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Hunt Institute was dedicated in 1961 as the Rachel McMasters Miller Hunt Botanical Library, an international center for bibliographical research and service in the interests of botany and horticulture, as well as a center for the study of all aspects of the history of the plant sciences. By 1971 the Library's activities had so diversified that the name was changed to Hunt Institute for Botanical Documentation. Growth in collections and research projects led to the establishment of four programmatic departments: Archives, Art, Bibliography and the Library.

Ahaa

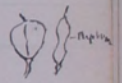
I return your notes which are good + clear. Your sections I have transferred to a bigger box, but have not studied looking over them yet. The only thing I find to criticise is that you have no stained preparation of Selaginella. If you have time after finishing the Melon seedlings it would be worth while to make some.

E.S.

Botanical Journal 1896

Agnes Robertson

Walberswick nr Southwold Suffolk

Date	In flower	In fruit	Remarks
Sat. June 13th	Silene cucubalus		growing on shingle
	v. maritima sea campion		
	Arenaria peploides sea purslane		
	Glaux maritima sea milkwort		
	Armeria vulgaris Thrift		
		Cochlearia officinalis common scurvy grass	mostly unripe 
	Spergularia rubra common sandspurry		
	Yellow flags		seen from windows of train
	" stonecrop		
	ragged robin		
	wild rose		

Date	In flower	In fruit	Remarks
Sun. June 11th	Triglochin maritimum sea arrow grass		
	Potamogeton acutifolius acute pondweed		
	Ranunculus hirsutus Hairy buttercup		In low lying field
	Sparganium ramosum Bur reed		
	Cynoglossum officinale Common houndstongue		
	Plantago coronopus Buckshorn plantain		
	Ranunculus sceleratus celery leaved R.		
	Ranunculus aquatilis water R.		
	Lycopsis arvensis small bugloss		
		Thlaspi arvense Penny mustard	
	Caltha palustris Marsh marigold		

Date	In flower	In fruit	Remarks
June	Fumaria officinalis		By roadside
June 15	Common fumitory		
	Potamogeton perfoliatus		In a dyke. Remarkably
	Pondweed		fine nuts
	Statice		Only in bud
	Sea Lavender		
	Aster tripolium		
	Sea aster		
	Polygala vulgaris		
	Common milkwort		
	Filago germanica		
	Cudweed		
	Erica cinerea		
	Bell heather		On the common
	White bedstraw		
	Potentilla tormentilla		
	Tormentil		
	Purplish broomrape (one spike in bud)		

Date	In flower	In fruit	Remarks
Tues June 16	Thlaspi arvense		
	Mithridate mustard		
	Sedum acre		
	Bitter stonecrop		
	Euphorbium paralias		
	Sea spurge		
	Plantago maritima		
	Sea plantain		
	Glaucium luteum		
	Horned poppy		
Wed June 15	Potentilla argentea		In lane leading to common
	Hornary potentilla		
	Galium saxatile		
	Heath bedstraw		

Date	In flower	In fruit	Remark
Thurs June 10	anagallis arvensis, pimpernel		
		medicago maculata, Spotted medick	
	Chrysanthemum Segetum, corn marigold		near Southwold
	viola tricolor, wild pansy		near Southwold
	papaver argemone, Pale poppy		near Southwold
	geranium pyrenaicum, mountain g.		
	geranium pusillum, small flowered g.		

Date	In flower	In fruit	Remarks
Frid:	Reseda lutcola		
June 19	dyers Rocket		
	cerastium vulgatum		
	mouse ear chickweed		
	geranium dissectum		
	cut leaved g.		
	scirpus maritimus (?)		
	Sea scirpus		
	erysimum sophia		
	Flixweed		
	Juncus compressus (?)		
	Round fruited rush		
	Papaver dubium		
	Long headed poppy		
	sedum anglicum		
	English stonecrop		
	Trifolium scabrum		
	Rough clover		
	Ornithopus perpusillus		
	Common birds foot		
	Chaerophyllum anthriscus		
	Bur cherod		

Date	In flower	In fruit	Remarks
Sat.	Meadowsweet		
June 20	scabious		seen from windows of train
	foxglove		

Hadley (Science Club expedition)

Date	In flower	In fruit	Remarks
Wed July 17	Hypericum perforatum (?) St Johns Wort		
	Hypericum montanum (?) Mountain St.		
	Nasturtium officinale Common watercress		
	Ranunculus Buttercup		
	Veronica beccabunga Brooklime		
	Ranunculus flammula Lesser spearwort		
	Ononis arvensis Rest harrow		
	Rubus fruticosus Bramble		
	Epilobium hirsutum Great willow herb		
	Sneezewort		
	Achillea ptarmica		

Date	In flower	In fruit	Remarks
	Lonicera periclymenum		
	Common honeysuckle		
	Campanula rotundifolia		
	Harebell		
	Pimpinella saxifraga		
	Burnet saxifrage		
	Agrimonia eupatoria		
	agrimony		
	Thistle		
	Solanum dulcamara		
	Bittersweet		
	Ligustrum vulgare		
	Common privet		
	Lotus corniculatus		2 varieties
	Birdsfoot trefoil		
	Prunella vulgaris		
	self heal		
	Wild rose		
	Geranium robertianum		
	Herb robert		
	Geum urbanum		
	Herb bennet		

Date	In flower	In fruit	Remarks
	Myosotis arvensis (2)		
	Field forget-me-not		
	Potentilla reptans		
	Cinquefoil		
	Chamomile		
	Trifolium repens		
	White clover		
	Senecrum vesorodonia		
	Wood sage		
		Carpinus betulus	
		Common hornbeam	
		Scrophularia nodosa	
		Figwort	
	Achillea millefolium		
	Yarrow		
	Trifolium pratense		
	Red clover		
	Bellis perennis		
	Common daisy		
	Chrysanthemum leucanthemum		
	Ox eye daisy		
	Dock		

Date	In flower	In fruit	Remarks
	Betony stachys (?)		
	sorrel dock (?)		
	Hawkweed (?)		
	An umbellifer		
	White bedstraw		
	stellaria		
	Hedge stachys (?)		
	small willowherb		
	Rush		
	Grasses		
			Noticed the pale green "midsummer shoots" of the oak
	X		

Botany 1897

July 28

Notes from Müller's "Fertilisation of Flowers"

From Darwin's preface:—
"Any one who will carefully study the present work & then observe for himself, will be sure to make some interesting discoveries."

From Part I

Sprengel published a book in 1793 in which he shewed how all the colours, scents & singular forms of flowers have some useful purpose. He discovered the fact that in some plants the pollen was conveyed to the stigma by insects. His book contained a rich store of accurate observations & brilliant interpretation, but the great flaw in it was that he did not perceive that cross fertilisation produced better results than self fertilisation.
A few years after Sprengel's book appeared Andrew Knight discovered by expts on the

pea, that "in no plant does self fertilisation occur for an unlimited number of generations"

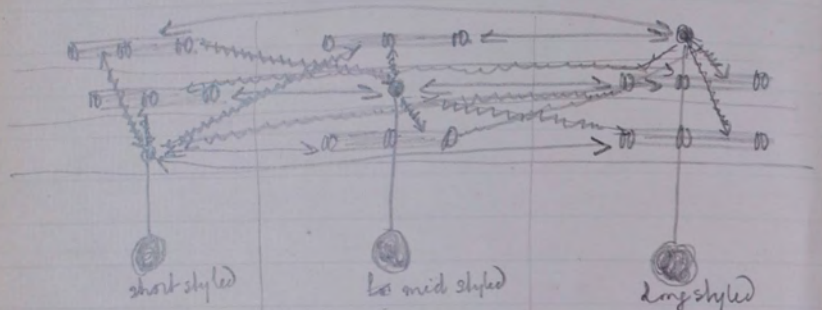


Diagram of fertilisation of heterostyled plants showing that there are 2 legitimate ways & 4 illegitimate ways in which each stigma can be fertilised

It is found that the offsprings of illegitimate crossings of heterostyled plants have all the characters of bastards produced by the union of distinct species. This broke down the sharp boundary line between species & variety which had formerly been supposed to consist in the more or less complete

Sterility of hybrids produced by crossing distinct species

Plants of Isle of Purbeck. Dr. W
(Supplementary Essay) Aug 3-18. 1897

Last year I was staying in the north of Poole Harbour, that is to say not really in the Isle of Purbeck, but my essay included some observations on the flora of the Isle. This year I have been staying at Kingston. This is a village on the top of a high hill about two miles from the sea, & in the southern arable part of the Isle of Purbeck, which is cut off from the heathy moorlands by the range of hills on which Corfe Castle stands, & which cuts the Isle from East to West. The Purbeck formation stretches from Kingston to the sea, & on the sea coast there are some dark crumbling Kimeridge Clay Cliffs. Behind Kingston the formation is Cretaceous

Notes from Dr Gray's notice of Strasburger's book. Bronds of Botany 1891

many Abietineæ have medullary rays containing, in the xylem, water conducting tracheides as well as living parenchymatous cells. Also most coniferæ have bordered pits on the tangential surfaces of the latest formed autumn wood. The development of these structures varies inversely. Both serve the same purpose of providing a radial connection between the water conducting tissues of successive annual rings. Respiration of deep seated living tissues of wood by means of intercellular spaces in rays.

In Abietineæ functions of companion cells are fulfilled by certain cells of the medullary ray [illegible]

In the conifers portions of the vast parenchyma either wholly or partly may discharge this function. The function of the cells is inferred from the fact that they reach maturity simultaneously with the sieve tubes, & become emptied & obliterated at the same time as they do. Also they are connected with the sieve tubes by pits resembling one sided sieve plates. The sieve plates themselves are never really open in the functional sieve tubes in Coniferæ The arrangement both of the true companion cells in Angiosperms, & their representatives in Gymnosperms

shews that they cannot serve for the longitudenal conduction of food substances. Their function is rather to receive the albuminous material conveyed by the sieve tubes, & finally to pass it on to the developing tissues.

The sieve tubes & companion cells of the Vine are emptied in winter.

The wood consists primarily of two forms of tissue only, tracheae & parenchyma. The fibrous elements may correspond by homologous with either; generally the parenchyma.

The vascular bundle of ranunculaceae shews a strong resemblance to those of monocotyledons.

Ready done at same time as Laboratory Work

I ✓ D^r Scott's Structural Botany. Part I. Flowering Plants
pp 1–18 ✓ 236–269 ✓
26–102 ✓
170–183 ✓
231–235 ✓

II ✓ Review by D^r Scott of Strasburger's
"Ueber den Bau und die Verrichtungen der Leitungsbahnen in den Pflanzen." *

III Van Tieghem's Traité de Botanique

IV Vines Text Book of Botany. The Gymnosperms Pp 463–489

V D^r Scott's Structural Botany Part II Flowerless plants

* For notes see preceding pages

Work in Miss Sargant's Laboratory. Reigate.

August 19.97 Began to work through D^r Scott's Structural Botany. Examined fresh specimens of wallflower, & cut some sections of stems (fresh material). Mounted some temporarily in dilute glycerine. N.B. Keep covers in acetic acid. Saw stomata nicely in section

August 20.97 I am to devote my time at Reigate chiefly to the acquirement of skill in microscopic manipulation

Notes on section cutting:—

(1) In cutting transverse sections of stems transverseness is more important than thinness. Hence the little groove in the pith which is to receive the stem must be exactly parallel to the axis of the pith. It is easy to see when the sections are becoming oblique because, as the circle of the pith is much larger than the circle of the stem it shows the obliqueness before it really begins to matter. However carefully you cut with a wedge shaped razor your sections must

get oblique in time, hence the advantage of using one of the small razors with a thin flat blade.

(2) In section cutting the preliminary arrangement of the object in the pith is of greater importance than the actual cutting

(3) The proverb "that a bad workman complains of his tools" is quite inapplicable to microscopy. The good workman should be most particular about his tools.

(4) It is a good plan to carefully cut away the hard outer part of the pith

(5) The texture of the pith varies a good deal. To take advantage of this always carefully see that as far as possible the texture of the pith & the texture of the object harmonises. as far as possible

NB. A white tile with lines drawn on it with a file as below is a good thing to lay ones slide on in mounting, in order to mount the section in the centre

A useful thing to put ones watch glasses, slides etc on so as to see ones sections more clearly, is made as follows:-
Two pieces of glass have a sheet of black paper laid between them & the edge is bound round with black paper; you then have a good substitute for a black slide.
For the greater part of the morning I made sections of wall flower stems (some from a branch, & some from a young plant just above the cotyledones) which had been preserved in spirit. Some I mounted in water & some in dilute glycerine. Others I stained with Schultzes solution. The endodermis full of starch grains came out very clearly, & also the starch-containing cells of the Xylem which occur in proximity to the wood vessels. In some of the sections the hairs appeared in section, & shewed their method of insertion between the cells of the epidermis very clearly. I also examined the hairs separately, by scraping them off a leaf which had been preserved in spirit. They are spindle shaped with

a short stalk in the middle, & they are rough with knobs containing calcium carbonate. I irrigated the slide with acetic acid, & bubbles came off. The knobs seemed to become less conspicuous & in some cases to disappear altogether

N.B. It is not much good to strop a razor immediately before use, but strop it & put it aside for 24 hours & its edge will recover itself

August 21. 97 Mounting in Glycerine Jelly

I watched Miss Sargant mount some of her sections in glycerine jelly. She had a test tube about half full of the solid jelly, which she heated in a beaker of water. The water was never allowed to boil because this would decompose the glycerine; a glass plate was laid over the beaker to keep the heat in. No water was allowed to reach the glycerine. When the jelly had melted Miss Sargant warmed a slide & coverslip till they were almost too hot to touch. She then put a drop of the glycerine into the centre of the slide. She spread the

drop about a little, as, if sections are put on the top of a convex drop they will run to one side when the coverslip is put on. She transferred the sections by means of a camels hair brush to the glycerine jelly, & gently poked them under the surface of the drop for the same reason as she had spread the drop about for. The sections had been kept in dilute glycerine, so that any liquid carried over with them would be of the same kind as the medium in which they were to be mounted. Miss Sargant gently lowered the coverslip by means of a pair of forceps. She did not put any glycerine on the coverslip. She put a large enough drop of glycerine to allow a little to exude round the edge of the cover to prevent air getting in; otherwise the cover glass would have to be ringed.

Staining :—

I watched Miss Sargant finish some of her staining. She had stained a section in haematoxylin to turn everything blue except the xylem, & then stained it in safranin to

twen the xylem read. In staining with safranin ~~to~~ you overstain so that it masks the haematun, & then remove the excess of safranin by washing. To do this you put it thro' alcohol of various strengths, the most dilute alcohol washing out most strongly. The great point is to transfer the section from 70% alcohol to absolute alcohol (which hardly affects the safranin) at the moment when as much washing as is required is done. To do this you watch the section thro' a magnifying glass.

Double Staining with Haematun & Safranin

I took some transverse sections of a branch of wallflower (which had been kept in spirit) which I made yesterday & have kept since temporarily mounted in dilute glycerine. I floated off the coverslip by putting drops of water round the edge, & washed the sections into a watch glass of distilled water. There were 5, 3 thinner than the rest. I divided them into two lots, two thick & three thin. I took some "Mayer's Haematun", a very complicated compound which is bought ready made, & diluted it with distilled water to which

a trace of potash alum has been added. Distilled water alone precipitates part of the stain after some hours, but too much potash alum must not be added, or the stain does not seem to "bite" properly. The stain is a very dark purple liquid. You tell when it is sufficiently diluted by the colour. I put the two thicker sections in to it a little before 10.30. (I divided the sections into two lots in case I should spoil one)

In staining one must be careful to put sections of the same thickness together. At about 12.40 the sections shewed quite distinctly in the staining fluid & I took them out & put them in tap water, (Tap water has to be used because it is alkaline, & the slightest acidity spoils the stain) & then transferred them to ·5% solution of safranin & left them till Monday.

August 29.97 I washed out the stained sections in

(i) Tap water

(ii) 30% alcohol to which I added its own bulk of tap water

" " " " " " smaller amt " " "

50% " " " " " " " " "

70% " " " " " " " " "

(My directions were "Various graduated strengths of alcohol made up with methylated spi: & tap water")

(iii) Placed in absolute alcohol
(iv) Transfered to Clove Oil
Examined in a drop of clove oil under the microscope to see if the stain is properly washed out. Xylem & hairs were red & the rest a purplish blue.
(v) Transferred to Xylol
(vi) Mounted in Canada balsam (in Xylol)

Mounting in Glycerine Jelly

I mounted six sets of transverse sections of wall flower stems of different ages etc, (which I had temporarily mounted in dilute glycerine) in glycerine jelly, as I had seen Miss Sargant do.

Longitudinal Sections of wall flower stems

Miss Sargant left the following message. "I have cut two bits of a tough stem & put them in a mixture of alcohol, water, & glycerin. The lid of the jar is left off so that the alcohol & water may evaporate. When the stem bits have sunk to the bottom, long. sections can be cut from them. You had better treat bits of the older roots in the same way." I cut some longitudinal sections &

mounted them temporarily in dilute glycerine. They shewed much more clearly than I expected. I made out the following points distinctly.

(1) In the xylem the order of the vessels from within outwards was

(a) Loose spiral vessels
(b) close " "
(c) pitted " (2)

(2) The pitted vessels (2) were particularly clear & the walls where they were cut shewed the pits in section beautifully.

(3) The spindle shaped bars [illegible] the phloem grow very accurately parallel to the axis of the stem, & their ends fit over one another, forming apparently an efficient protection to the stem.

N.B. If you make sections to keep it is well to keep some of each bt stained, & some unstained; i.e. make your preparations in pairs.

August 24 97 I shewed my stained sections to Miss Dyason & she said I had made a mistake in staining the thick ones, & mounting the thin ones in glycerine jelly; it should have been vice versâ. For the glyc:

jelly has a great tendency to make things transparent, so thin sections scarcely show at all, but in staining, the colour differenciates the tissues quite distinctly, so it is well to have quite thin sections.
I then began to stain my three thin sections. To get them out of the glycerine jelly in which I had mounted them I used hot water.

Longitudinal Sections

I cut some more longitudinal sections of old stems, but none were so good as those I did yesterday. I stained one of those I did yesterday in Schultz's solution. The xylem stained yellow & the starch grains blue. There were some coloured round bodies like drops of oil in some of the cells, which stained a deeper colour than the cells themselves.

Microphotography

Miss Sargant shewed me her apparatus for microphotography, & how it worked. The barrel of the microscope is put horizontal & light from an incandescent lamp is focussed on to the slide by means of a condenser. By means of a pivot arrangement the part of the table with the

microscope on it with sun right round so than an eyepiece can be attached & the microscope can be focussed. It is then turned back, & the eyepiece is replaced by a different lense which correct certain optical errors, & the end of the tube inserted in the nozzle of the camera. An image of the slide is thrown on the screen. The finer focussing is then done, & the photograph taken in the ordinary way.

Acer Pseudo-Platanus

I examined a number of slides made by Miss Sayant of the stem of acer pseudo-platanus. I saw pitted vessels, all with lignified walls pointed ends, & a few small pits, & especially the curious medullary rays which look so different in long: tang: & rad: section

Pinus

I cut up some pieces of wood of pinus which had been preserved in spirit, & put them in a mixture of glycerine & spirit to soften. which had been kept in glycerine & spirit of wallflower roots

August 25. 97 I cut some transverse sections of old stems & mounted them temporarily in dilute glycerine I then tried to cut some transverse sections of young wood, but all my sections were

too thick & not transverse.
In the sections of the old root I noticed the xylem plate, & the absence of pith.

August 26.97 I tried to cut sections of very young roots bearing root hairs; but I made the mistake of using material which had been kept in glycerine & was consequently too soft. In the aft^n I tried to cut some from material hardened in spirit. I had to work for the section under the dissecting microscope. I did not succeed in getting any.

N.B. If sections are transferred from methyl. to dilute alcohol they will uncurl.

Points to be observed at U.C.

(i) It is always worth while to take the trouble to have a sharp razor. You can keep a razor sharp with stropping for about a week. You must have several razors, & always keep a sharp one in reserve because razors sometimes give out suddenly before a week is out. You waste more time cutting useless sections with a blunt razor than you do in taking your razor to be sharpened.

(ii) It is always better to see one thing well than two things moderately; the reason being that having seen one thing thoroughly makes you learn so much more from the diagram of the next. This of course does not apply to research but only to work where you are following out what other people have done. It is not necessary to see everything you read about, but whatever you see, see thoroughly

Note:- I ought to have finished the vegetative part of wallflower by Sept 2; I am then to do the Lily by examining Miss Sayer's slides & then to set to work on the vegetative part of primula

August 27.97 Today I set to work on the wallflower leaf. I cut transverse sections of the fresh leaves, being especially careful to cut the midrib quite transversely. I saw the structure of the midrib nicely, & drew it. I also saw one stoma in the under side of the midrib very clearly. I could not see the structure of the mesophyll clearly, so Miss Sayer put some leaves into chromic acid to harden them.

August 30.97 I cut transverse sections of leaves hardened

in chromic acid. I could not make out that there was at all as much or as characteristically-shaped palisade parenchyma as was drawn in the diagram. Miss Sargant thinks that perhaps it was drawn from a winter leaf.

Note on fixing, hardening & preserving

Chromic acid is an excellent fixing & hardening reagent. It fixes the chlorophyll corpuscles etc in the position they were in during life. It produces a very nice consistency for cutting. Objects to be fixed in it must be cut up small, as the fluid does not penetrate well. If the objects are to be preserved after hardening they must be placed in different successive strengths of alcohol in the dark, (as the alcohol & acid make an insoluble ppt), & then finally transferred to absolute alcohol. They should not be left in abs: alc. for more than a week, else shrinkage takes place. But they may be used for sections immediately after hardening in chromic acid without the use of alcohol. Chromic acid cannot be used as a preservative as it gradually dissolves the tissues

I cut some long sections of an old root. I saw the xylem parenchyme & fibrous cells quite clearly, but I was not sure about the vessels.*

I examined the epidermis of the leaf & saw the hairs & stomata on the lower side.

August 31 97 I cut a series of transverse sections to shew the development of the vascular system in the hypocotyl. However the seedling was rather too old to shew it very nicely.

September 1. 97 I shewed Miss Sargant my sections, & she shewed me a beautiful series of sections of the hypocotyl of the mustard, I saw also a whole shewed the transition from stem to root perfectly. Miss Sargant then shewed me a slide shewing the origin of a root in the tuber of an aroid seedling & another section shewing a circle of adventitious roots.

I began to stain yesterdays sections. I forgot to put down that yesterday Miss Sargant explained to me that the pointed xylem elements were classified as follows:

1. fibrous cells — approximately = in length to cambial cells
2. intermediate fibres

* On examining the slide Miss Sargant thought that I had mistaken vessels for xylem parenchyma

3. Woody fibres — very long

Miss Sayant showed me a section of an anther showing the peridem, because I had not seen it in the wall flower.

I have now finished the vegetative part of the wallflower.

I went on to the second type, the lily.

Miss Sayant showed me the following sections:-

A 1) Section of primary root. very small central cylinder surrounded by highly distinct endodermis. I could just make out two protoxylem groups at ends of xylem strand & two phloem groups

2) Section of base of cotyledone. apparently two bundles, but very slightly lymped. & clemish not clearly distinguishable

3) Section of petiole of first leaf. showing 3 vegorous bundles, 1 large, 2 small with distinct xylem & phloem. Epidermis beautifully distinct. Cells much narrower than in wall flower. Differs from structure of ordinary monocot: stem in having no lymbed pericycle, & in not having the sheath round each bundle thickened

B series of slides showing development of ovule, from

time when each ovulex is only a small excrescence, till the nucleus of the embryo sac had divided into two.

September 2:97 I finished staining my sections of the hypocotyl of wall flower & mounted them.

Miss Sargant shewed me more slides of the development of the embryo sac in the lily.

(1) The nuclei had begun to shew signs of dividing. The nucleus at the top had only 12 rods & the lower one 24-30. I could distinctly see the splitting in several of the lower rods

(2) The nucleus furthest from the micropyle had separated into two clusters of very numerous rods. The nucleus by the micropyle had fewer rods

(3) In this slide the division was over, & four resting nuclei were clearly visible

(4) The sac has grown so much that it is impossible to see all the nuclei at once. In one section I saw 3 nuclei dividing, two in the regular way & the one furthest from the micropyle apparently just dragging itself apart without division of the chromosomes.

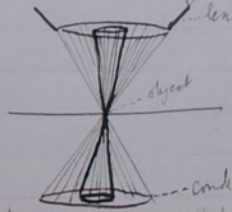
(5) ~~The sac has grown so much that~~
Can see 3 nuclei, all apparently dividing in the usual way. The fourth one which is dragging itself apart does not come int the section
(6) Two nuclei dividing in usual way, & one apparently dragging itself apart as in (4)
I have now seen 16 slides illustrating the development of the embryo sac in the lily

September 5th 1897 I began the 3rd type, a conifer. I cut transverse, longitudinal (radial & tangential) sections of stem of pinus sylvestris, ~~[illegible]~~ I saw, in the transverse sections, the sharp distinction between Autumn & Spring wood. I also saw the pits in section on the radial walls. In the tangential sections I saw the bordered pit again in section, & in the radial sections I saw them in surface view. I could not see the bast or cambium. I saw the curious xylem medullary rays with tracheids. I stained a transverse & tangential section in safranin, & mounted them in Canada Balsam. I also mounted a number of

sections of wallflower & Pinus in glycerine jelly.

September 4th 1897 I cut transverse & radial sections from fresh material of the outer rind of the stem of Picea Excelsa, the spruce fir. I saw the sieve tubes beautifully with pits on their radial walls, the zones of sieve tubes separated by tangential bands of phloem parenchyma, most of the cells of which contained starch, & some crystals of calcium oxolate. These were crossed by medullary rays which shewed clearly the two kinds of cell, the ordinary parenchymatous cells & the much elongated albumen cells. I stained two radial sections with chlor-zinc-iodine. Miss Sargant explained to me the rationale of staining:-

If you use a wide angle lense with a wide condenser you get the rays like this:-



If you are looking at a thin unstained section without coloured cell contents you simply see it: if the different refraction of the surfaces, & if the rays are as far from 11s as in diagram you (then see nothing): the rays of

light refracted in all directions interfere with one another. To remedy this a diaphragm may be put on below the slide, so that only a small number of rays which are comparatively approximately ||s enter the lense. (see digram) In this way a clearer outline is obtained but a great deal of light is lost. Now if the object is stained there is no longer any need to arrange the light so as to get the maximum of refraction, ∴ the staining differentiates the tissues etc, hence all the diaphragm may be dispensed with & all the rays which the condenser will reflect may be employed. And as in this way we get a better light we can use higher powers. So this is the rationale of staining.

September 6. 97 Cut transverse sections of fresh leaves of picea excelsa, the spruce fir. The sections shewed all the points Scott mentions most beautifully, except the resin canals which were absent. I made an elaborate drawing of the section

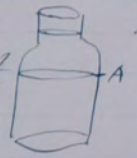
September 7. 97 I made longitudinal sections of the fresh leaves. These shewed the shape & pitting of the

endodermis very well indeed, also the shape of the transfusion tracheides. (see sketch book)
I cut transverse sections of two year old stems of picea, which shewed the peculiar shape produced by the leaf bases, the periderm etc.
Miss Sargant dug up some roots of picea which I cut up & placed in alc: alc:

September 8th 1897 I began to work on the first type in the second part of Dr Scotts Structural Botany; namely selaginella kraussiana. I worked thro' the vegetative part with material preserved in spirit. My best sections were those which I stained with safranine & mounted them in Canada Balsam in xylol

September 9th 1897 I cut transverse sections of roots of selaginella Kraussiana. I was not at all successful with the material which had been kept in spirit, so Miss Sargant got me some fresh material. After cutting a number of sets of sections I got some which shewed the structure & the root hairs very nicely. Some I stained with safranine & mounted in Canada Balsam for comparison with the rhizophores, & some I

mounted unstained in glycerine jelly. I also mounted some other slides I had got in glycerine jelly. It is a ~~mistake~~ mistake in D. Scott's Book where it says that there are air chambers round the stele in the roots of rhizophora. Miss Sargant told me a very nice way of transferring sections from water thro' different strengths of alcohol to alcohol absolute without displacing their tissues by poking them about in getting them from one watch glass to another, & without letting them dance so much as they do by that method. Fill a little bottle up to A with distilled water, & then very gently run in absolute alcohol down the side till it is full up to the neck. Then put in the section & let it slowly sink. It will then pass thro' successive strengths of alcohol.



The upper fluid is removed by means of a tube drawn out to a point

September 10th 1897 I examined the fertile shoots of Selaginella kraussiana. There appeared to be one macrosporangium at the base of each fertile shoot. The macrosporangia were very large, some still green.

& full, & others having opened by means of a slit parallel to the leaf in whose axil they were. The spores in the green macrosporangia were whitish. There were plenty of microspores & I traced their development very nicely. I only saw the ligule in the axil of one leaf. I also cut some more transverse stem sections among which I got one in which the section of the stele was fairly transverse. This I kept

September 11th 1897 I cut transverse sections of the roots of Picea excelsa which Miss Sargant dug up & put in alc. also on September 7th. They shewed the structure very nicely. The vascular system develops very slowly near the tip of the root, so I was able to get three sets of sections, the first shewing the cylinder differentiated, but no bundles, the second shewing the two protoxylem groups widely separated from one another, & the third shewing the primary xylem plate extending across the cylinder & the commencement of secondary thickening. It is curious to notice that near the tip of the root the

diameter is greater than in the older parts, as the thickness of the cortical layer is not compensated for very quickly by the secondary thickening.
I cut some longitudinal sections of the root-tip one of which was comparatively median, & shewed the meristematic tissue & root sheath tissue nicely after clearing with eau de Javelle

September 13. 1897 I cut tangential & radial sections of the root of picea excelsa. The tangential section shewed the structure of the many layered pericycle very well. They were thoroughly typical cells with the nucleus, binucleal nucleole & starch grains shewing most clearly. The pitted tracheides shewed nicely in radial section. The pits differ from those of pinus sylvestris.
I tried to stain my section of the root tip in haematoxylin, but it curled up in an inexplicable manner when I transferred it from clove oil to xylol, ~~so I threw it~~ which spoilt it a good deal

September 16th 1897 I began to examine the roots of the fern. First I cut transverse sections of the roots of Pteris aquilina, the bracken; these roots had been in spirit a very long time & also had been dug up from an extremely dry & sandy place, & consequently the cortex was shrivelled & the central cylinder looked almost as if it were suspended like a selaginella. The xylem & endodermis shewed very well. The roots were clearly diarch. Their shape in section was (1) I then cut transverse sections of the roots of Pteris cretica which had been kept in spirit. They shewed the structure very well, particularly the sclerenchymatous band round the central cylinder. I mounted them. Their shape was (2) In the afternoon I mounted several sets of sections in glycerine jelly.

September 15th 1897 I cut longitudinal sections of roots of Pteris cretica. They shewed the structure very nicely (see sketches) I then began on the melon seedlings (see notes further on)

Sept 16 - Sept 22. 97 I worked on the seedlings of Cucurbita vulgaris the common water melon. This was a little piece of original work. See paper & drawings I made 19 preparations to illustrate the paper.

Classification of slides, made at Rayate. By Miss Sayant

Wallflower.	Primary structure of stem.	Trans.	U.S. 3 . F.
			S. 2 . I.Q.
		Long.	U.S. — . —
	Secondary " " "	Trans.	U.S. 2 . I.Q.
			S. — . —
		Long.	U.S. 1 . I.Q
	Structure of leaf	Trans.	U.S. — . —
			S. — . —
	Primary structure of root	Trans.	U.S. — . —
			S. — . —
	Secondary " " "	Trans.	U.S. 1 . F
			S . — . —
		Long.	U.S. 1 .
	Hypocotyl (secondary thickening)	Trans.	U.S. 4.... F.
			S. 2 ...2Q.
Picea and Pinus.			
	Primary structure of stem Second year twig - Picea.	Trans.	U.S. 1 . Q
			S. — —
		Long.	U.S. — —
	Secondary structure of stem Pinus.	Trans.	U.S. 1 . I.Q
			S. 1 . F.
		Rad.	U.S. 1 . V.Q.
		Tang.	U.S. 1 . V.Q.
			S. 1 . Q.
	Secondary bast - Picea	Rad.	U.S. 1 . V.Q.
	Primary structure of root - Picea.	Trans.	U.S. 2 . I.V.Q.
	Secondary " " " "		S. — . —
		Trans.	U.S. 1 . Q
			S. — . —
		Tang.	U.S. 1 . F.
	Structure of leaf - Picea.	Rad.	U.S. 1 . F.
		Trans.	U.S. 1 . V.Q
Selaginella Kraussiana.			
	Stem	Trans	U.S. 1 . F.
	Rhizophore	Trans.	U.S. 1 . F
	Root	Trans.	U.S. 1 . Q.
			S. 1 . V.Q.
Pteris cretica	Root	Trans.	U.S. 1 . F.
		Long.	U.S. 1 . F.

Regate July 1901

If we find the 2 embryos in Lilium Martagon the thing that it will certainly & definitely shew will be that there are 2 potential O + 2 potential ♂ nuclei (This has been so far strongly assumed!)
It will also greatly increase the probability of the endosperm being hysterically an embryo.

Read Origin of Species. Better to read it several times rather quickly. Then read all the letters in the Life + Letters bearing on it.

Problem about manner of life of native plants. We don't know what proport. of perennials set seed, how far the different modes of reproduction work. What the seedlings are like etc

If leave a slide under microscope turn mirror so that the field is dark to prevent the stain fading.

Use Renaults Haematoxylin + Eosin. Practically it is only haematoxylin as the eosin fades.

The e.s. at the stage we want it is full of vacuoles + so the ~~coating~~ preservation is apt not to be good.

Notes on Transition from Stem to root in Citrullus Vulgaris

Sept 15.97 I examined some seedlings which were so young that their cotyledons were still folded together & partly enclosed by the coat of the seed. They had been in methylated spirit since the 13th & were sufficiently transparent to shew the connection between the vascular bundles of the cotyledons & the hypocotyl when they were held up to the light. This connection is shewn in fig 1 (Sk I) Two bundles enter the hypocotyl from each cotyledon. These run parallel to each other nearly to the base of the cotyledons & then appear to join. The seedling which I examined most carefully & from which the diagram is taken was so young that the plumule between the cotyledons only shewed as a minute point

fig 2 (Sk II) shews a general view of stained seedlings.

Sept 16.97 I cut a series of sections from the hypocotyl & root of a seedling A (fig 3 Sk I). I also cut two sets of sections from seedling B (fig 4 Sk I). I stained these with saf: & haem:

Sept 17.97 I examined my sections of A & cut a series of sections from seedling C (fig 5 Sk I) & put them to stain.

The conclusions I have arrived at at present are as follows:-
In the majority of the seedlings four bundles enter the hypocotyl from the cotyledons & two from the plumule. The two from the plumule coalesce ~~join the~~ others fairly soon. They are small & ~~straw~~ ~~like~~ like the ~~other~~ bundles from the cotyledons they do not shew the internal phloem characteristic of adult stems of the cucurbitaceæ. ~~However~~ ~~In~~ It ~~seems~~ difficult to ~~show~~ accurately ~~Transverse~~ sections of them, as their course in the hypocotyl is apparently oblique, in fact I ~~have~~ ~~cannot~~ ~~one~~ ~~could~~ ~~obtain~~ ~~any~~ ~~that~~ ~~showed~~ ~~the~~ ~~xylem~~. This shewed no internal phloem, but ~~two~~ ~~cells~~ bundles from the xylem three rows cells, ~~which~~ very narrow radially & apparently engaged in dividing. These ~~cells~~ ~~is~~ ~~an~~ ~~older~~, ~~one~~ perhaps ~~were~~ the cells which would later on have developed into the internal phloem. See Fig 6, Pl. I. Likewise the ~~are~~ visible folded teeth. In these very young seedlings ~~the~~ ~~root~~ ~~system~~ vascular system of the root appears not to be at all well developed. In ~~all~~ ~~of~~ ~~the~~ They were all so young that their ~~Cotyledons~~ ~~were~~ ~~not~~ ~~able~~ ~~folded~~ together.

If the upper phloem in the leaf of Cucurbita is [illegible] empty when the lower phloem is in full activity, the inference which Strasburger draws from the fact seems [illegible] to fact

For as a rule the young leaves in the [illegible] developing near the growing point of the stem receive their food supplies from actively assimilating older leaves; but the cotyledons being the first leaves have no older leaves to fall back upon, hence the second band "internal" phloem would be in their case useless

"From the fact that the upper phloëm of the bicollateral bundles in the leaf of Cucurbita is already empty at a time when the normal lower phloëm is in full activity, it is inferred that the former fulfils its function during the development of the leaf, serving to conduct to it the necessary food supplies, while the normal phloëm is also concerned in conveying the products of the leaf's own assimilation"

Text quoting Strasburger

[illegible]

~~This~~ seems consistent ~~with~~ the fact that the vascular bundles of the cotyledons & which pass out into the hypocotyl have no internal phloem. ~~For the cotyledons,~~ being the first leaves to develop, cannot receive food supplies from older leaves which are actively assimilating older leaves, as all the successive leaves do. ~~vascular bundles, before the radicle emerges from the seed, & hence before the root has become an absorptive organ. Hence there is no need of internal phloem. So the vascular bundles never have to convey food to the cotyledons. On the other hand the cotyledons~~

So ~~there is never any~~ need for the food ~~to be conveyed~~ from the root up into the cotyledons, hence internal phloëm would be useless.

~~as soon as they have risen above the ground & turned green begin to assimilate & so the normal phloem is of use & also it is of use to convey the ~~stored~~ food which is stored up in the cotyledon to the plumule & radicle~~

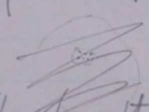
But the normal phloem is of use ^but^ to convey the food stored up in the cotyledons to the plumule & radicle & also, when the cotyledons have turned green in the seedling & begin to assimilate, to convey the products of their assimilation to ~~the [illegible] plumule~~ the young shoot & root.

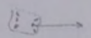
Note on Fig 5 In a seedling such as that drawn in fig 5 we ~~get~~ find that the ~~root structure~~ [illegible] is very slightly differentiated & that we pass from a well developed stem structure with ~~4~~ distinct collateral bundles (5/4) to a root structure showing a central cylinder ~~[illegible]~~ of [illegible] cells in ~~scarcely~~ which differentiation of xylem & phloem ~~[illegible] differentiated [illegible] bundles [illegible]~~ has scarcely begun ~~phloem~~. Thus in these young ~~bundles~~ seedlings it is impossible to trace the

transection from stem to root ~~quite~~ very satisfactorily

~~See~~ Slides to illustrate paper

1. Transverse section across hypocotyl just below cotyledons of a seedling of which I have not a ~~picture~~ diagram. Shape squarish, ~~shewing the four bundles from the cotyledons a little larger than [illegible]. The~~ The 4 bundles from the cotyledons are near the four corners. ~~Between them~~ Lying ~~Placed each of the between~~ about the middle of ~~two~~ sides ~~the~~ two small bundles from the plumule. One of these two bundles shews a





narrow tangentially ~~rad~~ 3 ~~radial~~ rows of cells, radially internally from the xylem. ~~[illegible]~~ These cells will possibly develope into the internal phloem

2 — 6 Sections of seedling A (1) at AB
(2) at CD
(3) & (4) bet CD & EF
(5) at EF

(1) Quadrangular section shewing the six bundles

(2) Oval sections shewing distinct stem structure except that the epidermis is replaced by a proliferous layer

(3) Same as (2) except that they are rather smaller

(4) Smaller & bundles approaching one another more closely

(5) Smaller & ~~xylem of bundles united in a ring surrounded by a ring of phloem~~ bundles united to form a ring of xylem around the medulla surrounded by a concentric ring of phloem

Unfortunately I have not got any sections nearer the tip of the root. I made a mess of seedling A first of all & before I realized how near the tip of the root I should have to go to get the transition

7 + 8 Seedling B (Cut at AB & D)

(1) Sections shewing a somewhat wavy outline central cylinder surrounded by a distinct endodermis with cutinized radial walls ~~which~~ ~~had stained brown~~ thickenings of the walls stained brown. Inside the endodermis a remarkable layer of cells extremely elongated radially which I suppose constitute the pericycle. This layer was in some places 1 cell deep & in some

places two cells deep. Inside this layer was a cylinder of cells whose contents stained deeply with the haematoxylin, & which had thin walls ~~& small~~ fairly large nuclei

(2) These sections were smaller but had essentially the same structure as (1) The layer of cells next inside the endodermis was even more noticeable from the extreme radial length of the component cells. It was, with scarcely an exception, one cell ~~thick~~.

9-16 Sections of seedling C. Saf: too much washed out, so staining [illegible]

(1) showed the 6 bundles.

(2) Shewed the transition from 6 to 4 bundles. one section [illegible] had off six [illegible], [illegible] [illegible] [illegible] [illegible] ~~Some~~ two ~~of the sections [illegible] [illegible] [illegible] 5~~ shewed 5 & the remaining two four bundles only.

(3) These sections were quadrangular, slightly [illegible], & shewed ~~the~~ four bundles, one in each corner

(4) These sections were strikingly different in shape, being considerably longer than broad & having a curved outline. The bundles were nearer one another & each bundle was more wedge shaped & less oval

(5) ~~The bundles have [illegible]~~ This section shows a distinct endodermis

surrounded a cylinder of thin walled cells
rich in protoplasm ~~to~~ Sporangial
+4 (6) In these sections part of the central cylinder
had dropped out but the structure appeared to
be the same as in 5. Cells there appeared to
be actively growing as in the central cylinder
Outline roundish
(7) Outline round. Same structure as 7
(8) Section of extreme tip of root. Same structure
on a smaller scale. Meristem nuclei
central cylinder

Heading of Paper

Material

Investigation of Parts { Arrangement of bundles in cotyledon & hypocotyl
Second Phloem group
Transit. General idea of fig 9

Investigation of { General remarks