mechanical tissue or exceptionally a single subepidermal strand or so. On the other hand the development of such a tissue in the central cylinder is very lively, by which at all events the stem grows both very strong and flexible. A one-layered pseudo-hypoderma covering the epidermis inside also contributes to strengthen the stem. Most similar species instead of this stratum are furnished with a complete circle of subepidermal bast-bundles. But in *P. ochreatus*, as we have seen, both these reinforcements occur combined also. The central cylinder,

Fig. 34. *P. confervoides* RCHB. A, Transverse section of stem (see the text!), $\frac{1}{2}$; B, Transverse section of peduncle, a, the median fused bundles, b, the lateral ones, $\frac{1}{2}$; C, Transverse section of a stem-leaf, m, vascular bundle, str, mechanical strands, $\frac{1}{2}$; D, Middle portion of a stem-leaf, showing the arrangement of the lacunae, $\frac{1}{2}$; E, and F, Tops of leaves, $\frac{1}{2}$; G, Turio, a, stem, b, scar of a leaf, 2-8 internodes and leaves of the turio, $\frac{1}{2}$.

tomy of the leaf. In the middle of the leaf there runs a vascular bundle with its bast-sheath, round which a circle of small lacunae is arranged. On both sides there appears a row of ample lacunae and in the borders sometimes a row of narrow channels, and always a little bast-bundle. One or a few subepidermal bast-bundles in the middle part strengthen the leaf-structure being nevertheless rather frail, since the epidermis is destitute of a supporting hypoderma. The blade of this species can consequently be said to be reduced to the very lacunar middle portion of the leaves of other species. Nothing is left of the lateral parts but the faint border-strand, and the reduction has evidently culminated. By this the species presents a great resemblance, or a transition, to the *Coleogeton* species in their most slender forms as is seen

surrounded with a strong O-endodermis, has the bundles arranged in the usual three groups, here often separated by bast-cells and by lignified or for mechanical purposes transformed pith-cells. The median bundles are two with common xylem cavity. The lateral ones are two or only one on either side (oblong diagram).

In the floral axis the median bundles run near to each other, their xylem parts dissolve, forming a common channel with great lumen and their bast-sheaths unite into a common endodermis-like sheath, outside which the two lateral bundles are placed one on either side (fig. 34, B). A one-celled pseudo-hypoderma is also to be found here. Both the stem and the peduncle have a rounded crosscut-form, and although elongate like that of a *Coleogeton*-species, the latter, however, is stiff as usual.

The fig. 34, C, shows the ana-

by a comparison between the fig. 16, *H*, and 34, *C*. The epidermis-cells of the leaves are of about cubic form as in the other species. The leaf-apex is certainly fine but not sharp as sometimes is stated, nor acuminate or mucronate as often in the *Pusilloids*. The mechanical tissue of the ligules is reduced to the two carinal strands of the other species. Front-field consequently with no strands at all.

Nethermost at the base of the stem there are a few leaf-less sheaths or scales beautifully coloured in a red-brown tone. A rich ramification distinguishes the species, yet not according to the type way of *P. trichoides*, but so that the branches of the first rank branch along their whole length with very short internodes, to which may be added that the internodes of the main-shoot are also short, 2—4 (upwards 5) cm.

No hibernating organs of this species have hitherto been described. The rhizomes, creeping on a depth of a few centimeters, might produce hibernating buds but nothing is known of it. But in the stem I have seen such true turios. They consist of transformed short branches in the basal leaf-axils about 15 mm in length. At the base they bear a prophyllum and two scales (Fig. 26, *G*, 2 and 3). The 4th leaf-organ is an ordinary leaf, but very short and pointed, basally a little grown together with the ligule, the fifth likewise, the other ones following are very short, obtuse, and wholly enclosed in the sheaths. The internodes are somewhat swollen and filled with starch. This way of forming turios we meet with again in *P. panormitanus* and other *Pusilloids*.

Distribution. *N. America*, Nov. Angl. TUCKERMAN (hb. Uppsal.), *N. Yersey* 1818, »Herb. Casströmii» (hb. Stockholm.).

Subsectio 13. *Pusilli* (GRAEBNER, l. c. 1907, 106) HAGSTR.

Caulis ± compressus vel rarius subteres pedunculis brevibus. *Folia* linearia pauci-[3—5(—7)]-nervia basi sæpe attenuata apice ± acuta vel cuspidata, suprema interdum ± loculosa vel fere subnatantia obtusa. *Ligulæ* fissæ vel integræ, in spatio intercarinali (antico) ut plurimum 8—9-nervia (3—13). *Pistillum* brevistylatum stigmatate ± rotundato. *Fructus* ± obovatus vel ± rotundatus lævis ± carinatus vel sæpius fere ecarinatus.

The *pusillus*-group forms the body of the small-leaved species being represented by species in Europe, Africa, Asia, North and South America; it is absent in Australia and Polynesia except in the Sandwich Islands.

For want of materials for examination it is unknown to the writer if *P. Curtisii* MOR. is to be reckoned hereto or not. For the present it is to be looked upon as a »planta dubia». Possibly it may be ranked with the next group or rather, perhaps, with the *Hybridi*. — Prof. GRAEBNER includes *P. Maackianus*, *P. confervoides* and *P. trichoides* also with the group, but excludes *P. limosellifolius* and *P. Preussii*.

The stem is more or less compressed or flattened as in several preceding groups (usually in the relation 2,5—3 : 1), sometimes faintly double-furrowed, more seldom

nearly terete. Ramification from the primary involucre leaves now very inconsiderable, now exceedingly abundant with branches of a high degree. The leaves often taper nearly stalk-like at the very base. Apex always provided with a sharp or blunt point, sometimes, it is true, very little obvious but in other instances very prominent, in general abruptly cut out, seldom gradually tapering. Compared with the *Oxyphylli* and others they are sparingly endowed with sclerenchymatous tissue, though among themselves rather different. Typically the leaves are 3-nerved but in broader leaves a pair of faint secondary nerves appear at the side of the chief lateral nerves especially towards the base, by which such leaves become 5—7-nerved. The group is, besides, characterized by the topmost involucre leaves of several species having a tendency towards a structure like that of a floating leaf, by which peculiarity the group shows relationship to the *Javanici*. The lacunar system along the midrib in a lot of species is more, in others, again, less developed. The lacunar and the mechanical systems are in the following crosscut-figures displayed. Oil-cells or vittæ at the leaf-base common.

The stipular sheath behaves differently in this group. In some species we have not the usual, open, convolute ligule, but a connate, closed ocrea, which differs from the ocrea in the sectio I. *Connati* by being non-plicate aback. By increasing thickness of the parts it encloses, it therefore breaks, which takes place in the back, where the tissue usually is thinnest, but in *P. mucronatus* it breaks both behind and in the front, thus in two lateral parts with strong nerves in the angles. These edge-nerves are three in most species of this group, otherwise one or two, but the ridges are always low and sometimes scarcely perceptible. Beside the lateral vascular bundles the ligules are strengthened by small mechanic strands both in the front-field (between the two ridges or edge-nerves) and back-field (in case of closed ligules) or wing-fields (if open), see the fig. 27. After performed office the ligules decay by the membranous top, which is lacking a border-strand, being dissolved and we very soon see a fringe above consisting of the remaining bast-cells. In full-grown, unhurt state the form of the top is rounded, only in *P. Hillii* rather subacute, though always blunt even here (Fig. 44 E).

The number of the front-strands is different in the different species, in *P. pusillus* for instance 8—9, in *P. Aschersonii*, of S. America, there are 3—5 only, and so on.

It is clear that the condition of the ligules remarked above has a considerable systematic value and will facilitate the discrimination of otherwise very similar species, for instance *P. pusillus* L. and *P. panormitanus* Biv., the former with open, the latter with connate ligules, and so on. Of *P. trichoides* CH. and SCHL., see above!

The turios partly consist of transformed tops of primary branches partly in wholly transformed branches or rudiments of branches; very rarely they appear in the rhizomatic parts, these being in all species belonging hereto very slender and weak, when present. In most cases true rhizomes are absent.

The pollen is always spheric and small-grained. Styles very short, often with a beak-formed excrescence above, not covered by the low rounded stigma. The sides of

the fruit smooth, back often without perceptible keel, but sometimes with a keel, now without, now with teeth or bosses.

The stem-anatomy of the species of this group is rather uniform. A pseudo-hypoderma is rare, subepidermal bast-bundles, on the contrary, are always present. The endodermis of this group, as is the case in the foregoing and following ones, consists of typical *O*-cells. The bundles of the central cylinder sometimes fuse into a compound bundle (circular diagram), more often they run separately in three groups, the lateral bundles being free from the two median ones and these always as to the xylem-parts fused and consequently with a common xylem-cavity (the oblong diagram).

I divide the *Pusillus*-group into two series: *Pusilli connati et convoluti*, the latter series into two subseries: *Acuti* and *Obtusi* according to the leaf-apex being acute or obtuse.

Series A. **Pusilli connati:** Vaginæ stipulares connatæ ochreate, non plicatæ. Folia acute $\pm$ longe cuspidata vel sensim attenuata ut plurimum $\pm$ rigida.

Of hereto belonging species *P. foliosus* stands more apart and separate from all the others by its short peduncle and peculiar crested fruit, the lid of which is sharply keeled. *P. limosellifolius*, which ought to be put here, forms the transition to the *Javanici* by its more differentiate upper leaves.

Series B. **Pusilli convoluti:** Vaginæ stipulares fissæ convolutæ.

We have a transition-form to the *Javan.* within this series also, viz. *P. Preussii*.

Subseries a. **Acuti:** Folia caulina $\pm$ acute $\pm$ longe cuspidata vel sensim attenuata $\pm$ rigida.

Subseries b. **Obtusi:** Folia caul. $\pm$ obtusa $\pm$ laxa, cuspidè minore.

Series A. **Pusilli connati** HAGSTR.

The rigidity of the leaves is produced by the structure of the nerves which are very prominent in the lower surface, and by the numerous subepidermal bast-bundles in the lacunar system and strong marginal strands.

P. foliosus RAFINESQUE.

Medical Repository, 2d hex. V, 1808, 354. — *P. pauciflorus* PURSH, Fl. Americæ Septentr. I, 1814, 21. — Fig. 1, L, 35.

The stem is flattened in the relation of 2—3 : 1 with rounded margins, and its anatomic structure is in accord with that of several other *Pusilli* being characterized by a circular stele-diagram. In the peduncle, on the contrary, the four vascular bundles usually do not spread as in some other species, but continue as a compound bundle with four phloem lots, separated by a mechanic tissue and surrounded by a common sheath or endodermis. In the middle the xylem dissolves into a common channel. Sometimes, however, the fusion of the bundles is not so complete, but nevertheless they run so near to one another that their sheaths fuse into a common

one. The subepidermal strands of the stem are lacking in the peduncle but a one-celled pseudo-hypoderma has supplied their place to stiffen the organ.

The middle part of the stem-leaf is arranged as in the cognates with a prominent midrib possessing only one greater air-channel at the side of the narrower lacunæ. The sclerenchymatous strands are numerous and the marginal bast-bundle is usually strong. The leaf-base generally tapers more slowly than the apex, that is

acute with more or less inconspicuous cusp. The side-nerves join the midrib at a distance from the very point of 1—2 times the leaf-width. In broad leaves a pair of marginal side-nerves occur, which join the main lateral nerves a good bit of way below the point. The nodes of this species lack the oil-cells often occurring in others.

The styles and stigmas correspond with those of *P. pusillus* and others with an inconspicuous style and a low rounded stigma expanding over the whole top surface of the style and its border.

The characteristics of this species are the short peduncles and the few-flowered spikes. The latter usually consist of two closely placed verticils with two flowers in each, forming a little clew. The statement on *var. californicus* MOR. that it sometimes has 'as many as 12 roundish fruits' must not be understood as if the spike were to contain 12 flowers. I have seen the PARISH's specimens underlying the Morongian description, and they have no more flowers in the spikes than has the species in general. Since each flower has four mericarps, 12 fruits mean three flowers, or 4 flowers, if we suppose someone or other of the pistils to be abortive as is often or mostly the fact. Characteristic to the species is further the crested dorsal

Fig. 35. *P. foliosus* RAF. A, A leaf of the broadest kind, 5-nerved, a, base, b, top, $\frac{1}{4}$. B, Top of a leaf, more tapering form, $\frac{3}{4}$. C, Transverse section of a narrower 3-nerved leaf, X indicates the places of sometimes occurring strands (m, n', str, as usual), $\frac{1}{4}$. D, Transverse section of peduncle. In the centrum four vascular bundles, fused into a common bundle with a common xylem cavity (x), end, endodermis, l, lacunar system, $\frac{1}{4}$. E, Pistil and F, fruit, showing the broadest and narrowest form of the keel (the dotted line), $\frac{1}{2}$. G, Transverse sect. of ligule, $\frac{3}{4}$, ic, front-field, r, ridges.

keel of the fruit. The height of the keel or crest varies considerably within the same spike (see the fig. 35, F, where the dotted line signifies the reduced keel). Another peculiarity of the species is the propensity of prolonging the stem by long branches from the base of the primary spike according to the type D, Fig. 2. I have measured such a spike-bearing branch of the first rank on a specimen and its length amounted to 40 cm. It bore no less than 17 leaves from the base up to the spike. The branches of the first rank, in their turn, will bear branches of the second etc. rank. This mode of branching closely corresponds to that of *P. pusillus*. *P. foliosus* also corre-

sponds with this species as to the development of buds, usually taking place in the tops of the long branches; but branches in bud-state, too, are rather often transformed into such turios. As to shape they almost entirely resemble the buds of *P. pusillus*. The difference lies in the ligules here being stronger, and in the outer leaves, endowed with a more conspicuous and acute cusp than in *P. pusillus*. As to size they vary with the plant itself, so that slender forms have slender turios.

MORONG calls *P. foliosus* »a variable species» (Naj. 1893, 39). This is true, but the variations only concern the magnitudinal conditions and I scarcely understand how to establish a real difference between the two Morongian varieties *niagarensis* and *californicus*. Both are of tall growth and furnished with broad, 3—5-nerved leaves. The only real difference might be that the former has a little longer stem (»2—3 feet») and somewhat longer leaves (»sometimes over 3 in. long»). The statement on the latter that the stem is a little winged and that the midrib of the leaf is like that of *P. obtusifolius* is either an erroneous observation or a misprint, perhaps both of these. Instead of *P. obtusif.* there should stand *P. mucronatus*. And as to the stem of this species it always has rounded margins. It is only in the plant-press the stem sometimes becomes falsely winged.

Distribution. *N. America*, Pine Plains, N. Y., HOYSRADT, »ex hb. ROBBINS» (hb. Stockholm.), In lacu Fresh, Mass., ROBBINS (hb. Stockholm.), Campden N. Jersey, PARKER (hb. Stockholm.), In lacu Molare ad Hubbardston, Mich., WHEELER (hb. Stockholm.), f. *californicus*; Eastern Mass., MORONG (hb. Uppsal.), Nova Scotia, HOWE et LANG (hb. Uppsal.), Nov. Angl., TUCKERMAN (hb. Uppsal.), Niagara, TUCKERMAN (hb. Uppsal.), »*P. niagarensis* TUCK.»; West Chester. Penn., W. D. (hb. Lund.), f. *niagarensis*; Wisconsin, LAPHAM (hb. Uppsal.), Washington, 79, WARD (hb. Uppsal.), Wisconsin, KUMLIEN (hb. Uppsal.), f. *niagarensis*; Englewood, Ill., MORONG (hb. Uppsal.), Yellowstone Park, 88, KNOWTON (hb. Uppsal.), Colorado, 95, BAKER (hb. Stockholm.), San Bernidino, California, 82, PARISH (hb. Stockholm.): stem-leaves 1,5—2 mm broad, 45—55 mm long, spike 4-flowered; Portorico, Guajataca, SENTENIS (hb. Stockholm.), Cuba, 1860—64, WRIGHT (hb. Stockholm.), Jamaica, SWARTZ (hb. Stockholm.). — *Mexico*, Mecapulco, 41, LIEBMANN (hb. Haun.). — *Canada*, B. C., Manitoba, Ont. (hb. Haun.).

***P. foliosus* RAF. × *pusillus* L. n. hybr. — *P. turionifer* HAGSTR.**

Caulis filiformis, ramosus uti parentes. Folia quoad formam apicis ut in *P. pusillo*, quoad nervaturam et structuram iis *P. foliosi* similia, vel in β quoad formam apicis ut in *P. fol.*, quoad struct. et nerv. ut in *P. pusillo*. Ligulæ fissæ biglandulosæ. Pedunculus brevissimus (5—10 mm). Spica parva sterilis. Hybernacula in apicibus ramorum iis *P. pusilli* simillima.

The main-form reminds very much of *P. pusillus* and should be called α *mucronulatus* n. f. — β *tenuis* n. f., is a slender form occurring in Cache Lake and Opeongo Lake, Ont.

Hab. of α: Brigham's Creek, Ottawa, Ont., Canada, l. MACOUN 6/10 00 (hb. Hauniense).

P. strictifolius AB. BENNETT.

Notes on Potamogeton, in the Journal of Bot., 1902, 148.

According to the description this species comprises one barren form of the Lake George, East Chicago, where it is detected by Rev. E. J. HILL, and one fruiting form from Canada (Lake Scugog, Ont.). I have not seen the latter, but I have examined Canadian specimens from Sea-Cow-Pond, Crane Lake, Assiniboia, Picanok River, Quebec, and Ottawa River, Que., which seem excellently to answer to the description of the fruiting plant of Lake Scugog. I cannot distinguish these specimens specifically from *P. panormitanus*. The barren form, again, which Rev. E. HILL has had the kindness of sending me for examination, corresponds with *P. foliosus* so eminently, that it must necessarily anyhow be connected with this species either as a variety, or as a crossing. The latter supposition is the most probable, since the nodes have oil-cells, lacking in *P. foliosus*, and the turios also are larger than in this species. I know no other American species than *rutilus*, which with *foliosus* would be able to produce such a form as *P. strictifolius*. The stem-anatomy also supports this opinion in an unexpected way by the short epidermis-cells and the extremely strong subepidermal bast-bundles, especially characteristic to *P. rutilus*.

The epidermis lacks a pseudo-hypoderma, the bundles of the central cylinder are fused into a compound one, and the stem is compressed just as in *P. foliosus* and *rutilus*. The oil-cells of the nodes derive their origin from the latter. Leaves and turios are intermediate between the two species. I am convinced that coming investigations concerning this barren form will confirm my assertion. *P. rutilus* has also its distribution-area in the direction of the regions where *P. strictifolius* has been found.

If the fruiting form of Canada should really be found to be a new species separated from *P. panormitanus*, I propose that it may have a new name and that the name *strictifolius* may be kept for the Indiana-form or, according to our assertion the hybrid *foliosus* × *rutilus*.

Distribution. N. America, East Chicago Lake, Ind., U. S. A. (hb. Stockholm.).

P. rutilus WOLFGANG.

Ap. J. A. et J. H. SCHULTES, Mantissa in vol. III syst. veg. C. A LINNÉ etc. 1827, 362. — *P. pusillus* var. *B* CHAM. & SCHLECHT., Linnæa II, 1827, 172. — *P. cæspitosus* NOLTE ap. REICHB., Icones etc. VII, 1845, 15, t. XXIII, f. 41, nomen solum. — Fig. 1, K, 36.

This beautiful species is well distinguished from all nearly allied by its *stretched turios* with almost adpressed leaves. They appear as transformed branches in bud-state or only transformed tops of older branches. The leaves are also very characteristic partly by the form of the apex (Fig. 36, C) partly by their strong mechanical strands appearing in the margin and along the three (or five) vascular bundles. Two strong bundles are also to be found subepidermally in the lacunar system on the lower surface and besides one or another thin strand as the fig. 36 shows. By these facts the leaves obtain their well-known stiffness. The lacunar system is but

little developed in the usual leaves, but in the involuclal leaves it is much more diffuse, fig. 36, *B*. We can here trace the first beginning of a differentiation between true submersed leaves and coriaceous leaves: a contracted, stalk-like basal part and an expanded blade-like upper part without stomata but with a well developed floating apparatus in the lacunar system. At the same time the form of the apex is altered from acute to roundish and consequently this form of the apex is an adaptation for swimming purpose. The next stage we see in the amphibial leaves with both lacunar system (for swimming) and stomata (for aerial life).

The submersed leaves are mostly three-nerved, but sometimes there are two marginal nerves in the lower half of the leaf ending blindly in the parenchyma. In such cases the leaves thus are 5-nerved.

The stem has the usual compression (2,5—3 : 1) and is endowed with very strong subepidermal bast-bundles. The epidermis-cells are shorter than in all the other species of the group. When, nevertheless, by the increase of the stem the basal half of the internodes become stretched, the epidermis-cells also increase in length in that part, while they remain unaltered in the upper half of the internode. Thus the condition is different to that of *P. vaginatus*, the main-f., in which elongated epidermis-cells never are to be seen. The lacunar system is deprived of strands as usual. For the central axis I refer to the diagram, fig. 1, *K*.

In the peduncle the median vascular bundles run near to one another or fuse together obtaining a common endodermis like that of *P. foliosus*, *confervoides* and *trichoides*. The subepidermal strands are absent, but a one-layered pseudo-hypoderma fills their office.

The fruit is very like that of *P. mucronatus* and *panormitanus*, a little less than the former and a little longer than the latter (2,25 mm). A little beak crowns the top.

Spikes are evolved according to the *B*-type, Fig. 2., but with some reduction of the number of branches.

The colour of this plant is lively green but in withering state it passes into a yellow tone as in *P. mucronatus* and *panormitanus*, with which this species exhibits much closer relationship than with *P. pusillus*.

Sometimes it occurs endowed with very few or no branches: f. *simplicissimus* TISEL., Pot. Suec. exs. fasc III, 1897, no. 105—106.

Distribution. Sweden, Scania, Kristianstad, 18, hb. E. FRIES (hb. Stockholm.). — Ostrogothia, Ö. Eneby in Gusjön, 82, STARBÄCK (hb. Stockholm., Uppsal., Lund.), Vårdnäs in Strep, 12, SUNDELIN. — Uppland, Fasterna in Metsjön, 52, LÖNROTH (hb. Stockholm.,

Fig. 36. *P. rutulus* WOLFG. A, Involuclal leaf developed as a semi-coriaceous leaf with obtuse rounded apex; petiole and blade more conspicuously differentiated than in *P. pusillus*, $\frac{9}{1}$. B, The apex of a leaf more magnified. C, Top of a submersed leaf, ca. $\frac{15}{1}$. D, Transverse section of a 3-nerved submersed leaf. The lacunar part is endowed with a strong bast-bundle on either side of the midvein (m), n', lateral nerve, l, lacuna. Marginal strands very strong, $\frac{120}{1}$. E, Pistil, lateral view, $\frac{10}{1}$.

Uppsal., Lund., Gothenb.), Närtuna in Trehörningen, 95, WEDBERG & TISELIUS (hb. Stockholm., Uppsal., Lund.). — *Jemtland*, Hammerdal, Viken, 83, JÖNSSON (hb. Lund.), northern-most station, year-is. + 2° C., Hassjö, Juleby (hb. Stockholm.).

Denmark, Bornholm, 68, NIELSEN and others (hb. Stockholm., Uppsal., Lund., Gothenb.). — *Finland*, Karelia oneg., 63, SIMMING (hb. Uppsal.). — *Germany*, Usedom, 54, MARSSON; Kiel, NOLTE (hb. Stockholm., Uppsal.). Bavaria, prope Altneuhaus, 05, FISCHER (hb. Stockholm.), prope Adelsdorf, 05, FISCHER (hb. Stockholm.), 49° N. L. — *Russia*, In lacubus prope Vilnam, hb. BESSER (hb. Stockholm.). — *Asia Pamir*: Jashilkul, 98, PAULSEN (hb. Haun.). — *N. America*, Nipigon, Lake Superior, 84, MACOUN (hb. Stockholm.).

P. rutilus WOLFG. × **Vaseyi** ROBB. (**P. gemmiparus** (ROBB.) MORONG in Bot. Gazette, 1880, 51).

Some specimens from »Eastern Mass., U. S. A., Coll. TH. MORONG», now in Uppsala museum, undoubtedly are the above written hybrid. Hitherto they have been considered to be a distinct species and are as such figured in MORONG, *Najadaceæ*, 1893, t. LIV. They present so great resemblances to *P. Vaseyi* to the form and structure of the leaves as well as to the turios that they necessarily must stand in close affinity to this species (fig. 59). Other properties as for instance the size and the longer outer leaves of the turios, the length of the peduncle, the ligules, stem-sclerenchyma etc. denote *P. rutilus*. The sterility and sporadic occurrence indicate also a hybrid origin and I am waiting no serious objection to my supposition of *P. rutilus* × *Vaseyi*.

P. mucronatus SCHRADER, ap.

REICHENBACH, *Icones fl. Germ. et Helv.* VII, 1845, 15. — *P. pusillus* var. *interruptus* SCHULTES, *Oesterr. Fl.* 1814, 328. — *P. compressus* β *tenuis* WAHLENB., *Fl. upsal.* 1820, 60. — *P. compressus* β *elongatus* WAHLENB., *Fl. suec.* 1824, 107. — *P. compressus* β *acutus* SCHLECHT., *Fl. berolin.* 1823, 117. — *P. pusillus* v. *A.* CHAM. et SCHL., *Linnæa* II, 1827, 171. — *P. pusillus* a. *major* FRIES, *Nov. Fl. suec.* 1828, 48. — *P. Friesii* RUPRECHT in *Beiträge zur Pflanzenkunde d. russ. Reiches* 1845, 43. — *P. Oederi* MEYER, *Fl. hannov. excurs.* 1849, 536. — *P. major* MORONG, *Najadaceæ* 1893, 41. — Fig. 37.

In habit this species is very much like *P. panormitanus* by the scarce occurrence of branches for the prolongation of stem according to the water-level. Usually there is a spike-bearing branch in the axil of the upper involucreal leaf and this branch often stretches its internodes. This branch rarely bears a branchlet, and branches of the third rank might not at all grow out. The plant rather stretches the topmost internode thus following an eventual rising of the water. From the leaf-

axils next below the primary spike spike-bearing branches are often met with or the young branches occurring there are transformed into turios, which appear partly as wholly transformed short branches, partly as branches with metamorphosed tops.

The *stem* is compressed in the relation of 3:1 with rounded margins. Its anatomy corresponds nearly with that of *P. foliosus*. Central stele terete and consisting of a compound bundle (circular diagram), subepidermal strands as the type, no pseudo-hypoderma and no interlacunar strands. Epidermis-cells of the upper part of an internode 2–5 times as long as broad, in the lower portion more stretched. — The *peduncle*, flattened like the stem and 20–65 mm in length, lacks seldom, if ever, a few subepidermal strands. The typical pseudo-hypoderma is present and the bundles, 4(–6 à 7) in number, run separately as is shown in the fig. 37, A (××, accidentally occurring bundles).

The leaf presents a row of large-celled channels on either side of the midrib, lacunulæ, and usually four strands of bast-bundles. The regular occurrence of an exterior side nerve and its course are already known from old times and correctly figured by CHAMISSE and SCHLECHTENDAL in Linnæa, 1827, t. IV, f. 5. In the same work is also pointed out the »rete cellularum» of the upper leaves »quod totum occupat interstitium nervum inter primarium et laterales». The involucral leaves of this species, namely, are often transformed into a sort of primitive floating leaves by a metamorphosis of the upper half or third part in such a manner as is described under *P. rutilus*. »Rete cellularum» is not a cellular tissue but the small air cells or lacunulæ of the leaves. But no stomata can be observed in this species either. Front-field of the ligules 11–13-fibrous.

The stem-leaves of this species are usually not much stretched, commonly 50–75 mm, but in a variety from Sweden, *Gestricia* (see below) I have found a leaf-length of as much as 100 mm (f. *borealis*: folia caulina longissima).

The upper part of the style is protracted backwards (outward) into a little beak. The fruit has about the same shape as in *P. panormitanus*, but is a little larger, 2,2–2,5 mm × 1,5 mm, and with a more obvious keel. However, it varies with conspicuous bosses on the lid, especially at the base, by which it chances to coincide more with the *pusillus*-fruit.

Besides it varies with narrower or broader leaves (ff. *angustifolius* FISCH. et *latifolius* RUTHE ap. FISCHER) and with more obtuse apex (f. *obtusior* FISCH.). A small-leaved form is f. *minor* TIS., Pot suec. exs. f. III, no. 101, 1897.

Fig. 37. *P. mucronatus* SCHR. A, Transverse section of the peduncle showing the situation of the bundles, str, bast strands, $\frac{2}{1}^0$. B, Transverse section of stem-leaf below the middle, midvein portion with 4 strands of subepid. sclerenchyma (str), × signifies accidentally occurring strands nearer to the leaf-base or in broader leaves, n' , n'' , lateral nerves, $\frac{2}{1}^0$. C, Pistil, side-view, $\frac{1}{1}^3$. D, Top of a leaf, showing the nervation and form of the apex, $\frac{2}{1}^0$. E, Transverse section of a ligule in young state, $\frac{2}{1}^0$, r, ridge, ic, front-field.

— The colour of the leaves is always lively green, often with a yellowish tone, just as in the foregoing and the following (*P. panormitanus*).

Distribution. Sweden, not common. *Scania*, Råbelöfsjön, 84, TEDIN (hb. Lund.); Köpingsån, 76, LJUNGSTRÖM & HUMBLA (hb. Stockholm, Uppsal., Lund.); Höj, hb. E. FRIES (hb. Uppsal.); Höjeå, hb. AG. (hb. Lund.); Lillsjön at Krageholm, DÜBEN (hb. Lund.); Malmö in the channel at the railroad, 61, C. A. W.; Vejle lake, DÜBEN (hb. Lund.), 81, WALLENGREN (hb. Stockholm.); Nybro, 08, JÖNSSON (hb. L. M. NEUMAN). — *Ostrogothia*, Roxen (hb. Stockholm.). — *Gothland*, near the church of Sanda, 53, WESTÖÖ (hb. Uppsal.). — *Sudermania*, Eskilstuna, HN. (hb. Stockholm.). — *Stockholm*, several stations (hb. Stockholm., Uppsal., Lund., Gothenb.). — *Uppland*, Skeboån, 67, MOSÉN (hb. Uppsal., Lund., Gothenb.); Sätuna, 46, AFZELIUS (hb. Uppsal., Lund.); Metsjön, 81, TISELIUS (hb. Stockholm., Uppsal.); Tranbygge mill-river, 81, TISELIUS (hb. Stockholm., Uppsal., Lund.); Valloxen, 81 TISELIUS (hb. Stockholm, Uppsal., Lund.); Sigtuna, Viby, 80, FLODERUS (hb. Uppsal.); Norrteljeviken (hb. Stockholm.); Uppsala at Falebro, 20, hb. WAHLENBERG (hb. Uppsal.); River at Håga, 51, ZDT (hb. Uppsal.). — *Gestrícia*, Gefle, the south Lillå, 48, HARTMAN (hb. Uppsal.); Islandsån, 64, THEDENIUS (hb. Stockholm, Uppsal.); River at the southern wharf, 35, THEDENIUS (hb. Uppsal.), f. *borealis* m. — *Helsingland*, Söderhamn, 47, SVEDBERG (hb. Uppsal.), the most northern locality of Sweden, on 61° 15' lat. bor.

Norway, Drammen, BLYTT in hb. E. FRIES (hb. Uppsal.); Skien, BLYTT (hb. Uppsal.). — *Denmark*, several stations (hb. Stockholm., Uppsal., Lund.). — *Finland*, Alandia, Geta, Bolstaholm lake, 01, PALMGREN & KLINGSTEDT (hb. Stockholm.). — *Germany*, several stations in Silesia, Brandenburg and Holstein (hb. Stockholm., Lund.). — *England* on several stations (hb. Stockholm.).

North America, Manistee, Mich., 80, HILL (hb. Stockholm.); PERRY, N. Y., 82, HILL, and GENEVA, N. Y., 84, MORONG (hb. Stockholm.); Nov. Angl., TUCKERMAN (hb. Uppsal.); Aux Bees Scies, Mich., 80, HILL (hb. Stockholm.); Hastings County, Canada, 74, MACOUN (hb. Stockholm.). The northern limit of this species in Europe and America may be the year-isotherm of + 4° C. How far to the south it extends is not fully known, at the most to the year isotherm of + 15° C., or perhaps rather, + 12° C.

***P. mucronatus* SCHR. × *obtusifolius* M. & K. (*P. semifructus* AR. BENNET ap. GRÆBNER, Potamogetonaceæ 1907, 138, nomen solum; ASCH. & GR., Syn. mittl-eur. Fl., 2 Aufl. 1913, 535, as *obtusifol.* × *Friesii*?).**

In Dr. C. J. HARTMAN's herbarium (hb. Uppsal.) I have found some specimens which must be referred to this hybrid. The leaves are in general like those of *P. obtusifolius* and brown-coloured, but part of them have the apex of a *mucronatus*-leaf. Ligules greenish and bicarinated as in *P. mucronatus*.

Other specimens, collected by J. H. WALLMAN at Linköping and by E. FRIES in Herb. Norm. V, 81 distributed under the name of *P. obtusifolius* v. *lacustris*, have an unusual scarce ramification, especially in the spike-region, lighter colour shading

a little in yellowish, somewhat longer and more persistent ligules, more elongated but obtuse leaf-apexes, and often longer peduncles, by which all it reminds of *P. mucronatus*, while the rest, the stem-anatomy, too, belongs to the *P. obtusifolius*. I have also seen the same singular form from the Krageholm-lake in Scania, where it grows together with *P. obtusif.* of usual habit and *P. mucronatus*. Cfr. E. FRIES, Nov. Fl. suec. 1828, 48! I hold this also to be *P. semifructus*. The youngest ligules in their basal part connate and reminding of those of *P. mucronatus* (interm.). The Friesian variety-name *lacustris* should be kept for this form, which may be identic with *P. obtusifolius* v. *fluvialis* LANGE et MORTENSEN, Bot. Tidskr. 1878, 200.

The first-mentioned form is collected by Dr. HARTMAN in 1821 in the Holmariver in the parish of East Vingåker, Sudermania, and may be named f. *olivaceus* n. f.

***P. mucronatus* SCHR. × *panormitanus* BIV. (*P. confinis* n. hybr.).**

Caulis ± compressus. *Folia* angustissima ± rigida acuta, 3-nervia. *Ligulae* interparentes medium habentes sed costulis subviridibus. *Hybernacula* cum iis *P. panormitani* subcongruentia.

The forms here considered present a somewhat compressed stem, narrow stiff leaves with sharp points, persistent ligules, at least in young state with greenish costal stripes. Hereby they remind of *P. mucronatus*, but the turios have the same shape as in *P. panormitanus*. They evidently derive their origin from the above written parent-species. Leaves small and 3-nerved locally with indications of an external side-nerve. In habit they are a *P. mucronatus* in miniature.

Distribution. Sweden, Uppland, near Uppsala, »Hvithulfsberg», hb. WAHLENBERG (hb. Uppsal.); Rivulet between Kvarnbo and Håga, 1818 (WAHLENBERG?), hb. TH. M. FRIES (hb. Uppsal.) probably *P. mucronatus* × *pusillus*. Vaksala near the church, 95, HELLSING (hb. Lund.), very likely the same station as the first written. — A specimen from *Ostrogothia*, Linköping, Kattbrunnen, 63, BLOMBERG (hb. Uppsal.) also seems to be the same hybrid.

Denmark, Helsingör, Marienlyst (hb. Lund.). — Holland »Amsterdam, Kalfje in Teichen bei Amstel», 83, TISELIUS (hb. Stockholm.).

***P. mucronatus* SCHR. × *pusillus* L. (*P. pusilliformis* HAGSTR. nov. nom.).**

P. intermedius FISCHER, Die bayer. Potamog. in Ber. bayer. Bot. Ges. 1907, 28, 122.¹

Part of the material going under the name of *P. Berchtoldi* FIEBER belongs to this hybrid. See, under *P. pusillus*, below! It is not by far so difficult to identify as the just described. Stem somewhat compressed, almost filiform, the ramification from the involucreal leaves sometimes like the one, sometimes the other of the parent-

¹ As the name *P. intermedius* was earlier applied by CHAMISSE and SCHLECHTENDAL, Linnæa 1827, 221, to a plant from Landstuhl, probably *P. polygonifolius*, a new name must be chosen for this hybrid.

species. Leaves with stronger nerves than in *pusillus* but with at least one channel-row along the mid-rib. Apex usually *mucronatus*-like. Ligules commonly a little longer and more persistent than in *P. pusillus*. It is infallibly recognized by the turios, when present, since something of *P. mucronatus* is always to be found in them. The specimen from Norby (hb. Uppsal.) is provided with fruit, which is a little larger than in the common *pusillus*. The fruit of *P. Berchtoldi* is also said to be larger than in *P. pusillus*. I think it impossible now to state whether all that FIEBER referred to his new species may be this hybrid, or if not partly pure *P. pusillus*, partly also the hybrid *P. dualis* m. is comprehended in it. The latter is very likely to be the fact, and when the name *Berchtoldi* is already applied by ASCHERSON and GRAEBNER (Synopsis) to a true *pusillus*-form, we shall have to give new names to the hybrids included in *P. Berchtoldi* of FIEBER.

Distribution. Sweden, Uppland, Uppsala, Norby in the river, 51, ZDT (hb. Uppsal.); Sigtuna, in a clay-pit at the bridge leading to Garns-bay, 82, FLÖDERUS et TISELIUS (hb. Stockholm.). — Scania, Björka in the parish of Kropp, 64, HULTBERG (hb. Lund.) — Besides *P. pusilliformis* occurs in Denmark, where it is collected by BAAGÖE in Skjernå between Clasensborg and Felding in Jutland in 1902, and in Skaber Möllesö (mill-lake), Jutland in 1905. — Specimens from Gull Lake, Cass. Co., Minn., U. S. A. 93, BALLARD (hb. Stockholm.) also seem to me to belong to *P. pusilliformis*.

P. panormitanus BIVONA BERNARDI.

Nuove piante inedite del barone ANT. BIVONA BERNARDI pubblicate dal figlio ANDREA. Palermo, 1838, 6—7. — *P. gracilis* FRIES, Novitiæ Fl. Suec., 1828, 50. — *P. Noltei* BENNETT, The nomenclature of Potamog., in The Journ. of Bot. 1890, 300. — Figs. 38, 39.

The earliest trace we find in the literature of this species is in the monograph of the genus by CHAMISSE and SCHLECHTENDAL in 1827. For, if certainly the narrow-leaved form of *panormitanus* is not alone included in their *P. pusillus* L., *D. forma tenuissima*, the description, nevertheless, is made so as to comprehend it therein, since the leaves are said to be »sæpe convoluta et inde subsetacea» etc. This narrow-leaved form, properly *P. pan. β minor* Biv. is in the next following year discerned by E. FRIES under the name of *P. gracilis*, the specific character of which he still in 1846 (Summa veget.) insists upon chiefly on account of the prominent midrib of the leaf and the lack of lateral nerves, though he had found it only in one single locality (in stagnis marinis ad Landskrona). HARTMAN adopted and maintained the species in the different editions of his Handb. i Skand. Flora, but only bowing to the eminent authority of FRIES and with a certain reservation. In the year 1838 the same species suddenly appears in the above named treatise by BIVONA, but now not only in its thinnest but mainly in its most broad-leaved form. Also BIVONA bases its specific rank principally on the stiff leaves, to which he adds the

broad ligules, the separated verticils of the spike, the yellowish-green perianths, and olive-coloured small fruits. GUSSONE adopted the new species in his Fl. Siculæ Synopsis, 1842, but with the remark that it seemed to him only slightly separated from *P. pusillus*, and in the Italian flora-literature it appears only as a synonym of this species. Nay, the name even falls into oblivion until BABINGTON in a dissertation on *P. lanceolatus* SM. (1881), though only incidentally, brings it into discourse. REICHENBACH adopts the species, but changes the Friesian name into the impossible designation of »*P. (pusillus L.) tenuissimus* M. K.», but nevertheless with the remark: — species videtur distincta. In our days *P. panormitanus* has been taken for a variety of *P. pusillus*. Thus AR. BENNETT in The Journ. of Botany, 1881, and MORONG in 1893. Lastly, in the year 1901, the name has been used in its original sense by HAGSTRÖM in his review of the Swedish species of the genus in NEUMAN, Sveriges Flora. At the same time the identity between this species and *P. gracilis* FR. has been pointed out. But I have not considered the two names to be quite synonymous. The difference above referred to exists, but the two names at all events cover the same species. The Friesian name, however, must recede, since it was earlier applied by WOLFGANG to another plant. Full recognition has not yet been bestowed on this species, since FISCHER in Mitteilungen n:o 32 der Bayer Bot. Ges., 1904, has adopted it only as a subspecies, while GRAEBNER (1907) relegates it to the rank of proles under *P. pusillus*. I believe, however, that a plant which with constant characteristics has spread over both the Old and the New World, thus, although of slight appearance following in the footsteps of the Great Powers will ultimately become duly observed and acknowledged.

Having placed two well developed specimens of the two species beside one another, everyone, at the first glance and comparison, will find that we have to do with two different species. Dr. H. LINDBERG at Helsingfors, having seen them growing together, writes to me (1908): — De voro ute i naturen så olika, att jag genast såg, att jag hade något nytt framför mig.¹ In the first place the very colour is different, *P. panormitanus* having a more light green often yellowish tint in accordance with *P. mucronatus*, while *P. pusillus* has a darker colour inclining to brown like *P. obtusifolius* with which it also for the rest shows a greater resemblance and relationship than with the species we are here concerned with. The mode of growth is also different: *P. panorm.* stretches itself elegantly upwards *rutillus*-like, *P. pus.* again expands like a bush with copious branches in the upper part, if there is space and occasion for it. The mode of prolongation finally is another, so that *P. panorm.* stretches the upper internodes of the stem to the necessary length, but never prolongs by branches of several ranks, distichously, which is, again, the characteristic of *P. pusillus*, *obtusifolius*, and others. Usually there is in the axil of the upper involucre leaf a very short spike-bearing branch, that is all (type A, of the fig. 2). *P. pusillus*, on the contrary, projects from the primary two involucre leaves long

¹ On observing them growing I immediately found that I had a novelty before me.

branches, which in their turn shoot out branches of the second rank and so on, in accordance with the length of the vegetative season and other influences (type *D*).

The stem is terete or faintly compressed ($1\frac{1}{2}:1$) with elongated internodes, the upper ones 6–10 cm, and with the branches usually crowded at the base, from where spike-bearing long branches grow forth (*A*-type). In the axil of the scale-leaf at the base of those branches the small and slender turios are usually developed, which in *P. pusillus* on the contrary occur apically on the branches. The anatomy of the stem does not essentially deviate from that of the nearly related species. In the stele the bundles fuse into a compound bundle with the phloem parts in the periphery and a common xylem cavity in the middle (circular stele-diagram). In the peduncle there

Fig. 38. *P. panormitanus* Biv. v. *minor* Biv. A, Transverse section of a stem-leaf, middle portion, $\frac{1}{1}^0$, m, midvein, n, lateral vein, str, bast-bundles. B, Transverse section of the stem, $\frac{8}{1}^0$, ep, epidermis, end, endodermis, cc, central axis, l, lacunar system, str, subepidermal bast-bundles. C, Tops of leaves showing the nervation and different form (1, 2) of apex, $\frac{1}{1}^0$. D, The fruit of the f. *stenocarpus* FISC., side-view, $\frac{8}{1}^5$. E, Fruit, side-view, $\frac{8}{1}^5$; the dotted line shows the fruitform of the f. *platycarpus* FISC.

appear seldom more than two separated bundles (the median ones), in *P. pusillus* four or more. The peduncle is terete, slender, 15–30(45) cm long.

By the prominent midrib, elevated over the lower surface of the leaf and the more or less strong marginal sclerenchyma the leaves are stiffer than in *P. pusillus* having softer leaves with low and broader midrib-portion. *P. panormitanus* never has the large-celled lacunæ along the mid-rib, by which the leaves are lacking the 1 to 2 light stripes, characteristic to *P. pusillus*, and the mid-rib looks greyish and not transparent. Only one row of narrow lacunæ, outwardly appearing like a delicate light stripe, occurs now and then. Those differences are

of no small consequence, since the lacunar system of the leaves constitutes an important part of the swimming apparatus of the plant. With its abundance of leaves *P. pusillus* needs a more developed apparatus for floating. Common to both species is the transformation of the involucral leaves in this direction, though more often occurring in *P. panormitanus* and also in β *minor*. The leaves are always 3-nerved; in the broader leaves there appears occasionally a pair of nerves beyond the usual number. Apex commonly sharper and longer than in the *pusillus*-leaf in general. The ligules have a light-brown colour, are more persistent than in *P. pusillus*, and 6–10-fibrous in the front-field, the uppermost broad and pretty long maintaining an inflated appearance owing to the inclosed spike. This consists of 2–3, a little separated, 2-flowered whorls and the perianths are endowed with a long claw. The styles are short and very thin, consequently the rostrum of the fruit is typically short and thin. Stigma covering the whole upper surface and even projecting a little beyond. The fruit is olive-coloured and smooth, in *P. pusillus* more green or dark-green and more

uneven on the surface. Usually it is not quite 2 mm long (1,7—2). The width varies between 1,1 mm and 1,5 mm, which considerably alters its appearance. Also the inside line downwards varies a little in form, now very faintly, now more evidently bent inward. The curvature of the lid is either more prominent or weaker, according to the width of the fruit, but always smooth and circular, to which is to be added that the fruit lacks the basal broadness, characteristic of a *pusillus*-fruit. The rostrum is apical and directed straight upwards or a little backwards. This description relates to dry material as concerning *P. pusillus* below. In fresh, specimens, of course, the measures are a trifle larger. Like the *pusillus*-fruit (contrary to FRIES and others) the back is also here not keeled and false keels exist very seldom, as the fleshy part of the fruit in this species is not so thick as in *pusillus*. Consequently the outlines of the embryo and the line of demarcation of the lid can be seen outwardly more often in this species than in *P. pusillus*. Frequently enough the fruit also has a small pit at the sides. Evidently we have here another fruit than in *P. pusillus*; but it is also evident that, owing to the smallness of the fruit and the comparatively large capacity of variation, the two species can nevertheless be found with fruits, in shape puzzlingly like each other, which fact may not at all be considered to prove that the two species pass into one another, just as little as, for instance, *pusillus* and *obtusifolius*, or *zosterifolius* and *acutifolius*, or others, may for the same reason be said to run into one another.

The most evident differences, however, between the two species before spoken of, lie in the stipular sheaths and in the shape and occurrence of the turios, fig. 39. As each species produces its different fruits, thus it also develops characteristic organs of propagation and hibernation. This species has most gracile and inconsiderable buds, in general only 12—15 mm long. They consist of transformed small branches with extremely short internodes that are a little thickened, in diameter of about $\frac{1}{3}$ or $\frac{1}{2}$ mm. Two small sheaths are situated at the base, the lowest of which is a prophyllum. Above these generally one but sometimes two to three leaves are to be found, spreading, short and with sharp points, further one or two still more reduced and adpressed, lastly the inner leaves enclosed by ligules forming the essential portion of the bud. The first buds always exist on the basal parts of the stem and branches. But when a bud is produced, for instance in the axil of a scale-leaf, and the season admits a further development of the branch, another bud is formed in the axil of the next following leaf and so on, whereupon at last even the very apex can sometimes be transformed. The development being ended, the whole branch breaks at the node of the scale-leaf, leaving only the lowest bud on the mother-plant, which disconnected from the branch seems to have produced the remaining bud in the leaf-axil. The dropped branch or bud-system corresponds nearly to the transformed short branches of *P. crispus* although the transformation in the latter is much more advanced. Of course, all buds break or sink at last to the bottom with the withering stem.

In *P. pusillus* the development is quite the contrary: the best developed buds occurring in the branch-tops, from where the generation proceeds downward by

transformation of the tops of the secondary branches. Those buds break separately when they reach their maturity. Moreover they are considerably larger and the lower free leaves are similar to the other leaves of the branch. Cfr HAGSTRÖM in NEUMAN, *Sveriges Flora* 1901, p. 802—803.

Very rarely there are turios on the rhizomes. As to their appearance it is traced in fig. 39, D.

Beside the main-form and v. *minor* BIV. FISCHER has established two intermediate forms: *vulgaris* and *rutiliformis*. Of var. *minor* he discerns four forms: *ramosus*, *squarrosus*, *platycarpus* and *stenocarpus*. Forma *ligulifolius* FISCH. is the form endowed with somewhat subcoriaceous involucral leaves. See FISCHER, *Die bayer. Pot.* 1907, 109—110.

A still more broad-leaved form than the main-form I have found in some herbaria and named

f. *austrinus* n. f. — Folia latiora, 1,5—1,75 mm lata.

This form is met with in Africa. The broad-leaved forms seem to spread southward from the Mediterranean, and the narrow-leaved to the north of it.

Distribution. Sweden. Generally not far from the Baltic and Bothnian coasts and often in brackish water. *Scania*, Vegeholm, 88, WALLENGREN (hb. Uppsal.), Lund, 45, L—M in hb. E. FRIES (hb. Uppsal.), Ringsjön, 82, NILSSON (hb. Lund., on a sheet together with the hybrid *P. panorm. × pusill.*). The original Friesian specimen of *P. gracilis* from Landskrona is not present in the Museums. — *Ostrogothia*, Borensberg, Brunneby par., 73, BERGSTRÖM (hb. Uppsal.) Vreta, Berg, 88,

Fig. 39. *P. panormitanus* BIV. β *minor* BIV. A, B, Two turios, $\frac{2}{1}$, a, stem, b, leaf, h, turio, f, prophyllum, l, scale-leaf. C, System of turios, nat. size, see the text! D, Rhizomatic turios (h—h), $\frac{2}{1}$, 1, 2, 3, 4, internodes. E, Transverse section of a young ligule at the middle showing the form and the bundles, $\frac{5}{1}$, ic, front-field. F, Young ligule, backfield-view, $\frac{8}{1}$, showing the top-form of the front-field and how far in some instances the apical slit of the back-field can extend downwards (dotted line).

AURELIUS (hb. Lund.), Tåkern, 83, TOLLIN (hb. Lund.), Linköping, Kattbrunnen, SANDÉN and others (hb. Uppsal. et Lund.), Grebo, Redinge, SANDÉN (hb. Uppsal.), Norrköping, 56, HAMMARSTEN (hb. Uppsal.). — *Westgothia*, Gothenburg, Kvillebäcken, Lindholmen and Gullbergsvass, LINDEBERG (hb. Gothenb.). — *Stockholm*, Värmdön, Rörsundsvik and some other places (hb. Stockholm., Uppsal., Lund.). — *Sudermania*: Igelsta in Hallsfjärden, 97, HAGSTRÖM (hb. HAGSTR.). — *Gestrícia*, Gefle, Hillevik in sinu maris, 47, HARTMAN, 35, THEDENIUS (hb. Uppsal.). — *Medelpad*, Skön, Fillan, 79, SETH (hb. Lund.). — *Westbothnia*, Ratan in aqua salsa, 68, KROK (hb. Stockholm.). — *Dalecarlia*, Hedemora, 02, TISELIUS (hb. Stockholm.).

Norway, Flagsta-river, 88, TISELIUS (hb. Stockholm.). — Denmark, Husum, 46, LANGE (hb. Uppsal.), Jutland, Nybro Kro, 96, BAAGÖE (hb. Uppsal.), Braband sö,

97, BAAGÖE (hb. Stockholm.). — *Finland*, Karelia austr. et Tavastia austr. 08, H. LINDBERG. — *Russia*, S:t Petersburg, 23, WEINMANN (hb. Stockholm.), Sarepta in Volga, BECKER (hb. Stockh.), Kronstadt, 57, KÖRNICKE (hb. Stockholm.). — *England*, Shropshire, 81, BECKWITH (hb. Stockholm.), Surrey, 81, BENNET, 82, NICHOLSON (hb. Stockholm.). — *France*, Carenton, 86, CORBIÈRE (hb. Stockholm., Lund.), BASSERVILLE (hb. Stockholm.) — *Germany*, Pomerania, 61, ZABEL (hb. Uppsal.), Königsberg, 71, BÄNITZ (hb. Uppsal., Lund.: var. *rutiformis* FISCH.), Holstein, 92, SIMMONS (hb. Lund.), Bremen, WIKSTRÖM and GRENIER (hb. Stockholm.), Bavaria, Bamberg, 02, FISCHER. — *Austria*, Vienna, 83, TISELIUS (hb. Stockholm.). The Tyrol, Kreutzberg, 71, HUBER (hb. Stockholm.). — *Hungary*, Ofen, STEINITZ and RICHTER (hb. Uppsal., Lund.). — *Istria*, BENTHAM (hb. Stockholm.). — *Transylvania*, Vizakna, SCHUR (hb. Stockholm.). — *Spain*, Guadalhore à Pizarra, 83, NILSSON (hb. Uppsal.). — *Portugal*, 55, SJÖGREN (hb. Stockholm. and Lund.). — *Italy*, Stagnis taurinensibus, ROSTAN (hb. Stockholm.: v. *minor*), Piedmont, HOHENACKER (hb. Uppsal.), Palermo, TODARO and LAGGER (hb. Uppsal.: v. *minor*), 83, LOJACONA (hb. Stockholm.: the main-form), Avola, 56, HUEL DU PAVILLON (hb. Uppsal.: the main-form), Sicily, Tineo in hb. C. F. NYMAN (hb. Stockholm.: the main-form), »Palermo al fiume Oreto, TOD.» in hb. C. F. NYMAN (hb. Stockholm.: v. *minor*).

Africa, Madeira, Fayal in rivulo, MANDON (hb. Stockholm.: the main-form), Abyssinia, prope Adoam, 37, SCHIMPER (hb. Stockholm., Uppsal.: f. *austrinus*); South-Africa, Grahamstown, 97, MAC OWAN (hb. Uppsal.: f. *austrinus*); Cape of Good Hope, WAHLBERG (hb. Stockholm.: the main-form). Natal, in riv. pr. Idutywa, 95, R. SCHLECHTER N:o 6272 »*P. pusillus* L.» (hb. Stockholm.). *Asia*, Afghanistan, 63—64, hb. GRIFFITH (hb. Stockholm.), China bor., Kansu, 85, POTANIN (hb. Stockholm.), a somewhat dubious form. *America*, Lees Lake, Colorado, 97, CRANDALL (hb. Uppsal.: v. *minor*), Chisago Lake, Minn., 92, TAYLOR (hb. Stockholm.: v. *minor*?), Ottawa, Canada, 82, FLETCHER (hb. Stockholm., approaching to the main-form). *Oceania* Honolulu, 52, ANDERSSON (hb. Stockholm.), lacks fruit and turios, but seems to be this species.

P. panormitanus BIV. × **pusillus** L. (**P. dualis** HAGSTR. n. hybr.).

It may be almost impossible to give so accurate a description of this hybrid that the different forms could, by such a one, be identified. It seems also to be very rare. Of all *Pusilli* I have examined I have met with only the few forms mentioned below which can with any amount of certitude be reckoned to this hybrid. To identify it we shall have first of all to pay attention to the buds and to the fruit, further to the nervation and stipular sheaths, and the mode of branching from the basis of the primary peduncle. If we know perfectly the characters of the supposed parents, we shall soon discover the deviations and the intermediate form between the one and the other.

From *Sweden* we have to record only one locality: Scania, Ringsjön, 82, NILSSON, fruiting, but probably this bastard (hb. Lund.). — *France*, Besançon, 70, GRENIER (hb. Uppsal.), Valleville, Eure, 55, MALEBRANCHE (hb. Stockholm.). — *England*, Ponds near York, 81, BENNETT (hb. Stockholm.), Shropshire, 86, BECKWITH (hb. Stockholm.). In some private herbaria I have seen plants which are likely to be this hybrid, viz. from *Denmark*, Nybro kro, 99, BAAGÖE and from *Starnberger See*, 03, M. v. ZUR MÜHLEN.

The above enumerated forms exhibit evident relationship to *P. panormitanus* and *pusillus*, but are very different among themselves as to their qualities. In habit and branching they approach now this form, now the other. Their leaves are always stiffer than in *P. pusillus*, and tipped with sharper points. Turios, unfortunately, seem to be pretty rare, but when present they resemble now more the one, now the other of the parent-species. — *P. dualis*, of course, is easily to be confounded with the hybrids *pusillus* × *trichoides* and *panormitanus* × *trichoides*. I have seen the latter from *Bavaria*, where it is collected by Dr. FISCHER at »Appendorf im Lautergrund» and at »Lauterbach». It is darker in colour, has more prominent leaf-points, more abundant sclerenchyma etc., by which it evidently shows a near affinity to *P. trichoides*, while the turios allow us to trace *P. panormitanus*.

***P. badius* n. sp.**

Caulis compressus (2—2,5:1) elongatus, internodiis 3—5 (summis 7) cm longis, subsimplex vel infra medium ± ramosus, dichotome prolongatus ramis spicigeris 1^a—2^a ordinis internodiis longis (ad 9 cm) instructis. *Folia* linearia 3—5-nervia basi angustata apice acuta ± acute cuspidata, caulina 50—100 × 2 mm, floralia 25—40 mm longa, numquam subnatantia, nervo medio badio prominente. *Ligulae* breves caducae eglandulosae vel subeglandulosae, in spatio intercarinali 11—12-nerviæ. *Pedunculi* breves ± 20 mm æquales. *Spica* subdensa 3—4-verticillata. *Stylus* rostro brevi instructus, stigmatibus parvo rotundato. *Fructus* subglobosus parvus, 1,75 mm longus, badius, dorso rotundatus, lateribus convexis, iis *P. panormitani* Biv. platycarpi simillimus. — Fig. 40.

By the nervation of the leaves and the form of the fruit this species is very closely related to *P. panormitanus*. It differs by the flattened stem, the elongated upper branches endowed with long internodes (*D*-type), the broad and elongated stem-leaves, by the involucre leaves never growing subcoriaceous, by the ligules lacking oil-cells and being 11—12-fibrous in the front-field. The styles are a little beak-formed above and the fruits more rounded. The turios consist of transformed branches in bud-state in the lower axils; they are about 10 mm long with short ± cuspidate appressed outer leaves and obtuser enclosed inner leaves. They resemble in a high degree the turios of *P. panormitanus* and *exiguus* m. At first I therefore believed that *P. badius* could be classed with the former of those. Later the differences have appeared too considerable and I now think it better to establish

a separate species. Possibly, however, the future might come to another result, when the African Pusilloids have been fully examined.

The anatomy of the stem and the peduncle is constructed after the type of the group but with a more or less complete supporting layer along the epidermis in both. No subepidermal strands are observed in the peduncle. The structure of the leaf is in accordance with that of the *panormitanus*-leaf with scarcely developed lacunar system where, moreover, a few strands appear. The chief lateral nerves run somewhat nearer the margin than the midrib and join at a distance of a leaf-width from the very apex. Without or within the primary side-nerves there appear casually (in broader leaves) fainter longitudinal nerves, the leaf consequently becoming 4–5-nerved, at least in its lower half.

Distribution. South Africa, Drege, N:o 4458, b, 114. 10, 1206 (hb. Stockholm.) referred by AR. BENNETT to *P. pusillus* L. under the name of v. *africanus* in L'Annuaire du Cons. etc. de Genève, 1905, 102. — King Williams Town, 83, LEIGHTON (hb. Stockholm.).

P. antaicus n. sp.

Caulis 0,5 m altus compressus ramosus, a foliis summis dichotome ramosus, internodiis 4–6 (summo 5–8) cm longis. *Folia* linearia 50–70 mm longa, 1,75–2,5 mm lata 3-nervia, nervo medio valido, basi attenuata, apice obtusa brevissime mucronata. *Ligulae* caducae 8–10 mm longae, eglandulosae vel subglandulosae, in spatio intercarinali 8–9-nerviae. *Pedunculus* brevis, 15–22 mm, spica densa triverticillata. *Stylus* brevis, stigmatate parvo. Fructus non visus. — Fig. 41.

In habit this species resembles *P. obtusifolius* M. & K. We find again also here the dichotomous ramification from the base of the primary spike (*D*-type), but the internodes are in general more elongated, with the one next under the primary spike longest, 5–8 cm. Also the short peduncles remind of the same species, to which is to be added, that the stem likewise has a somewhat compressed form. The leaf-apex is obtuse with nearly imperceptible cusp, less prominent than is generally the case in *P. obtusifolius*. The greatest difference lies in the nervation of leaves and stipules; the lateral nerves of the leaves run at a greater distance from the margin, in the middle between the margin and the outer line of the midrib, and are connected

Fig. 40. *P. badius* HAGSTR. A, B, Tops of stem-leaves, showing the nervation and the different form of the apex, $\frac{8}{1}$. C, Transverse section of a stem-leaf (at the middle), *, accidentally appearing secondary side-nerves, n', lateral nerve, m, midnerve, str, strands, l, lacunae along the middle vascular bundle, ca. $\frac{1}{4}$ °. D, Transverse section of stem, $\frac{1}{4}$ °. E, Pistil, side-view, $\frac{1}{2}$. F, Fruit side-view, $\frac{0.5}{1}$.

by often s-formed cross-veins. Finally they join the midrib at a greater distance from the very apex than in *P. obtusifolius*, about a leaf-width's distance from it, or often a little more. Cf. figs. 41, *A*, 51, *B*. In this respect the species resembles more *P. pusillus*. The middle vascular bundle is surrounded by a group of small lacunæ and a row of large channels which, by suitable enlargement, is visible outwardly like a light stripe along the midrib. The mechanical system within the lacunar area may best be seen in the adjoined figure.

Fig. 41. *P. antaicus* HAGSTR. *A*, Upper portion of a stem-leaf showing the characteristic nervation, $\frac{5}{1}$; *B*, Transverse section of the middle part of a stem-leaf, showing the vascular bundle (*m*), the lacunar system and the subepidermal strands (*str*), ca. $\frac{1}{1}$; *C*, Transverse section of the peduncle, showing its form, the lacunar system, and the disposition of the vascular and bast bundles, $\frac{5}{1}$; *D*, Pistil, *a*, from the side, *b*, back-view, $\frac{5}{1}$.

The front-field of the stipular sheath is 8–9-fibrous, whereas *P. obtusifolius* is 14-fibrous, and besides has open ligules.

The stem-structure is recognized by the fact, that it is endowed with a pseudo-hypoderma along the endodermis beside the usual subepidermal strands. The crosscut-form of the central cylinder is roundish or oval and the bundles are arranged according to the circular or oblong (in stouter stems) diagram.

Though the fruit-form is unknown this species can easily be identified by the characters given above. Our species cannot be identic with *P. denticulatus* LINK, since that species, for the rest little known, has acute leaves.

Distribution. *Africa*, S:t Antao, Cape Verde Islands. Leg. LOWE (hb. Stockholm.). Cfr THISELTON—DYER, *Flora of trop. Africa*, VIII, 2, 1901, 222, under *P. pusillus* L.!

P. exiguus n. sp. — Fig. 42.

Caulis humilis ad basin solum ramosus tenuis filiformis teres vel subteres, internodiis brevibus, 10–20 mm. *Folia* linearia, latitudinem maximam infra medium præstantia, basi attenuata, obtusa, caulina inconspicue mucronulata, ramulorum mucronata, trinervia, nervo medio reticulata, 20–35 mm longa, 1–2 mm lata (folia floralia 15–20 mm longa). *Ligulæ* breves (5 mm), caducæ, biglandulosæ, subpaucinerviæ. *Pedunculus* brevis (sub anthesin 5 mm, defloratus 8–10(15) mm) teres. *Spica* brevis densa 2–3-verticillata (4–6-flora). *Fructus* parvus, 1,5–1,75 mm longus, 1 mm latus, oblique obovatus, dorso rotundatus (siccus subcarinatus), rostro apicali brevissimo.

Among the few specimens of this species I have had at hand a single one has been found with a developed rhizome and a shoot arising from it. To judge from this the rhizome creeps superficially in the bottom. Rhizomatic winterbuds are probably not produced in accordance with the condition of things of our indigenous *pusillus*-like species. Into such organs, on the contrary, the small undeveloped branches, present on the lower portion of the stem, are transformed.

The transformation, however, is not very significant. The internodes cease to grow, increase somewhat in thickness and form a reservoir for starch. The leaves grow a little shorter, having for the rest the usual shape found in young branches.

This plant resembles at a first glance our common *pusillus*, or still more the main-form of *P. panormitanus* but differs on closer examination from both of them. The stem is merely about 20 cm high, sending forth now and then from the base a single fruiting branch according to the *A*-type, otherwise only endowed with buds or undeveloped branchlets, or branchlets transformed into turios. Nor do we find any propensity in this plant to prolong itself by spike-bearing branches from the involuclal leaves. I never saw more than one very short and insignificant spiciferous branch. Anatomically the stem is constructed as *P. pusillus*. In the peduncle, being a little thicker than the stem, the four vasal bundles run together, but beside the pseudo-hypoderma there are also scattered subepidermal bast-bundles. The leaves are somewhat broader below the middle, at the most 1,75–2 mm, toward the top 1 mm. At this enlargement of the blade there are often 5 nerves, but usually the leaves are three-nerved. The nerves join the midvein at about a leaf-width's distance from the very apex. The midrib is strong and generally accompanied by two rows of lacunæ almost up to the very apex. The apex is obtuse with only a little wart, but on the young branches described above the leaf-apex is more keenly cuspidate, by which fact the leaves can be said to be dimorphous. The front-field of the ligules is 7–9-fibrous. The perianth leaves have the usual rounded form. The fruit is both in size and form different from the *pusillus*-fruit, but on the other hand very like the fruit of *P. panormitanus*, with which *P. exiguus*, however, is not to be confounded for the sake of the obtuse stem-leaves, the turios, the subepidermal bast-bundles in the peduncle etc. It shows also great relationship to *P. antaicus* by the ligules, the obtuse leaves, and the course of the nerves, but the cross-veins are in the new species joined in almost right angles to the longitudinal nerves, the mode of branching and prolongation is another etc.

Distribution. Africa, Cape Town, 53, coll. N. J. ANDERSSON (hb. Stockholm.).

Fig. 42. *P. exiguus* HAGSTR. A, Transverse section of a stem-leaf at the middle, str, strands, n' lateral nerve, $\frac{1}{2}$. B, Top of a stem-leaf, $\frac{1}{2}$. C, Top of a branch-leaf, $\frac{1}{2}$. D, Fruit, outlined, lateral view, $\frac{1}{2}$.

P. limosellifolius MAXIMOWICZ.

In KORSHINSKY, Plantæ Amur. etc. in Act. Hort. Petropol., 1893, 393. — Fig. 43.

This species also joins the *Pusilli connati* by all its chief properties, but it cannot yet be said to be fully known. It is not present in the Swedish Museums. The specimens I here refer to are preserved in the Museum of S:t Petersburg and

labelled »Herb. of the U. S. North Pacific Exploring Expedition under Commanders RINGGOLD and RODGERS 1853—56. C. WRIGHT coll. Loo-Choo Islands». They are determined by MAXIMOWICZ himself as *limosellifolius*.

In habit and in most qualities it is like a small *P. panormitanus*. REGEL in Fl. Ussur. plainly calls it *P. pusillus*.

The stem is thread-like, terete or but faintly compressed and to the inner structure corresponding with the usual type of the group. The subepidermal strands are very faint; no pseudo-hypoderma; central cylinder of the circular diagram type.

Leaves three-nerved, stem leaves 20—30 mm long, scarcely 1 mm broad, base tapering, apex with a short cusp; a narrow channel on either side of the small lacunæ round the midvein (*l-l*), no strands are observed in the lacunar system. Accordingly *P. limosellifolius* is a non-sclerenchymatous species. The involucral leaves are semicoriaceous in close correspondence with *P. panormitanus*. Blade and petiole more or less distinctly differentiated; blade without stomata, not fully 2 mm broad. Ligules 8-fibrous connate as in *P. panormitanus*.

Fig. 43. *P. limosellifolius* MAXIM. A, Top of submersed leaf showing the nervation and the form of the cusp, $\frac{3}{4}$. B, Two involucral leaves (*a-b*) *b*, more conspicuously differentiated, $\frac{4}{5}$. C, Transverse section of a submersed leaf, $\frac{1}{10}$, see the text! D, Pistil, side-view, $\frac{8}{10}$.

The spike consists of only two verticils. Style short, stigma almost oval covering the whole upper surface of the style and projecting a little beyond. The fruit lacks a dorsal keel and outgrowths according to the outline of it made by MAXIMOWICZ on the label, and is somewhat like a *panormitanus*-fruit, but shows no affinity with the *Javanici*. No turios are seen by me.

Series B. *Pusilli convoluti* HAGSTR.

Subseries a. *Acuti* HAGSTR.

All the species of this subseries have a distinct, sharp cusp, or a slowly tapering point. I do not know more than the following seven species and hybrids: *P. Hillii*, *P. Gayii*, *P. Berteroanus* and *P. Aschersonii*, belonging to North and South America, *P. orientalis* a native of East Asia, and *P. Preussii*, of Africa. A South-American hybrid shows evident relationship to *P. Aschersonii* and *polygonus*.

P. Hillii MORONG.

In Botanical Gazette 1881, 290. — Fig. 44.

Stem flattened and furrowed at least on one side, 2,5 times as broad as thick, and of the typical structure; stele diagram oblong. Epidermis-cells of elongated form, 3. to 5 times as long as broad; a pseudo-hypoderma lacking in the stem is present in the peduncle, where, again, the sclerenchymatous strands are absent. The vascular bundles of the latter run very near together reminding in that circumstance of

P. foliosus, as well as by the peduncle being very short. Common to these two species are also many other characters, for instance the few-flowered spikes and the crest-formed outgrowth in the dorsal and ventral sides, which formations seem to be more conspicuous in the form without oil-cells. In size, again, the fruit reminds of *P. zosterifolius*.

The leaves are endowed with a well developed lacunar and mechanical system according to the figure below. Ligules more tapering than is usual, their front-field 10—13-fibrous.

Distribution. *N. America*, Manistee, Mich., 82, T. MORONG (hb. Stockholm.). The supposed Asiatic occurrence of this species is most doubtful.

P. Gayii AR. BENNETT.

Bemerkungen über die Arten der Gatt. Pot. etc. in Ann. naturhist. Hofmus. Wien, 1892, 293. — Fig. 45.

I have seen a great deal of individuals of this species, but none of them with so broad leaves as is stated in the original description, 4—9 mm. The leaf-width is about 3 mm and this is also the fact concerning specimens determined by BENNETT himself. Several

other statements in the description (for instance of the affinity etc.) compared with material deposited in Sweden seem to me very strange.

Although developing plenty of spikes the species has not been met with fruiting. This makes me think that the plant may be of a hybrid origin, an opinion which is supported by the fact that the pollen to the greatest part consists of wrinkled, angular, and empty grains. The stigmas on the contrary, that I have examined seem in no way to be abortive or deformed. We still know the South American species of this group quite too little to venture a proposition in any direction.

Characteristic to the species is, that it willingly elongates with spike-bearing branches above, yet not dichotomously, like for instance *P. obtusifolius*, but so that the branchlet of the lower involucral leaf is generally left undeveloped while the upper, stronger branch takes the charge of the stem-prolongation and development of spikes. By this there exist a great number of spikes (I have observed as many as five) ranked pseudo-laterally. No tendency to produce semi-coriaceous leaves can be traced in this species. Turios of transformed short branches are found at the base of the stem. Their lowest ordinary leaves narrow, but otherwise of usual shape. The next following 2—3 leaves short and narrower still, the innermost ones 1,1 mm broad, a little surpassing their sheaths and somewhat obtuser than the inferior leaves, the whole turio about 25—30 mm in length.

Fig. 44. *P. Hillii* MOR. A, stem-leaf, base (a) and top (b), $\frac{1}{4}$. B, Transverse section of the lacunar part of a stem-leaf, vascular (m) and bast bundles (str) hatched, about $\frac{8}{1}$. C, Transverse section of the peduncle showing the site of the bundles, $\frac{4}{1}$. D, Pistil, a, side-view, b, Stigma from above, $\frac{8}{1}$. E, Ligule, $\frac{2}{1}$.

The stem is flattened in the relation of about 2,3 : 1. Its endodermis has a pseudo-hypoderma with the usual subepidermal strands. The central cylinder presents the common oblong diagram. In the peduncle, being 2,5—5,5 cm in length, the four vascular bundles run separated by distinct interspaces. The hypoderma and the subepidermal strands we refind, as in the stem, though the latter are a little reduced in number and strength. The leaves have a more or less rounded base and a more or less tapered and cuspidate apex. The proper stem-leaves are 5-nerved, the branch-leaves usually 3-nerved. The former resemble very much a *mucronatus*-leaf, but the midrib is on either side accompanied by 3 rows of lacunæ in its basal half with mechanical strands running subepidermally. The ligules are convolute and exhibit 8—11 strands in the front-field. The style is short, stigma rounded or oval, broad and expanded (see the fig. 45, *C'*).

Distribution. Brazil: S. Paulo, Santos, 74, MOSÉN (hb. Stockholm., Uppsal., Lund.), »A. 821», LINDMAN (hb. Stockholm.). — The plant from S. Paulo, Amparo, LINDBERG. (hb. Stockholm.), with shorter (6—20 mm) internodes seems to be a hybrid (see p. 113).

P. Berteroanus PHILIPPI.

Plantarum novarum Chilensium etc. in Linnæa 1859—60, 200. — Fig. 46.

The discoverer of this plant has confounded it with the species afterwards named *P. Aschersonii*. I have in fact seen specimens from the very *locus classicus*, Tagua-Tagua, determined by PHILIPPI himself. They are not *P. Berteroanus*, but *P. Aschersonii*. The two species have of course grown together, but the author has made his description according to the broader-leaved form, since he writes, »foliis — — — 5-nerviis», whereas *P. Aschersonii* has, at least in general, 3-nerved and narrower (1,5—2 mm) leaves.

Stem distinctly compressed (2,5 : 1) and anatomically built up according to the usual type of the group with a one-celled or at the edges 2-celled pseudo-hypoderma and a full number of subepidermal strands. Central cylinder of the oblong diagram type. Peduncle almost terete with scattered subepidermal strands in the one-celled hypoderma. Vascular bundles

four, the median running together, the lateral ones more distantly from the centre.

Leaves 5—7-nerved. On either side of the midrib there are three (in the stem-leaves) or 2 (branch-leaves) rows of lacunæ. For the nervation I refer to the fig.

Fig. 45. *P. Gayii* BENN. A, Transverse section of peduncle showing the course of the vascular- and bast-bundles, $\frac{2}{1}$. B, Transverse section of a stem-leaf below the middle showing the lacunar system of the midrib and its strands (*str*) the disposition of the vascular bundles (*m n' n''*) and the marginal strand, $\frac{7}{1}$. C, Pistil, *a*, side-view, *b*, dorsal view, *c*, stigma from above, $\frac{12}{1}$. D, Transverse sect. of a ligule at the base showing the form of an open, convolute ligule, $\frac{25}{1}$, *ic*, front-field, *r*, ridges.

below, showing the mode in which the principal lateral nerves join the midvein in the apex, and how the outer and inner (sometimes missing) secondary nerves join the principal ones. Characteristic is that the principal side-nerves anastomose in the very apex, whereas the condition in *P. Aschersonii* is different in as much as these nerves unite with the midvein at a leaf-width's distance from the point. Leaf-base almost rounded and the top with a cusp, distinct and sharp especially on the branch-leaves. Ligules open, of usual form; their front-field 8—10-fibrous.

Distribution. The species is spread in *Chile of South America*, but how far beyond is unknown to me. — Rio Renaco, 06, MORTON MIDDLETON (hb. Stockholm.).

P. Aschersonii AR. BENNETT.

Notes on Potamog., Journ. of Botany, 1893, 294. — *P. tenuifolius* PHIL. in Anal. Mus. nac. Chile, 1891, App. 95, sec. A. BENN. l. — c. *P. pusillus* β *sphaerocarpus* K. SCHUM. in Fl. Brasil, 1894, 687 is held to be a synonym to *O. Berteroanus* PHIL. (see ASCH. & GRAEBN., Pflanzenreich, Potam. 1907, 118!), but the description of the leaves, »foliis modice latis trinerviis, pallide viridibus in rubellum vergentibus» is more correspondent to the species above; I have not seen specimens though. — Fig. 47.

P. Aschersonii belongs to the comparatively small species of this group, about 20 or 30 cm high with almost terete capillary stem prolonging itself by spike-bearing branches of 1st—2nd (—3d) rank in the same way as *P. panormitanus*. Nevertheless I have also seen veritable giant-specimens, which could not be taken for this species without a thorough examination. At a closer research it is, however, evident that it differs more by the bigness of all the organs than in the characteristic properties. See below!

The stem is often capillary and nearly terete, seldom more flattened (3:1). Both the stem and the peduncle are provided with a one-celled pseudo-hypoderma which organ seems to characterize all the South American species of this group, and besides with strong subepidermal strands. The central cylinder is nearly terete or oval in cross-section with a compound vascular bundle and a common xylem cavity, thus presenting a circular stele diagram, even if the stem is more compressed. In the peduncle this compound bundle dissolves into two (4) bundles as is shown in the figure.

The leaves are narrow, 1,5—2(—3) mm broad and three-nerved, obtuse with a cusp and tapering at the base. The midrib is accompanied by one or two rows of air-lacunæ with interjacent sclerenchyma (see the fig.!), which effects a certain stiffness like a *panormitanus*-leaf. The lateral nerves run nearer to the margin than to the midvein, which they join at a distance of a leaf-width from the very point. Ligules of usual shape, 8—10 mm long or more, front-field 3—5-fibrous.

Fig. 46. *P. Berteroanus* PHIL. A, Transverse sect. of the peduncle, vb, vasc. bundles, str, bast-bundles. B, Top of a stem-leaf.

The species shows no tendency to transform the top-most involucreal leaves.

The pistil has a short style with a more or less beak-shaped prolongation above, like *P. mucronatus*, and the rostrum of the fruit, therefore, presents a characteristic hook-formed curvature backwards. The fruit-flesh or epicarp is very thin causing the fruit to exhibit lateral pits. This may, however, be an accidental feature. The size of the fruit is recorded to be very considerable (BENNETT: »2½ lines by 1½ in. broad»; GRAEBNER: »fructus 4,5 mm longi, 3 mm lati»). Allowing for the misprint (»in.» for lines) I am nevertheless unable to understand how such measures could be arrived at on so small *pusillus*-like fruits.

Fig. 47. *P. Aschersonii* AR. BENNETT A, Top of a stem-leaf, $\frac{3}{4}$. B, Transverse section through the lacunar part of a stem-leaf at the middle, $\frac{1}{4}$, m, midvein, str, bast-bundles. C, Transverse section of the peduncle, $\frac{3}{4}$, str, bast-bundles, $\frac{1}{4}$. D, Pistil, side view, $\frac{1}{4}$. E, Fruit, side view, $\frac{1}{4}$.

The specimens from Santiago (see below!) are endowed with turios. They consist of somewhat swollen tops of branches or short branches, 25 mm long, the lower free leaves of which are considerably reduced in size, spreading and scarcely overreaching the obtuse inner ones, clasped by sheaths of equal length.

Distribution. South America. Chile, St. Jago?, PHILIPPI (hb. Stockholm.); Brazil, Rio de Janeiro, GLAZIOU (hb. Stockholm.); Uruguay, Montevideo, 79, ARECHAVALETA. Probably it does not transgress the 35° S. L. N. America, Canada, New Foundland, and Sable Island, MACOUN (hb. Haun.). Cuba, WRIGHT, 2305 (hb. Stockholm.).

The above mentioned gigantic form is gathered by P. DUSÉN in *Paraná*: mouth-district of Rio Cubatão (brackish water), $\frac{1}{4}$ 1912 (hb. Stockholm.). I have named it:

f. *pusilloides* n. f. — *Caulis* valde elongatus metralis, compressus, internodiis ca. 10 cm longis. *Foliis* majoribus, 90–120 × 2–3 mm, flexilibus iis *P. pusilli* simillimis.

One could almost expect the mechanical tissue to be more richly or strongly developed than usually is the case, but we find no tendency to this, rather to the contrary.

P. attenuatus n. (spec. v.) hybr.

(*P. Aschersonii* AR. BENN. × *polygonus* CH. & SCHL.).

Caulis c. 0,5 m altus subcompressus, simplex vel ramulosus, ab axillis foliorum floralium prolongatus ramulis primæ—secundæ ordinis, internodiis 20–30 mm longis. *Folia* rigida linearia apice sensim attenuata, modo *P. polygoni*, acuta, in superiore parte trinervia, infra medium ut plurimum 5–7-nervia; costa media reticulosa; fasciculi libriformes mechanici mediani et marginales validi fere ut in *P. polygono*. *Ligulæ* cito putrescentes, 10–12 mm longæ, in parte media 6–7-nerviæ. *Pedunculus* subteres, 20–30 mm longus. *Spica* 3–4 verticillata. Pistillum stigmatе oblongo. — Fig. 48.

In all specimens here available the pollen is quite sterile. In the vegetative

parts the plant presents an obvious similarity to *P. polygonus*, whereas spikes and pistils bear closer resemblance to *P. Aschersonii*. In several respects it is intermediate between the two.

The stem is little branched beneath the primary spike. From this it shoots out like *P. Aschersonii*. In shape it is a little compressed. The anatomic diagram shows an epidermis with a one-celled pseudo-hypoderma and scattered, very strong, subepidermal strands, but no interlacunar ones. The central cylinder has an oval crosscut-form with the lateral bundles separated from the median ones (oblong diagram).

Peduncle somewhat compressed; its vascular bundles being 4 in number run near together. Hypoderma and subepidermal strands as in *P. Aschersonii*.

The stem-leaves remind much of a *polygonus*-leaf, but are only 50–60 mm long by 2 mm broad. The marginal strand is very strong consisting of 50 bast-cells or more. For the rest I refer to the figure. The ligules are 6–7-fibrous in the front-field and decay in the same way as in *P. polygonus* by leaving a whorl of nerves at the base.

As to form and size the leaves nearly correspond with those of *P. orientalis*, which, however, has much softer leaves on account of a less developed sclerenchymatous tissue.

Distribution. *Brazil*: São Paulo. Campinas, 1868, S. HENSCHEN (hb. Stockholm. et Uppsal.). I have seen a specimen from »S:a Catharina, Graben am

Itajahy unterhalb Blumenau, 1886, H. SCHENK» (hb. Berolin.), which is likely to be this hybrid. — The main-form now described could be named: α *strictus*.

Another form of this hybrid is found at Amparo, Prov. S:t Paulo, of Brazil. It has short internodes, thence more *polygonus*-like. Stem-leaves 80–90 $\times$ 2 mm, 3-nerved (*P. Aschers.*), apex rather intermediate in shape, base always tapered; lacunar part not occupying the whole space between the midnerve and the chief lateral one. Ligules open, 10–11-nerved in the front-field (*P. polyg.*), with rounded tip, 10 mm in young state; on decaying they leave an annulus round the stem (*P. polyg.*). Peduncle 25 mm in length. Spike 4–5-verticillate. This form I will name:

β *polygoniformis*. — Caulis internodiis brevissimis ($\pm$ 10 mm). Folia quoad formam et structuram intermedia. — The specimen examined is preserved in Hb. Univ. of Copenhagen. Coll. »LINDBERG, in 1854», acc. to the label of BAAGÖE.

Fig. 48. *P. attenuatus* HAGSTR. A, Base (a) and top (b) of a stem-leaf showing the form and nervation. The primary side-nerves join the midvein in the very top as in *P. polygonus*, $\frac{1}{2}$. B, Cross-section of a stem-leaf at the middle, midrib-portion (m) and margin (str), ca. $\frac{1}{4}$. C, Pistil, a, side-view, b, inside view, c, stigma from above, $\frac{1}{2}$. D, Cross-section of peduncle. The four vascular bundles (vb), 9 subepidermal strands (str), $\frac{3}{4}$.

P. orientalis HAGSTRÖM.

New Potamogetons, in Botaniska Notiser, 1908, 102—103, with figures (tops of stem- and branch-leaves). — Fig. 49.

The stem of this species is compressed (2.5:1) and slightly furrowed or even two-sidedly furrowed. The arrangement of the vascular bundles of the stele is the same as in other kindred species and the stele diagram is oblong. The epidermis lacks a strengthening layer, but has rather strong subepidermal strands, which, however, do not continue in the peduncle. The four vascular bundles in the peduncle run rather near to one another. The stem branches dichotomously from the primary spike.

Fig. 49. *P. orientalis* HAGSTR. A, Transverse section of the midrib part of a stem-leaf, *m*, and *str.*, as usual, $\frac{8}{1}$. B, Transv. sect. of the peduncle, showing the site of the bundles, $\frac{2}{1}$. C, Pistil, side-view, $\frac{1}{1}$.

The leaf has about the same shape and size as that of *P. attenuatus*. The lacunar system also is much the same, consisting of three to four larger channels on either side of the midrib in the basal part, conducted by 2—3 subepidermal bast-bundles as the figure 49 shows. But the marginal strand has the usual faint structure. In the basal part and more or less far above the middle the stem-leaves usually are 5-nerved, the topmost third part, or so, in general 3-nerved. The main side-nerves join the midvein in the very apex. Ligules with large basal oil-cells and 8—10 intercarinal bast-bundles.

To judge from the rather scanty materials the styles seem to be enlarged above and the stigmas small, roundly oval. Fruit is not yet seen, but the plant is undoubtedly nearly kindred with *P. pusillus* L.

Distribution. Japan, R. Tama, Musashi, 88, MAKINO (hb. Stockholm.). — Assam, Brahmaputra at Dilmgach, 1896, Dr KINGS Collector (hb. Haun.). China, ICHANG (hb. Haun.). Probably in the whole of East-Asia.

P. Preussii AR. BENNETT.

Najadaceæ in the Flora of trop. Africa, VIII, 2, 1901, 222. — Fig. 50.

Having had no opportunity to examine the young ligules of the original specimens, I rank the species here additionally and *ad interim* on account of the affinity with *P. Hillii*, stated by the author. Besides, the stem-anatomy is congruent to that of the South American *P. Berteroanus*, and the shape and structure of the leaves correspond closely with those of *P. orientalis*. The affinity with the *Compressi* does not seem to be greater in this species than in the group on the whole. The leaf-form reminds also of that of *P. rutilus*. Pistils and fruits are not known to me.

The stem is nearly terete and with a shallow furrow as the figure shows. Along the epidermis a one-celled strengthening layer is arranged beside the usual bast-

bundles. Inside this stratum there is a circle of large-roomed lacunæ. Central stele compressed and its bundles arranged according to the oblong stele diagram in three groups with three xylem portions.

The stem-leaves are provided with sclerenchymatous strands in the lacunar part but the marginal strand is thin and there is no tendency to form bast-bundles like those characteristic to the *Compressi*. The leaves are 3—5-nerved and not at all digressing from the *pusillus*-type as to the nervation. »The closely packed veins» are the side-walls of the lacunæ and »the cross veins» are their cross-walls. The lacunæ do not occupy the whole space between the midrib and the lateral nerves in the upper half of the leaf. (See the figure!)

A plant labelled »Raikie's Niger Expedition 1857—59. Nupe. Coll. C. BARTER» (hb. Stockholm.) lacking floating leaves in the spike-region and resembling *P. Preussii* as well as *P. javanicus* might be of a hybrid origin. The stigmas are very small, by far not covering the upper surface of the style. Leaves as in *P. javanicus*. Ligules few-nerved in the front-field. Pollen small-grained, well-shaped. No fruit seen.

Subseries b. Obtusi HAGSTR.

The boundary-line between these two subseries is not very marked. Some forms of *P. pusillus* have obviously tapering leaves and the leaves of *P. obtusifolius* have a lacunar system with subepidermal strands (see the figs.) and I have said above that the *P. Asch.* f. *pusilloides* m. has pretty soft and flexible leaves; however, this arrangement can *ad interim* serve the purpose to give a survey of the species belonging hereto, until better knowledge is obtained as to the pistils and fruits.

P. obtusifolius MERTENS & KOCH.

In RÖHLING, Deutschlands Flora, 1823, 855. — *P. compressus* ROTH, Tent. Fl. Germ. I, 1788, 73; WALLMAN ap. LILJEBLAD, Utkast till en sv. fl., ed. 3, 1816, 706; WAHLENBERG, Fl. upsaliensis, 1820, 59. — *P. tataricus* LESSING in Linnæa IX, 1834, 206. — *P. angustatus* et *P. Liljeblii* WALLMAN ap. REICHENB., Icones fl. germ. VII, 1845, 16. — Fig. 1, F, 24, D, 51.

The stem has the usual compressed form. The longitudinal axis is a little more than twice the shorter one, on one or both sides slightly furrowed. Its ana-

Fig. 50. *P. Preussii* BENN. A, Top of a stem-leaf, $\frac{1}{10}$. B, Transverse section of a stem-leaf at the middle, m, midvein, n^1 , n^2 , lateral veins, str, scler. strands, $\frac{2}{10}$. C, Transverse section of stem, cc, stele, ep-hp, epidermis and its strengthening layer, $\frac{1}{10}$. The Preussian material of Kamerun employed for the drawings!

tomy is chiefly the same as in the next foregoing and following species. The deviations lie in the fact that the vasal bundles of the central cylinder distinctly divide into two lateral and two median bundles, that a single cell-layer or hypodermatic supporting stratum sometimes exists in the borders of the stem, where, in such a case, the strands also appear in a greater number, finally that rarely one or a few

Fig. 51. *P. obtusifolius* M. & K. A, Transverse section of a stem-leaf at the middle, $\frac{3}{4}$. B, Top of a stem-leaf, $\frac{1}{4}$. C, Transverse section of the rhizome, $\frac{5}{16}$. D, Pistil, a, side-view, b, from the back, $\frac{1}{16}$. E, Transverse section of the stem, $\frac{3}{16}$, * accidentally occurring bast-bundles. F, surface section of the stem-epidermis, $\frac{5}{16}$. G, Surface sect. of the epidermis of the peduncle, $\frac{5}{16}$. H, Transverse section through the leaf and ligule at the very base immediately above the insertion point and before the development of the bast-bundles in the upper surface of the leaf and in the intercarinal part of the ligule has taken place. The subepidermal strands of the stem continue in the lower surface of the leaf and in the wing-field of the ligule. Cf the fig. 271, $\frac{3}{16}$; m, midvein, n', lateral nerve, str, bast-bundles, l, lacunæ, cc, central stele, ic, intercarinal part (front field), r, ridge-part. K, Young ligule, $\frac{1}{16}$.

faint interlacunar strands occur on both sides of the central cylinder in the border-segments of the cross-section. In the peduncle the bundles run separate from each other, the two median ones approximated, the lateral ones more remote from the centre. No partition of the lateral bundles has been observed. A supporting layer is present, whereas the subepidermal strands are absent. The peduncle has the same shape as the stem but is a little thicker. The rootlets lack sclerenchymatic tissue and air-channels.

The rhizome is very slightly compressed in this species also. The bundle system of the central cylinder is reduced to a compound bundle, surrounded by an endoderm of rather thin-walled O-cells. In the cortex the lacunar system is reduced to nearly a single circle of narrow lacunæ, outside which the cell-tissue is more compact. Subepidermally there are scattered faint sclerenchymatous strands (see fig. 51, C!).¹

Respecting the anatomy of the leaf I refer to the figure. In the

upper part of the leaf the lacunæ along the midrib gradually disappear. The midrib and the lateral nerves finally grow very faint and join in the very apex. In the broader leaves there is not seldom a faint nerve within or without the proper lateral nerve, in which latter case the leaf bears a certain resemblance to a *mucronatus*-leaf. Those secondary lateral nerves, however, usually anastomose with the chief lateral nerves

¹ The rhizome described and figured by C. W. FONTELL in his *Beiträge* etc. (Taf II, f. 55) is the basal portion of a turio and not a true rhizome, which, besides, is a very rare occurrence in this species as well as in all its allies.

farther beneath than in *P. mucronatus* and are besides of a less prominent appearance. Ligules 14—15-nerved in the front-field.

Styles and stigmas do not differ from the type. The fruit has a more prominent keel and is in general larger, 3—3,5 mm long; but there is also a microcarp form, the fruit of which measures only 2,5 mm in length and is exceedingly like a large-fruited *P. pusillus*.

Just as in *P. pusillus* the stem prolongs itself, often dichotomously, from the base of the primary spike and the involucreal leaves are often tapering at base like a stalk from a somewhat broader blade. Their structure nevertheless remains unvaried, and the topmost involucreal leaves are built as the lower ones.

The propagating buds are considerably larger than, for instance, those of *P. pusillus*, but otherwise developed after the same type. The inner leaves overreach a little the sheaths.

The species varies as to the length of the internodes, the leaf-width, the shape of the leaf-apex, and the size of the fruit. Already CHAMISSE ascertained two forms: *contractus* (= f. *vulgaris* FISHER, Bayer. Pot. etc. 1907, 102) and *elongatus* (= f. *elongatus* FISCHER, l. c.), Linnæa 1827, 179. In both of those forms the leaf-width and the apex vary a little (see FIEBER, Pot. Böhm.). Forma *insolitus* TISELIUS, Pot. suec. exs. III 1897, N:r 150, presents distinctly interrupted spikes of three verticils.

Distribution. Sweden, scattered, or in some counties pretty common, as far as 63° N. Lat. Its northern limit in Finland, Sweden and Norway forms a line drawn from Kuopio to Örnköldsvik and southwestward to Drammen. Respecting its first detection in Sweden it may be quoted from labels in the museums (hb. Stockholm., Uppsal. et Lund.): (Ostro-Gothia) »i Rochella sjön $\frac{1}{2}$ mil från Linköping 1812 Potamogeton nov. spec. mihi», without signature, but the hand seems to be that of Bishop AGARDH; collector, however, probably D:r WALLMAN. (Halland) »Storå, ubi pro Fl. suec. novum detexi 1814 sed ex temporis genio pro *P. compresso* in Fl. Hall. habui»: E. FRIES (hb. Uppsal.). — In Gothland it does not occur.

In the museums (hb. Stockholm., Uppsal., Lund., Gothob.) the following European countries are represented: Denmark, many localities. — England, Surrey und E. Norfolk. — Scotland, Thornhill and Balgavies Loch. France, three stations. — Germany, several stations. — Bohemia. — Poland. — In the Old World as well as in North America *P. obtusifolius* probably does not extend to the south beyond the 40th degree N. L.

***P. obtusifolius* M. & K. × *panormitanus* Biv. (*P. Sturrockii* AR. BENNETT in Scottish Naturalist, 1883, 28, ut *subsp. sub. P. pusillo* L.).**

BENNETT says of this plant: »somewhat the habit of *obtusifolius* M. & K.» and that by rights. But not the habit only is like *P. obtusifolius*. The compressed (1,5:1) stem as well as the brown midrib of the leaves and the great vittæ at the base of the ligules recall this species. Our assertion that the original *P. Sturrockii* from Marlee Loch is a hybrid plant is also well founded. The thin stem, elongated peduncles, narrow leaves etc. aim at *P. panormitanus* and *pusillus* (*P. trichoides* is

out of question because of the northern locality). The prominent midrib seems to give preference to the former. The lateral nerves, on the contrary, are very feeble just as in *P. obtusifolius*. The ligules are convolute and 9—10-fibrous in the front-field. The very best proof of our combination, however, is given by the slender turios which for the most part are transformed small branches, an intermediate form between *P. obtusifolius* and *panormitanus*. Further observations of those turios will, no doubt, confirm my supposition.

Distribution. Scotland, Marlee Loch, Devonian Isla, Co. Perth, 82, STURROCK (hb. Stockholm.). Rev. E. S. MARSHALL gives it also from Loch Schechernich, E. Perth, 89. Other specimens named *Sturrockii* are not identic with this rare plant.

***P. obtusifolius* M. & K. $\times$ *pusillus* L. (*P. saxonicus* n. hybr.).**

Folia linearia obtusa, magnitudine inter parentes medium tenentia, basi glandulis oleiferis ut in *P. obtusifolio*. *Turiones* quam iis *P. pusilli* majores.

It is very strange, that *P. pusillus* and *P. obtusifolius*, so often seen together, nevertheless so extremely seldom produce bastards. Among the innumerable forms I have examined, it is only from two stations I have to record mules. One is collected by HÜBNER and labelled »*P. Berchtoldi* b, folia latiora». The leaves are really rather broad (2 mm) for a *pusillus*-form, otherwise its habit presents the greatest resemblance with this species. The prominent oil-cells (*vittæ*) at the nodes, the somewhat compressed stem, and, above all, the large turios with inner leaves a little exceeding the sheaths prove, in the meantime, very clearly that its origin is also due to *P. obtusifolius*. The leaf-apex is obtuse with a very insignificant cusp. — The other is a Norwegian plant.

Distribution. Germany, Heide, Saxony, 47, HÜBNER (hb. Stockholm.). — Norway, Kåterud in Rakkestad, leg. H. C. PRINTZ (hb. Christian.).

***P. obtusifolius* M. & K. $\times$ *trichoides* CHAM. & SCHL. (*P. gallicus* n. hybr.).**

Planta hybrida in omnibus partibus medium inter *P. obtusifolium* et *trichoidem* tenens.

Just as the two foregoing bastards, the present plant is also best known by the propagating buds being quite intermediate between the two parent-species. The sheaths surround here the inner leaves, the outer free leaves are short and stiff reminding of *P. trichoides*. In size the bud is more like that of *P. obtusifolius*. The leaves are narrow, 1,5 mm, with considerably sharper and more tapering apex than the foregoing. The oil-lacunæ are also here well developed. Ligules 8—9-nerved in the front-field, convolute. The stem has a somewhat compressed form (intermediate), the epidermis-cells are short as in *P. trichoides*, and the central cylinder has a more or less oval cross-cutform and the bundles conspicuously disposed like *P. obtusifolius*.

The few ripe fruits seen are in form and size like small fruits of the last mentioned species. The peduncles are 15—25 mm long. The colour of the plant is at first dark-green, as in *P. trich.*, but turns finally into brown (*P. obtusif.*). Beside the colour and apexes of the leaves, their strong mechanical strands stand decidedly up for *P. trichoides* as the one of the parents of this hybrid.

The plant described above is gathered by FOUCAUD in France, Charente-Inférieure, Marais du Four-du-Diable près Echillais, 52 (hb. Stockholm.) and in the same station in 1890 by JOUSSET and FOUCAUD (hb. Lund.). By French authors considered to be *P. Berchtoldi* FIEB.

A plant from *Hercegovina*, Buna-river, gathered (^{11/7} 1889) by Prof. S. MURBECK (hb. Stockholm., Uppsal., Lund.) is also the same hybrid. It lacks turios but all its properties are intermediate between the two above written species. The affinity with *P. trich.* is especially evident anatomically as well as morphologically. From this firm starting point the other partner can easily be traced in the leaves and ligules.

No other stations for this bastard are known to me. —

P. obtusifolius is said to occur in The Himalayas (ex BENNETT, in GRAEBNER, Pot. 1907, 161). I have seen the specimens here concerned, collected by Dr BRANDIS, 1864, n:r 3333 and now preserved in Calcutta, India. This plant, standing very close to the new American species below, and perhaps only a broad-leaved variety of this, certainly has the habit of *P. obtusifolius*, to which can

be added that the size and form of the leaves also correspond pretty closely to that species, but their nervation and inner structure is quite different. The leaves are about 2 mm broad and 3-nerved, the lateral nerves join the midrib a leaf-width beneath the point and the midrib is accompanied up to the very apex by a richly developed lacunar system, never occurring in *P. obtusifolius*. The stem is nearly terete, the epidermis without supporting layer and the cortex has two circles of large lacunæ. The central cylinder is of a circular diagram type with the bundles fused together into a compound bundle with a common xylem-channel.

I have not the plant at hand now, so that I am not able to give a full description of it — the specimens mentioned lacked fruit —, but the above characters are nevertheless sufficient to distinguish it from all the other Pusilloids. From *P. Henningii*, of Caucasus, it differs by narrower leaves with fewer lateral nerves, besides which *P. loculosus* has a more easterly distribution. Leaving a couple of sketches of this species also I propose to name it:

Fig. 52. *P. loculosus* HAGSTR. A, Top of a leaf showing the nervation and the areolation, ♀. B, Transverse section of stem, cc, central cylinder, str, mechanical strands, l, lacunæ, ep, epidermis, ca. 60.

P. loculosus n. sp. — Fig. 52.

P. habitu P. obtusifolii M. & K. *Caulis* subteres ramosus. *Folia* linearia obtusa mucrone minutissimo trinervia, ad nervum medium valde usque ad apicem lacunosa (see fig. 52!).

P. lacunatus n. sp. — Fig. 53.

Caulis filiformis, subcompressus, ramosus $\pm$ elatus, internodiis 6—7 cm longis, superne brevioribus, supra spicam primariam dichotome prolongatus. *Folia* linearia, trinervia, subcuspidata—subacuta, caulina 4—6 cm longa, 1—1,5 mm lata (0,5—0,75), media in parte inter nervos laterales valde reticulosa, basi attenuata. *Ligulae* obtusae, membranaceae, caducae, biglandulosae, 6—7 mm longae, paucinerviae. *Pedunculus* aequalis, brevis, 10—20 mm longus. *Spica* minima, capitata, biflora. *Folia* perianthii rotundata, breviter unguiculata. *Pollen* globosum, parvum. *Pistillum* stylo brevissi, mostigmate rotundato. *Fructus* rotundatus, siccus subcarinatus, lateribus subcompressus, $2 \times 1,5$ mm.

Forma *Novae-Angliae* habitu graciliore foliis angustissimis, 0,5—0,75 mm latis.

As to habit and form and size of the leaves this species is extremely like *P. pusillus*. A closer examination of the leaves, however, shows the difference at once. Nearly over their whole width, at least always over the space between the lateral nerves, they are endowed with small channels. By this the present species among all species within the *pusillus*-group comes nearest to *P. confervoides*. The lateral nerves run near the margins, and grow very faint towards the top of the leaf, where their course can only be traced by greater enlargement. They join the midvein as is shown in the fig. In the lacunar part mechanical strands are usually wanting or occur occasionally, but very sparingly. The leaves get their firmness from the numerous longitudinal and transverse walls of the lacunae. Fruit is observed only in the form *Novae-Angliae*. It is *pusillus*-like, but a little broader above, 1,5 mm. The spikes are only biflowered, capitate; pistils four in number.

Pollen is well developed and abundant so that the plant can not be suspected to be of hybrid origin.

As to the ramification and in the development of turios it behaves like *P. pusillus*, *obtusifolius* etc. It has numerous branches of the first, fewer of the second rank, but elongates willingly dichotomously from the basis of the primary spike. The turios consist of transformed branch-tops very near to those of *P. pusillus* and *foliosus*, but a little weaker or slenderer.

Both in the stem and the peduncle the vascular bundles fuse into a composite one with common xylem channel. In the peduncle the subepidermal strands are wanting. Stem and peduncle of rounded or suboval cross-cutform, central stele likewise. For the rest I refer to the fig. 53.

Distribution. North America, »In stagno ad Jamaica Plain, Mass. orient. Leg. C. E. FAXON $\frac{1}{3}$ 1880. Herb. TH. MORONG» (hb. Stockholm.), of high growth and with dark sheaths or scales at the base like *P. confervoides*. »Eastern Mass. U. S. A. $\frac{1}{3}$ 83, FAXON» (hb. Uppsal.) probably the same locality as the former. »In cursu molario fluente velociter. Ashland, Mass. Leg. T. M. MORONG $\frac{2}{0}$ 81» (hb. Stockholm), held by Rev. MORONG partly for *P. pusillus*, partly for *P. Claytonii* (= *Nuttallii*). In Salt Lake, Anticosti, Que., Canada, 12. 8. 83, J. MACOUN (hb. Stockholm.), of low growth, by MACOUN labelled *P. obtusifolius*, by AR. BENNETT »*P. pusillus vel Friesii?*».

Forma *Novæ-Angliæ* is collected by E. TUCKERMAN jun. in »Nov. Angl.» (hb. Uppsal.), no further statement about the locality.

The species, thus, seems to be a native of eastern North America. In the American Museums it is probably stored under the name of *P. pusillus*. A revision of the American *pusillus*-forms, therefore, may give very interesting results.

P. pusillus L.

Sp. pl. 1753, 127. — *P. Griesbachii* HEUFFEL in Verhandl. des Zoolog.-botan. Vereins in Wien, VIII, 1858, 200? — *P. Berchtoldi* FIEB., Die Potamogeta Böhm., 1838, 40–41, saltem pro parte (maxima parte?). — Figs. 24, C, 54, 55.

Concerning the last quoted name I am convinced that it does not represent a form specifically separated from *P. pusillus*. Its chief characters: the light stripes along the midrib and the position of the lateral nerves (nearer to the border than to the main rib) are proprieties exactly characteristic to *P. pusillus*. It is also sure that *P. pusillus* is sometimes occurring with rather sharp-pointed leaves according to the description of *P. Berchtoldi*. But when also described as with larger fruits and broader leaves than those of *P. pusillus* this plant may answer to the hybrid *P. mucronatus* $\times$ *pusillus* and I take it for granted that *P. Berchtoldi* comprehends at least two separated forms, by FIEBER confounded with each other.

The stem of this species is very little compressed. Its anatomy coincides with that of the type: epidermis, subepidermal strands, lacunar system, and a central stele of the circular diagram type. Of *P. Berchtoldi* I have seen specimens from the very locus classicus »Landskron Bohemia» determined by FIEBER himself. They

Fig. 53. *P. lacunatus* HAGSTR. A, Base (a) and b, top of a stem-leaf, $\frac{1}{10}$. B, Top of a branch-leaf, $\frac{1}{10}$. C, Pistil, a, from the side, b, ventral view, $\frac{1}{15}$. D, Fruit of the f. *Novæ-Angliæ*, from the side, $\frac{1}{4}$. E, Transverse section of stem. All bundles of the central cylinder fused into a composite bundle with a single xylem channel, $\frac{1}{10}$; F, Transverse section of a stem-leaf below the middle, m, midrib, n', lateral nerves, str, marginal strand, $\times$ occasionally occurring strands, $\frac{0}{15}$.

have more flattened stem, sharp and more prominent leaf-points, 3—4 rows of lacunæ on either side of the midrib, strong lateral nerves and stronger interlacunar strands in the leaves. They belong to *var. β acuminatus* FIEB. l. c., and are not at all a *pusillus*-form but very obviously and surely *mucronatus* × *pusillus*.

In the *peduncle*, like the stem of a rounded or slightly oval cross-cutform, the vascular bundles run separated though more or less closely approached to one another. The sheaths of a couple of bundles may sometimes fuse into a common one. The lateral bundles casually separate into two or three, and are in the latter case also generally more spread or scattered. No subepidermal bast is observed in the peduncle.

The *leaves* are always, in *f. tenuissimus* also, three-nerved and furnished with one or two rows of lacunæ on either side of the midrib. The lateral nerves join the midvein at a leafwidth's distance from the very point, but their ends are extremely faint and almost imperceptible. Within the lacunar part a few very faint strands appear subepidermally and likewise in the very border a faint strand. The

Fig. 54. *P. pusillus* L. A, Transverse section of the peduncle, $\frac{1}{10}$, *ep*, epidermis and its supporting layer, *a*, median, *b*, lateral bundles. The lacunæ are left out. B, Transverse sect. of the ligule, *ic*, the front-field, $\frac{1}{10}$. C, Longitudinal section of the stem-epidermis, $\frac{1}{10}$.

vascular bundles have also but a few mechanical cells. All this causes the leaves to become soft and flexible in opposition to the leaves of *P. panormitanus*, that has narrower lacunæ, the midrib more elevated over the lower leaf-surface, stronger strands and vascular bundles and consequently stiffer and more *rutilus*-like leaves. Typically the leaf-apex is more or less rounded with a faint subobtuse point.

In the cases when the leaves grow longer they generally also taper more gradually and when growing broader they also get a little more prominent cusp (*v. Berchtoldi*). But this

general rule has many exceptions and the apex varies rather considerably in form as is shown in fig 55, *a—h*. The form is somewhat different even in the same individual and it proves to be very difficult to distinguish forms or varieties by the form of the leaf-apex only. The width varies also with gradual transitions from 0,5 mm to about 1,5 mm or a little more. The largest leaves I have observed have held a measure of 65 mm by 2 mm. In general the width is 1 mm. When N. J. SCHEUTZ (Pl. vasc. Jenis.) states higher measures for *pusillus*-forms from Nikandrovskii ostrov, this evidently refers to the above described new species *P. sub-sibiricus*. The colour varies from dark-green to light-green.

The *involutral leaves* deserve a special mention in being often (at least the topmost ones) transformed into a sort of primitive floating leaves. This proceeds so that their blade increases a little in width. At the same time the lacunar part expands and grows wider but the lacunæ decrease in size growing narrower and especially shorter than in general along the midrib. Nevertheless no such tissues are developed by which a difference is established between a lower and an upper surface of the leaf. Only about the middle nerve a faint beginning of it is to be seen. Neither

does the epidermis get a supporting stratum as in the *Coleogeton*-species nor have stomata been perceived. At the same time as that transformation takes place the leaf-apex rounds itself so that the best developed of them have a fully rounded apex (Fig. 55 *B, C, D*). Indeed, here we have the very first beginning of an evolution of floating leaves. The next step is the evolution of palisade-tissue and stomata and a greater difference between blade and stalk. This takes place in the *Javanici*, having in this respect, therefore, reached a higher stage than has *P. pusillus*, and species of the *pusillus*-group in general.

The development of floating leaves has its natural reason in the necessity of holding the shoots erect and of reaching the surface of the water, which end the plant in general and originally attains by its lacunar system of the stem and leaves. A still higher degree of evolution is the transformation of floating leaves into air-leaves.

The *ligules* of *P. pusillus* are 6—8-nerved in the front-field and always open and convolute in contradistinction to *P. panormitanus* and the other *Pusilli connati*.

The *turios* of this and related species are for the purpose of classification of great importance. In *P. pusillus* they consist of transformed branch-tops. The lower free leaves of the turio, usually 3(2—4), are commonly somewhat shorter and at their

base a very little thicker than the other leaves of the branches, but in other respects quite like. The upper part of the turio presents, by the amassment of leaves and sheaths, a considerably incrassate and fusiform shape, and the sheaths embrace quite the inner obtuse leaves. By this the species differs very clearly from the otherwise nearly similar *P. panormitanus*.

The *pollen* and *pistils* do not differ from the type of the group. The *fruit*, in its fresh state with rounded back, gets often when dry a false keel. In size it varies from 2 to 2,5 mm in length, in form as in the fig. 55, *G* is exhibited by

Fig. 55. *P. pusillus* L. A, a—h, Tops of typical stem-leaves showing the different shape of the apex, $\frac{1}{10}$. B, C, Involucral leaves (floral leaves) developed as primitive floating leaves, the lacunar part dotted, ca. $\frac{1}{10}$. D, Top of such a leaf, in form less differing from the original shape, $\frac{1}{10}$. E, Transverse section of the leaf B at the middle, $\frac{5}{10}$. F, Transverse section of a common stem-leaf at the middle showing the nerves (m, n'), strands (str), and lacunar system, (l), $\frac{6}{10}$. G, Fruit, lateral view, showing the demarcation line of the operculum. The dotted lines on the inner side and at the base show the variations in form, $\frac{1}{10}$.

dotted lines. Its somewhat broad basal portion with disposition for boss-shaped outgrowths is a characteristic of this species. The fruit occurs, besides, with long rostrum as well as short-beaked.

On the *mode of prolongation* and growth of the stem etc., see under *P. panormitanus*!

Many forms described as »*pusillus*»-varieties are not at all varieties of this species but of a hybridous origin. Different narrow-leaved forms they have called »*pusillus*» without paying attention to their true characteristic qualities, and the limits of this species have been very vague in the literature.

Var. α *major* M. & K. (ap. RÖHL., Deutschl. Fl. 1823, 857) must be kept as main-form. Concerning *P. pus. α major* FRIES, see under *mucronatus*! FISCHER puts up as main-form his α *mucronatus* which to me seems to be identical with α *major* M. & K. Kindred forms are *vulgaris* FRIES, Nov. Fl. Suec., the short-leaved *brevifolius* MEYER (ASCHS. et GRAEBNER, Syn.), further a form endowed with floating leaves, *ligulifolius* FISCHER, Bayer. Pot., and the form with very short internodes and of small growth that MORONG (Najad.) has called *polyphyllus*.

P. pusillus v. *africanus* BENNETT is at least pro (maxima) parte in my opinion a form of *P. panormitanus* BIV. Of a hybrid origin are, no doubt, the varr. *capitatus*, *elongatus*, *acuminatus* and *Sturrockii* (see above, all established by AR. BENNETT!). Var. *rigidus* AR. BENN., to judge from the description, is probably a form of *P. panormitanus*. Var. *squarrosus* ASCH. & GRAEBN. seems to be a bastard, for which also the single occurrence speaks. The same seems to be the case with the forms *spathaceus* and *retifolius*, established by FISCHER.

The form with the narrowest leaves (0,5 mm) is v. *tenuissimus* M. & K. The description of the form does not suggest anything but true *pusillus*. FISCHER is of the opinion that this form also contains *P. panormitanus* β *minor*, wherefore he has given a new name: *cuspidatus* (l. c. p. 116).

I have seen two new forms of this narrow-leaved var.

f. *pygmæus* n. f. — Planta statura humili et omnibus partibus diminuta.

This form is analogous to v. *polyphyllus* MOR., which has the usual leaf-width. f. *pygmæus* is collected in Sweden: *Dalecarlia*, Hedemora in Brunnsjön in 1875 by INDEBETOU (hb. Stockholm., Uppsal. et Lund.) and at Boda, hb. E. FRIES (hb. Uppsal.). *West-Bothnia*, Umeå, 1876, by ANDERSSON (hb. Stockholm.) and at Haparanda, Porras udde (head-land), 1868, by KROOK (hb. Stockholm.).

f. *brevirostris* n. f. Planta foliis angustissimis, rostris brevissimis.

This plant, collected in Norway: Stav, Gudbrandsdal, 1868, by NORDSTEDT (hb. Stockholm., Uppsal., Lund., Gothob.), has been taken for *P. gracilis* FR.

Var. *Berchtoldi* (FIEB.) ASCH. et GRAEBN., Syn. mitteleur. Fl. 1897, 345, is the form with rather acute leaves of usual width (1 mm ore more) of which FIEBER already has established two forms: *ramosissimus* and *simplex*. As to *P. Berchtoldi* β *acuminatus* FIEB., see pp. 97, 122! The two lateral »nerves» conducting the midrib, mentioned by FIEBER as characteristic of this »species», are formed by the two

rows of lacunæ (see fig. 55 *F*, *l*) which in their outer appearance look like two light nerves.

Some other *pusillus*-forms are described especially by Dr. FISCHER in his just cited work, but partly they concern too insignificant alterations partly they are very difficult to distinguish from each other, in consequence of which they cannot be of any more common use or value.

Distribution. *Sweden*: scattered or common through the whole country up to Lapland: Karesuando, 1826, LÆSTADIUS (hb. Stockholm., Uppsal.). Var. (or f.) *tenuissimus* has the same distribution but is more rare. Var. *Berchtoldi* is observed from the following stations in *Sweden*: *Scania*, Kjells Nöbbelöf, 66, CÖSTER (hb. Uppsal., Lund.); *Halland*, Halmstad, 59, BLOMBERG (hb. Lund.); *Gothland*, Church of Sanda, 53, WESTÖÖ (hb. Uppsal.) gathered together with *P. mucronatus*; *Nericia* Viby, 47, Z. (hb. Upps.). — An ordinary *P. pus.* f. *vulgaris* FR. from *Bleking* is labelled: »Sötvattensform af *P. gracilis* FR. enl. Prof. FRIES tanke» and »in litt.» (fresh-water form of *P. gracilis* FR. ex FRIES in litt.), Lyckeby å, 55, J. A. (hb. Stockholm., Uppsal.), probably not sufficiently examined by Prof. FRIES. — A barren form from *Sudermannia*, Säfstaholm 89, 90, PERSON (hb. Uppsal. et Lund.) might be the bastard *panormitanus* × *pusillus*.

Norway northward to Næsseby, 58, Sommerfelt, and Pasvig elv (river), 64, FRIES (hb. Uppsal.). The beautiful f. *ligulifolius* FISCHER is collected in N. Mandals amt, Ydre Fleckerö, 61, by WITTRÖCK (hb. Stockholm. et Uppsal.). — *Iceland*, 70, GRÖNLUND (hb. Uppsal.). — *Denmark*, in several places (hb. Stockholm., Uppsal. et Lund.). — *England* Anglesea, 86 GRIFFITH (hb. Stockholm.) labelled »subsp. *Sturrockii* mihi. comm. AR. BENNETT» is nearly identical with v. *polyphyllus* MOR.; Westmorland, 74, BAILY (hb. Stockholm.): f. *ligulifolius* FISCHER, by AR. BENNETT in the Journ. of Bot. 1881, p. 67, named »v. *panormitanus*». Ordinary form from other stations (hb. Stockholm., Uppsal., Lund.). — *Scotland*, Stirling, 92, KIDSTON & STIRLING (hb. Stockholm.) is v. *Berchtoldi* (FIEB.). — *France*, several stations (hb. Stockholm., Uppsal.). — *Germany*, several places, among others: Wolgast, 55 MARS-SON (hb. Stockholm.), v. *Berchtoldi*, and Hannover, Bassum, 82, EBERMAIER (hb. Lund.), the same var. — *Austria*, mostly v. *Berchtoldi* (hb. Stockholm., Uppsal., Lund.). Part of it might be *panormitanus* × *pusillus* or *mucronatus* × *pusillus*. — *Switzerland*, Aargau, 34, SCHMIDT (hb. Stockholm.). — *Spain*, The Pyrenees, 56, ZETTERSTEDT (hb. Stockholm., Uppsal.): var. *Berchtoldi*. — *Finland*, several stations (hb. Stockholm., Lund.). — *Russia*, Osilia, 99, SKOTTSBERG (hb. Stockholm.), f. *ligulifolius* FISCHER; Poland, 92, WOŁOCZCZAK (hb. Stockholm.), var. *Berchtoldi*. —

The *Pusilli* of East-Asia need a thorough revision. — *Armenia*, Caracoche, BOURGEOU (hb. Lund.) is var. *Berchtoldi*. — *N. America*, Eastern Massachusetts, MORONG (hb. Stockholm., Uppsal.), var. *polyphyllus*, in fact only an ordinary *pusillus*-form of low growth; Nova Anglia, ROBBINS (hb. Uppsal.) and other stations of the United States (hb. Stockholm. et Uppsal.). — I have seen no true *pusillus*-forms from *Africa*, *Australia*, and *S. America*.

P. pusillus L. $\times$ **trichoides** CHAM. & SCHLECHT. (**P. franconicus** FISCHER, Die bayer. Potamogetonen, in Ber. bayer. Bot. Ges. XI, 1907, p. 29, 123).

This hybrid is by far not so difficult to distinguish as some of the preceeding, because the parent-species have rather different qualities both in the vegetative system and in the fructification. The stem of the hybrid is thread-like, terete and branched. In habit it resembles now *P. trichoides* with numerous spike-bearing branches shooting out from the stem beneath the primary spike, now *P. pusillus* forkedly branched above the first spike. Of the two buds in the axils of the involucreal leaves now the undermost (*P. trich.*), now the upper one is the strongest (*P. pus.*). The turios consist of transformed tops of branches of an intermediate shape. The leaves are, like the stem, now of darker green (*P. trich.*), now of a rather light-green colour, the leaf-width intermediate, or more or less approaching to the one of the parents, always stiffer than in *P. pusillus*, on account of the strong nerves and always with stronger marginal sclerenchyma than in *P. pusillus*, and with a sharp point, in their lower part more or less lacunous, the broader ones reminding of *P. pus. v. Berchtoldi*, but distinguished through their rigidity. The peduncle is often more elongate than in *P. pusillus*, up to 75 mm in the danish form from Villa Gallina (see below!). Pollen mostly or wholly barren.

Beside the Danish specimens I have seen a few specimens from *Germany*, *France*, *England*, and *Sweden*. They are conveniently to be divided into two series:

α **spicosus** n. var.: — Pars superior caulis ut in *P. trichoides*, vide supra!

Distribution. *England*, Hedge Court Mill Pond, Surrey, 86, BEEBY (hb. Stockholm.), Glastonby, Somersetshire, 82, Rev. MURREY (hb. Stockholm.). — *France* Ecausseville (Manche), 86, CORBIÈRE (hb. Stockholm.), with the leaf-base of the same structure as in *P. pusillus*. — *Sweden*, Gothenburg, 77, WINSLOW (hb. C. ALM).

β **dichotomus** n. var.: — Ramificatio ut in *P. pusillo*, vide supra!

Distribution. *Germany*, Brandenburg, Rudomer, Wiesen, 78, POTONIÉ (hb. Stockholm.), internodes 3—5 cm long. I have seen the same form from Freijenstein (Brandenburg), leg. RIETZ, 1895, from Cadolzburg at Nürnberg, leg. FISCHER, 1903, and from Kirchfarnbach and Wittinghof (Fürth), the latter, however, a little different. — *Denmark*, Sjælland, Villa Gallina, 02, BAAGÖE (hb. Stockholm.), an extremely beautiful form that could be called

f. **longipes** n. f. — Planta gracilis, altissima. Internodia elongata, 5—15 cm; pedunculus longus (3—7 cm).

Mr BAAGÖE took this plant for *P. pusillus capitatus* AR. BENN.

P. pusillus L. $\times$ **Vaseyi** ROBB (**P. lateralis** MORONG in COULT., Bot. Gazette, V, 51, 1880, as species).

That the plants here alluded to really are of hybrid origin does not admit of any doubt, nor that they are *Vaseyi*-hybrids. The rather frequently existing floating

leaves, the turios and the stem anatomy plainly bear witness of *P. Vaseyi*. *P. diversifolius* is quite out of question for the sake of its characteristic peduncles and fructification, of which nothing at all can be traced in the *P. lateralis*, even by the minutest observation.

As the other parent, that must have only submerged leaves one could think of *P. foliosus*, or *panormitanus*, or *pusillus*. With respect to the first-mentioned, it has sharply keeled fruits as *P. Vaseyi*, whereas the hybrid often, easily gets a weaker keel and the basal part of the lid like that of *P. pusillus*. To this may be added, that neither the spike nor the peduncle is influenced by *P. foliosus*, that has very short peduncles and few-flowered spikes. As to the turios, generally consisting of transformed tops of branches, they evidently deviate toward *pusillus* rather than to *P. panormitanus*. All this taken into consideration the choice between those three cannot be difficult. All deviations from *P. Vaseyi*, even the leaf-structure, aim at *P. pusillus*.

The hybrid is not met with out of the distribution-area of *P. Vaseyi* and seems to occur in waters where *P. Vaseyi* and *pusillus* are growing together. It is known in three different forms:

1. Endowed with floating leaves, usually however narrower than in *P. Vaseyi* (influence from *P. pusillus*); always barren. It could conveniently be named:

f. *incompletus* n. f. — Sterilis; foliis summis vere natantibus.

2. Another form without floating leaves, i. e. more *pusillus*-like in habit, but with leaves as to structure more like the submersed leaves of *P. Vaseyi*. For this form I propose the name:

f. *subcompletus* n. f. — Forma sæpe fructibus paucis evolutis, foliis submersis.

3. The third form resembles *P. pusillus* v. *tenuissimus* in such a degree that Rev. MORONG has taken it for this plant. It has, however, more sharply pointed leaves and slender buds approaching in form to *P. Vaseyi*. Yet I desist from naming it, until more material can be had and further observations eventually made. It grows together with the suggested parents in the lake Quinsigamond near Worcester, Mass., U. S. A., where it was collected by Rev. Dr. TH. MORONG.

Distribution. N. America, In flumine Charles, Dedham, Mass., U. S. A., 80, MORONG (hb. Stockholm. et Uppsal.) According to ROBINSON and FERNALD, Hand-book flower. pl. 1908, 76, it is met with as well in Connecticut and westward to Michigan.

***P. groenlandicus* n. sp.**

Caulis compressus (1,8 : 1), simplex vel subramosus, internodiis 3—4 cm longis vel ultra. Folia uniformia, ca. 60 × 1 mm, angustissime linearia, 5—9-nervia, apice triangularia v. subcuspidata v. rotundata cum mucrone verrucæformi (vide fig. 55, A, a, b, c!), basi ad nervum medium ± lacunosa, nervis minutissimis. Ligulæ fissæ,

apice rotundatae, in spatio intercarinali 7—8 nerviae, ca. 12 mm longae, biglandulosae. Spica ignota.

Anatomy coincides nearly with that of *P. pusillus* except that the leaves, in their upper half and sometimes also farther down, are lacking the lacunar rows along the midrib, and on either side of it always are furnished with very thin, mechanical strands scarcely perceivable to the naked eye. The topography of the central axis of the stem is of the circular type, and for the rest of *pusillus*-structure.

This species constitutes an interesting combining link between the *Oxyphylli* (*P. subsibiricus*) and *Pusilli* (*P. pusillus*) and would be ranked together with the former almost with the same right as with the latter. Ligules and leaf-apexes, however, unite it with the *Pusilli*.

Distribution: Greenland, probably endemic. It is gathered at Ivigtut (83, BERLIN), Christianshåb (90, HARTZ), Jakobshavn (92, SÖRENSEN), Kingua Orpiksnit, 68° 30' N. L. (90, HARTZ), Ritenbenk, 69° 44' (88, HANSEN) and at Sarkak, 70° N. L. (90, HARTZ). The materials are preserved in Hb. Univ. Copenhagen.

Subsectio 14. *Javanici* GRAEBNER, in A. ENGLER, Das Pflanzenreich IV, 11, Potamog. 1907, 45.

Caulis teres vel rarius subcompressus, ramosus. *Folia* semper biformia: vere natantia brevipetiolata, paucinervia; submersa anguste linearia paucinervia in apicem acutum sensim attenuata, secundum costam mediam saepe valde lacunosa. *Ligulae* typice fissae, in spatio medio paucinerviae. *Stylus* conspicuus vel subelongatus. *Fructus* carinatus saepe rugosus vel muricatus.

Morphologically as well as anatomically and biologically (the turios!) this group most closely associates to the species of the pusilloids which have subcoriaceous involucreal leaves, but exhibits also affinity with the *natans*-group, to which *P. Vaseyi* can be said to form the transition by its characteristic submersed leaves.

The coriaceous leaves exhibit the simplest structure with small air-cells in the upper surface, a little larger in the lower surface and, typically, between those a one-celled layer, separating the upper and the lower lacunae from each other. Upper surface endowed with stomata.

As far as known to the writer the ligules are open and convolute except in the new species *P. subjavanicus* n. in which they are connate at the base.

As to the fruit the group presents resemblance to the *Compressi*, *Monogyni* and *Muricati*.

The stem anatomy of the *Javanici* differs from that of the *Pusilli* by being typically endowed with a pseudo-hypoderma and by the cross-cut form of their central axis being mostly rounded. In other words the anatomical conditions are more uniform than in the group next before. But exceptions occur also here.

Beside the five species here treated of, four other, namely *P. cristatus* REG. & MAAK, *asiaticus* AR. BENN., *numasakianus* AR. BENN. and *miduhikimo* MAK. also belong to the *Javanici*. The group should be divided into, three series: *Subjavanici* (*P. subjav.* m.), *Eujavanici*, and *Americani* (*P. Vaseyi* ROBB.).

***P. subjavanicus* n. sp. — Fig. 56.**

Caulis humilis ramosus vel simplex, subteres, filiformis, internodiis brevibus (± 40 mm), ramulo brevi prolongatus. *Folia* linearia attenuato-acuta trinervia, nervo medio utrinque stria albida instructo, nervis lateralibus versus marginem sitis, caulina 60 mm longa, 1 mm lata, ramulina paulo breviora et angustiora, natantia lingulato-lanceolata, in petiolum decurrentia, 5-nervia, $25 \times 2,5$ mm. *Ligulae* membranaceae caducae, 7–10 mm longae, ima basi connatae. *Pedunculus* brevis (12 mm) aequalis. *Spica* 3-verticillata. Appendices staminorum longe unguiculati. *Pistillum* stylo conspicuo stigmate anguste oblongo. Fructus non visus.

Stem very slightly compressed, its epidermis with a one-celled pseudo-hypoderma, endodermis of *O*-cells as in all the other *Javanici*, central cylinder of four vascular bundles fused into one compound bundle with a common xylem air-channel. Subepidermal strands consisting of 5–10 bast-cells.

Midrib-part of the submersed leaf with faint or no strands (in the fig. signed by a cross). For the rest the submersed leaves present close resemblance to those of the *P. miduhikimo*, but are almost more slowly tapering (see the fig.!). They are widest below the middle. The lateral nerves join the midrib a little below the very tip as the fig. shows. In shape and structure these leaves are also closely like the leaves of *P. Preussii*. The floating leaves of the material examined are narrow, but this fact may depend on special circumstances, and broader leaves might occasionally occur. They are widest at the middle or toward the top and by these leaves the species reminds very much of *P. limosellifolius*.

The ligules are at least at the base connate and in the front-field 5–6-fibrous.

We have referred *P. subjavanicus* to the *Javanici* chiefly on account of the pistils coming very near to those of *P. javanicus*. But just as *P. Preussii* and *P. limosellifolius* form transition links to the *Javanici*, in the same way *P. subjavanicus* is, within the latter group, a transition form to the *Pusilli*. And if the fruit should be found to correspond with that of the *Pusilli*, the species must be ranked there in spite of the floating leaves. At all events it shows the close affinity between the two groups.

Fig. 56. *P. subjavanicus* HAGSTR. A, Two floating leaves of different form, $\frac{3}{1}$. B, Top of a submersed leaf, $\frac{8}{1}$. C, Transverse section of submersed stem-leaf, midrib part; $\times$ occasionally occurring mechanical strands, $\frac{1}{1}$. D, Transverse section of stem, *ep-hyp*, epidermis and pseudo-hypoderma, *skl*, strands, *l*, lacunae, 2 circles, *cc*, central stele, $\frac{4}{1}$.

The plant differs from *P. javanicus* by the short internodes, the ligules and the submersed leaves lacking the broad lacunar part on either side of the midrib.

Distribution. *S. Africa*, »Zwarkopsrivier 1830» (hb. Stockholm.). It is probable that the collector is ZEYHER.

***P. quinquenervius* n. sp. — Fig. 57.**

Caulis ramosus elongatus, internodiis 2—5 cm (summo 4—8 cm), ramis spiciferis 1:æ—2:æ ordinis prolongatus compressus (2 : 1). *Folia* submersa linearia acuta, caulina 70—90 mm longa 2 mm lata, 5-nervia, nervo medio striis albidis utrinque duabus instructo, ramulina paulo breviora et angustiora 3—5-nervia, natantia lanceolata $\pm \frac{3}{4}$ mm, petiolata, petiolo laminis breviora, 7-nervia. *Ligulae* fissae membranaceae cito evanescentes, ad basin glandulis oleiferis, in spatio frontali 7-nerviæ. *Pedunculus* 15—25 mm longus, caule subcrassior. *Spica* 5-verticillata, densa. Appendices staminum rotundati, breviter unguiculati. *Pistillum* fere ut in *P. javanico*.

The habit, form and nervation of the floating leaves etc. of this plant coincide nearly with those of *P. javanicus* to which it is also reckoned by AR. BENNETT (as a var. *major*) in GRAEBNER, Potamog. 1907, 161. On closer examination, however, it is clear that the plant considerably differs from the Kunene-form, considered also by the same eminent author to be the var. *major* of *P. javanicus*. It is not only in all parts larger, but the submersed leaves have also another lacunar system and apices of a different shape as the figure evidently shows. The pistil is stouter than in *P. javanicus*, probably also the fruit. Ovary very conspicuously keeled, style well developed and stigma oblong; its point free from the style. (See the fig.!)

Stem, like the peduncle, somewhat flattened, its epidermis furnished with a one-celled hypoderma, central cylinder's cross-cutform lanceolate-oval and the lateral bundles distinctly separated from the median ones. For the rest the stem exhibits the usual structure (see the fig.!). The midrib of the submersed leaves is on either side surrounded by two rows of lacunæ and this lacunar part is strengthened by four subepidermal bast-bundles in the usual manner.

The specimens examined are collected by MAIDEN in the Centennial Park, N. S. W., *Australia* in 1897 (hb. Stockholm.) and the species is likely to be confined to this part of the world.

Fig. 57. *P. quinquenervius* HAGSTR. A, Part of a stem-leaf below the middle showing the extension of the lacunar system (l) over the leaf and the nervation, $\frac{3}{4}$. B, Transverse section of this leaf, $\frac{3}{4}$. C, Top of a branch leaf, $\frac{3}{4}$. D, Pistil, side-view, the keel of the ovary hatched, $\frac{1}{2}$. E, Transverse section of stem (see the text!), $\frac{1}{4}$. F, Transverse section of peduncle, showing the site of the vascular bundles, (vb) $\frac{3}{4}$. G, Transverse section of a young ligule at the base, ic, frontfield, $\frac{3}{4}$. H, Young ligule, $\frac{3}{4}$.

P. ligulatus n. sp.

Caulis altus, subteres, ramosus, internodiis elongatis (8—6 cm). *Folia* biformia, superiora coriacea lanceolata, laminis 30—50 mm longis, longe petiolata, petiolis 30—70 mm longis, apice et basi sensim attenuata, 7—13-nervia, submersa angustissime linearia, $70—130 \times 0,75$ mm, in apicem sensim attenuata. *Ligulae* demum 30—40 mm longae, persistentes, juniores 18—25 mm longae, fissae, apice rotundatae, in spatio intracarinali 5-nerviae. Pedunculus subteres crassiusculus 35 mm longus. Spica 4—5 verticillata, verticillis approximatis. Fructus ignotus.

This species differs from *P. javanicus* by its long-stalked floating leaves, the structure of the submersed leaves, and its long ligules. The form of the apex of the submersed leaves is that of *P. subjavanicus* or *javanicus* (see figs. 56, *B* and 58, *A*), but as to the nervation they are 5-nerved even in the very top. It seems to be a near relation to *P. quinquenervius* but differs by the above properties. Especially the sheaths are characteristic.

The anatomy is noteworthy. Beside the usual mechanical system of the stem (subepid. strands + pseudo-hyp. + *O*-end.) there appear in the bark 2 bundles, one on each side of the stele descending from the ridges of the strong ligules (cf. figs. 4, *str*, 51, *E**). These carinal strands should be regarded the first constituents of the ligular circle of the bark, usual in species with strong sheaths (cf. figs. 13, *str*, 62, *E*, 75, *C*, *str*). The peduncle has not only the usual central bundles and scattered subepidermal strands but even a full circle of cortical strands, by which the species shows a close relationship to the more coarse-grown species. In fact, *P. ligulatus* is in its upper part the coarsest of the *Javanici* known to me. The submersed leaves, however, are very narrow and delicate. They are endowed with 2 rows of lacunae and several pairs of thin nerves as said above. The stem-leaves are 5-nerved in the apex, by which they differ from all the other *Javanici*.

Distribution. Australia, N. S. W., Centennial Park, coll. J. H. MAIDEN (hb. Hauniense).

P. javanicus HASSKARL.

Retzia sive observationes botanicae etc. in Act. Soc. Indo-Neerland. I, 1856, 26—27. — *P. tenuicaulis* F. MÜLLER, Fragn. Fl. Austr., I, 1858, 90, 244. — *P. parviflorus* BUCHENAU, Reliqu. Rutenb. in Abh. Naturw. Ver. Bremen, VII, 1880, 32—33. — *P. Huillensis* WELWITSCH ex SCHINZ in Schweiz. Bot. Ges. I, 1891, 61. — *P. octandrus* REICHENBACH ap. A. BENNETT, Bemerkungen etc. in Annalen Nat. Hofmus. Wien 1892, 288. — Fig. 58.

This species is, according to the original description, richly branched in a dichotomous way (*herbæ* — — — *dichotome ramosissimæ*), which scarcely can mean anything else than that the stem prolongs itself dichotomously by spike-bearing branches of

different ranks. Further it is said to have 5—7-nerved small floating leaves ($24-13 \times 8-2$ mm) and submersed leaves with the size of 52×1 mm, for the rest described

Fig. 58. *P. javanicus* HASSK. A, Top of a submersed stem-leaf, $\frac{5}{1}$. B, Transverse section of the same below the middle (material from Madagascar) m, midvein, n', lat. nerve, $\frac{100}{1}$. C, Transverse section of a submersed stem-leaf (Corean material), $\frac{100}{1}$. D, Turio in a leaf-axil, somewhat enlarged; E, Pistil, side-view, $\frac{1}{2}$. F, Transverse sect. of a young ligule at the base, $\frac{2}{1}$, ic, front-field.

thus: *utrinque attenuata apice acuminatissima, margine sæpe undulata, juxta nervum medium nervis debilibus valde approximatis utrinque binis prædita* etc. The last statement might concern the dark lines near the midrib, which easily can be seen by an ordinary magnifying glass and which properly designate the site of the partition-walls of the two largest lacunæ. I have not seen this plant from Java, but all specimens, hitherto held for *P. javanicus*, possess in the submersed leaves a lacunar system extending over the middle of the leaf from side-nerve to side-nerve. A cross-section of the leaf shows 3, or more frequently 4 rows of lacunæ on either side of the lacunulæ round the midvein. Such a lacunar system *P. cristatus* also possesses, and even the form and nervation both of the submersed and floating leaves coincide in the two species. The floating leaves are at full development always 7-nerved, but the utmost pair of nerves run so near to the marginal bast-bundle, that they sometimes, to the naked eye, seem to be confluent with it, the leaves thus becoming falsely 5-nerved. *P. quinquenervius* m. has also exactly a similar nervature in the floating leaves. — The ligules are open and convolute, 5—6-nerved in the front-field. They remind much of those of *P. trichoides* and their internal structure is the same in the intercarinal part having much smaller cells on the inner than on the outer surface.

The pistils are characterized by the broad, keeled ovary and narrowly oblong stigma. The fruit has prolonged rostrum and a dorsal keel with obvious small bosses.

Of the materials here accessible the WILFORD specimens of *Corea* seem to correspond most strictly to the description, whereas the African materials pretty much deviate from it, for instance by broader but softer leaves, longer internodes, different mode of prolonging the stem (cincinnately not dichotomously), longer peduncles etc. The species seems to form numerous turios, as to form corresponding with the turios of *P. miduhikimo*. They consist of small, transformed, narrowly fusiform branchlets with 2—3 angularly spreading, short, sharply pointed external leaves, and many inner ones wholly clasped by the sheaths, which together with the leaves form a protracted sharp point.

Stem terete or nearly so. Its epidermis lacking (Corean and Japanese forms) or possessing (African and Indian specimens) a one-celled hypodermatic stratum;

subepidermal strands pretty feeble, otherwise as in the pusilloids. Beneath the primary spike the central stele is nearly terete with a rounded crosscut-form, the bundles indistinctly separated or quite fused with a single central cavity. The stele of the stem-prolongation, again, has rather oval crosscut-form and the lateral bundles distinctly separated from the median ones by mechanical tissue. The hypoderma of the stem-prolongation often 2-layered to stiffen that spike-bearing organ.

The lacunar system of the submersed leaves typically provided with subepidermal strands in the lower surface (fig. 58, *C*, *str.*) or sometimes lacking them (specimens from Madagascar and Kunene), in which case the leaves become more flexible.

These small anatomical differences together with the different mode of prolonging the stem, dichotomously or cincinnately, might suggest other discrepancies not yet sufficiently attended to.

Distribution. Asia, Khasia Ind. or., HOOKER & THOMSON (hb. Stockholm., Uppsal., Lund.), Corea, Port Chusan, 59, WILFORD (hb. Stockholm.), sterile, pollen richly developed, but to the greatest part of wrinkled grains! Japan, 63, MAXIMOWICZ (hb. Stockholm.). — Africa, Madagascar, HUMBLT 330 (hb. Lund.). The habit-figure in GRAEBNER, Potamog. 1907, 47, fig. 14, *A*, seems to me to represent the Madagascar plant. Natal, in riv. Umschlangwe pr. Phoenix, 93, R. SCHLECHTER, n:o 3125 (hb. Zürich, Stockholm.). N. O. Rhodesia, Bangweolo-Lake, Chirni-island, 11, R. E. FRIES, N:o 1024; Kunene bei Humbe, 99, BAUM (hb. Stockholm.) v. *major* BENN.

Fig. 59. *P. Vaseyi* ROBB. A, Top of a submersed stem-leaf, $\frac{1}{4}$. B, Transverse section of a subm. stem-leaf below the middle, $\frac{1}{50}$. C, Marginal part of this leaf, ca. $\frac{1}{50}$, *n'*, side-nerve, *str.*, marginal bast-bundle, *l*, lacunæ. D, Transverse section of peduncle, *eh*, epidermis and its one-celled pseudo-hypoderma, *l*, lacunæ; in the middle the four vascular bundles, *vb*, $\frac{5}{16}$. E, Pistil, side-view, $\frac{1}{16}$. F, Fruit, side-view, $\frac{3}{16}$.

P. Vaseyi ROBBINS.

Ap. GRAY, Manual of the Botany of the north U. S., 1867, 485. — Fig. 59.

The stem of this species commonly prolongs itself by one or two short spike-bearing branches consisting of only one internode, by which the plant becomes very few-spiked (1—3 spikes). The lower branches do not seem to come to a spike-bearing development but determine themselves by turios. These turios can scarcely be distinguished from those of *P. javanicus* and *miduhikimo*. They are usually small, transformed branches in the leaf-axils. Submersed leaves 3-nerved traversed by

numerous channels, and in the margins, at least in their lower half, with several layers of mesophyllum. Thus we here have a real transitional form to the leaf characteristic to *P. natans*. The marginal strand is very strong. The nervation and form are exhibited in the fig. 59. Ligules 5-nerved in the front-field, open, convolute. By its submersed leaves *P. Vaseyi* holds quite a similar intermediate place between the *Javanici* and *Natantes* as *P. limosellifolius* by its involucreal leaves between the *Pusilli* and *Javanici*. Stem-anatomy with very thin subepidermal strands, otherwise like that of *P. pusillus* and the Corean *javanicus*. Peduncle, see the fig. above!

Distribution. N. America, Ottawa, Canada, 82, FLETCHER (hb. Stockholm.), Barnet, Vt, U. S. A., 82, BLANCHARD (hb. Stockholm.), East Mass., U. S. A., MORONG (hb. Uppsal.), Chisago Lake, Minn., TAYLOR (hb. Stockholm.), a little verging to *P. diversifolius* RAF.

Subsectio 15. Hybridi (GRAEBNER) HAGSTR.

Hybridi GRAEBNER in A. ENGLER, Das Pflanzenr. IV, 11, 1907. 50. exclus. *P. Nuttallii*.

Caulis teres vel compressus. Folia biformia, natantia evaginata petiolata ovalia obtusa basi attenuata pauci- vel multinervia, submersa linearia obtusa paucinervia valde reticulata vaginata et ligulata vel evaginata ligulis vaginantibus. *Ligulae* (vaginæ) membranaceæ truncatæ vel subretusæ, connatæ vel fissæ, in spatio antico inter nervos laterales paucinerviæ vel subenerviæ. *Pistillum* stylo nullo vel subnullo, stigmatæ parvo humili. *Fructus* compressus rotundatus lateribus impressus carinatus vel tricarinatus; carina media sæpe undulato-cristata; embryo spiralis.

Neither cauline nor rhizomatic turios are found in the specimens examined by me.

The shape of the fruit and embryo etc. make us refer *P. Nuttallii* to this group. Prof. GRAEBNER on the contrary ranks it among his *Fluitantes*.

The anatomic state of the first four species is noticeable. The crosscut form of the central stele is oval and the lateral bundles are separated from the median ones. In the lower stem-internodes the lateral bundles of each side are fused into a common bundle, and the median bundles have a common xylem part dissolving to a common cavity (oblong diagram-type). Higher up in the stem, again, the two median bundles run separately (four-bundled diagram). In the internodes of the stem-prolongation, being a little thicker, both the median and the lateral bundles at last dissolve and the more original state with eight bundles return (eight-bundled diagram). The trio, however, remains united forming a compound bundle, a trio-bundle. In *P. gramineus* this trio-bundle also dissolves into a bundle-trio in the branches of the highest rank (cf. the fig. 102!). Besides, the anatomic diagram of the upper branches serving as stem-prolongation, differs also from that of the basal or lower internodes of the stem by the epidermis possessing a one-celled hypoderma, whereas the subepidermal bast-bundles of the species, furnished with such strands

underneath, either totally disappear or become reduced to a minimum. Those bast-bundles are present in *P. conjungens* m. in full and in a form of 2—5-celled strands, and in *P. dimorphus* at intervals and consisting of only 2—4 cells each. *P. diversifolius* and *P. spirilliformis* m. are destitute of them altogether. The endodermis of *P. dimorphus* and *spirilliformis* m. has thin-walled *O*-cells, whereas the two other species have rather thick-walled endodermis-cells and, besides, a richer sclerenchymatous tissue in the central cylinder.

The interpretation of the singular development of the anatomic structure in the branches above the primary spike lies in the fact that those branches partly must serve as peduncles, which in all these species are extremely short. Consequently they need an internal structure making them stiff like a peduncle and apt to bear up the spikes. This is obtained by a coarser central cylinder with numerous free bundles and a pseudo-hypodermis along the epidermis. *P. spirilliformis* m., always lacking the subepidermal strands as a compensation of them possesses very short epidermis-cells, 2—3 times as long as broad, while the other species have longer epidermis-cells: *conjungens* m. about 5 times the width, and *dimorphus* and *diversifolius* respectively 5—10 and 10—20 times the width.

The submersed leaves of all the species are rich in lacunæ but poor in sclerenchymatous tissue.

The ligules of *P. Nuttallii* very much resemble those of the first four species as to the membranous structure, the venation, and truncate apex, but are free from the leaves and open. The submersed leaves of the *Euhybrid*i m. are sheathing and endowed with a ligule. Sheaths and ligules typically connate, and like those of the *Pusilli connati* smooth and not plicate at the back as in some of the *Coleogetons*. After performed primary function the sheath longitudinally breaks aback and thus you will always find the full-grown old sheaths open.

On account of the condition of the ligules the group must be divided into two series: *Euhybrid*i and *Nuttalliani*.

Series A. *Euhybrid*i HAGSTR.

Folia submersa vaginata ligulata, vaginis ± connatis. *Fructus* rostro minimo faciali. — *Herbæ* statura graciliore.

Fig. 60. A, B, C: *P. conjungens* HAGSTR., A, Floating leaf, nat. size; B, Top of a submersed stem-leaf, $\frac{1}{1}$. C, Fruit, side-view, $\frac{1}{1}$. D—I: *P. spirilliformis* HAGSTR., D, Floating leaf $\frac{1}{1}$; E, Top of a submersed stem-leaf, $\frac{1}{1}$; F, Transverse section of a subm. stem-leaf, m, midrib, n', lateral nerve, l, lacunæ, str, a faint marginal bast-bundle, $\frac{1}{1}$; G, Diagrams of the central stele, a, from a basal internode, b, a little higher up, c, in the branches of the stem-prolongation. H, Pistil, a, ovary, b, stigma, $\frac{1}{1}$; I, Fruit, side-view, $\frac{1}{1}$. K, L: *P. dimorphus* RAF., K, Top of a subm. stem-leaf, $\frac{1}{1}$. L, Fruit, side-view, $\frac{1}{1}$; M, *P. diversifolius* RAF., Top of a subm. stem-leaf, $\frac{1}{1}$.

Floating leaves small, few-nerved. Pistils with the stigma on the ovary. Fruit small. The anatomy of *P. javanicus* reminds, to a certain degree (see above), of that of the *Euhybrid*i, namely as regards the stem prolongation, otherwise the affinity of the two groups seems to be more external than essential.

Series B. **Nuttalliani** HAGSTR.

Folia emersa multinervia; submersa 5-nervia evaginata, vaginis stipularibus (ligulis) axillaribus fissis. *Fructus* majores rostro minimo apicali. — *Herbæ* statura robustiore.

The two species belonging to this series occupy an intermediate place between the small-grown, narrow-leaved groups and the following broader-leaved subsections. Their distribution area seems also to be rather narrow, chiefly the same as that of *P. dimorphus* RAF., or on the south spreading to the year-isotherm of +18° C.

Ser. A. **Euhybrid**i HAGSTR..

P. dimorphus RAFINESQUE.

Monthly Magaz. and critical Review, 1817, 358. — *P. diversifolius* BARTON, Prodrum. fl. Philad. 1815, I, 27, e RAF. l. c. — *P. Zetterstedtii* WALLMAN in Bot. Zeit. 1843, 256—258. — *P. Spirillus* TUCKERMAN, Amer. Journ. Sci. and Arts, 1848, 228. — Fig. 60, K, L; 61, D.

We adopt the name *P. dimorphus* on account of MR. AR. BENNETT's authority (in litt., 1899 and 1900). Else we consider the name *P. Zetterstedtii* to concern, positively, this species, to judge both from the original description and from plant fragments with this name in the Univ. Mus. of Uppsala (coll. DALMAN). The species is recognizable by the roundedly obtuse, commonly more or less evidently ovate-oblong to oblong, 7—11-nerved floating leaves, the short obtuse submersed leaves, the numerous small short-peduncled submersed spikes, the many-flowered rather long-peduncled superior spikes and, especially, by the yellowish, shining, rounded and beakless fruits, wholly lacking lateral keels but on the contrary with a prominent crestlike dorsal keel. In the stem we find a few very thin subepidermal strands. The species fruits richly. Some barren specimens I have seen are without doubt the hybrid *P. dimorphus* × *diversifolius*.

Distribution. N. America CHARLES ad NATTICK, Mass., 79, MORONG (hb. Stockholm.), In lacu Bantam, Conn., 83, MORONG, Ashland, Mass., 83, MORONG, In lacu Spot, Mass., 81, MORONG Chisago Lake, Minn., 92, Baltimore TAYLOR (all in hb. Stockholm.), Maine, 81, BLAKE (hb. Lund.), Salem, Carolina, DALMAN (hb. Uppsal., see above!), N. Angl., TUCKERMAN (hb. Uppsal.), Pennsylvania, 84, GALEN (hb. Uppsal.). A specimen from Delaware, Canby, and another from S. Carolina, CURTIS (both in Uppsal.) might be the above said hybrid. — Canada, Que. and Ont. (hb. Haun.).

P. spirilliformis n. sp. — Fig. 60, D—I, 61, A—C.

Caulis teres—subteres, ramosus, ramis subrecurvatis, a spica primaria ramis sæpe cincinnatiforme valde prolongatus. *Folia* natantia apice rotundata obovata, 7—10-nervia, petiolata evaginata, petiolis lamina brevioribus, laminis $20-25 \times 5-8$ mm; submersa linearia inconspicue trinervia, obtusiuscula, $10-30 \times 1$ mm, vaginata, ligulata. *Pedunculus* spica brevior, 1—2 mm longus. *Spica* brevis, fructifera 3—5 mm longa, 4—6-flora. *Fructus* parvus $1,2-1,5 \times 1-1,25$ mm, rotundatus, a latere compressus, 3-carinatus, carinis gibbosis, brevissime rostratus. *Embryo* $1\frac{1}{3}$ circulis curvatus.

The stem-anatomy differs from that of the nearest related species by the absence of subepidermal bast. The necessary strength is obtained by the short epidermis-cells, in general only 2—3 times as long as broad. From *P. dimorphus*, with which it can easily be confounded, it differs by the usually obovate floating leaves, the straighter lower branches, the short upper peduncles, and few-flowered short upper spikes and, above all, by the fruit being somewhat beaked, smaller, and with a less prominent dorsal keel, but with low and a little prickly lateral keels, which are absent in *P. dimorphus*, the fruit of which on both sides of the dorsal keel presents a smooth roundness corresponding to the form of the embryo. The colour of the fruit is olive-brown.

The stem is destitute of subepidermal bast.

The sheaths and ligules of the submersed leaves of this and the coordinate species are figured close by. In *P. dimorphus* the ligule is truncate or subemarginate, open, and nearly nerveless in the front-field; the leaf-sheath usually connate, seldom open. In *P. spirilliformis* the ligule and sheath are always closed, the ligule usually very slightly emarginate and 2—5-fibrous in the front-field. *P. diversifolius* has usually a stretched narrow ligule in form and structure, besides, nearly like that of *P. spirillif.* *P. conjungens* m., lastly, has the ligule more or less open above and the tip more or less roundish-truncate.

Distribution. Brazil, Rio grande do Sul, 92, LINDMAN (hb. Stockholm). Uruguay, Vera, 01, BERRO (hb. Haun.).

Fig. 61. *P. spirilliformis* HAGSTR. A, Transverse section of the stem, lower part, $\frac{1}{5}$. B, Transverse section of the stem-prolongation, $\frac{1}{5}$, vascular bundles of the stele hatched. C, Young sheath, l, ligular part, bl, blade, basal part, i, insertion line; the dotted line above designates the variation of the incisure, $\frac{1}{5}$. D, E, F, Corresponding organ of *P. dimorphus*, *P. conjungens* m. and *P. diversifolius* resp. C, D, a, F, back-view, E, side-view, D, b, split.

P. conjungens n. sp. — Fig. 60, *A—C*; 61, *E*.

Caulis teres—subteres ramosus, ramis recurvatis ut in *P. dimorpho*, ramulis spiciferis prolongatus, internodiis infimis brevibus, superioribus longioribus. *Folia* nantantia 11-nervia obtusa ovalia evaginata, petiolata, petiolo inferiorum foliorum lamina longiore, superiorum subbreviore, laminis $20-30 \times 10-12$ mm; submersa angustissime linearia subobtusa vaginata ligulata $50-70 \times 0,75$ mm; ramulina breviora, omnia inconspicue 3-nervia. *Pedunculus* brevis, 1–4 mm longus. *Spicæ* densæ, infimæ ca. 8-floræ, summæ ca. 20-floræ. *Fructus* parvus, $1,3 \times 1$ mm, rotundatus, a latere compressus, erostratus tricarinatus carinis gibbosis. —

This species has qualities reminding both of *P. dimorphus* and of *diversifolius*. Of the former remind the floating leaves with their rounded apices and numerous nerves, but the lower ones are longer petioled whereupon the stalk-length gradually abates upwards. They are widest at the middle as is usually the case in *P. diversifolius*, which, again, has the apices shaped so that both the marginal lines meet in a more or less acute angle. Submersed leaves of about the same length as in *P. diversifolius* but more obtuse, however not so rounded at the top as in *P. dimorphus*, see the fig. 60, *B*! Sheaths and ligules, see above! Branches recurved as in just mentioned species, but seldom (the uppermost) or never they terminate themselves by spikes as does *P. dimorphus*. Peduncles very short, the topmost only 3–4 (5) mm, in the two other species 10–15 mm. Fruit very small, a little shorter than that of *P. diversifolius*, which also has more prominent dorsal keel, by which its fruit as well grows a little broader. Besides, the fruits of these two species are extremely alike, both lacking a beak (like *P. dimorphus*) and possessing small prickles on the dorsal and lateral keels (common to *P. spirilliformis* too), see the fig. 60, *C*! The upper spikes are many-flowered; all richly fruiting, consequently it should not be considered a hybrid in usual sense, though probably of a hybrid origin.

The species has been mixed up with *P. diversifolius*, but differs easily from it by the deviating floating leaves and short upper peduncles, the more obtuse submersed leaves and the more faintly keeled, smaller fruits. Full-numbered subepidermal bast seems always to be present in the stem.

Distribution N. America, Mexico, San Luis Potosi, 79, SCHAFFNER (hb. Uppsal. et Lund.). Lancaster Co., Pa., 90, SMALL (hb. Haun.), New Jersey (hb. Haun.),

P. diversifolius RAFINESQUE, in Medical Repository, 1811, 409. — *P. hybridus* var. *b* MICHX, Flora boreali Americana I, 1803, 401, e RAF. l. c., non *hybridus* PET., Inst. bot. 1787. — *P. capillaceus* POIRET ap. LAMARCK, Enc. Suppl. IV, 1816, 535. Fig. 60, *M*; 61, *F*.

T. MORONG has adopted the Rafinesquian name for this species (Najad., 1893, 48). The description, however, may not be considered as fully decisive. It runs: »*Potamogeton diversifolium* RAF. (*P. hybridum* b. MICH. fl. bor.) Foliis submersis

linearibus acutis, sessilibus, emersis oblongo-ovalibus natantibus, spicis cylindricis. In Carolina et Delaware.» *P. capillaceus* POIR. seems otherwise to be the earliest name being unquestionable and employable.

CHAMISSE and SCHLECHTENDAL have correctly described the floating leaves of this species: — »utrinque acuta apice ipso obtuso paululum brevissime producto» (Linnæa 1827, 208). The marginal lines, you will observe, meet under more or less acute angles, whereas the preceding three species always have more or less roundedly obtuse floating leaves. Submersed leaves elongated and narrowly tapered, seemingly »uninerved» but properly with three vascular bundles, floating leaves 5—7-nerved. Upper peduncles about 10 mm long, above a little club-shaped. Stem lacking subepidermal bast.

MORONG has distinguished two varieties of this species (l. c. 48, 49): — *multidenticulatus* and *trichophyllus*. To those should be added a very low-grown (1—3 cm) terrestrial form with merely coriaceous or subcoriaceous, more or less obtuse leaves and small two-flowered spikes with fruit of typical shape:

f. *limosus* n. f.

Statura humillima; *folia* omnia ± obtusa ± coriacea.

This beautiful form is gathered »in the mud of Goose Pond, Dune Park, Ind., U. S. A.» in 1898 by Rev. E. J. HILL, who has kindly sent me a specimen.

Distribution. N. America, South Natick, Mass., MORONG (hb. Stockholm.), Wellesly, Mass., 81, MORONG (hb. Stockholm.), Andover, Mass., 80, BLAKE (hb. Stockholm.), Nov. Angl., TUCKERMAN (hb. Uppsal.), St. Louis, Mo., GEYER, 42 (hb. Uppsal.), labelled »*P. diversifolius* Barton v. *spicatus* ENGELMAN». It is not known to me that ENGELMAN has published this name. Middle Florida, BUGEL (hb. Stockholm.), Baltimore, Md., TAYLOR (hb. Stockholm.), Cuba, WRIGHT, No. 3204 (hb. Stockholm.). Mexico? S. America?

Ser. B. *Nuttalliani* HAGSTR.

P. Nuttallii CHAM. & SCHLECHT.

De plantis in exped. spec. Romanzoffiana observ., in Linnæa. 1827, 226. — *P. pensylvanicus* WILLD. ap. CHAM. et SCHL., l. c., 227. — *P. pumilus* WOLFG. ap. SCHULTES, Mantissa III, 1827, 354?¹ — *P. Claytonii* TUCKERMAN, Observ., in Amer. Journ. Sci. and Arts, 1843, 38. — *P. epihydrus* RAF. In Med. Rep. VI, 5, 1808, 354? See the Index! — Fig. 62.

This species is easily recognized by the fructification and by the floating leaves having their apex rounded with a slight curve outward and their base sloping into the stalk. Petiole of the length of the blade or shorter, the nethermost leaf often

¹ The statement of the width of the submersed leaves, »3—4 lin. lata» does not agree with *P. Nuttallii*, rather with *P. cayugensis* (WIEG.), or with *P. nodosus* × *Nuttallii*, hence my hesitation.

with shorter lamina. Submersed leaves usually 5–7-nerved with tapering base and top, generally 3–5 mm broad, with a lacunar portion filling, in the lower half of the leaf, the whole space between the midrib and the chief lateral nerves, by which

Fig. 62. *P. Nuttallii* CHAM. & SCHL. A, Floating leaves, nat. size; B, a, b, Tops of submersed leaves, showing the form and nervation, slightly enlarged; C, Pistil, a, side-view, b, back-view, $\frac{1}{10}$; D, Longitudinal section of the fruit, showing the embryo (a), putamen (b) and the flesh and dorsal keel (c), $\frac{1}{1}$; E, Transverse section of the stem, $\frac{3}{10}$ showing nine bundles. In the central stele eight bundles are visible, tr, the compound trio-bundle.

the species shows affinity to the *Euhybridi* and *Javanici*. Pollen spheric and small-grained. Stem compressed in the proportion of 2:1, and sometimes slightly furrowed. The epidermis is destitute of a hypodermis, but instead of this its cells are very short, often cubic or 1.5–2 times as long as the width. This is a significant and excellent characteristic of this species, especially of great importance for determining its hybrids. The cortical bast- and vascular bundles appear only laterally in the utmost interlacunar wall (see the fig!) as in *P. Robbinsii*, and sometimes with one or another bundle so near to the epidermis that it might almost be called subepidermal. Proper subepidermal bast absent. Endodermis of O-cells. The central cylinder has two median bundles, one compound and one simple, and three lateral on either side, all separated from one another by mechanical tissue. This anatomical diagram of the trio-type is very constant in this species. The submersed leaves are destitute of sclerenchymatous tissue in the lacunar part but possess a strong bast-bundle in either margin.

The species does not vary much, chiefly to the size only. Var. *portoricensis* GRAEBNER does not belong to this species (see below!). Var. *cayugensis* WIEGAND is a nearly allied distinct species.

P. Nuttallii and *P. cayugensis* certainly occupy a separate position within the subsection, but they nevertheless stand in the nearest affinity to its other species. This especially becomes clear from the style, consisting only in a swelling on the ovary, the fruit-form, and the curvature of the embryo. The fruit, namely, is flattened with a conspicuous pit on the sides and a prominent dorsal keel, and the embryo has the spiral form characteristic to the other species of the group. But the linear, submersed leaves also with their ex-

expanded areolation, and the floating leaves with petioles equal to the laminae accomplish the likeness to the preceding series while at the same time the species can be said to form the transition to species with larger floating leaves and broader submersed ones. — *P. cayugensis* (WIEG.) differs from *P. Nutt.* by 9–11-nerved broader and obtuser submersed leaves, by the ligules being densely 10–15-nerved in the front-

field, by larger fruits, and by scattered subepidermal bast-bundles and stretched epidermis-cells in the stem.

Distribution. *North America*, many stations in U. S.: Mass., N. York, N. Jersey, Minn., Mich. (hb. Stockh., Uppsal., Lund.) and Canada, Plevna, Ont., 02, FOWLER (hb. Stockh.).

Subsectio 16. **Alpini** (GRAEBN., l. c. pag. 70. incl. *P. linguatus* etc.) HAGSTR.

Caulis teres, sub foliis floralibus simplex. *Folia* natantia obtusa basi attenuata brevipetiolata (petiolus lamina non longior); submersa evaginata sessilia linearia—lanceolata—ovata (rarissime) vel ovalia (*P. stylatus*), multinervia. *Ligulae* membranaceae apice rotundatae—emarginatae fissae ejugae in spatio intermedio paucinerviae (2—4-nerviae in *P. alpino*). *Pistillum* stylo elongato tenui compresso, stigmatibus oblongo. *Fructus* lenticularis carinatus rostratus (*P. alpinus*).

P. alpinus differs from the *Amplifolii* so considerably as to deserve to be put into a separate group, to which *P. stylatus* HAGSTR. also may provisionally be referred as a transition form to the *Amplifolii*. Its fruit is still unknown, but the styles remind of *P. alpinus*.

A longitudinal section of the ripe fruit shows that the putamen is upwards endowed with a thorn or point forming the kernel of the always rather prominent beak.

The turios of *P. alp.* are noticeable. They are formed by a single shoot in bud state (from the third node and so on) in the top of the rhizome without incrasation but with thickened scales, which serve as reservoirs for stored food.

The group is poor in schlerenchymatous tissue and associates anatomically as well as morphologically closely with the next following.

P. alpinus BALBIS.

Miscellanea botanica, in Mémoires de l'Académie des sci., litt. etc. de Turin. 1804, 329. — *P. annulatus* BELLARDI, Stirpes novae etc. l. c. 1804, 447. — *P. semipellucidus* KOCH et ZIZ, Catalogus plantarum etc., 1814, 5, 18.¹ — *P. rufescens* SCHRADER ap. CHAMISSE, Adnotationes quaedam etc., 1815, 5—6. — *P. obscurus* DC., Flore française etc. Vol. VI, 1815, 311. — *P. purpurascens* SEIDL in PRESL, Flora czechica, 1819, 251. — *P. microstachys* WOLFGANG ap. SCHULTES, Mantissa in Vol. III. etc., 1827, 360. — *P. obtusus* DUCROS ap. GAUDIN, Fl. helvetica etc., 1828, 468—469. — Fig. 63.

The two earliest descriptions of this species are very dissatisfying, and the figure, added by BELLARDI to the description, resembles with its sharp-pointed leaves more *P. gramineus* than *P. alpinus*. KOCH and SCHRADER—CHAMISSE first state

¹ Pag. 5 signed only with KOCH's name.

the characteristics of the species: the coriaceous floating leaves with petioles shorter than the lamina and the compressed fruits (KOCH), the obtuse, submersed leaves, the obovate floating leaves with sloping base (CHAM.). In our days the turios and stem-anatomy (RAUNKIÆR), the stigmas (ALMQUIST) and styles (HAGSTRÖM) have been described more or less completely.

The stem prolongs itself by branches of as far as the fifth rank. The anatomy of the stem is constant whether the plant is growing in running or stagnant

water. I have not been able to observe any other change than a fusion or division, within certain limits, of the central cylinder's vascular bundles. The epidermis lacks a hypoderma and its cells are large-roomed and stretched, 5—15 times the width. Bast-bundles do not occur in the bark neither sub-epidermally nor interlacunary. The endodermis always consists of *O*-cells and the central stele has usually six lateral and two median bundles, of which the one is composed of three (a trio-bundle). This trio-bundle sometimes dissolves into a bundle-trio and some one or other of the lateral bundles often splits into two (see the fig. *D*!).

The earlier authors (CAMISSO etc.) were of the opinion that the species typically developed floating leaves and held the form, endowed with such leaves as main-form. This is also, no doubt, correct. Where the species accidentally lacks floating leaves, it depends on unfavourable external facts, as rapid streaming or swelling of the water during the florification. In such cases a leaf-form intermedi-

Fig. 63. *P. alpinus* BALBIS. A, Floating leaf, $\frac{1}{2}$. B, Pistils, a, side-view b, from the inner side, $\frac{1}{2}$. C, Longitudinal section of the fruit showing the embryo (a), the putamen (endocarp) with its thorn (b) and the epicarp, c, $\frac{1}{2}$. D, Transverse section of a central stele with more than six lateral bundles, tr, compound bundles belonging to the second leaf upwards, ctr, opposite bundle, and fb, foliar bundle, belonging to the leaf next above $\frac{4}{5}$. E, Part of a transverse section of the stem, $\frac{4}{5}$, ep, epidermis, end, endodermis, l, lacunar system. F, Top of a young ligule, $\frac{1}{2}$, b-b, chief nerves, ic, front-field, wg, wing-field.

ate between submersed and floating leaves, is developed which I have called amphibial leaves, a biologic occurrence by which the species adapts itself to the existing external facts. Because of that it is more appropriate to rank the variations according to the shape of the submersed leaves (CHAMISSO, HARTMAN, FRIES etc.) than to the appearance, presence or absence of the floating leaves (FIEBER and others). CHAMISSO separates from the main-form a »*forma angustifolia*, quæ *P. alpinus* et *annulatus* Auct., folia habet submersa summa $4\frac{1}{2}$ poll. longa 5 lin. lata» etc. and a »*forma latifolia* quæ *P. purpurascens* SEIDEL, folia possidet submersa $6\frac{1}{2}$ poll. longa 15 lin. lata» etc. (Linnæa, 1827, 211—212). Thus the main-form becomes the commonest one with the submersed

leaves 15—20 mm. broad. The rivulet-form of this, with often greener leaves, is var. *rivularis* HARTM. Var. *palustris* M. & K. is a form with very short internodes, and f. *brevifolius* TISELIUS has shorter leaves than usually, $\frac{5.0-9.0}{10-15}$ mm. Forma *longifolius* LÆSTADIUS has elongated leaves $150 \times 10-15$ mm. Forma *minor* HARTM. originally seems to have been the same as f. *angustifolius* CHAM., but became defined in Handb. i Skand. Fl., 1820, as a form »till alla delar dubbelt mindre» i. e. in all parts only the half of the main-form (=f. *borealis* TIS.). Var. *lacustris* MARSSON is a narrow-leaved form with elongated internodes (=f. *gracilior* TIS.). I have observed a narrow-leaved extreme form with only 5—6 mm broad submersed leaves which may be named:

f. *gracillimus* n. f. — Folia submersa 5—6 mm lata.

All more narrow-leaved forms may be united under a common variety-name:

var. *linearifolius* n. var. — Folia submersa angusta lanceolate-linearia $100 \times 5-8$ mm.

This var. thus comprehends ff. *minor* HN, *lacustris* MARS. (*gracilior* TIS.) and *gracillimus* HAGSTR.

A broad-leaved extreme form I have named:

f. *ovatifolius*: folia submersa 70—80 mm longa, 35 mm lata.

All forms destitute of floating leaves in proper sense constitute the var. *obscurus* ASCH.

The Fieberian exposition is maintained by FISCHER in his work Die bayer. Pot. in 1907, where several new forms have been established and earlier names have obtained a new meaning.

Distribution. Sweden. *P. alpinus* occurs through the whole of Sweden from Scania as far as the most northern parts of Lapland, and plenty of materials from all counties except Öland is deposited in the Museums. F. *gracillimus* is known from two localities: *Westgothia*, Släpsjön, 87, NORDSTEDT (hb. Lund) and *Herjedalia*, Lillherdal, 01, ENANDER (hb. Stockholm. et Lund.).

Other northern habitats are: *Norway*, many stations, *Iceland*, *Greenland*, *Russian Lapland*, Varsuga, 89, KIHLMAN (hb. Stockholm.) Voronisk, 87, KIHLMAN (hb. Stockholm.). *Siberia*, recorded by SCHEUTZ, Plantæ vasc. Jeniseenses from small lakes in the region of Dudino, 69° 25, N. L. It occurs also in a lake in the Laostrovskoje island, 69° 45, N. L. (hb. Stockholm.) and, consequently, transgresses the year-isotherm of — 10° C. — In *N. America*, however, it may not reach this line. ROBINSON & FERNALD in GRAY's New Manual, 1908, record: Labrador to Alaska, and the author has seen specimens from Yukondistrict coll. by O. NORDENSKJÖLD 1898 (hb. Stockholm.). The northern boundary of this species, therefore, may be the year-isotherm of — 6° to — 10° C. To the south of this line it spreads through Europe, Asia and North America, but surely not much beyond the year-isotherm of + 15° C. Asiatic statements from the south of this line may be referable to *P. stylatus* HAGSTR. (Bot. Not., 1908). It is not at all probable that it in Asia transgresses the European south boundary, rather the contrary, on account of the high summer warmth.

Denmark and Germany: a great many specimens are present in the Swedish

Museums. *F. ovatifolius* from Brandenburg, gathered by BUCHENAU (hb. Lund.). Specimens, however, are also present from *England, Russia* (St. Petersburg, Osilia, Poland), *France, Austria* and *Switzerland* (higher mountain-lakes).

From *N. America* there are specimens from Canada, Brit. Columbia, and from the States, Nov. Ebor., TUCKERMAN jr. (hb. Upps.); Lewis Creek ad Ferrisbergh, Vermont, 81, FAXON (hb. Stockholm.); California, S. Francisco, 74, EISEN (hb. Upps.).

***P. alpinus* BALB. × *crispus* L. (*P. venustus* BAAGÖE, Préparation des Hydroph., in Actes du Congrès int. de Bot., 1900, 517, nomen solum. — *P. Baagöei* Ar. BENNETT ap. GRAEBNER, Potamog., 1907, 132, nomen.). — Fig. 64.**

Fig. 64. *P. venustus* BAAG. A, Top of leaf, a little enlarged. B, Marginal epidermis-cells, at * a little boss or dilatation of the cell designating a disposition to denticulation.

As in *P. undulatus* WOLFG. the stem of this hybrid is also a little flattened and on either side furrowed, by which appears its relationship with *P. crispus*. The anatomy also answers to that of *P. crispus* in the parts in which this species deviates from the *P. alpinus*, namely in the central cylinder, where the lateral bundles are more reduced so that the crosscut-form becomes oval, whereas in *P. alpinus* it is square with rounded corners. The epidermis has also the pseudo-hypoderma found in *P. crispus*. The characteristic of both species, viz. the complete absence of cortical bast, is to be found here too. The peduncles and spikes remind of *P. crispus* in a high degree. This species appears in the ramification also and in the complete absence of floating leaves and petioles in the upper leaves, which, however, occasionally have the base tapering like a stalk. An influence from *P. crispus* can obviously be traced in the midrib of the leaves too, but, for the rest, the nervation is an inheritance from *P. alpinus*, although with some reduction as to the number of the lateral nerves by which the leaves in general become 7-nerved. *P. alpinus* appears also in the intermediate ligules and, above all, in the slightly crisp leaves with smooth margins.

Only in the very youngest leaves and by higher enlargement a faint disposition to denticulation can be observed by a slight swelling of the marginal cells at intervals. — The pollen grains have the same size and shape as in *P. alpinus* but merely a few grains are fertile. Styles and stigmas, on the contrary, remind of *P. crispus*, the latter, however, often abortive. Turios are not observed either in the stem or the branches.

This hybrid can easily be mistaken for *P. crispus* × *praelongus*, which, however, has more whitish-green ligules, more rounded to cordately rounded leaf bases very obtuse apices, whereas *P. venustus* has brownish-green ligules, narrower lanceolate or lance-oval leaf-base, in the upper leaves somewhat stalk-like, and not quite so rounded apices (see the fig.!). The very most significant character is the perfect absence of sclerenchyma in the bark of the stem.

Distribution. *Denmark.* Sæll., Vigersdalså, 96, FERDINAND, 99, BAAGÖE (hb. Stockholm., Upps., Lund.), Jutl., Gudenå in Lilleå at Lögstrup, 99, BAAGÖE (hb. Upps.). More stations than these are not known as yet.

P. alpinus BALB. $\times$ **gramineus** L. (**P. nericius** HAGSTR.). — Fig. 65.

The few specimens of this hybrid hitherto found can be described as follows:

Caulis teres subcrassus (ut in *P. alpino*) simplex vel (ad medium) ramulo debilissimo (interm.) instructus. *Folia* submersa lanceolata, superiora $\pm$ petiolata laminis decurrentibus apice $\pm$ obtusa, ramulina apice subcuspidata $\pm$ obtusa, omnia integerrima; natantia lanceolata obtuse cuspidata, petiolata et laminis decurrentibus ut in *P. alpino*. Ligulæ intermediæ, debiliores quam in *P. gramineo*, subbicarinatæ, fuscovirides. *Pedunculus* vix incrassatus. *Spica* sterilis.

The colour of this plant reminds of *P. gramineus* more than of *alpinus*, but in habit it resembles most the latter, although the stem, at the middle, usually has a short and very faint branch (influence from *P. gramineus*). Very significant are the dark-green submersed leaves the structure, nervation, and smooth margins of which are most like those of *P. alpinus*. Their tops taper gradually or end with a slight cusp and are always a little more obtuse than in *P. gramineus* (influence from *P. alpinus*). The floating leaves resemble as to stalk, and the size and form of the blade, nearest *P. alpinus*, but the apex is intermediate with a very faint and obtuse cusp. All the ligules are paler than in *P. alpinus*, which they otherwise resemble as to structure, the basal nerves being by far fainter and the keels lower than in *P. gramineus*. The styles are not in such a state that they can be examined.

The anatomy of the stem: Cortical strands as in *P. gramineus*, sometimes, however, a little weakened. The arrangement of the vascular bundles of the central cylinder varies, in the common way of the hybrids, from more *alpinus*-like to almost quite *gramineus*-shaped. Endodermis of one-sidedly thickened *u*-cells as has *P. gramineus*, but influenced by *P. alpinus* the suberisation is somewhat weaker. The epidermis is destitute of a hypoderma and its cells approach, as to the length, the measure usual in *P. gramineus*.

Distribution. Sweden, Nericia, Götlunda in Hasta-rivulet, 82, TISELIUS (hb. Stockh.) growing together with the parents: *P. gramineus* f. *fluctuans* TIS. and an *alpinus*-form with elongated upper internodes and large floating leaves. Several other Scandinavian and North European plants have falsely been taken for this hybrid. *P. gracilis* WOLFG., *P. Wolfgangii* KIHLM. and specimens named *P. alpinus*

Fig. 65. *P. alpinus* BALB. $\times$ *gramineus* L. (*P. nericius* HAGSTR.). A, Top of a submersed stem-leaf, $\frac{1}{2}$. B, Top of a branch-leaf, a little enlarged. C, Floating leaf, $\frac{1}{2}$. D, E, Diagrams of the central cylinder from different individuals. The median bundles with common xylem-cavity as in *P. gramineus*, the lateral ones free (in D) as in *P. alpinus*, in E, united as in *P. gramineus*.

gramineus var. *graminifolius* FR. by S. ALMQUIST in Bot. Not., 1889, 66, are not this hybrid, see under *P. gramineus* L. — Norway, Senjen, Bryggehaug, 10, Notö.

P. nericius must until further be looked upon as a most rare plant.

***P. alpinus* BALB. × *natans* L. (*P. Drucei* FRYER, Potamog. of the British Isles, 1898, 31, t. 21). — Fig. 66.**

Fig. 66, *P. Drucei* FRYER. A, Blade of the youngest leaf of a spike-bearing shoot, sloping at the base, rather thin, $\frac{1}{4}$. B, The lowest leaf but one, on a barren shoot from the Bot. Garden of Copenhagen, $\frac{1}{4}$.

There can scarcely be any doubt of the hybrid nature of the Berkshire plant named *P. Drucei* (FRYER 1899, as a full species). The large floating leaves distinctly indicate that *P. natans* is to be considered as one of the originators. A closer investigation of all the organs of the plant does not contradict the supposition either. But which the other parent species may be is not quite a matter of course. The first proposition of DRUCE on *P. alpinus*, however, seems to be favoured with all probabilities. The long petioles of the floating leaves certainly seem to be adverse to it, but they are likely to originate from local conditions (River Loddon). The leaf-base is sloping as in *P. alpinus* and in the river-form of *P. natans* which also has long petioles. The floating leaves besides appear very early, already below the primary spike, which confirms the supposition that either of the two parent-species is furnished with coriaceous leaves. The submersed leaves are also long-stalked as the other *natans*-hybrids. The ligule can be said to be intermediate, 75–85 mm long (*P. nat.*), brown (*P. alp.*) with faint ridges. The styles and stigmas remind of *P. polygonifolius* almost more than of *natans*, but the smallness of the stigma, especially, may depend on deformity, a usual occurrence in the hybrids. We are so much the more inclined to think so, having seen specimens cultivated in the Botanical Garden of Copenhagen with *alpinus*-stigmas.

A cross-section of a spike-bearing stem shows a structure very obviously confirming the presumption about *P. alpinus* and *natans* as the true origin of this hybrid. Endodermis and central stele nearly typical *P. alpinus*, epidermis with a pseudo-hypoderma and scattered bark-bundles influenced by *P. natans*. Yet

P. alpinus has considerably reduced the number of the bundles, and subepidermal bundles are quite absent. Interesting and absolutely decisive is the fact, that the cultivated individuals of the original *P. Drucei* above mentioned vary in the stem-anatomy in such a manner, that the endodermis and central cylinder answer to *P. natans*, whereas the hypoderma and the cortical strands are quite absent as in *P. alpinus*. In the former case *P. alpinus* has forced its way to the central parts of the stem, *P. natans*, on the contrary, has mastered the periphery. In the latter the fact is the very reverse. Both cases, taken together, are the most excellent prove that can ever be exhibited, that the two said species are represented in *P. Drucei*.

The following facts forbid the combination *P. natans* $\times$ *polygonifolius*: the hybrid is always destitute of subepidermal bast-bundles, and, at least sometimes, furnished with an *O*-endodermis both of which could not occur, provided that *P. natans* is the one of the parent-species (against FRYER, 1907, in GRAEBNER, Pot.).

Distribution. England, Berkshire, River Loddon, 04, DRUCE (hb. Stockholm., Lund.).

***P. alpinus* BALB. $\times$ *nodosus* POIR. (*P. rectifolius* AR. BENNETT, Notes on Potamogeton, in The Journ. of Bot., 1902, 147, as *P. americanus* $\times$ *alpinus*. — *P. subobtusus* HAGSTRÖM). — Fig. 67.**

The materials of this hybrid here accessible consists of a barren and a fruiting shoot, both simple, the latter with a stem-prolongation of two spike-bearing and one undeveloped branch of 1st—3d rank.

Stem terete; basal internodes 2—3 cm, above 4—6 cm long. Lower leaves sessile, but with a stalk-like base, narrowly lanceolate. The four leaves next below the primary spike long-petioled and with narrowly sloping blades (see the fig.!), the apexes of which are even and obtuse. In the whole these leaves are 14—15 cm long, the blade $\frac{7.0-9.0}{15}$ mm, more or less coriaceous. The involucreal leaves and the leaves of the stem-prolongation are nearly similar to those just mentioned, coriaceous but thin and narrow as usually in *P. alpinus*. The barren shoot has the uppermost leaves endowed with longer petioles (100 mm) and slowly sloping blades (100 mm), thus more intermediate. Ligules deciduous, 50—60 mm long, without or with very low keels at the base. Peduncles stout (*P. nodosus*), 100 mm long; spike deflorate 35—45 mm long (*P. nodosus*). Style as in *P. nodosus*. Pollen sterile to the greatest part. The stem shows the same anatomic diagram as the two parent species, the structure of which is essentially the same.

Distribution. N. America, »Nov. Ebor.», E. TUCKERMAN Jr (hb. Upps.). — The original habitat of *P. rectif.* is Stony Island, Chicago, Ill., where it was gathered 30.8.01, by Rev. E. J. HILL. A specimen kindly sent from the discoverer has,

Fig. 67. *P. subobtusus* HAGSTR. One of the four leaves below the primary spike, $\frac{1}{4}$.

however, proved to be the hybrid *P. nodosus* POIR. $\times$ *Richardsonii* RYDB., and I therefore have chosen a new name for the above hybrid.

***P. alpinus* BALB. $\times$ *perfoliatus* L. (*P. prussicus* HAGSTRÖM, New Potamogetons, in Bot. Not. 1908, 103—106).**

This bastard has been collected only in Germany and Norway. It is easy to distinguish from *P. alpinus* by the leaf-serrulation (to be studied on young, unhurt leaves), from *P. perfoliatus* by the ligules more or less verging to those of *P. alpinus* and by the leaf-bases, from *P. nitens* (i. e. *P. gramineus* $\times$ *perfoliatus*), which it extremely resembles, by the obtuse leaves, the much slighter denticulation and by the anatomical conditions of the stem consisting in the absence of cortical strands and in an endodermis of *O*-cells.

According as the leaf-form corresponds more with the one or the other of the parent-species the different forms are referable to the two varieties:

α . **abbreviatus** HAGSTR. l. c., or

β . **alpinifolius** HAGSTR. l. c.

To the former var. I have reckoned the form of Darkehmen, East-Prussia, f. *darkehmensis* HAGSTR. l. c.; and to the latter f. *pelplinensis* HAGSTR. l. c., from Pelplin, West-Prussia. — Norway Romerige: Raumaelv and Östensö, BLYTT (hb. Christ.).

***P. alpinus* BALB. $\times$ *polygonifolius* POURR. (*P. spathulatus* SCHRADER ap. KOCH et ZIZ, Catalogus plantarum Palat., 1814, 5, 18. — *P. Kochii* SCHULTZ, Archives de la Flore de France et d'Allem., 1842, 72).**

FISCHER has divided the forms of this hybrid into two series: ser. *Kochii*, approaching to *P. alpinus*, and ser. *Curtii* verging to *P. polygonifolius*, yet without a closer explanation of the similitudes or differences. All the Palatine specimens I have seen are like *P. polygonifolius* in that respect that the lower leaves are petioled. This form I propose to name:

α . **palatinensis** n. f. — Foliis inferioribus petiolatis.

Our Scanian form, on the contrary, has the lower leaves sessile but with a narrow stalk-like base. This form may be called:

β . **svecicus** n. f. — Foliis inferioribus sessilibus.

The upper leaves of both forms are long-petioled with petioles as long or longer (rarely shorter) than the blades with their sloping bases. Apex obtuse as in *P. alpinus*. The stem-anatomy shows influence from both the parent-species and can be said to be intermediate.

Distribution. Sweden, Scania, Broby in Helgeå, 57, SCHEUTZ (hb. Upps.) ex hb. E. FRIES, who has written on the label: »Est *P. rufescens*»; the same station, 65, THEDENIUS (hb. Upps.); S. ALMQUIST has noted of this: »är icke *polygonifolius*, möjl. dess hybrid med *rufescens*» (= Possibly *polygonif.* $\times$ *rufesc.*). — Germany, Rhein-Pfalz, Kaiserslautern, A. BRAUN (hb. Lund.), 43, SCHULTZ (hb. Stockholm. et Uppsal.). — More stations hitherto not known; misreported from Norway by GRAEBNER in Potamog., 1907, 133.

P. alpinus BALB. × **praelongus** WULF. (**P. nerviger** WOLFG. ap. SCHULTES, Mantissa in Vol. III, 1827, 359. — *P. Griffithii* AR. BENNETT, in the Journ. of Botany, 1883, 65, t. 235).

I have had an opportunity to see and examine some specimens, determined by WOLFGANG himself and labelled: »*Potamogeton nervigerus mihi J. W.*» They are conspicuously the hybrid written above. As to the stem-anatomy *P. alpinus* is traced in the *O*-endodermis and in the obvious reduction of the number of bark-bundles, otherwise originating from *P. praelongus*. The latter appears in the pseudo-hypoderma, in the stout stele, and in just mentioned cortical bundles. They occur as only one interlacunar circle but never subepidermally. The English specimens are also evidently this hybrid, but the stem-anatomy comes much nearer to *P. praelongus* than it does in the preceding. *P. alpinus*, however, has influenced both the endodermis, which exhibits only faint *u*-cells, and the cortical strands, the number of which always is less than in *P. praelongus*. Especially the subepidermal strands are few.

As to the leaf-form the two parent-species appear in the hybrid according to the descriptions.

P. nerviger has been considered by several authors (KUNTH, Enumer., RICHTER, Pl. Eur., ASCHERS. & GRAEBN., Syn., A. BENNETT in the Journ. Bot., 1889 and 1891) now identic with *P. alpinus* now as a subspecies or variety of it. The occurrence, however, of cortical bast in the stem as is shown above does not allow such a presumption. — WOLFGANG himself wrote the name *nervigerus*, yet I use the first published form of it. — As to *P. Griffithii*, A. FRYER (Pot. Brit. Isl.), after BENNETT, has conceived it as an independent species, later on as a supposed *polygonifolius*-bastard (The Journ. Bot., 1907, 300). Its hybrid origin, however, is beyond all doubt and may nowadays be disputed in earnest by nobody. GRAEBNER still writes (1907): *Planta originis dubiosæ*.

Distribution. *Lithuania*, Vilna, HORANINOW (hb. Uppsal.), leaves lanceolate, sessile or with the base sloping stalk-like, top gradually tapering, obtuse, 8—9 × 1,5—2 cm. — *England* Llyn-an-afon, near Aber, Carnarvonshire. *N. Wales*, 82, 85, 86, 87, 88, GRIFFITH (hb. Stockholm.). — No more stations hitherto known.

P. alpinus BALB. × **pusillus** L. (**P. lanceolatus** SMITH, Engl. Bot. Vol. 28, 1809, t. 1985, Engl. Fl. I, 1824, 232, as species. — *P. rivularis* GILLOT in MAGNIN, Scrin. VI, 1887, 118). — Fig. 68.

In the course of time *P. lanceolatus* SM. has been much written of and much misunderstood. It was only rather late that its hybrid origin has been called into question. A. FRYER is the first who, on account of its narrow distribution, has considered it to be a hybrid: the case in favour of the hybrid origin of *P. lanceolatus* is strongly supported by the local distribution of the species (The Journ. of Bot., 1894, 339). On account of the glands at the leaf-base and the habit of the plant in young state this author regarded it as a *Friesii*-hybrid. The Anglesea-form is admitted to be a *pusillus*-hybrid. As the other co-active species *P. heterophyllus* has

been set up but without argumentation. FRYER has also first of all pointed out the near relationship between *P. lanceolatus* and *P. rivularis*.

The stem of this plant is terete and capillary without the compression characteristic to the body of the pusilloids. This being the case, there can be thought of only three linear-leaved species which possibly may have produced *P. lanceolatus* and *P. rivularis*, viz. *P. pusillus*, *panormitanus*, and *trichoides*. The last mentioned is excluded partly on account of the short peduncles of the hybrid, partly for its lively green colour, partly for the weak nervation and obtuse broad apex of the submersed leaves, and finally for the very faint subepidermal strands in its stem-anatomy. The nervation and leaf-apexes taken together with the behaviour of the stem-prolongation are against *P. panormitanus* also, which, besides, usually has longer peduncles.

The ligules, however, are decisive to my opinion. They are always open and convolute and as to the nervation intermediate between the above two species by being 4—6-nerved in the front-field.

Fig. 68. *P. lanceolatus* SM. A, Top of a submersed leaf, showing the nervation, $\frac{1}{2}$. B, Floating leaf, $\frac{1}{2}$. C, Pistil, side-view, $\frac{1}{2}$.

If we proceed from the leaves, we must as the one of the parents think of a species with floating leaves and many-nerved submersed leaves, thus *P. gramineus*, *alpinus*, *polygonifolius* or *coloratus*. The first mentioned is excluded partly on account of the smooth margin of the submersed leaves, partly and absolutely for the obtuse leaf-apexes with their peculiar nervation, as the side-nerves do not bend out into the point but end with a curve in the midrib. *P. gramineus* $\times$ *pusillus* and still more *P. gram.* $\times$ *mucronatus* must necessarily have cuspidate submersed leaves since this character is essential to both these species. Other circumstances also are against *P. gramineus*, for instance the form of the peduncle, the *O*-endodermis of the stem, the absence of cortical interlacunar bundles in the stem, the feeble ligules, etc. The sessile submersed leaves exclude also undoubtedly the suggestion of *P. polygonifolius* and *coloratus*, whereas everything points in the direction of *P. alpinus*, the stem-anatomy also by the epidermis consisting of large-roomed cells without hypodermatic layer and the endodermis of *O*-cells. Cf. under *P. variifolius*! Above all it is the nervation of the submersed leaves together with their blunt points, the form of the floating leaves and their stalks (always shorter than the blades) and the feeble ligules without ridges that favour the supposition that *P. alpinus* has been active in this case. The stem's mode of prolonging itself corresponds entirely to that of *P. pusillus* and *P. alpinus*. — Turios are not seen by me and are not hitherto described by any author.

The central cylinder of the stem is the same as in *P. pusillus*, which holds good for both the English and French forms. Concerning the description and figures of the former I refer to AR. BENNETT, *P. lanceolatus* SM., in the Journ. of Bot., 1881, t. 217.

Distribution. England, Anglesea, N. Wales, 1808, DAVIES (hb. Uppsal.), »*Potamogeton* sp. nov. Rev. HUGH DAVIES to SMITH 1808 from North Wales»; 1836,

WILSON (hb. Uppsal.), River Lligwy, 75, BAILEY, and others (hb. Stockholm., Uppsal., Lund.); Cambridgeshire, Burwell Fen, 80, BENNETT (hb. Stockholm., Uppsal., Lund.). — *France*, Nièvre, 84, GILLOT (hb. Lund.). — No other stations are known.

***P. stylatus* HAGSTR.**, New Potamog., in Bot. Not., 1908, 98.

I refer this species to the *Alpini* on account of the close relationship it seems to have to *P. alpinus*, both in morphological and anatomical respect. And I catch the opportunity to correct and complete the description of the stem-anatomy of the plant after later investigations of the materials (hb. Haun.).

The anatomical difference between *P. alpinus* and *stylatus* seems to lie in the facts (1) that the former has a large-roomed epidermis without a strengthening layer, whereas the latter possesses a one-layered pseudo-hypoderma and a narrow-roomed epidermis, and (2) that the central cylinder of *P. stylatus* has an oval form instead of the rounded shape outlined in the fig. 63, *D, E*. The bundles are arranged according to the trio-type (fig. 1, *C*) much as in *P. alpinus*.

Subsectio 17. ***Amplifolii* HAGSTR.**

Caulis teres sæpe simplex. *Folia* natantia longepetiolata, breviter—brevissime obtuseque mucronata; submersa ± petiolata, integerrima, sæpè cuspidata, ut plurimum cito putrescentia. *Ligulæ* sæpissime caducæ. *Stylus* brevis, superne crassus vel incrassatus. *Fructus* magnus crassus lævis carinatus vel interdum ecarinatus. *Anatomia* culis: *O*-endodermis; fasciculi libriformes interdum adsunt, sæpius desunt. Fasciculi centrales liberi, mediani duo, sæpe quattuor.

This group comprises a great deal of species endowed with larger or smaller floating leaves (except *P. membranaceus* m.) and large fruits without bosses often prominently keeled and more or less beaked. Styles, as far as known, usually short and a little enlarged upwards. Stigmas oval or oblong often with a free part, which in *P. amplifolius* is rather considerable and characteristic. This species has also more persistent ligules with prominent ridges and richly developed sclerenchyma in the stem.

Within this group we often meet with an arrangement of the vascular bundles of the stele that must be considered to be prototypic. The median bundles belonging to the second leaf, reckoned from beneath, and being in most species united into a compound bundle with three phloem parts, are here often free (*tr* in the figs. 76 and 80), whereby the median bundles grow four: the bundle trio and the opposite bundle. The species with this prototypic disposition are the following: *P. pulcher*, *Fryeri*, *badioviridis*, *linguatus* and *amplifolius*. This interesting fact, however, does not prove anything of the age of these species, since the prototypic condition, after extinction of many interjacent forms, in some respect or other, can return in late arising species. At all events it must not be taken as an evidence that the

coriaceous-leaved species represent the prototype, since many species with floating leaves, as we already have observed, have a reduced number of bundles and the prototypic disposition also occurs in species with only submersed leaves. On investigating in which species this prototypic arrangement appears, we shall find it mostly in the coarser species, especially those with thick stems. From this fact the conclusion may be drawn that the prototype may have been a coarse plant. As I have before pointed out it has been provided with only submersed leaves, which have besides been amplexicaul or sheathing, perhaps also serrulate like *P. Robbinsii* and *densus*, which obviously are ancient types.

Beside the species treated of below we shall probably have to include *P. montevidensis* AR. BENN., *P. Delavayi* AR. BENN., and *P. stenostachys* K. SCHUM. with the *Amplifolii*. The first mentioned has an endodermis of feeble *u*-cells bordering by it upon the *Colorati*. Likewise *P. parmatius* HAGSTR., of Madagascar, may perhaps be referred to this group, or rather to the *Coloratus*-group, or it may be a combining link between them. The position of *P. Thunbergii* is questionable.

P. jamaicensis (GRISEB.) cannot be a var. of *P. plantagineus* DUCR. as is supposed by the author of the Flora of the Brit. W. Ind. Islands, 1864, 506, but must, according to the description, be referred to the *Amplifolii* as a proper species.

On *P. promontoricus* m., see under the *Colorati*!

P. pulcher TUCKERMAN, Amer. Journ. of Science and Arts, 1843, 38. — Fig. 69.

Fig. 69. *P. pulcher* TUCK. A, Transverse section of a colour-wart and air-lacuna close by a septum, $\frac{1}{2}$. B, Radial and longitudinal section through a colour-wart, a, septum, ep, epidermis, hp, strengthening layer, $\frac{1}{2}$. C, Pistil, side-view, $\frac{1}{2}$.

touch of yellow, and so on. They are organs or places arranged for secretions especially dye-stuffs, and always situated at the thin cross-walls of the outer channels. The dissolved pigment moves by degrees to the epidermis-cells and enter their outer walls which, therefore, are sometimes intensively coloured. In *P. pulcher* the colour-warts appear in the shape of small, usually oval or nearly circular, low swellings on the parts concerned.

The stem of this species is described as verrucose and black-spotted (verrucosus: TUCK.; black-spotted: ROBB., MOR.) yet without a closer explication. These blackish green papillæ appear not only on the stem but also on the peduncle and petioles. They correspond the coloured spots or papillæ found in many other species especially on rhizomatic parts and at the base of the stem, for instance in *P. natans*, where they shade in a reddish-brown, *prælongus*, in which they have a

The epidermis, otherwise in general consisting of elongated cells, about 5 times as long as broad, consists here of very short cells of more or less regular cubic form. Inside the epidermis settle 2—4 layers of parenchymatous cells of the same form as the common cortical cells, but to the size generally a little smaller than those. The bottom of the lacuna is extended across those cells (Fig. 69, B, a). In species with 2- or more-celled pseudo-hypoderma no increase takes place and, therefore, no external protuberances are to be found. *P. pulcher* has only a single cell-stratum and, accordingly, papillæ are formed.

As the figure above shows *P. pulcher* has only a single strengthening stratum and lacks subepidermal strands. Interlacunar strands occur neither in the stem nor in the petioles. The central stele of the stem is surrounded by an *O*-endodermis. Vascular bundles arranged according to the diagram in fig. 80 with four median bundles, that is to say a bundle-trio and an opposite bundle.

The species can easily be recognized by its narrowly ovate-lanceolate, short-petioled, submersed leaves with broad lacunar part along the midrib as far as the very apex and feeble ligules. The pistils are those typical to the group. Pollen small-grained.

The species occurs also without true submersed leaves:

f. *amphibius* n. f. — Fol. omnibus coriaceis vel subcoriaceis.

Distribution: U. S. of N. America: Delaware, 74, CANBY (hb. Uppsal.), Nov. Angl., TUCKERMAN (hb. Uppsal.), Massachusetts, several stations: Ashland, Naticks, Readvill, 80—82—83, MORONG (hb. Stockholm.), f. *amphibius*; Apponang Pond, Rhode Island (hb. Stockholm.).

P. rotundatus n. sp. — Fig. 70.

Caulis subhumilis (± 30 cm) teres simplex, internodiis 2—5 cm longis, a foliis floralibus ramis 1:æ—2:æ ordinis prolongatus. *Folia* submersa subcoriacea, infimum phyllodio simile, cetera longe petiolata lanceolata obtusa; natantia coriacea longe petiolata oblonga v. oblongo-lanceolata subcuspidata, 50—75 $\times$ 20—30 mm, 13—19-nervia, subprasina. *Ligulæ* membranaceæ ecostatæ badiæ caducæ cito putrescentes. *Pedunculus* æqualis, 5—8 cm longus. *Spica* florens 22—25 mm, fructificans 25—35 mm longa. *Pollen* globosum. *Pistillum* stylo brevi, stigmatæ parvo ovali-suboblongo. *Fructus* oblique obovatus brevissime rostratus, dorso rotundatus ecarinatus, latere ventrali sæpe inferne sinuatus, 3 $\times$ 2,25 mm.

The colour of the floating leaves of this species is usually prasinous, the shape oblong-lanceolate, their petioles of equal length to the blade or longer. The lower leaves are subcoriaceous, but with longer petioles and narrower lamina. Ligules membranous and without ridges. Peduncle of the same thickness as the internode next below or a little thicker. Fruit of middle-size thorough-

Fig. 70. *P. rotundatus* HAQSTR. A, Floating leaf $\frac{1}{2}$. B, Pistil, side-view, magnified. C, Fruit, side-view, $\frac{1}{2}$.

ly lacking both dorsal and lateral keels. It is rounded upwards and very shortly beaked, on the inside there is usually a sinus (see fig. 70!). Perianths of rounded form broadly obovate—obcordate—nearly square-formed with rounded corners, etc., varying as is often the case with most species. Pollen well-shaped abundant spheric, scarcely of middle-size.

Stem-anatomy: Epidermis without strengthening layer and lacking subepidermal strands, to. Interlacunar bundles wanting. Endodermis of typical *O*-cells; central cylinder with eight free vascular bundles. I have scarcely met with a species corresponding so nearly to *P. nodosus* as regards the stem-anatomy as this. It differs by the smooth leaf-margin, the long lower petioles, the prasinous leaf-colour, the ligules, the styles, and chiefly by the characteristic fruits.

Distribution. *N. America*, Novo-Mexico, 1847, FENDLER (hb. Stockholm.), Mexico, State of Chihuahua, Guerrero, 87, PRINGLE (hb. Uppsal.), signed »1390. *P. fluitans* RTH». Nebraska, 93, RYDBERG (hb. Haun.); Marin Co., Cal. 78, EDWARDS (hb. Haun.).

P. Tepperi AR. BENNETT.

Journal of Botany, 1887, 178. — Fig. 71.

Beside fruits only a few fragments of this species are present. — Stem terete, 1.5–2 mm thick. The stem-anatomy is characterized by the epidermis possessing a one-celled pseudo-hypoderma but typically lacking subepidermal strands. The bark consists of three circles of rather narrow lacunæ without bast- and vascular bundles. Central cylinder comparatively thick, of oval crosscut-form with *O*-endodermis and 8 (–12) well separated vascular bundles with more or less strong and complete bast-sheaths. The bundle-trio is united into a compound bundle, trio-type diagram.

Fig. 71. *P. Tepperi* AR. BENNETT. Transverse section of the stem, $\frac{3}{4}$, ep, epidermis, l, lacunar system, cc, central cylinder, tr, trio-bundle.

The specimen examined is labelled »500 miles N. of Brisbane. Queensland. Australia, 1885. leg. F. M.

BAILEY» (hb. Stockholm.). The species is Australian. The Asiatic statements of this plant are doubtful and need confirmation.

P. insulanus n. sp. — Fig. 72.

Caulis teres tenuis ca. 0.5 m altus, internodiis $\pm$ 5 cm longis paulo ramosus, ramo prolongatus. *Folia* submersa anguste lanceolata, petiolata vel subpetiolata, apice $\pm$ obtusa, integerrima, 5–7-nervia, cito putrescentia; natantia $\pm$ coriacea petiolata lanceolata, 45–50 $\times$ 8–9 mm, 7–11-nervia. *Ligulæ* ca. 20 mm longæ membranaceæ caducæ. *Pedunculus* æqualis $\pm$ 75 mm longus. *Spica* parva, 5–10 mm longa.

To judge from the persistent remainders, the submersed leaves have been about

Fig. 72. *P. insulanus* HAGSTR. A, Floating leaf, $\frac{1}{2}$. B, Top of submersed leaf (enlarged).

70 to 80 mm long and 6 mm broad. In case the specimens quoted under *P. nodosus* belong hereto, these leaves are a little longer and broader than the measures above stated. The base tapers petiole-like or is short-petioled. Upper leaves longer stalked, petioles of the floating leaves nearly equalling the lamina. Submersed leaves quite lacking a serrulation, and only the midrib seems to be provided with lacunæ. — The materials, however, are rather scanty and specimens with broader floating leaves may be found.

The stem-anatomy reminds much of *P. nodosus* or *alpinus* by its *O*-endodermis, free vascular bundles of the central cylinder and the absence of interlacunar bundles in the cortex. Someone or other strand sometimes seems to occur subepidermally, though it may not be the normal. Upon all accounts it seems to be separate from *P. nodosus* as well as from *P. Nuttallii*; nor can it be, as I think, a cross between these species, though the small, undeveloped spikes might seem to indicate a hybrid origin of the plant.

Distribution: America, Portorico, Aguas buenas, 85, SINTENIS (hb. Stockholm.); the label bears the following note: — »*P. Sintenis*: Plantæ Portoricenses no. 2537. *P. pensylvanicus* WILLD. Aguas buenas 8. 9. 1885. Det. A. BENNETT». As it will be seen Mr. BENNETT has considered it to be *P. pensylv.* (= *P. Nuttallii*) and it is likely to be the same or a similar form which GRAEBNER (in Pflanzenreich, 1907, 56) has named *P. Nuttallii* γ *portoricensis*. Might this plant of Puerto Rico be identic with the *P. plantagineus* var. *jamaicensis* of GRISEBACH?

P. hindostanicus n. sp. — Fig. 73.

Caulis teres simplex, internodiis 6—8 cm longis, ramo prolongatus. *Folia* submersa integerrima lanceolata longe et acute cuspidata longe petiolata ca. 15-nervia, laminis 100—120 mm longis 20—22 mm latis, petiolis $\pm$ 50 mm, superioribus ad 80 mm longis; natantia lanceolata apice obtuse subcuspidata, 80 $\times$ 20 mm. *Ligulæ* badiæ subpersistentes amplectentes, ad basin $\pm$ conspicue bicostatæ, 40—50 mm longæ. *Pedunculus* æqualis $\pm$ 80 mm longus. *Spica* florens 15 mm, deflorata 40 mm longa.

As to shape the submersed leaves resemble the leaves of *P. lucens*. The lateral nerves do not spring from the basal part of the midrib, but branch from it

Fig. 73. *P. hindostanicus* HAGSTR. A, The blade of a submersed leaf showing the course of the longitudinal nerves (see the text), $\frac{1}{2}$. B, The top of a submersed leaf showing the venation and the form of the nerve-spaces (somewhat enlarged).

along the whole length up to the middle and above. The interspaces formed by the cross-veins are narrow especially at the middle of the leaf. Margin smooth, base oval to lanceolate, petioles long but shorter than the blades at least below.

Stem-anatomy: Epidermis with a one-celled pseudo-hypoderma, no or few cortical bundles, O-endodermis and 8 free vascular bundles in the central cylinder (trio-type).

Though we cannot give the description of the pistils and fruits, the species however is recognizable by the proprieties stated above. I have hesitatingly distributed the above name to the plant concerned, inasmuch as it in many respects seems to answer to the description of *P. sumatranus* MIQ. When nevertheless, according to MIQUEL's own statement, his species lacks floating leaves and even indications of them, *P. hindostanicus* cannot possibly be identical with it. Nor with *P. indicus*, which, like *P. sumatr.*, has the submersed leaves more obtuse, never cuspidate as in *P. hindostanicus*, cf. CHAM., Linn. 1827, 230. See also under *P. nodosus*!

Distribution: Asia, Western Himalaya, Kashmir, 56, SCHLAGINTWEIT (hb. Stockholm.), »no. of Catalogue 4615». Bengal, aug. 68. Leg. S. KURZ (hb. Haun).

***P. Franchetii* AR. BENNETT et BAAGÖE, in AR. BENNETT, Two new Japanese Potamogetons, The Journ. of Botany, 1907, 234. — Fig. 74.**

Fig. 74. *P. Franchetii* BENN. & BGE., and *P. digynus* WALL. A, Transverse section of the central cylinder of the latter, $\frac{1}{10}$, end, endodermis. B, Pistil, side-view, $\frac{1}{10}$, and C, Stigma, from above, $\frac{1}{10}$, of *P. Franch.* D, Fruit, side-view $\frac{6}{1}$, (*P. dig.*).

This species seems to be profusely spread in East Asia, together with *P. perversus* AR. BENN., which is *P. digynus* WALL. and *P. elegans* WALL.. They differ from one another in the following way: *P. Franchetii*: Upper leaves broader, 15–17-nerved, more obtuse; stigma, see fig. 74, B, C; fruit with lateral bosses upwards. *P. digynus* (*perversus*): Leaves narrower, 13-nerved, more acute, much as the shape of the fig. 77, B; stigma more rounded; fruit without pectoral bosses (fig. 74, D).

Stem-anatomy: epidermis lacking strands and pseudo-hypoderma, no bast- or vascular bundles present in the cortex, endodermis of O-cells (*P. Franchetii*), or O-cells with more or less conspicuous u-cells intermixed at intervals (*P. dig.*). Central cylinder of trio-type in both.

Distribution. *P. dig.*: Korean Archipelago, 1863, coll. R. OLDHAM (hb. Stockholm). Nepalia, WALLICH 5177, Singapor, WALL. 5178, — *P. Franchetii*: Japan, Yokohama, 1862, MAXIMOVICZ (hb. Stockholm), Tokio, Hirimushiro and Yokoska, NIPPON, FRANCHET (hb. Haun.).

***P. apicalis* n. sp.**

Caulis ca. 3 dm. v. ultra, teres, crassus (3 mm. in diam.) dense nigripunctatus, nodis annulatus, internodiis mediocribus (summo ca. 6 cm.), simplex v. ramis 1:æ—2:æ ordinis prolongatus. *Folia* (late) lanceolata, coriacea (infima ?) longe petiolata, summa

21-nervia, 90×30 mm, sub spica prim. 100×25 , 19-nerv. *Ligulae* 40—50 mm longæ, bicarinatæ, badiæ, membranaceæ, in spatio intercarinali 15-nerviæ. *Pedunculus* primarius ca. 90 mm l., crassiusculus. *Spica* deflorata ca. 40 mm. longa. *Folia* perianthii longe unguiculata. *Pistillum* breviter stylatum, stigmate oblongo. *Fructus* $3,2 \times 2,5$, $\pm$ carinatus, rostro brevi apicali v. subapicali, operculo rotundato.

Anatomy of the stem: epidermis-cells about ten times as long as broad, two-layered pseudo-hypoderma, no subepidermal or ligular bundles, O-endodermis, central cylinder prototypic (see p. 162).

The specimens examined are labelled: *Uruguay*, Paso Zapeyú, 01, BERRO (hb. Haun.).

P. membranaceus n. sp. — Fig. 75.

Caulis teres simplex ut videtur, ramo primæ ordinis prolongatus, internodiis elongatis, sub spica primaria ca. 12 cm. longis. *Folia* omnia membranacea, lanceolata, apice brevissime et obtuse mucronulata, basi lanceolata vel ovali-lanceolata, $55-65 \times 13-15$ mm, integerrima, 13—15-nervia, nervo medio reticulata, petiolata, petiolo 8—20 mm longo angusto. *Ligulae* membranaceæ caducæ fere ecostatæ, 25—30 mm longæ in superiore parte caulis. *Pedunculus* æqualis, ± 10 cm longus. *Spica* florens 15 mm longa densa. *Pollen* globosum parvum. *Pistillum* breviter stylatum, stigmate parvo ovali instructum.

The species described above is by Mr. AR. BENNETT in Dr. TISELI herbarium (now in hb. Stockh.) united with his *P. Cheesemanii*. The latter species, however, being characterized by a rich production of floating leaves, can scarcely be united with *P. membranaceus*, in which no trace at all of such leaves can be observed. Besides, the leaves are short-petioled and provided with an obtuse little cusp, certainly very short but distinct. Further they are broader and with more nerves than the submersed leaves of *P. Cheesemanii*. Styles shorter and not so much swollen. Fruit not seen.

The central cylinder of the stem has eight to ten free vascular bundles and O-endodermis. In the bark there is a circle of bast- and vascular bundles, but no subepidermal strands are observed. Epidermis without strengthening layer.

The branch which prolongs the stem has unusually stretched internodes, the lowest as far as 19 cm. The specimens examined are gathered in running water,

Fig. 75. *P. membranaceus* HAGSTR. A Involucral leaf with the crossveins left out, $\frac{1}{2}$. B, The top of the same, magnified. C, Diagrammatic cross-section of the stem, showing only the form of the central cylinder and the arrangement of its bundles and of the bundles of the bark, $\frac{2}{3}$. cc, central cylinder, str, cortical bundles, ep, epidermis. D, Pistil, side-view and from above, $\frac{1}{2}$.

but the differences from *P. Cheesemanii* cannot be explained from that fact, at least not the short upper petioles, broader lamina, and the above described little cusp. The pistil is also another and likewise the stem-anatomy. I refer to what is said under

P. Cheesemanii and to the figures 75 and 91. Although I have seen no ripe fruit and, besides, but inconsiderable materials, I do not hesitate to consider it as a distinct species which may ad interim be united with the *amplifolius*-group.

Distribution. New Zealand, Waihi stream, Waikato, N. Isl., 84, CHEESEMAN (hb. Stockholm).

P. Fryeri AR. BENNETT.

Two new Japanese Potamogetons, in The Journ. of Bot., 1907, 234. — Fig. 76.

The plant from Japan, Kiusiu, preserved in hb. Stockholm, no doubt belongs to this species, although the long spikes do not answer to the description. The spikes are in flowering state 30—40 mm, and deflorate 40—50 mm long. *P. Fryeri* is said to have the spikes merely 2 cm in length and the peduncles thickened above, which is not the case with here accessible materials. A very significant property of the Kiu-Siu plant is the long-petioled perianth-leaves. Limb broadly rounded and shorter than the claw. Pollen of middle size and spheric. Styles elongated and incrassate upwards, with oval, rather small stigmas. There would be no hesitation if the anatomic diagram of the stem were given in the description. The plant here referred to has the following stem-structure: The epidermis, which consists of large-roomed cells, has a one- or two-celled strengthening layer with bast-bundles scattered at intervals. These pseudo-hypodermal bast-bundles often show an inclination of moving a little inward to the radial interlacunar walls. Interlacunarily there are

Fig. 76. *P. Fryeri* AR. BENNETT. A, The nethermost leaf of the stem, $\frac{1}{2}$. B, The lowest leaf but one, blade, $\frac{1}{2}$. C, Involutural leaf, base and top of the blade (blade $\pm 80 \times \pm 35$ mm). D, Perianth leaf straightened, and magnified, with anthers. E, Pistil, a, side-view, b, from the inside, c, stigma from above, $\frac{1}{2}$. F, Part of a ligule in cross-section at base showing a ridge and some bundles, $\frac{1}{2}$. G, Part of a cross-section of the stem, $\frac{3}{4}$, tr, bundle-trio, hp, strengthening layer with 3 bast-bundles, ep, epidermis, str, cortical bundles, cc, central cylinder.

2 to 3 circles of bast- and vascular bundles (see the fig.). The endodermis consists of O-cells and the central cylinder has ten free vascular bundles, six of which are lateral and 4 median, the arrangement consequently being prototypic as in *P. pulcher*.

Distribution. Japan, Kiusiu, Kundalo-San, 1863, MAXIMOWICZ (hb. Stockh.). I have also seen specimens from »Hakodate Arigona», gathered ¹²/₂₄ June 1861 by MAXIMOWICZ, it. sec. (hb. Petersburg), and from Ins. Saghalien, 08, FAURIE (hb. Haun.).

***P. pleiophyllus* n. sp. — Fig. 77.**

P. natans L. f. *indica* MIQ., Fl. Ind. Bat. Suppl. I, 1860—62, 259, 597? Cf. MIQ., Flore de l'Arch. Indien, 1870—71.

Caulis 30—70 cm. altus teres tenuis simplex vel inferne ramulis brevibus, internodiis ca. (10—) 60—120 mm longis. *Folia* infima linearia filiformia, 100 × 1 mm, ± acuta, 3-nervia; superiora ± coriacea numerosa petiolata, petiolis tenuibus 50—110 mm longis, lanceolata vel basi ± rotundata, apice brevissime et ± obtuse cuspidata (»les feuilles nageantes sont plus ou moins elliptiques au sommet aiguës, à la base aiguës ou presque aiguës»: MIQ.), 35—70 × 10—18 mm, 11—13-nervia. *Ligulae* tenues, 20—40 mm, inconspicue bicarinatae, fusciscentes deciduae, 5—6-nerviae. Spec. sine fructu.

Tall specimens of this species are easily recognizable by the numerous (10—12) and slenderly long-petioled small leaves with more or less coriaceous blades even beneath the primary spike. The lowest leaf, at least in deep-water specimens, lacks limb, whereupon follows one or a couple of transitional leaves with very slight limb (10—20 mm). In shallow-water specimens those transition leaves seem to be the very nethermost.

Stem-anatomy: Central cylinder with 2 median and 6 lateral free bundles, O-endodermis, one circle of interlacunar bast- and vascular bundles in the cortex and no or extremely few subepidermal strands, epidermis without, or endowed with a one-celled strengthening layer.

MIQUEL has looked upon this plant as a variety of *P. natans*. I am inclined to think that his f. *indica* consists of both *P. pleioph.* and *P. digynus*.

Distribution. Asia, India: Khasia, HOOKER & THOMSON (hb. Lund). — Specimens from »Alatan pandjang, W. K. Sumatra» (leg. TEYSMANN) seem to me to belong to this species, or possibly rather to *P. digynus* (*perversus*). — China, Yunnan, and Formosa, l. HENRY (hb. Haun.).

Fig. 77. *P. pleiophyllus* HAGSTR. A, Top of the lowest submersed leaf, ⁵/₁. B, Blade of a floating leaf showing the usual shape of it, ¹/₁. C, Part of a transverse section of the stem, ⁵/₁, str, subepid. strand, cc, central cylinder, end, endodermis, vb, cortical bundles, ep, epidermis.

***P. stagnorum* HAGSTR. ap. R. E. FRIES, Bot. Unters. in Wiss. Ergebn. schwed. Rhod.—Kongo-exp. 1911—12, I, 1915, 187, fig. 16. — Fig. 78.**

Caulis ca. 30 cm altus simplex teres vel subteres, internodiis inferioribus 50—75

mm longis. *Folia* omnia petiolata laminis coriaceis $\pm$ tenuia; inferiora petiolis longioribus laminis parvis, superiora petiolis brevioribus, ca. 75 mm longis, laminis majoribus, $65-70 \times 25-30$ mm, ± 19 -nerviis, oblongis, basi et apice rotundatis vel apice subcuspidatis; petioli $\pm$ biconvexi. *Ligulae* 30–50 mm longae subcaducae basi obsolete bicarinatae. *Spicae* desunt.

Anatomy of the stem: Epidermis-cells of usual form about 3–5 times as long as the width; one-celled pseudo-hypoderma; no subepidermal strands. Cortex of usual structure with one circle of vascular and bast bundles (about twelve in number). Endodermis of *O*-cells. The central cylinder presents an eight-bundled diagram type. Bast-cells and other mechanical cells are few in number.

Distribution. South Africa. Rhodesia, in the Chimona River near the Lake Bangweolo in stagnant water, ROB. E. FRIES, 1911, n:o 691. This is the only station from which this plant is hitherto known.

Fig. 78. *P. stagnorum* HAGSTR. A, Transverse section of the stem, $\frac{5}{1}$, cc, central cylinder, l, lacunar system, vb, cortical bundles, ep, epidermis, hp, pseudo-hypoderma. B, Transverse section of a petiole showing the five principal vascular bundles (vb), the arrangement of the lacunar system (l), the cortical bundles (cb) and the subepidermal strands (str), $\frac{2}{1}$.

P. fibrosus n. sp. — Fig. 79.

Caulis teres, 2–2,5 mm crassus. *Folia* superiora oblonga vel ovato-lanceolata, brevissime et obtuse cuspidata, $75-85 \times 25-30$ mm, 15–19-nervia, nervo medio prominente, petiolata brunnea. *Ligulae* inferne conspicue bicarinatae, ca. 40 mm longae. *Spica* deflorata 45 mm longa, verticillis quindecim. *Pedunculus* ut in *P. natante*. *Fructus* non visus. *Anatomia caulis*: vide infra!

Only the three top most internodes of a spike-bearing shoot have been accessible, in habit very much resembling a top of *P. natans*, or any other species with similar floating leaves. It seems as if the leaf-base would hardly assume the subcordate form characteristic to some other species. The styles and stigmas are overripe and cannot, therefore, be described. Nevertheless the species can easily be distinguished from all the other similar forms by the anatomic diagram of the stem. The epidermis is provided with a one-celled strengthening layer and numerous bast bundles. Interlacunarily there is one, and commonly a faint beginning to a second circle of vascular- and bast bundles. Endodermis of *O*-cells, central cylinder with 8 free vascular bundles, each with strong bast elements along the endodermis and in the pith. Those strong open bundle-sheaths are exceedingly significant of this species.

The habitat of this plant is not surely known to me. The label bears only a number, »91», but I am probably not mistaken, when supposing it to originate from South Africa.

The specimen here concerned is kept in hb. Stockholm.

P. badioviridis n. sp.

Caulis teres crassus simplex, internodiis 30 mm longis vel ultra. *Folia* inferiora subcoriacea ovalia $\pm$ longe petiolata multinervia caduca, superiora coriacea tenuia oblonga basi rotundata apice rotundata vel obtuse subcuspidata $\pm$ 21-nervia, $80-85 \times 35-40$ mm, petiolata petiolis longis (± 100 mm). *Ligulae* 80 mm longae bicarinatae badiovirides. *Spicae* non evolutae. *Anatomia* caulis: vide infra!

Stem stout, 3–4 mm in diam., for the rest of about the habit of *P. rotundatus* or *stenostachys*. From these, however, it is well distinguished by the above given characters and the anatomic stem diagram. Especially significant are the long ligules and the broad lower leaves of subcoriaceous structure. Nor can it be intermingled with *P. linguatus*, otherwise of the same distribution, which has true membranous submersed leaves with shorter ligules and richly developed subepidermal bast bundles.

Stem-anatomy: Epidermis with a two-celled strengthening layer; few faint subepidermal strands of only 1 to 3 or 5 cells, and interlacunarly in the bark 1–2 circles of bundles. The endodermis consists of usual *O*-cells and the arrangement of the vascular bundles of the central stele is prototypic with four median bundles, see the fig. 80, A.

Distribution. *S. America.* W. Patagonia, Rio Yelcha, 8. 1908. C. SKOTTSBERG (hb. Uppsal.), n:r 386.

P. ferrugineus n. sp.

Caulis ca. 0,5 m altus v. ultra, teres, crassus (3 mm in diam.), nodis annulatus, internodiis mediocribus v. brevibus, simplex usque ad spicam primariam. *Folia* ferruginea, coriacea (omnia v. fere omnia), superiora (omnia?) longe petiolata petiolis laminas aequantibus v. superantibus, lanceolata, basi sensim attenuata, apice obtuse et conspicue cuspidata, laminis $70-90 \times 20-30$ mm, 19–21-nervia. *Ligulae* 35–45 mm l., bicarinatae fuscae firmæ, in spatio intercarinali 12–15-nervia. *Pedunculus* teres aequalis ca. 6 cm longus. *Spica* deflorata ca. 30 mm. l. *Fructus* siccus $3,5 \times 2,5-3$ mm eo *P. nodosi* simillimus (sed major) carinatus, rostro subapicali, operculo conspicue carinato, epicarpio loculoso.

Anatomy of the stem: epidermis-cells somewhat stretched (3 to 6 : 1), pseudo-

Fig. 79. *P. fibrosus* HAGSTR. A, Blades of the floral leaves, $\frac{1}{2}$. B, Part of cross-section of stem, $\frac{3}{2}$, str, subepid. strands, skl, sclerenchymatous tissue, cc, central cylinder.

hyp. two-(1-)layered, scattered subepidermal strands, no ligular or cauline bundles, *O*-end., and a stele with a prototypic diagram.

This species resembles very much some other South-American species, wherefore I think it proper to give the following

Synopsis of some S. American coriaceous-leaved species, which non-fruitlet often are very difficult to distinguish from each other:

- A. Pseudo-hypoderma wanting:
 - a. Cortical strands entirely absent *P. nodosus.*
 - b. Ligular strands few, in one circle » *montevidentis.*
 - c. Lig. str. + cauline str., in two circles » *stenostachys.*
- B. Pseudo-hyp. one-layered: » *spoliatus* m.
- C. Pseudo-hyp. two-(1—4-)layered. Central cyl. of the prototypic type:
 - a. Cortical strands entirely absent *P. apicalis.*
 - b. Subepidermal strands present » *ferrugineus.*
 - c. Ligular bundles only » *badioviridis.*
 - d. Subepid. str. + lig. + cauline bundles » *linguatus.*

Distribution of *P. ferrugineus*. *Argentine Rep.*, Casa Bamba, Sierra chica de Cordoba, 09, STUCKERT, n. 19876 (hb. Haun.). *Uruguay*, Vegigas, 06, BERRO, n. 4189 (hb. Haun.).

P. linguatus HAGSTR.

Ap. P. DUSÉN, Zur Kenntnis der Gef.pfl. des südl. Patagoniens, in Öfversigt af K. Vet. Ak. Förh., 1901, no. 4, 259—262, cum fig. — Fig. 1, B, 80.

Fig. 80. *P. linguatus* HAGSTR. A, Anatomic diagram of the central stele, *tr*, bundle trio, *ctr*, opposite bundle, *p*, pith, *end*, endodermis. B, Pistil, side-view, $\frac{1}{2}$. For other details I refer to the original description, where also a habitus fig. is given.

This species is at full development coarse-grown with thick and rigid stem, broad, many-nerved (± 21 nerv.), not lacunous submersed leaves, and broad, strong ligules. The floating leaves seem generally not to appear at the primary spike, but first in the eking piece of the stem, which consists of many internodes. The stiffness of the stem is caused by the rather short epidermis-cells, the 2—3-layered pseudo-hypoderma, the numerous subepidermal strands, and the many free bundles of the stele. The median bundles of the stele are typically four and the lateral ones about eight, four on each side, encompassed by an *O*-endodermis, the whole thus presenting a prototypic aspect (Fig. 80, A).

The fruit and styles cause this species to be united with the *Amplifolii*. The styles are namely short and thick with oval or oblong small stigmas. Pollen spheric of middle size. *P. alpinus* forms a separate group on account of the styles and fruits and so does also *P. nodosus* because of the leaf serrulation. The phyloge-

netic position of *P. linguatus*, earlier a little doubtful (cf. BENNETT in The Journ. of Bot. 1902, 147!), can now be considered as fully settled by the knowledge of the pistils.

Distribution. *South America*, Chile austr., Llanquihue, 97, DUSÉN (hb. Stockholm.), Patagonia, Kark, 99, BORGE (hb. Stockholm.), Tierra del Fuego, Betbederdal, $14\frac{1}{3}$ 08, SKOTTSBERG (hb. Uppsal.).

***P. amplifolius* TUCKERMAN.**

Observations on some New England Plants, in The American Journ. of Sci. and Arts, 1848, 225—226. — Fig. 81.

The submersed leaves are entire (without serrulation) and many-nerved; principal nerves accompanied by lacunæ; the last branching of the midrib takes place above the middle as in *P. hindostanicus* and *linguatus*. Ligules elongated and strong, with prominent sharp double ridges at base. Styles a little thickened; stigmas narrow, with a long free part. Pollen spheric, of middle-size.

The floating leaves have the same form as in *P. natans*, but differs from this and all the other species by the very numerous (30—40) longitudinal nerves. The stem-epidermis is provided with a one-celled strengthening layer typically lacking bast-bundles. Interlacunarily, on the other hand, several circles of bundles occur in the cortex. Endodermis of usual *O*-cells; the arrangement of the vascular bundles of the central stele prototypic.

For the variations I refer to AR. BENNETT, Notes on Potamogeton in The Journ. of Bot. 1904, 70. He distinguishes three forms: var. *ovalifolius* MORONG, f. *amphibius* BENN. and an extreme form with larger submerged leaves than in general. Of the first mentioned there are specimens in hb. Stockholm. from Manistee, Mich., coll. by MORONG himself and labelled »v. *ovalifolius* MORONG» with his own hand. I have also seen a form quite destitute of floating leaves, f. *homophyllus*, m.

Distribution. *N. America.* Several specimens are present in the Swedish Museums from Canada, Plevna, Ont. 02, FOWLER (hb. Stockh.) and the United States gathered by MORONG, TUCKERMAN (hb. Upps.) and TORREY (hb. Stockh.). How far it extends to the north and the south is not fully explored. SMALL does not record it in his Flora of the South-eastern United States, 1903. ROBINSON & FERNALD in GRAY'S New Manual, 1908, state, »N. Scotia to B. Columbia, south to N. Y., Ky., Kan., and Col.» — Records from S. America, Argentina, no doubt refer to another species,

Fig. 81. *P. amplifolius* TUCK. A, Top of a submersed leaf, showing the form and nervation (a little magnif.). B, Pistil, sideview, $\frac{1}{2}$, st, stigma, sty, style, ov, ovary.

P. amplifolius TUCK. × **illinoensis** MOR. (**P. scoliophyllus** HAGSTR. n. hybr.).

Folia submersa ± recurvata modo *P. amplifolii*, natantia in omnibus partibus præsertim ad apicem, nervaturam, magnitudinem, petiolosque medium inter *P. amplifolium* et *illinoensem* tenentia.

The plant here concerned manifests its connection with *P. amplifolius* by the densely running longitudinal nerves of the floating leaves. *P. illinoensis* can be traced in the obtuse apices and dense cross-veins of the amphibial leaves, the shorter ligules, the rudimentary denticulation of the submersed leaves, the short internodes of the branches of the stem-prolongation, and in the anatomical conditions of the stem. In the respect last mentioned it corresponds nearly quite with *P. illinoensis*. Only in the complete absence of subepidermal bast we detect an influence from *P. amplifolius*. The petioles of the submersed leaves correspond with those of the two parent species. The petioles of the proper floating leaves are not quite so long as the laminæ and consequently intermediate. Such floating leaves are found first in the second rank branch of the stem-prolongation and are small, 35—50 × 20 mm, an obvious influence from *P. illinoensis* which often lacks proper floating leaves. The peduncles are slightly incrassate. The plant is quite barren and the pollen is also sterile.

The collector of the plant has labelled it as *P. lucens* but added in a parenthesis »an *P. Zizii* M. & K.?» and, in fact, it has a great habitual resemblance of it. On closer examination, however, it appears, that the plant has nothing to do either with *P. lucens* or *gramineus*. In the Berlin Museum there are some specimens from the same locality labelled »*Potamogeton lucens* × *gramineus* den 6 febr. 1899. P. GRAEBNER det.» I know this beautiful hybrid from only two other stations, viz. »Cedar Lake, Ontario» and »Buckingham, Quebec». Several North-American »*P. Zizii*», nevertheless, might be this hybrid. Since it is probable that the American botanists will find forms of this hybrid with more *amplifolius*-like aspect in the floating leaf region the now distinguished form with late developed and small floating leaves may conveniently be named:

forma *barensis* n. f. — Forma *P. scoliophylli* foliis coriaceis parvis et sero evolutis.

Distribution: »In lacu Bar ad Manistee, Michigan, U. S. A., 1882, »MORONG (hb. Stockholm., Berolin.). Canada, see above!

Subsectio 18. **Muricati** HAGSTR.

Caulis ut in præcedente. *Folia* natantia sæpe breviter petiolata obtusa; submersa ± petiolata vel sessilia. Ligulæ ± persistentes. *Pistillum* stylo magis elongato vel saltem conspicuo. *Fructus* carinatus rostratus ± muricatus. *Anatomia* caulis: O-endodermis; fasciculi libriformes subepidermales et intraloculares semper adsunt. Fasciculi centrales liberi, mediani semper duo.

The species belonging to this group develop their fruits, like the *Javanici*, with protuberances on the keels and sides, for which a disposition can be observed already on the ovaries. As, besides, the styles are also more conspicuous, the ligules stronger, the coriaceous leaves often short-petioled and more roundish-obtuse, and the stem always furnished with numerous cortical strands, but usually no hypodermatic layer etc., the group is easily distinguished from the next foregoing. It seems to be a special Australian group, although, interesting enough, a South-American species also, and probably *P. mexicanus* (= *P. montanus* PRESL?), of Mexico, belong hereto.

Of *P. similis* AR. BENNETT, see under *P. Cheesemanii*.

P. muricatus n. sp.

Caulis teres, 2—3 mm crassus, simplex, sed a spica primaria ramis 1:æ—2:æ ordinis spiciferis prolongatus, ca. 0,5 m altus, internodiis 2—5 cm longis. *Folia* inferiora membranacea ovato-lanceolata, 60—80 × 25—30 mm, breviter petiolata, petiolo lato ± 5 mm longo, obtusa integerrima 11—13-nervia, nervo medio reticulata; nantia coriacea ovalia—ovato- vel subcordato-ovalia—subcordato-rotundata, 45—50 × 25—30 vel 45—65 × 35—45 mm, apice obtusa vel subretusa, 17—23—27-nervia, petiolata, petiolo lamina brevior ± 25 mm longo valido, jam infra spicam primariam 4 evoluta. Ligulæ membranaceæ caducæ bicostatæ, costis humilibus, ad basin loculis oleiferis annulatum instructæ. *Pedunculus* crassitie caulem æquans, 35 demum ad 60 mm longus. *Spica* sub anthesin densa, 25 mm longa, deflorata 50 mm, multiflora. *Appendices* staminate cuneatæ. *Pollen* sphæroideum, magnitudine media. *Pistillum* stylo elongato superne incrassato, stigmate parvo ovali. *Fructus* rotundatus rostratus, 3 × 2,25 mm, tricarinatus carinis cristatis, lateribus impressis superne muricatis. — Fig. 82.

At first I thought this plant to be identic with *P. sulcatus* BENN., which also is a member of this group. It must, however, be

Fig. 82. *P. muricatus* HAGSTR. A, 1, Floating leaves, 2, submersed leaf. B, Fruit, side-view. C, Pistil, a, lateral view, b, from the ventral side, c, from above. D, Part of a transverse section of the stem. ep, epidermis, str, subepid. strands, i, interlacunar bundles, lb, lateral bundles, tr, triobundle, ctr, opposite bundle of the central stele.

another species according to the author's description in 1892, which later approved is adopted by P. GRAEBNER in his revision of the genus in 1907. *P. sulcatus*, therefore, has 30—36-nerved leaves, much larger fruits, longer spikes, and so on.

P. muricatus is recognized by the broad-petioled ovate-lanceolate submersed leaves, the broad short-petioled early appearing floating leaves, conspicuously elongated styles and particular fruits (see the fig.!). The anatomic topography of the stem has the following aspect: epidermis without a pseudo-hypoderma but with numerous bast bundles, one circle of scattered interlacunar bast- and vascular bundles, *O*-endodermis and 8 free central bundles with strong bast-sheaths (in the fig. more strongly hatched). In the trio the bundles are sometimes more fused, sometimes, again, more free from each other, thus forming a transition to the foregoing group. Except those bundle-sheaths there is no mechanic tissue in the pith.

Distribution. *Australia:* »N. S. Wales, Major Vicary, 1836, 7» (hb. Stockholm.). Another station is: N. S. Wales, Tia River near Walcha, where it is gathered by J. H. MAIDEN, 1897.

***P. samariformis* n. sp.**

Caulis humilis teres simplex, ramo unico prolongatus. *Folia* submersa sessilia, lanceolata, basi attenuata, apice obtusa, 7—9 cm longa, 7—10 mm lata, 7-nervia, nervo medio non lacunosa, summa natantia ovalia obtusa obscure cuspidata, basi ovata vel obscure cordata, 35—45 × 16—20 mm, 13-nervia petiolata petiolis brevioribus (ca. 30 mm longis). *Ligulae* tenues badiæ deciduæ, ca. 20 mm longæ. *Pedunculus* teres, non incrassatus ca. 30 mm longus. *Spica* deflorata 23—25 mm longa, 7—8-verticillata. *Pistillum* stylo subalato conspicuo, stigmathe ovali parvo. *Fructus* compressus, 3 × 2,5 mm, pæne circularis, sinuose alato-carinatus, rostratus rostro alato.

The anatomical diagram of the stem is characterized by an epidermis without pseudo-hypoderma, numerous subepidermal bast-bundles but no cortical strands, *O*-endodermis and an eight-bundled central cylinder.

The plants here concerned might be mistaken for *P. similis* A. BENN., but differ by longer submersed leaves which are 7-nerved and obtuse, by the absence of a lacunar areolation along the midvein, by the even peduncle, and by the fruit lacking bosses at the base.

I have seen specimens only from »Nov. Holland. austr., Dr BEHR», coll. by F. MÜLLER (hb. Kristiania), named *P. natans* R. BR.

***P. tricarinatus* F. MÜLLER & AR. BENNETT.**

In the Journal of Botany, 1892, 229.

The stigma of this species is oblong and as to about half its length free from the style (see fig.!). The stem anatomy does not essentially differ from that of the

preceding. The interlacunar bundles usually appear in two circles and the central cylinder has a more rounded or rhomboid cross-cut form. The cortical lacunar system consists of 4 circles of rather narrow and equal canals. In the preceding the difference between the inner and outer ones is relatively greater. The trio is transformed into a single bundle.

Distribution: New Zealand, Nepan River, 99, MAIDEN (hb. Stockh.). Also in Eastern Australia.

Fig. 83. *P. tricarinatus* M. & B. A, Cross-section of the stem, *tr*, trio-bundle, *ctr*, opposite bundle (for the rest, *cfr* fig. 82), $\frac{1}{2}$. B, Pistil, *a*, side-view, *b*, stigma from above, $\frac{1}{2}$.

P. sessilifolius n. sp. — Fig. 84.

Caulis 0,5 m altus et ultra, internodiis 5–6 cm longis, teres ca. 2 mm. in diametro crassus, simplex, a basi pedunculi ramis spiciferis 1:æ–2:æ ordinis prolongatus. *Folia* natantia cordato-rotundata v. subcordato-ovalia 15–17-nervia, 25–27 × 17–21 mm, petiolata, petiolis fol. floralium laminis longioribus, ceteris æquilongis; submersa ovali-lanceolata sessilia brevissime cuspidata integerrima membranacea margine undulata 11-nervia, nervo medio reticulata, 65–100 × 13–18 mm. *Ligulæ* membranacæ fere ecostatæ subpersistentes amplexantes ± 20 mm longæ. *Pedunculus* crassitie caulem æquans, ca 4–6 cm longus. *Spica* florens 15–20 mm longa. *Pistillum* stylo conspicuo fere ut in *P. muricato*.

Fig. 84. *P. sessilifolius* HAGSTR. A, Floating leaf, $\frac{1}{2}$. B, Submersed leaf, $\frac{1}{2}$. C, Top of submersed leaf a little enlarged. D, Pistil, side-view, $\frac{1}{2}$. E, Anatomic diagram of the stem, showing the mechanical system in the bark and the arrangement of the vascular bundles of the stele, $\frac{2}{3}$, *ep*, epidermis, *str*, subepid. strand.

The specimens of this species I have seen lack fruit, but to judge from the ovary the fruit will grow sharply keeled and beaked, by which this species associates with *P. muricatus* and related. The floating leaves are of about the same size as in *P. Cheesemani* which probably has caused it to have been mixed up with that species (J. BAAGÖE in hb. Lund.).

They have rounded apex and the base more or less conspicuously cordate. Lower involucral leaves long-petioled (± 50 mm), upper ones with petiole and blade of equal length. Submersed leaves evidently cuspidate, their base oval or oval-lanceolate.

Stem terete, its epidermis lacking a pseudo-hypoderma but with numerous, rather strong, mechanic strands. Cortically and interlacunarly there are always a few (3—6) vascular and bast bundles. Central stele of roundish crosscut-form and with 8 free bundles encompassed by strong, more or less open bast-sheaths. The arrangement of the bundles becomes apparent by the diagram above. The median bundles are merely two as in *P. tricarinatus* (eight-bundled type). The lacunar system is the usual: 3—4 circles of lacunæ, the outer relatively large, the inner ones narrower.

Distribution. *Australia.* The label bears only this annotation: — Nov. Holland. meridional. *Plantæ Müllerianæ.* (Hb. Lund.).

***P. spoliatus* n. sp. — Fig. 85.**

Fig. 85. *P. spoliatus* HAGSTR. A, Involucral leaf, $\frac{1}{2}$. B, Pistil, ovary a little grown out, $\frac{1}{10}$. C, Transverse section of stem, $\frac{3}{10}$. ep, epidermis, hyp, pseudo-hypoderma, str, subepidermal strand, i, interlacunar bundle, cc, central cylinder, tr, trio-bundle.

Caulis 0,5 m altus et ultra, teres subcrassus simplex, internodiis 3—6 cm longis, ramo uno prolongatus. *Folia* superiora coriacea lanceolata vel ovalilanceolata, mucrone obtuso, 15—18-nervia, $40-60 \times \pm 20$ mm, late petiolata, petiolis foliorum floralium ca. 30 mm longis. *Ligula* basi subcostatae membranaceae cito putrescentes, summæ 40—45 mm longæ. *Pedunculus* æqualis 55 mm longus. *Spica* densa multiflora, deflorata 35 mm longa. *Pistillum* stylo elongato stigmate oblongo.

This species is characterized by the short-petioled upper leaves, very soon decaying lower leaves, and the noticeable

pistil (see the fig!). Already in an early stage the lower leaves fade away and the plant, therefore, presents a poor and naked appearance, so much the more as it is simple all up to the primary spike. In this respect it presents a great resemblance with *P. stenostachys* SCHUM. which, however, has long-petioled leaves and very ample sheaths, remarkable perianth leaves and a short fragile style.

Stem-anatomy: The epidermis is strengthened by a pseudo-hypoderma and scattered bast-bundles. Interlacunar bundles in the cortex in one circle always present. Outer lacunæ of the cortex considerably wider than the inner ones. Endodermis of O-cells and the central stele with eight free vascular bundles with equal number of xylem canals. Bundle-trio reduced to a compound bundle with three phloem parts and interjacent bast-cells. By those anatomic conditions it differs from *P. montevidensis*, which for instance lacks both strengthening layer and subepidermal strands.

Distribution. South America, Lagunas de Pictina, Cordoba, La Plata, 77, HIERONYMUS (hb. Stockholm.).

Subsectio 19. *Sclerocarpi* HAGSTR.

Caulis teres simplex v. subsimplex. *Folia* natantia parva apice rotundata aut nulla; submersa breviter petiolata v. sessilia obtusa; ligulæ caducæ. *Pistillum* stylo brevi incrassato aut fere nullo. *Fructus* minor v. media magnitudine tricarinatus. *Anatomia* caulis: fasciculi vasculares tubi centralis duo in medio sejuncti, laterales etiam duo rarius plures. *Endodermis*, vide infra!

The styles of the species I here class together are not yet fully known. This is true about *P. Drummondii*, *P. porrigens* m. and *P. repens* m. In the South American *P. sclerocarpus* the style is very short and thin, in *P. reduncus* m. extremely insignificant, but in *P. Cheesemanii* more conspicuous and incrassate, by which this species draws near to the next group. The Australian species, however, seem to be more in accordance with the South American, Indian, and African species than with the European.

Anatomy of stem: Typically we have here no pseudo-hypoderma (exception: *P. repens* m.) but often subepidermal mechanical strands; no cortical bundles are observed. Endodermis of O-cells often with a faint tendency of forming feeble u-cells at intervals. By this character the group approaches to the subsequent group, but differs from it by the particular central axis, which exhibits two median and two lateral xylem canals, one on either side, separated by mechanical tissue. The type is accordingly four-bundled. The median cavities seldom unite into a common one as sometimes in *P. repens* m. Concerning the anatomic deviation of the Hokianga-plant (see under *P. Cheesemanii*!), which presents more lateral bundles in the central stele than the type, this is accounted for by the fact, that in shallow-water-forms in general, as also in the basal parts of high-grown species with reduced lateral bundles, this reduction or fusion does not at all or but partly take place.

Like the preceding this group is also chiefly an Australian one, and *P. australiensis* AR. BENN. might belong hereto (or to the *Muricati*?) rather than to the *Colorati*. The description of *P. Drummondii* seems to involve two different species. The genuine *P. Drumm.* is to my opinion long-peduncled and richly provided with floating leaves of about the size 30×13 mm.

P. sclerocarpus K. SCHUM.

Flora Brasiliensis, III, 3, 1894, 688, t. 120. — Fig. 86.

The specimen of »Minas Geraes, Gongo secco» I have examined has very short internodes (4–8 mm) at the lower half of the stem, higher up a little longer, 10–50 mm, and the stem is prolonged by 1 or 2 branches from the primary spike, otherwise unbranched. Floating leaves long-petioled with small laminae of oblong lanceolate form and obtuse, 30×10 mm, 13-nerved. Submersed leaves linear-lanceo-

late, 55×4 mm, sessile, tapering at both ends, 3-nerved, obtuse; ligules thin whitish, about 10 mm in length. Peduncle not incrassate; spike 1.5–2 cm long. Style short but conspicuous; stigma rounded. A close relationship is assumed between this species and the N. American *P. Nuttallii*, but neither the style and fruit nor the stem-anatomy suggest such a relation. Fruit with low dorsal keel and elongate recurved beak, ventral face prominently convex and so are also the sides. Embryo curved in usual manner.

Anatomy of stem: Epidermis without strengthening layer and strands, cortical bundles absent and the central stele four-bundled encompassed by an *O-U*-endodermis.

Distribution. Brazil, Minas Geraes, Gongo Secco (hb. Berlin.). Beside *P. Ulei* it seems to belong to the higher mountain regions and might also be met with in the western alpine States.

Fig. 86. *P. sclerocarpus* SCHUM. A, Top of submersed leaf, $\frac{2}{3}$. B, Pistil, side-view, $\frac{1}{2}$. C, Transverse section of stele a, median bundle, b, lateral bundle, $\frac{1}{2}$.

***P. repens* HAGSTR.** ap. R. E. FRIES, Bot. Unters. in Wiss. Ergebn. schwed. Rhod.—Kongo-Exp. 1911–12, I, 1915, 185, f. 15. — Fig. 87, 88.

Rhizoma repens teres 1–2 mm crassus (in diam.). *Caulis* teres, 1 mm in diam. simplex vel paullo ramosus internodiis brevissimis (infer. ± 5 mm). *Folia* tenuia canaliculata, typice 7-nervia linearia sessilia integerrima subacuta (inf. $50-60 \times 2-3$, superiora $90 \times 3-4$ mm). *Nervatura* vide fig. *Ligulae* membranaceae tenues caducae ± 20 mm longae subbicostatae. Spicae desunt.

Anatomy of the stem: Epidermis-cells of usual form, 3–5 times as long as broad. The epidermis is strengthened by a one-celled pseudo-hypoderma and scattered small bast-bundles (see the fig. 87, C). Cortex of usual structure. Lacunar system of three circles of lacunae. True cortical bundles absent. Endodermis of *O*-cells. The central cylinder exhibits two median bundles with common xylem cavity on either side of which there is a lateral bundle. Mechanic tissue as the figure shows.

The rhizome differs in the usual way by free bundles in the central cylinder, smaller lacunae of about equal size among themselves, and a two-layered hypoderma with few mechanic cells.

The leaves are 7-nerved, linear, tapered at the base and top, gutter-shaped. Internal structure and lacunar system as the figure shows. The specimens examined were young plants and it is therefore not known to me if *P. repens* can produce floating leaves or not. Ligules 7-nerved in the front-field, apex obtuse. Intervaginal scales lanceolate 1 mm long, seven or more in number.

The course of the subepidermal strands of the stem and that of the bast and vascular bundles of the leaf and ligule is shown by the longitudinal section through a node figured below. The subepidermal strands generally do not continue in the wing-fields of the ligule, but that organ has its own bundles, which descend through

Fig. 87. *P. repens* HAGSTR. A, Top of a leaf, $\frac{3}{4}$, showing the form and nervation. B, Young ligule, $\frac{1}{4}$. C, Transverse section of part of the epidermis and its strengthening layer, ep , epidermis, hp , pseudo-hypoderma, str , bast bundle. D, Transverse section of the central stele, sc , showing the vascular bundles and the interjacent mechanic tissue. E, Transverse sect. of a leaf at the middle and, F, at the base, immediately above the insertion point, ic ; m , midvein, n' , principal and n'' , secondary lateral nerves, str , marginal bast bundle, $vbus$, bundles of the upper, and $vbls$, of the lower surface of the leaf (cf. fig. 88). G, Transverse section of a ligule immediately at the insertion point, ic , front-field, wf , wing-field; the bundles of the wf turn their vessels to the stem-side, the bundles of the ic towards the leaf-side (cf. fig. 88).

the cortex but disappear immediately below the insertion point, and the internodal part of the stem accordingly is always devoid of interlacunar bast and vascular bundles. The bundles of the upper and lower surface of the leaf belong only to the basal fourth part of the leaf and the cross-section at the middle exhibits an appearance as is shown in the fig. 87, E. The subepidermal strands of the stem disappear below the node and appear again above it as is shown in the fig. (str). Only some one or other continues through the node. — Another type is described and figured on p. 70, fig. 27.

Distribution. *Africa.* *Rhodesia* in the Lake Bangweolo on sandy ground, creeping by long rhizomes mostly above the bottom. 19. 9. 1911. ROB. E. FRIES. N:o 655.

It is noticeable that S. America (Brazil), Africa (Bangweolo-district), Australia, and New Zealand, separated by vast oceans, nevertheless exhibit *Potamogeton*-species of evidently common origin.

Fig. 88. *P. repens* HAGSTR. Longitudinal section through a node, schematized; explanation see above! a, stem, b, leaf, ic, ligule, front-field, wf, wing-field, cc, central cylinder, vbie, vasc. bundles of the ligule, vbus, those of the upper, and vbls, of the lower surface of the leaf, mb, midvein of the leaf, vbw, bundles of the wing-field of the ligule, str, subepidermal bast strands of the stem.

the cortex into the central cylinder, and the same is also true concerning the leaf. Not only the midvein and the lateral veins enter the central cylinder but also the bundles of the lower surface ($vbls$ in the fig. 88). The bundles of the upper surface of the leaf and those of the intercarinal part of the ligule, again, descend into the lacunar system of

P. porrigens n. sp. — Fig. 89.

Caulis elongatus teres tenuis subfiliformis simplex, internodiis summis elongatis, 10—25 cm, a spica primaria ramo internodiis longis prolongatus. *Folia* natantia parva 15—20 × 5—6 mm, oblongo-lanceolata, apice obtusa basi attenuata, 5—7-nervia, longissime (10—15 cm) petiolata, petiolo filiformi; submersa lineari-lanceolata sessilia—subpetiolata, apice obtusa, 50—60 × 3—4—5 mm, integerrima 3(—7)-nervia. *Ligulae* membranaceae cito evanescentes breves (5—15 mm longae). *Pedunculus* aequalis filiformis, 10—12 cm longus. *Spica* 5-verticillata, deflorata 8—10 mm longa. *Fructus* non visus.

Fig. 89. *P. porrigens* HAGSTR. A, Base (a) and top (b) of a submersed leaf; the interrupted lines indicate nerves frequently appearing, but which also wholly or partly can be absent, $\frac{5}{7}$. B, Floating leaf, $\frac{1}{2}$. C, Diagrammatic cross-section of the stem showing the central cylinder, epidermis and subepidermal strands, $\frac{3}{4}$, mb, median bundles, lb, lateral bundles.

This species, the fructification of which, on account of the defective material, can not be described, yet is easy to identify by its elongate filiform upper internodes, peduncles, and petioles and by the minute floating leaves. Spikes usually with 5 verticils and thus small. The submersed leaves are as to form and size almost quite like those of *P. sclerocarpus*, but destitute of the midrib canals, there always present, beside which the nervation also is different. To judge from the description of *P. Drummondii* and from a diagram of the central stele of it drawn by C. RAUNKJÆR in his Anat. Pot. Stud., 265, f. 4, A, *P. porrigens* would be very closely allied with that species. But the stem-anatomy of *P. Drumm.* runs: ep. + subep. str. + lig. str. (±) + O-end. + CC eight-bundled, accord. to DRUMMOND's own spec. (hb. Haun.), and, besides, its habitat is West Australia, in consequence of which I cannot consider them identic. Nor is it congruent to the *P. Cheesemanii*, with which it shares a common distribution, though extremely nearly related also to that multiform species.

In the topography of the stem-anatomy we immediately observe the compressed central cylinder with two prominent median bundles (mb) and small lateral ones (lb), one on either side, all separated by a strong central mechanic tissue. Besides we notice an O-endodermis, no interlacunar bundles, no strengthening layer, but a few subepidermal strands. Three circles of lacunae of the usual form.

Distribution. Nova Zelandia: Hokianga, 74, BERGGREN (hb. Stockholm., Uppsal., Lund.).

P. reduncus n. sp. — Fig. 90.

Caulis tenuis internodiis summis ca. 5 cm longis. *Folia* submersa membranacea lanceolata, apice obtusa basi attenuata sessilia vel subpetiolata 5—7-nervia integerrima ca. 50—150 × 5—10 mm; natantia rariora minora longe petiolata obtusa.

Ligulae cito evanescentes. *Pedunculus* brevis (0,5—1 cm), demum ca. 2 cm longus et deflexus. *Spica* brevis subglobosa pauciflora. *Pistillum* stylo subnullo, stigmate parvo rotundato. *Fructus* parvus, $1,5 \times 1,5$ mm rotundatus erostratus 3-carinatus, carina media prominente subgibbosa.

This plant of southwestern Australia has been considered to be *P. Drummondii*. However there must be any misconception, as it very little answers to the description of *P. Drummondii*. It nearly always lacks floating leaves, has recurved short peduncles, quite beakless fruits etc. The epidermis of the stem lacks a strengthening layer but possesses a full-numbered circle of rather strong strands. In the bark inside it no bundles appear. The central stele has *O*-endodermis and four free bundles separated by strong bast sheaths and arranged as in the foregoing.

The style of this species is very slightly developed and the fruit seems to be quite beakless. This fact combined with the above described properties: no floating leaves etc. makes us feel inclined to class this species in a separate group. Principally on account of its stem structure the *P. reduncus* may be united with the foregoing species. Future researches may possibly alter this arrangement.

Distribution. S. Western Australia (hb. Stockholm.). On the label Mr. AR. BENNETT has noted: »not been refound. f. Baron v. MUELLER; leg. JAMES DRUMMOND ex MUELLER» etc. and determined it as *P. Drummondii* BENTH.

Fig. 90. *P. reduncus* HAGSTR. A, Habitus-figure, $\frac{1}{2}$. B, Top of a leaf, $\frac{2}{3}$. C, Pistil, sideview, $\frac{1}{10}$. D, Fruit from the side, $\frac{1}{5}$. E, Transverse section of the stem, showing the central stele, with two larger median bundles, each of them having a xylem canal, the interjacent bast cells, and the subepidermal strands, $\frac{1}{1}$. F, Part of the epidermis with an adjoining channel wall and a bast bundle (more enlarg.).

P. Cheesemanii AR. BENNETT.

Journal of Botany, 1883, 66. — Fig. 91.

Several specimens of this species even from the original station, St. John's Lake, have been examined. They are all characterized by small, ca. 30—35 mm long, rounded, obtuse, or even slightly emarginate, oval, floating leaves, usually appearing already one or a few internodes below the primary spike. The eking piece of the stem consists of a spike-bearing branch. Spikes of middle size; Pollen spheric small-grained; the upper part of the pistil incrassate and the stigma oval, comparatively small, and covering only the middle portion of the upper surface of the style.

The fruit of specimens from Takapo Lake is obliquely obovate, with a short beak and faint dorsal keel, scarcely 2 mm long by 1.3 mm broad. — Genuine submersed leaves, when occurring, rounded obtuse or slightly emarginate in the apex, nerved as is shown in the fig. below. Midrib lacunous, the two chief lateral nerves running nearer to the margin than to the midrib. Leaf-base narrow and a little sloping; petiole at least in the lower leaves very short or inconspicuous.

The epidermis of the stem, consisting of somewhat stretched cells, always lacks strengthening layer. Endodermis composed by *O*-cells with a very faint tendency

Fig. 91. *P. Cheesemanii* BENN. A—D, typical form. A, Involucral leaf, $\frac{1}{2}$. B, Top of a submersed leaf, $\frac{2}{3}$ (from Lake Pearson). C, Pistil, side view, $\frac{1}{4}$ (from St. Johns Lake). D, Transverse section of the stele, a — a , median bundles; b , bast; c , lateral bundles, $\frac{1}{2}$. — E—H, form *tasmanicus* HAGSTR. E, Involucral leaf, $\frac{1}{2}$. F, Top of a submersed leaf, $\frac{2}{3}$. G, Pistil, lateral view (a), from above (b), $\frac{1}{2}$. H, Diagrammatic cross-section of the stem, showing the central stele (identical with that of the typ. form) and the subepidermal strands, $\frac{2}{3}$.

to one-sided thickening. The cortical bast or vascular bundles now spread toward the epidermis, now appear between the utmost lacunar circle and the next to it. The central cylinder is characterized by the two great median bundles with interjacent compact mechanic tissue. The lateral bundles are usually reduced in number, more rarely 2—3 on either side (shallow-water form from Hokianga, below! and pp. 169, 176!).

The length of the peduncles and the upper internodes varies considerably. In the main-form, of *St. John's Lake*, the petioles of the primary involucral leaves are of equal length to the blades and those of the leaves next below likewise comparatively short. Specimens from Nelson (see below!) have rather

elongate internodes (10—17 cm) next below the primary spike and the petioles of the primary involucral leaf likewise elongate (9—10 cm). I have called such specimens:

f. corymboides n. f. — *F. foliis flor. prim. longissime petiolatis, internodiis superioribus valde elongatis.* —

The specimens from Hokianga evidently are a shallow-water form with a couple of branches at the base, short internodes and only coriaceous leaves:

f. frondosus n. f. — *F. foliis omnibus coriaceis v. subcoriaceis.* —

The specimens from Tasmania, again, have sessile or very short-petioled submersed leaves and reduced faculty of developing coriaceous leaves. Besides, this form entirely lacks the interlacunar circle of bundles, whereas the subepidermal one is well supplied. This plant I name:

f. tasmanicus n. f. — *Folia submersa sessilia vel in superiore parte caulis brevipetiolata, omnia obtusa, basi lanceolata; natantia sero evoluta parva ovalia.* — Fig. 91, E—H.

I have not seen fruit of this form. Possibly we have here a form of higher systematic value. Possibly it stands in any relation to *P. similis* BENN. which I have not yet had an opportunity to study. It is said to have 3—5 longitudinal nerves in the submersed leaves. The styles and stigmas are not described. In *f. tasmanicus* they do not deviate from *P. Cheesemanii* so much that a specific difference can be founded on them. *P. similis* seems to me to be most probably referable to the *Muricati* on account of the fruits (»tricarinate with the three margins sinuous-winged» etc.: BENN.).

Distribution of the species. *New Zealand*, St. John's Lake, N. Isl., 81, CHEESEMAM (hb. Stockholm., Det. & comm. AR. BENNETT); Lake Pearson, Ins. bor., 74, BERGGREN (hb. Stockholm. et Uppsal.); Ponds, Nelson; S. Isl., 69, TRAVERS (hb. Stockholm. et Uppsal.), *f. corymboides*; Hokianga, Ins. bor., 74, BERGGREN (hb. Lund), *f. frondosus*; Lake Takapo, S. Isl., 83, CHEESEMAM (hb. Stockholm.) »alt. 2500 feet» Det. & comm. AR. BENNETT. *Tasmania*, R. C. GUNN (hb. Stockholm.), *f. tasmanicus*.

Subsectio 20. *Colorati* (GRAEBN.).

Caulis ut in præcedente v. rarissime ± ramosus. *Folia* superiora tenuia—semicoriacea—coriacea; submersa membranacea ± petiolata; ligulæ ± caducæ. *Pistillum* parvum stylo brevi valde incrassato stigmatæ parvo ovali-rotundato. *Fructus* minores sæpe erostrati ± carinati. *Anatomia* caulis: fasciculi vasculares tubi centralis in medio quattuor sejuncti, laterales terni vel plures. *Endodermis*, vide infra!

The characteristics of this group are the swollen styles (Fig. 92 *E*), small stigmas, and small fruits with insignificant beak and in fresh without or nearly without keels. The upper leaves are often thin and proper coriaceous floating leaves are late developed, usually first on the stem-prolongation, in contradistinction to the next foregoing groups, but more corresponding with the *Alpini*, a contrast of which, nevertheless, this group is by the form of the styles. The turios consist of but little differentiated leafy shoots. The anatomy of the stem is characterized by an endodermis of mixed *O*- and *U*-cells (or, a tendency of producing *u*-cells), by which the group approaches the *Natantes*.

Of the species hitherto known only *P. polygonifolius* and *P. coloratus* properly belong to this group. As an appendix, and *ad interim*, I have here included the new-established *P. promontoricus* m., which is likely to be a *capensis*-hybrid, also much reminding of some *Amplifolii* as to style and stigma. *P. semicoloratus* seems to combine the *Colorati* with the *Amplifolii*. The position of *P. australiensis* is not fully known, and the same is the case with *P. parmatus* (p. 152) and *P. suboblongus* m.

P. polygonifolius POURRET.

Extrait de la *Chloris Narbonensis* etc., in Mémoires de l'Académie de Toulouse, III, 1788, 325. — *P. oblongus* VIVIANI, Annales botanici, I: 2, 1802, 102. — *P. Plan-*

tago BASTARD, Essai sur la flore du dép. Maine & Loire, 1809, 64. — *P. parnassifolius* SCHRADER apud MERTENS & KOCH, Deutschlands Flora, 1823, 839. — *P. uliginosus* et *affinis* BOEMINGHAUSEN ex CHAM. & SCHL., Linnæa, 1827, 216. — *P. paludosus* BORY ex CHAM. & SCHL., l. c., 216. — *P. Leschenaultii* CHAM. & SCHLECHT., l. c., 223? — (*P. elegans* WALLICH, Catal. 5178, 1828, ex BENNETT, Journ. of Bot., 1893, 133—134 and *P. digynus* WALLICH, l. c., 5177, ex BENNETT in hb. Haun., but see above, p. 156). — *P. Hornemanni* MEYER, Chloris Hanoverana, 1836, 521. — *P. cyprifolius* LOWE, ex GRAEBNER, Potamog., 1907, 65. — *P. natans* c. *media*, et d. *minor* KOCH et ZIZ, Catal. pl. Palat., 1814, 18. — *P. natans* β *acaulis* WAHBERG, Flora Gothoburgensis, 1820, 23. — *P. natans* δ . *intermedius* et ϵ . *minor* MERT. & KOCH, l. c., 839, CHAM. & SCHL., l. c., 221. — Fig. 92.

This species shows great affinity with *P. coloratus*. The styles and stigmas are quite the same in the two species, and the stem-anatomy is so near alike that it is practically useless for the distinction of the species.

The styles are much swollen upward and the stigmas small and oval. The stem is lacking strengthening layer along the epidermis but instead of it there are strong lists of several cell-rows in the angles between the lacunar walls and the epidermis (see the fig.!). Subepidermal bast-bundles typically present both in stem and petioles, though sometimes reduced in number. Especially in *P. coloratus* they are frequently brought down to a minimum. Interlacunar vascular bundles are absent in these species both in stagnant and running water.

The subepidermal bundles behave as is shown in the figure 88. They are only internodal and disappear at the level, where the vascular bundles of the leaf and the ligule enter the cortex to descend into the central axis.

In a single case¹ I have observed three to four vascular bundles situated interlacunary in the cortex, beside a pseudo-hypoderma, but this specimen had grown in shallow-water on muddy ground. Shallow-water plants of more or less high-grown species show a certain disposition to procure (or maintain) properties belonging to the basal part of stretched stems. They accordingly deviate accidentally (for instance on account of the state of the bottom, see above!) in this direction from the typical form growing in deeper water. As regards the anatomy those basal characteristics are principally 1) a thickened pseudo-hypoderma, two-celled or at least locally so, if one-celled at the middle of the stem, 2) increasing width of the wall-cells of the lacunæ (f. i. *P. natans*), 3) sometimes an augmented number of the lacunar circles (f. inst. in *P. pectinatus*), 4) increase of the width of the central cylinder together with an increased number of the lateral (cauline) vascular bundles. *P. Cheesemanii* f. *frondosus* furnishes example of this basal characteristic in a shallow-water plant; 4) increase of the number of cortical bundles when such bundles occur in a species; 5) in species interlacunary destitute of cortical bundles (the ligular circle) some one or other of the bundles of the ligules and leaves may descend more or

¹ In a specimen from France, »Petits ruisseaux dans la forêt d'Andaine, Domfront (Orne), 73, CORBIÈRE» (hb. Stockholm.).

less far down into the internodal portion of the stem. This basal phenomenon has come to pass in the shallow-water form of Domfront. But on the whole it is a very rare event.

The endodermis-cells are originally *O*-cells with a tendency to become *u*-cells at the places where they border on the bast sheaths of the central bundles. Close by the nodes the endodermis always has *O*-cells, as also generally in the portions of it, lying between the bundles. In *P. polygonifolius* we often find the *u*-cells very faint, whereas in *P. coloratus* they are much stronger, in consequence whereof this species never lacks *u*-cells proper in the internodal parts.

The leaves are better differentiated in *P. polygonifolius* than in *P. coloratus* and the floating leaves have a greater number of longitudinal nerves, mostly 17—19 (13—23), whereas the number in *P. coloratus* almost constantly is 15 at the middle of the leaf. The apex of the submersed leaves of both species, but especially in *P. polygonifolius*, is slightly cucullate, by which they show affinity with *P. praelongus*. The species has also a tendency to stretch the petioles and only land-forms have shorter petioles, yet mostly as long as the blade. The colour, especially at the base of the plant and on the fruit has a touch of reddish-brown. The usual measure of the fruit is $2-2,5 \times 1,5$ mm. Prof. P. GRAEBNER states (Potamog. 65): »plerumque 3 mm» which, of course, is a misprint. Operculum strongly keeled.

As to the variations, CHAMISSO and SCHLECHTENDAL have already established two, *cordifolius* and *lancifolius* (Linnæa 1827, 215). To this is to be remarked, that the species seems to tend to the subcordate leaf-form, which, therefore, in general is met with when the plant has had occasion to prolong itself by branches of a higher degree (3rd—4th), even if the primary and the secondary involucreal leaves have a lanceolate base. The cordate (subcordate) leaves often get almost straight sides, by which they obtain a very characteristic appearance (Fig. 92, A). The commonest form is without doubt v. *amphibius* FRIES, to which belong such forms as *ericetorum* SYME (leaves long-stalked, blade oblong, oval—rounded, $5 \times 2,5$ cm), *Arrhenii* FRIES (small-leaved as *P. parnassifolius*, and with a touch of yellow), *sphagnophilus* NEUMAN (shorter-petioled, blades of ordinary size and form and shading in yellow). To this var. belongs also a Norwegian form, with short petioles (of about the length of the blade) and broadly lanceolate blades (see fig. 92, B!):

f. *norvegicus* n. f. —: Folia elliptico-lanceolata, petiolis lamina æquantibus. — Fig. 92, B.

Hab. Norway, Sogn, 64, WITTRÖCK (hb. Lund.). —

A form of this species from Madera, S. Anna, 65, MANDON (hb. Stockholm.) is very broad-leaved. I have named it:

f. *maderensis* n. f. — Forma foliis maximis, $70-80 \times 25-50$ mm. *P. Leschenaultii* CHAM. & SCHL. in Linnæa, 1827, 223?

This form may be something near f. *maximus* FISCHER. —

P. parnassifolius, to my opinion properly a small-leaved form of v. *lancifolius*, has already by GRENIER been classed as a variety of this species (Fl. Fr. III, 1855, 313). — *F. angustifolius* FRIES and f. *largior* TISELIUS cannot be distinguished from the

f. (or var.) *lancifolius* CH. & SCHL. Both occur in rivulets. The same is the case with v. *pseudo-fluitans* SYME. — *F. rotundifolius* FISCHER is probably the same as *ericetorum* SYME. — If the f. *cancellatus* FRYER is not a hybrid, it might be considered a form of v. *lancifolius*. Its short-petioled submersed leaves (FRYER, Pot. Brit. Isles, 1898, 21, t. 12) make it a more dubious form.

Distribution: *P. polygonifolius* occurs in many places of the *Scandinavian peninsula* up to a line drawn from South Helsingland, Stråkärä, the most northern station in Sweden (coll. ZETTERSTEDT, hb. Uppsal. et Lund.), through south *Dalarne*

Fig. 92. *P. polygonifolius* POURR. A, Late in the year developed floating leaf from the top of a branch, $\frac{1}{3}$. B, Floating leaf of the f. *norvegicus* HAGSTR., $\frac{1}{3}$. C, Floating leaf of the f. *maderensis* HAGSTR., $\frac{1}{3}$. D, Part of a transverse section of the stem, ep, epidermis, l, lacuna, i, intercellular canal, f, strengthening lists, b, bast-bundle, $\frac{1}{10}$. E, Pistil, a side view, b back view, c, from above, $\frac{1}{10}$.

(Grangärde) to the middle of *Vermland* (Råda, coll. HAGSTRÖM, hb. Stockholm), and from thence westward through *Norway*, where it follows the western coast to *South Nordland* (Melö, 66° 50' according to BLYTT, Norges Fl. I, 1902, 46). Eastward it has spread to *Alandia* (Geta, Svartträsk, 01, PALMGREN & KLINGSTEDT, hb. Stockholm.), but is wanting in *Oland* and in *Gothland*, and does not in the whole of Europe transgress the 20th degree east longitude. From Europe it has spread to the eastmost parts of *Canada* (New Foundland and Sable Island to Nova Scotia). From the above said northern boundary, corresponding to the year-isotherm of + 4 to + 5 degrees, it has ranged the whole of *Europe* and northwestern *Africa* (Algeria, Morocco, to Madeira and the Azores) reaching the year-isotherm of + 20°, but surely not much transgressing it. Specimens from *Madagascar* held for *P. polygonifolius* are *P. parmatum* HAGSTR.

An *Asiatic* distribution-area is also recorded (»Siberia altaï (Led.) to Mongolia, and China to India and Japan»: AR. BENNETT, Pot. polygonif. in Bot. Gaz. 1901, 59. »Sibirien bis Ostasien»: GRAEBNER, Pot. 1907, 66). But I have seen no specimens of true *P. polygonif.* from those regions, and the specimens recorded from *New Zealand* may be the new species treated of here below.

P. coloratus VAHL.

In HORNEMAN, Flora Danica, 1813, t. 1449. — *P. plantagineus* DU CROZ ap. ROEMER et SCHULTES, Syst. veg. III, 1818, 504. — *P. helodes* DUMORTIER, Flor.

belg. 1827, 163. — *P. Hornemanni* MEYER, ex KOCH, Synopsis, 1837, 674. — *P. microcarpus* BOISS. & REUT., Diagn. Pl. nov. Hisp, 1842, 24? — *P. siculus* TINEO ap. GUSSONE, Fl. Sic. Syn., II, 1845, 790. — *P. subflavus* LORET & BARRANDON, Flore de Montpellier, 1876, 671.

The floating leaves of this species are generally thinner than in other species dependent on a reduction of the palisade-tissue into one or 2 cell-strata of cubic cells without the air-rooms appearing there otherwise. Rarely we meet with leaves with air-cells in that tissue, which then is very like ordinary palisade tissue. Apex of the floating leaves usually obtuse without distinct cuspidation or pointing (see fig. 93, B). Exceptionally there are individuals with the upper leaves cuspidate. I name this form:

f. *cuspidatus* n. f. — Folia superiora cuspidata (vide fig. 93, A).

Sometimes the floating leaves are small, $20-30 \times 10-15$ mm, and the submersed leaves narrow:

f. *subflavus* n. f. — *P. subflavus* LOR. & BARR., l. c. — Specimens from France, Manguio (Hérault) 73, LORET and others (hb. Stockholm. et Lund.) and from Germany, Daunstadt (Palatinat) 55, SCHULTZ (hb. Stockholm. et Uppsal.).

This plant is still held for a subspecies of *P. alpinus* BALB. by Prof. P. GRAEBNER in his Synopsis der Mitt. Fl. 1912 p. 476 (2d ed. III Lief.). Prof. G. FISCHER writes (in FEDDE, Repert. 1914) of the same plant: — »certe et habitu et fructu distat a *P. alpinus* BALB. et accedit ad *P. coloratum*. Utrum autem subspecies vel proles *P. colorati*, an planta hybrida inter *P. coloratum* et *P. alpinum* (vix *P. polygonifolium*) habendus sit, adhuc ambigitur».

The Héraultian plant is without any doubt a true form of *P. coloratus* and not at all of a hybrid origin. —

A form with rounded, ovate, superior leaves, ca. 30×24 mm, is v. *rotundifolius* MERT. & KOCH. — Now and then forms appear with very large leaves, 70—80 mm long or more, by 30—45 mm broad:

f. *grandifolius* n. f. — Folia amplissima, $70-80 \times 30-45$ mm.

Var. *pachystachyus* RCHB. has thicker spikes than the other forms (not seen by me). — Var. *jamaicensis* GRISEB., to judge from the description, may not at all belong to this species, the plant occurring aside from the distribution-area, and the fruit being half as large as in *P. lucens* and sharply keeled, the stipules keeled etc., see GRISEBACH, Fl. Br. West Ind. Isl. 1864, 506!

The terrestrial form, f. *terrestris* TISELIUS, is very often seen.

Distribution. Sweden, Scania, Eskilstorp, 91, LARSSON and others (hb. Stockholm., Uppsal., Lund.), Bulltofta, 94, JOHANSSON and others (hb. Stockholm., Uppsal., Lund.), Arrie, 67, TULLBERG and others (hb. Stockholm., Uppsal., Lund. et Gothob.). Bleking, Marielund, ASPEGREN, hb. HARTMAN (hb. Uppsal.), labelled:

Fig. 93. *P. coloratus* VAHL. A, Involucral leaf of the form *cuspidatus* HAGSTR. B, Top of an involucral leaf of the common form.

»*P. fluitans*; *P. oblongus* sec. FRIES.» On the contrary the specimens from »Ekeberg», coll. 1854, C. A. W (= C. A. WESTERLUND), HARTM. Handb. Skand. Fl., 12th ed., 1889, 45, are *P. polygonifolius* v. *amphibius* FRIES. *Gothland*, several stations: Fleringe and Bunge, the northernmost localities of Europe, Rute, Westerhejde, Ardre, Bäl etc., gathered by different collectors, the oldest specimens by LÖNNROTH, 1853, and ELMQUIST also in 1853 (hb. Stockholm., Uppsal., Lund. et Gothob.).

Denmark, many stations in the islands; locus classicus is »Öxemose prope Hofmansgave Fioniae, ubi primum invenit celeberrimus M. VAHL»: HOFMAN BANG in hb. — *England* in Kent, Cambridgeshire, Norfolk, Yorkshire and westward in Herefordshire (hb. Stockholm., Uppsal., Lund.). — *Holland*, (see VUYCK, Revisie etc. 1895!). *Belgium*, Tirlemont, THIELENS (hb. Stockholm.), Middelkerk, CRÉPIN (hb. Stockholm.). — *Germany*: Hannover to Baden (hb. Stockholm., Uppsal., Lund.). — *Switzerland*, Geneva, AYASSE (hb. Uppsal., Lund.), Oerlikon, 81, BUSER and others (hb. Stockholm., Uppsal., Lund.). — *Austria*, Moosbrunn (Nieder Öst.), 76 WIESBAUR (hb. Stockholm., Uppsal.), Bohemia, Lissa, CELAKOVSKY (hb. Lund.), Hungary, Altöfen, STEINITZ (hb. Lund.). — *Greece*, according to GRAEBNER, Potamog. 1907, 69 (not 1912). — *France*, many stations (hb. Stockholm., Uppsal., Lund.). — *Spain*, Ojos del Guadiana (La Mancha), 83, NILSSON (hb. Uppsal.). — *Italy*, Genoa, 42, DEHOTARIS (hb. Stockholm., Lund.), Sardinia, 81, REVERCHON (hb. Stockholm., Uppsal., Lund.), Sicily, leg. LOJACONE (hb. Stockholm.) and CITARDA (hb. Stockholm.).

The species is also recorded from North *Africa* (Algeria), *Arabia* and *Australia*, but I have not seen specimens from there. *Norwegian* specimens (Arendal: BLYTT, 1897) are undoubtedly mistaken for *P. polygonifolius* POURR.

As is shown above the distribution area of this species is, on the whole, the same as that of *P. polygonifolius* but it does not spread so far towards the north and westward, and seems also to choose a more calcareous ground (cf. the occurrence of the two species in the Scandinavian peninsula!).

***P. coloratus* VAHL × *polygonifolius* POURR. (*P. anglicus* n. hybr.).**

Folia submersa sat longe petiolata; natantia subcoriacea, ad nervaturam ut in *P. colorato*. Color ad basin caulis rufus ut in *P. polygonifolio*.

Although *P. coloratus* and *polygonif.* are so closely connected one to another, yet nobody has observed any crossing between them. Some specimens from Woking Heath in Surrey, *England*, gathered by AR. BENNETT in 1881, however, seem to me in all probability to be such a bastard. The colour is reddish; submersed leaves pretty long-petioled; floating leaves scarcely coriaceous; ligules rather long (influences from *P. polygonif.*). On the other hand the nervation of the floating leaves resembles that of *P. coloratus* with more distant longitudinal nerves. Of all specimens from different countries I have seen, these are the only ones occupying a position that makes me presume a hybrid origin. Yet I ought to add that I have not seen *P. coloratus* from any place in Surrey, but it is growing in the neighbouring Kent (see above!).

P. coloratus VAHL $\times$ **gramineus** L. (**P. Billupsii** FRYER, Notes on Pondw. in the Journ. of Bot., 1893, 353 p. p. (t. 338, non t. 337!), by FRYER held for »*coriaceus* $\times$ *plantagineus*«).

The English specimens I have examined are by FRYER himself determined as *P. Billupsii* and considered to be a combination of his *P. coriaceus* and *coloratus*, which would mean *P. gramineus* $\times$ *lucens* $\times$ *coloratus*. Anything of *P. lucens*, however, cannot be discovered in the specimens here concerned, but, indeed, in the specimens figured in t. 337, which evidently are *P. Zizii* (i. e. *gramineus* $\times$ *lucens*) with serrulated margins on the lower leaves and shorter petioles in the upper ones. In the specimens figured on the plate 338 *P. coloratus* can easily be traced in the leaf-texture, the lack of marginal one-celled teeth, and the petioles. *P. gramineus* on the other hand appears in the apexes of the submersed leaves and in the sometimes long petioles of the floating leaves, longer than the blades. The latter property often occurs in *P. gramineus*, whereas it is never met with in *P. Zizii*, where the petioles always are abbreviated by the influence of *P. lucens*. The feeble ligules are also extraneous to a *lucens*-bastard; they are intermediate between the above parents suggested by us. Nor has the very weak, unbranched, and low-grown stem of our specimens anything to do with, or reminding of *P. lucens*. The arrangement of the vascular bundles of the stem are also intermediate. Cortical bast and vascular bundles as in *P. gramineus*; endodermis of *u*-cells.

Habitat: England, Cambs., Parsonware Drove, Benwick, 92, FRYER (hb. Stockholm.), together with the hybrid *P. Zizii*, hb. TISELIUS. *P. Billupsii* is also found in Sweden, Gothland, in a rivulet emptying into Tenglingsmyr (hb. HAGSTR.). —

An interesting plant from East Africa, Island of Socotra, gathered by B. BALFOUR in 1880 (hb. Stockholm), has been described by AR. BENNETT. To complete his description I am here going to add what I have noted down of this form:

P. semicoloratus AR. BENN., New Potamogetons, in Journ. Bot. 1910, 150. — *Folia* submersa obtuse subcuspidata non cucullata. Nervus lateralis intimus cum nervo principali usque ad medium folii conjunctus. Petioli foliorum natantium angusti, longi, laminas æquantés vel longiores. Laminæ subcoriaceæ. *Fructus* (parum evolutus) rostratus esse videtur in statu maturo.

The submersed leaves are not rounded or cucullate at the apex but endowed with a slight obtuse cusp. The lateral nerves follow the midrib up to the middle of the leaf before bending out into the blade. Petioles of the floating leaves long, even longer than the laminæ, which in some leaves are subcoriaceous. Unfortunately the specimens have no ripe fruit and no young pistils. In the stem-anatomy the form deviates by an endodermis of typical *O*-cells, and, for the rest, approaches very much to the species of the *Amplifolius*-group, with which it also has the leaf-apex in common, and it is therefore possible, or even probable, that the species, when the pistils and fruits have been studied, must be referred to this group. Till then it should be considered as a connective link between the *Colorati* and the *Amplifolii*.

P. suboblongus n. sp.

Caulis humilis teres tenuis simplex, superne (ex axillis fol. flor.) emittens ramos radicanes. *Folia* coriacea (omnia?) ovalia obtusa, 11—15-nervia, longe petiolata, parva, 30—40 × 13 mm. *Ligulae* badiæ tenues deciduæ. *Pedunculus* teres tenuis 50—90 mm longus. *Spica* deflorata 12 mm longa. *Fructus* parvus siccus 2 × 1,5 mm, breviter rostratus dorso rotundatus vel subcarinatus. Operculum angustum dorso rotundatum.

The anatomy of the stem reminds of that of *P. polygonifolius*, but the epidermis-cells are narrower, the epidermis is strengthened by a pseudo-hypoderma and only a few bast-bundles, and the endodermis consists of thinwalled *O*-cells; and the same is the case with the sheaths of the vascular bundles of the stele.

The specimen examined belongs to the Univ. Mus. of Christiania and is thus labelled: — »n:o 3154. *P. polygonifolius* POURR. Taupaki. Kaipara. N. Island. N. Zealand. 3. 84. leg. T. F. CHEESEMAM, com. ARTHUR BENNETT, F. L. S., England.» It is likely to be the specimen referred to in a note by A. BENNETT in the Bot. Gaz. 1901, p. 60, where *P. polygonif.* is recorded from New Zealand.

The plant, indeed, resembles very much a small *P. polygonifolius*, also the fruit bears great resemblance to this species. But the anatomical diagram of the stem is another, and the fruit is, on closer investigation, also another. *P. polygonifolius* has the fruit sharply keeled and the operculum is broader and keeled as is shown in the fig. 116, C. *P. suboblongus*, again, has an operculum of the narrower thicker type, high-vaulted and rounded almost as the fruit in the fig. 116, H. Besides it is conspicuously smaller, in dry state only 2 × 1,5 mm (*P. polygonif.* 2,5 × 1,75). The styles and the stigmas are not known to me.

Leaves and ligules etc. as is stated above.

P. promontoricus n. sp. (vel hybr.?).

Caulis teres subtenuis altus, medio ramosus, internodiis 4—10 cm longis. *Folia* superiora coriacea lanceolata 75—80 × 12—15 mm, longe (40—60 mm) petiolata ca. 13-nervia, inferiora membranacea longiora, 150—200 × 13—15 mm, longissime (100—150 mm) petiolata, margine lævia 5—7-nervia, nervo medio reticulosa, apice obtusa, attenuata. *Ligulae* badiæ subpersistentes conspicue bicostatæ, ca. 50 mm longæ, ad folia floralia ca. 40 mm. *Pedunculus* æqualis, primarius ca. 80 mm longus. *Spica* florens ca. 18 mm longa. *Pistillum* stylo incrassato, stigmatate parvo, fere ut in *P. polygonifolio* et *colorato*.

To judge from the materials accessible to me this plant seems to be high-grown and branched at the middle. On the other hand it may rarely prolong itself by branches from the axils of the involucral leaves. It is characterized by its (especially below) long, narrow, and long-petioled leaves, lacking denticulation, and its swollen

styles and small stigmas. The top of the submersed leaves gradually tapered into a blunt 5-nerved apex. As to shape and nervation these leaves remind much of *P. capensis*. The very habitus also and the stem-anatomy, the styles etc. bear resemblance to the same species. The pollen of the specimen examined lack well-shaped and fertile grains, which makes me think that the plant may be a hybrid. This view is supported by the peculiarity in the stem-anatomy that the endodermis of the lower internodes consists of *O*-cells, whereas it higher up has typical *U*-cells. In the latter case the diagram shows nearly complete correspondence with *P. capensis*.

Anatomy: The epidermis has usually, at least locally, a one-celled hypoderma, in which at intervals bast-bundles appear. Interlacunary there are generally two circles of bast- and vascular bundles. The central cylinder, basally in the stem exhibiting 8 free bundles, gets the number a little reduced at the middle of it by fusion of part of the lateral bundles.

Provided that *P. promontoricus* is a *capensis*-hybrid the other parent species should be looked for among the *Amplifolii* (*P. fibrosus*?).

Distribution. *South Africa*: »Promont. Bonæ Spei. DREGE» (hb. Uppsal.).

Subsectio 21. *Nodosi* HAGSTR.

Caulis ut in præcedente. *Folia* natantia longe petiolata; submersa petiolata, media in parte et secundum nervos præsertim principales valde lacunosa, serrulata. *Pistillum* et *fructus* ut in *Amplifoliis*. *Anatomia* caulis: *O*-endodermis, fasciculi libriformes corticales typice desunt.

In most of its properties corresponding with the *Amplifolius*-group and occupying by its one-celled leaf-teeth an intermediate position between the group just mentioned and the *Lucentes*, *P. nodosus* is to be classed as a group by itself. The denticulation of this species is more fugacious than that of the others and seems to be of slight significance in the life of the plant. Perhaps it might be regarded as an ancestral feature.

P. nodosus POIRET.

Apud LAMARCK, Enç. mét. bot. suppl. IV, 1816, 535. HAGSTRÖM ex BAAGÖE, Vidensk. Medd. Nat. För. Kjöbh. 1903, 179. — *P. indicus* ROXB., Fl. Ind. I, 1820, 469? — *P. petiolaris* PRESL, Deliciæ prag., I, 1822, 151. —

Fig. 94. *P. promontoricus* HAGSTR. A, Stem-leaf, the 8th from the top downward, a, basal portion, b, upper half, $\frac{1}{2}$. B, Top of a leaf a little higher up (somewhat enlarged). C, Pistils, a, side-view, b, ventral view, $\frac{1}{2}$.

P. canariensis LINK in BUCH, Beschreib. Canar. Inseln, 1825, 138. — *P. Leschenaultii* CHAM. & SCHLECHT. in Linnæa, 1827, 223? — *P. occidentalis* SIEBER ap. CHAM. & SCHL., l. c. 224. — *P. americanus* CHAM. et SCHL., l. c., 226. — *P. syriacus* CHAM. & SCHL., l. c., 227. — *P. mascarensis*, *P. marianensis*, and *P. owaihiensis* CHAM. & SCHL., l. c., 228. — *P. petiolatus* WOLFG. ap. SCHULTES, Mantissa in vol. III etc., 1827, 252. — *P. Roxburghianus* SCHULTES, l. c., 367? — *P. Besseri* STEUDEL, Nomenclator ed. 2, II, 1841, 384? — *P. Billotii* SCHULTZ, Archives de la Fl. de France et d'Allem., I, 1842, 61. — *P. lonchitis* TUCKERM., Observations etc. in The Am. Journ. Sci. and Arts, 1848, 226. — *P. fluitans* (ROTH) RAUNKIÆR, Anatom. Pot. Studies etc. in Bot. Tidskr. 1903, 271—280. — Fig. 1, C, 95.

By the earlier authors, KOCH, GAUDIN etc., and quite up to later times (BUCHENAU), this species has been mixed up with *P. natans* L., and placed as a variety under that species (*P. natans* β *explanatus* MERT. & KOCH, 1823, 837—838, etc.). Other authors, separating it true enough from *P. natans*, have commingled it with some hybrids under the name of *P. fluitans* ROTH. Thus P. GRAEBNER, who, although distinguishing between fruiting and sterile forms, yet looks upon them all as »einheitliches Ganzes» (Lebensgesch. etc. 1906, 435; so still in Synopsis, 1912, 464 sq.) possibly of hybrid origin. With this view the name *P. fluitans* can be said to be the only correct name for those forms. C. RAUNKIÆR has by means of specimens determined by ROTH tried to prove that the name *P. fluitans* only is due to the fruiting plant, which under a great number of names, but first by POIRET, has been described. This proof would be very strong, if those specimens examined also really corresponded with the original description by ROTH »foliis inferioribus longissimis» etc. (Tentam. Fl. Germ. I, 1788, 72), which they can scarcely be said to do. Nor has RAUNKIÆR tried to show that. Rather this description answers to the hybrid *lucens* $\times$ *natans*, which more often than *P. nodosus* has very long and always more durable submersed leaves. Only in very rare cases *P. nodosus* has leaves of a foot-length or more. Strange to say G. FISCHER, however, finds this description adequate to the fruiting plant when writing, »Wäre nur die erste Publikation ROTH's v. J. 1788 vorhanden, so würde ich nicht das mindeste Bedenken tragen, der Art den Namen *P. fluitans* ROTH zu belassen. Denn die kurze Beschreibung stimmt dazu.» On the other hand the same author is of the opinion that ROTH's second and more detailed description contains more characteristics not at all agreeing with the plant, looked upon as a true species, but referable to a hybrid. FISCHER, therefore, writes in 1907, »*P. fluitans* (ROTH? RCHB. p. p.) KOCH, s. str. F.», a mode of signifying, which, probably, will not gain adherence. Seven years later he writes: *P. fluitans* ROTH, and divides it into two parts: *Proles* (vel *sectio*, *series*) I. *P. Rothii* FISCHER, and *Proles* (vel *sectio*, *series*) II. *P. Raunkiæri* FISCHER, the latter »= *P. natans* $\times$ *lucens* sec. RAUNK., HAGSTR.»¹ (Bemerkk. zu den Potamogetoneæ etc in Mitt. Bayer. B. Ges. 1914). Farther below, on the same page, he notes, »Meine Vollmannsdorfer Exemplare sind — — — sicher *P. lucens* $\times$ *natans* und sollen den Namen *P. Harzii*

¹ RAUNKIÆR and HAGSTRÖM write *P. lucens* $\times$ *natans*.

tragen». This name is earlier used of a f. *pernatans* of *P. Noltei* FISCH. and to it cannot further be attributed the sense of a name for the hybrid *P. lucens* $\times$ *natans* in the main, and the name »*P. Raunkiaeri*» is strictly to be written *P. fluitans* ROTH *proles Raunkiaeri* FISCHER, which designation means all forms of »*P. fluitans*» referable to the »hybrid fluitans». Consequently, with the great abundance of names, we still do not possess a specific name for the bastard we call *P. lucens* L. $\times$ *natans* L.

FISCHER has found a support for the maintenance of ROTH's name in the fact that, both of old and in later times, *P. nodosus* has been gathered in the Hunte River, the station recorded by ROTH for his *P. fluitans* (FISCHER, Beitrag z. Kenntniss bayer. Pot. IV, 362, and Die bayer. Potam. 1907, 143). It must be admitted that, if the Hunte were the sole locality recorded by ROTH, the occurrence of *P. nodosus* there now-a-days would be an important instance for the name question, but ROTH's note of the locality originally runs thus: »Hab. in fossis profundis lente fluentibus et in Hunte fluvio» etc., which evidently shows that ROTH with his description has also had in view other forms than the plant of the Hunte River. To me the fact is conclusive that ROTH, in his original description, states nothing separating the fruiting plant from similar bastard plants found in the same region. On account of this circumstance the name *P. fluitans* has been used, by different authors, with just the same right, now in one, now in another sense. The confusion and fluctuation have also increased by the fact that we have at least five hybrids (or more, if we count the extra-European forms) corresponding to the description of *P. fluitans*, viz. beside the rather commonly acknowledged *P. lucens* $\times$ *natans*, also *natans* $\times$ *nodosus*, *natans* $\times$ *polygonifolius*, *lucens* $\times$ *nodosus*, *gramineus* $\times$ *natans*, i. e. almost all *natans*-hybrids, which are endowed with very long submersed leaves. If we, therefore, wish to avoid a fruitless contest on a name to the end of the days I am able to see only two ways out: one, with ASCHERSON and GRAEBNER, to join all forms answering to the description into a unity, *P. fluitans* ROTH, without discrimination, which must be rejected as leading into a chaos, the other, with disapproval of that vague (»floating») name, to separate the different forms after their essential characteristics, giving them names, if not already done. Concerning the fruiting European plant (the »fertile fluitans») it does not stand in need of name, as it, on the contrary, has a great abundance thereof (see above!). The oldest I have been able to trace out is the above-cited by POIRET, whose description, after specimens from BROUSSONET, of the Canary Islands, undoubtedly is referable to our species, which fact is also confirmed by the fruit-description, made by CHAMISSE and SCHLECHTENDAL in Linnæa in 1827, p. 223, Tab. IV, f. 22. Many years ago I have suggested this good name to be adopted. The species is indeed *nodosus*, as the submersed leaves soon decay, making the nodes appear more obviously than otherwise.

Respecting the origin of the *fluitans*-forms of which some authors have written, we well know that of the bastards mentioned above. *P. nodosus*, again, is thought to be a variety of *P. natans* (BUCHENAU) or a developmental stage of a primordial bastard (GRAEBNER). FISCHER writes (1904): »Vielleicht ist der fertile und der sterile Form *P. fluitans* doch auf einen gemeinsamen Typus oder Stamm zurückzuführen

und beide haben nur im Laufe der Zeit sich in entgegengesetzten Richtungen fortentwickelt.» He still in 1914 suggests something of a development from a hybrid *alpinus* $\times$ *lucens* (yet with?) and expects a good help from the paleontologic study.

To this I want to say. *P. nodosus* is a distinct species like all the other real species, the origin of which we cannot give more exactly than by the statement of its near affinity with the *Amplifolii* and a more remote relation to the *Lucentes*. It is a connecting link between those two. In all its properties it shows a distinct fixedness whether it is met with in Europe or in another quarter of the world. The above mentioned hybrids, again, vary in all their properties and in habit to greater likeness now to one, now to the other of the respective parents. The fact that they in most of their forms come very near to *P. nodosus* is highly interesting. At the same time it renders the determination difficult, it urges to cautiousness and a thorough consideration of each particular case. On account of their nature the coactive species must produce forms of that aspect. The anatomical conditions of the plant, however, give rise to finding the right solution in most cases.

On the anatomical structure of *P. nodosus*, see C. RAUNKIÆR, l. c., 1903, 274—275. The characteristics there remarked I have found confirmed by examining a great number of specimens from four different quarters of the world. Those properties are: 1) Absence of a supporting layer (pseudo-hypoderma) in the stem; 2) Absence of vascular- and bast-bundles in the cortex of the stem, as well as 3) of the petioles; 4) a typical *O*-endodermis; and 5) a central cylinder of genuine trio-type, see fig. 1, *C*. The importance of these facts cannot be nullified by the very rare occurrence of one or a few faintly developed cortical bast-bundles in the stem, or by the circumstance that the *O*-cells of the endodermis rarely tend to grow a little thicker at the inside, as we have observed in a few cases. Besides, this unilateral incrassation is oftenmost more seeming than real. It arises in this way that thickwalled cells of the central bundle-sheaths stratify themselves to the endodermis, whereby the very endodermis-cells also seem to be thicker there, than at the outside, where they border to the thin-walled cortical cells. This fact can also be observed in several other species with *O*-endodermis. As to the *Potamogeton*-species there is no reason to depreciate the systematic value of the anatomic facts or to give the anatomical characters a slighter importance than the morphologic conditions.

I, therefore, cannot agree with Prof. P. GRAEBNER, who has arrived at the conclusion that almost everyone of the commoner species can be divided into more »species» on account of their anatomic facts (Lebensgesch. 1906, 436). The case is just the very contrary. The anatomic stem-diagram is so fixed that it is very little, if at all, influenced by the morphologic variations within the same species; nay, even morphologically well separated species being nearly related can have the same anatomic diagram. But, of course, just as the leaves, for instance, vary as to the width etc., so the cortical bast-bundles, f. i., can deviate a little as to number and thickness, and the thickness of the endodermis-cells can vary a trifle, mostly depending on age and alimential conditions. In the cases when a species is able to grow both in stagnant and running water and the stem is lacking cortical bundles,

it does not at all strengthen its resisting power against the pulling energy of the current water, in the latter case, by sclerenchymatous tissue in the bark, but by stronger sheaths round the central vascular bundles, or by transforming the pith cells into mechanic tissue with thicker walls, by suberised epidermis cells, and by a strengthening layer, or by lists etc. SCHWENDENER'S statement (1874) upon the development of mechanic tissue in *P. fluitans*, in running, and its disappearance in stagnant water, is accounted for by the fact that very different constituents have of old been reckoned to this »species». The cortical bundles of the stem originate chiefly in the petioles and the ligules and do not appear on account of accidental mechanic necessities. If the petioles are void of those mechanic elements and the ligules only are faintly endowed with strands, the stem, as far as hitherto known, lacks the bark-bundles, whether the species is growing in running or stagnant water. This is the case with *P. nodosus*, in which, however, as in other similar species one or another of the ligular strands rarely descends a little piece of way into the bark-parenchyma below the node. The absence of sub-epidermal strands in the petioles also causes the submersed leaves easily and early to decay or to be torn away by the motion of water. In herbarium materials, thus, we mostly see very little of those leaves. The plant evidently does not need them long for its existence but, instead of them, early produces subcoriaceous or coriaceous leaves, wherupon it prolongs itself by branches from the top according to need, thus procuring a rich evolution of floating leaves during the whole vegetative season. Besides, the lowest floating leaves have an incredible power of stretching their petioles to reach the surface, and these leaves neither fall away nor are pulled off on account of the extremely strong bast-sheaths round the vascular bundles, with which the species is able to supply itself.

The submersed leaves are characterized by their abundance of lacunæ, which appear partly along all longitudinal nerves, partly and especially as a broad ribbon or areolation along the midrib all up to the very apex (see the fig. 95, A!). The shape is lanceolate and the apex obtuse evenly narrowed or with a very faint cuspidation. On the margins they are beset with small forward directed one-celled denticles without sinuses in the leaf and so extremely fugacious that they seldom or never are to be found in adult leaves but only in the very youngest ones. In the hybrids, again, above mentioned, except *P. lucens* × *nodosus*, those teeth, even in the youngest leaves, are absent or to be

Fig. 95. *P. nodosus* POIN. A, Top of a submersed leaf, $\frac{3}{4}$; B, Marginal part of it (enlarged) showing the serrulation. C, Floating leaf, $\frac{1}{4}$. D, Pistils, a, lateral view, b, from the inside, $\frac{1}{10}$. E, Pistil with abnormal stigma, $\frac{1}{10}$.

found only as rudiments. The inner side-nerves run along the midnerve nearly up to the middle before bending out into the lamina. Ligules brown, long, transient and with very low ridges at the base. The colour of the foliage often has a prasinous tone and decaying a yellowish or brownish-green touch. The peduncle sometimes has the same thickness as the subjacent internode, but is more often a little thicker, however without the characteristic incrassation present in *P. lucens* and its hybrids. Pollen spheric and rather small-grained; style conspicuous and a little swollen; stigma small, oval, but often deformed and elongated as in the fig. 95, *E*, which seems to be the cause why the species rather often fruits scarcely, with only a few nutlets in the spike. Fruit usually large with prominent dorsal keel but the species varies also with less fruits just as the bulk of the species. The turios are rhizomatic and correspond nearest with those of *P. alpinus*. They are first described by ROYER (Fl. Côte D'Or, 1881, 520) and figured in GLÜCK, Wasser- und Sumpfgew., II, 1906, t. VI, f. 73. Different fruit-forms are figured in Linnæa 1827, t. VI, figg. 22, 23, 24, 26. Stem-diagram, vide RAUNKIÆR l. c., 274, f. 9. REICHENBACH, Icones vol. VII, 1845, t. 49, f. 88, may be, according to FRYER and FISCHER, the hybrid *lucens* × *natans*; t. 48, f. 87, seems to me to represent a form of *P. alpinus*.

The species varies with elongate laminae (river-form): var. *Billotii* (SCH.) and occur also as land-form: f. *terrestris* GLÜCK. Besides, FISCHER has distinguished a f. *spathulifolius*, a f. *brevifolius*, and a f. *latifolius* the characteristics of which are expressed in the very names, and even a var. *lacustris* in habit similar to *P. natans*. —

An extreme form of the var. *Billotii* is gathered in the Zambeze River, Rhodesia: f. *angustissimus* HAGSTR., ap. R. E. FRIES, l. c., p. 186.

Folia omnia angusta, submersa angustissima. *P. fluitans* ROTH. f. *elongatus* KUEHN, ap. ABROMEIT, Bericht etc. in Schr. Phys. Ök. Ges. Königsb. 1893, 43? —

In the collections of the museums there is a form of *Ustin*, gathered by Ulehlá, with obviously small leaves, which, however seems to be a true *P. nodosus*. I name it: f. *moravicus* n. f. — *Folia* submersa et natantia parva.

I have also seen this form from *Turkestan* (»Pr. Chan-ova inter Hurw novam et Hurw antiquam, 1884, A. REGEL, Iter turkestan.» labelled *P. polygonifolius*?). —

In the University Herbarium of Upsala there is a plant, labelled »Pl. ind. or. (Mont. Nilagiri) Ed. R. F. HOHENACKER. 1312. *P. natans* L. — Steud. Prope Utacamund Jun. m.» which I have referred to *P. nodosus*. Others regard it as *P. indicus* ROXB. or *P. Roxburghianus* SCHULTES. The anatomic diagram of the stem corresponds with the anatomy of *P. nodosus*, and its other properties seem to me to deviate rather slightly from the type. Fruit is lacking in those specimens and likewise in specimens from the same station, gathered by PRONDLOCH in 1902 (hb. Haun.). Any complete description of the fruit is not given either in ROXBURGH, Fl. Ind., or in SCHULTES, Mant. 1827, but the description of the submersed leaves seems to answer well to a plant from Roxel Dacca (hb. Haun.), which must be referred to the *Amplifolii*. Its stem-anatomy is: ep. + pshp. + cort. str. in 2–3 circles + O-, or O—U-end. + CC of trio-type.

Distribution. *Europe.* *Germany*, many stations, the most northern at Königsberg, 91, SCHULTZ (hb. Uppsal.). — *Switzerland*, Geneva, 70, AYASSE (hb. Uppsal.). — *France*, Nantes, Loir, 81, LLOYD (hb. Stockholm.), Aix-les-Bains, BOULLU (hb. Stockholm.). — *Italy*, Sicilia: Palermo, Siracusa etc. (hb. Stockholm., Uppsal.). — *Spain*, Andalusia, Ronda, 89, REVERCHON (hb. Uppsal. et Lund.), Guadalhorce, 83, NILSSON (hb. Uppsal.). — *Austria*, several places (hb. Stockholm., Uppsal., Lund.). — *Herzegovina*, 1889, MURBECK (hb. Stockholm., Uppsal., Lund.). — *Russia*, Lithuania, Wilna, WOLFGANG (hb. Stockholm., »*P. petiolatus*»); Volhynia and Podolia (hb. Petersb.). — *Greece*, In valle Cephissi, 88, Dr. HELDREICH, and by him labelled: *P. natans* L. f. *græca* (hb. Stockholm.). — *Asia*, Persia prope Schiras, 42, KOTSCHY (hb. Stockholm., Uppsal.). — Ind. or. Penjab, THOMSON (hb. Stockholm.), fruit not deviating; Utacamund, HOHENACKER (hb. Uppsal., »*P. indicus*»); Chiwa. — *N. America*, Cuba, WRIGHT, 1860—64 (hb. Stockholm.), Pl. cubenses Wriethianæ n:o 603, 604, 3202; one sheet of n:o 603 contains a dubious form, possibly a hybrid. *Porto Rico*, prope Bayamon, 85, URBAN, prope Utuado, 87, SENTENIS (hb. Stockholm.), the former of these specimens determined by URBAN, the latter by BENNETT, but both dubious, both lacking, as far as I can find, serrulation in the submersed leaves; probably they belong to what I call *P. insulanus*, the floating leaves of which, however, are narrower. To *P. Nuttallii*, as it seems to me, they can not possibly be referred (cf. GRAEBNER, Potam. 1907, 56!). *Antigua*, 41, LIEBMANN (hb. Haun.). — *Mexico*, Casa de Tena (hb. Stockholm.), Jicaltepec and Vera Cruz, 41, LIEBMANN (hb. Haun.). — As to the *U. S. of Am.* I have seen it from Courtland, Minn., 92, BALLARD (hb. Stockholm.), Cayuga-Lake, N. Y., 84, MORONG (hb. Stockholm.), North Ferrisbergh, Vt, 85, MORONG (hb. Stockholm.), New Engl., MORONG (hb. Uppsal.), together with a top of *P. gramineus* × *nodosus*; Niagara, E. TUCKERMAN (hb. Uppsal.), large-leaved 100 × 40 mm; near Washington, SEAMAN (hb. Uppsal.), small and narrow leaves; Lees Lake, Colorado, 97, CRANDALL (hb. Uppsal.); Texas. — *Canada*: Que., Ont., B. C. (hb. Haun.). — *S. America*: Rio de Janeiro (hb. Christ.). — *Africa*, Algeria, 72, WARION (hb. Stockholm.); Socotra, 80, BALFOUR (hb. Stockholm.), Madeira in rivulo prope Machico, 65, MANDON (hb. Stockholm.), Pl. Maderenses, n:o 232, labelled: »*P. gramineus* L. var., *P. heterophyllus* v. γ. LLOYD, Fl. Ouest, *P. Machicanus* MANDON in schedula (Coss.)»; Machico, 28, HOLL (hb. Lund.). Gran Canaria, 97, GELERT. — Rhodesia, in Zambese River, a little above the Victoria falls, 1911, R. E. FRIES (hb. Uppsal.), f. *angustissimus* HAGSTR. — Prope Tripoli: Dr. ROTHMAN (hb. Stockholm.): of low growth, very short internodes, ligules short, 15—20 mm, with rather low ridges, at last ripped up into threads; fruit of the same shape as in *P. nodosus* but less, 2,5 × 2 mm and with indistinct dorsal keel. Stem-anatomy not deviating. — Egypt. — Mascarene Is. »Boivin pl. ins. Borboniæ» (hb. Christ.). — »O-Wohy» ded. CHAMISSE, and Marianne Is. (hb. Haun.).

In Europe, thus, the species spreads northward to the 55 parallel (Königsberg, see above), but does not occur in Holland (according to VUYCK l.c.), Great Britain, and Ireland. Nor have I seen it from Portugal. From this non-occidental occurrence we may be permitted to conclude that *P. nodosus* is an easterly plant with its

original habitat in the inner Asia, from where it has spread westward to Europe and eastward to N. America. And it seems also to have arrived at the South American continent. — The northern limit in N. America may be the 50th lat. and in the Old and the New World, as a whole, the year-isotherm of about 8° C.

In Africa it has crossed the equator and spread to the western islands, but if it were an original African plant it ought to have early spread to South America and should now be met with there more abundantly than is the case.

***P. nodosus* POIR. × *Nuttallii* CHAM. & SCHL. (*P. subsessilis* n. hybr.).**

Caulis teres (= *P. nodosus*), anatomia ut in *P. Nuttallii*. *Folia* submersa 140—200 × 5—7 mm subsessilia in petiolum attenuata, nervatura ut in *P. Nuttallii*. *Folia* natantia ligulæque ut in *P. nodoso*. *Sterilis*. — Fig. 96.

Fig. 96. *P. subsessilis* HAGSTR. Tops of submersed leaves (a little enlarged).

In habit this form is like *P. nodosus*, but its characters are intermediate. Especially it is characterized by the submersed leaves being a little broader than has *P. Nuttallii* and tapering into a stalk-like base, but as to the nervation etc. reminding of *P. Nuttallii*.

Distribution. N. America. Eastern Mass., U. S. A., MORONG (hb. Uppsal.), by MOR. looked upon as a *P. lonchitis*. — In the Journ. of Botany 1908, p. 250, AR. BENNETT states that he is the owner of two specimens (from New York, and East Mass.) collected by MORONG and supposed to be this hybrid, which he names *P. americanus* × *P. pensylvanicus*.

Of *P. nodosus* × *Richardsonii* is spoken above, p. 148. The denticulation and the form of the apices of the submersed leaves beside the presence of a pseudohypoderma in the stem are here decisive.

Subsectio 22. *Natantes* GRAEBNER.

Caulis teres ± ramosus. *Folia* natantia longe petiolata; submersa linearia crassa semiteretia ± canaliculata; *ligulæ* fibrosæ persistentes. *Pistillum* et *fructus* ut in *Amplifoliis*. — *Anatomia* caulis: *u*-endodermis, fasciculi librif. et vasc. corticales numerosi. — *Turiones* rhizomatici desunt.

The species here concerned are obviously connected with the *Amplifolius*-group by *P. amplifolius* with its strong ligules and cortical bundles in the stem. They are all rich in sclerenchyma and, besides, provided with an internodal *u*-endodermis. Hereby they form a bridge to the coriaceous-leaved species of the next group especially those in which the central vascular bundles are free as for instance *P. illinoensis*.

Another characteristic uniting this subsection with the *Lucentes* appears in the submersed leaves, reduced to petioles and midribs, forming so-called phyllopodia, frequently seen in *P. lucens*.

Finally the pistils with their short styles are common to both groups.

Rhizomatic turios are not known in this group.

P. natans LINNÉ, Sp. pl. 1753, 126. — *P. serotinus* SCHRADER in KOCH, Syn., 1844, 775.

The stem of this species usually prolongs itself with only one spike-bearing branch from the top, very rarely with branches of the second or third rank. Beneath the primary spike the species usually has 2—3 floating leaves generally with longer stalks and narrower, often also shorter, laminae. The leaves of the stem-prolongation are mostly more conspicuously cordate and shorter than the primary involucral leaves. On limiting the varieties or forms from each other by the floating leaves we, therefore, may conveniently go out from the latter leaves, comparing them as to their variations. They usually are 25—27-nerved (in narrower forms 17—21-nerved) with more indistinct cross-veins than in species with otherwise very similar leaves. Submersed leaves canaliculate, 5-nerved and of the same anatomical structure as the petiols of the floating leaves; apices always obtuse. The ligules have broad light scarious borders, low, not winged ridges, and a length of as far as 18 cm, generally however about 10 cm.

The epidermis-cells of the stem belong to the shorter type of those cells, 1.5 to 3 (4) times as long as broad; they are strengthened by a pseudo-hypoderma, one-celled or more rarely two-celled. Only the very nethermost in the mud standing internodes have more stretched epidermis-cells, 5—20 times the width. The endodermis consists of U-cells. CHRYSLER, The structure etc. 1907, Fig. 14, t. XV, shows a central cylinder with O-endodermis, which surely by mistake is signed as *P. natans*; it seems to me to be *P. amplifolius*. Both stem and peduncles are rich in sclerenchyma in 3—4 circles beside the subepidermal one. The cauline more or less fused trio-bundle forms in the stem-prolongation a conspicuous bundle-trio with separate xylem canals. As usual the peduncle lacks an endodermis round the central vascular bundles.

Serial sections through a node show that the subepidermal strands are internodal, that the outer cortical circle of the vascular bundles derives its origin from the ligule, the bundles of which descend into the bark and continue to the node next below, finally that the inner circles of the cortical bundles generally are cauline and connected with the vascular bundles of the central axis.

The investigations have proved that the terrestrial forms of the species have the same anatomical stem-diagram as the forms of running water, and that the anatomical conditions are fixed. The thickness of the lower internodes is considerably greater than that of the middle ones. The diameter of the 13th internode reckoned from the primary spike, for instance, has once been found to be 4 mm, whereas that of the 5th internode from the same spike measured only two mm. This difference is chiefly dependent on a gradual diminution of the cells from below upwards, whereby the lacunae also grow considerably larger in the basal part of the stem. The number of the lacunar circles is about the same (5—6) through the whole stem.

P. natans has been mixed up with *P. nodosus* and *polygonifolius* by several earlier authors and many »*natans*-forms» belong to these species.

The genuine *natans*-forms may be divided in the following varieties:

Var. **vulgaris** KOCH et ZIZ: — »Folia late ovalia tripollicaria» (= v. *lacustris* FRIES).

Var. **ovalifolius** FIEBER: — »Folia ovato-oblonga» about 110×30 mm.

Var. **rotundifolius** BRÉBISSE: — »Feuilles larges, courtes, arrondies».

Var. **prolixus** KOCH: — »Folia oblongo-lanceolata». Internodes and petioles, besides, stretched (= v. *fluvialis* FRIES, 1828, non SCHLECHT., 1823), an adaption to running water.

Var. **pymæus** GAUDIN is a small-leaved shallow-water form.

Var. **terrestris** GRAY is the terrestrial form of the species (= f. *amphibius* FRIES).

A small-leaved *ovalifolius*-form I have named, in herbaria:

f. *pygmæoides* n. f.: — Folia natantia $60-70 \times 20$ mm.

On *P. sparganifolius* which is the hybrid *gramineus* $\times$ *natans*, see below.

The species has been figured innumerable times from the days of L. FUCHSIUS (De hist. stirp. comm. ins. 1542, 651.) up to the very latest time. Figures to the anatomy of stem and leaves etc. in C. RAUNKJÆR, De danske Blomsterpl., 1896, M. A. CHRYSLER, The structure etc. 1907, t. XV, and C. W. FONTELL, Beiträge etc. 1909, t. V. f. 121—126; Hybernating organs in GRAEBNER, Potamog. in KIRCHNER etc., Lebensgeschichte etc. 1906, 427, f. 243.

Distribution. In Sweden it is common through the whole country from Scania up to the northern-most parts of Lapland, in Oland and Gothland, too (hb. Stockholm., Uppsal., Lund., Gothenb.). Likewise in Norway to »Rebbenæsön nord for Tromsö; sjelden nordligere»: Blytt, Norges Fl. I, 1902, 45; and Iceland, up to Akureyri, 83, STRÖMFELT (hb. Uppsal.). Russia, Peninsula Kola. From thence to Asia, Sibiria, Tungusk Jenisei, 76, BRENNER (hb. Stockholm., Uppsal.). The north boundary seems to coincide nearly with the year-isotherm-line of -5° C. N. America many stations (hb. Stockholm., Uppsal., Lund.) up to about the same isotherm. To the south of this line it spreads through all countries down towards the equator, and is said to occur also in South Africa, but I have seen no specimens. According to P. DUSÉN, Die Gefässpflanzen der Magellansländer, 1900, 234—235, *P. natans* is said to be known from Chile and probably growing also in *Fuegio orientalis* at Cabo-Peñas and »in dem Aysen-Thal an der Westküste von Patagonien», but I have seen no *P. natans* from those regions. And it is a mistake when P. GRAEBNER states: »Süd-America: Patagonien (DUSÉN, det. HAGSTRÖM)», Potamogetonaceæ 1907, 161.

***P. natans* L. $\times$ *polygonifolius* POURR. (*P. gessnacensis* FISCHER, Die bayer. Potamog. etc. 1907, 31, 42—43.)**

Var. **Richtsfeldii** FISCH., l. c. — F. *hibernicus* n. f.

Caulis metralis, simplex tenuis. *Folia* submersa tenuia angustissima (1 mm) longissima; emersa tenuia lanceolata $50-60 \times 15-17$ mm, ca. 15—17-nervia, petiolis

longis ca. 170—225 mm. *Ligulae* olivaceae breviores et citius putrescentes quam in *P. natante*. *Spicae* parvae steriles; pedunculi parum evoluti.

Not having seen the Bavarian specimens I cannot pronounce an opinion on them. They are said to appear as intermediate forms between the two suggested parent-species in anatomical respect as well as in the morphology. The author expresses himself with some hesitation (»wahrscheinlich *P. natans* $\times$ *polygonifolius*») which, however, is not heard of in his later »Bemerkungen zu den Potamog. in d. 2. Aufl. der Synopsis d. mitteleur. Fl. von ASCH. u. GRAEBNER, 1914». The above described form has proved to be a genuine hybrid of *P. natans* with *P. polygonifolius*. It was gathered at Killarney, Ireland, by R. M. BARRINGTON, in 1874¹, and under the name of *P. natans* L. f. *linearis*, kindly sent to the writer by Mr AR. BENNETT, who has also had the kindness of mentioning my view of the plant in The Journal of Bot. 1908 p. 250. According to GRAEBNER (Synopsis, 1912) this Killarney plant is distributed as »*P. natans* $\times$ *polygonifolius* G. CL. DRUCE, Rep. Bot. Exch. Club III, 1, 321, 1912». Consequently Mr. DRUCE seems to have come to the same conclusion on the Killarney plant as the writer, whereas GRAEBNER suggests a combination *P. natans* $\times$ any species of the *Chloëphylli* (l. c., p. 458).

The stem anatomy exhibits a thin central axis with 8 free vascular bundles, endodermis of *U*-cells, and reduced cortical strands [one subepid. circle, one complete and one incomplete (of 2—3 strands) interlacunar circle of vascular bundles]. *P. natans* has more circles, *P. polygonifolius* only a subepidermal one, the Killarney plant keeps the medium.

Probably it is the same plant of which Mr R. W. SCULLY writes in The Journ. of Bot. 1889, 86: »in its most extreme form this plant (from Kerry) produces only long capillary leaves and passes from this almost imperceptibly into *P. natans* with floating leaves plicate at the base. Both Mr BENNETT and Mr FRYER say that this variety must be referred to *P. natans* instead of *P. polygonifolius*.»

***P. natans* L. $\times$ *trichoides* CHAM. & SCHL. (*P. variifolius* THORE, Essai d'une Chloris du dép. des Landes, 1803, 47). — Fig. 97.**

Ripe fruit was never, or extremely seldom, observed in this plant. Pollen is also quite unfit for fertilization. That manifests the hybrid nature of the plant, which is also confirmed by its solitary occurrence, in some rivulets of southeast France, and by the variable anatomical stem-diagram.

As evident as this fact is, just as difficult it seems to be to find out the two species, a crossing product of which the plant must be. Nor has anyone hitherto applied himself to this question in earnest. P. GRAEBNER says, »planta dubia», and includes it with his *Javanici*. G. ROUY writes: »*P. polygonifolius* $\times$ *gramineus*?» (Fl. de France, T. XIII, 303).

If we take the upper leaves as a starting point, it is quite clear that one of the parent species must have been endowed with coriaceous leaves and further that

¹ The label runs thus: »*Potamogeton polygonifolius* var. *linearis*. Upper Lake Killarney. Kerry. R. M. BARRINGTON 27 june 1874.»

the other factor must have wanted them, since the hybrid has very much reduced upper leaves. The very narrow and long submersed leaves point in the direction of *P. natans* and some narrow-leaved species. Superficially observed these leaves seem to be 7-nerved, but as the figure below shows, the vascular bundles are in fact only three. The same figure also shows that these leaves are very rich in sclerenchymatous strands. The apexes of the submersed leaves vary from rather acute to roundly obtuse, see the figure! The ligules are strongly nerved, dark-green, and in

the front-field five-nerved. At their base there are prominent glandulous swellings (nodal vittæ or oil-cells). The stem is high-grown, terete, at the middle thread-like. It prolongs itself by one single spike-bearing branch. The spikes are small, 3—5-whorled. All these properties taken together undoubtedly allude to the combination written above.

If nevertheless there would be any hesitation in admitting a crossing between one of the largest (*P. natans*) and any of the most delicate species it must disappear on the discovering, in the hybrid, of cauline turios, evidently like those characteristic of some small-leaved species. A closer examination proves that no other species but *P. trichoides* together with *P. natans* has been able to produce such turios. The figure gives a better idea of it than any description can do.

In a surprising way the stem anatomy also confirms the morphologic and biological testimonies. The central cylinder of stem, thus, has now (in narrower internodes) an arrangement of bundles quite as in *P. trichoides*, now, again, it is

Fig. 97. *P. variifolius* THORE A, a, b, c, d, Different forms of floating leaves, $\frac{1}{2}$. B, a, b, Tops of submersed leaves, $\frac{1}{10}$. C, Part of a submersed leaf at the middle, lacunar system and superficial sclerenchyma (subepid. str.) visible, $\frac{2}{10}$. D, Transverse section of a submersed leaf at the middle, showing the arrangement of the lacunæ and the subepidermal strands, us, upper, and ls, lower surface, m, midnerve, n' lateral nerves, str, bast bundles, $\frac{7}{10}$. E, Turio, a, stem, b, leaf, gl, gland, $\frac{1}{2}$.

intermediate between the two: with 2 free median and 2 free lateral bundles. The subepidermal strands are also full-numbered and strong; in the bark, moreover, there are one or two circles of bundles, which can be said to be a reduction of the circumstances of *P. natans*, in which we usually find three or four circles. The endodermis-cells are, in all the cases examined, u-cells as in *P. natans*. The anatomy of the peduncle corresponds most closely with that of *P. natans* with a reduction of the number of bundles here, too. The cross-section can be said to exhibit a *P. natans* in miniature.

The anatomy of the submersed leaves will be rendered clear by the figure

above, a characteristic modification of the *natans*-leaf and *trichoides*-leaf, similar to both by its abundant sclerenchyma.

Finally it may be stated that *P. trichoides* predominates in the structure of the ligules, often in the tops of leaves too, whereas *P. natans* is prevailing over *P. trichoides* for instance in the number of pistils, here being four, not as in the latter a single one. The shape of ovaries seems to approach to *P. trichoides*. As to the ramification it is met with now *trichoides*-like, now *natans*-like.

It is interesting to observe as how, at crossing, a *u*-endodermis most often prevails over an *O*-endodermis. If therefore, as some authors assume, *P. lanceolatus* SM. (see p. 149!) were a crossbreed of *P. gramineus* with *mucronatus* or *pusillus*, we should expect to find a *u*-endodermis, especially as *P. gramineus* has very prominent *u*-cells. Instead of it we here find an *O*-endodermis.

Distribution. France: »Gironde, In fluvio Leyre prope Mios. Julio 1899 leg. E. J. NEYRAUT» (hb. Lund.); »In rivo prope Uza, Dpt Les Landes — — — Endress Junio 1831» (hb. Uppsal.). It is noticeable that this hybrid has been able to stay in those regions from its first discovery up to our days, a period of more than a century.

***P. Richardii* SOLMS LAUBACH in SCHWEINFURTH, Beitr. Fl. Aethiop. 1867, 194, 292.**

It seems to me that this species by its morphological and anatomical characters comes very near to *P. natans*, to which it has also been referred by SCHIMPER. It reminds also of *P. nodosus* and some species of the *amplifolius*-group (*P. fibrosus*).

The two specimens here preserved were collected in a deflorate state without fruit. — Stem stout and thick, a little branched, and prolonged from the axils of the involucreal leaves by an undeveloped branch; internodes shorter or longer (40—140 mm), shortest below the primary spike. Inferior (or lowest) leaves linear, almost filiform, the following petioled with more or less coriaceous, oval—ovate-oval, or sometimes a little cordate-ovate (fol. flor.), red-brown or leather-coloured lamina of the size of 70—100 × 40 mm, about 20—25-nerved with obtuse mucro. Petioles long, broad, those of the lower leaves a little longer, the topmost somewhat shorter than their blades. Ligules 40—50 mm long, brown, with ridges only at the base, soon decaying. Peduncle even, 70 mm long; spike 40 mm.

Stem-anatomy: Epidermis with a one-layered pseudo-hypoderma but no (or a few), subepidermal strands, in contradistinction to *P. natans* being provided with a full-numbered circle of subepidermal bast bundles. Three circles of bundles in the bark. *O-u*-endodermis. The bundles of the central axis arranged according to the trio-type.

This anatomical diagram distinguishes it both from *P. natans* and from *P. nodosus* and *P. fibrosus*. From the former it is besides separated by the broader petioles, the abundance of floating leaves below the primary spike, by browner and soon decaying ligules, narrower submersed leaves, and stouter stem. The ripe fruit

of this species I have seen is very large, sharply three-carinate, and very much reminding of the fruit of some species within the *amplifolius*-group, to which, at all events, *P. Richardii* forms a transition.

The specimens examined are collected in *Africa*, Abyssinia, and labelled »Schimperii iter Abyssinicum — — — 135 *Potamogeton natans* L. In rivis et aquis stagnantibus prope Adoam U. i. 1840. d. 11 juni 1837.» (hb. Stockholm.). Another specimen, also belonging to the Museum of Stockholm and only labelled »*P. natans* 1207» presents a little smaller leaves, 45×25 mm, 19—21-nerved, and has the stem prolonged with branches of as far as the 6th rank.

P. Oakesianus ROBBINS in A. GRAY, Manual of the Botany of the north. U. S., 5 ed. 1867, 485.

This American species is as yet rather incompletely known. The material, preserved in Sweden, deviates from the original description by the stem being quite unbranched as far as the primary spike, from where it prolongs itself with a branch.

Undeniably it is very much like a delicate *P. natans*, so like indeed as to be thought to be a hybrid of that species. Knowing it from several localities, MORONG also remarks, »usually not fruiting freely», which seems to confirm such a supposition. Nevertheless I have not hitherto found further support of it, and its reduced fruiting ability may result from a similar cause as in *P. Robbinsii*, the rather as the distribution areas of these species nearly coincide.

The submersed leaves are narrowly linear, thin, 3-nerved, obtuse (almost *filiiformis*-like); floating leaves long-petioled (65—80 mm), their blades $45-50 \times 20$ mm with rounded or a little cordate base, and obtuse to almost rounded apex, 17—21-nerved, their ligules brown, 30 mm long, without ridges. MORONG's statement does not stand in opposition hereto: — »stipules hardly keeled». Peduncles thicker than the internode next beneath, 50—65 mm long, spikes small-flowered of eight whorls, 12—20 mm long. Deflorate spike quite without fruit.

Stem-anatomy much reminding of that of *P. natans*: *U*-endodermis, numerous free bundles in the central cylinder (trio-type diagram), 1 ligular circle (or 2 circles) of interlacunar bundles and, besides, well developed subepidermal strands. The difference chiefly lies in the reduced cortical bundles, fewer circles of lacunæ, and in the absence of a strengthening layer along the epidermis, which consists of elongated cells, ca. 4—7 times as long as broad.

The Morongian specimens, from South Natick, again, remind as to the stem-anatomy more of *P. gramineus* by the lateral bundles of the stele being more reduced in number. The two median ones are also here free with separate xylem canals. These individuals have still smaller floating leaves, ca. 25×12 mm, and shorter ligules.

P. Purshii TUCK., with »acuminate leaves», does not seem to belong hereto.

Distribution. *N. America*, »Brandscomb Pond St Johns» »Morison Newf:d» (hb. Stockholm.); »In paludibus ad South Natick, Mass., U. S. A.,» 81, MORONG (hb. Stockholm.). — The specimens from Pine plains, N. Y., leg. HOYSRADT (hb. Stockholm.) must be considered the hybrid *gramineus* $\times$ *natans*.

P. Morongii AR. BENNETT.

Notes on *Potamogeton*, in The Journal of Botany, 1902, 145. — Fig. 98.

The specimens of the collections here preserved are deprived of fruit, but their other organs answer rather exactly to the description, and their habitat is not far from the localities recorded by AR. BENNETT, because of which I regard my determination as correct.

Floating leaves of our specimens long-petioled (above 100 mm) with lanceolate or oval laminae, 50—60 $\times$ 13—20 mm, the apex of which is a little elongated, obtusely cuspidate. Ligules 45—55 mm long, persistent, with numerous strong nerves, dark-brown or greenish-brown, without ridges. Submersed leaves very narrow, faintly canaliculate and 3-nerved, striate by the numerous strong subepidermal strands. The arrangement of those strands and of the lacunar system is shown by the figure added.

Stem-anatomy much like the diagram of *P. natans*: endodermis of more or less one-sidedly thickened cells, two (three) circles of interlacunar bundles in the bark and a full-numbered circle of subepidermal strands; epidermis with a one-celled strengthening layer. The bundles of the central stele arranged according to the trio-type diagram.

Distribution. *Japan*, Tokio, Prof. R. YATABE (hb. Uppsal.).

Fig. 98. *P. Morongii* AR. BENN. A, Blade of a floating leaf $\frac{1}{2}$. B, Transverse section of a submersed leaf *us*, *ls*, *m*, *n'*, *str* as in fig. 97, $\frac{8}{10}$. C, Part of a transverse section of the stem, see the text, $\frac{6}{10}$, *ep*, epidermis, *cc*, central stele.

Subsectio 23. *Lucentes* GRAEBNER.

Caulis ut in præcedente. *Folia* infima linearia ut in præced., summa sæpe coriacea, cetera semper membranacea lanceolata cuspidata, petiolata v. sessilia, serrulata; ligulæ persistentes sæpe fortiter bicostatæ. *Pistillum* stylo brevi. *Fructus*

dorso carinatus v. rotundatus. — *Anatomia caulis*: *U*-endodermis, fasciculi libriformes et vasculares corticales $\pm$ numerosi semper obvii. — *Turiones* rhizomatici adsunt.

Beside the species here below treated of, I include in this group, which I have called *Dentati* in Bot. Not. 1908, 101, also *P. dentatus* and *Gaudichaudii*, nearly kindred with each other, further *vaginans* and *azoricus*, by AR. BENNETT referred to *P. lucens* but evidently distinct species, as also *P. brasiliensis* and v. *floridanus* (*fragilinus* m.), furthermore *P. ziziiiformis* and *nipponicus*, finally with some hesitation *P. distinctus*, *sumatranus*, and *Schweinfurthii*, the leaf margin of which is as yet not described.

Closely related to the *Nodosi* the group belongs to the Potamogetons which, just as the group next before, are rich in sclerenchymatous tissue, anatomically showing also close likeness to the following (*Prælongi*).

***P. illinoensis* MORONG.**

In Botanical Gazette V, 1880, 50. — Fig. 99.

The distribution-area of this species is said to be »Illinois to Iowa and Minnesota» (MORONG in BRITTON & BROWN, Ill. Fl., 1896, 70; ROBINSON & FERNALD, Gray's New Man., 1908, 73). It has, however, a much wider distribution than has hitherto been thought. Beside from Mexico and Texas (see below!), I have also seen it from Florida (ca. 28° 30' north. lat., O. VESTERLUND, 1889), and from Michigan. Finally I have traced it in Canada by its connections with *P. amplifolius* and *gramineus*. It varies considerably in habit, occurring like *P. gramineus* both with floating leaves and without. No doubt it is often confounded with *P. Zizii*, which it often resembles in habit.

The following properties are common to all forms I have hitherto observed: — 1) Stem typically always more or less branched, at least upwards, prolongs itself willingly by short-jointed branches of first to 2d rank. 2) Upper internodes, especially those of the stem-prolongation, short, 2–3 (5) cm or less. Sometimes the branches are rosette-like with extremely short internodes (see below!). 3) Submersed leaves serrulate and short-petioled, or at least with stalk-like base. The petioles of the floating leaves usually a little longer, than those of the submersed ones, but generally shorter than the laminae. 4) The apex is cuspidate and has a characteristic broad shape (see fig. 99, *A*, *B*!). 5) The midrib of the submersed leaves, often also the chief lateral nerves, especially below, accompanied by a more or less broad lacunar part. 6) Cross-veins usually very dense, by which the nerve-spaces get a narrow, broadwise elongated form especially in the amphibial leaves. 7) Ligules of the stem-leaves strong, brownish, conspicuously bicarinate, with broad base, finally spreading and breaking loose from its footing. 8) Style very short, stigma oval or oblong not covering the upper surface of the style. 9) The dorsal keel of the fruit extends typically to the base of the nutlet. 10) The lid of the endocarp always keeled. 11) The stem-anatomy is characterized by a one-celled pseudo-hypoderma and at least

a few (rarely no) subepidermal strands. Interlacunary there is always to be found the ligular circle of vascular and bast bundles and mostly scattered bundles inside it. The endodermis consists of *u*-cells, generally well developed, and of a laterally compressed form very much like those of *P. gramineus*. In the central axis there are always two large median xylem cavities separated from each other by mechanical tissue. Otherwise the arrangement of the bundles varies from diagrams of trio-type to those of eight-bundled type, and the lateral bundles are sometimes reduced in number.

Two aberrant forms may be established:

f. *rosulatus* n. f.: — Rami primæ ordinis rosulati internodiis brevissimis.

N. America: Florida, leg. O. VESTERLUND.

f. *homophyllus* n. f.: — Folia omnia submersa, membranacea.

Fig. 99. *P. illinoensis* MORONG. A, Top of a submersed leaf (somewhat enlarged). B, Top of a floating leaf showing the blunt, broad mucro and the nervation (a little enlarged). C, Part of an anatomical stem-diagram str, subepidermal strands, X, occasionally occurring bundles in the bark, $\frac{1}{10}$.

This form is destitute of floating leaves, even at the secondary spikes. Occurs in *Mexico*, State of Michoacan, Lake Patzcuaro, 90, PRINGLE (hb. Stockholm.), labelled »No. 3327 *P. Zizii* ROTH». *Texas*, DRUMMOND, 3d coll., no. 272 (hb. Lund.). Pine Lake, Mich., 92, Wheeler (hb. Haun.)

***P. illinoensis* MOR. × *lucens* L. (*P. pseudolucens* n. hybr.).**

Folia omnia submersa, ad formam ut in P. lucente, ad nervationem vero iis P. illinoensis simillima.

Dr. T. MORONG, who collected the plant here concerned, has determined it as *P. lucens*. Undoubtedly this species is also present in it with some properties. Especially obvious are the sharp leaf-tips, but the petioles also and the leaf-shape bear witness of *P. lucens*. On the contrary, the ramification of the nerves is more like that which is characteristic of *P. illinoensis*, besides which the rather short (30—35 mm) ligules, narrow nerve-spaces, and the anatomic stem-diagram belong to the just mentioned species. All the leaves, also the topmost ones, are constructed as submersed leaves lacking stomata. On the other hand the topmost leaves remind

of some small-leaved form of *P. illinoensis* by their slight size. Besides, the sterility also suggests the hybrid origin of this plant.

P. pseudolucens occurs »in lacu Fresh, Cambridge, Mass., U. S. A.» gathered by T. MORONG, 1880 (hb. Stockholm), and at N. Haven, Ct., 1858, EATON (hb. Christ.).

Of *P. pseudo-Zizii*, m., which is *P. gramin.* $\times$ *illin.* $\times$ *lucens*, see under *P. gramineus*!

***P. illinoensis* MOR. $\times$ *nodosus* POIR. (*P. Faxoni* MORONG, A revision of the North American Najadaceæ etc. in Mem. Torr. bot. Club, III, 2, 1893, 22, t. XXXII). —**

The Potamogetons gathered by C. E. FAXON in the years 1880 and 1882 at Ferrisbergh, Vermont, U. S. A., have been judged of very differently. FAXON himself seems to have held them for *P. rufescens* (= *alpinus*). AR. BENNETT has thought them to be *P. rufescens* $\times$ *Nuttallii* (*Claytonii*) (i. e.: *alpinus* $\times$ *Nuttallii*) (Journ. of Bot., 1890). In 1893 T. MORONG has described them under the name of *P. Faxoni* and also thought them a hybrid, but proposes the combination *lonchitis* $\times$ *rufescens* (i. e. *alpinus* $\times$ *nodosus*). In BRITTON & BROWN, Ill. Fl., 1896, this suggestion is not further mentioned, in consequence whereof it is probable that MORONG before his death has abandoned it as too uncertain. In 1901 AR. BENNETT (Journ. Bot.) seems to have been inclined to leave the thought that *P. alpinus* has been a co-agent. Any closer explanation, however, is not given. P. GRAEBNER establishes *P. Faxoni* (1907) as a proper species of the »*subsectio Alpini*», but refers also to the opinion of Mr AR. BENNETT (1890) though with some hesitation (»?»). Finally Mr AR. BENNETT has in The Journ. of Botany, 1908, 248, on account of the habitats, asserted quite a new idea of two different hybrids: one which he names *P. americanus* (*lonchites*) CHAM. $\times$ *pensylvanicus* CHAM., originating from »Little Otter Creek», and the other from »Lake Champlain», which he calls *P. alpinus* $\times$ *pensylvanicus* or $\times$ *P. Champlainii*. BENNETT is of the opinion that the former of those ought to maintain the name *P. Faxoni*.

Before we enter upon an investigation of the plants concerned, I should state first that I have had an opportunity to study specimens of both the stations collected by FAXON himself and belonging to MORONG's herbarium and by him determined as *P. Faxoni*; and further that the Little Otter Creek is one of the rivulets flowing into the Lake Champlain (emptying into the lake: MOR.).

An examination of the fructification plainly shows that it is about a cross-breed. The difficulty is to find the two parent species of the hybrid.

If you examine the submersed leaves you will find that both the forms are characterized by the margin not being smooth as in *P. alpinus* and *Nuttallii*, but studded with small faint teeth. From that fact the sure conclusion can be drawn that at least the one of the parents but rather both the partaking species must be endowed with serrulate submersed leaves. Consequently the combination *alpinus* $\times$ *Nuttallii* is inconceivable. The submersed leaves are further characterized by a nervation and structure typical of *P. nodosus* and in some degree also of *P. illinoensis*

(lacunæ along the principal nerves). Colour dark-green as most often in *P. illinoensis*. Their tips obtuse and often with the broad shape characteristic to the last mentioned species. To this should be added that they are always petioled with sloping bases quite in accordance with the above proposed species, in length intermediate or more approaching to *P. illinoensis* (shorter petioles).

Observing again that the plant is always endowed with floating leaves we conclude that at least one of the parents but rather both produce such leaves. In shape these leaves are intermediate but often smaller than in *P. nodosus* depending on the fact that *P. illinoensis* presents a slighter ability of developing coriaceous leaves than the coactive species. Those small floating leaves remind much of *P. Nuttallii* which fact seems to have been conclusive to BENNETT (floating leaves are nearly those of *pensylvanicus*: BENN.). Ligules, even the lower ones, persistent and, besides, as to structure and length intermediate between *P. nodosus* and *illinoensis*.

If we take the stem-anatomy as a starting point, all forms from Ferrisbergh seen by me accord with each other. The centralstele and the endodermis belong decidedly to *P. illinoensis*. The cortical bundles, again, are considerably reduced, evidently an influence from *P. nodosus*, with weaker ligules and typically lacking cortical strands. In the hybrid I have discovered a few interlacunar bundles but no subepidermal strands.

Thus we find that the morphological as well as the anatomical conditions of the plant agree with each other and unanimously argue for my proposition above; and as the plant, moreover, belongs to the distribution-area of those species, sufficient evidence may have been presented for its correctness.

The specimens from the Lake Champlain ad Ferrisbergh are preserved in the Nat. Hist. Museum at Stockholm. — On the hybrid *P. Zizii* from the same locality, vide p. 216. — The hybrid *P. alpinus* × *Nuttallii* (*pensylv.*) is as yet not discovered.

***P. illinoensis* MOR. × *perfoliatus* L. (*P. subdentatus* n. hybr.)**

Caulis ramosus ramis angulate curvatis in modo *P. perfoliati*. Anatomia ut in *P. illin.*, vide fig. 99, C! *Folia* caulina inferiora sessilia, elongata, debiliter dentata; nervatura et apices ut in *P. illin.*, basi lanceolata v. subovata. *Ligulæ* fuscae ut in *illinoensi* sed breves, caducæque (*P. perfol.*).

Two forms are found:

α **sessilis**: — Fol. floralia sessilia. — Collected in N. America, Queenston, Ont. (hb. Haun.).

β **petiolatus**: — Fol. floralia petiolata. — Coll. in Griffin Lake, B. C., N. Amer., 89, MACOUN (hb. Haun.).

P. subdentatus differs from *P. nitens* through the nervation, the leaf-apex, narrower leaf-base, and the colour of the sheaths.

P. fragillimus n. sp.

P. lucens L. var. δ *floridanus* AR. BENN., in GRAEBNER, Potamag., 1907, 79 & 161.

This species differs from all the other *Lucentes* by the following characteristics: *Stem* simple up to the primary spike, from which it prolongs after the *B*- or *D*-type. *Anatomy*: epid. + one-layered pseudohp. + subepid. strands + ligular bundles + *u*-end. Central stele of trio-type (= *P. illin.*). *Leaves* all short, short-petioled, slightly cuspidate, 7—9-nerved with short nerve-spaces; mid-vein not much lacunous; lateral nerves joining the midvein in the leaf-apex like *gramineus* (fig. 102, *H—L*). Denticulation extremely fugacious. *Ligules* lowly bicarinate, 7-nerved in the front-field. *The fruits* I have seen are *malaianus*-like with dorsal keel, ventral curvature, and apical rostrum as in fig. 115.

The plant examined was gathered in *Guatemala*, Laguna de Ayarza, dep. Jalapa, alt. 8,000 ped, 1892 by HEYDE & LUX (hb. Haun.).

P. macrophyloides n. sp.

Caulis metralis teres, internodiis longis, simplex v. subramosus. *Folia* anguste lanceolata, caulina 20—25 cm $\times$ $\pm$ 20 mm, denticulata cuspidata petiolata, petiolis $\pm$ 20 mm longis, typice 11-(13)-nervia; sine phyllopodiis; folia coriacea non observata; nervus medius lacunosus; spatia internervalia rhomboidea (vide fig.). *Ligulae* tenues longissimae, 80—90 mm, obtusae bicarinatae, carinis inferne humilibus. *Pedunculus*, *spicae*, *fructus* non visi. — Anatomia caulis, vide infra! — Fig. 100, *A*, *B*, *C*.

Anatomy: Stem-epidermis of rather short cells, generally 2—3 times as long as broad. Along the epidermis there is a one-celled strengthening layer and no or few subepidermal bast bundles. Inside we meet with 1 (2) circles of bast and vascular bundles. The central axis is surrounded by a typical *U*-endodermis and besides endowed with 4 (2) median bundles and 3 (2—3) lateral ones on either side, all with non-fused xylem canals. The lacunar part of the leaf round the central vascular bundle is destitute of interlacunar as well as subepidermal strands.

The habit of this plant is much like that of *P. lucens* v. *longifolius*. Stem with long internodes, simple or with rudimental branches and long-lanceolate leaves, all of which are narrow and petioled. The first and second rank veins fork as the figure shows. For the form of the apex and of the nerve-spaces I refer to the figure, too.

At the base of every shoot there are two sheaths, after which follows a narrowly lanceolate leaf, not as in *P. lucens* a phyllopodium, of which this species as it seems is void, just as it is also void of the *lucens*-inclination to diminishing the blades from both ends. Only the midnerve portion is lacunous but lacks mechanic tissue, because of which the leaves are soft and not rigid as in *P. lucens*. *Ligules* very long, the ridges of about the same height as the thickness of the ligule, thus considerably lower than in *P. lucens*, which has the ridges 3—4 times as high as the thickness of the ligule (fig. 110, *B*).

Though the specimens examined are devoid of spikes and fruits they differ from *P. lucens*, *ziziiformis*, and any other allied species so much that they cannot be mistaken for any of them.

Distribution. *South America: Paraná*, within the mouth-district of Rio Cubatão, gathered $\frac{1}{2}$ 1912 by P. DUSÉN (hb. Stockholm.). Probably also in Brazil and Argentine.

P. capensis SCHEELE apud AR. BENNETT, Bemerkungen über die Arten der Gatt. Potamogeton etc., in Annalen Nat. Hofmus. Wien, 1892, 287 (nomen solum). — *P. Schweinfurthii* AR. BENNETT, Najadaceæ in THISELTON-DYER, Fl. trop. Afr. VIII, 2, 1901, 220? — Fig. 101.

AR. BENNETT has certainly published the Scheelean name without a closer description, but as he refers to a positive herbal specimen easily accessible, it ought not to be rejected. And if *P. Schweinfurthii* should be identic with *P. capensis*, as BENNETT himself supposes (Annuaire du Conserv. etc. Genève, 1905, 95), a description of *P. capensis* is herewith also given. I have seen and examined the original specimen of the Bremen museum, thus signed: »*Pot. capensis* mihi. In Zwartkopsrivier prov. Uitenhage lgt ZEYHER Julio» »E Hb. Scheelei, qui schedulam scr.» And the specimens taken by ZEYHER and others, preserved in the Swedish museums are identic with them.

The *stem* is terete, high-grown and prolongs itself by branches of as far as the fifth rank. Below the primary spike again it seems typically to be unbranched. Possibly it emits long-branches from the base. *Submersed leaves* short-petioled (10–20 mm) and lanceolate or narrowly lanceolate, 70–80 × 10–15, or 150–170 × 15–30 mm, with long, narrow, but obtuse tip, and more or less on the petiole decurrent base, serrulate, 5–7-nerved, the broader and upper ones 12-nerved at the middle, all of *lucens*-structure. In the spike-region the leaves are usually longer petioled (20–30 mm) more or less coriaceous, blades lanceolate, a little shorter, 60–80 × 15–18 mm, 13-nerved. *Ligules* brown evidently bicarinate, persistent, 30–40 mm long. *Peduncle* ca. 5–9 cm long, even, and not or but little thicker than the interjacent internode. *Spike* deflorate 30–40 mm in length. *Style* thickened above, stigma small, oval or oblong. *Fruit* on the Cape specimens not present. In the form from the Delagoa province it is 4 mm long by 2.5 mm broad with distinct, somewhat recurved rostrum and strongly keeled back; sides convex with faint keels (dry state).

Fig. 100. A–C, *P. macrophylloides* HAGSTR. D, *P. ziziiformis* HAGSTR. A, Stem-leaf, lower half, $\frac{1}{2}$. B, Top of a stem-leaf, $\frac{1}{2}$. C, Middle part of a stem-leaf, $\frac{2}{3}$. D, Corresponding part of a stem-leaf of *P. ziziiformis*, $\frac{2}{3}$, n', n'', lateral nerves.

Stem-anatomy: The epidermis has a one-layered pseudo-hypoderma, but no subepidermal strands are observed. Cortically there is only the ligular circle of bundles. Endodermis of *u*-cells. The arrangement of the central bundles varying, like that of *P. lucens*, from eight-bundled to oblong type.

Unquestionably the species very much approaches to *P. illinoensis*. Especially the fruit-form is much the same in the two species. The rostrum, however, seems to be a little longer in *P. capensis*. The leaf-form is narrower and the submersed leaves lack a lacunar system along the lateral nerves. Nor do they present the recurved form and position as in *P. illinoensis*.

From the hybrid *P. Zizii* it differs by the fruit, the narrower peduncles, longer petioles, and obtuser leaf-apexes.

It differs from all non-coriaceous-leaved species of the *Lucentes* by its upper leaves, and from *P. ziziiiformis*, besides, by the absence of subepidermal cauline strands, occurring in *P. ziziiiformis*.

P. lucens, *dentatus*, *malaianus* and *gramineus* and others have sharper-pointed submersed leaves, some of them even long-pointed.

Distribution. Africa. Cape. ZEYHER (hb. Lund.); Zwartkopsrivier (Distr. Uitenhage) 1830 (hb. Stockholm.), one sheet signed »919», another »8799»; Prom. Bonæ Spei. DREGE (hb. Uppsal.); In aquosis Mathibis Kom, in prov. *Delagoa*, 86, BOLUS (hb. Uppsal.), labelled: »Herb. Normale Austro-Africanum conflaverunt MACOWAN et BOLUS. Regio orientalis n:o 1393. *Pot. lucens*. L.»; *Natal*, Umschlangwe River, 93, R. SCHLECHTER n:o 3120 (hb. Stockholm et Zürich, labelled *P. lucens* L.).

P. Chamissoi AR. BENN.

Notes on Potamog., in Journ. of Bot., 1904, 74—75.

The leaf-margin of this species is furnished with a minute, frail denticulation like that of the *Lucentes*. The remaining properties also suggest that the species must be referred to this group. The anatomical diagram of the stem does not differ very much from that of the foregoing: Epidermis, one-layered pseudo-hyp., a full ligular circle of bundles, faintly developed *u*-endodermis (*O*-*u*-end.), and a central cylinder according to the eight-bundled type.

The specimen examined is gathered by JOHNSTON in »Rivière de Moha, Mauritius, 1889» (hb. Haun.).

P. gramineus L. Sp. pl. 1753, 127. — *P. heterophyllus* SCHREBER, Spicilegium fl. lips., 1771, 21. — *P. graminifolius* BENKÖ, Transs., I, 1778, 123. — *P. hybridus*

Fig. 101. *P. capensis* SCHEELE. A, Floating leaf (Capespecimen), $\frac{1}{2}$. B, Submersed leaf (from Cape, $\frac{1}{2}$. C, Pistil, a, side-view, b, from behind (the Delagoa plant), $\frac{1}{2}$. D, Fruit side-view (Delagoa plant), $\frac{3}{4}$.

PETAGNA, Inst. Bot. II, 1787, 289. — *P. palustris* TEESDALE, Trans. Linn. Soc. V. 1800, 43. — *P. distachyus* BELLARDI, Stirpes novæ etc., in Mémoires acad. Turin, 1804, 447. — *P. augustanum* BALBIS, Miscellanea bot., in Mémoires acad. Turin, 1804, 330. — *P. lanciformis* ROEMER et SCHULTES, Syst. vegetab., 1818, 512. — *P. paucifolius* OPIZ, Böheims phän. und crypt. Gew. 1823, 23. — *P. crassipes* KITAIBEL, in CHAM., Adnot. etc. 1815, 5. — *P. Proteus heterophyllus* CHAM. et SCHL., Linnæa, 1827, 202. — *P. gracilis* WOLFG. ap. SCHULTES, Mantissa III, 1827, 355, ex KIHLMAN, Bot. Not. 1887, 84. — *P. nigrescens* FRIES, Mantissa III, 1842, 17. — *P. longepedunculatus* MÉRAT, Revue de la Fl. paris. 1843, 494. — *P. Kochii* LANG, Fragm. Herz. Verd. in Flora, 1846, 471. — *P. varians* MORONG ap. FRYER, Notes on Pondweeds in The Journ. of Bot., 1889, 33 p. p. — *P. Wolfgangi* KIHLMAN, Herb. Mus. Fenn. ed. 2. 1, 1889, 128. — Fig. 102. —

Although LINNÉ in his short description of this plant has not mentioned either floating or petioled leaves, the species, however, should be considered a coriaceous-leaved *Potamogeton*.

The habitat of this plant, you will observe, is shallow lakes and ponds, shallow rivulets and inside the edge of the reed of larger lakes, where the water is calm. In such places *P. gramineus* thrives and fruits abundantly and prolongs the stem by short branches of as far as the fifth or sixth rank, all endowed with coriaceous leaves. But the plant also accommodates itself to other conditions. On trying to invade deeper water and more rapid or large rivers, it limits the development of floating leaves to a minimum and returns to a more primitive stage. Ampliating the surface of the submersed foliage as a compensation for the floating leaves it stretches the internodes and the peduncles instead of prolonging the stem by branches in the top. By this adaptation the deepwater-form (var. *lacustris* [FR.]) and the river-forms (var. *fluvialis* [FR.]) arise, with a habit very different from the shallow-water-form (var. *heterophyllus* FR.). In such forms of adaptation I have met with primary peduncles of as much as 35 cm in length when the length of it otherwise is a few cm. Any change of the stem anatomy, however, does not take place by that adaptation. It remains steadily the same under different external conditions.

E. FRIES has thought that the Swedish Nordland fluvial form of the species ought to be established as main-form (*α. graminifolius*), since LINNÉ first during his Laplandian travel (1732) has observed and described the plant. In Species plantarum though, among other amendments of the earlier description, LINNÉ has made the addition that the species is annual and as habitat of the plant stated: »in Europæ fossis et paludibus», from which it is clear that he properly has had in view a slender, young plant from ditches. The reference to RAJI Synopsis will not mean more than that LINNÉ has considered his Lapland plant to answer to the figure 3 (t. 4) of the Synopsis, regarded by some to represent *P. obtusifolius*, by others, again, *P. acutifolius*, both of them not at all occurring in Lapland. There is no reason to reject the Linnéan name, and a misdetermination in LINNÉ's herbarium does not alter the dignity of the good old name.

The arrangement of the forms made in his Novitæ fl. succicæ, 1828, E. FRIES

has not applied to his herbarium, where thus no f. *fluviatilis* nor f. *stagnalis* etc. is to be found, but only specimens named »*P. gram. heterophyllus*». In *Summa vegetabilium Scand.* they are no more admitted, but on the other hand *P. nigrescens* is kept as a separate species. The original specimen of this »species» is still in the Nat. Hist. Museum, labelled, »in rivulis — — — Paræciæ Arjeploug Lappon. Pitens. 1824. LÆST.» It is the well developed form occurring in shallow rivulets, ditches etc. with slow current; it is endowed with floating leaves often with a little sloping base (fol. — — — natantibus ovalibus in petiolum folia longiorem attenuatis: FRIES, = *P. varians* MORONG in FRYER's herbarium) and rather large (in the original specimen 60×7 mm) submersed leaves, frequently turning dark in the press. Internodes short and the plant usually richly branched, though the original specimens, being young and low plants without spikes, do not present any particular development of branches (subsimpler: FR.). S. ALMQUIST has, less correctly, considered the form probably to belong to the v. *graminifolius* and to »imitate *P. alpina*» with »towards both ends less pointed lower leaves». All *gramineus*-forms have lanceolate, pointed, and a little mucronate leaves, which property is so prominent that as to the apex it always (or nearly so) predominates in the combination *gramineus* $\times$ *perfoliatus*.

A similar form occurs in streams with slow current: f. *fluctuans* TISELIUS. It has still larger submersed leaves, elongated internodes, and usually some large floating leaves, sometimes very large, as much as 100×50 mm on petioles of 100 mm in length and above. It grows likewise blackish in the press. Probably it was this form that E. FRIES had in view when establishing his »*heterophyllus* c. *fluviatilis*» which according to the author belongs to the south-Swedish streams (Nov. 2. p. 38).

The middle- and south-Swedish forms appearing in lakes, are by FRIES classed together under the »forma b. *lacustris*» (without floating leaves) and »forma d. *stagnalis*» (»with floating leaves and shorter submersed leaves).

Beside the land-form, f. *terrestris* FRIES (»f. *riparius*» FR. is probably a *nitens*-form), MORONG has established a f. *maximus*, which according to the description as well as to specimens in MORONG's herbarium is rather many-shaped, a f. *minimus*, a f. *myriophyllus* (ROBB.) small-leaved and with extremely short rameal internodes, and a f. *longipedunculatus* (MÉRAT) with much stretched upper internodes and peduncles (as far as 20—25 cm).

P. paucifolius OP. is according to MERTENS and KOCH a deep-water form with elongated internodes and slightly developed floating leaves.

To the forms lacking floating leaves belong partly long-leaved river-forms, v. *fluvialis* FRIES, partly other deep-water or lacustral forms which FRIES comprehended under the name of »b. *lacustris*», with shorter leaves and more branched stem. The former occurs under three forms owing to the width of leaves: f. *angustifolius* TIS. (leaves: $70-110 \times 4-5$ mm), f. *Wolfgangii* (KIHLM.) HAGSTR. (leaves: $70-110 \times 7-10$ mm), and f. *septentrionalis* (TIS.) HAGSTR. (leaves: $70-110$ (160) $\times 10-15$ (27) mm, see HAGSTRÖM in NEUMAN, Sveriges Flora, 1901, 796!). Forma *jemtlandicus* TIS. is a transitional form (stem-leaves $60-80 \times 7-8$ mm) to the shorter-leaved *lacustris*-forms; f. *angermanicus* TIS. is identic with *P. Wolfgangii*, which, according

to specimens determined by KIHLMAN himself, has leaves of 7—10 mm in width and is a genuine *gramineus*-form. Of all these river- and deep-water forms, however, it may be said that they now and then produce one or a few small subcoriaceous or coriaceous leaves. Peduncles sometimes very long (as far as 30—35 cm).

The form *pseudo-nitens* AR. BENN. is, according to specimens from BENNETT's herbarium, a true *nitens*-form (*i. e.* *P. gramineus* $\times$ *perfoliatus*); *f. lanceolatifolius* TIS. is the hybrid *P. Seemenii* (see below!). Forma *marinus* TIS. is identical with *v. lacustris* FR., and *f. ovatifolius* TIS. seems to run into *f. jemtländicus* with only a little broader leaves (80×10); *v. debilis* TIS. coincides with *f. septentrionalis* (TIS.).

Of var. *lacustris* FR., with leaves usually not above 50 mm (ASCH. & GRAEBN.), there are forms with narrower (2—4 mm) and broader (5—6 mm) leaves, besides which I have seen *lacustris*-forms with very short and narrow leaves, 25×3 mm or smaller still.

Var. *platyphyllus* REICHENB., Icones, t. XLIII, 77, 78 is evidently (see the leaf-apex!) a form of $\times P. Zizii$.

All true *gramineus*-forms have sessile submersed leaves with tapered, lanceolate base, serrulate margins and sharp apex with a nervation as in the fig. 102 H—L. The cross-veins are situated more distantly than in *P. lucens*, by which the nerve-spaces grow more extended in longitudinal direction also in the upper half of the leaf, besides which the nerves always appear more obscure or vague than in the *lucens*-leaf, a characteristic of great importance, when it is about to determine the many hybrid forms.

The anatomy of stem is characterized by an endodermis of narrow-roomed strong *u*-cells laterally compressed, by always only a single circle of cortical interlacunar bundles (the ligular circle) and a more or less full-numbered circle of subepidermal strands. In the stele the median bundles fuse and form a common xylem cavity, and the same is the case with the lateral ones and consequently the number of the xylem canals becomes three (the genuine oblong type). If other conditions appear at the middle of the stem, viz. weaker *u*-cells in the endodermis, two or three lateral xylem canals or two median such ones in the stele, more than one circle of interlacunar vascular bundles in the bark, or a complete circle of subepidermal strands etc. you will, on closer examination, find it to be about any *gramineus*-hybrid. A strengthening layer along the epidermis is either wholly or partly absent. At the base of the stem again such a one-celled hypoderma always is to be found. The increase of the thickness down the stem is chiefly produced by the increase of the bark layer, whereas the central cylinder and the arrangement of the bundles are only little changed. Upwards, in the internode next below the primary spike, as in the branches of the stem-prolongation the thickness is caused both through the increase of the bark layer on account of the increase, in size and number, of cells and lacunæ, and through the increase of the stele in volume and the spreading of the bundles, too, in conformity with the facts in the *hybridus*-group (see p. 135!). The purpose is also the same, viz. to afford sufficient stiffness to this part of the plant which has to support the spikes. At the middle again the plant needs the greatest

flexibility and toughness, which is effected by the narrow form of the central cylinder, the fusion of bundles, the incrassation of the endodermis-cells, and the reduction of bark.

The close relation between *P. lucens* and *gramineus* is already pointed out by E. FRIES. It is obvious in the morphologic facts as well as in the anatomy and

Fig. 102. *P. gramineus* L. A—E, Anatomical diagrams of the central cylinder of the stem (from a single individual, gathered in the lake Måsnaren near Södertelje, Sweden). A, nethermost internode (the fusion of the lateral bundles is here more complete than what sometimes is the case; diameter of the internode: 2,1 mm). B, from the middle of the stem (diameter: 1,5 mm). C, the internode next below the primary spike (bundles separate, bundle-trio fused into a single bundle like the opposite bundle; diameter 1,9 mm). D, from a prolongation branch of the second rank (a genuine prototypic diagram, tr, bundle-trio), diameter: 2,2 mm. E, from a 4th rank branch (top-branch), again with only two median bundles (eight-bundled diagram type), diam.: 2 mm; all bundles hatched, $\frac{5}{1}$. F—G, *P. gramineus* var. *heterophyllus* Fr. f. *nigrescens* (Fr.) HAGSTR. F, Floating leaf, $\frac{1}{1}$. G, Submersed leaf, $\frac{1}{1}$, outlined from the original plant of Arjeplog. H—L, *P. gramineus* L. Tops of youngest branch-leaves, showing the form and nervation, H, $\frac{1}{1}$, K, $\frac{2}{1}$, L, $\frac{4}{1}$.

some biologic circumstances (rhizomatic turios etc.). They also easily hybridize with each other, but the latter is also the case in quite the same degree or still more with *gramineus* and *perfoliatus*. Any reason to unite them into a common species is not present and the cross-breeds grow sterile in most cases. But there are no reasons either for taking out from the species and forming new species of such forms as *P. varians* MOR. and *graminifolius* FRYER, or *Wolfgangii* KIHLM., or *nigrescens* FRIES. The specific differences of those so called »species» are not, in reality, so prominent as the descriptions give us to know. They belong all to the varying power of the species and do not go above it.

Distribution. Sweden. *P. gramineus* is met with over the whole of Sweden; in the northern rivers the ff. *Wolfgangii* and *septentrionalis* are pretty common. LÆSTÆDIUS named these and the hybrids of them with *P. perfoliatus* (see under *P. nitens*!) now *P. salicifolius*, now *P. lanceolatus*, or *P. nigrescens*. Plenty of specimens from all provinces are preserved in hb. Stockholm., Uppsal., Lund., and Gothob.

A specimen from Pajala (Westbothnia), leg. LÆST. (hb. Stockholm.), bears the note »*alpin.* × *gramin.* v. *graminifolius*? At. i Hn. ed. 12». Anything of *P. alpinus* is, however, not to be found in this plant, being a true *gramineus*-form.

Norway, likewise through the whole country up to »Mageröen and Sydvaranger» (BLYTT, Norges Fl. 1902, 47). Materials from East Finmarkia (Elvenæs, 64, FRIES), and other stations are in the museums of Stockholm, Uppsala, Lund, and Christiania. — Finland, northward to Muonio, Enara etc. (hb. Stockholm., Uppsal., Lund.). —

Russia, Lapponia ross. Nuortijaur, 83, HOLLMÉN (hb. Stockholm., Uppsal., Lund.), f. *septentrionalis* and f. *Wolfgangii*; Kama, 64, ANDERSSON (hb. Stockholm.), v. *lacustris*; Dnjeper prope Kiev, 09, LONATSCHEWSKIJ (hb. Stockholm.). — *Iceland*, Hof i Vatnsdal (hb. Lund.); Reykiavik, 76, GRÖNLUND (hb. Uppsal.). — *Faroe Islands*: SUDERÖ (hb. Stockholm.), f. *terrestris*. — The northernmost boundary of this species seems to coincide with that of *P. natans*, but it does not spread so far to the south at all. The southern limit may be about the year-isotherm of + 16° C or a little beyond. Traces of a south Italian occurrence, see under *P. gramineus* × *lucens*, p. 215!

Some *English* forms from Cambridgeshire and Huntingdonshire gathered by A. FRYER (hb. Stockholm.) and sometimes labelled as *P. varians* MOR., sometimes as *P. falcatus* FRYER etc. are mostly pure *P. gramineus* f. *nigrescens* FRIES, sometimes verging to f. *jemtlandicus* TIS. and f. *Wolfgangii* (KIHLM.). The fact that the submersed leaves are sometimes large (100 × 8—13 mm) ought to be ascribed to the ground conditions (growing on peat: FRYER). So for instance some specimens from Grunty Fen (n:os 1732, 2243, 1277), pure f. *nigrescens*; likewise n:os 2056, 2057 from Block Fen, Chatteris, labelled »*Potamogeton spathæformis* TUCK? = *Zizii* × *heterophyllus varians major?*»; and n:o 2054 from Witcham Meadlands, Mepal, labelled: »*Potamogeton varians* MORONG! Specimens from this locality were sent to Dr. MORONG and named *variens* by him. This is the typical English form described in *The Journal of Botany*», and many other specimens from the same station are f. *nigrescens* (with transitions to f. *jemtlandicus*); n:os 2156 and 2160 (same locality) is *P. Zizii* or sooner *gramineus* × *Zizii*. Huntingdonshire, Stocking Fen, Ramsay, 89, FRYER n:os 1265, 1275, 1086, labelled »*Potam. falcatus* FRYER» are true *P. gramineus* verging to f. *jemtlandicus* TIS., or f. *nigrescens* FR. — Further on *P. falcatus*, see under × *P. nitens*, p. 231!

Asia. Siberia, Yenisei, Vorogova, 76, ARNELL (hb. Stockholm., Uppsal.), terr. silv. in lacu minore, the main-form, year-isotherm — 5° C. Ob, 66° 46' lat. bor., 80, SOMMIER (hb. Kristiania), f. *Wolfgangii*. Pamir, 98, PAULSEN (hb. Haun.).

N. America. Brit. Columbia, 89, MACOUN (hb. Stockholm.), Manitoba, 96, MACOUN (hb. Kristiania). Northern U. S., many stations (hb. Stockholm., Uppsal., Kristiania). Besides the main-form, I have seen the f. *jemtlandicus* from N. Ebor., TUCKERMAN (hb. Uppsal.) and from Idaho, 92, Mc. DOUGAL (hb. Stockholm.), f. *Wolfgangii* (KIHLM.) from N. Angl., TUCKERMAN (hb. Uppsal.), f. *nigrescens* from Mass. and Mich. (hb. Stockholm.), and v. *myriophyllus* from *locus classicus*, Apponang Pond, Rhode Island, 81, MORONG (hb. Stockholm.). — *Greenland*, Julianehaab, 83, NATHORST (hb. Uppsal., Lund.), Igalito, 47, VAHL (hb. Stockholm., Uppsal.). Also in N. America the species may occur between the year-isotherms of — 5° and + 18° C.

***P. gramineus* L. × *illinoensis* MOR. (*P. deminutus* n. hybr.).**

Folia superiora late et obtuse cuspidata more *P. illinoensis*, submersa breviter petiolata—subsessilia, fuscoviridia. Ceterum in omnibus fere partibus etiam in anatomia caulis planta medium inter parentes tenens.

This hybrid is recognizable by the leaves of the spike region (floating and transitional leaves), which are roundly obtuse with broad obtuse mucro and their petioles are often shorter than the lamina. In *lucens*-hybrids the apexes of those leaves usually are narrower and sharper. Submersed leaves lanceolate, serrulate, dark-green, short-petioled or with a stalk-like base, and cuspidate apex. The innermost sidenerve runs nearer the midrib than in the hybrid *P. Zizii*, which usually reminds more of *P. lucens*. Ligules strong, persistent, and in general longer than in *P. gramineus*. As in the morphology so it is also in the stem anatomy intermediate between the parent species. Interlacunar cortical strands occur in one circle, which, however, contains more bundles than has *P. gramineus* (influence from *P. illin.*). Some subepidermal strand or other as in the parents. Endodermis of strong *u*-cells, and central stele usually with two median xylem-canals as in *P. illinoensis*. Lateral bundles now as in *P. gramineus*, now free as in *P. illinoensis*. By the anatomy this hybrid can hardly be distinguished from *P. illinoensis* $\times$ *lucens*, which again is distinguishable by its more *lucens*-like leaves and the lack of floating leaves. Also *P. gramineus* $\times$ *lucens* (*P. Zizii*) has a more or less *lucens*-like nervation especially in the branch-leaves. Beside the more elongate leaf-apex, the last mentioned hybrid typically has only one median xylem-canal in the central stele of the stem and fused lateral bundles.

Distribution. *N. America*, In lacu Pleasant ad Wenham, Mass., U. S. A., MORONG (hb. Stockholm.), labelled: »*Potamogeton Zizii* M. K.»; Green Lake, Chicago Co., Minn. U. S. A., 92, TAYLOR (hb. Stockholm.); *Canada*, station and collector not named (hb. Stockholm.) bears a couple of *gramineus*-like fruits. The »*P. spathulæformis* (ROBB) MOR., *P. varians* MOR.» (hb. Stockholm., Uppsal.), gathered by T. MORONG in Mystic Pond at Boston, seems to me to belong hereto. At all events it is a real *gramineus* hybrid. The stem anatomy argues rather for a combination with *illinoensis* than with *lucens*. The apexes of the floating leaves do not contradict this suggestion. — A plant from Glenwood, Minn., 91, TAYLOR (hb. Haun.) is likely to be *P. gramin.* $\times$ *illin.* $\times$ *lucens* (*P. pseudo-Zizii* n. hybr.): Folia subm. sessilia v. subsessilia.

***P. gramineus* L. $\times$ *lucens* L.**

(*P. Zizii* MERT. et KOCH, Deutschlands Flora I, 1823, 845. — *P. lucens* β *nitens* CHAM., Adnot. 1815, 6. — *P. lucens* β *rotundifolius* SCHULTZ, Flora starg. suppl. I, 1819, 9. — *P. lucens* v. *angustifolius* GRAY, Nat. arrang. Brit. Pl. 1821, 34. — *P. angustifolius* PRESL, Rostlinar aneb o pirozenosti rostlin I, 1821, 19? — *P. heterophyllus* δ *latifolius* MERT. et KOCH l. c. — *P. lucens* α *ovalifolius* MERT. et KOCH l. c., 849, p. p. — *P. heterophyllus* β *fluviatilis* SCHLECHT., Fl. Berol. 1823, 116? — *P. Proteus Zizii* CHAM. et SCHL., Linnæa, II, 2, 1827, 197.) — Fig. 103.

The above written list of synonyms till and including the year 1827 shows how this hybrid has been conceived: now as a proper species, now as a variety of *P. lucens* or of *gramineus*, now as a variety of a new-established species *P. Proteus* and of similar value with *P. lucens* and *gramineus*. This doubtfulness of the authors,

continued quite up to the present, is the most evident proof of the impossibility to keep up the difference between a separate species standing between *P. gramineus* and *lucens*, and the hybrid of both.

For the sake of completeness I will here communicate a review of the opinions held by the modern authors. If we begin with S. ALMQUIST, his view is given in HARTMAN'S Handb. Skand. Flora (KROK ed.) 1889, 47. Part of the intermediate forms between *lucens* and *gramineus* may be hybrids; another part are imitative forms, which, until further, he summarizes under the name of *P. lucens* β *Zizii*. He was the first to suggest the hybridity of certain *Zizii*-forms but gives the name *Zizii* to some imitative forms (»härmformer») that is to say forms imitating or approaching to *P. gramineus*. Keeping up in the same direction A. FRYER, On the specific rank of *P. Zizii*, in The Journ. of Botany, 1892, 114—115, regards the typical forms of *P. Zizii* as more or less fertile hybrids between *P. lucens* and *P. gramineus* L. In the varying fruiting ability especially he finds a »character which strongly points to hybridity». T. MORONG again in his aforesaid Revision of the North American Najadaceæ, 1893, 29, classes *P. Zizii*, under the name of *P. angustifolius* BERCH. & PRESL (fide AR. BENNETT), as an independent species, but with the remark: »seems to be intermediate between *P. heterophyllus* and *P. lucens*.» G. TISELIUS included *P. Zizii* with the varieties of *P. lucens* which he displayed in his Potamogetones suecici exsiccati, fasc. II, 1895 nos. 59—65. He considered those forms to be more primeval than the proper *P. lucens*: Verisimilius esse videtur, has omnes formas minores esse vetustiores vel primarias, atque causis ex multis suspicor, *P. lucentem* »verum», formam robustiorem, quæ in rebus opportuniorebus crescit, paulatim ex iis minoribus exstitisse formis, quæ nunc plerumque in rebus angustioribus et nasci et vivere videntur (Notula 59). Thus the quite reverse to what all reasons claim. L. VUIJCK renews the earlier supposition of *P. Zizii* as a variety of *P. gramineus* L., in Nederl. Kruidk. Archief, 1895, 653. C. RAUNKJÆR mentions it again as a variety of *P. lucens* in De Danske Blomsterpl. Naturhistorie, 1896, 59. O. HAGSTRÖM in NEUMAN, Sveriges Flora, 1901, 796, does not know any intermediate species between *P. gramineus* and *lucens*; all the intermediate forms are of a hybrid origin. Influenced by this Swedish author J. BAAGÖE says of the forms concerned, »perhaps a hybrid» (Potamogetonaceæ from Asia-media in Vidensk. Meddel. 1903, 180). From the same source K. R. KUPFFER may also have been induced to speak of the hybrid *gramineus* $\times$ *lucens* as identical with *P. Zizii*, in VON ZUR MÜHLEN, Die Potamogetonen des Ostbaltikums, Riga Korrb., 1906, 168. AR. BENNETT does not admit this hybrid in LINTON'S List of Hybrids in The Journal of Botany 1907, 299, but speaks further on (p. 373) of *P. angustifolius* BERCHT. & PRESL, which he considers to be the correct name of *P. Zizii*. That is, however, not at all quite certain. On the contrary it is most likely that *P. angustifolius* as well as *P. paucifolius*, both originally gathered by Opiz in ponds at Bohdaneč, where also *P. heterophyllus* (= *P. gramineus* L. with floating leaves) was growing, are only *gramineus*-forms without floating leaves. And the very description, published by BENNETT in The Journ. Bot., 1889, 263, suggests the same, especially the expression *folia stipulis angustiora*. A *Zizii*-form

with so narrow leaves, about 3—4 mm, may be an extremely rare thing. Among many hundreds of specimens I at least never saw such a narrow-leaved *Zizii*-form. The German author G. FISCHER regards *P. Zizii* as an independent species chiefly, as it seems, on account of the fruit-spikes of some forms, or (1914) at least some forms from Switzerland, as a subspecies under *P. gramineus* L. and proposes to make out the hybridity by »Bastardierungsversuch zwischen *P. lucens* und *gramineus*» (Bayer. Potamog. 1907). This way, however, is not performable, unfortunately. It is much easier to examine the germinative ability of the seeds. I am persuaded that *P. Zizii* very rarely, if ever, propagates itself by seeds. And if even seeds able to germinate were to be found, this fact, however, would not be an instance against the hybrid origin, since hybrids now and then produce fertile seeds. P. GRAEBNER in Potamogetonaceæ, 1907, and Synopsis, 1913, ranges *P. Zizii* as an independent species at the side of *P. lucens*. The Finlander C. W. FONTELL leaves the question open (Beiträge Kenntn. anat. Potam., 1909, 63).

All the specimens of *P. Zizii* I have had an opportunity to examine lack independent, constant, specific characters and possess no other properties than those found in *P. gramineus* and *P. lucens*, or which constitute a modification of the characters of both, in perfect correspondence with the so-called intermediate characters of the other hybrids of this genus.

Thus it is characterized 1) by the mode of prolonging the stem (intermediate) with often two (1—3) spike-bearing branches of the first and 2d (3d) rank; and by the way, in which the branches below the primary spike branch again (often *gramineus*-like). 2) Involucral leaves often subcoriaceous, most frequently with conspicuous petioles, nearly without exceptions longer than the cusp. 3) Stem-leaves very short-petioled (intermediate). 4) Branch-leaves always comparatively small if even the stem-leaves are of *lucens*-size. 5) The venation and structure of the submersed leaves obviously intermediate. 6) Ligules of an intermediate size and shape. 7) Fruit, if present, also intermediate and most frequently infertile. 8) Stem-anatomy intermediate, and so are also 9) the rhizomatic turios.

As to habit *P. Zizii* appears in all conceivable transitions from the most *gramineus*-like to the most *lucens*-like forms.

Its fruiting faculty appears, as it seems, in part of the crosses nearly quite undiminished or normal, in most forms again considerably reduced, and in many cases, finally, it is quite lacking.

Very explanatory is the occurrence of *P. Zizii* in Sweden. It is met with locally together with *P. gramineus* and *P. lucens*, spreading to the parallel which is the northern boundary of *P. lucens* but not beyond, though *P. gramineus* continues to more northern latitudes. In other words, *P. Zizii* lacks a distribution area of its own, being dependent, for its spreading, on *P. gramineus* and *P. lucens*. Sweden may be the country of Europe where *P. Zizii* is most frequently met with, but there is no »independent species *P. Zizii*» in Sweden, and as far as my experience goes in no other contries either.

As to the stem-anatomy *P. Zizii* holds the medium between the two efficient

species respecting the interlacunar cortical bundles which often occur in two circles or in one complete ligular circle and one incomplete one within it, whereas *P. gramineus* always has only one (the ligular) and *P. lucens* always (2—) 3. Subepidermally there are scattered strands. The endodermis-cells sometimes present the *lucens*-type, sometimes the more compressed type characteristic of *P. gramineus*. The arrangement of the central bundles corresponds with that of the two parent-species.

In order to get a synopsis of the many forms, the Fiberian arrangement of the year 1838 can still be maintained with the closer definition I have made in NEUMAN, *Sveriges Flora*, 1901, 796. It is namely apparent that the middle internodes of every form has a tendency to elongate themselves, whereas the upper ones seem to present more constancy.

Var. α **validus** FIEBER: *Internodia* omnia aut saltem superiora tria sub spica primaria breviora, 30—60 mm, vel infra. *Folia* suprema interdum nantia vel subcoriacea.

To this form-series ought to be reckoned:

f. *lucescens* (TIS.) HAGSTR. *P. lucens* β *lucescens* TIS., l. c. no. 59: — *Folia* caulina magna, 20—25 mm lata, omnia breviter petiolata. Stipulae breviores et magis quam in *P. lucente* caducae.

This form passes over into f. *foliosus* which, however, has longer internodes and nearly sessile and still larger stem-leaves. The ligules always show influence from *P. gramineus*.

f. *longipetiolatus* (TIS.) HAGSTR. *P. lucens* γ *longipetiolatus* TIS. l. c. no. 60, non no. 144: — *Folia* superiora longe petiolata. *Ligulae* magis persistentes.

Leaves as in the precedent, but at (under and over) the primary spike (in the stem-elongation) long-petioled (influence from *P. gramineus*), petioles never longer than the blades, though, usually shorter. Ligules longer persistent, i. e. more *lucens*-like. The topmost leaves sometimes have nearly subcoriaceous structure (from *gramineus*).

f. *lucentiformis* HAGSTR.: *Folia* caulina omnia sat longe petiolata, magna, 25—30 mm lata. *Ligulae* fere ut in *P. lucente*. Fig. 103, A.

The most *lucens*-like of all *Zizii*-forms by its large, petioled leaves, and durable stipules. The branch-leaves, the apexes of the upper leaves, and the ramification of

Fig. 103. *P. Zizii* M. & K. A, Involucral leaf of forma *lucentiformis* HAGSTR., $\frac{1}{2}$, from *locus classicus*: Sudermania in lacu Mäskaren ad Fredriksnäs; showing the relation between the length of the petiole and the apex. B, Stem-leaf of a specimen from Long Drove, Pidly Fen, Huntingdonshire, England, 88, FRYER no. 1188, showing an extremely rare instance of reduced lamina, according to what often is the case in *P. lucens*. The reduction has here fallen on the top, whereas the base has its usual shape, $\frac{1}{2}$. C, Stem-leaf of forma *communis* HAGSTR. from Sicily, the »*P. lucens*» L. *psilostachyum* TIN., described by TINEO, $\frac{1}{2}$.

the upper part of the stem, nevertheless, show an evident influence from *P. gramineus*.

f. *communis* HAGSTR.: *Folia* caulina minora angustiora 60—100 × 10—20 mm ± conspicue petiolata. Ligulæ sat persistentes. *Pedunculus* ± 100 mm longus. Fig. 103, C.

This form includes all crosses of *validus*-type without floating leaves proper, with more or less small and narrow, more or less evidently short-petioled stem-leaves, rather long persistent stipules, 20—40 mm long, and peduncles of middling length. The small differences occurring here, are not of the importance to deserve own names. Part of hereto belonging crosses approaches very much to *P. gramineus* f. *jemtlandicus* which, however, has longer internodes and quite sessile leaves as every true *gramineus*-form.

f. *coriaceus* (MERT. et KOCH). *P. lucens* ♂ *coriaceus* M. & K., Deutsch. Fl. 1823, 850. — *P. coriaceus* FRYER, Notes on Pondw. in Journ. of Bot. 1889, 8—10: — All forms of *validus*-type (short internodes, see above) with conspicuously coriaceous leaves, usually appearing in shallow water. The smallest form is »*P. lucens* f. *terrestris* TIS.» in TISELIUS, l. c., nos. 66—67.

Var. β *elongatus* (FIEBER) REICHENB., Icones VII. 1845, 24, t. XXXIX, f. 68: — *Internodia* omnia producta (10 cm et ultra). *Pedunculus* ut plurimum etiam elongatus, 20—30 cm.

f. *foliosus* (TIS.). *P. lucens* ζ *foliosus* TIS. l. c. no. 63: — *Folia* caulina magna, fere ut in *P. lucente*, ramea minora (effectu *P. graminei*) omnia sessilia v. subsessilia; folia floralia interdum breviter petiolata. Ligulæ ad *P. gramineum* vergentes.

As in all *Zizii*-forms, the branch-leaves are also here considerably less than in *P. lucens*, though the stem-leaves are very large and *lucens*-like; all nearly sessile except sometimes the involucreal leaves (influence from *P. gramin.*). Ligules verging towards *P. gramineus*, consequently more or less deciduous (less durable than in *P. lucens*).

The short branches below the primary spike are frequently branched again by branches of the second rank, hence the name *foliosus*. This mode of branching is inherited from *P. gramineus* and characteristic of many *Zizii*-forms.

f. *longipedunculatus* (TIS.): — *Folia* caulina angustiora (80—140 × 18—19 mm), suprema ± conspicue petiolata. *Pedunculus* longissimus, 20—40 cm.

This form comprehends *P. lucens* η *longipedunculatus* TIS., l. c., no. 64 as well as θ *splendidissimus* TIS., l. c., no. 65 (*P. Zizii* subv. *Tiselii* GRAEBNER, Potamog. 1907, 82) between which no real difference is to be found.

f. *pulcherrimus* n. f. — *P. lucens* ι *longipetiolatus* TIS., l. c., no. 144, non no. 60: — *Folia* superiora ± longe petiolata, ceterum ut præcedens.

This form differs from the form next before only through the longer petioles of the upper stem-leaves and from f. *longipetiolatus* by its longer upper stem-internodes and not quite so long petioles.

Distribution of *P. Zizii* M. & K. Sweden, in lakes etc. locally among the parents, from Scania to the northern limit of *P. lucens* in Medelpad and Jemtland.

A specimen of *f. communis* HAGSTR. in herb. Nat. Hist. Mus. Stockh. is evidently mislabelled »Piteå Lpmk» (see also S. ALMQUIST, l. c.!) without closer statement of locality or collector. Without doubt it originates from Mjösjö, *Jemtland*, where the same form is gathered by TISELIUS (1881) and others. — A great many specimens are preserved in the Museums of Stockholm, Uppsala and Lund.

Denmark several stations, especially in the islands (hb. Stockholm., Uppsal., Lund., Gothenb.). — *Norway*, Asker, in Semsvand NÖVIK (hb. Stockholm.), *f. longipedunculatus*, Gjellumvand etc.; Jarlsberg in Fossanelven, Hadeland, Frosta and Romerike (hb. Christiania). — *England*, Cauldshiels Loch, Melrose Roxburgh, 79, BROTHERSTON (hb. Lund.); Coniston Lake, N. Lancashire, 82, BAILY (hb. Stockholm.), *f. foliosus* (Tis.) HAGSTR.; Cambridgeshire: Doddington, Sutton, Chatteris, and Mepal, scattered, gathered by FRYER (hb. Stockholm. et Uppsal.) mostly developed according to the *validus*-type and with floating leaves, *f. coriaceus* (*P. coriaceus* FRYER); but the other forms are also represented in typical specimens and transitions between them; Huntingdonshire, likewise in several places, coll. FRYER (hb. Stockholm.) among others a rare *cornutus*-form (no. 1188), see fig. 103, *B!* — N. Wales, Llwidiard Lake, 84, GRIFFITH (hb. Stockholm.). — *Scotland*, Kingham Loch, 74, Dr BOSWELL SYME; »*lucens* with floating leaves» ex SYME; conspicuous *P. Zizii*. — *Ireland* according to A. BENNETT in Journ. of Bot. 1881, 312. — *Finland*, Savonia borealis, par. Jorvis in lacu Valvatos, 93, LINDBERG; Åland, Hammarland in a lake, 09, B. FLORSTRÖM (hb. C. G. ALM). — *Germany*, Pommern, Gutsdorf, 81, SYDOW (hb. Gothenb.), *f. communis* HAGSTR.; Wittbeck b. Ratzeburg, NOLTE (hb. Stockholm.), *f. coriaceus* M. K., Kiliæ, NOLTE (hb. Stockholm., Uppsal.), *f. communis* HAGSTR., labelled: »*P. lucens—angustifolius*»; Süsil, Hols., hb. ENGLER (hb. Berolin.) lab. »*natans* × *gramineus* od. vielleicht *gram.* mit *polygonifolius*» »*P. GRAEBNER* det.»; Sileciæ (hb. Uppsal.), *f. communis* HAGSTR.; Dresden, HÜBNER (hb. Stockholm.) *elongatus*-form; »Egelse Saxon.», 45, HÜBNER (hb. Stockholm.), *f. communis* HAGSTR.; Berlin, Grunewald See, 86, SCHEPPIG (hb. Stockholm., Uppsal. et Berolin.), *validus*-form, labelled. »*P. decipiens* NOLTE», later on by P. GRAEBNER named *P. berolinensis*, and lastly regarded as a variety of *P. lucens* × *prælongus* (Potamog. 1907, 137) or as a *P. lucens* × *gramineus* but not a *P. Zizii*-form (Synopsis 1913), corresponds nearly with *f. lucescens* with rather broad (20—25 mm) short-petioled leaves and intermediate ligules, has nothing to do with *P. prælongus* WULFEN. Bavaria bor., Erlangen, 89, GLÜCK and others (hb. Stockholm., Uppsal.) *f. communis* HAGSTR. — *France*, Lac d'Annecy (Savoie), DIDIER (hb. Stockholm.), *elongatus*-form; Vauville (Manche), CORBIÈRE (hb. Stockholm., Lund.), *f. communis* HAGSTR. — *Switzerland*, Zürich, 81, JÄGGI (hb. Stockholm.). — *Italy*. A plant in the Nat. Hist. Museum (Bot.) of Stockholm, according to the label (»Herb. sic.») originating from *Sicily*, belongs also to this hybrid. This station is the most south of Europe. As *P. gramineus* L., as far as I know, is not at present met with in *Sicily*, this *Zizii*-form may be a remainder from past times. But of course it is also possible that, from a more northern locality, it has any way been brought to its present place. It is in all parts a *P. gramineus* × *lucens* *f. communis* HAGSTR., but is by TINEO held for a *lucens*-form and also by

him described and determined as »*P. lucens* L. *psilostachyum* TIN.» The label bears the note »TINEO scripsit!» See fig. 103, C!

The hybrid also spreads eastward following the parent-species, but few localities are hitherto known.

N. America. True specimens are seen from Fresh Pond in Massachusetts, MORONG (hb. Stockholm. and Kristiania) f. *pulcherrimus* HAGSTR.; Pine Plains, N. Y., HOYSRADT (hb. Stockholm.), labelled »*P. gram.* L. var. *maximus* MORONG», »Ex hb. MORONG»; Lake Champlain ad Alburgh, Vt., 85, MORONG (hb. Stockholm.), f. *pulcherrimus* HAGSTR. — AR. BENNETT has established four special North American varieties (see GRAEBNER, Potamog. 1907, 83), but many *Zizii*-like North American plants are not at all this hybrid, but of another origin, and great carefulness is necessary when considering these difficult forms.

***P. gramineus* L. × *lucens* L. × *natans* L.**

(*P. crassifolius* FRYER, On a new hybrid Potamogeton, in The Journal of Botany, 1890, 321—322, t. 299).

FRYER has displayed an abundant and splendid collection of plants from England which are said to represent this hybrid, signed by the author as »*P. Zizii* × *natans*». The specimens from Cambridgeshire, Co. 29, Distr. 7, Westmoor, Doddington (*P. crassif.* f. *verrutus* FRYER) gathered in 1890 under no. 1668 (hb. Stockh.) must be considered to have the greatest probability for this descent. Also nos. 422 and 423 from Doddington, 1887 (hb. Stockholm.), seem to be this double hybrid. They have longer and narrower petioles than the »*crassifolius*»-forms from the two other localities, thereby showing their relation to *P. gramineus*, of which the ligules also remind. Towards *P. lucens* point the apexes of the floating leaves by being somewhat elongated, and their comparatively short petioles (not longer than the blades). *P. natans* appears especially in the structure of the submersed leaves and in the ligules. Its occurrence in a place where *P. Zizii* was growing together with *P. natans* confirms also the supposition made by FRYER. The stem-anatomy, however, cannot give any positive conclusion in the case. Respecting the rest of the specimens, see under *P. lucens* × *natans*!

***P. gramineus* L. × *lucens* L. × *perfoliatus* L.**

(*P. Torssandri* (TIS.). — *P. decipiens* β *Torssandri* TISELIUS, Potamog. suec. exsicc., II, 1895 no. 75. — (*P. gramineus* × *lucens*) × *perfoliatus* ex HAGSTRÖM in NEUMAN, Sveriges Fl. 1901, 796).

I have formerly considered the plants belonging hereto to be a mule between *P. Zizii* and *perfoliatus*, but must now leave open whether we have to think this combination or possibly *P. lucens* × *nitens*, or *decipiens* × *gramineus*. I still, however, consider the three species written above to have partaken in producing the plants concerned. *P. perfoliatus* evidently appears in the rounded leaf-bases, especially those

of the branch-leaves, the soon decaying ligules, and the short zigzag-placed internodes. *P. lucens* has likewise evidently influenced the leaf-apexes, which are sharper and longer than in $\times P. nitens$, beside which the leaf-size, the length of the ligules and the occurrence of two circles of interlacunar cortical bundles also point toward the same species. The subcoriaceous structure of the floating leaves, again, and the presence of stomata undoubtedly show influence and cooperation of *P. gramineus*. The above said especially refers to the plant from the Sillen Lake which, besides, in habit reminds of $\times P. nitens$ as well as of $\times decipiens$. But the rest of the below noted forms also, in habit most reminding of $\times P. Zizii$, and with short-petioled stem-leaves, point towards *P. perfoliatus* by their sessile branch-leaves with rather broad base, and by the central stele of the stem with two median xylem canals, and (the plant from Vologne) with three free lateral bundles.

Distribution. Sweden, Sudermania, Vårdinge in the Sillen Lake, 93, TORSSANDER and others (hb. Stockholm., Uppsal., Lund., Gothenb.). Upland in the Fyris River at Ekeby mill, 59, TISELIUS (hb. Norrköping); Norrsunda in the outlet of the Oxunda Lake, 94, ALMQVIST (hb. Stockholm.) together with $\times P. decipiens$ and $\times P. Zizii$. Westgothia, Trollhättan, Skärbo, 88, LANDTMANSON (hb. Uppsal.). — Denmark, Suså ad Hjelmsölille S. S., 95, BAAGÖE (hb. Stockholm.) leaf-point *decipiens*-like, upper leaves petioled like those of *P. Zizii*.

France, Vologne, LEBEL (hb. Uppsal.). This form has weaker *nitens*-like serrulation, perceptible only in the very youngest leaves. The ligules again are *lucens*-like, brown-coloured, conspicuously bicarinate. The narrow (5—7 mm) branch-leaves and long-petioled upper stem-leaves witness of an influence from *P. gramineus*. The specimen from Trollhättan resembles the Vologne specimens, but has shorter and broader branch-leaves (60—70 $\times$ 7—10 mm) with a little more prominent serrulation. The French form, in habit and morphologic facts least reminding of *P. perfoliatus*, has, on the contrary, this species best of all represented in the stem-anatomy (see above!).

A plant from Denmark, Glænö, Sæll., 97, leg. J. BAAGÖE, is very likely the above hybrid. In habit and as to leaf-size (stem-leaves ca. 50 $\times$ 10 mm) and ligules it resembles much *P. nitens* and is distributed by AR. BENNETT as *P. nitens* var. η *cuspidatus* in GRAEBNER, Potamog. 1907, 91. On closer examination, however, it presents great deviations, which all point to *P. lucens*: leaf-apex with a long, sharp cusp; serrulation *lucens*-like; nervation and bases of the lower stem-leaves likewise; anatomical stem-diagram like that of *P. gramineus* except that the endodermis-cells are more *lucens*-like.

P. gramineus L. $\times$ *natans* L.

(*P. sparganifolius* LÆSTADIUS ap. FRIES, Nov. Mantissa I, 1832, 9. — *P. Kirkii* SYME, Engl. Bot. ed. 3, vol. 9, 1869, 31, t. 1403. — *P. Tiselii* RICHTER, Plantæ Eur. I, 1890, 13. — *P. dubius* TISELIUS, Pot. succ. exs., I, 1894, no. 19.) — Fig. 104. —

With the same right as for instance the name of *P. nitens* WEBER is used of all the forms of the hybrid *P. gramineus* $\times$ *perfoliatus*, the name of *P. sparganifolius* of LÆSTADIUS ought also to be applied to the hybrid here concerned, as the description as well as all specimens delivered by LÆSTADIUS must be referred to it. Cfr also S. ALMQUIST, on *P. sparganifolius* in Bot. Not., 1891, 129! The Richtertian name is certainly attributed to the hybrid *gramin.* $\times$ *natans* as its particular name,

but this, I think, can nowise displace the right of priority being due to the Læstadian name.

As mainform, f. *typicus*, I therefore regard the Lapland form and the crosses from North Europe congruent to it, usually with elongated stem, often extremely long and very narrow submersed leaves, and nearly always narrowly lanceolate or long-lanceolate floating leaves.

The other crosses are by ASCHERSON and GRAEBNER distributed on the var. *pergramineus*: »untergetauchte Blätter sehr lang und schmal linealisch» and *pernatans*: those leaves »kürzer und breiter, lanz.—längl. lanz.» It would thus be the var. *pergramineus* which resembles *P. natans*, and the v. *pernatans* which is like *P. gramineus*. Cfr S. ALMQUIST in HARTMAN, Skand. Fl., ed. 12, 1889, 48! To those KUPFFER adds a f. *intermedius*, which in habit is said to stand about half-way between the two parents: »hält im Aussehen ziemlich gut die Mitte zwischen den Eltern».

Fig. 104. *P. sparganifolius* LÆST. A—E, Different forms of the blades of the folia floralia, 1. F, Cross-section of a submersed leaf showing the arrangement of nerves, subepidermal strands and lacunæ, 20, belonging to the Misterhult plant, see below!

In all its forms *P. sparganifolius* is best distinguished from *P. lucens* $\times$ *natans* by its upper leaves, being less conspicuously and not so sharply cuspidate and, besides, longer stalked (petioles usually longer than the laminæ). Cf. the figs. 104 and 121! The form *typicus* has the base of those subcoriaceous leaves usually sloping; the more south forms are usually more richly endowed with floating leaves, which have rounded or subcordate base and the apex short, obtusely mucronate.

On ligules etc., see under *P. lucens* $\times$ *natans*, p. 239! where the difference between the two is more closely determined.

The anatomy of the stem behaves as in all the other hybrids. It generally approaches to that of *P. natans*, but occurs with deviations, more or less obvious, toward *P. gramineus*. It exhibits noticeable similarities to the anatomy of *P. lucens* $\times$ *natans*. In many cases, however, the number of the cortical interlacunar bundles is considerably reduced in *P. sparganifolius*.

Distribution. Sweden. Lapland, Karesuando, 29 (and several following years) LÆSTADIUS (hb. Stockholm., Uppsal., Lund., Gothenb.). This station is the original habitat. LÆSTADIUS first regarded this hybrid as a deformed *P. natans*, but confounded it later with *P. gramineus*. The earliest specimens are named »*P. tereticaule*» and »*P. lineare*», later on also »*P. subcoriaceus*» (specimens with floating leaves). Torne lpm, Pysäkoski, 52, FRISTEDT (hb. Stockholm.); Little Lule River, 96, VESTERLUND (hb. Lund.); Majtun, 04, WOLF (hb. Lund.); Jockmock, 06, WOLF (hb. Stockholm.). — *Nordbothnia*, Pajala, LÆSTADIUS (hb. Stockholm., Uppsal., Lund.); Pite River, 65, HÅKANSSON and others (hb. Stockholm., Uppsal., Lund., Gothenb.). — *Angermania*, Gideå River, 37, J. Å—M (hb. Uppsal.). — *Jemtland*, Ottsjöns utlopp (outlet), 91, COLLIJN (hb. Stockh., Uppsal.). — *Herjedalia*, Sveg in the Ljusnan, 98, ENANDER (hb. Stockholm., Lund.). — *Vermland*, Sunne in Fryken, 14, FRÖDING (hb. FRÖD.). — *Stockholm*, Drottningholm, 98, HAGSTRÖM & LAGERWALL, 99, LAGERWALL (hb. Stockholm., Lund.). — *Sudermania*, Gryt in Båven, 06, SONDÉN (hb. Stockholm.). — *Smoland*, Målilla, Hagelsrum, 64, BJÖRKGREN (hb. Stockholm.), 81, HAGSTRÖM and others (hb. Stockholm., Uppsal., Lund., Gothenb.): »*P. dubius* TIS.»; Misterhult, L. Laxemar, 65, EKSTRAND (hb. Stockh.); Järeda, Klöfdala in the Emån, 65, EKSTRAND (hb. Stockholm.). — *Scania*, »hb. C. M. NYMAN» (hb. Stockholm.) lab. »*P. fluitans* ROTH»; Billinge, Rönneå at Stockamöllan, 93, CÖSTER (hb. Stockholm., Lund.); Tjörnarp, 81, NILSSON (hb. Lund.). — More Swedish stations than those are not known to me; consequently this hybrid is much rarer in Sweden than $\times$ *P. Zizii*.

Norway, Dovre: Goverlivandet, 65, FALCK (hb. Uppsal., Lund.); Porsanger, 63, hb. T. M. FRIES (hb. Uppsal.); Laugen in the outlet into Mjösen, 96, LANDMARK (hb. Stockholm., Lund.); East Finmarkia, South Varanger: Elvenæs, 64, FRIES (hb. Uppsal.). — *Lapponia rossica et fennica*: Nuortijaur, 83, HOLLMÉN (hb. Stockholm., Uppsal., Lund.); Kola peninsula, Lovanserski reka, 90, EKSTAM (hb. Stockholm.); Lapp. inarensis: Kaamos, 03, TORCKELL (hb. Stockholm., Uppsal., Lund.); Lapp. kem., Par. Sodanskyla, 82, BLOM (hb. Stockholm.); Lapp. Imandræ, 92, KIHLMAN (hb. Stockholm.). — *Finland*: Valkjärvi, Metsakylä, Saijoki, 95, LINDEBERG (hb. Stockholm.); Alandia: Bräkträsk, 01, PALMGREN et KLINGSTEDT (hb. Stockholm.). — *Denmark*, Odenseaa, Funen (Fyen), 47, LANGE and others (hb. Stockholm., Uppsal.) »*P. fluitans rivularis* LGE»; Gudenå, 95, BAAGÖE (hb. Stockholm.); Hanbjergå, Jutl., 99, BAAGÖE (hb. Stockholm.); I have also seen it from Snesere, Sæll., Storå at Holstebro, Jutl., and Kongeå, Jutland (hb. HAGSTRÖM). — *East Baltikum*, see K. R. KUPFFER, l. c. — *Germany*: »Saxenwalde Nolte» (hb. Stockholm.), labelled: »*P.*

spathulatus M. & K.»; Ilmenau, 86, C. NÖLDEKE (hb. Breman.); Berlin, Potsdam, Havel bei Baumgartenbrück, 83, SCHEFFIG (hb. Brem.); more dubious forms are seen from Schlesien (Silesia), Vratislavia, 64, UECHTRITZ (hb. Stockholm.), and Nassau, 83, TISELIUS (hb. Stockholm.). — *England*, Surrey, 86, BENNETT (hb. Stockholm.); Yorkshire, River Ure near Ripon, 80, NICHOLSON (hb. Lund.), labelled: *P. polygonifolius* POURR; Shobden March, Herefordshire, 89, Rev:d A. LEY (hb. AR. BENNETT). — *Ireland*, Lough Corrib, Galway, 53, KIRK (hb. Uppsal.): »*P. Kirkii* SYME»; Maam Co. Galway, 85, LINTON (hb. Stockholm.). — *Scotland*, a dubious form from Caithness, 86, MARSHALL (hb. Stockholm.). — A couple of rather dubious plants from *Faroe Islands* are present in hb. Stockholm.

North America. Pine Plains, New York, HOYSRADT (hb. Stockholm.), by MORONG labelled: *P. Oakesianus* ROBBINS. The relationship with *P. gramineus* and *natans* seems rather obvious.

***P. gramineus* L. × *nodosus* POIR.**

(*P. argutulus* HAGSTRÖM, New Potamogetons in Bot. Not., 1908, 106—108. —

Cfr. EUG. SIMON, Une pl. poitevine nouv. pour la sc. in Bull. Soc. Bot. des Deux-Sèvres 1913—14, 37—44.) — Fig. 105.

Fig. 105. *P. argutulus* HAGSTR. β *nodosifolius* HAGSTR. A, Top of a subm. leaf of the Tuckerman plant, ½. B, Top of a subm. leaf of the Morongian plant.

Two forms of this hybrid are present in the Museum at Upsala both of them originating from New England and belonging to the *nodosifolius* series of the hybrid, but otherwise a little deviating one from the other.

All forms of this hybrid have serrulate submersed leaves a little more durable than those of *P. nodosus*, and ligules a little longer and more deciduous than those of *P. gramineus*. The latter species mostly predominates in the stem structure.

α *gramineifolius* HAGSTR. l. c.

Caulis ramosus; *folia* ramea lanceolata sessilia.

This var. is described and figured in the aforecited papers.

β *nodosifolius* HAGSTR. l. c.

Caulis simplex v. subsimplex; *folia* ± petiolata.

The Tuckerman specimen (see below) has long internodes; submersed leaves long-petioled (2—6 cm.) acute; floating leaves rather narrow, long-petioled; ligules long, 5—7 cm, with ridges similar to those of *P. nodosus*, rather durable like the lower leaves (*P. gramineus*). Habit like *P. nodosus*. Wholly sterile. Anatomy of stem nearly quite as *P. gramineus* except that the central cylinder has two median xylem-canals and weaker *u*-cells in the endodermis (influence from *P. nodosus*).

The other plant collected by T. MORONG is a barren shoot without floating leaves, in habit more like *P. gramineus* with shorter stem-leaves and shorter petioles (1—3 cm). Leaves serrulate, a little obtuser than in the foregoing, in size 6—10 ×

1—1,5 cm, durable. Stem-anatomy more intermediate i. e. with fewer bundles than in *P. gramineus*.

I defer naming these forms till more material can be had. Meanwhile the plants may be named the Tuckerman specimen and the Morongian specimen.

Habitat. *N. America*, »Nov. Angl.», E. TUCKERMAN Jr. (hb. Uppsal.); New England, T. MORONG (hb. Uppsal.). — A specimen from »Jamaica, SWARTZ» (hb. Stockholm.) might also belong to this hybrid, but is more dubious. It has narrowly lanceolate leaves on petioles of 15—20 mm in length; stem simple, but only a barren shoot without floating leaves is at hand.

***P. gramineus* L. $\times$ *perfoliatus* L.**

P. nitens WEBER, Supplementum fl. Holsaticæ 1787, 5. — *P. curvifolius* HARTM., Handb. i Skand. Flora, 1820, 78—79. — *P. heterophyllus* β *lacustris* CHAM., Adnot. 1815, 5. — *P. (Proteus?) curvifolius* HN, ex CHAM. & SCHL., Linnæa, 1827, 197. — *P. salicifolius* WOLFGANG in SCHULTES, Mantissa III, 1827, 355. — *P. divaricatus* WOLFG., l. c.,? — *P. falcatus* FRYER in The Journ. of Botany, 1889, 65, t. 286. — *P. salignus* FRYER in The Victoria County Hist. Devonsh. I, 1906, 129, Pot. Brit. Isles, 1912, 76, pl. 49. — Figg. 106, 107, 108.

In the course of time this plain hybrid has been conceived differently by different authors and the opinions are still parted, as French, Dutch, and German researchers continue to give a more independent position to a *P. nitens* (as species, or as variety, or subspecies, and of like value with *P. gramineus* L. under a collective species *P. heterophyllus* or *gramineus*), separate from a possibly existing hybrid *gramineus* $\times$ *perfol.*, of which the authors now concerned speak very reservedly and vaguely. — Dr. G. TISELIUS's view is in his herbal work expressed thus: Formæ multæ ad similitudinem *P. graminei* proxime accedere mihi videntur, nonnullæ sunt fortasse *P. gramineus* $\times$ *perfoliatus*, aliæ *P. gramineus* $\times$ *prælongus*, aliæ dupliciter hybridæ in infinitum.

No one has as yet been able to draw up any morphologic or other boundary difference between the »species» (subspecies) *nitens* and the hybrid. The main difference is said to lie in the fruiting faculty, which is supposed to exist in the former but to be lacking in the latter. The fact is, though, that the greatest part by far of all specimens belonging hereto show partly complete sterility partly a much reduced fruiting ability. And when the fruit production is as it seems normal a great percentage of the fruits will be found to be more or less defectively developed. The same result we arrive at when examining the pollen. The least part of the specimens possess a greater percentage of fertile pollen and these grains are often of different size among themselves, in part being like those of *P. perfoliatus* (comparatively large), and in another part those of *P. gramineus* (smaller and slightly ovoid). These facts beside the rich variation of the form of all organs, between *perfoliatus* and *gramineus*, with both of which *P. nitens* also associates, make me quite

convinced that the forms in question are a hybrid plant, which, like *P. Zizii*, in some crosses is able to produce some fruit or other. For the distribution and the subsistence of the plant, however, this faculty, no doubt, plays a very subordinate part. What I have said above of *P. Zizii* is true about *P. nitens* also. The list below displays its abundant occurrence in the Scandinavian peninsula, but there is no independent species *P. nitens* there and I have seen no such a plant from any other place either.

By cooperation of *P. perfoliatus* with cordate clasping leaf-base and *gramineus*, the submersed leaves of which are lanceolate, the base of those leaves of the bastard usually grows rounded-cordate, half clasping. Most rarely we meet with forms, the stem-leaves of which present a lanceolate base, in which case the branch-leaves, nevertheless, have a more or less rounded base. In doubtful cases the *nitens*- and *gramineus*-forms are distinguished by the bases of the branch-leaves. The apex of the submersed leaves is in general cuspidate, extremely seldom rounded. In the former case often sharp as in *P. gramineus*, but often a little broader (influence from *P. perfoliatus*), in perfect analogy with the hybrids *P. decipiens* and *Babingtonii*. The upper leaves of the spike-region turn usually, by cooperation of the two species, short and broadly petioled with sloping lamina. When *gramineus* in this part predominates the petioles grow longer, nearly so long as in *P. gramineus*, but always a little broader especially upward. If *P. perfoliatus*, again, has gained ascendancy, these leaves also turn sessile with the base half clasping or ovate-lanceolate. As regards the consistency and structure, the top-leaves are an intermediate thing between floating leaves and submersed leaves, typically furnished with numerous stomata (influence from *P. gramineus*). As the difference between the efficient is most evident in the spike-region, the hybrid forms also grow most different there, and consequently I have tried to group the numerous forms of the hybrid according to those conditions. Cf. O. HAGSTRÖM in NEUMAN, *Sveriges Flora* 1901, 797! This is so much the rather suitable, as the hybrid, like the parents, generally in an early state produces spikes, whereupon it prolongs itself by branches of as far as the fifth rank or more, by which a great abundance of spikes exists and consequently plenty of involucreal leaves mostly are present. The submersed leaves are always endowed with small, most frequently very fugacious denticles. Nerve-spaces usually more elongated than in *P. gramineus* (influence from *P. perfol.*). Ligules decaying sooner than in *P. gramineus*, likewise an influence from the other parent-species. From the same cause the peduncles are typically shorter than in *P. gramineus*, but often a little thickened at the middle or upwards. The spikes of the specimens now examined are to the greatest part quite sterile. According to our experience fruiting *nitens*, of which so much is spoken, is extremely rare, but in different collections, true enough, I have now and then met with fruiting specimens determined as *P. nitens*, which in reality have been pure *P. gramineus*.

As regards the stem-anatomy you will always find one or two cortical circles of vascular and bast bundles beside the subepidermal strands. The endodermis-cells and the diagram of the stele vary from pure, oblong *gramineus*-type to pure trio-type of *P. perfoliatus*, but an amalgamation of both, a hybrid-diagram, is the commonest.

Already S. ALMQUIST, having first established this hybrid (see the Index!), has divided the forms in two groups, one in habit and vegetative conditions very like *P. gramineus*, the other more similar to *P. perfoliatus* (in HARTMAN, Handb. ed. 12, 1889, 49). The former group C. RAUNKIÆR later on has named *subgramineus*, the latter *subperfoliatus* (Danske Blomsterpl. 1896, 100). As the forms or crosses, however, are so innumerable as here is the case, it has proved necessary and practically suitable partly to establish an intermediate group, partly to limit the group-characters to one or a couple of more prominent characters, or to the properties of a certain part of each plant. The upper portion of stem with its involucreal leaves and different habit presents itself as most convenient and most easily obtainable (O. HAGSTRÖM, l. c.).

α subgramineus (RAUNKIÆR) HAGSTR.: — *Folia floralia primaria basi angustata ± petiolata, secundaria semper conspicue sæpe longe petiolata subcoriacea—coriacea.* — Fig. 106. A. —

β subperfoliatus (RAUNKIÆR) HAGSTR.: — *Folia floralia primaria basi cordata sessilia, secundaria basi cordata—rotundata sessilia.* — Fig. 107. A. —

γ subintermedius n. nom. **γ intermedius** HAGSTR., l. c.¹ — *Folia floralia primaria ambo, aut saltem superius, basi lanceolata (inferius interdum basi rotundatum) quam plurimum sessilia, secundaria basi lanceolata sessilia—breve petiolata membranacea aut interdum subcoriacea.* — Fig. 108. A. —

Folia floralia primaria and *secundaria* imply the first and the second pair of opposite involucreal or floral leaves appearing in the spike region. In the exceptional cases, when merely a single leaf appears at the primary spike we proceed to the spike next above, belonging to a first rank branch.

In distinguishing the different forms within the particular series, there is no more convenient principle of division than the size and form of the submersed leaves. The spikes and the flowers are in most cases deformed, consequently not employable. Nor are the anatomical facts available on account of their being inconstant. By this method the mensural conditions of the leaves certainly seem to get more importance than usual, but that cannot be avoided, if you wish to arrive at any clearness as to all those innumerable crosses.

Synopsis of forms:

α subgramineus (RAUNKIÆR) HAGSTR.

f. innominatus (TIS.) *P. nitens* s. *innominatus* TIS., l. c. n:o 49: — *Folia caulina submersa ovali-lanceolata basi ± rotundata, 70—75 × 12—15 mm; ligulæ ± persistentes; spicæ demum floribus apertis remotis.*

f. involutus FRYER in The Journ. Bot., 1896, 1, t. 353, 354. — *Folia caulina subm. ovali-lanceolata basi rotundata vel ± subcordata, 80—85 × 15—18 mm; ligulæ tenues caducæ; spicæ parvæ floribus ± abortivis.*

¹ The name of *intermedius*, as earlier used by TISELIUS of a »var. ♂» of *P. nitens* (Pot. suec. exs. fasc. I n:o 48), must be changed for another.

- f. *Læstadii* n. f. — *Folia* caul. subm. elongata basi subcordata, $100-120 \times 15$ mm.
 f. *subovalis* n. f. — *Folia* caul. subm. basi ovalia subcordata, $45-60 \times 10-11$.
 f. *brevior* n. f. — *Folia* caul. subm. brevia, basi subcordata—cordata, $35-45 \times 10-12$ mm.

Fig. 106. *P. nitens* WEB. α *subgramineus* (RAUNK.) HAGSTR. A, Habit-picture showing the primary and secondary involucreal leaves, $\frac{1}{2}$, α , primary spike. B—H, Submersed stem leaves, $\frac{1}{2}$, B, f. *involutus* FRYER; C, f. *Læstadii* HAGSTR., D, f. *subovalis* HAGSTR., E, f. *brevior* HAGSTR., F, f. *stenobasis* HAGSTR., G, f. *restrictus* HAGSTR., H, f. *innominatus* (TIS.) HAGSTR.

f. *restrictus* n. f. — *Folia* caul. subm. parva, 20×6 mm, basi rotundata.

Habitat: *N. America*, see below!

f. *stenobasis* n. f. — *Folia* caul. subm. basi lanceolata, spathulata, $50 \times 7-8$ mm, vel supra.

This rare form has narrower leaf-basis than all the others and can easily be mistaken for pure *P. gramineus* or the hybrid *P. Zizii*. It is distinguished by the leaf-apexes and the stem-anatomy etc.

At last I should remark that, like *P. gramineus*, almost each of the different crosses seems to be able to produce terrestrial forms with more or less coriaceous leaves (f. *terrestris* FRIES, Nov. Fl. Suec. 1828, 35. — TISELIUS, l. c. nos. 44, 142, 143).

β *subperfoliatus* (RAUNKIÆR) HAGSTR.

f. *prælongifolius* (TIS.). *P. nitens* β *prælongifolius major* TIS., l. c. n:o 45.

Stem-leaves with broadly cordate rounded base $120-150$ (170) $\times 20$ (30) mm. Topmost leaves, on the stem prolongation, rarely with stalk-like base; internodes usually very long.

This beautiful plant is a true *nitens* (*gramin.* $\times$ *perfoliatus*)-form and presents no influence from *P. prælongus*. It coincides with, or is at least most like *P. salicifolius* WOLFG. according to the description as well as specimens

gathered and determined by WOLFGANG himself and labelled: »*P. salicifolius* mihi e fluvio Wilia Lithuania J. W.» »Mis. WOLFGANG» (in hb. Petersburg). The same plant is the »*P. salicifolius* WOLFG. In fluv. Willia Lithuan. Herb. W. BESSER» ex »Herb. LEDEBOUR» (hb. Petersb.). Besides, I have seen the same plant from the »Herb. Musei Palat. Windob.»

I have also examined specimens from Lithuania labelled »*P. salicifolius*» which have been identical with another hybrid, *P. lithuanicus* GORSKI, but they cannot be regarded as authentic. These two hybrids must therefore be kept separated from each other. Both are crosses of *P. perfoliatus*: the former (*salicif.*) with *gramineus*, the latter (*lithuan.*) with *lucens*, see below! Consequently they have nothing to do with *P. alpinus*, which everyone must admit having once seen the true *alpinus* × *gramineus*. As to the hybrid *alpinus* × *lucens* of which is spoken in the literature, nobody can yet pretend to have seen it.

A good figure of this form is to be found in REICHENBACH, Icones etc. vol. VII, 1845, t. XXXI, f. 55. On p. 19 it is, however, confounded with *P. lanceolatus* SM. and *P. lithuanicus* GORSKI.

f. *perfoliatifolius* TIS., l. c. n:o 41. With this form *P. nitens* β *prælongifolius minor* TIS., l. c. n:o 46 coincides, and this again is *P. nitens* f. *latifolius* TISELIUS in GRAEBNER, Potam. 1907, 90. *P. nitens* v. *maximus* AR. BENNETT, Forms etc., in Journ. Bot. 1907, 173. — Stem-leaves 60—70 (40—80) mm long by ± 20 mm wide; base cordate.

f. *subtilis* (TIS.) *P. nitens* γ *subtilis* TIS., l. c. n:o 47. — Very like the precedent but with narrower leaves, 55—65 × 14—15 mm; peduncles often stretched.

A similar form is the following:

f. *flumineus* n. f. — *Folia caulina submersa elongata* ca. 80 × 12 mm, basi cordata.

The present form seems to belong to the rivers of South Sweden. Leaves of a darker colour than the preceding which has very thin, membranous, light leaves.

f. *extensus* TISELIUS in herb. Stockholm. — »Pl. internodiis longissimis instructa» ca. 100—250 mm; *Folia caul. subm.* ca. 50—60 × 7—10 mm.

Fig. 107. *P. nitens* WEB. β *subperfoliatus* (RAUNE.) HAGSTR. A, Habit-picture showing the primary and secondary involucral leaves, 1, a, primary spike. B—H, Submersed stem-leaves, 1, B, f. *prælongifolius* (TIS.) HAGSTR., C, *perfoliatifolius* TIS., D, f. *subtilis* (TIS.) HAGSTR., E, f. *flumineus* HAGSTR., F, f. *maritimus* TIS., G, f. *lacuum* HAGSTR., H, f. *brevipes* HAGSTR.

f. *elongatus* BAAGÖE in herb. — *Folia* caul. subm. ca. $35-40 \times 10-11$ mm. Internodia 300–350 mm longa.

f. *maritimus* TIS., l. c., n:o 42. — *Folia* caul. subm. ca. $40 (30-50) \times 10-15$ mm, basi cordata.

Similar to the f. *elongatus* but the internodes of usual length.

f. *lacuum* n. f. — *Folia* caul. subm. ca. $40-60 \times 10-12$ basi rotundata, apice quam in præcedente angustiora.

f. *brevipes* n. f. — *Folia* caul. subm. $30-50 \times 4-5$ mm basi rotundata, ramea minima; pedunculus brevissimus, 20 mm longus.

This beautiful small-leaved form is only known from *Upland*, Svartsjölandet, near Stockholm.

f. *obtusus* n. f. — *Folia* caulina subm. basi cordata apice obtusa, parva ca. $25-35 \times 10$ mm.

While all the other forms of this hybrid have *gramineus*-like leaf-apexes this form alone has the leaf-apexes rounded like those of *P. perfoliatus*. It is remarkable that the last mentioned species as to the form of the leaf-apex so extremely seldom predominates over *P. gramineus*. True specimens of this form are, namely, hitherto found in only one locality (see below), but I have seen less certain specimens from Russia also, »Petersburg insula Krestofsky» (hb. Stockholm.).

Denmark, »Skive å. Jylland», 04, J. BAAGÖE (hb. J. O. HAGSTRÖM), by the collector taken for *P. perfoliatus*.

γ *subintermedius* HAGSTR.

f. *typicus* (TIS.): *Folia* caul. submersa $35-50 \times 9-10$ mm basi ovata—subcordata.

Here I class together not only the proper f. *typicus* TIS., l. c. n:o 34, but also his f. *speciosus*, n:o 36, f. *jemtlandicus*, n:o 38, f. *curvifolius* (HARTM.) TIS., l. c., n:o 37 and some other crosses, forming transitions to β *subgramineus* by slightly developed floating leaves, scarcely differing from each other, and all with the above stated leaf-size. This form is in Germany considered to be the original *P. heterophyllus lacustris* CHAM., but see CHAM. in Linnæa, 1827, 205–207; rather *P. nitens* β *heterophyllus* FRIES, which however certainly comprises many different forms. — This intermediate form may be the commonest of all, at least in Sweden.

f. *mælarensis* TIS., l. c. n:o 35: — *Folia* caul. subm. lanceolata, $70-100 \times 7-10$ mm, basi subovata.

The plant from the Nossen Lake in Smoland (Sweden), *P. Lundii* RICHT., Pl. eur. I 1890, 13, which S. ALMQUIST in HARTMAN, Handb. Skand. Fl. ed. 12, 1889, 49, has misdetermined and distributed as *P. gramineus* × *prælongus*, coincides with this f. *mælarensis* TIS. and must be included with it.

f. *subsimilis* TIS., l. c. n:o 39: — *Folia* caul. subm. aliquanto latiora, $65-80 \times 12-14$ mm, præterea ut in præcedente.

f. *intermedius* (TIS.). *P. nitens* ♂ *intermedius* TIS., l. c. n:o 48. — *Folia* caul. subm. $50-60 \times 7-9$ mm; spica floribus apertis remotis.

f. *robustior* TISELIUS in herb. Stockholm. (nomen): — *Folia* caul. subm. majora 75—80 × 10—17 mm; spicæ vulgo ut in præcedente.

f. *vadosus* TIS., l. c. n:o 43: — *Folia* caul. subm. ca. 50 × 15 mm.

f. *fyrisensis* TIS., l. c. n:o 40. — *Folia* caul. subm. ca. 50—65 × 10—14 mm. Forma transitoria inter β et γ .

f. *gotlandicus* n. f. — *Folia* caul. subm. breviora basi cordata, 30—35 × 11—13 mm.

f. *spicosus* n. f. — *Folia* caul. subm. elongata, 100—150 × 15—18 mm, basi anguste cordato-rotundata, superiora sæpe subcoriacea; ligulæ valde caducæ.

As regards the leaf-size this form is like f. *prælongifolius* (TIS.) HAGSTR. as well as *P. gramineus* f. *septentrionalis* (TIS.) HAGSTR. From the former it differs by the narrower leaf-base and more *gramineus*-like (subcoriaceous) upper leaves; from the latter by the extremely fugacious ligules and a little broader leaf-base, besides which the peduncles also are shorter and the spikes small, always sterile.

f. *neidensis* n. f. — *Folia* caul. late lanceolata, 80 × 22 mm. *Ligulæ* ± persistentes, 20—25 mm longæ.

Distribution. *P. nitens* associates with the parent-species from Switzerland and France up to the highest North, and not beyond their distribution area; in Europe as well as in

N. America; rare to the south, where *P. gramineus* also is rare, more common northward, where the parents are common; with small-leaved forms (f. *typicus* etc.), where the originators are small-leaved, and with larger, more elongated leaves in the north and in rivers (f. *Læstadii*, *prælongifolius* etc.), where *P. gramineus* appears as f. *septentrionalis*, or f. *Wolfgangii*, and *P. perfoliatus* as f. *longifolius* etc.

Fig. 108. *P. nitens* WEB. γ *subintermedius* HAGSTR. A, Habit-picture showing the primary and secondary involucre leaves, $\frac{1}{2}$, a, primary spike. B—K, submersed stem-leaves, $\frac{1}{2}$, B, f. *typicus* (TIS.) HAGSTR., C, *melarensis* TIS., D, *subsimilis* TIS., E, *intermedius* (TIS.) HAGSTR., F, *robustior* TIS., G, *fyrisensis* TIS., H, *gotlandicus* HAGSTR., K, *spicosus* HAGSTR.

Here below I give a list of the *P. nitens* collections present in our Swedish Museums annotating the form-names of the typical specimens.

Sweden. Scania, Kjefflinge, 18, FRIES (hb. Uppsal.), f. *intermedius*; Vejlesjö, 37, v. DÜBEN (hb. Lund.); Krageholm Lake, 37, v. DÜBEN (hb. Lund.), γ *subintermedius*; Malmö, 94, JÖNSSON (hb. Stockholm.), Allerum, 78, WALLENGREN. — *Smoland*, Dagsbo (hb. Uppsal.); Vireda, 74, NILSSON (hb. Uppsal.), f. *intermedius*; Jönköping, 81, SVANSTRÖM etc. (hb. Uppsal., Lund.), ff. *subovalis* and *fyrisensis*; Vimmerby in the Nossen Lake, 68, A. W. LUND (hb. Lund., Gothenb.), f. *mælarensis*, this is the supposed »*P. gramineus* × *prælongus* (*P. Lundii* RICHT.)», see above! but anything of *P. prælongus* cannot be discovered in this plant; N. Vixen, 86, ROMARE (hb. Lund.), the same f.; Moheda, 74, HYLTEŇ-CAVALLIUS (hb. Uppsal.), a more dubious f. with narrow leaf-bases; Hvetlanda, in Emån, 85, SAMUELSSON (hb. Stockholm.); Upplanda, d:o (hb. Stockholm.). — *Gothland*, Fardume Lake, 52, WESTÖÖ and others (hb. Uppsal., Lund), f. *gotlandicus*; Tingstäde Lake, 95, JOHANSSON (hb. Stockholm.), the same f.; Öja, 90, LAURIN (hb. Stockholm.); Bunge, Hultungs, 95, JOHANSSON (hb. Uppsal.); Gothemsån, 43, WESTÖÖ (hb. Stockholm.), f. *typicus*. — *Eastgothia*, Norrköping in Motala River, 78, GREVILLIUS (hb. Uppsal.), f. *subsimilis*; 56, HAMMARSTEN (hb. Uppsal.), f. *fyrisensis*; Linköping, 83, EURÉN (hb. Lund.), f. *innominatus*; Vadstena in the Vetter, 45 (hb. Uppsal.), f. *lacuum*; Asby, 86, MOLIN (hb. Lund.), f. *lacuum*; Sjögesäter, 54, STENHAMMAR (hb. Lund.), f. *stenobasis*; Borkhult, 51, HOLMGREN (hb. Uppsal.), f. *subsimilis*; Hvena Lake, 84, STRÖMFELT (hb. Stockholm.), f. *intermedius*; Nynäs in Haurida, 89, MATSSON (hb. Uppsal.) f. *typicus*; Norsholm, 83, EURÉN (hb. Lund.), f. *subovalis*. — *Westgothia*, Fröjered, 80, JUNGNER (hb. Uppsal., Lund.), f. *flumineus*; Kinnarum, 65, J. A. R—M (hb. Lund.), f. *mælarensis*; Toarp, 89, OLSSON (hb. Stockholm., Lund.), f. *typicus*; Grimstorp, 99, NORDSTEDT (hb. Lund.), f. *perfoliatifolius*; Trilleholm in Tidån, 63, VÄSTBERG (hb. Lund.), f. *robustior*; Sjötorp in the Lake Vener, 1911, B. LAGERWALL. — *Dalia*, Gunnarsnäs, 58, WITTRÖCK (hb. Uppsal.), f. *typicus*; Furusjön, 86, KELLGREN (hb. Lund.), f. *mælarensis*; Holm at Töresbyn, 04, FRYXELL (hb. Lund.), f. *typicus*. — *Nericia*, Öskevik, 40, Z:DT (hb. Lund.). — *Su-dermania*, Hvitsand near Södertelje in the Mælar, 96, LINDMARK (hb. Stockholm., Lund.), f. *mælarensis*; Östertelje in Uttran, 93, HAGSTRÖM et TISELIUS (hb. Uppsal.), f. *intermedius*; Eskilstuna, 34, HARTMAN (hb. Stockholm., Uppsal.), f. *typicus*; Herrestad, 86, KÖHLER (hb. Stockholm., Uppsal.), f. *typicus*; Linasound at Södertelje, 92, HAGSTRÖM and others (hb. Stockholm., Uppsal.), f. *typicus*; Nyköping in the river, 51, FRISTEDT (hb. Stockholm.), f. *typicus*; Mariefred, 85, KÖHLER (hb. Lund.), f. *mælarensis*; Vårdinge in Yngen, 98, EKSTRÖM (hb. Lund.), f. *mælarensis*; Strengnäs in Rullingen, 93, KÖHLER (hb. Lund.), f. *typicus*; besides in Yngaren, Måsnaren etc. (hb. HAGSTRÖM); Gryt in Båven, 06, SONDÉN (hb. Stockholm.). — *Stockholm* and neighbourhood, Svartsjölandet, 68, BERNDEN (hb. Uppsal.), f. *brevipes*; Skurusund, NYMAN (hb. Uppsal., Lund.), f. *maritimus* in hb. norm. 8: 67; Nockebybro, 04, FRIES (hb. Stockholm., Lund.), f. *subovalis*; Ulfsundasjön, WAHLBERG (hb. Lund.), f. *typicus*; Brunnsviken, 94, TISELIUS (hb. Stockholm., Uppsal., Lund.), f. *maritimus*;

Tjärhofvet, 64, WESTLING (hb. Lund.), f. *maritimus*; Svartsjölandet at Vändholmen, 81, TISELIUS (hb. Stockholm., Uppsal., Lund.), f. *mälarensis* and f. *intermedius*; Brännkyrka in Drevviken, 96, JAKOBSSON and others (hb. Stockholm.), f. *subovalis*; Drottningholm, Käsö, 01, LAGERWALL and TISELIUS (hb. Stockholm.), f. *perfoliatifolius*; Värmdön at Rörsundsvik, 94, TISELIUS (hb. Stockholm., Uppsal.), f. *extensus*; Tranebergsbro, 52, THEDENIUS etc. (hb. Stockholm.), f. *typicus*; Vinterviken, 41, STÅHL, and Kungsholmen, 41, J. E. W—M (hb. Stockholm.), f. *typicus*; Värmdö, 86, SCHLEGEL (hb. Stockholm.), f. *maritimus*; Värmdö, Ekudden 87 (hb. Stockholm., Uppsal.), f. *maritimus*, labelled »*P. gramineus* × *perfoliatus* β At i HN. ed. 12. c. fr.» ALMQUIST scrips.; Värmdö, Ekudden in palude, TISELIUS (hb. Uppsal., Lund.), f. *vadosus*; Järlasjön, BJÖRNSTRÖM (hb. Uppsal.), f. *typicus*; Hammarbysjön, V. B—M (hb. Uppsal.); Rivulet between Rönninge Lake and Stora Värtan, 01, JAKOBSSON (hb. Stockholm.), f. *subovalis*. — Upland, Signildsberg, 1803 (hb. Uppsal.), f. *intermedius*; Gottsunda, 50, FLODERUS (hb. Uppsal.), f. *fyrisensis*; Sigtuna, 82, FLODERUS (hb. Uppsal.), f. *typicus*; Norrtelje in the river, 84, HEDLUND and others (hb. Stockholm., Uppsal., Lund.), f. *typicus*; Frötuna, 80, HEDLUND and others (hb. Stockholm., Uppsal.), f. *robustior*; Frötuna, lake, 67, THEDENIUS (hb. Stockholm.), f. *typicus*, probably the same cross as the foregoing; Upsala in the Fyris at Ensta and other localities, WAHLENBERG and others (hb. Stockholm., Uppsal., Lund., Gothenb.), f. *fyrisensis*; Ensta, 82, TISELIUS (hb. Stockholm., Uppsal., Lund., Gothenb.), f. *innominatus*; Ensta in the Fyris, 87, ALMQUIST (hb. Stockholm.), f. *perfoliatifolius*, lab. »*P. gramineus* × *perfoliatus* β i HN. ed. 12» ALMQUIST scrips. Another specimen from the same station is labelled »*P. gramin.* × *perfol.* α», but is evidently the same crossing, which now approaches to *P. perfoliatus* and must be classed together with β *subperfoliatus*, now approaches more to the other parent species and must be referred to γ *subintermedius* (f. *fyrisensis*, f. *typicus* and f. *intermedius*). This is an evident instance that one and the same crossing sometimes exhibits a considerable varying faculty. F. *innominatus* from Ensta, however, is after all a separate cross. Ekeby mill, 28, WAHLENBERG (hb. Uppsal.), f. *typicus*; Skedige, 58, TISELIUS (hb. Uppsal.), f. *innominatus*; Upsala, WAHLENBERG (hb. Uppsal.), f. *brevior*; Lena, Vattholma, 84, ÖSTERBERG and TISELIUS (hb. Stockholm., Uppsal., Lund.), f. *perfoliatifolius*; Skederid, 82, TISELIUS (hb. Stockholm.), f. *maritimus*; Almunge, Väsby, 68, HJORT (hb. Uppsal.), f. *subovalis*; Mælar, several places (hb. Stockholm., Uppsal.), f. *typicus*; Valö, Gålamora, 86, FRÖMAN (hb. Stockholm.), f. *typicus*; Ryd in Lejondalsjön etc., 81, TISELIUS (hb. Stockholm., Uppsal., Lund.), f. *typicus*; Ryd in Tranbyggeå, 03, TISELIUS (hb. Stockholm.), f. *subovalis*; Närtuna in Trehörningen, 96, TISELIUS (hb. Stockholm.), f. *fyrisensis*; Grönsö in the Mælar, 98, TISELIUS (hb. Uppsal.), f. *lacuum*; Fasterna in Metsjön, 82, TISELIUS (hb. Uppsal.), f. *fyrisensis*; f. *intermedius* and f. *subovalis* confluent into one another, probably the same crossing; Fasterna in Rånäs river, 82, TISELIUS (hb. Uppsal., Lund.), f. *robustior* partly like f. *gotlandicus*. — Westmanland, Björksta, 82, LUHR (hb. Stockholm., Uppsal.), f. *typicus*; Engsön, 73, COLLÉN (hb. Uppsal.), f. *typicus*; Engsön, Skurusundet, 80, LUHR (hb. Stockholm.), f. *subovalis*; Kungsåra, 86, LUHR (hb. Stockholm.), f. *intermedius*.

— *Vermland*, Karlstad in the Klara River, 05, HAGSTRÖM (hb. Stockholm.), f. *mælarensis*. — *Gestrikland*, Gefle, Trösken, 74, HN (hb. Uppsal.), f. *lacuum*. — *Helsingland*, Jerfsö in Ufås lake, 89, SCHLYTER (hb. Uppsal.), f. *intermedius*. — *Medelpad*, Holmsjön, 87, TISELIUS (hb. Stockholm., Uppsal.), f. *subtilis* passing into f. *extensus*. — *Herjedalia*, Sveg in the Ljusnan, 01, ENANDER (hb. Stockholm., Lund.), f. *spicosus*, growing together with *P. gramineus* f. *septentrionalis* which to a certainty is the one of the parent species. — *Jemtland*, Ytterån, 94, WISTRÖM, Refsund, Gimån, Bräcke, 84, TISELIUS (hb. Stockholm.); Undersåker in fluvio Hjerpströmmen, 85, SUNDBERG (hb. Stockholm.) f. *perfoliatifolius*; Hällesjö in Ansjön, 86, TISELIUS (hb. Stockholm.), f. *typicus*; Ansjöns å, 81, TISELIUS (hb. Uppsal., Lund.), f. *lacuum*; Gefsjön, 68, KEMPE and others (hb. Stockholm.), f. *subtilis*; Gefsjön, 85, TISELIUS and others (hb. Uppsal., Lund.), f. *subtilis* and f. *perfoliatifolius*; Märling River, 84, TISELIUS (hb. Stockholm., Uppsal., Lund.), f. *prælongifolius*, subm. leaves as much as 140 mm long by 34 mm wide; Storsjön, 84, TISELIUS (hb. Stockholm.), f. *perfoliatifolius* with transitions to f. *subtilis*; Semån, 86, ÖRTENDAHL (hb. Lund.), f. *brevior*. — *Norrbotten and Lapland*, Pajala, LÆSTADIUS (hb. Stockholm., Uppsal.), f. *spicosus* and f. *Læstadii*, the latter growing together with *P. gramineus* f. *septentrionalis*, lab. »*alpin.* × *gram.* v. *graminifolius*? At i HN ed. 12», ALMQUIST scrips., but anything of *P. alpinus* is not present either in the former or in the latter of these forms; Pajala, Torne River, 89, SAMZELIUS (hb. Stockholm.), f. *Læstadii*, labelled with the same note; Kengis, 31 and 49, LÆSTADIUS and others (hb. Stockholm., Uppsal., Gothenb.), f. *spicosus* and f. *Læstadii*, the latter on a sheet together with *P. gramin.* f. *septentrionalis* and with the endorsement by LÆSTADIUS: »*Pot. salicifolius* WOLFG. et incauta exsiccatione *P. nigrescens* FR.»; Karesuando, LÆSTADIUS (hb. Stockholm.), and Vittangi, Torne River, 52, FRISTEDT and others (hb. Stockholm.), f. *spicosus*; Muonio River, 21, ZETT. (hb. Lund.) and Lycksele, 32, ZETT. (hb. Lund.), f. *mælarensis*; Seskar, 3 miles from Haparanda, HAMMARÉN.

Norway. Næs, Verdalen, ZETT. (hb. Lund.); Mjösen, 88, TISELIUS (hb. Stockholm., Uppsal., Lund.), f. *intermedius*; Flagsta river near Hamar, 88, TISELIUS (hb. Stockholm.), f. *stenobasis*, lab. »*P. spathulæformis*?». Besides, in many places together with the parent-species, from Hvalöerne—Porsgrund—Lister—Jæderen, up to Hindö—Senjen—Seida, and Sydvaranger, Neiden, Foslingten, 03, OVE DAHL (hb. Christianiense), f. *neidensis*. — *Denmark*, Ulse lake, Sæll., 94, BAAGÖE (hb. Uppsal., Lund.), f. *typicus*; Ringsted River, 99, BAAGÖE (hb. Stockholm.), f. *stenobasis*; Susaa, 94, MÖLLER (hb. Lund.), f. *lacuum*; Hald lake, Jutl., 70, NIELSEN (hb. Uppsal.), f. *typicus*; Tuel lake at Sorö, 46, LANGE (hb. Uppsal.), f. *flumineus*; Skærum river, Jutl., 96, BAAGÖE (hb. Stockholm., Uppsal., Lund.), f. *robustior*; Skiern river, Jutl., 47, LANGE (hb. Stockholm., Uppsal.), f. *typicus*; Ove lake, Örum lake, Fussing lake (hb. HAGSTRÖM); Skive å, Jutl. (hb. HAGSTRÖM), f. *obtusius*; *Faroe Islands*, Sandö, 97, HARTZ and OSTENFELD (hb. Stockholm., Lund.), f. *typicus*; *Iceland*, Reykiavik, 76, GRÖNLUND (hb. Uppsal.), f. *typicus*. — *Germany*, Holstein, NOLTE (hb. Stockholm., Uppsal.), f. *maritimus* and *fyrisensis*; Ratzeburger See, NOLTE (hb. Stockholm.) and Sleswig, 74, HINRICHSSEN (hb. Lund.), f. *typicus*; Mecklenburg, Neu-

stadt, 55, BROCKMÜLLER (hb. Stockholm., Uppsal.), f. *typicus*; Silesia, 89, HELLWIG (hb. Stockholm.), North Germany, BÄNITZ (hb. Gothenb.), f. *robustior*. — *England*, Surrey, 88, BEEBY and others (hb. Uppsal.), f. *typicus*; Cambridgeshire, Witcham Meadlands, Mepal, 87, FRYER no. 492 (hb. Stockholm.); Huntingdonshire, Stocking Fen, Ramsay, 89, FRYER, no. 1265 (hb. Stockholm.), f. *typicus*, lab. »*Potamogeton falcatus* FRYER», FRYER scrips; Canal Aldershot, S. of Engl., 81, BENNETT (hb. Stockholm.), labelled »*P. heterophyllus* SCHREB. var. *pseudo-nitens* mihi. J. of Botany 1881 p. 344», BENN. scrips., consequently an authentic specimen, but without spikes, an unambiguous *P. nitens* with half-clasping leaves. — *Scotland*, White Loch, E. Perthshire, 82, STURROCK (hb. Stockholm.) lab. »*P. heterophyllus* var. *pseudo-nitens* mihi» BENN. scrips., lacking spikes but a clear *P. nitens*; Kirbiston Loch, Orkney Isles, J. B. SYME, 75 (hb. Stockholm.). — *Russia*, Petersburg, ins. Krestofsky, REGEL (hb. Stockholm.), f. *obtusius*, a dubious form, peduncles and topmost branch-leaves reminding of *P. gramineus*; possibly, however, a genuine *P. perfoliatus*; »Gubern. Perm» (hb. BREM.); Petrosavodsk (hb. BREM.). — *Finland*, Alandia, Geta, 01, PALMGREN and KLINGSTEDT (hb. Stockholm.). —

N. America, Milwaukee, Wisconsin, LAPHAM (hb. Uppsal.), f. *restrictus*; Putnam, Conn., 71, J. W. ROBBINS (hb. HAGSTRÖM). — *P. nitens* seems to be a rare plant in N. America, which should be looked for. ROBINSON and FERNALD do not mention it in GRAY's New Manual, of 1908.

***P. gramineus* L. × *polygonifolius* POURR.**

(*P. Seemenii* ASCH. et GRAEBNER, Synopsis mitteleur. Fl., I, 1897, 335).

A true form of this hybrid lies under no. 139 in TISELIUS, Potam. suec. exsicc. (hb. Stockholm., Uppsal., Lund., Gothenb.) named *P. gramineus* f. *lanceolatifolius* TIS. TISELIUS is of the view that the deviating peculiarities of this plant originate from »*naturâ loci et modo vivendi*». It proves, however, to possess all the characteristics of a hybrid plant. The pollen is sterile, and in every part of the plant two special principles are contending about the dominancy over the form.

α ***lanceolatifolius* (TIS.) HAGSTR.** — *Folia* submersa inferiora sessilia vel breviter petiolata laminis anguste decurrentibus, apice attenuata vix subcuspidata, superiora ± petiolata, summa coriacea basi lanceolata. *Ligulæ* caducæ, 2—3 cm longæ; *spica* parva, 9—11 (17) mm.

The submersed leaves are very characteristic. Their base lanceolate with a short stalk, or with the lamina narrowly decurrent as far as the insertion, often with a conspicuous waist-like contraction between the stalk-like part and the blade (see the fig. 109, A); margin often unteethed, but sometimes (from the same locality) a very faint rudimental serrulation, at greater enlargement, grows visible; apex equally tapered (*P. polygonif.*) and mostly rather sharp (*P. gramin.*). Also the nervation and the structure are intermediate. Upper leaves stalked etc., see O. HAGSTRÖM, in NEUMAN, Sveriges Flora 1901, 797!

Habitat: Sweden, Smoland, Ålem, Strömsrum in fluvio Alsterån, 96, H. RAPPE et H. TISELIUS; Tveta in rivo Emån, 1862, JOHANSSON (hb. Uppsal.).

Another form is found in Scania with more *gramineus*-like lower leaves:

β *subcuspidatus* n. f. *Folia* submersa inferiora sessilia ut in *P. gramineo* apice subcuspidata, superiora petiolata summa coriacea basi sæpe subcordata; ligulæ caducæ; spica major ut in *P. gramineo*.

The colour of this form is like that of *P. polygonifolius*. Both forms accord with each other as to the ligules, the non-serrulate leaf-margins and the nervation, non-increassate peduncles, and in the complete sterility. The stem-anatomy also corresponds very nearly: *P. gramineus* generally predominates in the periphery, *polygonifolius* again in the central cylinder. Consequently we always find cortical and subepidermal bundles as in the former, but two median xylem canals and more or less free lateral bundles in the stele as in the latter. Endodermis of *u*-cells, intermediate.

Habitat: Sweden, Scania, Pinneå, 1911, L. M. NEUMAN.

The plants described above do not coincide with a plant from *Borkum* preserved in the Berlin Museum, gathered by O. v. SEEMEN and labelled »*P. polygonifolius* × *gramineus*. *P. Seemenii*.» »*P. GRAEBNER* det.» »*Herb. P. ASCHERSON*.» The hybrid nature of this plant is not quite certain, as all its pollen is fresh and fertile. At any rate it extremely approaches to *P. gramineus*: Leaf-margin serrulate (ca. 10 teeth a cm), apex acute, branch-leaves — like the lower stem-leaves — sessile, style and anatomy of the stem like those of *P. gramin.* On the other hand the upper narrow leaf-bases and the narrow peduncle are really a little strange to *P. gramineus*; but the specimen is also a late flowering autumnal shoot (gathered 23. VIII, with fresh pollen!), from which no certain conclusions can be drawn. Be this as it may, the name *P. Seemenii* must stand for the hybrid *P. gram.* × *polygonif.* (*polygonif.* × *gram.*, ex GRAEBN.).

A dubious plant from Scotland, gathered by F. COLES is also possibly this hybrid. No other localities are hitherto known.

Fig. 109. *P. gramineus* × *polygonifolius* (*P. Seemenii* A. & GR.). A, f. *lanceolatifolius* (TIS.) HAGSTR., Submersed leaf, $\frac{1}{2}$. B, f. *subcuspidatus* HAGSTR. Top of a young submersed leaf, $\frac{1}{2}$.

P. gramineus L. × *prælongus* WULF.

(*P. navicularis* n. hybr., non *P. gramin.* × *prælongus* ex ALMQUIST in HARTM., Handb. Skand. Fl., ed. 12, 1889 p. 49, *P. Lundii* RICHT., Pl. Eur. I, 1890, 13, qui est *P. gramin.* × *perfol.* (*P. nitens* WEB.) γ *subintermedius* HAGSTR. f. *mælarensis* TIS., vide supra, p. 226.)

Habitu et colore *P. prælongo* similis. *Folia* ramea superiora parva, basi lanceolata vel brevissime lateque petiolata; omnia margine integerrima apice navicularia.

In 1889 S. ALMQUIST (*l. c.*) relates of a *Potamogeton* from »Ö. Sm., Vimmerby,

sjön Nossen (A. W. LUND)» which he takes for »*P. graminea* × *prælonga*». More closely examined this plant has later on (HAGSTRÖM, in NEUM., Sveriges Fl., 1901, 797) been found to be a form of *P. nitens* WEB. (see p. 226).

A plant from Lunan Burn (Scotland) has also been thought to be the hybrid *gram.* × *præl.* AR. BENNETT has a note of it in the Journ. of Bot., 1907, p. 174, but in the List of hybrids published by Rev. E. F. LINTON in the same Journ. 1907, p. 299, it is not further mentioned.

That is all what literature has to state about a hybrid which in 1913 has really been found in Sweden, at Borås in the Viskan river.

In habit this plant reminds much of a low-grown *P. prælongus*. The collector has hesitatingly held it to be *P. gramin.* × *perfol.*, from which, however, and from all the forms of *P. decipiens* it is easily distinguished by its leaves. Branches mostly sterile, zigzag-formed with numerous, very short internodes, especially upwards small-leaved. Leaves rounded at the basis and cymbiform at the tip, which is somewhat more narrowly contracted than in *P. prælongus*. Topmost branch-leaves lanceolate at their base or broadly short-petioled. All leaves with an obscure venation like all *gramineus*-hybrids and fewer-nerved than *P. præl.* Margins smooth. Ligules intermediate as to form and nervation, the nerves of the front-field not so much crowded as in *P. præl.* Peduncles of the specimens examined as in *P. præl.* Spike sterile. In a single spike, however, two fruits like those of *P. prælongus* have been found.

Stem-anatomy intermediate but multifariously varying as in all hybrids. Central cylinder at the base of the stem more *prælongus*-like, upwards, in the same specimen, more like *P. gramin.* Endodermis always of *u*-cells like that of both the parents. Cortical strands always fewer than in *P. præl.*, but more numerous, again, than in *P. gramin.* Pseudo-hyp. one-layered (*P. gram.*) in some internodes, in others, again, 2-layered, at intervals intermediate. Subepid. strands few or wanting (*gramineus*).

Habitat. Sweden, Borås in the Viskan, 1913, C. SANDBERG and A. HOLMERTZ.

***P. lucens* L., Species pl., 1753, 126.**

P. lucidus GÜLDENSTÄDT, Reisen, I, 1787, 76. — *P. acuminatus* SCHUM., En. pl. Sæll., 1801, 49. — *P. longifolius* GAY in LAMARCK, Enc. mét. Bot. IV, 1816, 535. — *P. volhynicus* BESSER in ROEM. & SCHULT., Systema vegetabil. III, 1818, 509. — *P. cornutus* PRESL, Flora ceclica, 1819, 37. — *P. caudatus* SEIDL in OPIZ, Böheims Gew., 1823, 23. — *P. macrophyllus* WOLFG. in SCHULTES, Mantissa in vol. III, 1827, 358. — *P. Proteus lucens* CHAM. & SCHL., Linnæa 1827, 197. — *P. corniculatus* SCHUR, Enum. plant. Transsilv., 1866, 633. — Figs. 1, *H*, 2, *A*, 110, 111, 115, *I*.

This species always lacks coriaceous or subcoriaceous floating leaves and even the tendency of producing such ones. On the contrary it has a prominent faculty of reducing the size of the stem-leaves with the maintenance of the midrib-portion, by

which a transitory form to the semi-terete submersed leaf is formed. This reduction mostly takes place when the plant grows in tufts and many shoots spring from the same rootstock; but is also met with in solitary specimens standing alone, and not only in greater lakes with vehement billows but even in smaller ones. For the purpose of assimilation short branches are developed with always ordinary membranous leaves. This peculiarity is characteristic for the species, and therefore we always find one or a few semi-terete stem-leaves, at least at the base. If this reduction is continued higher up to the stem's middle the leaves or phyllopodia grow very long; at the top, again, they have the usual length anew. This reduction of the laminae cannot be regarded as a variety in usual sense as the same rhizome obviously is able to produce shoots of much reduced form beside such ones bearing leaves of usual width. The reduction of lamina passes on in about the same proportion from both ends or in a little higher degree from the apex. When *lucens*-leaves, consequently, on account of this reduction grow longpetioled, they also have a corresponding elongated cusp. Among other differences from a pure *P. lucens* the large-leaved forms of the hybrid *P. Zizii* exhibit is the property that, with more or less long upper leaf-stalks, they want the prolonged cusp peculiar to the *lucens*-leaf (influence from *P. gramineus*).

Leaves in general 11-nerved in such way that three on either side are running near the margin and two at a greater distance from one another and the midnerve through the middle part. The nerve-spaces formed by the crossveins are, thus, in this species typically short and broad in the longitudinal direction of the leaf, in *P. gramineus*, again, more extended, often longer than broad. This peculiarity is also traced in the hybrids *lucens* $\times$ *natans* and *gramineus* $\times$ *natans* in the leaves constructed as submersed leaves. Besides the leaves are always petioled, branch-leaves always very shortly, stem-leaves usually some mm longer petioled or considerably longer if the laminae are reduced. On the margins the leaves are furnished with close, small sinuses, each with a stout, acute, forward directed topcell, by which a beautiful denticulation is formed. This denticulation is always suppressed in crosses with *P. natans*, but is maintained, though much debilitated by hybridizing with *P. praelongus*, which shows that it properly belongs to the thin, membranous, submersed leaves, but is extraneous to the semi-terete ones. On the stipules etc., pollen, pistil, and fruit, see O. HAGSTRÖM in NEUMAN. l. c. 1901, 797! Endocarp not keeled.

Concerning the stem-anatomy you may compare C. SAUVAGEAU, Notes biol. in Journal de bot., 1894, n:o 6. The deviation mentioned there on p. 119 with regard to the incrassation of the endodermis-cells, *o*-cells in one internode while all the others had *u*-cells, must not be conceived as if this species could have now *u*-cells now *o*-cells in the stem-endodermis. The deviation is only an accidental return to the primitive type, which obviously has been *o*-cells. In the very numerous specimens I have examined I never found this otherwise very interesting fact. The condition is quite the same with the behaviour of the vascular bundles of the stele. Typically these bundles are arranged so that the xylem parts of the median bundles unite and by degrees dissolve into a common xylem canal. Sometimes, however, the fusion

fails and a more primitive state appears with two median xylem canals. Anything such like more often takes place with the lateral bundles which not rarely are two (or even three) free from one another, although the typical is a compound bundle on either side, see the figure 1. In *P. gramineus* the conditions are much more fixed and the *lucens*-type perfectly carried out, while the specialization of the leaves here is more advanced. But in this respect, again, a regress to the prototype can often be seen in a reduction of number and size of the floating leaves and a simplifying of their structure to a greater resemblance to the submersed leaves. The anatomical conditions of *P. lucens* are quite analogous with the morphological facts of *P. gramineus*. — In the bark there are 2—3 interlacunar circles of bundles present and commonly scattered 2 à 3 (0—10) subepidermal strands in the strengthening layer.

The stem presents little intention of prolonging itself by branches above the primary spike, while quite the reverse is the case with *P. gramineus*. Usually there is only one single spike-bearing branch, type A, fig. 2. For the purpose of keeping the spike over the water-surface, it stretches the middle internodes of the stem. The upper ones, again, and the peduncles are rarely elongated (f. *excelsus* HAGSTR.).

For the rest the species does not vary much except as to the size of the stem-leaves. The largest stem-leaves I have seen have measured 200 mm in length by 60 mm in width. — The most remarkable variety is v. *longifolius* DC. (*P. macrophyllus* WOLFG.), which has long, narrow stem-leaves and also narrow branch-leaves. — A form with long stem-leaves (as much as 300 × 56 mm) and branch-leaves of the usual sort is f. *insignis* TIS. The ligules of the stem-leaves as far as 110 mm long. — The form with rather short and broad leaves has been called f. *ovalifolius* M. K. which, however, at first seems to have comprised similar forms of the hybrid *P. Zizii*, too. — The main-form is f. *vulgaris* CHAM. (= f. *lanceifolius* M. K.). — *P. acuminatus* was identified as a *lucens*-form in the year 1816 by E. FRIES in Nov. Fl. Suec. and by J. H. WALLMAN in LILJEBLAD's Flora. Which of these works was first published it not known to me. — *P. lucens* β *nitens* CHAM. is a *Zizii*-form, and the same is true about the *P. lucens* β *lucescens* TIS. Pot. suec. exs. n:o 59 and the following numbers 60—67 and 144, see also under *P. Zizii*, above! — What is meant by v. *fluviatilis* THORE and v. *rivularis* THORE is till now not quite disentangled. Var. *lacustris* THORE is very likely a form of *P. nodosus*. — *P. lucens* v. *floridanus* AR. BENNETT, Notes etc. in The Journ. Bot. 1907, 374 is not at all *P. lucens* to conclude from the description (see also GRAEBNER, Potamog. 1907, 161: Leaves 50 × 16 mm, stipules ca. 2,6 cm etc.).

Figures. For figures I refer to *Flora Danica*, t. 195, t. 1384. — Linnæa 1827, t. V, f. 16. — REICHENBACH, Icones etc. vol. VII, 1845, t. XXXVI, f. 64, t. XL, f. 69, 70. — MORONG, Najadaceæ etc., 1893, t. XXXVIII. — SCHENCK, Vergleich. Anat., 1886, t. VII, f. 38: cross-section of central cylinder. — SAUVAGEAU, in Journ. de Bot., 1894, p. 117—122, ff. 23—27: turios, cross-sections of stem and turios. — RAUNKIÆR, Danske Blomsterpl., 1896, 47, f. 17, C: cross-section of endodermis, 55, f. 20, A: vernation, 58, f. 23, A: leaf-part, nervation, 60, f. 25, D: top of leaf, 70, f. 33: cross-section of leaf, 81, f. 44: turios. — GRAEBNER in KIRCHNER,

Fig. 110. A—C, *P. lucens* L. A, Leaf-margin, showing the denticulation and the sinus between two denticles, enlarged. B, Transverse section of part of the ligule at the base, $\frac{2}{1}$, showing the structure and the height of the ridge in relation to the thickness of the intercarinal part, *ic*. F, and G, corresponding parts of *P. gramineus* $\times$ *lucens* (*P. Zizii* M. K.) and *P. gramineus* L. to show the intermediate position of the former. C, Pistil, *a*, side-view, *b*, stigma from above, $\frac{1}{1}$. D—E, *P. lucens* L. v. *longifolius* DC. D, Basal and apical part of a stem-leaf, $\frac{1}{1}$. E, Basal and apical part of a branch-leaf, $\frac{1}{1}$. F, *P. gramineus* $\times$ *lucens* (*P. Zizii* M. K.), transverse section of ligule, as in B, $\frac{2}{1}$. G—H, *P. gramineus* L. G, Transv. sect. of ligule, as in B, $\frac{2}{1}$. The dotted line indicates the height of the ridge at the involucre leaves. H, Leaf-margin, showing the denticulation, enlarged.

LOEW, SCHRÖTER, *Lebensgesch.*, 1906, 450, f. 254: hibernating forms. — FONTELL, *Beiträge etc.* 1909, t. III, f. 80—83, t. IV, f. 90—91: anatomical pictures of stem, rhizome etc.

Distribution. Sweden, Scania and through the whole country (hb. Stockholm., Uppsal., Lund., Gothbg.) as far as *Helsingland*, Jerfsö, Kalfsjön, 89, SCHLYTER (hb. Uppsal.), *Medelpad* (the valley of the Ljungan and the Gimån) Borgsjön, 04, RINGIUS (hb. Lund.), Torpsjön, 60, C. RN (hb. Uppsal.), f. *insignis*, Stödesjön, 05, COLLINDER, Mellansjön, 10, NORDSTRÖM, and *East Jemtland*, Holmsjön, 84, TISELIUS (hb. Stockholm.), Hällesjö, Håsjö, 64, TISELIUS (hb. Stockholm., Uppsal., Lund.) and Håsjö—Ragunda: Mill-lake, 86, SUNDBERG, the most northern station of Sweden, ca. 63° n. lat. with a year-isotherm of about +3° C. Consequently it is not observed in *Western Jemtland*, *Herjedalia*, *Western Helsingland*, *West and North Dalarne* and *Wernland*.

Norway, Hærsöen, BLYTT (hb. Uppsal.), Asker, Högstadtj. and Padderudsv., Hadel. (Jaren), Hedem. (Stavsjö); besides in Jæderen, Söglandsv. (hb. Christian.). — Finland, Tavastia austr., Rauntunselkä, 83, GRANBERG (hb. Stockholm., Uppsal., Lund.). The statement in HJELT & HULT, *Vegetationen o. Floran i en del af Kemi Lappmark etc.* in *Meddel. Soc. Fauna et Flora fenn.* XII, 1885, that *P. lucens* occurs at Kolari, is no doubt a mistake (probably for *P. gramineus* f. *septentrionalis* TIS. (HAGSTR.)). *P. lucens* is a much more southern species than *P. gramineus*. — In the Swedish Museums there are a great many specimens from Denmark, England, France, Germany, Austria—Hungary, Switzerland, Italy, Venetia, 78, RIGO (hb. Lund.), *Hercegovina*, 89, MURBECK (hb. Stockholm., Uppsal., Lund.). Lithuania, Vilna (hb. Stockholm., Uppsal., Bremen.), v. *longifolius*: — Has long internodes and short branches; stem-leaves narrow and protracted 200—350 $\times$ 15—20 mm, short-petioled (10—20 mm) and with rather weak serrulation (*foliis integerrimis*: WOLFG., is misleading), their ligules 70—100 mm long; branch-leaves likewise narrow, 12—15 mm, with more or less abruptly cuspidate apex, see the figure 110, tapering base, short

petioles (5 mm) and shorter ligules; peduncle incrassate. It wholly coincides with specimens from *France*, St. Denis (hb. Lund.).

This variety, of which I never saw fruit, has often appeared to me as a *planta dubia*. In some respects it reminds of the hybrid *P. lucens* $\times$ *natans*. On closer examination, however, I have not been confirmed in such a supposition. The topmost leaves never show the least tendency of getting a structure like the floating *natans*-leaf. Nor does the stem-anatomy properly approach to *P. natans*. I must regard it as a singular, characteristic river-form of *P. lucens*. The narrow shape of stem- and branch-leaves and the sterility must be owing to local conditions. Prof. K. R. KUPFFER, who is also somewhat hesitating as to this form, has expressed a supposition that it might be a proper species (Riga Korr. Bl. 1906, 161—162). The rare and sporadic occurrence and the sterility seem, however, to contradict this thought. I know it only from three localities outside the Westrussian district, viz. from the above named station in France, one locality in Denmark (Skalså), and from the Lena River in Siberia, Kirensa, ca. 58° N. lat. (hb. Petersb.).¹ The original habitat was »la rivière de Bapaume» in the Northeast France to the south of Lille. GRENIER, in his Flore de la Chaîne Jurassique, II, 1869, says on *P. lucens*: »Hab. toutes les mares et rivières, depuis la plaine jusque sous les sommets, où il prend ord. la form β » ($\beta = \beta$ *fluitans* COSS. et GERM. = β *longifolius* DC.). According to this statement the form would belong to the rather high-situated mountain brooks. A mistake may, however, possibly have been made between this variety and the river-form of *P. nodosus* which often extremely resembles var. *longifolius* of *P. lucens*. Prof. G. FISCHER hesitates between the possibilities of *P. lucens* $\times$ *alpinus*, *lucens* $\times$ *natans*, and *lucens* $\times$ *nodosus*. But its occurrence in Siberia, where *P. nodosus* does not grow is against the last combination and against the two first placed partly the leaf-serrulation, partly, among others, what is said of it above. Already in 1827 CHAMISSE wrote: »Speciminibus inspectis *P. longifolium* GAY nil aliud quam hæc forma longifolia» (i. e. *P. lucentis*), and this view is no doubt the only correct. The weakened serrulation does not derive from a hybrid origin (in which case rudimental teeth were rather to be expected) but from the abating width of the leaves. In specimens with reduced blade in some leaves we always find the strongest serrulation in the leaves (stem- and branch-leaves) which have their full width, while the narrower have a comparatively weaker serrulation. The local conditions may perhaps also play any part. Besides we must not forget that in older leaves, and then especially from running water, the serrulation to a great part or even completely can be abraded, so that the margin seems to be quite smooth.

P. lucens occurs also in *N. America* and in *Asia*, Kashmir, 92, DUTHIE (hb. Kristiania), Khiva, 99, PAULSEN (hb. Haun.), but the distribution is not yet fully known. A revision of *lucens*-like forms is highly wanted. Especially is that the case as to the *African* plants which have been included with *P. lucens* (*azoricus*, *vaginans* etc.). True *P. lucens* is not seen by me from the regions to the south of the equator.

¹ I have seen a similar form, but with longer-stalked stem-leaves, from Pend Oreille River, Oregon, U. S. A., leg. Dr. LYALL 1861 (hb. Stockholm., Berolin.).

Fig. 111. *P. lucens* L., form with verticillate leaves. Anatomical diagram of the vascular bundles of the central cylinder $\frac{1}{2}$.

Lastly I will remark that I have seen a *verticillatus*-form of *P. lucens* from the Nibsa in Denmark with four leaves placed in a verticil round the stem. In the central cylinder it exhibits four free large vascular bundles running in the centre, and three peripheric ones belonging to lowest leaf next above, besides which the traces of the other three leaves are crowded in a separate quarter. The figure 111 gives an idea of the complicated arrangement of the bundles. For the rest the anatomical conditions are normal.

P. lucens L. $\times$ *natans* L.

(*P. sterilis* n. nom. — *P. natans* $\times$ *lucens* ex BEEBY, On *P. fluitans* ROTH in The Journ. Bot., 1890, 204. — *P. lucens* $\times$ *natans* (*P. fluitans* Auctt.) ex RAUNKIÆR, Danske Blomsterpl., I, 1896, 97. — *P. Noltei* FISCHER, vide infra!).

Caulis sæpissime altus robustus ramosus. *Folia* subm. $\pm$ longe petiolata integerrima laminis longis anguste—angustissime lanceolatis; suprema sæpissime $\pm$ coriacea petiolis lamina typice brevioribus, basi in petiolum $\pm$ angustata, conspicue et $\pm$ acute cuspidata. *Ligulæ* 5—9 (15) cm longæ bicarinatæ $\pm$ persistentes. *Pollen* semper sterile.

The English authors AR. BENNETT and A. FRYER have used the name *P. fluitans* of this hybrid. F. BUCHENAU, Flora nordwestd. Tiefeb. 1894, also considers part of the »*fluitans*»-forms to be the hybrid *lucens* $\times$ *natans*. Of the earlier authors E. F. NOLTE and E. FRIES likewise have evidently had this hybrid in view when mentioning *P. fluitans*. S. LILJEBLAD, again, in Utkast till Svensk Flora, 1798, describes the hybrid *P. gramineus* $\times$ *natans* under the name *fluitans*; but according to J. E. SMITH, Flora britannica, 3. 1391, *P. fluitans* is supposed to be *P. alpinus* BALBIS, and in PURSH's Flora Americæ septentr. 1814, it is obviously about *P. Nuttallii*. — G. FISCHER has first signed this hybrid with a proper name: »*P. Rothii* BENNETT» (which name BENNETT has not distributed) later rejected for the name *P. Noltei* (Mitteil. n:o 32 der Bayer. Bot. Ges. 1904, 375) which name BENNETT really used in 1890 of *P. gracilis* FR. To FISCHER is »der fertile und der sterile *P. fluitans* doch auf einen gemeinsamen Typus oder Stamm zurückzuführen» (G. FISCH., Bemerkungen etc. 1914), and consequently he writes: »*P. fluitans* proles I (= *P. nodosus* POIR.)» and »proles II *Raunkiæri*», with which he includes the var. *typicus* BGE, the var. *sublucens* BGE, and »*P. Harzii*», of which all, see below!

Like its originators *P. sterilis* is usually branched and of high growth but varies otherwise in habit especially as to its upper half, where it now approaches to *P. natans* with abundant, now to *P. lucens* with very faint evolution of floating leaves. Usually it keeps a medium between the two, then having one or a couple of rather distinct subcoriaceous leaves, which always are thinner than in *P. natans*. In part

of forms *P. sterilis* is difficult to distinguish from *P. nodosus*, when sterile, *sparganifolius*, *subrufus* and *Schreberi*.

It differs from *P. nodosus* 1) by its stem which mostly has short branches with short internodes and with more or less narrow and short, upward often more or less coriaceous leaves; 2) submersed leaves usually long-stalked or with a stalk-like, narrow base, entire and persistent; 3) floating leaves commonly thinner in texture and with sharper points, their petioles typically shorter than the blade, usually scarcely half the length of it; 4) ligules in general very long, ca. 5—9 cm, and more durable; 5) peduncles usually conspicuously incrassate at the middle; 6) spikes always barren; 7) the anatomy of stem and petioles always characterized by interlacunar bast- and vascular bundles; the epidermis of stem always endowed with strengthening layer and scattered subepidermal strands; interlacunarily in the stem cortex there are always several circles of bundles; the endodermis consists of *u*-cells and the median bundles of stele are always or nearly always furnished with separate xylem canals.

Characters in distinction from *P. sparganifolius*: 1) stem often thicker; 2) lower leaves broader, longer with shorter nerve-spaces; 3) upper subcoriaceous (coriaceous) leaves with more elongated, acuter or sharply cuspidate blade, shorter and broader petioles; 4) ligules longer, darker, stronger and more persistent, usually more prominently bicarinate; 5) spikes mostly larger. By the stem-anatomy, again, these hybrids cannot in general be distinguished, since both usually have been considerably influenced by *P. natans*. Vide also under *P. sparganifolius*! *P. natans* predominates also as to the smooth margin of the submersed leaves both in *P. sparg.* and *P. sterilis*.

From *P. subrufus* it is easily distinguished by the smooth margin of the submersed leaves, which besides are narrower, and by the stem anatomy (see under *P. subrufus*!). *P. sterilis* also exhibits a richer development of floating leaves and branches with subcoriaceous upper leaves, depending on its connection with *P. natans*.

The difference between *P. sterilis* and *P. Schreberi* may chiefly lie in the stem anatomy and the floating leaves, which as to the latter hybrid are thus described: foliis natantibus coriaceis basi rotundatis vel in petiolum attenuatis ovalibus vel oblongolanceolatis rarius cordato-ovatis (FISCHER).

Most difficult may it, however, be to distinguish *P. sterilis* from *P. crassifolius*. The difference must lie in the influence from *P. gramineus* which is to be traced in the latter but not in *P. sterilis*. The Fryer specimens of *P. crassifolius* are present from three stations: 1) Horselod Fen Drain, Chatteris; 2) The Engine Drain, Mepal, and 3) Doddington, all situated in Cambridgeshire, Co. 29, Distr. 7. In spite of eager and careful investigation of the numerous examples from the two first mentioned places I have not been able to discover anything distinctly referring to *P. gramineus*. All properties point to *P. lucens* and *natans*. The Doddington plants may nevertheless really be a hybrid *gramineus* $\times$ *lucens* $\times$ *natans*, since they have something in their habit reminding of *gramineus* as well as of the two other species.

P. sterilis is figured in Flora Danica t. 2105 (1834); cross-section of stem is to be found in RAUNKJÆR, Anat. Pot. Stud., 1903, 273, f. 8.

To judge from its description *P. Noltei* β *Harzii* FISCH. is a somewhat dubious plant to me, although the author writes: — »Meine Vollmannsdorfer Exemplare sind sicher *P. lucens* $\times$ *natans* und sollen den Namen *P. Harzii* tragen» (FISCH., Bemerkk. 1914). The very short internodes, short ligules and leaves, and the slight cusp of the floating leaves with roundish bases seem to me to remind of another hybrid.

As to the name *P. Harzii* I think it incorrect to give to a hybrid with its

many forms the same name as has already been used of a particular form of the hybrid concerned. (Vide The International rules, Art. 4:2: avoidance of ambiguity and confusion).

P. fluitans β *rivularis* LANGE from Fyen is the hybrid *P. sparganifolius* according to specimens of the year 1847, gathered and named by LANGE himself (see p. 219!). But I have seen true *P. sterilis* also from the same river (Odenseaa). — *P. fluitans* α *typicus* BAAGÖE in ASCH. & GRÆBNER, Synopsis, is the hybrid *lucens* $\times$ *natans* according to specimens from the author himself; δ *sublucens* BAAGÖE, l. c., is *P. sub-rufus*, see below!

Distribution: Sweden, Scania, Vegeholm, 81, WALLENGREN (hb. Stockholm.); Helgeå, AHNFEIT (hb. Uppsal.) ex hb. E. FRIES, lab.: *P. fluitans*. — Smoland, »Gnillinge mader» near Vrigstad, 93, HAMNER (hb. Stockholm.). — Upland, Svartsjölan-

Fig. 112. *P. lucens* $\times$ *natans* (*P. sterilis* HAGSTR.). A, B, C, Different forms of floating leaves, C, more rare and utterly like a leaf of *P. sparganifolius*, $\frac{1}{2}$. Cf. fig. 104.

det »Väntholmen väster om Norrskog i Kronängens dike», 46, LAGERHEIM and others (hb. Stockholm., Uppsal., Lund., Gothenb.) in hb. E. FRIES, named by himself »*P. fluitans* ROTH»; Vallstanäs, in effluvio lacus Fysingen, 87, TISELIUS (hb. Stockholm., Uppsal., Lund.).

Denmark, Jutland, Vardeå, 95, OSTENFELD-HANSEN and others (hb. Stockholm., Lund.); Gudena, 95, BAAGÖE (hb. Uppsal.); Skiernå, 95, BAAGÖE (hb. HAGSTRÖM); Vardeå, 99, BAAGÖE (hb. HAGSTR.); Skalså, 04, BAAGÖE (hb. HAGSTR.); Fyen, Odenseå, 97, BAAGÖE (hb. HAGSTR.). — Germany, »Oldeslo nicht fern von Lübeck, NOLTE» (hb. Stockholm.); Holsatiæ, NOLTE (hb. Stockholm.); »fl. shl» (hb. Stock-

holm., Lund., Brem.); »E loco Nolteano, Sonder (hb. Uppsal.); »Holstein und Lauenburg», E. F. NOLTE» (hb. Stockholm., Uppsal.); Ejdern at Rendsburg, 44, NOLTE (hb. Uppsal.); Holstein, POULSEN (hb. Uppsal.). It is these German specimens G. FISCHER names f. *perlucens* or *sublucens* of a »series genuinus». Marchia prope Bero linum, 88, (hb. Stockholm.). — *Austria*, Austria superior prope Hallstatt, STAFF (hb. Lund.). — *England*, Surrey, Wey & Arun Canal, 88, BEEBY (hb. Stockholm., Uppsal.); Cambridgeshire, The Engine Drain, Mepal, 90, FRYER (hb. Stockholm., Uppsal.); A. FRYER has labelled it: »*P. crassifolius* mihi = *coriaceus* × *natans*?» and noted: »This plant differs from *P. fluitans* ROTH by the submerged leaves at the time of flowering being distinct stalked like the upper floating leaves and by the petiole being flat above, not convex as in fluitans». But those properties do not point especially to *P. gramineus* in contradistinction to other »fluitans» (= *lucens* × *natans*); Of course the plant might be *Zizii* × *natans*, but I think it impossible to demonstrate it. Horselode Fen Drain, by the 16 acre Gate, Chatteris, 90, FRYER (hb. Stockholm.), lab. »*P. crassifolius* mihi var. = *Zizii* × *natans. petiolatus* WOLFGANG?»

A plant from *Russia*, Guv. Minsk, 93, PACZOSKI (hb. Petersb.) might also be this hybrid. It differs by the dark green colour and by the upper leaves being non-coriaceous. The colour reminds much of *P. praelongus*. No other stations are known to me.

***P. lucens* L. × *nodosus* POIR. (*P. subrufus* n. hybr.).**

Caulis sæpe altus robustus simplex. *Folia* submersa omnia ± longe petiolata lanceolata ± acuta vel ± obtusa, ± serrulata; suprema ± coriacea, petiolis lamina brevioribus, sæpe rufescentia obtusa. *Ligulae* tenues longæ olivaceæ ± conspicue bicostatæ. Pollen sterile.

In the Museums here this hybrid is present in specimens from two far separate stations, one European and one North-American. They are characterized by the high-grown, often stout, unbranched stem, usually prolonged by a branch from the base of the primary spike. Topmost leaves more or less coriaceous, lanceolate with shorter petioles than the blades, obtuse, often red-brown, 15—20 × 2,5—3 cm; lower leaves petioled, lanceolate, finely serrulate, apex now like *P. nodosus*, now more like that of *P. lucens*, which is also the case with the nervation and the consistency, always more durable than in *P. nodosus*, and with more persistent ligules, being thin, long, brown, and more or less bicarinate. Spikes and peduncles as in the parent-species. Pollen sterile. Stem-anatomy intermediate: 1) Subepidermal strands mostly wanting, 2) interlacunar bundles in 1—3 circles, always fewer than in *P. lucens*, 3) endodermis of weaker, one-sidedly thickened cells than has *P. lucens*. Beside the leaf-serrulation these three facts thoroughly contradict a supposed combination of *lucens* × *natans*. 4) The vascular bundles of the stele are arranged now as in *P. lucens*,

now more *nodosus*-like. In the latter case the cortical bundles again are more numerous, (2—)3 circles, in the former fewer, 1—2 circles.

For the rest this hybrid varies with more prominent serrulation (*lucens*-like), whereas the leaves otherwise verge toward *P. nodosus*, or with weaker, *nodosus*-like serrulation together with large leaves and short petioles (*lucens*-like), but with *nodosus*-like apex. Thus especially the Danish form from Gudenå, which is »*P. fluitans* f. *sublucens* BAAGÖE» in ASCH. & GRAEBN., Synopsis 1897, 308. *P. olivaceus* BAAGÖE, Prép. des Hydroph. 1900. When I first was studying this plant (1899) I considered it to be the hybrid *alpinus* $\times$ *lucens* (hence the admission *alp.* $\times$ *lucens* J. BAAGÖE, l. c.), though some characters, especially the petioles of the submerged leaves were opposed. I thought me bound to this conclusion, because *P. nodosus* does not occur in Denmark at present. When establishing the only possible combination, *lucens* $\times$ *nodosus*, it is clear, that I also admit *P. nodosus* to have formerly belonged to the flora of Jutland, though probably by the disimprovement of climate it has now disappeared from it, just as, for instance, *Trapa natans* from the southern Swedish waters. By its relationship to *P. lucens* the hybrid is more adapted to a rough climate and has consequently been able to endure.

The American examples are somewhat dissimilar among themselves: one specimen without floating leaves (more *lucens*-like), the others endowed with such leaves, thus more *nodosus*-like, but all with longer petioles and more reduced lamina than the Jutland specimens. Anatomically they behave alike.

Under the name of *P. Rugelii* AR. BENNETT has distributed some Florida specimens as a hybrid *P. americanus* $\times$ *lucens* (The Journ. of Bot. 1908, 250, without descr). Although I consider *P. americanus* to be *P. nodosus*, I do not, however, use the name of *P. Rugelii*, because I suspect the Florida plant to be something other than a *lucens*-hybrid.

Distribution. Denmark, »In amne Gudenå ad Kongensbro, Jyllandia», 99, BAAGÖE (hb. Stockholm., Uppsal., Lund.). — N. America, »In lacu Seneca ad Geneva, N. Y. »84, MORONG (hb. Stockholm.), labelled: »*P. lonchites*».

***P. lucens* L. $\times$ *perfoliatus* L.**

(*P. decipiens* NOLTE in HANSEN, Herb. der Schleswig—Holstein—Lauenburgischen Flor no. 715, 1838, et in KOCH, Synopsis Fl. germ. et helv., 1844, 779. — *P. lithuanicus* GORSKI, Herb., et in Reichenb., Icones, VII, 1845, t. XXXI. — *P. olivaceus* LANG in Flora 1846, 472.)

On this beautiful hybrid the following observations may be made: 1) In the description of KOCH (l. c.): foliis omnibus — — — basi rotundatis sessilibus ovalibus oblongisve obtusis mucronatis, margine lævibus, pedunculis æqualibus etc., the last two characteristics are incorrectly given, in as much as the leaf margin is somewhat rough by small, but often very soon decaying, or abraded teeth, most distinctly visible in very young, not yet quite full-grown leaves, and the peduncles often or

oftenmost are a little thickened upwards. The serrulation, never absent in the two parent-species, is not wanting in the hybrid either, except in leaves from which it any way has been obliterated. NOLTE's own specimens have this serrulation too. Individuals quite lacking the faculty of developing one-celled leaf-teeth, as also such ones that develop floating or subcoriaceous leaves, cannot be united with this hybrid.

2) In Botaniska Notiser 1884, 15 sq. Dr. G. TISELIUS has proved the Swedish forms, partly more long- and narrow-leaved, partly with comparatively broader and horter leaves, to belong to one single »species (type)», for which he proposes that a common special name should be established, as the forms of the former kind can be said to correspond to *P. salicifolius* WOLFG. and those of the latter to *P. decipiens* NOLTE, which names ought to be kept as series-names. His arrangement of these series and forms is the following:

Ser. A.	1) <i>P. lithuanicus</i> GORSKI	Leaves	120 × 13 mm
	2) <i>P. salicifolius</i> WOLFG.	»	120 × 14 »
	<i>P. upsaliensis</i>	»	140 × 20 »
	»	»	180 × 20 »
	2) <i>P. upsaliensis</i> f. <i>major</i>	»	190 × 40 »
	3) <i>P. decipiens</i> NOLTE f. <i>maxima longifolia</i>	»	210 × 53 »
Ser. B.	1) Narrow-leaved forms of <i>P. decipiens</i>		
	NOLTE:	Leaves	120 × 20, 100 × 25, 80 × 24 »
	2) <i>P. decipiens</i> NOLTE f. <i>typica</i>	Leaves	85 × 40 »
	» » broad-leaved forms	85 × 40, 65 × 30, 90 × 50	»
	3) » » f. <i>maxima ovalifolia</i>	Leaves	115 × 60 »

This on the whole correct view (on *P. salicifolius*, see next p.!) TISELIUS later on, in his herbarary work (fasc. II, 1895), abandoned and established two species: *P. decipiens* and *P. upsaliensis*.

3) Possibly influenced by Dr. TISELIUS's herbal work the German researchers P. ASCHERSON and P. GRAEBNER in Synopsis mitteleur. Flora, 1897, have divided *P. decipiens* into two halves, one the hybrid *P. lucens* × *perfoliatus* and the other a hybrid *P. lucens* × *prælongus*. This view, represented by several other authors, is kept by GRAEBNER in his latest work (1913). G. FISCHER writes: — »*P. decipiens* NOLTE (p. m. p. = *P. lucens* × *perfoliatus*)», 1911 and 1914.

4) The earlier Aschersonian view (Flora Prov. Brandenb., 1864) of *P. decipiens*, as *P. lucens* × *prælongus*, C. RAUNKLÆR has tried to prove in his work on De danske blomsterplanter naturhistorie 1896. He has, however, happened to identify two quite different plants, the »Susaa-form» and the »Gudenaa-form» of Randers, of which the latter really is *P. lucens* × *prælongus*. The Susaa plant, on the contrary, with sharper leaf serrulation, weaker ligules, lower ridges of the ligules, sharper leaf points, more rounded leaf-base and fewer cortical cauline strands is *P. decipiens*, i. e. *lucens* × *perfoliatus*. By the leaf-nervation and the bundles of the central cylinder of the stem these two hybrids cannot be distinguished from each other. The

endodermis of *lucens* $\times$ *prælongus* is usually more conspicuously one-sidedly thickened than in *lucens* $\times$ *perfoliatus*. Further, see *P. Babingtonii*! *P. decipiens* sometimes lacks subepidermal bast, but when some scattered strands, as usually is the case, are present they always appear near the epidermis in contradistinction to the other hybrid. The cortical bundles do not generally appear so near to the endodermis as in *P. Babingtonii*. The bast is often reduced to 1—2 circles by influence from *P. perfoliatus*, which is devoid of sclerenchyma.

5) There is no doubt at all that the Swedish forms, preserved in our herbaria and Museums under the names of *P. decipiens* and *P. upsaliensis*, and by TISELIUS, in his Potamog. suec. exs., II, 1895, distributed under the numbers 68—74, 77—84, belong to a single hybrid. And all the German forms I have seen, named *P. decipiens*, those also distributed by NOLTE himself, belong to the same hybrid as the Swedish forms. As regards the Fyris forms (*P. upsaliensis*), most reminding of *P. prælongus*, TISELIUS remarks, l. c., p. 20, that *P. prælongus* is not met with in that river. On the other hand *P. lucens* as well as *P. perfoliatus* are growing there abundantly. Having once seen a true *lucens* $\times$ *prælongus* and studied its peculiarities (the aspect of the leaf-margin, the very apex of the leaves etc.) you will soon be able to distinguish between this very rare hybrid and the much commoner *P. decipiens* NOLTE.

6) The Noltean name of *P. decipiens* ought to be used of this hybrid with similar right as the *P. nitens* of WEBER is used of all forms of the hybrid *P. gramineus* $\times$ *perfoliatus*. The name *salicifolius* ought not to be used as series-name for the long-leaved *decipiens*-forms, since *P. salicifolius* according to the description as well as several by WOLFGANG himself distributed specimens (hb. Petersb. etc.) belongs to the hybrid *gramineus* $\times$ *perfoliatus*.

7) Three series of forms may properly be established:

α **latifolius** n. var. — Folia caulina superiora ca. 100 mm longa, 25—40 mm lata.

Hereto belonging forms are:

f. *typicus* TIS., l. c., no. 70: The Noltean specimens, see below!

f. *major* TIS., l. c., nos. 68—69: — Folia latiora, ca. 40 mm.

f. *transiens* TIS., l. c., nos. 71—72 and 77—78 (*P. upsal.* f. *major*): — Folia subelongata, ca. 120 mm.

β **brevifolius** n. var.: — Folia breviora, angustiora.

f. *pulchellus* TIS., l. c., nos. 73—74: — Folia 65—75 $\times$ 15—20 mm.

f. *lithuanicus* (GORSKI) n. f. — *P. upsaliensis* TIS. β *jäsevadensis* TIS., l. c., nos. 82—84: — Folia 70—90(—120) $\times$ 12—18 mm.

γ **longifolius** n. var.: — Folia longiora subangusta, 150—200 mm longa, $\pm$ 20 mm lata.

f. *upsaliensis* (TIS.) n. f. — *P. upsaliensis* TIS. f. *genuinus* TIS., l. c. nos. 79—80 et f. *intercedens*, no. 81: — Folia caulina (superiora) basi rotundata.

f. *memellanus* n. f. — *P. Heidenreichii* ASCH. et GRAEBNER, Syn. 327, p. p.: — Folia caulina 200—240 × 16—22 mm basi apiceque valde angustata. — Fig. 113.

This form approaches to f. *lithuanicus* which has shorter stem-leaves; from f. *upsaliensis* it is distinguished by more elongated leaf-points, which have the somewhat recurved position, peculiar to *P. decipiens*, and by narrower, slightly rounded leaf-bases. It is to be looked upon as a cross of *lucens* var. *longifolius* × *perfoliatus*. Cf. KUPFFER in Riga Korr. Bl., 1906, 171! — Dr. G. FISCHER has established a »f. *subperfoliatus* = ser. VOLLMANNI F.», which seems to be identical with f. *typicus* TIS.

Distribution: Sweden, Scania: Krageholm Lake, 49, Z:DT (hb. Uppsal.). — *Halland*, Frillestad, hb. E. FRIES (hb. Uppsal.). — *Stockholm* and vicinity: Brunnsviken, 51, Z:DT and others (hb. Stockholm., Uppsal., Lund., Gothenb.); Blockhusudden, 63, FREDRIKSSON (hb. Gothenb.); Norrström, 46, LAGERHEIM (hb. Stockholm.), f. *upsaliensis*; Trehörningen, 27, BEURLING (hb. Stockholm.); Långsjön, 26, BEURLING (hb. Stockholm.). — *Uppland*: Lake Mælar ad Runsa, 88, FLÖDERUS and TISELIUS (hb. Stockholm., Uppsal.); Sigtuna: Skålgrund, 83, and Garnsviken, 88, FLÖDERUS and others (hb. Stockholm., Uppsal., Lund.), f. *pulchellus*; Funbo, DANIELSSON (hb. Stockholm.); Säfva å, 60, TISELIUS (hb. Stockholm.), f. *pulchellus*; Norrsunda, Holmboda Lake, in the outlet, 94, LUNDBERG and others (hb. Stockholm., Uppsal., Lund.); Fyris River at Ulfva, 28, WAHLENBERG and others (hb. Stockholm., Uppsal., Lund., Gothenb.); at Ensta, hb. E. FRIES and others (hb. Stockholm., Uppsal., Lund., Gothenb.), Leaves sometimes very large, as much as 170 × 60 mm; at Ekeby mill, 59, TISELIUS (hb. Stockholm., Uppsal.); at Jäsevad, 84, TISELIUS near (hb. Stockholm., Uppsal., Lund.). — *Sudermania* in Uttran and Malmsjön, Södertälje; and *West-Gothia* in Husgårde lake and Ökull lake (hb. HAGSTR.).

Denmark, Suså, Sæll., 95, OSTENFELD—HANSEN and others (hb. Stockholm., Lund.); Hald sø Jutl., 70, NIELSEN (hb. Uppsal.); Gudenå ad Kongensbro, Jutland, 97, BAAGÖE (hb. Stockholm.). — *England*, Cambridgeshire, 84, FRYER (hb. Stockholm., Uppsal., Lund.). This plant, beside a specimen of *P. prælongus* WULFEN, labelled »Herb. Floræ germanicæ exsicc. curante LUDWIG REICHENBACH N:o 2501 *Potamogeton longifolius* GAY. Golssen in der Nieder Lausitz. Apoth. BURKHARDT», are determined by P. GRAEBNER as »*Potamogeton prælongus* × *lucens* (*P. decipiens* NOLTE in KOCH Syn. ed. 2. 779 (1844)) var. *Babingtonii* (BENN. Journ. of Bot. XXXII, 204, (1894)) A. u. G., Syn. I, 332» (hb. Berolin., P. GRAEBNER's own hand). — *Germany*, Vratislaviæ, UECHTRITZ (hb. Stockholm., Uppsal.). Kiliæ, NOLTE (hb. Stockholm., Uppsal.), »*P. decipiens* NOLTE»: Stem-leaves 75—120 × 20—30 mm, ligules short, very soon decaying; Holstein und Lauenburg, E. F. NOLTE (hb. Uppsal.), ex hb. E. FRIES, labelled: »Herb. der Schl.—Holst.—Lauenb. Fl. no. 715 (1838) publicirt NOLTE» (NOLTE's own hand): Leaves 100 × 25 mm. These specimens are the so-called *P. lucens* × *præ-*

Fig. 113. *P. decipiens* NOLTE f. *memellanus* HAGSTR. Stem-leaf at the primary spike, $\frac{1}{2}$, ca. 13-nerved.

longus α *eu-decipiens* ASCH. & GRAEBN., Synopsis, 1897, 331, GRAEBN. Potamog. 1907, 137, Syn. 1913, 505, but no character of *P. praelongus* is here present; they are all very clear *lucens* $\times$ *perfoliatus*. »Tilsit in Memela, 1866, HEIDENREICH» (hb. Stockholm., Berolin.), *f. memelanus*, is *P. Heidenreichii* ASCH. et GR. The Berlin specimens are labelled: »Flora Borussiae orientalis. Potamogeton longifolius Gay. Tilsit in Memela fluvio Junio 1886 legit Dr. F. HEIDENREICH Tilsit» »Herbarium A. ENGLER». »Potamogeton *lucens* $\times$ *gramineus* (P. HEIDENREICHII) A. u. G. Syn. I. 327. (1897). 1897. P. GRAEBNER det.»: Leaf margin strongly serrulated, apex of *decipiens*-type, see above! base, see fig. 113! Ligules 40—60 mm, thin, fugitive; anatomy: subepidermal strands lacking or almost lacking (influence from *perfol.*), central stele *lucens*-like. It is impossible to discover anything of *P. gramineus* in this plant. — *Switzerland*, Geneva in Rhône, CHAVIN (hb. Stockholm., Lund.). — *Lithuania* in lacu Kromán ad Naliboki, 93, DYBOWSKI (hb. Stockholm.), *f. lithuanicus*; »Im Flusse Vilia (Nevis Lithuanorum) bei Vilna. Prof. S. B. GORSKI» (hb. Stockholm., Uppsal.), »*P. lithuanicus* GORSKI»! Only the upper portion of a stem with a branch at the primary spike. No tendency of forming floating leaves; Leaves lanceolate, sessile, serrulate; involucre leaves rounded at base, 100×12 —15 mm; Ligules pretty durable, without ridges, 30 mm long; Anatomy: 2 cortical circles of bundles and scattered subepidermal strands. On account of these properties the plant can neither be *lucens* $\times$ *praelongus* (GORSKI), nor *alpinus* $\times$ *lucens* (ASCH. & GRAEBNER, AR. BENNETT), nor *gramineus* $\times$ *perfoliatus*, but is an evident and beautiful *decipiens*-form approaching to the Swedish form from the Fyris River at Jäsevad, see above!

This hybrid is not yet discovered in *N. America*.

***P. lucens* L. $\times$ *praelongus* WULF.**

(*P. Babingtonii* AR. BENNETT, Notes on Potamogetons in The Journ. of Botany, 1894, 204—205.)

In its Danish forms this hybrid comes partly very near $\times$ *P. decipiens*, partly *P. lucens*, with which two it has also been mixed up. From the latter, however, it is easily distinguished by the sessile leaves with only rudimental, only in not yet full-grown leaves microscopically perceivable teeth. Leaf-base most frequently narrower than in $\times$ *P. decipiens*, often stalk-like; Ligules longer and more strongly bicarinate. The very tip of the leaves is always a little broader and shorter than in *P. lucens*, flat or somewhat bent upward by influence from *P. praelongus*; in the two just mentioned (*P. $\times$ decip.* and *P. luc.*) the tip is somewhat canaliculate and recurved. Peduncles also usually more elongated than in $\times$ *P. decipiens*, and the spikes larger. The cortical bundles of the stem are present in several circles beside the subepidermal one. The bundles of this circle have an inclination to bending inward, from the epidermis into the radial septums (influence from *P. praelongus*) which never or at least extremely seldom may be met with in $\times$ *P. decipiens*.

Central cylinder intermediate, endodermis always of *u*-cells like the parents. It is not known to me, if the BABINGTON Irish plant of Lough Corrib, figured in Engl. Bot. Suppl. t. 2847, entirely coincides with the Danish form. It seems not to have been refound since the year 1835. BABINGTON named it *P. longifolius*, and thus it seems correct to keep the name for the Irish plant and write:

f. *longifolius* (BAB.): »leaf-tip terminating in a point like those of *lucens*»; and name the Danish plant:

f. *danicus* n. f.: — Folia sessilia lanceolata basi attenuata apice breviter obtuseque cuspidata margine lævia. Pedunculus subelongatus.

Distribution: Denmark, Gudenå prope Randers, 96 BAAGÖE and others (hb. Uppsal., Lund.); other forms from Gudenå, f. inst. at Kongensbro, are not this hybrid, but $\times$ *P. decipiens*, $\times$ *P. sterilis*, $\times$ *P. subrufus* and $\times$ *P. undulatus*. Nibså, 00, BAAGÖE (hb. Stockholm.); Odenseå, Fionæ, 97, BAAGÖE, (hb. Stockholm.); also growing in Sneumå, Skalså and Varming Lake (hb. HAGSTRÖM).

On *P. lucens* $\times$ *praelongus* β *berolinensis* ASCH. & GRAEBN., see above, p. 215! —

Fig. 114. *P. biformis* HAGSTR. A, Third leaf of a branch (top and basal half) showing the form and nervation, $\frac{1}{4}$. B, 4th leaf from the same branch (basal part). $\frac{1}{4}$. C, 9th leaf of the same branch, $\frac{1}{1}$. D, Leaf-margin, $\frac{1}{4}$. E, Fruit, $\frac{1}{4}$.

In 1899, on investigating part of the Potamogeton collections of the museums of Bremen and Petersburg, I observed a plant gathered by ALEX. SCHRENCK in Songaria in 1840. I had not an opportunity of describing it immediately and some years later (1904) AR. BENNETT published his *P. distinctus* of East Asia, which seems to have a close connection with the Songaria plant of SCHRENCK. Not having access to the type of *P. distinctus* AR. BENNETT, I have not as yet succeeded in clearing up the affinity or identity of the two plants. To judge from the description of the fruit they are well distinguished from one another, *P. distinctus* having the middle keel undulated and the lateral ones »produced here and there into small knobs» etc. (AR. BENN.) which is extraneous to the Songaria plant. Leaving to the future to get the connection with *P. distinctus* cleared up, I will here publish my remarks on the interesting plant concerned:

***P. biformis* n. sp. (vel forma *P. distincti* AR. BENN.?). — Fig. 114.**

Caulis ramosus teres habitu *P. graminei* L. *Folia* superiora coriacea ad formam et magnitudinem iis *P. graminei* L. simillima; submersa angusta denticulata breviter cuspidata, caulina ad basin in petiolum angustata, ramea parva, 20—40 mm $\times$ 2—4 mm, biformia, inferiora petiolata, superiora sessilia basi rotundata iis *P. crispi*

L. simillima (vide figuram 114!). *Ligulæ* badiæ subecarinatæ caducæ, foliorum caulinarum 35—40 mm longæ, ramorum breviores. *Fructus* oblique semiorbiculatus carinatus stylatus, 3×2 mm. — *Anatomia* caulis, vide infra!

The anatomy of the stem: Epidermis without bast-bundles and pseudo-hypoderma. Interlacunar bundles present in two circles or only one, the ligular circle. Endodermis of *u*-cells as in *P. lucens*. Central cylinder presenting the oblong type. Accordingly the stem-anatomy exhibits great resemblance or accordance to that of *P. dentatus*, see the figure 115, *H!* which, however, is endowed with a one-layered pseudo-hypoderma.

The leaf margin of *P. distinctus* is not described. It may be denticulate, but it is probably smooth, since the serrulation of the *Lucentes* can be observed almost by the naked eye. If its leaf margin is destitute of denticles *P. distinctus* is to be referred to another subsection.

As to nervation the submersed leaves of *P. biformis* are like those of *P. distinctus*, thus described by AR. BENNETT »secondary nerves (not basal) produced along the central nerve about halfway up». This corresponds nearly with what is the case of the stalked leaves of *P. biformis*, but the sessile leaves have a nervation very much resembling that of a *P. crispus*-leaf.

The plant here described is gathered in »Songaria-Sümpfe von Urdshar» and *East Asia* may therefore be its distribution-area.

***P. malaianus* MIQUEL.**

Flore de l'Archipel Indien 1870—71, 46. — *P. mucronatus* PRESL, Epimeliæ Botaniciæ 1849, 245. — *P. japonicus* FRANCHET et SAVATIER, Enumer. pl. Jap. II, 1879, 15 (nomen solum)? — *P. Wrightii* MORONG, Bull. Torr. Bot. Club, 1886, 158, t. 59. — *P. tretocarpus* MAXIMOW., ex AR. BENN., Journ. of Bot., 1891, 154, et spec. Petropol. — Fig. 115.

This species approaches to *P. lucens* by its stalked, sharp-pointed, serrulate submersed leaves, persisting ligules, and by the absence of floating leaves; but differs well from it by somewhat longer petioles (± 3 cm), narrower blades, and different nervation, the innermost nerve-pair forking from the midrib first at the middle, not at the base of the leaf. By this and by the stem-anatomy (central cylinder), also, it shows affinity with *P. nodosus* and *hindostanicus*. By its styles and stigmas again it approaches to *P. perfoliatus*, which species the fruit also exhibits a great resemblance to.

The stem-anatomy lacks subepidermal bast, but possesses 2—3 circles of interlacunar bundles; epidermis-cells short, almost cubical; the endodermis seems typically to be composed of faint *u*-cells, but has often longer or shorter stretches of ordinary *o*-cells (*o*—*u*-endodermis); central cylinder with all bundles free. The prototype consequently is here more purely represented, by which the species can be said to form the one terminus of the group, while *P. gramineus* forms the other.

Its nearest relation is, of course, *P. dentatus*, which differs by another, *Zizii*-like anatomic stem-diagram, more *lucens*-like nervation and shape of leaves, shorter petioles but longer cusps (± 10 mm each, in the stem-leaves), shorter (± 3 cm) ligules with higher ridges and smaller, *gramineus*-like fruit ≈ 2 mm longus, 1,75 mm latus complanatus suborbiculatus v. oblique obovatus, rostro brevi subapicali, dorso siccus subcarinatus», see HAGSTRÖM, New Potamogetons (Bot. Not. 1908, 101–102, fig. 4–6)! This species, again, differs but little from *P. Gaudichaudii* of Ladrone Islands, the original specimens of which are no more accessible (specimina originalia desunt: GRAEBNER). But I have seen specimens from the very *locus classicus*: Guam, Agana River, coll. by MC GREGOR, 1911 (hb. Haun.), that present stem-leaves with a shorter cusp and shorter ligules, 16–18-flowered spikes, no cortical strands in the stem, except the ligular circle, and a *cc.* of the oblong type. Fruit not seen.

P. malaianus prolongs itself by branches of as far as the 4th rank, but shows no tendency to develop coriaceous leaves.

Distribution: Herb. E. FRIES (hb. Uppsal.) contains a specimen without stated locality, but obviously identic with the TEYSMANN specimens, of *Halma-haira*. — Japan, Jokohama, 62, MAXIMOWICZ (hb. Stockholm., Petropol.); Tokyo, 84, MAKINO (hb. Petropol.) — *Mandshuria* »Flumen Mudandsian, fl. Sungari infl. in rivulo Saling tun. Provincia Kitin», leg. V. L. KOMAROV (hb. Petropol.). — The distribution-area seems to be the Malayan and Japanese Archipelago and adjacent countries, where *P. dentatus* also obviously has its spreading.

Fig. 115. A–E, *P. malaianus* MRO. A, Stem-leaf with appendant ligule, $\frac{1}{2}$. B, Pistil, sideview, $\frac{1}{2}$. C, Fruit, sideview, $\frac{1}{2}$. D, Part of the transverse section of stem, about $\frac{1}{10}$, ep epidermis, hp, pseudo-hypodermis, vb, vasc. bundles, cc, central cylinder. E, Longitudinal and tangential section of epidermis, $\frac{1}{10}$. F–I, *P. dentatus* HAGSTR., E, Stem-leaf with appendant ligule, nat. size. G, $\frac{1}{10}$. H, Part of the transverse section of stem, about $\frac{1}{10}$, lettered as at D. I, Epidermis drawn as E; the same showing also the stem-epidermis of *P. Gaudichaudii* CHAM. & SCHL. and *P. lucens* L. $\frac{1}{10}$.

Subsectio 24. *Prælongi*. HAGSTR. — *P. prælongus*-group RAUNKIÆR.

Caulis teres ramosus. *Folia* omnia submersa membranacea sessilia margine integerrima apice cucullata, basi cordata semiamplexicaulia vel infima lanceolata; ligulæ fibrosæ ± persistentes ecostatæ. *Pistillum* stylo conspicuo ± angusto. *Fructus* magnus valde carinatus. — *Anatomia* caulis: *u*-endodermis, fasciculi librif. et vasculares corticales numerosi. Fasciculi tubi centralis prototypice dispositi. — *Præfoliatio* convoluta. Turiones rhizomatici desunt.

On account of the peculiar cucullate form of the leaf-apex etc., see below, the single hereto belonging species cannot be placed together with *P. perfoliatus*, though the pistils and stigmas of the two species are much the same. In his Anatomical Potamogeton-Studies (1903) C. RAUNKIÆR therefore is correct in putting them in separate groups after having classed them together in his earlier work, De danske blomsterplanter naturhist. (1896, 108–109). In the Synopsis der mitteleur. Fl. 1912, P. GRÆBNER still unites them into a common group *Perfoliati*.

P. prælongus WULFEN.

Plantarum nov. descriptiones, in ROEMER, Archiv für die Botanik, III, st. 3, 1805, 331. — *P. flexuosus* WREDOW, Mecklenb. Fl. 1807, ex SCHLEICHER, Cat. pl. Helv. 1815, 23. — *P. flexicaulis* Detharding, in Strelitzer Anzeig., 1809 no. 50. — *P. acuminatus* Wahlenberg, Flora upsal., 1820, 58. — *P. perfoliatus* v. *lacustris* WALLMAN, in S. LILJEBLAD, Utkast till en Sv. flora, 1816, 706. — *P. gramineus* a *borealis* LÆSTADIUS, Beskrifning öfver några sällsyntare växter etc., in K. Sv. Vet. Ak. Handl. 1824, 162. — *P. salicifolius* WOLFG. ex FRIES, Summa veg. scand. I, 1846, 213, et ex HARTMAN, Handb. Skand. Fl., 1879, 432.¹ — Figs. 1, A, 116, 117, P, 118, C.

With regard to the styles and stigmas this species does not essentially differ from *P. perfoliatus*; the pollen grains are also much the same, of middle size, spheric or spheric-ovoid in shape. Nor do the form and the nervation of the leaves present any more considerable differences. The ligules are thicker and more persistent but without the double ridges like *P. perfoliatus* and *alpinus*. What, nevertheless, necessitates to put these habitually similar species into separate groups is above all the fruit-form, the form of leaf-apex, the character of leaf-margin, and some anatomical properties. The lid of the putamen mostly quite rounded in *P. perfoliatus*, is in *P. prælongus* sharply keeled, the fruit therefore, both in fresh and dry state with a prominent keel especially upwards, while the fruit of the former in fresh state is rounded on the back and merely in dry state sometimes endowed with a faint false keel. The cells of the endocarp, on the contrary, in both groups comparatively thin-walled

¹ A fossil from Toppeladugård (Scania) described by me in Geol. Fören:s Förhandl. 1906 under the name of *Holstia splendens* has later proved to be *P. prælongus*.

in distinction to the *Natantes* and the *Lucentes*, the stone-cells of which are very thick-walled and hard. — Leaf-apex of *P. præl.* always cucullate and the margin smooth.

Anatomically *P. prælongus* belongs to the species which are rich in sclerenchyma, while *P. perfoliatus*, again, is a non-sclerenchymatous form and even lacks the interlacunar ligular bundles in the stem-cortex. The former has consequently very numerous bast-bundles in the stem as well as in the peduncle, in the midrib of the leaf and in the ligules, to which may be added that *P. prælongus* has also a well developed *u*-endodermis in the stem, whereas *P. perfoliatus* has *o*-endodermis. Judging from these and other facts *P. perfoliatus* seems to represent a more primitive type than *P. prælongus*. It approaches also obviously to *P. densus*.

It may be remarked that among all known species *P. prælongus* has the longest peduncles, as much as 65 cm long.

From the fossil occurrence of the two species in Scanian peat-mosses it is clear that *P. perfoliatus* has immigrated to Sweden almost immediately after the melting of the land-ice and that *P. prælongus* has followed rather close upon its heels.

P. prælongus sometimes varies with strongly recurved leaves:

f. curvatus n. f.: Folia valde recurvata.

The forms can, besides, be ranked to any of the following varieties: *latifolius* ALPERS, *brevifolius* CELAK., *angustifolius* GRAEBNER with both stem- and branch-leaves very narrow, and *elegans* TIS. with elongated leaves, 210—250 × 20 mm, and long internodes above.

Distribution. *P. prælongus* occurs locally through the whole of the *Scandinavian Peninsula* as far as Alten and South Varanger in the Norwegian Finmark, 64, HENSCHEN (hb. Uppsal.), and the *Russian Lapmark*, Nuortijaur, 83, HOLLMÉN (hb. Stockholm., Lund.) and Imandra, 92, KIHLMAN (hb. Stockholm.).

The most northern *Swedish* localities are: *North-Bothnia*, Kengis, 31, LÆSTADIUS (hb. Uppsal.), leaves green, elongated and narrow, 200 × 20 mm, labelled »*P. gramineum* v. *lanceolatum* LÆST. Vet. Acad. Handl., Kengis, 1831, sed semina nondum visa. An nitens vestrum p. parte? HARTM. in Fl. scand. Ed. 2, prælongum sed perperam traxit». LÆSTADIUS has changed the name here to »*lanceolatum*» instead of »*boreale*» in Vet. Acad. Handl., probably in order to express the shape of the leaves:

Fig. 116. A—F, *Praelongus* WULF. A, Lowest stem-leaf, $\frac{1}{2}$, showing the form of the base of the 1—4 lowest leaves. B, Pistil, side-view, $\frac{1}{2}$. C, Transverse section of the fruit, $\frac{1}{2}$, l, lid, p, putamen, f, epicarp. D, Part of a transverse section of the stem, $\frac{1}{2}$, showing the position of the pseudo-hypodermal strands, str, ep, epidermis, hp, the two-layered pseudo-hypoderma, il, intercellular lacuna, vb, vascular bundle of the ligular circle, inside which there are 3—4 circles of bundles, iv, interlacunar wall. E, Surface section of the epidermis, $\frac{1}{2}$. F, Transverse section of the lacunar portion of a fullgrown stem-leaf (lower half), $\frac{1}{2}$, m, mid-bundle, vb, vase. bundle, str, bast-bundles. G—H, *P. perfoliatus* L., G, Transverse section of the lacunar portion of an adult stem-leaf (lower half), $\frac{1}{2}$ (Obs! without bast-strands). H, Transverse section of the fruit, $\frac{1}{2}$, l, lid, p, putamen, f, epicarp. (Cf. C!).

»foliis lineari-lanceolatis». The note of the label is evidently directed to Prof. E. FRIES, who on a separate label autographically has added: »*Potamogeton salicifolius* WOLFG. ex FR. S. V. Sc.! Angermannia LÆSTADIUS.» Afterwards HARTM., Skand. Fl., has recorded, after FRIES, Kengis as the single station of *P. salicifolius*, which according to both HARTMAN's and FRIES' earlier (cf. Fr. Nov. 2. 41) views has been looked upon as *P. prælongus*. With this »*P. salicifolius*» HARTMAN later on united a » β lanceolatus», comprising partly forms of *P. gramineus*, partly also of the hybrid *P. nitens* (see above!). — Lapland, Lap. pit., 23, LÆST. (hb. Stockholm.), »*P. salicifolius* FR. S. V. Sc.», »*P. prælongus* β *graminifolius* HARTM.»; Arjeplog, 24, LÆST. (hb. Uppsal.), hb. HARTMAN, by LÆST. named »*P. gramineus* v. *lanceolatus*», to which HARTMAN has added the following parenthesis »(v. *boreale* L. V. Ac. H. 1825)», narrow-leaved (stem-leaves 15 mm broad); Lp tornense, Dr. DEUTSCH, hb. Z:DT. (hb. Lund.), Karesuando, LÆST. (hb. Stockholm., Uppsal.).

According to SCHEUTZ, Pl. vasc. Jeniseens., this species is gathered by H. W. ARNELL in the Nikandrovsij island situated in the Gulf of Yenesei 70° 20' N. L., which is its most northern habitat. From this northern limit it descends to the south and is met with in the Farøe Islands, Shetland Islands, British Isles, Denmark etc. through Europe to the Jura Mountains, Switzerland (Lac de Faillères, GODET, hb. Uppsal.) and the Alps, and through Asia, Japan (Moraran, Ezo, 42° 10' N. L., Coll. PÈRE U. FAURIE) to the year-isotherm of about +12° C. (inner Asia probably 10° or 5°) and in North America the southern boundary seems to be the same (cf. BRITTON and BROWN, Ill. Fl. etc., 1896, I, 71!).

Subsectio 25. **Perfoliati.** (GRAEBNER) HAGSTR. — *P. perfoliatus*-group
RAUNKIÆR.

Caulis ut in præcedente. *Folia* omnia submersa membranacea sessilia amplexicaulia vel infima basi rotundata, apice $\pm$ canaliculata serrulata; ligulæ breves ecostatæ valde caducæ vel in fibrillas cito scissæ. Pistillum ut in præcedente. Fructus magnitudine media, vivus dorso rotundatus. — Anatomia caulis: *O*-endodermis, fasciculi libriformes vascularesque corticales typice desunt. Fasciculi mediani tubi centralis ut in Fig. 1 *C* dispositi. — Præfoliatio convoluta. Turiones rhizomatici obvi.

This group includes a few nearly allied species united formerly into one species, *P. perfoliatus*, but lately, by P. A. RYDBERG and M. L. FERNALD detached from the genuine *P. perfoliatus* and established as separate species. Of those *P. Richardsonii* is a comparatively better marked form than *P. bupleuroides*, which perhaps rather might be put as a subspecies under *P. perfoliatus* L.

As to the stem-anatomy they are all quite like, thus behaving almost as the species of the group *Polygonifolii*, and you will have no help from the inner structure of the stem in distinguishing the species from each other. They are all non-sclerenchymatous plants in contradistinction to the preceding group. It is noticeable that *P. Richardsonii* with its strong ligular fibers nevertheless is devoid of ligular

strands in the cortex. The explanation of this fact is that the strands of the ligules are only mechanical in their character and not vascular bundles. The stone-cells of the fruit as in the preceding group.

In conformity with this segregation of the American forms, it might also be necessary to conceive the Australian v. *Muelleri* A. BENN. as a separate species.

P. Richardsonii (AR. BENN.) RYDB.

Studies on the Rocky Mount. Fl. in Torrey Bot. Club, 1905, 599. — *P. perfoliatus* L. v. *lanceolatus* ROBB. in Asa Gray. Man. Bot., 1867, 488. — *P. perfol.* v. *Richardsonii* AR. BENN. in Journ. of Bot., 1889, 25. — Cf. FERNALD, in ROB. and FERN., Gray's New Man., 1908, 74!

This species differs from *P. perfoliatus* by the following properties:

1) *Leaves* more recurved, their nerves very densely placed, by which the leaves often (at least the larger ones) become 19-nerved (15—25). The chief lateral nerves join the midrib often in the very apex as is the case in *P. perfol.* and *praelongus*, but sometimes also a little beneath. Denticulation is another: In *P. perfol.* the denticles are more prominent and directed outward, in *P. Richardsonii* the denticulation is very low and the tooth-cell has a broad base by which the cells almost seem to be lying in a row along the margin, which makes denticulation very characteristic and singular.

2) The *ligules* differ as to length, form, and structure. They are more elongate, more narrowed, though obtuse, and endowed with strong bast-strands connected conspicuously with each other in the apex of the ligule. The interjacent parts are membranous and easily dissolved, so that the fibers only soon are left.

3) The *stigma* is lower and more like that of *P. praelongus*.

4) The *fruit* is said to be somewhat larger (MORONG, Naj., 1893, 34). The fruits I have seen had the size of full-grown *perfoliatus*-fruits, or the length of about 3,25 mm. The beak may perhaps be somewhat more facial than is the condition in *perfol.*, i. e. more like that of *praelongus*. The epicarp has the same rounded form as in *P. perfol.*, but the lid of the endocarp is built in conformity with that organ in *P. praelongus*. The fruit occupies in fact a *perfect intermediate position* between these two species: endocarp = *prael.*, epicarp = *perfol.*

As to growth and ramification the species resembles the two said species, which in this respect are much the same. The form of the base and apex of leaves, the peduncle and spikes seem to coincide with *P. perfoliatus* and the same is true as regards the anatomy of the stem. The epidermis-cells are of the elongate type. Someone or other subepidermal strand is sometimes observed, but so is the case, though rarely, in *P. perfoliatus* also. The fact that the strong bundles of the ligule do not descend into the bark as a ligular circle of bundles is noticeable. The reason of this is that they lack ducts and are mechanical only in character. The ligular circle always consists of vascular bundles. The anatomy of the peduncle is the same as in *P. perfol.*

With regard to the nervation of leaves and ligules as well as respecting the stigma, the rostrum, and the endocarp of the fruit the species is closely related to *P. prælongus*.

My first acquaintance with this plant made me consider it a hybrid *P. perfoliatus* $\times$ *prælongus* and I am still convinced that it has risen by cooperation between those two species. Especially the fruit and the denticulation are persuasive. My considering it now a separate species is dependent on the following facts: 1) Pollen in the cases examined relatively well developed. 2) Fruit likewise. 3) The presence of some (even though inconsiderable) independent properties (the form of ligules and the nervation of the apex in some instances), and 4) Its occurrence, as I think, like a species, not only on scattered stations like a mongrel. Its distribution-area like that of *P. prælongus* seems to be Canada and the northern States with its centrum round the great Lakes, and as those regions have been covered by the great land-ice during the glacial period it is clear that *P. Richardsonii* is a relatively new species. 5) The constancy of its properties. All the specimens I have seen and examined from Michigan, Wisconsin, Minnesota and Wyoming deviate very slightly from each other. Especially the stem-anatomy is fixed, which, I think, were impossible, if it not were about one single cross, which had got the faculty of propagating itself by seeds. None of the Potamogeton hybrids known to me behaves in this way. I particularly think of *P. nitens*, *Zizii*, *sparganifolius* and others. *P. Richardsonii* is, no doubt, a highly interesting form, and I should like to obtain materials from different localities for further anatomical investigations.

Dr. ROBBINS' specimen, signed »R. Dr.», is preserved at Stockholm (hb. Nat. Hist. Mus.).

***P. perfoliatus* L.**

Sp. pl. 1753, 126. — *P. Loeselii* ROEM. et SCHULT., Syst. veg. 1818, 508. — *P. amplexicaulis* KAR., in Bull. Soc. Nat. Mosc., 1839, 173 (nomen solum). — Figs. 116, *G*, *H*, 117, 118, *A*.

The stem of this species common in the north hemisphere is usually much branched especially upwards, like the type *C* (Fig. 2), but occurs also unbranched or nearly simple (f. *simplex* TRS.). Internodes generally short above, or often very short. Rarely they are stretched as far as 100 to 150 mm:

f. *prolixus* n. f.: — Internodia superiora sub spica primaria elongata, 100—150 mm.

Anatomically it is of no consequence whether the plant grows in currents or in stagna. The stem shows the same non-sclerenchymatous type. Only in very rare cases someone or other subepidermal strand is to be found. Epidermis-cells stretched, 4—6 times as long as broad or a little more. — In the peduncle also the bundles are running comparatively centrally and but few and small bundles are to be found in the outer septæ, whereas *P. prælongus* has a great number of strands

in the peduncles as well as in the stem. The same is the case with the leaves of the two species, cf. fig. 116, *F*, *G*.

Leaf-base always cordate-amplexicaul (cordatis amplexicaulibus: L.); the very apex a little recurved, slightly retuse and slightly canaliculate in order to facilitate the water to run off from the blade and to prevent the non-sclerenchymatous leaves to be broken. Hereby it behaves biologically in a way contrary to *P. prælongus* with its hooded apex. Besides, the form of the apex is very variable with all transitions from broadly rounded to evenly narrowed and more or less cuspidate. Margin always more or less rough by a fine serrulation, at least in young state. Teeth always one-celled, usually prominent and more erect than in other species, without inter-jacent sinuses.

The ligules are very short, broadly rounded or sometimes broadly and obtusely cuspidate or retuse, pale, membranous, fugacious, without ridges. Their mechanical strands very faint and obscurely joining each other in the apex.

Peduncles even. If *perfoliatus*-like forms are endowed with upwards thickened peduncles, we have to do with the hybrid *P. nitens*, which, at least in most cases, influenced by *P. gramineus*, has more or less conspicuously incrassate peduncles.

The species varies considerably as regards the size and shape of the leaves but all those forms seem to me most suitably to be included in the three varieties acknowledged of old, namely *v. ovatifolius* WALLR. (1823), *v. rotundifolius* WALLR. (1823), and *v. gracilis* CHAM. & SCHL. (1827).

V. *ovatifolius* WALLR. (*v. ovatus* RCHB.).

To this variety belong all the forms which have ovate or sometimes ovate-oval shape (foliis ovatis: W.). The typical form of this variety is *α vulgaris* SPENNER (f. *typicus* TIS. [1895], *v. typicus* ASCH. & GR. [1897]). — When the leaf-width

Fig. 117. A—O. *P. perfoliatus* L., A—H, Tops of leaves, $\frac{1}{2}$, showing the different form of the apex of the stem-leaves. K, Stem-leaves of *f. acutifolius* HAGSTR., $\frac{1}{2}$. L, Pistil, $\frac{1}{10}$, a, side view, b, stigma from above. M, Leaf margin (enlarged), showing the denticles. N, Surface section of the stem epidermis, $\frac{1}{10}$. O, Transverse section of a ligule, a, at the base, b, at the middle, $\frac{1}{10}$, showing no ridges at all. P, *P. prælongus* WULF. Part of the transverse section of a ligule at the base, $\frac{1}{10}$, showing a faint protuberance (r) representing one of the ridges.

increases more conspicuously upwards, to the middle of the leaf, we have γ *oblongus* SPENNER (β *oblongifolius* DUM.). — Here may also be ranked f. *macrophyllus* BLYTT (specimens seen from Modum, Norway, 55, BLYTT, hb. Uppsal.), f. *microphyllus* BAAGÖE, f. *imbecillus* TIS., f. *prolixus* HAGSTR., f. *pseudo-densus* ASCH. & GR. Also v. *Muelleri* BENNETT is likely to be reckoned here. — In great lakes (e. g. Lake Vener and Lake Mælar, Sweden) and rivers I have found a very large-leaved form:

f. *exornatus* n. f. — Folia caulina maxima $80-150 \times \pm 30$ mm. —

A form with beautifully cuspidate leaves (see fig. 117, K) is:

f. *acutifolius* n. f. — Folia caulina cuspidata. — This form is gathered in Sweden Ostrogothia, Jonsberg, Gränsö, 77, by ELMQUIST (hb. Lund.), typical, but transition-forms are seen now and then.

V. *rotundifolius* WALLR.

Hereto belonging forms are: f. *caudiformis* ASCH. & GR., probably also f. *densifolius* MEYER, and others, all with rounded leaves (foliis rotundis: W.). A small-leaved plant from India orientalis, hb. WIGHT (hb. Stockholm.) presents very short peduncles, only 20—25 mm.

Examples with comparatively narrow and long leaves are aggregated under the name of »*Forma gracilis*» by CHAMISSE and SCHL. This will consequently become the third variety:

V. *gracilis* CH. & SCHL. (var. δ . MERT. & K., β *cordato-lanceolatus* FIEB., γ *ovato-lanceolatus* REICH.): — »Foliis latioribus aut angustioribus ex ovata basi angustatis.» — It is met with not only, as often stated, in current water, but also in smaller lakes. So is, for example the hereto belonging β *gracilis* FR. gathered in Ifö-Lake, Scania. Such forms, however, as f. *longifolius* TIS., with the leaf-size of $80-100 \times 15-18$ mm may really be inhabitants of the greater and colder rivers. F. *lanceolatus* BL., according to BLYTT's own specimens (hb. Uppsal.) has a stem-leaf-size of $70-75 \times 12$ mm. The Friesian specimens, of Scania, gathered in 1824 (hb. Uppsal.) measure a leaf-size of only $50-60 \times 12-15$ mm, thus not very much elongate.

Var. *mandschuriensis* BENN. The fruit is said to be »decidedly winged». If that means that the lid of the fruit is otherwise shaped than in *P. perfoliatus*, or that the epicarp behaves as in *P. praelongus* we shall here have quite a new species belonging to either of the two preceding groups (*Luc.*, resp. *Præl.*), according as the leaf-margin be smooth or denticulate etc. But the fruit is perhaps winged in dry state only, in which case the fruit may rather be called falsely keeled. I have seen no specimens.

P. perfoliatus v. **lacustris** WALLMAN in LILJEBL., Utkast t. en sv. fl. 1816, p. 706, is *P. praelongus* WULFEN, which is now for the first time recorded as a Swed-

ish plant. — *P. perfoliatus* v. *Jacksoni* LEES, The bot. Record Club Report 1880, p. 50, is a form of the hybrid *P. Cooperi* FRYER, see above, p. 62!

Distribution: *P. perfoliatus* is common through the whole of the Scandinavian peninsula and spreads in the north to *Lapponia murmanica* (87, KIHLMAN, hb. Stockholm.). In *Asia* it occurs, in the Yenisei-valley northward to the Nikandrovskii ostrov, 70° 20' N. L. (f. *longifolius* TIS.). I have seen it from Yenisei (hb. Stockholm., Uppsal.) and also from Bering Island (79, KJELLMAN, hb. Uppsal.) and it seems likely that the northern boundary line coincides with that of *P. natans* and *gramineus*, or the year-isotherm of about — 5° C, with the usual Siberian curve in the north of about 5 degrees. The same line we also meet with in *N. America*.

From this northern line it spreads to *North Africa* and *India*. *India orientalis*, herb. WIGHT (hb. Stockholm.), small-leaved, peduncles very short, 20—25 mm, fruit with strongly convex sides. From there it has probably spread to *Australia*, where it also occurs small-leaved in New S. Wales (97, J. H. MAIDEN, hb. Bot. Gardens, Sydney). No specimens, however, are seen from North Australia. Nor have I seen specimens from South America.

***P. perfoliatus* L. × *prælongus* WULF.**

(*P. cognatus* ASCHERSON et GRAEBNER, Synopsis mitteleur. Flora 1897. 317). — Fig. 118.

I have seen beautiful specimens of this hybrid from

Denmark, where it occurs in Varming Lake and in its outlet Nibsa near Ribe (96 and 99, BAAGÖE, hb. Stockholm., Uppsal.). Leaves with cordate base and rounded apex in a very interesting way intermediate between the two parent-species: The border is namely in the very top bent over as in *P. prælongus*, though not so strongly, and, besides, endowed with a faint canaliculate lip according to the shape of the apex of *P. perfoliatus*. See fig. 118, B. Leaf-margin without hair-like teeth, in this respect consequently corresponding to the hybrid *P. undulatus* as this commonly occurs. Ligules intermediate, somewhat shorter and more deciduous than those of *P. prælongus*.

In the stem-anatomy we find an endodermis corresponding with that of *P. perfoliatus*, while the bark, as in *P. prælongus*, is furnished with vascular and bast bundles, but fewer in number by the influence of *P. perfoliatus*.

The German *Spree*-specimens of this hybrid are said to have the leaf-margin serrulate: Blätter am Rande von ziemlich entfernten feinen Zähnen rauh. If this be true we should have two varieties: one with serrulation, the other without it.

The former might be named:

α. **denticulatus** n. var. — Folia margine rare denticulata.

The latter: β. **lævis** n. var. — Folia margine integerrima.

Fig. 118. A, *P. perfoliatus* L. Top of stem-leaf, $\frac{2}{3}$. B, *P. perfoliatus* × *prælongus*. Top of stem-leaf, a little enlarged, showing the peculiar intermediate form of the apex. C, *P. prælongus* WULF. ca. $\frac{1}{2}$.

Although this variety β , in the locality stated, probably is only one cross, it nevertheless appears in two rather different forms: one with large, broad leaves, in shape more *perfoliatus*-like, $90-130 \times 40-55$ mm:

f. *Varmingii* BAAGÖE in herb. J. O. HAGSTRÖM 1902: — *Folia magna lata P. perfoliati* similiora.

The other has narrower but comparatively more elongated, i. e. more *praelongus*-like leaves, $110-130 \times 30-35$ mm:

f. *subpraelongus* BAAGÖE, l. c. 1897: — *Folia quam in praecedente angustiora et longiora, iis P. praelongi* similiora.

This var. occurs small-leaved in *Norway*, Hindöen, 10, Notö (hb. Christian.).

The Canadian specimens, again, determined by AR. BENNETT under the name of *P. intermixtus*, should be ranked under *P. cognatus* as a var. or f. *intermixtus*, provided that they really are *P. perf.* $\times$ *prael.*

Neither the Canadian specimens nor those from »Waddainsee bei Serbigal» (KUPFFER, in M. v. ZUR MÜHLEN, Pot. Ostbalt., 1906, 172) are described as regards the leaf-margin.

It is striking that *P. praelongus* and *perfoliatus*, the stigmas and pollen of which are much the same, so very rarely produce mongrels between themselves, whereas *P. perfoliatus* and *gramineus*, for inst., dissimilar in the afore-named respects scarcely can grow together without producing crosses. This rare occurrence is also stated respecting the other *praelongus*-hybrids (*alpinus* $\times$ *prael.*, *crispus* $\times$ *prael.*, *gramineus* $\times$ *prael.*, and *lucens* $\times$ *prael.*). The explanation of this peculiar fact lies in the early florification of *P. praelongus*, by which the pistils of *P. prael.* are prevented to receive pollen from its coexistents. Only the last emitted pollen of *P. prael.* can be thought to hit the stigmas of its companions.

***P. bupleuroides* FERNALD in ROB. and FERN., GRAY's New Manual of Bot., 1908, 75.**

According to specimens (hb. Stockholm.) from the lakes Fresh Pond and Mystic Pond, Mass., U. S. A., near the Atlantic coast, and a specimen from Connecticut, leg. A. GRAY (hb. Christiania) this species is characterized by a stem with very short and very short-jointed *branches*, and by short and rounded leaves like those of the f. *rotundifolius* of *P. perfoliatus*. Their apex and basis, nervation and serrulation as in *perfoliatus*. Ligules as to form and nervation as in *perfol.* Peduncle, spike and pistil scarcely deviating. *Fruit* smaller, 2.5×2 mm (*perfol.* $3.25 \times 2.2-2.5$ mm), rounded at the apex and with a thin rostrum. Anatomy like that of *perfoliatus*.

Without fruit this species will be very difficult to distinguish from *P. perfol.* v. *rotundifol.* WALLR. as you have only the short-jointed, small-leaved branches to conclude from. FERNALD states, it is true, that the leaves are »flat, not crisped», but also the said form of *P. perfol.* has such leaves, at least sometimes, which is even acknowledged by FERNALD when saying of *P. perfol.* »leaves... usually obtuse and crisped» (l. c. 74).

P. bupleuroides FERN. $\times$ **gramineus** L. (**P. subnitens** n. hybr.).

Some plants from the eastern states of N. America must be held for *bupleuroides*-hybrids. They are like the *nitens*-forms of Europe, but differ in habit and leaf-denticulation. The latter is extremely inconsiderable. That is the case with a *gramineus*-hybrid from Wenham Lake, Mass., 1882, leg. FAXON (hb. Stockholm.). Anatomically this hybrid cannot be distinguished from *P. nitens*. —

A hybrid form from the Mystic Pond, Mass., *P. mysticus* MOR., is by FERNALD (l. c. 75) held to be:

P. bupleuroides FERN. $\times$ **pusillus** L. (**P. mysticus** MORONG in Bot. Gaz. 1880, 50).

The anatomy of the stem does not contradict this supposition. Central cylinder thin, its crosscut-form suboblong, endodermis of *O*-cells. No cortical strands, but a few very thin subepidermal ones, resembling those of *P. pusillus*. Also other characters point in the same direction especially the form and nervation of the leaf-apex, the thin peduncle, and the short spike. —

A plant from Lake Bantam at Ditchfield, Conn., coll. 25. VII, 83 by T. MORONG (hb. Stockholm.) has weaker ligules than *P. Richardsonii* usually has, but stronger than has *P. perfoliatus*. Leaves short, denticulation not quite typically that of *P. Richardsonii*. It might be *P. bupleuroides* FERN. $\times$ *P. Richardsonii* (BENN.) RYDB. American botanists, I hope, will consider the hybridism between *perfoliatus*, *bupleur.*, and *Richardsonii*.

Sectio V. **Laterales** HAGSTR.

Enantiophylli KOCH, Synops, 1837, 678. — *Groenlandia* GAY in Comptes rend. Acad. sc. Paris, 1854, 703, pro gen.

Caulis teres. *Folia* basi breviter vaginantia, serrulata, subopposita, floralia stipulata. *Stipulae* laterales. — *Præfoliatio* convoluta. *Hybernacula* desunt.

The single species belonging hereto exhibits a peculiar habit and stipules strange to all the other species, which have made J. GAY consider the plant a separate genus *Groenlandia*. We shall soon see that the fruit also presents properties deviating considerably from what we have hitherto heard of the *Potamogeton*-fruit, and by which *P. densus* occupies a position intermediate between *Potamogeton* on the one side, and *Zannichellia* and *Althenia* on the other, as *Ruppia* forms a transition to *Diplanthera*.

Although there are strong reasons for detaching *P. densus* from the genus *Potamogeton*, and although I acknowledge that this section has another position than the four preceding ones, and almost should be considered an appendix sooner than a real section of the genus, I, however, follow the traditions of our great

Linnaeus, the rather so as many properties really are common, and others not are so important as they seem to be (the internodes and the position of leaves). G. ROUY, Fl. Fr., T. XIII, has made *P. densus* form a separate *subgenus* *Groenlandia*, but if an alteration is to be made you may go the whole figure and reestablish the genus *Groenlandia* GAY.

Subsectio 26. *Densi* HAGSTR.

Caulis teres ramosus. *Folia* omnia uniformia submersa basi semi-vaginantia. *Pistillum* stylo tenui in rostellum postice protracto. *Fructus* carinatus compressus $\pm$ rostratus. *Embryo* spiralis. — *Anatomia* caulis: o-endodermis semper ex cellulis tenuibus; fasciculi corticales desunt.

P. densus L.

Sp. plant. 1753, 126. — *P. setaceus* L., l. c., 127. — *P. pauciflorus* LAM., Fl. franç. III, 1778, 209. — *P. oppositifolius* LAM. et DC., Fl. franç., III, 1805, 186.¹ — *Groenlandia densa* Fourr. in Ann. Soc. Linn. Lyon. nouv. sér., 1869, 169. — Fig. 119.

This species seems to represent a very ancient type. The leaves have namely a semi-clasping base with two lateral stipular auricles, free between themselves, but somewhat connate with the blade. They are present only in the involucre leaves. The primordial function of stipules and ligular sheaths, therefore, seems to be to protect the flowers in bud-state. An additional function is to cover the youngest part of the vegetative shoot especially against destruction from the microzoa of water. In *P. densus* the latter purpose is obtained by the pricking serrulation of the leaf-margin.

The seedling deviates from that of all the other species by the second internode being very strongly abbreviated. Hereby the first and the second ordinary leaf come in close neighbourhood of each other and of the bottom, where the plant grows. From such an arrangement the plant has the profit of being able immediately to give forth two rhizomes, by which it cares for its continuance at the habitat, a very precarious matter to such a small plant. This abbreviation of every other internode once given repeats itself along the whole shoot. In rather deep rivulets, however, the basal internodes (except, I think, the very nethermost ones) grow elongate, according to SCHUR, Phyt. Fragm., 1870, 282 (f. *alternifolius* SCHUR), of course in order to reach the surface of water with the flowering spikes.

The leaf-apex is plane and obtuse, if also often narrow and stretched; but because the leaves are recurved, the tip is directed downwards. I have not been able to discover anything in the anatomy of the leaf which can be said to be extraneous to the genus in the whole. But the base of the leaf, again, is singular by serving as a sheath. Its lowest part, therefore, is pale and by a peculiar flexion disposed

¹ On *P. serratus* L., see the index!

for this purpose. This arrangement is not to be found in any other *Potamogeton*-species, but it reminds much of the leaf of *P. Robbinsii*, which, however, has a true sheath and ligules proper. The stipules of the *densus*-leaf are as to their inner margin connate with this vaginal part of the leaf (Fig. 119, *D*), while the external border is free. — It is not fully known what var. *stipulata* ARC. may be.

The pollengrains are of middle size and similar in shape to those of *P. perforiatus*, but *P. densus* is not likely to hybridize either with this or any other *Pot.*-species. The foliar appendage of the stamen (perianth-leaf) is triangular, whereas all the other species have this organ broadly rounded or truncate upwards.

The style is narrow and short with a backwards produced beak above, not quite covered by the low stigma.

The fruit of this species differs from that of all the foregoing ones. Already F. HEGELMAIER has called attention to its thinness (Bot. Ztg, 1870, p. 317). Since that time nobody has, as far as I know, made the fruit a subject of investigation. In order to make the difference clear it is necessary to remind of the following, pertaining to the fruit. The single fruit is a drupelet. The drupelet consists of two parts, the pericarp and the seed.

A. The pericarp has an external fleshy or lacunous part (the epicarp) inside the usually large-celled epidermis, and an internal hard layer of stone-cells (endocarp), bordered inward by elongate prosenchymatous stone-cells following the direction of the spire. The endocarp forms, from the ventral side inward, a partition along the seed. On the back it forms a lid or operculum. Between the epicarp and the endocarp there are a few layers of narrow transition cells, often with rings or pores. Even the species with the thinnest pericarp, for instance *P. dimorphus*, have an external fleshy and an internal 2—3 celled part of stone-cells. *P. densus*, again, is destitute of both the fleshy and the stone-celled part. Its pericarp has only the outer epidermis, 2—4 layers of transition cells, and the inner, sclerotized epidermis-cell. The partition-wall, further, is thin, especially upwards, and relatively short, and only slightly curved depending on the particular form of the seed. In the other species this lamella is more curved and upwards enlarged. *P. densus* has, finally, the ventral cavity of the pericarp, in cross-cut view, conspicuously wider than the dorsal one, whereas the condition otherwise is the reverse.

B. The seed is surrounded by a membranous, brown testa, formed, in all the species, by somewhat elongate parenchymatous cells. It either surrounds the embryo tightly along the whole spiral, following the spiral to the tip of the cotyledon which it encloses, or it encloses the hypocotyledonic part to the plumule, whereupon it forms a sack-like enlargement, enclosing the spirals of the cotyledon. The former is the case

Fig. 119. *P. densus* L. *A*, Pistil, lat. view, $\frac{1}{10}$. *B*, Fruit, lat. view, $\frac{5}{1}$. *C*, Perianth-leaf, $\frac{5}{1}$. *D*, Stipule, $\frac{5}{1}$. *E*, Transverse section of the peduncle, $\frac{3}{1}$, *vb*, vascular bundles, *ep*, epidermis, *hp*, pseudo-hypoderma.

in the groups 1—25 (also in the *Hybridi*), the latter in *P. densus* only. By this 1) the seed gets another shape than in all the other species, and 2) the cavity of the pericarp the above-said shape, 3) the lamella the said short form, as it extends only to the point where the sack-like expansion begins.

The embryo has a more or less curved form, inasmuch as the cotyledon has a tendency to coil itself like a spiral. The most usual case is that the embryo is curved like an angling-hook, $\frac{3}{4}$ of a turn (Fig. 63, *C*), more seldom in a complete circle (f. i. *P. Robbinsii*), or coiled $1\frac{1}{3}$ turn (*P. spirilliformis*), $1\frac{1}{2}$ turn (*P. Nuttallii* Fig. 62, *D*), $1\frac{2}{3}$ — $1\frac{3}{4}$ (*P. dimorphus*). In *P. densus*, again the embryo is coiled 3—4 turns, but the spiral is enclosed by the testal sack, the whole reminding of the coiled embryo of the *Zannichellia*.

As regards the stem-anatomy *P. densus* differs from all the other species by its endodermis-cells, which do not show any tendency to get thickened walls. Besides, the stem is characterized by the perfect absence of mechanical tissue. The two median bundles of the stele unite into a single one (oblong type), but in the peduncle the primordial condition again appears, for which reason we there find four bundles, two median and two lateral ones all approached to each other, but without a distinct common endodermis. This arrangement reminds of *P. perfoliatus* and of the *Pusilli* and nearly related groups. The stem is destitute of, but the peduncle is endowed with a pseudo-hypoderma.

The different forms are most conveniently distributed on the three varieties of old: α *latifolius* WALLR., β *lancifolius* MERT. & KOCH and γ *angustifolius* WALLR.

Distribution. The most northern locality of *P. densus* is in Sweden, Halland: Söndrum in Möllegårdsbäcken, 74, NEUMAN and others (hb. Stockholm., Lund.), where the plant is to be considered a remainder from a milder climate. — Norway, Fredriksstad, 83 (hb. Christian.). — To the south of the Scandinavian peninsula it spreads through Denmark, Germany etc. to Italy (hb. Christiania) and North Africa, Algeria, El-Kantara, 96, MURBECK & OLIN (hb. Stockholm., Lund.). Westward it occurs in England at many stations (hb. Stockholm., Uppsal., Lund.), the most northern known to me is HOWDEN, 45, STOREY (hb. Lund.). How far it ranges in Asia is not fully known. I have seen it from Armenia turcica, coll. Sintenis (hb. Lund.). But it is also recorded from countries east of it: Afghanistan and North India.

On p. 127 I have mentioned a plant from Lake Quinsigamond, Mass., U. S. A., which I consider a hybrid of *P. pusillus* with *P. Vaseyi*. During the printing of this treatise I have seen another most interesting plant, which has grown together with *P. dimorphus* in the same lake. This is evidently a hybrid of *P. dimorphus* with *P. pusillus* and may briefly be described as follows:

P. dimorphus RAF. $\times$ **pusillus** L. (**P. dimorphoides** n. hybr.).

Pot. ad ramificationem *P. dimorpho* similis. Pedunculi elongati ut in *P. pusillo*. Folia omnia submersa forma structuraque intermedia.

The ramification of this plant is like that of *P. dimorphus*. Leaves intermediate. Lateral nerves very faint. Ligules open, 6-fibrous in the front-field. Peduncles like those of *P. pusillus*. Spikes small. — Gathered by T. MORONG, 81 (hb. Haun.).

As to the distribution of *P. gramineus* $\times$ *natans* (p. 219) two more localities may be added, viz. *Norway*: Senjen isl., 63, NORMAN, 10, NOTÖ (hb. Christian.), and Hvalöerne: Kirkeö at Böbakke, 42, PRINTZ (hb. Christ.). —

P. nericius (p. 145) occurs in *Iceland*, Reykhult, 76, GRÖNLUND, Reykjavik, 95, OSTENFELD HANSEN (hb. Haun.).

P. Torssandri (p. 216) has been gathered in *Norway*, Frosta, Liavand, 14, by I. JÖRSTAD. —

The most northern habitat of *P. polygonifolius* Pourr. hitherto known is Vestvågöen in *Norway*, where it has been gathered by J. M. NORMAN in 1878 (hb. Christian.) —

I will lastly give a brief summary of the groups and the number of the species and hybrids belonging to each of them:

Groups	Species	Hybrids	Groups	Species	Hybrids
1. Filiformes	4	2	P. Curtissii	1	—
2. Amblyophylli	1	—	14. Javanici	9	—
3. Vaginati	3	—	15. Hybridi	6	2
4. Pectinati	1	1	16. Alpini	2	8
P. Livingstonei	1	—	17. Amplifolii	22	1
5. Serrulati	2	1	P. Thunbergii	1	—
6. Crispi	1	3	18. Muricati	8	—
7. Compressi	2	2	19. Sclerocarpi	7	—
8. Monogyni	1	1	20. Colorati	6	2
9. Ochreatei	2	—	21. Nodosi	1	2
10. Polygoni	3	—	22. Natantes	4	3
11. Oxyphylli	5	—	23. Lucentes	19	17
12. Monticoli	1	—	24. Prælongi	1	—
13. Pusilli	19	14	25. Perfoliati	3	3
P. uruguayensis	1	—	26. Densi	1	—

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capillaceus POIR. — 138.
capillaris FISCH., l. c. 120. — 76.
capillaris GAUD., Fl. helv. I, 1828, 479: *pus.* L. var. β.
capitatus AR. BENN., Notes etc. in Journ. of Bot. 1901, 201: *pus.* L., var. — 124, 126.
caricifolius WILLD. — 39.
carinatus KUPFFER. — 65.
Casparyi KOHTS, Üb. Pot. Casp. in Österr. Bot. Zeitschr. 1870, 289—292 (A dubious form; by some auth. considered to be pure *P. alp.* BALB., in the favour of which view the descr. of the fruit seems to speak.)
caudatus SEIDL. — 233.
caudiformis ASCH. & GR., Synopsis mitteleur. Fl. 1, 1897, 314. — 256.
cayugensis HAGSTR. — 140.
cayugensis WIEG., Some Vair. of Pot. etc. in Rhodora, 1900, 102: *Nuttallii* CH. & SCHL. v. — 140.
Chamissoi AR. BENN. — 57, 204.
Champlainii AR. BENN. (*alp.* × *pensylvanicus*). — 200.
Cheesemanii AR. BENN. — 7, 157, 158, 165, 167, 169, 172 — 175.
Claytonii TUCK. — 121, 139, 200.
Claytonii × *rufescens* (*alpinus*)? ex AR. BENN., Notes in Journ. of Bot., 1890, 301; 1901, 199. — 200.
Claytonii × *Zizii* ex AR. BENN., l. c., 1904, 71 (see *epiphydrium.* × *angustifol.*).
cognatus ASCH. & GR. (*perfol.* × *prælongus*). — 257.
coloratus VAHL. — 67, 150, 175—178, 180—182.
color. × *gramineus* (*P. Billupsii* FRYER p. p.) ex HAGSTR. — 181.
coloratus × *polygonifolius* (*P. anglicus* HAGSTR.). — 180.
coloratus × *Zizii* ex FRYER. — 12.
communis HAGSTR. — 214, 215.
comparandus TIS., Pot. succ. exs. III, 1897, n. 141: *nitens* WEB.?, f.
complanatus WILLD. — 65.
compressus L. (ex OEDER Fl. Dan. 1765, t. 203 = *mucronatus* SCHR. A great many authors follow this work: SCHUM., Enum., ENG. Bot., t. 418, SPENNER, Fl. frieb., HARTMAN, 1820, MERT. & KOCH, 1823, DUMORTIER, Fl. belg., GAUDIN, Fl. helv., FIEBER 1838, REICHENB., Icones etc. 1845, and others. — ROTH, Tent. fl. germ. I, 1788, understands *P. obtusifol.* M. & K. by *compressus* L. This view is also entertained by WILLDENOW, Berl. Mag., LILJEBLAD, Utkast etc., CHAMISSE, Adn., and WAHLENB., Fl. ups. and Fl. succ. — A third view is the one represented by E. FRIES, Nov. 1828, and followed by KOCH, Syn., 1844, v. DEN BOSCH, 1851, BLYTT 1861 and 1902, GRENIER, 1855, ASCHERSON, 1864, ASCH. & GR. 1897, WOLFARTH in KOCH's Syn. 1904, GRAEBNER, 1913, FISCHER 1907 (a little hesitating), ROUY, Fl. Fr., and others. — In LAM. & DC., Fl. Fr., lastly, the name has a rather vague meaning. — The name has been rejected (not used) by NOLTE, Nov., 1826, SONDER, Fl. hamb. 1851, ROBBINS,

- 1867, AR. BENN., Bem., 1892, MORONG, Naj. 1893, and in BRITT. & BR. Ill. Fl., 1896, ROBINSON & FERN., Gray's New Man., 1908, RAUNKLER, 1896, BAAGÖE, Herb., VUYCK, Rev. 1895, HARTM. (later on), TIS., Exsicc., ALMQUIST, 1889, HAGSTR., 1901). — 57, 65, 115, 117.
- compr.* × *Maackianus* ex GRAEBNER. — 57.
- compr.* × *trich.*, ex GRAEBNER, Potamog. in ENGL., l. c., 133 (= *ripensis* BGE).
- concilium* AR. BENN. (*P. pennsylvanicus* × *heteroph.* = *P. Nuttallii* × *gram.*).
- concinnum* AR. BENN. (in Journ. of Bot., 1908, 162: *crisp.* × *pusillus*). — 64.
- concinnum* HAGSTR. — 63.
- condylocarpus* FISCH., l. c., 97. — 71.
- condylocarpus* TAUSCH. — 74, 77.
- confertus* TIS., Pot. succ. exs., II, 1895, n. 62: *lucens* L., e. — 211.
- confervoides* REICH. — 7, 85—87, 93, 120, 121.
- confinis* HAGSTR. — 97.
- congestus* FISCHER, Bayer. Pot. 1907, 54: *fluitans* (ROTH?) KOCH, f.
- conjungens* HAGSTR. — 135, 137, 138.
- connecticutensis* ROBB., in GRAY, Man. Bot. 1867, 488: *lucens* L. v.?
- contortus* DESF., Fl. atlant. 1798, 150 (= *Zannich. c.*).
- contractus* CH. & SCHL. — 117.
- controversus* NOLTE ap. AR. BENN. in Journ. of Bot. 1891, 307.
- Cooperi* FRYER. — 61, 62, 257.
- cordato-lanceolatus* FIEB., Pot. Böhm. 1838, 14: *perfol.* L. v. — 256.
- cordifolius* CH. & SCHL. — 177.
- cordifolius* FISCH., Bem. Syn. Mitt., Fl. 1914, 104: *Schreberi* FISCH., f.
- coriaceus* M. & K. (FRYER, 1889, as species). — 214, 215, 241.
- coriaceus* × *plantag.* (*P. Billupsii* FRYER). — 181.
- corniculatus* MEYER (SCHUR, En. pl. Transs., 1866, 633 as species). — 233.
- cornutus* LINT. — 60.
- cornutus* PRESL. — 233.
- coronatus* HAGSTR. — 46, 49.
- corymboides* HAGSTR. — 174, 175.
- crassifolius* FRYER (*P. Zizii* × *natans*), *gram.* × *luc.* × *nat.* ex HAGSTR. — 216, 239, 241.
- crassipes* KIT. — 205.
- crenatus* AR. BENN., Notes etc. in Journ. of Bot. 1908, 251: *perfoliatus* L., f.
- crenulatus* DON. — 58.
- crinisimilis* HAGSTR. — 17.
- crispatus* WALLM. — 58, 60.
- crispus* L. 8, 12, 54, 58—64, 67, 101, 144, 258.
- crisp.* × *Friesii* (*P. Lintoni* FRYER in The Sixteenth Ann. Rep. Wats. Bot. Club., 1899—1900, et in The Journ. Bot. 1900, 366.)
- crisp.* × *mucronatus* ex GRAEBNER, Pot. in ENGLER, l. c., 1907, 133.
- crisp.* × *obtusifolius* (*P. Bennettii* FRYER). — 63.
- crisp.* × *perfoliatus* (*P. Cooperi* FRYER). — 61, 62.
- crisp.* × *praelongus* ex CASPARY (*P. undulatus* WOLFG. ex RAUNKLER, Danske Blomsterpl. I, 1896, 104).
- 12, 62—63, 144, 258.
- crisp.* × *pusillus* ex HAGSTR. (= *P. Bennettii* FRYER). — 63—64.
- cristatus* REGEL et MAACK, in REG., Fl. Ussur. 1861, 9, t. 10. — 129.
- cristatus* WALLR., ex GRAEBNER, Pot. in Engl., l. c., 1907, 51: = *diversif.* RAF., ex GRAEBN.
- Curtii* FISCH., Bayer. Pot., 1907, 28, 50. — 148.
- Curtissii* MOR. in Bull. Torr. Bot. Club, 1886, 145. — 87.
- curvatus* AR. BENN., in Journ. Bot. 1908, 249 (*angustifolius* × *lucens*).
- curvatus* HAGSTR. — 251.
- curvifolius* HARTM. — 221, 226.
- curvifolius* HÜBNER in Flora 1846, 16: *Zizii* M. & K., var. (without descr.).
- cuscutiformis* REICHB. ap. AR. BENN., Nomenclat. in Journ. of Bot. 1890, 300: *filif.* PERS., v.?
- cuspidatus* BGE, in HAGSTR. — 66.
- cuspidatus* AR. BENN. ap. GRAEBN., Pot. in ENGLER, l. c., 91: *nitens* WEB., var. — 217.
- cuspidatus* FISCH., l. c., 97: *zosterifolius* SCHUM. f. — 66.
- cuspidatus* FISCH., l. c., 116: *pusillus* L., var. — 124.
- cuspidatus* HAGSTR. — 179.
- cuspidatus* HAGSTR. — 20—21.
- cuspidatus* SCHR. — 65, 67.
- cymatodes* ASCH. & GR. (*perfol.* × *crispus*). — 61.
- cymbifolius* FISCH. (*crisp.* × *perfoliatus*). — 61, 62.
- cyprisfolius* LOWE. — 176.
- czarnahorensis* ZAP., Consp. Fl. Galic. I, 1906, 239: *alpinus* BALB. var.
- danicus* GANDOG. — 77.
- danicus* HAGSTR. — 247.
- darkehmensis* HAGSTR. — 148.
- debilis* TIS., Pot. succ. exs. I, 1894, n. 33. — 207.
- decipiens* NTE. — 215, 216, 217, 222, 233, 242—246.
- dec.* × *nitens* (*P. Brotherstonii* AR. BENN. ap. LINTON, in Journ. of Bot. 1907, 300).
- Delavayi* AR. BENN., Notes etc., in Journ. of Bot. 1892, 228. — 152.
- delicatus* BERTOL., Mus. Ben. 5 et Misc. bot. 1854, 15. (= *diversifolius* RAF., or *dimorphus* RAF.)
- deminutus* HAGSTR. — 209, 210.
- densifolius* MEYER, Chloris Han. 1836, 523: *perfol.* L. v.
- densus* L. — 9, 54, 152, 251, 259—262.
- dentatus* HAGSTR. — 198, 204, 249.
- denticulatus* HAGSTR. — 257.
- denticulatus* LINK ap. BUCH, Phys. Beschreib. Canar. Ins. 1825, 138. — 106.
- devestitus* HAGSTR. — 46.
- dichotomus* HAGSTR. — 126.
- dichotomus* WALLR. — 49, 50.
- diffusus* HAGSTR. — 44, 46—50.
- digynus* WALLICH, Cat. 1828, n. 5177. — 156, 159, 176.
- dimidiatus* CRÉP., Notes sur q. pl. rar. ou crit. Belg. IV, 1864, 44: *compressus* L., var. (= *P. mucronatus* SCHR. ex CRÉP. in letter to Prof. P. ASCHERSON).
- dimorphoides* HAGSTR. — 263.
- dimorphus* RAF. — 135—138, 261, 262.
- dimorph.* × *diversifolius* ?, ex HAGSTR. — 136.

- dimorph.* × *pusillus* (*P. dimorphoides* HAGSTR.). — 263.
dissimilis AR. BENN., New Pot., in Journ. of Bot. 1910, 150. — 52, 53.
distachyus BELLARDI. — 205.
distachyus FISCH., Bem. Pot. etc. in Mitt. Bayer. Bot. Ges. 1914, 106; *Zizii* M. K., *lusus*.
distinctus AR. BENN., Notes etc. in Journ. of Bot. 1904, 72. — 198, 247, 248.
divaricatus WOLFG. — 221.
diversifolius BARTON, Fl. Philad. Prodr. 1815, I, 27 (= *dimorphus* RAF. et *setaceus* PURSH, e RAF., Am. monthly Mag. etc. 1817, 358).
diversifolius MERT. & KOCH in RÖHL., Deutschl. Fl., 1823, 849; *lucens* L., var.
diversifolius RAF. — 127, 134, 136—138.
Drucei FRYER. — 146—147.
Drummondii BENTH., in BENTH. & MÜLL., Fl. austral. VII, 1878, 171. — 169, 172, 173.
drupaceus LANG. in Flora II, 1846, 472. — 40.
drapaceus KOCH ap. LANG., l. c., *pectinatus* L. β.
dualis HAGSTR. (*panormit.* × *pusillus*). — 103, 104.
dubius TIS. — 217, 219.
Duschlii FISCH., Bayer. Pot. 1907, 42; *gessnacensis* FISCH. var.
elegans TIS. Pot. succ. exs. II, 1895, n. 85, 86; *præl.* WULF. f. — 251.
elegans WALLICH, Catal. 1828, n. 5178. — 156, 176.
ellipticifolius ROUY, Fl. Fr. T. XIII, 315; *prælongus* WULF. β.
ellipticus GAUD., Fl. helv. I, 1828, 467; *natans* L. v.
ellipticus KIRSCHLÄGER, Fl. d'Als. 2, 114; *fluitans* RTH. var.
elongatus BGE ap. HAGSTR. — 226.
elongatus BGE ap. DALLA TORRE & SARNTH., Fl. Tir. VI, 1906, 134; *filiformis* PERS. var.
elongatus AR. BENN. in MACOUN, Cat. Canad. pl. V, 1890, 371; *pusillus* L., v. — 124.
elongatus CH. & SCHL. — 117.
elongatus FISCH., l. c., 37; *natans* L., f. — l. c., 115; *pusillus* L. f.
elongatus HAGSTR. — 60.
elongatus KUEHN ap. ABROMEIT, Ber. etc. in Schr. Phys. Ök. Ges. Kön. 1893, 43; *fluitans* RTH., f. — 188.
elongatus LANGE ap. HERVIER, Rech. fl. Loir, 1885, 49; *polygonif.* POURR. var.
elongatus MERT. & K. ap. RÖHL. Deutschl. Fl. I, 1823, 845; *heteroph.* SCHR., var. (a dubious form).
elongatus MERT. & K. ap. FIEB., Pot. Böhm. 1838, 26 Cf. REICHENB., Ic. 1845, 24; *Zizii* M. K., var. — 214, 215.
elongatus WAHLENB. — 94.
epihydrum RAF. in Med. Repository VI: 5, 1808, 354 (by AR. BENN. considered to be identic with *P. Nuttallii* which is contradicted by the description of the subm. leaves: foliis — — — submersis subcordatis: RAF., Med. Rep. 1811, 409. — The name is to be rejected). — 139.
epihydrum (*P. Clayt.*) × *angustifolius* (*Zizii*) ex AR. BENN., Notes etc. in Journ. of Bot. 1904, 71 (suggestion of hybridity: AR. BENN., l. c.).
ericetorum SYME, ENGL. Bot. ed. 3. vol. IX, 1869, 28; *polygonif.* POURR., var. — 177.
eu-Cooperi GRAEBNER. — 62.
eu-decipiens ASCH. & GR. — 246.
excelsus HAGSTR. — 235.
exiguus HAGSTR. — 104, 106—107.
exornatus HAGSTR. — 256.
explanatus MERT. & K. — 184.
extipulatus MUHL., Cat. pl. Am. sept. 1813, 18 (not further known; only described by a name: «Hollow-leaved pondweed».)
extipulatus WILLD. in SCHULTES, Mantissa etc. 1827, 365 (A dubious form; = *pect.* L. ex CHAM., Linnæa 1827, 166, and others).
extensus TIS. ap. HAGSTR. — 225, 229, 230.
falcatus ASCH. & GR., Syn. I 1897, 326; *gramineus* × *nitens*, var.
falcatus FRYER. — 209, 221, 231.
fallax ASCH. & GR., l. c., 330 (*nitens* × *perfoliatus*).
fasciculatus WOLFG. — 14, 17, 18.
Fauriei AR. BENN. Notes etc. in Journ. Bot. 1904, 76. — 84.
Faxonii MOR. — 200.
fennicus HAGSTR. 24, 52.
ferrugineus HAGSTR. — 161, 162.
fibrosus HAGSTR. — 160, 183, 195.
Fieberi ROUY, Fl. Fr. T. XIII, 320; *pusillus* L., race I
filicardis SCHUR. — 40.
filifolius PHIL., Florula atac. 1860, 50 (= *Ruppia obtusa* HAGSTR.).
filiformis PERS. — 14—30, 33, 34, 43, 47.
filif. × *pectinatus*, ex ALMQUIST. — 20—24.
filif. × *vaginatus*, ex FONTELL. — 24, 25.
filiformis RAF., in Med. Rep. N. Y. 3: 2, 1811, 409 (cannot be identified).
Fischeri GRAEBNER, Syn. mitteleur. Fl. 1913, 504; (*perfoliatus* × *gramin.*, ex FISCHER).
Fischeri HAGSTR. — 62.
flabellatus, BAB. — 22—23, 40, 41, 48, 49.
flabellatus CRÉP., Notes etc. 1864, 45; *pectin.* L., var.
flavescens FISCH., l. c., 116; *pusillus* L., f.
flexicaulis DETH. — 250.
flexuosus WRED. — 250.
floridanus AR. BENN. — 198, 204, 235.
floridanus SMALL; Fl. of the Southeast U. S., 1903, 37 (probably belonging to the group *Amplifolii*).
fluctuans TIS. Pot. succ. exs. I, 1894, n. 28—29. — 145, 206.
fluitans COSS. & GERM., Fl. env. Par. 1845, 571; *lucens* L., v. — 237.
fluitans RTH, Tent. fl. Germ. I, 1788, 72 (Variously conceived by different authors: SMITH, Fl. Brit. 1800 = *alpin.* BALB.; so also Fl. Dan. t. 1450, but t. 2105 = *P. sterilis* HAGSTR. — CHAM., Adn., 1815 = *natans* L., var. — DC., Fl. fr. = *variifolius* THORE, — MEYER, Chlor. han. 1836 = *oblongus* VIV. α, etc.). — 180, 184, 185, 217, 238, 240, 241.
fluit. × *natans* (*P. Schreberi* FISCH., l. c., 59—61, = *natans* × *nodosus* ex HAGSTR.). — 185.
flumineus HAGSTR. — 225, 228.

- fluvialis* FISCH., Bayer. Pot. 1907, 37: *natans* L., f.
fluvialis FR. Nov. fl. Suec. 1828, 36: *gramin.* L. f. — 11, 205, 206.
fluvialis LANGE & MORT. — 97.
fluvialis TIS. in COLLINDER, Medelpads Fl. 1909, 179: *alpin.* BALB., f. (nomen solum; to judge from herbal materials it seems to be identic with *P. alp. f. palustris (minor)* TIS., Pot. suec. exs. I, 1894 n. 13: folia submersa 100—120 × 10—12 mm).
fluviatilis FISCH. in BAUMANN, Veg. Untersees 1911, 92: *coloratus* VAHL., f.
fluviatilis FR., l. c., 28: *natans* L., v. — 192.
fluviatilis FR., l. c., 37: *gramineus* L., f. — 206.
fluviatilis SCHL., Fl. berol. I, 1823, 115: *natans* L., v. — 192.
fluviatilis SCHL., l. c., 116: *heterophyllus* SCHR., v. — 210.
fluviatilis SCHÜBLER u. VON MART., Fl. Würt., 1834, 111: *pectinat.* L., v. — 51.
fluviatilis THORE, Essai etc. 1803, 46: *lucens* L., v. — 235.
foliosus FIEB., Pot. Böhm. 1838, 43: *pectinatus* L., var. (signed: *foliosus* M. & K.).
foliosus M. K., ap. RÖHL., Deutschl. Fl. I, 1823, 844: *heteroph.* SCHR., v.
foliosus RAF. — 7, 9, 89—93, 95, 120, 127.
fol. × *diversifolius* ? (*P. lateralis* MOR.) ex AR. BENN. Notes etc. in Journ. of Bot. 1900, 128 (without vindication).
fol. × *pusillus* (*P. turionifer* HAGSTR.). — 91.
fol. × *rutis* ex HAGSTR. (*P. strictifolius* AR. BENN.). — 92.
foliosus TIS. Pot. Suec. exs. II, 1895, n. 63. — 213—215.
fragillimus HAGSTR. — 198, 202.
Franchetii AR. BENN. & BGE. — 156.
francoicus FISCH. (*pusillus* × *trichoides*). — 126.
Friesii RUPR. — 94, 149.
Friesii × *acutifolius* ? ex AR. BENN., l. c. 1907, 175.
frondosus HAGSTR. — 174—176.
Fryeri AR. BENN. — 151, 158.
furcatus HAGSTR. — 79, 80.
fyrisensis TIS. — 227—230.
gallicus HAGSTR. (*obtusif.* × *trich.*). — 118.
Gaudichaudii CHAM. & SCHL., De plantis etc. in Linnæa. 1827, 199. — 198, 249.
Gayii AR. BENN. — 108—110.
geminatus HAGSTR. — 41, 51.
gemmifer REICHENB. — 60.
gemmiparus MOR. — 94.
gemmiparus ROBB. in ASA GRAY, Manual etc. 1867, 489: *pusillus* L., v? (= *gemmiparus* MOR.). — 94.
genuinus FISCH., Bayer. Pot. etc., 1907, 145: *Noltei* FISCH., ser. (See *perlucens* FISCH.)
genuinus FISCH., l. c., 54: *fluitans* RTH., v.
genuinus REICH. — 59.
genuinus SONDER, Fl. hamb., 1850, 96: *heteroph.* SCHR., v.
genuinus TIS., Pot. Suec. exs. II, 1895, n. 79—80: *upsaliensis* TIS., f. — 244.
genuinus VAN DEN BOSCH, Crit. beschouw. etc., in Nederl. Kruidk. Arch. I, 2: 2, 1851, 64: *pectinatus* L., α.
gessnacensis FISCH. (*natans* × *polygonif.*, waarschijnlijk). — 192.
gevaliensis HAGSTR. — 21.
glaucescens CH. & SCHL., — 47, 50.
glaucus GÜLDENSTEDT, Reise I, 1787, 49 (form still unknown).
gotlandicus HAGSTR. — 227—229.
gracilior TIS., l. c., I, 1894, n. 17. — 143.
gracilis AR. BENN. in GRAEBNER, Pot. in ENGL., l. c., 83: *Zizii* M. K., var.
gracilis FISCH., l. c., 116: *pusillus* L., f.
gracilis FR., l. c., 42: *perfoliatus* L., v. — 256.
gracilis FR., l. c., 49—50. — 75, 98, 124, 125.
gracilis WOLFG. — 145, 205.
gracillimus HAGSTR. — 143.
græcus HELDR. ap. GRAEBN., Pot. in ENGL., l. c., 69: *fluitans* RTH. f. (= *coloratus* VAHL ex GR., l. c., = *P. nodosus* POIR. in hb. Stockh.). — 189.
gramineifolius HAGSTR. — 220.
gramineus L. — 5, 6, 7, 11, 12, 13, 67, 134, 141, 145, 146, 150, 164, 181, 185, 195, 198, 200, 202, 204—236, 239, 241, 244, 246, 248, 252, 255, 257, 258, 259.
gram. × *illinoensis* (*P. deminutus* HAGSTR.). — 209.
gram. × *illin.* × *lucens* (*P. pseudo-Zizii* HAGSTR.). — 200, 210.
gram. × *lucens* (*P. Zizii* M. & K. p. p.) ex FRYER, On the spec. rank of *P. Zizii*, in The Journ. Bot. 1892, 114—118. — 211.
gram. × *lucens* (*P. Zizii* M. & K.) ex HAGSTR. — 11, 181, 209, 210—216, 236.
gram. × *lucens* × *natans* (*P. crassifolius* FRYER) ex HAGSTR. — 216, 239.
gram. × *lucens* × *perfoliatus* (*P. Torssandri* (TIS.) HAGSTR.). — 216, 263.
gram. × *mucronatus* (*P. lanceolatus* SM.) ex ASCH. & GR., Syn. mitt. Fl. I, 1897, 348). — 12, 150.
gram. × *natans* ex ALMQU. Om gruppindeln. o. hybr. etc., in Bot. Not. 1889, 63 et in Hn. (without further argumentation). — 218.
gram. × *natans* (*P. sparganifolius* LÆST.) ex HAGSTR. — 12, 185, 192, 197, 217—220, 238.
gram. × *nitens* ex ASCH. & GR., l. c., 326.
gram. × *nodosus* (*P. argutulus* HAGSTR.). — 189, 220.
gram. × *perfoliatus* (*P. nitens* WEB.) ex ALMQU., l. c., 1889, 66. — 11, 12, 206, 218, 221—233, 244—246.
(gramin. × perfol.) × gramineus (*P. innominatus* TIS. in HARTM. Sk. Fl. 1889, 49). — 223, 229.
(gram. × perfol.) × perfoliatus ex ALMQU. in HARTM. Sk. Fl., 1889, 49: *gram. × perfol.* β. — 229.
gram. × *polygonifolius* ex GRAEBN. (*P. Seemenii* ASCH. & GR.). — 215, 231, 232.
gram. × *prælongus* ex ALMQU. (see AR. BENN. in Journ. of Bot. 1907, 174). — 228, 232.
gramineus × *prælongus* (*P. navicularis* HAGSTR.). — 232, 233, 258.
gram. × *pusillus* ex ASCH. & GR., Syn. mitteleur. Fl., 1897, 348. — 150.
gram. × *Zizii* ex GRAEBN. Pot. in ENGLER, l. c., 1907, 136. — 209.

- graminifolius* FR., Nov. etc. 1828, 36: *gram.* L., α — 205, 206, 208.
graminifolius BENKÖ. — 204.
graminifolius HARTM. ap. HAGSTR. — 252.
grandifolius HAGSTR. — 179.
Griffithii AR. BENN. — 149.
Grisebachii HEUFFEL in Verh. Zool. — Bot. Ver. Wien, 1858, 200 (status *P. pusilli* incrustatus, ex SMK: NYMAN). — 121.
groenlandicus HAGSTR. — 127—128.
Hartmanii HAGSTR. — 21, 22.
Harzii FISCH., l. c., 28, 57: *Noltei* FISCH., ser. vel f. — 184, 240.
hawaiensis GRAEBNER, Pot. in ENGLER, l. c., 1907, 166 (nom. solum).
Heidenreichii ASCH. & GR., Syn. etc., 327: *lucens* $\times$ *gramineus*. — 245, 246.
helodes DUM. — 178.
helveticus FISCH., l. c., 134: *vaginatus* TURCZ., var. — 33.
Henningii AR. BENN., New Pot. in Journ. of Bot. 1910, 151. — 83, 119.
heterophyllus FR., l. c., 34: *lucens* L., var. (is *P. Zizii* M. & K.).
heterophyllus FR., l. c., 35: *nitens* WEB., β . — 226.
heterophyllus FR., l. c., 37: *gramineus* L., β . — 205.
heterophyllus SCHREB. — 121, 150, 189, 204, 211.
heteroph. $\times$ *coloratus* (*P. gracilis* WOLFG.) ex AR. BENN. ap. LINTON, Hybr. etc. in Journ. of Bot. 1907, 300.
heteroph. $\times$ *Friesii*: *P. lanceolatus* SM. p. p. ex FRYER, *P. rivularis* GILLOT, in Journ. of Bot. 1894, 337—340. — 12, 149.
heteroph. $\times$ *natans* (*P. Tiselii* RICHT.) ex AR. BENN. ap. LINTON, l. c.
heteroph. $\times$ *perfoliatus*: *P. nitens* WEB. ex AR. BENN. ap. LINTON, l. c.
heteroph. $\times$ *pusillus*: *P. lanceolatus* SM. p. p. ex FRYER, l. c. — 12.
hibernicus HAGSTR. — 192, 193.
Hillii MOR. — 88, 108—109, 114.
hindostanicus HAGSTR. — 155, 156, 163, 248.
Hohenackeri GANDOG. — 58.
holmiensis HAGSTR. — 20.
homophyllus HAGSTR.: *amplifol.* f. — 163.
homophyllus HAGSTR.: *illin.* f. — 199.
Hornemanni MEYER. — 176, 179.
huillensis WELW. — 131.
humilis DUM., Flor. belg. 1827, 163: *crispus* L. β . (without description). — 60.
hungaricus GANDOG. — 58.
hybridus MICHAUX, 1803. — 138.
hybridus MAKINO, 1891 = *P. cristatus* REGEL & M.
hybridus PETAGNA. — 138, 204.
Illinoensis MOR. — 164, 198—202, 204, 209, 210.
illin. $\times$ *lucens* (*P. pseudolucens* HAGSTR.). — 199, 210.
illin. $\times$ *nodosus* (*P. Faxonii* MOR.) ex HAGSTR. — 200.
illin. $\times$ *perfoliatus* (*P. subdentatus* HAGSTR.). — 201.
imbecillus TIS., l. c., II, 1895, n. 92: *perfol.* L., f. — 256.
incompletus HAGSTR. — 127.
incrustedus TIS., l. c., III, 1897, n. 128: *pect.* L., f. — 49.
indicus MIQU. — 159.
indicus RTH. ap. ROEM. & SCHULT., Syst. veg. III, 1818, 516 (= *Aponogeton monostachyus* ex ipso auctore: SCHULTES, Mant. etc. 1827, 366).
indicus ROXBURGH. — 156, 183, 188.
innominatus TIS. ap. ALMQU. Pot. in HARTN., Handb. 1889, 49: *nitens* WEB. ? α . TIS. Pot. Suec. exs. I, 1894, n. 49. — 223, 228, 229.
insignis TIS., Pot. suec. exs. II, 1895, n. 56. — 235, 236.
insolitus TIS. — 117.
insulanus HAGSTR. — 154, 155, 189.
intercedens TIS., l. c., II, 1895, n. 81: *upsaliensis* TIS., f. — 244.
interior RYDB., in ROB. & FERN., Gray's New Man. 1908, 47. — 18.
intermedius AR. BENN., Journ. of Bot. 1907, 174: *heteroph.* SCHREB., v.
intermedius CHAM. & SCHL., De plantis etc. in Linnæa 1827, 221.
intermedius FISCH. — 97.
intermedius GAUDIN, Fl. helv. I, 1828: 471: *plantag.* DU CROZ, γ .
intermedius HAGSTR., Pot. in NEUM., Sv. Fl., 1901, 797: *gramin.* $\times$ *perfol.*, ser. — 223.
intermedius HAGSTR. — 20.
intermedius KUFFEER, l. c., 168: *gram.* $\times$ *nat.*, f. — 218.
intermedius MERT. & K. — 176.
intermedius SPENNER, Fl. frieb. 1825, 33: *densus* L. v.
intermedius TIS., l. c., I, 1894, n. 48: *nitens* WEB.?, δ . (cfr. FRYER in The Journ. Bot. 1890, 178). — 226—230.
intermixtus AR. BENN., *P. præl.* etc. in Journ. of Bot. 1903, 166: *perfol.* $\times$ *præl.*, f. — 258.
interruptus AR. BENN., l. c., 1890, 302: *pusillus* L., var.
interruptus KIT. — 33, 48, 50.
interruptus SCHULTES. — 94.
intricatus NOLTE ap. AR. BENN., l. c., 1889, 297 (= *P. Berchtoldi* FIEB.?).
involutus FRYER. — 223.
iteratus TIS., l. c., I, 1894, n. 18: *alpinus* BALB., f.
Jacksoni LEES. — 62, 257.
jæsevadensis TIS., l. c., 1895, n. 82—84: *upsaliensis* TIS., β . — 244.
jamaicensis GRISEB. — 152, 155.
japonicus AR. BENN., Notes etc. in Bull. Herb. Boiss. 1896, 549: *Robbinsii* OAKES, v. — 56.
japonicus FRANCHET & SAV. — 248.
javanicus HASSK. — 75, 115, 129—134, 136.
jemtlandicus TIS., l. c., I, 1894, n. 23: *gramin.* L., f. — 206, 207, 209, 214.
jemtlandicus TIS., l. c., n. 38: *nitens* WEB.?, f. — 226.
juncifolius KERNER. — 14, 19, 22—23, 27, 33.
juncif. $\times$ *pectinatus?* ex FISCH., Bayer. Pot. etc. 1907, 133.
Keissii FISCH., l. c., 43: *gessnacensis* FISCH., v.
Kernerii HAGSTR. — 22, 27.
Kihlmanii HAGSTR. — 18.
Kirkii SYME (*P. gramin.* $\times$ *nat.* ex HAGSTR. — *nat.* $\times$ *polygonif.*, probably, ex FRYER: LINTON in Journ. of Bot., 1907, 300). — 217.
Kochii FISCH., l. c., 28, 50: *spathulatus* SCHR., ser. — 148.
Kochii LANG. — 205.

- Kochii* SCHULTZ. — 148.
lactucaceus MONTAND. — 58.
lacunatus HAGSTR. — 120, 121.
lacustris ASCH., Fl. Prov. Brand. 1864, 661: *nitens* WEB., f. (= *lacustris* CHAM.).
lacustris CHAM., *heterophyllus* SCHR., v. — 221, 226.
lacustris FISCH., l. c., 68: *Zizii* M. & K., var.
lacustris FISCH., l. c., 55: *fluitans* v. — 188.
lacustris FR., Nov. fl. suec., 1828, 28: *natans* L., a. — 192.
lacustris FR., l. c., 37: *gramin.* L., f. — 205, 206, 207, 209.
lacustris FR. — 96.
lacustris HAGSTR. — 96.
lacustris MARSSON. — 143.
lacustris ROEMER ap. GRAEBNER, Pot. in ENGL., l. c., 58: forma *latifolia* P. *fluitantis* esse videtur: GR. l. c.
lacustris SCHL., Fl. berol. I, 1823, 118: *pectin.* L., v.
lacustris THORE, Essai etc., 1803, 46: *lucens* L., v. — 235.
lacustris WALLM. — 250.
lacuum HAGSTR. — 225, 226, 228, 230.
Læstadii HAGSTR. — 224, 227, 230.
lævis HAGSTR. — 257.
lanceolatifolius TIS., l. c., III, 1897, n. 139: *gramineus* L., f. — 207, 231.
lanceolatifolius HAGSTR. — 231.
lanceolatus BL., Norges Fl. I, 1861, 367. — 256.
lanceolatus GAUD., Fl. helv. I, 1828, 464: *densus* L., v.
lanceolatus GRAEBNER, l. c., 166: *natans* L., v. (sine descr.).
lanceolatus HARTM. — 252.
lanceolatus LÆST. — 208, 251.
lanceolatus MEYER, Chloris han., 1836, 522: *rufescens* SCHR. var.
lanceolatus POIR. ap. LAM. Enc. méth. Suppl. IV, 1816, 536 (is *P. gramineus* L., ex RICHTER, Pl. eur. I, 1890).
lanceolatus ROBB. — 253.
lanceolatus SM. — 12, 99, 149, 150, 225.
lanceolatus WOLFG. et GORSKI ap. REICHB., l. c., 24: *Zizii* β *elongatus* M. K.: RCHB.
lancifolius CHAM. & SCHL. — 177, 178.
lancifolius FIEB., Pot. Böhm. 1838, 23: *natans* L., v. (= *prolixus* KOCH?).
lancifolius MERT. & K., ap. RÖHL., Deutschl. Fl. I, 1823, 819: *lucens* L., v. — 235.
lancifolius M. & K., l. c., 859: *densus* L., v. — 262.
lancifolius ROTH ap. STEUDEL, Nomencl. II, 1841, 384: (= *lancifolius* M. K.).
lancifolius VISIANI in Memorie Istituto Veneto etc. 1877, 193: *perfol.* L., v.
lanceiformis ROEM. & SCHULTES. — 205.
largior TIS., Pot. Suec. exs. I, 1894, n:o 9. — 177.
lateralis MOR. (*pusillus* $\times$ *Vaseyi* ex HAGSTR.). — 126, 127.
laticaulis WAHLENB. — 65.
latifolius ALPERS, Verz. d. Gfpfl. d. Landdrostei Stade, 1875, 86. — 251.
latifolius BÄNITZ in Physik. Ökon. Ges. Königsb. 1873, 16: *alpin.* BALB. var.
latifolius AR. BENN., Notes etc., in The Journ. Bot., 1907, 375: *ochreateus* RAOUL, f.
latifolius BESSER, ex AR. BENN., Journ. of Bot., 1900, 127: *lanceolatus* SM. β (= *nitens* WEB.: BENNETT).
latifolius CHAM. & SCHL., l. c., 1827, 212: *rufescens* SCHR., f. — 142.
latifolius CHAM. & SCHL., ex FR., Nov., 1828, 30: *oblongus* VIV., f. (= *cordifolius* CHAM. & SCHL.).
latifolius FIEB., l. c., 30: *nitens* WEB., f.
latifolius FIEB., l. c., 32: *crispus* L., f. — 60.
latifolius FIEB., l. c., 38: *obtusifol.* M. K., var. β .
latifolius FISCH., Bayer. Pot. 1907, 37: *natans* L., f.
latifolius FISCH., l. c., 40: *polygonif.* POURR., f.
latifolius FISCH., l. c., 54: *fluitans* RTH. f. — 188.
latifolius FISCH., l. c., 45: *alpin.* BALB. f.
latifolius FISCH., l. c., 97: *compressus* L., f. — 95.
latifolius FISCH., l. c., 97: *acutifol.* LINK., f. — 71.
latifolius FISCH., l. c., 115: *pusillus* L., f.
latifolius HAGSTR. — 244.
latifolius MEYER, Chloris han. 1836, 527: *pectinatus* L., v.
latifolius MEY., l. c., 526: *pusillus* L., v. (is thought to be = *mucronatus* SCHRAD.)
latifolius MERT. & K., l. c., 845: *heteroph.* SCHR. v. — 210.
latifolius MOR., A rev. N. Am. Naj., in Mem. Torr. bot. Cl. III, 2, 1893, 44: *Vaseyi* ROBB. v.
latifolius MOR., l. c., 52, t. 59. — 40.
latifolius ROBB., Bot. King's Exp. 1871, 338: *pectinatus* L., v.? — 50.
latifolius RUTHE ap. FISCHER, l. c., 100: *mucronatus* SCHR., f.
latifolius TIS. ap. GRAEBNER, l. c., 1907, 90: *nitens* WEB., f. — 226.
latifolius WALLR., l. c., 66: *densus* L. α . — 262.
latifolius WIRTGEN, ap. FISCH., l. c., 54: *fluitans* RTH. f.
latusculus HAGSTR. — 46.
latus HAGSTR. — 63.
laxifolius COSS. & GERM., Fl. env. Paris 1845, 591: *oppositifolius* LAM. & DC., v.
laxifolius GRENIER, ap. GREN. & GODR., Flore Fr. III, 1855, 320: *densus* L., v.
laxus FISCH., l. c., 1907, 115: *pusillus* L., f.
laxus OPIZ, ap. FIEBER, l. c., 1838, 13: *densus* L., v.
laxus TIS. — 21, 47, 50.
leiocarpus ASCH. & GR., Syn. mitt. Fl. I, 1897, 347: *trichoides* CH. & SCHL., v. (= *leiocarpus* ASCH.).
leptophyllus GANDOG. — 58.
leptophyllus WALLR. in GRAEBNER, Pot. in ENGLER, l. c., 51 (is *diversifolius* RAF., ex GR., l. c.).
Leschenaultei CHAM. & SCHL. — 176, 177, 184.
Liebmanni BUCHENAU in Abh. Nat. Ver. Brem. III, 1873, 349 (= *Schollera graminea* WILLD. ex AR. BENN., Journ. of Bot. 1890).
ligulatus HAGSTR. — 131.
ligulifolius FISCH., Bayer. Pot. etc., 1907, 110: *panormitanus* BIV., f.
ligulifolius FISCH., l. c., 115: *pusillus* L., f. — 124, 125.
Liljebladii WALLM. ap. RCHB. — 115.
limosellifolius MAXIMOW. — 87, 107, 129, 134.
limosus FISCH., l. c., 37: *natans* L., f.
limosus HAGSTR. — 139.

- Lindenbergii* LEHM. ap GRAEBN., l. c., 81 (is *Zizii* M. K.? ex GR., l. c.).
- linealis* PETERMANN, Anal. Pfl. schlüssel, 1846: *pectin.* L., var.
- linearifolius* HAGSTR. — 143.
- linearis* LÆST. — 219.
- linearis* BENN. — 193.
- linearis* SYME. — 193.
- linguatus* HAGSTR. — 7, 10, 141, 151, 161, 162, 163.
- linipes* HAGSTR. — 17.
- Lintoni* FRYER, The sixteenth Ann. Rep. Wats. Bot. Exch. Cl. 1899—1900, Journ. of Bot. 1900, 366: *crispus* × *Friesii*.
- viocarpus* ASCH., Fl. Prov. Brand. etc. 1864, 665: *trichoides* CH. & SCHL., v. — 77.
- viocarpus* FISCH., l. c., 97: *acutifol.* LINK., f. — 71.
- lithuanicus* GORSKI. — 225, 242—246.
- litoralis* FR., Nov. fl. Suec. 1828, 35: *nitens* WEB., f.
- Livingstonei* AR. BENN., Naj. in THISELTON-DYER, Fl. trop. Afr. VIII. 2, 1901, 223. — 53.
- loculosus* HAGSTR. — 119, 120.
- Loeselii* ROEM. & SCH. — 254.
- lonchitis* TUCK. — 184, 190, 200.
- lonch.* × *amplifolius* ex AR. BENN., Journ. Bot. 1901, 199.
- lonch.* × *rufescens* ex MOR., l. c., 1893, 22: *P. Faxonii* MOR. — 200.
- longepedunculatus* MÉRAT. — 205.
- longicaulis* C. G. WESTERLUND, Ronnebytr. f. o. fl. 1890, 155: *P. polygonif.* POURR., f. (= f. *cordifolius* CHAM.).
- longifolius* BAB. in ENGL. Bot., Suppl. 1840, t. 2847. (is *Babingtonii* AR. BENN.). — 247.
- longifolius* DC., Fl. française vol. VI, 1815, 311. — 202, 233, 235—237.
- longifolius* FIEB., l. c., 32: *crispus* L., f. — 60.
- longifolius* FISCH., l. c., 1907, 37: *natans* L., f.
- longifolius* FISCH., l. c., 115: *pusillus* L., f.
- longifolius* GAY. — 202, 244.
- longif.* × *lucens*? ex KUPFFER, l. c., 162.
- longifolius* × *perfoliatus* ex KUPFFER, l. c., 171. — 245.
- longifolius* HAGSTR. — 244, 247.
- longifolius* LÆST. ap. BEURL., Syn. etc., in Bot. Not. 1853, 88: *rufescens* SCHR., v. — 143.
- longifolius* TIS., Pot. succ. exs. I, 1894, n. 15: *alpinus* BALB., f. (= *longifolius* LÆST.). — 143.
- longifolius* TIS., l. c., III, 1897, n. 146: *perfol.* L., f. — 227, 256, 257.
- longipedunculatus* TIS. — 48.
- longipedunculatus* TIS., l. c., II, 1895, n. 64: *lucens* L. var. — 214, 215.
- longipes* FISCH., l. c., 115: *pusillus* L., f.
- longipes* HAGSTR., *P. fennicus*, f. — 25.
- longipes* HAGSTR., *P. franconicus*, f. — 126.
- longipes* ROHLENA, in Sitzber. Böhm. Ges. Wiss. 1902, 15: *lucens* L., v.
- longipetiolatus* FISCHER in BAUMANN, Veget. Untersees 1911, 101: *Zizii* × *gram.*, f.
- longipetiolatus* TIS., l. c., II, 1895, n. 60: *lucens* L., v. — 213.
- longissimus* MERT. & KOCH ap. SPENNER, Fl. frib. I, 1825, 35: *pectin.* L. var.
- lucens* L. — 4, 5, 7, 9, 11, 12, 67, 164, 181, 184, 185, 188, 190, 198, 199, 200, 202—204, 207, 208, 209—219, 225, 233—248, 258.
- lucens* × *gramineus* ex FRYER (*Zizii* M. & K., p. p. (the typical forms). — 215.
- lucens* × *gramin.* (*P. Heidenreichii* ASCH. & GRAEBN.). — 164, 215.
- lucens* × *natans* (*P. fluitans* RTH., ex p. (ex BUCHENAU, Fl. Nordw. Tiefb., 1894, 48. — 238.
- lucens* × *natans* (*P. fluitans* Auctt.) ex RAUNKIÆR, Danske Blomst. etc. I, 1896, 97. — 238.
- lucens* × *natans* (*P. Noltei* FISCH.). — 208.
- lucens* × *natans* (*P. sterilis* HAGSTR.). — 185, 218, 219, 234, 237—241.
- lucens* × *nodosus* (*P. rubrifus* HAGSTR.). — 12, 185, 237, 239, 240—242.
- lucens* × *perfoliatus* ex MARSS. — 12, 242—246.
- lucens* var. *longifol.* × *perfoliatus* ex KUPFFER. — 245.
- lucens* × *polygonifolius* (*P. Drucei* FRYER) ex FRYER, ap. GRAEBNER, Pot. in ENGLER, l. c., 1907, 65, 138.
- lucens* × *praelongus* ex CASPARY. — 12, 215, 243, 246, 247.
- lucens* × *praelongus* (*P. Babingtonii* AR. BENN.). — 246, 247, 258.
- lucentiformis* HAGSTR. — 213.
- lucescens* TIS., l. c., II, 1895, n. 59: *lucens* L., β. — 213, 215, 235.
- lucidus* GÜLDENSTEDT, Reise durch Russl. etc. I, 1787, 76. — 233.
- Lundii* RICHT. — 226, 228, 232.
- luxurians* DÖLL., Fl. des Grossherz. Baden, 1857—62, 458. — 50.
- luxuriosus* HAGSTR. — 16, 18.
- Maackianus* AR. BENN. — 56—57, 67, 87.
- Maackianus* × *malaianus* (*P. philippinensis* AR. BENN.). — 57.
- machianus* LOWE, ap. GRAEBN. Pot. in ENGL., Pfl. reich IV. 11, 1907, 58 (= *fluitans* ROTH, ex GRÆBN., l. c.).
- machicanus* MANDON in herb. — 189.
- Macounii* MOR. — 18.
- macrocarpus* FISCH., Bayer. Pot. etc. 1907, 115: *pusillus* L., f.
- macrophyllodes* HAGSTR. — 202.
- macrophyllus* ASCH. & GR., l. c., 314: *perfoliatus* L., subv.
- macrophyllus* BL. — 256.
- macrophyllus* FR., l. c., 1828, 33: *lucens* L., α.
- macrophyllus* WALLR., Schedulæ crit. 1822, 65: *lucens* L., β.
- macrophyllus* WOLFG. — 233, 235.
- macrorrhyncus* GANDOG. — 58, 60.
- Maevicarii* AR. BENN. in Ann. Scot. Nat. Hist. 1907, 106—108: *praelongus* × *polygonifolius*.
- maderensis* HAGSTR. — 177.
- mælarensis* TIS. — 226, 230, 232.
- magellanicus* HAGSTR. — 27.
- Magnini* ROUY, Fl. Fr., T. XIII, 315.: *præl.* WULF., ε.
- magnus* TIS. — 65.
- major* AR. BENN. — 130, 133.
- major* FIEB., l. c., 1838, 34: *acutifolius* LINK, var. — 71.

- major* FISCH., Bayer. Pot. 1907: 97: *acutifolius* LINK, f. — 71.
- major* FISCH., l. c., 109: *panormit.* BIV., v.
- major* FISCH., l. c., 45: *alpinus* BALB., f.
- major* FR., l. c., 1828, 48. — 94.
- major* FRYER, Journ. of Bot., 1890, 321: *coriaceus* FRYER, var.
- major* HARTM., Phys. obs. i Sv. Vet. H., 1818, 158: *rufescens* SCHR., v.
- major* KOCH & ZIZ., Cat. plant. etc. 1814, 17: *natans* L., α .
- major* MERT. & KOCH, ap. RÖHL., l. c., 1823, 857: *pusillus* L. α . — 124.
- major* MEYER, Chloris han. 1836, 527: *densus* L., v.
- major* RUTHE, ap. FISCHER, Beitr. etc., in Mitt. bayer. bot. Ges. 1904, 377: *mucronatus* SCHR., v.
- major* TIS., l. c., II, 1895, n. 68—69: *dec.* NTE. f. — 244.
- major* TIS., l. c., III, 1897, n. 114—115: *filif.* PERS. f. — 17, 18, 21.
- major* TIS., Bot. Not., 1884, 19: *upsaliensis* TIS., f. — 243, 244.
- major* ZAP., Consp. Fl. Gal. I, 1906, 242: *compressus* L., v. — 65.
- malalanus** MIQU. — 57, 202, 204, 248, 249.
- manchuriensis* AR. BENN., in J. Bot. 1904, 76: *acutif.* LINK, ssp. — 83.
- mandschuricus* GRAEBNER, Pot. in ENGLER, l. c., 166: *perfol.* L., v. (nomen solum, misprint?).
- mandschuriensis* AR. BENN., Notes etc. in l'Ann. Conserv. Genève, 1905, 100: *perfol.* L., var. — 256.
- marianensis* CHAM. & SCHL. — 184.
- marinus* L. — 14, 39.
- marinus* TIS., l. c., III, 1897, n. 137: *gramineus* L., f. — 207.
- maritimus* POHL. — 14.
- maritimus* TIS., l. c., I, 1894, n. 42: *nitens* WEB.? f. — 226—230.
- mascarensis* CHAM. & SCHL. — 184.
- maximus* BGE, ap. FISCH., Bayer. Pot. 1907, 37: *natans* L., f.
- maximus* AR. BENN. — 225.
- maximus* MOR. ap. AR. BENN., Notes etc. in Journ. of Bot., 1881, 241: *heteroph.* SCHR., f. — 206.
- maximus* FISCH., l. c., 40: *polygonif.* POURR., f.
- maximus* RÖHLING, ex STEUDEL, Nomencl. 1841, 648 (a form hitherto unknown).
- medius* KOCH & ZIZ. — 176.
- membranaceus** HAGSTR. — 151, 157.
- memelanus* HAGSTR. — 245, 246.
- merloensis* TIS., l. c., I, 1894, n. 50: *nitens* WEB.?, ζ .
- methyensis* AR. BENN., Notes etc. in Journ. of Bot. 1891, 432: *angustifolius* PRESL., v.
- mexicanus** AR. BENN., l. c., 1887, 289. — 165.
- microcarpus* BOISSIER & REUT., Diagn. pl. nov. Hisp. 1842, 2 (= *oblongus* VIV., ex COSS. & GERM., Fl. env. Paris 1845). — 179.
- microcarpus* FISCH., l. c., 115: *pusillus* L. f.
- microcarpus* NEUM., Några krit. eller sälls. växter etc., 1888, 23—25: *zosteraceus* FR., f.
- microphyllus* BGE, ap. GRAEBN., in ENGL., l. c., 44: *natans* L., f.
- microphyllus* BGE ap. V. ZUR MÜHLEN, Pot. Ostbalt., in Korr. Nat. Ver. Riga, 1906, 160: *perfoliatus* L., f. — 256.
- microstachys* WOLFG. — 141.
- miduhikimo** MAKINO, Ill. Fl. Jap. 1891, 2, t. 54. — 129, 132, 133.
- minus* MOR., l. c., 1893, 25: *heterophyllus* SCHREB., f.
- minor* BIV., Nuove piante etc. 1838, 6: *panormit.* BIV., v. — 98, 100—103, 124.
- minor* V. D. BOSCH, Crit. beschouw. etc., in Nederl. Kruidk. Arch., I, 2, 2, 1851, 58: *oblongus* VIV., f.
- minor* FIEB., l. c., 35: *acutif.* LINK, v. — 71.
- minor* FISCH., Bayer. Pot. etc. 1907, 45: *alpinus* BALB., f.
- minor* FISCH., l. c., 97: *compressus* L., f. — 66.
- minor* FISCH., l. c., 97: *acutifol.* LINK, f. — 71.
- minor* GAUDIN, Fl. helv., 1828, 471: *plantagineus* DU CROZ, v.
- minor* GRAEBNER, Pot., in ENGLER, l. c., 1907, 168: *fluitans* ROTH., v. (nomen solum).
- minor* HARTM., Physiogr. obs. etc., in K. Sv. Vet. Ak. H., 1818, 158: *rufescens* SCHR., v. — 143.
- minor* KOCH & ZIZ. — 176.
- minor* NOLTE, in L. HANSEN, Herb. Schlesw.-Holst.-Lauenb. Flor, 1837, n. 251: *lucens* L. v.
- minor* TIS., Pot. succ. exs. III, 1897, n. 113: *filif.* PERS. f.
- minor* TIS., l. c., n. 101: *mucronatus* SCHR., f. — 95.
- mollifolius* HAGSTR. — 74.
- mongolicus* AR. BENN., Notes etc., in Journ. of Bot. 1894, 203—204: *pectinatus* L., v. — 42, 44, 50.
- mongolicus* MAXIMOWICZ, ap. AR. BENN., Notes on Jap. Pot., in Bull. Herb. Boiss. 1896, 546: *gramineus* L., v. (= *gracilis* WOLFG., ex BENN. l. c.).
- monogynus* GAY. — 74.
- montanus** PRESL., Reliquiæ Hænk. II, 1835—36, 85. — 165.
- montevicensis** AR. BENN., Bemerkk. etc., in Ann. Hofm. Wien, 1892, 293. — 152, 162, 168.
- monticolus* SCHWEINITZ, ap. AR. BENN., l. c., 292. — 85.
- moravicus* HAGSTR. — 188.
- Morongii** AR. BENN. — 197.
- mucronatus* FIEB., Pot. Böhm. 1838: 40: *Berchtoldi* FIEB., α .
- mucronatus* FISCH., l. c., 1907, 97: *acutifol.* LINK, f. — 71.
- mucronatus* PRESL. — 248.
- mucronatus** SCHRADER. — 12, 72, 88, 91, 93—99, 112, 116, 117, 125, 150, 195.
- mucron.* $\times$ *obtusifol.* (*P. semitractus* AR. BENN.), ex GRAEBN. — 96.
- mucron.* $\times$ *panormit.* (*P. confinis* HAGSTR.). — 97.
- mucron.* $\times$ *pusillus* (*P. intermedius* FISCH., l. c., 28, 122). — 97, 122.
- mucronulatus* HAGSTR. — 91.
- mucronulatus* FISCH., l. c., 115: *pusillus* L., α . — 124.
- Muelleri* AR. BENN., in Journ. of Bot., 1887, 177: *perfol.* L., v. — 253, 256.
- multidenticulatus* MORONG, l. c., 1893, 48—49: *diversifol.* RAF., v. — 139.
- muricatus** HAGSTR. — 165, 166, 167.
- muticus* FIEB., l. c., 1838, 38: *obtusifol.* M. K., f.

- myriophyllus* ROBB., in ASA GRAY's Man. Bot. 1867, 487: *gramin.* L., v.? — 206, 209.
- mysticus* MOR. — 259.
- najadoides* GRAEBNER. — 60.
- natans* L. — 12, 134, 146, 147, 152, 163, 176, 184, 185, 189, 191—197, 209, 215, 216—220, 234, 237—241, 242, 257, 263.
- natans* × *alpin.* ? (*P. Drucei* FRYER) ex FRYER, Pot. Brit. Isles, 1898: 31. — 146.
- natans* × *gramin.* ex ASCH. & GR., Synopsis, I, 1897, 333. — 215.
- natans* × *lucens* ex BEEBY, On P. fluit. Rth in Journ. of Bot. 1890, 204.
- natans* × *nodosus* ex HAGSTR. — 185.
- natans* × *polygonifolius* ex ALMQU. in Bot. Not. 1889, 66.
- natans* × *polygonifolius* (*P. gessnacensis* FISCH., Beiträge etc., in Mitt. bayer. Bot. Ges. 1905, 472 et in l. c. 1907, 42: wahrscheinlich: F.). — 185, 192, 193.
- natans* × *polygonif.* ? (*P. Kirkii* SYME) ex FRYER, ap. LINTON, Hybr. etc., in Journ. Bot. 1907, 300.
- natans* × *trichoides* (*P. variifolius* THORE) ex HAGSTR. — 193—195.
- natans* × *Zizii* (*P. crassifolius* FRYER) ex ASCH. & GR., Synopsis etc. 1897, 332.
- navicularis* HAGSTR. (*gramin.* × *præl.*). — 232.
- neidensis* HAGSTR. — 227, 230.
- nericius* HAGSTR. (*alpin.* × *gramin.*). — 145, 263.
- nerviger* WOLFG. (*alp.* × *prælongus*). — 149.
- nervosior* HAGSTR. — 63.
- niagarensis* TUCK., Observ. in Amer. Journ. Sci. and Arts 1849, 354. — 91.
- nigrescens* FR. — 205, 208, 209, 230.
- nipponicus* MAKINO, Ill. Fl. Jap. I, 1891, 2, t. 58 (The material is scanty: BENN. in Journ. of Bot. 1900). — 57, 198.
- nitens* CHAM., Adnot. ad fl. berol. 1815, 6: *lucens* L., β. — 235.
- nitens* FISCH., Bayer. Potamog. 1907, 68: *Zizii* M. & K., v.
- nitens* WILLD., ap. CHAM., l. c., 6 (= *nitens* CHAM.).
- nitens* WEBER. — 11, 148, 201, 209, 210, 216—218, 221—231, 233, 244, 252, 254, 255.
- nitens* × *heteroph.* ? ex FRYER, Supposed hybr. etc., in Journ. of Bot. 1890, 178.
- nitens* × *perfoliatus* ex GR., Pot. in ENGLER, l. c., 1907, 138.
- nodosifolius* HAGSTR. — 220.
- nodosus* POIRET. — 7, 12, 147, 148, 154, 155, 162, 183—190, 192, 195, 200, 201, 220, 235, 237, 242, 248.
- nodosus* × *Nuttallii* (*P. subsessilis* HAGSTR.). — 190.
- nodosus* × *Richardsonii* (*P. rectifolius* AR. BENN.) ex HAGSTR. — 148, 190.
- Noltei* AR. BENN. — 98.
- Noltei* FISCH., Beitr. etc., in Mitt. bayer. Bot. Ges. etc. 1904, 375. — 185, 238.
- normalis* TIS., Pot. suec. exs. I, 1894, n. 22: *gramin.* L., f.
- norvegicus* HAGSTR. — 177.
- notabilis* TIS., l. c., II, 1897, n. 133: *pectin.* L., f. — 49.
- Notarisii* GANDOG. — 58.
- novæboracensis* MOR., Revis. N. Am. Naj., in Mem. Torr. bot. Club III: 2, 1893, 20—21: *lonchitis* TUCK., v.
- Novæ-Angliæ* HAGSTR. — 120, 121.
- numasakianus* AR. BENN., Notes etc. in l'Ann. Conserv. Genève, 1905, 104. — 129.
- Nuttallii* CHAM. & SCHL., De plantis etc., in Linnæa, 1827, 226. — 4, 121, 134, 135, 139, 140, 155, 170, 189, 190, 200, 201, 262.
- Nuttallii* × *gramineus* (*P. concilius* AR. BENN., Journ. of Bot. 1908, 250).
- Oakesianus* ROBB. — 196, 197.
- oblongifolius* AR. BENN., in Ber. Schw. bot. Ges., 1896, 96: *perfoliatus* L., v.
- oblongifolius* DUM., Fl. belg. 1827, 163. — 256.
- oblongifolius* HOOKER F., Handb. N. Zeal. Fl. 1862, 742 (is *P. Cheesemani* AR. BENN. ex BENN.).
- oblongo-rufescens* SCHULTZ, in Flora, 1849, 230. — 148.
- oblongus* SCHNEIDER, in Verh. bot. Ver. Brand., 1872, X (is *P. gramin.* L. v. *terrester* FR., ex GRAEBNER).
- oblongus* SPENNER, Fl. frib. I, 1825, 32: *perfol.* L. γ. — 256.
- oblongus* VIV. — 175, 180.
- obovatifolius* TIS., ap. FRYER, in Journ. of Bot., 1891, 289: *nitens* WEB., f.
- obtusifolius* WOOD, Classbook, 1845, 176 (is *P. alpin.* BALB., f., ex ROBB., in GRAY's Man. 1867, 486).
- obscurus* DC. — 141, 143.
- obtusifolius* FIEB., Pot. Böhm. 1838, 32: *crispus* L., β. — 59, 61.
- obtusifolius* MERT. & KOCH. — 7, 20, 22, 56, 58, 64, 91, 96, 97, 99, 105, 106, 109, 115—121, 205.
- obtusif.* × *Friesii* (*P. semifructus* AR. BENN.) ap. GRAEBNER, Potam. in ENGL., l. c., 1907, 138). — 96.
- obtusifol.* × *panormitanus* (*P. Sturrockii* AR. BENN.) ex HAGSTR. — 117.
- obtusifol.* × *pusillus* ex ALMQU. in Bot. Not., 1889, 66.
- obtusifol.* × *pusillus* (*P. saxonicus* HAGSTR.). — 118.
- obtusifol.* × *trichoides* (*P. gallicus* HAGSTR.). — 118.
- obtusifolius* MEYER, Chlor. han., 1836, 523: *lucens* L. f.
- obtusior* FISCH., Bayer. Potam. etc. 1907, 101: *mucronatus* SCHR., f. — 95.
- obtusius* DU CROZ ap. GAUD., l. c., 1828, 468. — 141.
- obtusius* FIEB., l. c., 38: *obtusifol.* M. K., f.
- obtusius* HAGSTR.: *suecicus* RICHT. δ. — 20, 22.
- obtusius* HAGSTR.: *nitens* WEB., f. — 226, 230, 231.
- obtusius* SCHLECHTEND., Fl. berol. I, 1823, 117: *compressus* L., v. (is *obtusifolius* M. & K: SCHULT. Mant.).
- occidentalis* GRAEBNER, Potam. in ENGLER, l. c., 1907, 91: *nitens* WEB., ζ.
- occidentalis* ROBB., in King's Explor. 40 Mer. U. S. A., 1871, 339: *marinus* L., v. — 18, 19.
- occidentalis* SIEBER. — 184.
- ochreatus* RAOUL. — 10, 58, 79, 86.
- octandrus* POIRET ap. LAM., Enc. Suppl. IV, 1816, 534 (= *Hydrogeton*-species).
- octandrus* REICHENB. herb., ex AR. BENN., in Ann. Nat. Hofm. Wien, 1892, 288 (is *javanicus* HASSK. ex BENN.). — 131.
- odontocarpus* GANDOGER in Bull. Soc. bot. France, 3, sér. VI, 1899, 393 (planta dubia).

- Oederi* MEYER. — 94.
olivaceus BGE, Prép. Hydroph. etc., Compte-rendu Congrès int. Bot., 1900, 517: *alpin.* × *lucens*, ex BGE. — 242.
olivaceus HAGSTR. — 97.
olivaceus LANG. — 242.
oppositifolius LAM. & DC. — 260.
orientalis HAGSTR. — 83, 108, 114.
orthorrhyncus GANDOG. — 74, 77.
ostiarius HAGSTR. — 48.
ovalifolius FIEB., Pot. Böhm., 1838, 23: *natans* L., v. — 192.
ovalifolius FISCH., Bayer. Pot. 1907, 37: *natans* L., f. — 192.
ovalifolius FISCH., Bem. Syn. Mitt. Fl. 1914, 104: *Schreberi* FISCH., f.
ovalifolius MERT. & K. — 210, 235.
ovalifolius MOR., ap. AR. BENN., in Journ. of Bot. 1904, 70: *amplifol.* TUCK., f. — 163.
ovatifolius HAGSTR. — 144.
ovatifolius TIS., l. c., III, 1897, n. 138: *gramin.* L., f. — 207.
ovatifolius WALLR., Sched. crit. 1823, 66: *perfoliatus* L., α. — 255.
ovatilanceolatus FISCH., l. c., 1914, 104: *Schreberi* FISCH., f.
ovato-lanceolatus REICHENB., Icones fl. Germ. et Helv. VII, 1845, 19: *perfoliatus* L., var. — 256.
ovato-oblongus FIEB., l. c., 20: *oblongus* VIV., v.
ovatus DÖLL., Rhein. Fl. 1843, 232: *densus* L., α.
ovatus REICHENB., l. c., 19: *perfoliatus* L., v. — 255.
owaihiensis CHAM. & SCHL. — 184.
oxyphyllus MIQUEL. — 82—84.
pachystachyus REICHENB., l. c., 25: *plantagineus* DU ROZ? v. — 179.
palatinensis HAGSTR. — 148.
pallidior GANDOG. — 58.
paludosus BOENN., in STEUDEL, Nomenclator, 1841, 384 (= *natans* L.).
paludosus BORY. — 176.
palustris MERT. & K., in RÖHL., Deutschl. Fl. I, 1823, 841: *rufescens* SCHR., α. — 143.
palustris SCHLECHT., Fl. berol. I, 1823, 115: *heterophyllus* SCHREB., v.
palustris TEESDALE, in Transact. Linn. Soc. V, 1800, 43 (is *gramineus* L., ex STEUDEL, Nom.). — 205.
pamiricus BGE. — 14, 25, 38.
panormitanus BIVONA BERNARDI. — 6, 9, 77, 88, 92, 93—96, 98—104, 105, 107, 108, 111, 117, 118, 122, 123, 124, 125, 127, 150.
panorm. × *pusillus* (*P. dualis* HAGSTR.). — 103, 104, 125.
panormit. × *pusill.* ex FISCHER, Bayer. Pot. 1907, 123 (nur problematisch: F.). —
panorm. × *rutilus*? ex FISCH., Beitr. etc., in Mitt. bayer. Bot. Ges. 1904, 387.
panorm. × *trichoides* ex FISCH., l. c. (*P. trinervius* FISCH.). — 104.
parmatus HAGSTR., New Pot., in Bot. Not., 1908, 97. — 152, 175.
parnassifolius SCHRAD. — 176—178.
parvifolius BUCHENAU, Rel. RUTENB. in Abh. Naturw. Ver. Brem. 1880, 32. — 131.
parvifolius FISCHER, Bayer. Pot. 1907, 46: *alpin.* BALB., f.
pauciflorus LAM., Fl. fr. III, 1778, 209 (is *P. densus* L.).
pauciflorus PURSH. — 89.
pauciflorus × *hybridus*? ex AR. BENN., in Journ. of Bot., 1900, 128.
pauciflorus SCHUR, En. pl. Transsilv., 1866, 633: *pusillus* L., var.
paucifolius FISCHER, Bemerk. Pot. in d. 2 Aufl. Syn. etc., in Mitt. bayer. Bot. Ges. 1914, 106: *Zizii* M. K., f.
paucifolius OP. — 205, 206, 211.
pectinatus L. — 14—17, 20—21, 23—25, 28, 30, 33—35, 37, 39—53, 176.
pectinat. × *vaginatus* ex FONTELL (*P. bottnicus* HAGSTR.). — 24, 52.
pelplinensis HAGSTR., l. c., 1908, 105: *prussicus* HAGSTR., f. — 148.
pennsylvanicus WILLD., ap. CH. & SCHL. in Linn., 1827, 227. — 139, 155, 190, 200, 201.
pensylv. × *heterophyllus* (*P. concilius* AR. BENN., in The Journ. Bot. 1908, 250).
perfoliatifolius TIS. — 225, 228—230.
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perfol. × *crispus* (*P. cymatodes* ASCH. & GR., Synopsis etc. I, 1897, 337). — 61.
perfol. × *nitens* (*P. fallax* ASCH. & GR., l. c., 330).
perfol. × *præl.* (*P. cognatus* ASCH. & GR., l. c., 317). — 254, 257, 258.
perfol. × *Zizii* ex GRAEBNER, Pot. in ENGLER, l. c., 1907, 139 (*P. Torssanderi* TIS.).
pergramineus ASCH. & GR., Synopsis etc. 1897, 333: *nat.* × *gramin.*, v. — 218.
perluceus FISCH., Bayer. Pot. 1907, 57: *Noltei* FISCH., f. (= »Ser. *genuinus* F. = f. *sublucens*», FISCH., l. c., 145. — Is *P. sterilis* HAGSTR. f.). — 241.
permucronatus FISCH., l. c., 122: *P. intermedius* FISCH., f.
pernatans ASCH. & GR., Synopsis mitteleur. Fl. I, 1897: 333: *nat.* × *gramin.* var. — 218.
pernatans FISCH., l. c., 57: *Noltei* FISCH., f. (= »ser. *Harzii* F. = f. *subnatans*» FISCH., l. c., 145. — Is *P. sterilis* HAGSTR., f.). — 185.
pernatans KUPFFER, ap. V. z. MÜHLEN, in Korr. Nat. Ver. Riga, 1906, 168: *gram.* × *nat.* f.
perneglectus GANDOG. — 74, 77.
perpusillus FISCH., Bayer. Pot. 1907: 122: *mucron.* × *pus.* (*P. intermed.* F.) f.
perpusillus MEIGEN, Fl. Umgeb. Wesel etc. 1886, 40 (planta dubia).
perramosus FISCH., l. c., 116: *pusillus* L., f.
peruvianus PRESL., ap. AR. BENN., Nomencl. etc., in Journ. of Bot., 1890, 298 (= *mexicanus* AR. BENN.).
perversus AR. BENN. in Philipp. Journ. Sci. 1914, 343. — 156.
petiolaris PRESL. — 183.
petiolaris RAF., Potamog. in Med. reposit. 1811, 409 (not identifiable on acc. of the incomplete descr.).
petiolatus HAGSTR. — 201.

- petiolatus* WOLFG. — 184, 189, 241.
Phialæ POST, Pl. Postianæ fasc. VI, in Bull. Herb. Boiss. I, 1893, 409. — 74.
phialensis POST, l. c. — 60.
philippinensis AR. BENN. — 57.
pinguis TIS., Pot. succ. exs. III, 1897, n. 126: *pect.* L., f. — 49.
pinnatus FISCHER, l. c., 1907, 116: *pusillus* L., f.
pinnatus WALTER, Fl. Carol. 1788, 90 (= *Myriophyll. scabratum*, ex SCHULT., Mant.).
planifolius MEYER, Chloris han. 1836, 523: *crispus* L., v. — 60.
plantagineus DU CROZ. — 155, 178.
Plantago BASTARD. — 176.
platycarpus FISCH. — 102.
platyphyllus MEYER, l. c., 520: *gramin.* L., v. (is *plathyphyllus* RCHB. = *Zizi* M. & K.). — 207.
pleiophyllus HAGSTR. — 159.
polaris HAGSTR. — 17, 19.
polygonifolius POURR. — 5, 67, 146—150, 175—180, 182, 185, 192, 193, 215, 220, 263.
polygonif. × *gramin.* (*P. Seemenii* ASCH. & GR.). — 231, 232.
polygonif. × *gramin.* ? ex ROUY: *P. variifolius* THORE ex R. — 193.
polygonif. × *heteroph.* ? ex BEEBY, ap. FRYER, Pot. Brit. Isles, 1898, 21: *polygonif.* POURR. f. *cancellata* FRYER, l. c. — 178.
polygonif. × *prælongus* (*P. Macvicarii* AR. BENN. in Ann. of Scott. Nat. Hist., 1907, 106) ex GRAEBN. Pot., in ENGLER, l. c., 1907, 139.
polygoniformis HAGSTR. — 113.
polygonus CHAM. & SCHL. — 67, 80—82, 85, 108, 112—113.
polyphyllus MOR., in COULT., Bot. Gaz. V, 1880, 51: *pusillus* L., v. — 124, 125.
polystachyus SCHULTES, Mantissa in vol. III C. a LINNÉ Syst. etc., 1827, 364: *pect.* L., v.
porcalus MUHL., Cat. pl. Amer. sept., 1813, 18 («Furrow-leaved Pondweed» MUHL. — Specimens in herb. J. E. SM., lab. »*P. porcatum* n:o 54, 1793» is said to be *P. spirillus* TUCK., ex AR. BENN. in The Journ. Bot. 1890, 297).
porrectifolius AR. BENN. ap. GRAEBNER, Pot. in ENGLER, l. c., 1907, 83: *Zizii* M. K., var.
porrigens HAGSTR. — 169, 172.
portoricensis GRAEBN. in URBAN, Symb. antill. IV, 1903, 73: *pensylvanicus* CH. et SCHL., v. — 140, 155.
prælongifolius FISCH., l. c., 46: *alpin.* BALB., f.
prælongifolius TIS. — 224—227, 230.
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præl. × *crispus* ex ASCH. & GR., Syn. mitt. Fl. I, 1897, 338.
præl. × *gramin.* ex ASCH. & GR., l. c., 330.
præl. × *heterophyllum* ? ex AR. BENN. in Journ. of Bot. 1903, 166.
præl. × *lucens* ? (*P. decipiens* NOLTE) ex ASCH., Flora Prov. Brand. etc. 1864, 662. — 243.
præl. × *polygonif.* (*P. Macvicarii* AR. BENN., in Ann. Scott. Nat. Hist. 1907, 106).
præl. × *Zizii* ex GRAEBNER, Pot. in ENGLER, l. c., 1907, 139.
Preussii AR. BENN. — 87, 108, 114, 129.
prolixus KOCH, Syn. Fl. Germ. et Helv. 1844, 775: *natans* L., v. — 192.
prolixus HAGSTR. — 254, 256.
promontoricus HAGSTR. — 175, 182—183.
protensus ASCH. & GR., Syn. etc. 1897, 314: *perfol.* L., subv.
protensus CHAM. & SCHL., in Linnæa 1827, 190: *perfol.* L., f.
protensus FISCH., l. c., 1907, 37: *natans* L. f.
protensus FISCH., l. c., 61: *Schreberi* F., f.
protensus WALLR. — 48.
Proteus CHAM. & SCHL. — 205, 210, 221, 233.
prussicus HAGSTR. (*alpinus* × *perfoliatus*). — 148.
pseudo-densus ASCH. & GR., Synopsis etc., 1897, 314: *perfol.* L., var. — 256.
pseudo-fluitans SYME, ENGL. Bot. IX, 1869, 28: *polygonif.* POURR., var. — 178.
pseudolucens HAGSTR. (*illinoens.* × *luc.*). — 199, 200.
pseudomarinus AR. BENN. in Trans. Norf. & Norw. Nat. Hist. Soc., 1882, 381: *pectin.* L., v.
pseudo-nitens AR. BENN. in Journ. of Bot. 1881, 344: *heterophyllum* SCHREB., v. — 207, 231.
pseudopolygonus HAGSTR. — 81.
pseudo-rutilus AR. BENN., in l. c., 1901, 4: *pus.* L., v.
pseudo-Zizii HAGSTR. (*P. gram.* × *illin.* × *lucens.*). — 200, 210.
psilostachyus GUSSONE, Fl. sic. Synopsis II, 1845, 790: *luc.* L., var.
pulchellus TIS. — 244, 245.
pulcher TUCKERM. — 10, 151, 153, 158.
pulcherrimus HAGSTR. — 214.
pumilus NUTTALL, ap. AR. BENN., Bem. etc. in Ann. Naturh. Hofm. Wien. 1892, 292 (= *Robbinsii* OAKES, ex BENN., l. c.).
pumilus WOLFG. — 139.
purpurascens SEIDL, in PRESL, Fl. Cech. 1819, 37. — 141, 142.
Purshii TUCK., Observ. in Am. Journ. Sci. and Arts, 1848, 228. — 196.
pusilliformis HAGSTR. (*mucronatus* × *pus.*). — 97—98.
pusilloides HAGSTR. — 112, 115.
pusillus L. — 9, 13, 63, 64, 72, 75, 76, 88, 90, 91, 93, 94, 97—104, 107, 115, 117, 118, 120—129, 134, 149, 150, 195, 259, 262, 263.
pusillus × *trich.* (*P. franconicus* FISCH.). — 104, 126.
pusillus × *Vaseyi* (*P. lateralis* MOR.) ex HAGSTR. — 126, 127.
puyensis HAGSTR., New Pot. in Bot. Not. 1908, 107: *argutulus* HAGSTR., f.
pycnostegus KIHLM. ap. HAGSTR. Cfr. TIS., l. c., III, 1897, notulæ 115—116. — 16, 18.
pygmaeoides HAGSTR. — 192.
pygmaeus GAUDIN, Fl. helv. I, 1828, 467: *natans* L., v. — 192.
pygmaeus HAGSTR. — 124.

- quinquenervius** HAGSTR. — 130—132.
ramosissimus FIEB., Pot. Böhm., 1838, 40: *Bercholdi* FIEB., f. — 124.
ramosissimus MERT. & K., ap. FIEB., l. c., 43: *pectin.* L., var.
ramosus FISCH., Bayer. Pot. etc., 1907, 105: *rutilus* WOLFG., f.
ramosus FISCH., l. c., 109: *panormit.* BIV. f. — 102.
ramosus FISCH., l. c., 116: *pusillus* L., f.
ramulosus HAGSTR. — 51.
Raunkiaeri FISCH. — 185, 238.
rectifolius AR. BENN. in Journ. of Bot. 1902, 147: *americ.* × *alpinus*; *nodosus* × *Richardsonii*, ex HAGSTR. — 147.
recurvatus HAGSTR. — 28, 35, 37—39.
reduncus HAGSTR. — 169, 172, 173.
reflexus AR. BENN., Bem., in Ann. Naturh. Hofm. Wien, 1892, 291 (is *zosterif.* SCHUM. ex BENN., l. c.).
Reichenbachii LÖHR, ap. BEURLING, Syn., in Nya Bot. Not., 1853, 90 (= *pusillus* L. ex BEURL., l. c.).
repens HAGSTR. — 169—171.
reptans HUMMICKI, Cat. pl. Luxeuil. 1876, 61 (nom. so- lum; *pusillus* L. β, ex ROUY, Fl. Fr. 320).
restrictus HAGSTR. — 224.
retifolius FISCH., l. c., 1907, 115: *pusillus* L., f. — 124.
retusus SMITH, ex AR. BENN., in Journ. of Bot., 1887, 372 (= *alpin.* BALB., ex BENN., l. c.).
Richardii SOLMS-LAUBACH. — 195, 196.
Richardsonii AR. BENN., in Journ. of Bot., 1889, 25: *perfol.* L., v.
Richardsonii RYDBERG. — 148, 252—254, 259.
Richtseldii FISCH., Bayer. Pot. etc. 1907, 43: *gessna- censis* FISCH., var. — 192.
rigidus AR. BENN., in Scott. Naturalist, 1883, 25: *pusillus* L., v. — 124.
rigidus FISCH., l. c., 115: *pusillus* L., f. — 124.
rigidus OPIZ, ap. FIEB., l. c., 1838, 13: *densus* L., α.
rigidus WOLFG., ap. SCHULTES, Mantissa etc., 1827, 359. (pl. dubia. *P. gramin.* ? *nodosus* ?).
riparius FISCH., l. c., 1907, 37: *natans* L., var.
riparius FISCH., Bem. Pot. in d. 2 Aufl. Syn. etc. in Mitt. Bayer. Bot. Ges., 1914, 106: *Zizii* M. K., f.
riparius FR., Nov. Fl. Suec., 1828, 38: *gramineus* L., f. — 206.
ripensis BGE (*trich.* × *zosterif.*). — 77.
rivicolus HAGSTR. — 18, 23.
rivularis FRIES, l. c., 30: *rufescens* SCHRAD., f.
rivularis GILLOT in MAGNIN, Scrib. VI, 1887, 118, et in Bull. Soc. Dauph., 1887, 584. — 149, 150.
rivularis HARTM., Handb. i Skand. Fl., 1820, 79: *rufe- scens* SCHR., v. — 143.
rivularis LANGE, Haandb. Dansk Fl., 1864, 129: *fluit.* RTH, var. — 219, 240.
rivularis MERT. & K. ap. RÖHLING, l. c., 1823, 841: *rufescens* SCHR., var.
rivularis THORE, Essai d'une Chloris etc., 1803, 46: *lucens* L., v. — 235.
Robbinsii OAKES. — 5, 7, 11, 13, 54—56, 59, 67, 80, 140, 152, 196, 261, 262.
robustior TIS., ap. HAGSTR. — 227—231.
rostratus HAGSTR. — 27, 28.
rosulatus HAGSTR. — 199.
Rothii AR. BENN. ex FISCH., Beitr. etc., in Mitt. bayer. Bot. Ges., 1904, 362: *lucens* × *natans*; later on: *fluitans* RTH, proles (= *P. nodosus* POIR.) in Bem. etc. 1914, 103. — 184, 238.
rotundatus HAGSTR. — 153, 154, 161.
rotundifolius ASCH. & GR., Synopsis 1897, 310: *coloratus* VAHL., v.
rotundifolius BRÉBISSE, Fl. Norm., 1859, 285: *natans* L., f. — 192.
rotundifolius FISCH., Bayer. Pot. 1907, 40: *polygonif.* POURR. f. — 178.
rotundifolius FISCH., l. c., 85: *crispus* L., v. (»mit breit stumpflichen Blättern»: GRAEBNER).
rotundifolius MERT. & K., ap. RÖHLING, l. c., 843: *plan- tagin.* DU CROZ, v. — 179.
rotundifolius SCHULTZ. — 210.
rotundifolius WALLR., Sched. crit., 1822, 67: *perfol.* L., v. — 255, 256, 258.
Roxburghianus SCHULTES. — 184, 188.
rubrinævus GANDOG. — 58.
rubricans GANDOG. — 58.
rufescens SCHRAD. — 141, 148, 200.
rufescens-natans SCHULTZ, in Jahresber. Pollichia, 1861, 119. (Is *P. spahulatus* SCHR.) — 148.
rufescens × *Nuttalli* ex AR. BENN. — 200.
rufulus ROUY, Fl. Fr. T. XIII: 307: *coloratus* VAHL., subv.
Rugelii AR. BENN. (*americanus* × *lucens*). — 242.
rutiliformis FISCH., Bayer. Pot. 1907, 109: *panormit.* BIV., f. — 102.
rutilis WOLFG. — 75, 92—94, 114, 122.
rut. × *mucronatus* ? ex FISCH., Beitr. etc. in Mitt. bayer. Bot. Ges. 1904, 387.
rut. × *trichoides* ? ex FISCH., l. c., 384.
rut. × *Vasyei* (*P. gemmiparus* (ROBB.) MOR.) ex HAGSTR. — 94.
salicifolius FR., l. c., 1828, 34: *nitens* WEB., α.
salicifolius WOLFG., ap. SCHULT., Mant. etc., 1827, 355 (*lucens* × *alpinus* ex BENN. 1908; *gramin.* × *perfol.* ex HAGSTR.). — 208, 221, 224, 225, 230, 243, 244, 256, 252.
salignus FRYER (*gramineus* × *perfol.* ex HAGSTR.). — 221.
salinus SCHUR, Phyt. Fragm. in Österr. Bot. Zschr. 1870, 280. (= *fasciculatus* WOLFG., ex SCHUR). — 14.
salinus VOCH, ex AR. BENN., in Journ. of Bot., 1907, 174: *pectinatus* L., v. (= *pseudomarinus* AR. BENN. ex BENN., l. c.).
samariformis HAGSTR. — 166.
saxonicus HAGSTR. (*obtusif.* × *pusillus*). — 118.
Schedlei PREUSS, ex GRAEBN., Pot. in ENGLER, l. c., 1907, 67 (= *polygonif.* POURR. v. *sphagnophilus* NEUM., ex GR., l. c.).
Schreberi FISCH., Bayer. Pot. etc. 1907, 28, 58—62: *fluitans* × *natans*. — 239.
Schweinfurthii AR. BENN., Najad., in THISELTON-DYER, Fl. trop. Afr. VIII, 2, 1901, 220. — 198, 203.
sclerocarpus SCHUMANN. — 169—170, 172.
scoliophyllus HAGSTR. (*amplifol.* × *illinoensis*). — 164.
scoparius WALLR. — 48, 51.

- scoticus* HAGSTR. — 62.
- Seemenii* ASCH. & GR., Synopsis etc., 1897, 335: *polygonif.* × *gramineus*. — 207, 231, 232.
- selenocarpus* FISCH., l. c., 1907, 97: *compressus* L., f. — 66.
- semicoloratus* AR. BENN. — 175, 181.
- semifructus* AR. BENN. — 96.
- semipellucidus* KOCH. — 141.
- semipunctus* AR. BENN., see *semifructus* AR. BENN.
- septentrionalis* TIS., l. c., I, 1894, n. 30—32: *gramin.* L., v. — 11, 206, 207, 208, 209, 227, 230, 236.
- serotinus* SCHRAD., ap. KOCH, Synopsis, 1844, 775 (= *natans* L., v. *prolixus* KOCH, ex KOCH, l. c.). — 191.
- serratus* HAGSTR. — 62.
- serratus* L., Sp. pl., 1753, 126 («simply a curious form of *P. crispus* L.»: AR. BENN. in Journ. of Bot. 1889, 243. — This name is differently conceived: SCOPOLI, Fl. car. I, 1772, 117 = *prolongus* WULF.; HUDSON, Fl. angl. I, 1778, 75 = *crispus* L.; WEB., Prim. fl. hols., 1780, 16 = *lucens* L.; ROTH, Beiträge II, 1783, 126: *alpinus* BALB.; NOLTE in HANSEN Herb. n. 1114 = *Zizii* M. K.; M. & K., in RÖHLING, 1823, 860 = *densus* L. v. *lanceifolius* M. K. — The English view, supported by LINNÉ's herbarium and also embraced by the Dutchman L. VUYCK, Revisie etc., 1895, is no doubt correct. — 58.
- serrulatus* FISCH., Bem. etc. in Mitt. Bayer. Bot. Ges., 1914, 107: *gramineus* L., f. «submersae Blätter dreinervige, hellgrün und deutlicher gezähnelte». May be reckoned to the plantæ dubiæ.
- serrulatus* HAGSTR. — 62.
- serrulatus* REG. & MAACK. — 56, 57.
- serrulatus* SCHRADER, ex. OP., in Flora V, 1822, 267 (= *crispus* L. var. *serrulatus* SCHR. ex REICHB., Icones etc., VIII, 1845, 18, t. XXX, f. 52). — 58, 60.
- sessilifolius* HAGSTR. — 167.
- sessilis* HAGSTR. — 201.
- setaceus* GILIBERT, ex SCHULT., Mantissa etc., 1827, 355 (= *divaricatus* WOLFG., ex SCHULT., l. c.).
- setaceus* L., — 260.
- setaceus* MEYER, Chloris han., 1836, 527: *pectinatus* L. var.
- setaceus* MAZZIARI, Fl. corcirese etc., I, 1834—35, 956 (pl. dubia).
- setaceus* PURSH, Fl. Am. sept. I, 1814, 120 (= *hybridus* MCHX, ex TUCK., Am. Journ. 1848, 230. = *dimorphus* RAF. ex RAF. in Am. month. mag. etc., 1817, 358).
- setaceus* SCHUMACHER, Enum. pl. Sæll., 1801—03, n. 170 (= *filiformis* PERS. ex NOLTE). — 14.
- sibiricus* AR. BENN., Nomenclat. etc., in Journ. of Bot., 1890, 300. — 83, 85.
- siculus* TINEO. — 179.
- similis* AR. BENN., in Journ. of Bot., 1902, 146. — 165, 175.
- simplex* FIEB., l. c., 1838, 40: *Berchtoldi* FIEB. f. — 124.
- simplex* TIS., Pot. suec. exs., III, 1897, n. 145. — 254.
- simplicissimus* TIS. — 93.
- sinuatus* FRIES, l. c., 1828, 43: *crispus* L., v. — 60.
- sinuensis* TIS., l. c., I, 1894, n. 21: *gramin.* L., f.
- sparganifolius* LÆST. — 192, 217—220, 239, 240, 254.
- spathaceus* FISCH., Bayer. Pot. etc. 1907, 116: *pusillus* L. f. — 124.
- spatheformis* TUCK., ex ROBB., in ASA GRAY, Man. etc. 1867, 487 (is considered to be a misprint for: *spathulæformis*: Journ. of Bot. 1900, 129). — 209.
- spathulæformis* ROBBINS, l. c.: *gramin.* L. v? — 210, 230.
- spathulatus* MARSSON, Fl. Neu-Vorpomm. etc., 1869, 490: *alpinus* BALB. var. (= *rivularis* HARTM.)
- spathulatus* SCHRAD. — 148, 220.
- spathulifolius* FISCH., l. c., 1907, 43: *gessnacenensis* FISCH., f.
- spathulifolius* FISCH., l. c., 45: *alpinus* BALB., f.
- spathulifolius* FISCH., l. c., 54: *fluit.* RTH., f. — 188.
- speciosus* TIS. — 226.
- sphærocarpus* SCHUMANN in Fl. brasil., III, 3, 1894, 692: *pusill.* L. v. — 111.
- sphagnophilus* NEUM., in Bot. Not., 1896, 91: *polygonif.* POURR. v. — 177.
- spicatus* ENGELMANN ex ROBB. in ASA GRAY, Man. etc. 1867, 486: *diversifolius* BART. var. (ROBB. follows TUCK., acc. to whom *P. div.* BARTON = *hybridus* MICHX, i. e. *P. capillaceus* POIR.). — 139.
- spicosus* HAGSTR. (*francoicus* FISCH. ser.). — 126.
- spicosus* HAGSTR. (*nitens* WEB. f.). — 227, 230.
- spirilliformis* HAGSTR. — 135, 137, 138, 262.
- spirillus* TUCK. — 136.
- spissus* TIS. — 48.
- splendens* FISCH., Bem. in Mitt. bayer. Bot. Ges., 1914, 106: *Zizii* M. K., f.
- splendidissimus* SCHULTZ Herb. Norm. 1890, n. 2693: *Zizii* M. K., var.
- splendidissimus* TIS., l. c., II, 1895, n. 65: *lucens* L. var. — 214.
- spoliatus* HAGSTR. — 162, 168.
- squarrosus* ASCH. & GR., Synopsis, 1897, 345: *pusillus* L. var. — 124.
- squarrosus* FISCH. — 102.
- stagnalis* FISCH., l. c., 68: *Zizii* M. & K., var.
- stagnalis* FR., l. c., 1828, 37: *gram.* L., f. — 206.
- stagnalis* NEUM., Några krit. ell. sälls. växter etc. 1888, 25: *marinus* L., f.
- stagnatilis* KOCH, Synopsis etc., 1844, 776: *fluit.* RTH., v.
- stagninus* SCHLECHT., Fl. berolin. I, 1823, 118: *pectin.* L., var.
- stagnorum* HAGSTR. — 159, 160.
- stenobasis* HAGSTR. — 224, 228, 230.
- stenocarpus* FISCH. — 102.
- stenophyllus* MEYER, Chlor. han. 1836, 520: *gramineus* L. v.
- stenostachys* SCHUM. in Fl. brasil., III, 2, 1894, 687, t. 119. — 152, 161, 162, 168.
- sterilis* HAGSTR., (*lucens* × *natans*). — 238—241.
- stipularis* ROUY, Fl. Fr., T. XIII, 315: *præl.* WULF., v. ζ.
- stipulatus* ARCANGELI, Comp. Fl. It., 1882, 643: *densus* L., v. — 261.
- striatus* RUIZ & PAV. — 39—40, 42, 44, 51, 53.
- strictifolius* AR. BENN. — 92.
- strictior* HAGSTR. — 74.
- strictus* PHIL. — 16, 26.
- Sturrockii* AR. BENN. — 117, 118, 124.
- stylatus* HAGSTR. — 141, 143, 151.
- subaquabilis* HAGSTR. — 46.
- subcompletus* HAGSTR. — 127.

- subcoriaceus* LÆST., ex HAGSTR. — 219.
subcrispus FISCH. Beitr. in Mitt. bayer. Bot. Ges. 1904, 366: *cymbif.* FISCH., f. — 62.
subcuspidatus HAGSTR. — 232.
subdentatus HAGSTR. (*illinoensis* × *perfoliatus*). — 201.
subdrupaceus FISCH. — 48.
subflavus LORET & BARR. — 179.
subgramineus RAUNKJÆR, Danske Blomst. I, 1896, 100: *nitens* WEB. f. — 223—224, 226.
subintermedius HAGSTR. — 223, 226, 227, 228, 232.
subjavanicus HAGSTR. — 128—131.
sublaevis FISCHER in BAUM., Veget. Untersees, 1911, 101: *Zizii* × *gramin.*, var.
sublatifolius HAGSTR. — 49.
sublucens BGE. — 238, 240, 242.
sublucens FISCH., Bayer. Pot., 1907, 145: *Noltei* FISCH., f. — 241.
submarinus FR. — 47.
subnatans FISCH., l. c., 145: *Noltei* FISCH., f.
subnatans ROEM. & SCH., Syst. veg. etc., 1818, 507: *lanceolatus* SM., var. (Probably = *alpin.* BALB.)
subnitens HAGSTR. — 259.
suboblongus HAGSTR. — 175, 182.
subobtusus HAGSTR. (*alpin.* × *nodosus*). — 147.
subovalis HAGSTR. — 224, 228, 229.
subperfoliatus FISCH., Breitr. in Mitt. bayer. Bot. Ges. 1904, 366: *cymbifol.* FISCH., f. — 62.
subperfoliatus FISCH., Bayer. Pot. etc., 1907, 149: *decip.* NTE, f. (= ser. *Vollmanni* F.) ex FISCH., l. c.).
subperfoliatus RAUNK., l. c., 1896, 100: *nitens* WEB. f. — 223—226.
subpraelongus BGE ap. HAGSTR. — 258.
subretusus HAGSTR. — 30—32, 37.
subrufus HAGSTR., (*lucens* × *nodosus*). — 239, 240, 241.
subsessilis HAGSTR. (*nodosus* × *Nuttallii*). — 190.
subsibiricus HAGSTR. — 84, 122, 128.
subsimilis TIS. — 226, 227, 228.
subspathaceus ASCH. & GR., Syn. mitt. Fl., I, 1897, 310: *coloratus* VAHL, *lucens* (= »*plantagineus* DU CROZ β ? *pachystachyus subspathaceus*» REICHENB., Ic., 1845, t. XLVI).
subspatulatus VUYCK, Revisie gesl. Pot., in Ned. Kruidk. Arch., 1895, 649: *plantagin.* DU CROZ, var. (Probably a misprint for *subspathaceus* = the prec.)
substagnalis FISCH., in BAUM., l. c., 1911, 101: *Zizii* × *gramin.*, var.
subtilis TIS. — 225, 230.
subtrichoides SCHUR., Enumeratio pl. transsilv., 1866, 633. (= *pauciflorus* SCHUR.).
subverticillatus KIT., in AR. BENN., Nomenclat. in Journ. of Bot. 1890, 299 (= *interruptus* KIT., ex BENN.).
subviridis TIS., l. c., II, 1895, n. 61: *lucens* L., var. δ.
sudermanicus HAGSTR. (*acutifol.* × *pusill.*). — 73.
suecicus HAGSTR. — 148.
suecicus RICHT. (*jilif.* × *pectin.*) — 17, 20, 24—27.
sulcatus AR. BENN., Bem. etc., in Ann. Naturh. Hofm. Wien, 1892, 294. — 166.
sumatranus MIQU., Flora Ind. Bat. Suppl. I, Prodr. Fl. Sum., 1860, 259, 597. — 156, 198.
syriacus CHAM. & SCHL. — 184.
tasmanicus HAGSTR. — 174, 175.
tataricus LESSING. — 115.
tenuicaulis MÜLL. — 131.
tenuifolius FISCH., Bayer. Pot. etc. 1907, 116: *pusillus* L., f.
tenuifolius KUNTH. — 39.
tenuifolius PHIL., in Anal. Mus. nac. Chile, 1891, App. 95 (= *Aschersonii* AR. BENN., ex BENN., in Journ. of Bot., 1893, 294). — 111.
tenuifolius RAF., Enumer. of Am. Pot. in Med. Rep. N. Y., 1811, 409. (Might be *gramin.* L. — ff. without floating leaves — and *Zizii* M. & K.)
tenuifolius SCHULT., Mant. etc. 1827, 364: *pectin.* L., var.
tenuifolius SCHUMANN in Fl. brasil., III, 3, 1894, 692: *pusil.* L., var. (= *tenuifol.* PHIL.).
tenuior MIQUEL, Ill. Fl. Arch. Ind., 1871, 47: *malaianus* MIQU., v.
tenuior TIS., l. c., III, 1897, n. 107—108: *vag.* TURCZ., f. — 35.
tenuis HAGSTR. — 91.
tenuis MEYER, Fl. han. exc. 1849, 537: *pectin.* L., v.
tenuis WAHLENB., Fl. ups. 1820, 60: *compressus* L., var. (is *P. mucron.* SCHR.). — 94.
tenuissimus LÖHR, ex BEURL., l. c., in Nya Bot. Not., 1853, 90 (= *tenuissimus* M. & K., ex B.).
tenuissimus MERT. & K., ap. RÜHLING, l. c., 1823, 857: *pus.* L., v. — 98—99, 122, 124, 125.
Tepperi AR. BENN. — 154.
tereticaulis LÆST., ex HAGSTR. — 219.
terrestris COSS. & GERM., Fl. env. Paris, 1845, 569: *oblongus* Viv. subv.
terrestris FISCH., Bayer. Pot. 1907, 68: *Zizii* M. K., f.
terrestris FR., Nov. fl. succ. 1828, 38: *gramin.* L., f. — 206, 209.
terrestris FR., l. c., 35: *nitens* WEB., f. — 224.
terrestris GLÜCK, Biol. u. morph. Unters. etc. II, 1906, 234: *fluitans* ROTH, f. — 188.
terrestris GRAY, Natur. Arr. Brit. Pl., 1821, 33: *natans* L., v. — 192.
terrestris MEYER, Fl. han. excurs., 1849, 535: *perfol.* L., v.
terrestris SCHLECHT., Fl. berolin. I, 1823, 116: *heterophyll.* SCHREB., v.
terrestris TIS., Pot. succ. exs. I, 1894, n. 8: *plantag.* DU CROZ, f. — 179.
terrestris TIS., l. c., n. 26, 27: *gramin.* L. f. (= *gram.* f. terr. FR.).
terrestris TIS., l. c., n. 44, 142, 143: *nitens* WEB.?, f. (= *nitens* f. terr. FR.).
terrestris TIS., l. c., II, 1895, n. 66, 67: *lucens* L. f. (= *Zizii* M. K., v. *coriaceus* M. K.). — 214.
terrestris TIS., l. c., n. 76: *decip.* NTE, γ *Torssandri* TIS. f. *Thomasii* AR. BENN., Bem. etc. in Ann. Naturh. Hofm. Wien, 1892, 288 (= *alpinus* BALB., ex BENN., l. c.).
Thunbergii CHAM. & SCHL., in Linnæa, 1827, 221. — 152.
tibetanus HAGSTR. — 19.
Tiselii GRAEBN., Pot. in ENGL., l. c., 1907, 82: *Zizii* M. K., subv. — 214.
Tiselii RICHTER, Pl. Eur. I, 1890, 13 (*gram.* × *nat.*). — 217—220.

- Torssandri* TIS., l. c., II, 1895, n. 75, 76: *decip.* NTE, var. — 216, 263.
- transiens* TIS. — 244.
- tretocarpus* MAXIM. — 248.
- tricarínatus* MÜLL. & BENN. — 166, 167, 168.
- trichoides* CHAM. & SCHL. (ranked by KUNTH, En. pl. 1841, 137, under *pus.* L. as a var.; *trich.* ex GRAY, Man. 1848, et TUCK. in Amer. Journ. Sci. 1849, 358 = *conferv.* REICHB.). — 6, 68, 74—78, 87, 104, 117—119, 126, 150, 193—195.
- trich.* × *zosterifol.* (*P. ripensis* BGE). — 77.
- trichophyllus* HAGSTR. — 46.
- trichophyllus* MOR., Revis. N. Amer. Naj. 1893, 49: *diversifol.* RAF., v. — 139.
- tricostatus* WALLR. in GRAEBNER, Pot., in ENGL., l. c., 1907, 51 (= *dimorphus* RAF., ex GR., l. c.).
- Trimmeri* CASP., in The Journ. Linn. Soc. 1865, 273: *trich.* CH. & SCHL. var. — 76.
- trinervius* FISCH., Bayer. Pot. etc., 1907, 29, 123: (*panorm.* × *trich.*).
- tuberculatus* TENORE, ap. GUSS. in Ad. Fl. neap. syll. app. V, 1842, 4 (ranked by SONDER, Fl. hamb. 1851, 101, under *trich.* CH. & SCHL. = *tuberculatus* GUÉPIN, Fl. Maine et Loire, Supp. 2). — 74.
- tuberculosus* HÜBNER, in Flora, 1846, 16: *pectin.* L., var. *tuberculosus* REICH., Ic. fl. Germ. & Helv. etc. VII, 1845, 13, t. XXII, f. 35: *trich.* CH. & SCHL. v. — 77.
- tuberosus* ROXB., Hort. Beng. 1814, 12, et Fl. Ind., ed. WALLICH, I, 472. (*P. crispus* affinis videtur species, an diversa? CH. & SCHL. in Linnæa 1827). — 58.
- Tuckermanni* ROBB. — 85.
- turionifer* HAGSTR. (*foliosus* × *pusillus*). — 91.
- typicus* ASCH. & GR., Synopsis etc., I, 1897, 314: *perfol.* L., v. — 255.
- typicus* BGE ap. ASCH. & GR., l. c., 307: *fluitans* RTH, v. — 238.
- typicus* FISCH., Bayer. Pot. etc., 1907, 46: *alpinus* BALB., f.
- typicus* FISCH., l. c., 115: *pusillus* L., f.
- typicus* FISCH., l. c., 37: *natans* L., f.
- typicus* HAGSTR.: *undulatus* WOLFG., f. — 63.
- typicus* HAGSTR.: *sparganif.* LÆST., f. — 218.
- typicus* TIS., Art-typer etc., in Bot. Not., 1884, 19: *decipiens* NTE, f. — 243, 244.
- typicus* TIS. Pot. succ. exs. I, 1894, n. 6: *fluitans* RTH, f.
- typicus* TIS., l. c., n. 7: *plantagineus* DU CROZ, f.
- typicus* TIS., l. c., n. 20: *gramineus* L., f.
- typicus* TIS., l. c., n. 34: *nitens* WEB.? f. — 226, 231.
- typicus* TIS., l. c., II, 1895, n. 87—88: *prælongus* WULF., f.
- typicus* TIS., l. c., n. 89: *perfoliatus* L., f. — 255.
- typicus* TIS., l. c., n. 93, 94: *crispus* L., f. — 59.
- typicus* TIS., l. c., n. 95, 96: *zosterifolius* SCHUM., f.
- typicus* VUČEK, Revisie etc. in Nederl. Kruidk. Arch., 1895, 693: *pectin.* L., f.
- Ulei* SCHUMANN. — 67, 81, 82.
- uliginosus* BOENNINGH. ex CH. & SCHL., in Linnæa, 1827, 216. (= *oblongus* VIV. fide CH. et SCHL. — Specimens gathered by V. BOENN. 8, 1820 = *polygonifolius* POURR.). — 176.
- ulvensis* HAGSTR. — 49.
- undulatus* FISCH., l. c., 1907, 46: *alpinus* BALB., f.
- undulatus* WOLFG. — 61, 62, 144, 257.
- ungulatus* HAGSTR. — 44—46.
- upsaliensis* TIS., Art-typer etc., in Bot. Not., 1884, 15—20. — 243—245.
- uruguayensis* AR. BENN. et GR., in ENGLER, l. c., 1907, 111. — 263.
- vadosus* TIS. — 227, 229.
- vaginalis* J. FISCHER. — 40.
- vaginans* BOJER, ap. AR. BENN., in l'Ann. Conserv. etc. Genève, 1905, 94: *lucens* L. subsp. — (distinct species, ex HAGSTR.). — 198, 237.
- vaginatus* TURCZ. — 7, 8, 9, 14, 15, 22, 24, 32—37, 51, 52, 76.
- vag.* × *filif.* ex FONTELL. — 24.
- vag.* × *pectin.* ex FONTELL. — 52.
- Vaillantii* ROEM. & SCHULT. — 39, 49.
- validior* TIS., l. c., III, 1893, n. 109, 110: *vagin.* TURCZ., f.
- validus* FIEB., Pot. Böhm. 1838, 26. — 213.
- varians* MOR. — 205, 206, 208, 209.
- variifolius* THORE. — 150, 193—195.
- Varmingii* BGE, ex HAGSTR. — 258.
- Vaseyi* ROBB. — 94, 126, 127, 133, 134.
- venustus* BGE (*alpinus* × *crispus*). — 77, 144.
- verrutus* FRYER, Pot. Brit. Isles, 1898, 9: *crassifol.* FRYER, f. — 216.
- verticillatus* KIT. ex CHAM. & SCHL. in Linnæa, 1827, 166. (= *interruptus* KIT.).
- virescens* CASPARY, in Phys. Oek. Ges. XXIV, III, 1883, 70 ex ASCH. & GR., Syn. 1897, 312: *rufescens* SCHR., f.
- viridicans* FISCH., l. c., 1907, 45: *alpinus* BALB., f.
- viridis* TIS., l. c., I, 1894, n. 14: *alpinus* BALB., f.
- volhynicus* BESSER, ex ROEM. et SCHULT., Syst. veg. III, 1818, 509 (= *lucens* L., f. *acuminatus* (SCHUM.) FR.). — 233.
- Vollmanni* FISCH., l. c., 1907, 149: *decipiens* NTE, ser.
- vulgaris* CHAM. & SCHL., l. c., 1827, 165: *pect.* L., var.
- vulgaris* CHAM., Adnot. etc. 1815, 6: *lucens* L., α. — 235.
- vulgaris* FIEB., Pot. Böhm. 1838, 32: *crispus* L., f. — 60.
- vulgaris* FIEB., l. c., 26: *purpurascens* SEIDL., var.
- vulgaris* FISCH., Bayer. Pot. 1907, 43: *gessnacensis* FISCH., f.
- vulgaris* FISCH., l. c., 44: *coloratus* VAHL., var.
- vulgaris* FISCH., l. c., 85: *crispus* L., v. — 60.
- vulgaris* FISCH., l. c., 102: *obtusifol.* M. & K., v. — 117.
- vulgaris* FISCH., l. c., 109: *panormitanus* BIV. var. — 102.
- vulgaris* FRIES, Nov. fl. Suec. 1828, 48: *pusillus* L., var. — 124, 125.
- vulgaris* KOCH u. ZIZ, Cat. pl. Palat., 1814, 18: *natans* L., v. — 192.
- vulgaris* SPENNER, Fl. friburg. I, 1825, 32: *perfol.* L., α. — 255.
- vulgaris* TIS., l. c., III, 1897, n. 111—112: *filif.* PERS., f. — 16—18.
- Wahlenbergii* HAGSTR. — 22.
- Wolfgangii* KIHLMAN, in SELAN, KIHLM. et HJELT, Herb. Mus. Fenn. I, 1889, 28 (= *gracilis* WOLFG. ex KIHLM. in Bot. Not. 1887, 84). — 11, 145, 205, 206, 208, 209, 227.
- Wrightii* MOR. — 248.
- ysanensis* HAGSTR. — 21, 22.

Zetterstedtii WALLM. — 136.
Zizii M. & K. — 11, 164, 181, 198, 199, 204, 207, 209—
 216, 217, 224, 234, 235, 236, 241, 254.
Zizii × *gramin.* ex ASCH. & GR., Synopsis etc. I, 1897,
 327.
Zizii × *heterophyllus* ex FRYER, supposed hybr. etc. in
 The Journ. Bot., 1890, 174. — 209.
Zizii × *natans* (*P. crassifol.* FRYER). — 241.
Zizii × *perfoliatus* ex FRYER, l. c., 1890, 174.
Ziziiformis HAGSTR. — 198, 203, 204.

zosteraceus FR., l. c., 1828, 51. — 22, 39, 40, 42, 43, 49—51.
zosteroides FISCH., l. c., 1907, 125: *pectinatus* L., f. — 49.
zosterifolius SCHUMACHER. — 54, 55, 65—70, 72—75,
 78, 80.
zosterif. × *acutifolius* ex FISCH. — 73.
zosterif. × *trichoides*, ex FISCH., Bayer. Pot. etc., 1907,
 121.
zosterophyllus DUM., Fl. belg., 1827, 164 (= *zosterifolius*
 SCHUM., ex DUM., l. c.). — 65.

Errata.

P. 9, l. 18 fr. below: tops-pike, to be read: top-spike.
 » 10, » 17 and 21 fr. above: Developement t. b. r. Development.
 » 12, » 8 fr. a.: parallell, t. b. r. parallel.
 » 13, » 6 fr. b.: badeo, t. b. r. badio. So also pp. 21, 22,
 27, 30, 31, 38.
 » 17, » 20 fr. a.: shallow, t. b. r. shallow.
 » 18, » 20 fr. b.: an, t. b. r. and.
 » 19, » 8 fr. a.: juncifolius, t. b. r. juncifolius.
 » 19, » 16 fr. a.: Fig. 4, t. b. r. Fig. 3.
 » 22, » 4 fr. b.: Bennet, t. b. r. Bennett. So also pp. 33,
 56, 103.
 » 24, » 6 fr. a.: differed, t. b. r. different.
 » 24, » 9 fr. a.: makes, t. b. r. make.
 » 26, » 1 fr. b.: thanin, t. b. r. than in.
 » 27, » 3 fr. a.: fig. 2, t. b. r. fig. 4.
 » 30, » 2 fr. a.: convexe, t. b. r. convex.
 » 32, » 6 fr. b.: Potamogon, t. b. r. Potamogeton.
 » 40, » 1 fr. a.: 476, t. b. r. 472.
 » 58, » 3 fr. a.: 1902, t. b. r. 1802.
 » 73, » 4 fr. a.: Pedunculus, t. b. r. Pedunculus.
 » 73, » 7 fr. b.: 21, t. b. r. 121.
 » 74, » 11 fr. b.: a like, t. b. r. alike.
 » 81, » 7 fr. a.: narrow, t. b. r. narrows.
 » 101, » 8 fr. a.: In fresh, specimens, t. b. r. In fresh specimens.
 » 103, » 7 fr. a.: rutiformis, t. b. r. rutiliformis.
 » 103, » 16 fr. a.: Lojacona, t. b. r. Lojacono.
 » 111, » 15 fr. a.: 687, t. b. r. 692.
 » 111, » 15 fr. a.: *O. Berteroanus*, t. b. r. *P. Berteroanus*.
 » 111, » 3 fr. b.: later alnerves, t. b. r. lateral nerves.
 » 120, » 12 fr. a.: brevissi, mostigmate, t. b. r. brevissimo,
 stigmat

P. 121, l. 19 fr. a.: *Griesebachii* t. b. r. *Grisebachii*.
 » 124, » 11 fr. a.: *mucronatus*, t. b. r. *mucronulatus*.
 » 126, » 3 fr. a.: preceeding, t. b. r. preceding.
 » 131, » 7 fr. b.: parviflorus, t. b. r. parvifolius.
 » 135, Fig. 60, l. 3 fr. b.: *dimorpha*, t. b. r. *dimorphus*.
 » 136, l. 6 fr. a.: 5-nervia, t. b. r. 5—11-nervia.
 » 138, » 7 fr. a.: pedunculus, t. b. r. pedunculus.
 » 141, » 8 fr. a.: brevipetiolata, t. b. r. breviter petiolata.
 » 142, » 2 fr. b.: Seidel, t. b. r. Seidl.
 » 133, » 14 fr. b.: Voronisk, t. b. r. Voroninsk.
 » 147, » 21 fr. a.: consists, t. b. r. consist.
 » 151, » 4 fr. b.: *linguatus*, t. b. r. *linguatus*, *apicalis*, *ferru-*
gineus.
 » 154, » 7 fr. a.: to, t. b. r. too.
 » 155, » 13 fr. b.: *Nuttallii* t. b. r. *Nuttallii*.
 » 160, » 15 fr. b.: top most, t. b. r. topmost.
 » 161, » 4 fr. b.: -nervia, t. b. r. -nerviæ.
 » 170, » 4 fr. a.: *Nuttallii* t. b. r. *Nuttallii*.
 » 176, » 3 fr. a.: Boemünghausen, t. b. r. Boenninghausen.
 » 176, » 9 fr. a.: Wahberg, t. b. r. Wahlberg.
 » 188, » 20 fr. a.: occur, t. b. r. occurs.
 » 192, » 11 fr. a.: *pymæus*, t. b. r. *pygmæus*.
 » 216, » 8 fr. b.: *decipieus*, t. b. r. *decipiens*.
 » 235, » 16 fr. b.: it, t. b. r. is.
 » 243, » 3 fr. b.: leaf, points, t. b. r. leaf-points.
 » 249, Fig. 115, l. 5 fr. a.: *E*, t. b. r. *F*.
 » 249, » » l. 6 fr. a.: *G*, t. b. r. *G*, Fruit.

Some other small misprints and linguistic inaccuracies occur, which the benevolent reader will please to have forbearance with.

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