

Bidrag till Skånes Flora

49. Flora och vegetation i Loshults socken

AV SVEN SNOGERUP

(Meddelanden från Lunds Botaniska Museum, Nr 112.)

Uppgifterna från Loshult är i äldre litteratur mycket sparsamma. Linné färdades bl.a. därigenom på sin skånska resa, och noterade då *Veronica spicata* från Loshults by, där den fortfarande växer. I Are-schougs »Skånes flora», 1881 års upplaga, nämns tretton arter från socknen, nämligen *Cornus suecica*, *Thalictrum aquilegiifolium*, *Euphorbia cyparissias*, *Scheuchzeria palustris*, *Potamogeton polygonifolius*, *Rhynchospora alba*, *R. fusca*, *Trichophorum caespitosum*, *T. alpinum*, *Carex pauciflora*, *C. limosa*, *Picea abies* ssp. *europaea* f. *virgata* och *Osmunda regalis*. Uppgiften om *Osmunda* avser dock säkerligen en lokal i Osby socken. På Hård av Segerstads utbredningskartor från 1924 finns 30 lokaler från Loshult. Av dessa arter har *Calystegia sepium* och *Anchusa officinalis* ej kunnat återfinnas.

I senare tid har exkursioner i trakten företagits främst av professor H. Weimarek och fil. mag. A. Hall i Osby. Mina förkunskaper om socknen grundade sig huvudsakligen på muntliga meddelanden av dem. Mina egna undersökningar har företagits under vegetationsperioderna 1954 och 1955. Därvid har konstaterats 497 arter inom socknen, av vilka 231 noterats från samtliga de 10 sektioner, i vilka socknen indelats. Härvid har släktena *Hieracium* och *Taraxacum* helt förbigåtts, liksom huvuddelen av släktet *Rubus*. Trädgårdsflyktingar har medtagits endast i de fall, då de visat förmåga till självspredning eller längre tid hållit sig kvar på någon lokal. Likväl måste antalet arter betecknas som frapperande lågt jämfört med i andra skånesocknar av samma storleksordning.

Loshults socken ligger helt inom det sydsvenska höglandet. Endast ett litet område vid Drivån i socknens sydvästra hörn når under 100 m

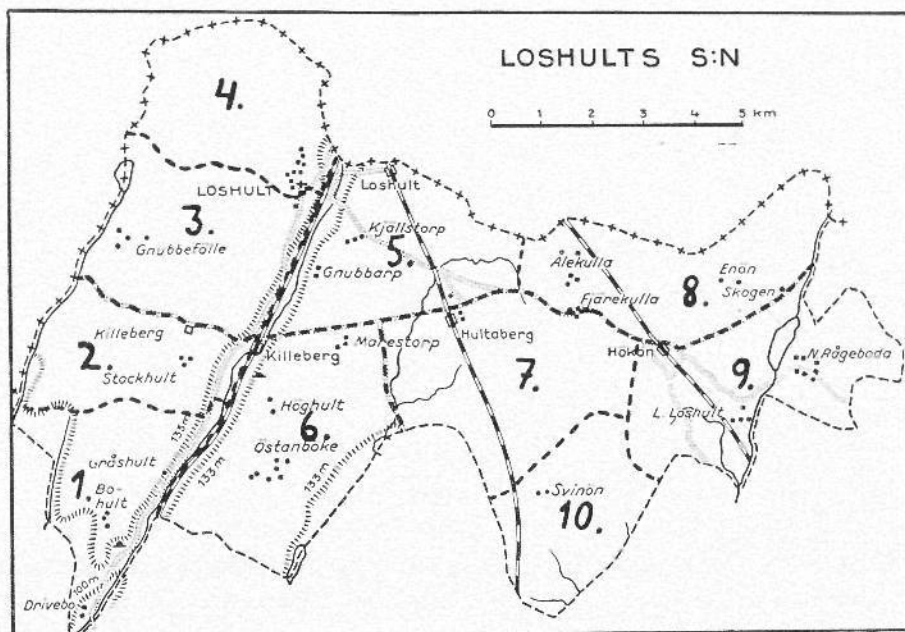


Fig. 1. Loshults socken med sektionsindelning.

ö.h. Området är endast svagt kuperat, speciellt är hela östra delen av socknen mycket flack och till stor del upptagen av plana myrtytor. Största uppmätta höjden finns 2,5 km nordväst Loshults kyrka och mäter 177 m. I nordvästra delen finns även i övrigt höjder på 160—170 m, medan området i allmänhet ligger mellan 130 och 160 m ö.h.

Berggrunden utgöres till övervägande del av järngneis, men här och där, särskilt i östra delen, finns diabasgångar av olika bredd. Dessa bestå mest av finkornig hyperit, som flerstädes varit föremål för brytning i stor skala, främst vid St. Trånghylltan, L. Loshult och Hultaberg. Brytning av lösa block, s.k. suggebrott, har förekommit på många ställen i socknen. Stenbrytningen är nu nedlagd överallt utom vid St. Trånghylltan, där ett stort stenbrott ännu är i gång och levererar material för gravvårdar.

Anstående berg, som når ytan, finns endast på två ställen: vid vägen Killeboda-Gnubbefälle och norr L. Loshult. I det senare fallet rör det sig om hyperit, som även någon gång varit föremål för brytning. Den är dock här som annorstädes mycket hård och vittringsbeständig och har inte alls förmått påverka växtligheten.



Fig. 2. Rest av ängsbacke i form av slänt mellan åkrar, nära Loshults kyrka, öster om vägen. Detta är den enda kvarvarande lokalen för *Veronica spicata* i socknen.

— Foto: G. Weimarek, 1954.

Den morän, som överallt överlagrar berget, är kalkfattig urbergs-morän. Denna magra grund i förening med det för skånska förhållanden bistra klimatet gör, att Loshult framstår som ett magert och i botaniskt hänseende enformigt område. Så mycket skarpare framträder de små områden, där en mera näringsrik morän är till finnas. Ett sådant område ligger söder om hyperitförekomsten vid L. Loshult. Här är dock den näringsrikare moränen ojämnt fördelad och starkt uppblandad. Vid S. Hulta märks en liknande, svag gödningsverkan över ett relativt stort område. Men här finns också ett c:a 25×100 m stort

område med starkt eutrof prägel. På detta ställe ligger en mängd större och mindre block av grovkornig, lös och lättvittrad grönsten, och det är framförallt intill och på dessa som de mest krävande arterna växer. Denna stentyp är troligen endast en mera storkornig och lättvittrad form av hyperiten, från centralare delar av gångarna. Detta framgår också av ett block vid L. Stockhult, som till en del är hårt och finkornigt och varit föremål för brytning, men på ena sidan successivt övergår till samma grovkorniga, »murkna» sten som den i S. Hulta-blocken. Likadana block har också observerats vid N. Hulta, i omedelbar anslutning till ett mycket markerat rikkärr. En rikare flora än i det övriga området finns också längs Älmhultsåsen, som genomdrar socknen åt sydsydväst genom Loshults och Killebergs samhällen mot Drivebro. Dessa åskomplex innehåller material från den stora diabasgången vid Möckeln, vilket också visar sig genom närvaron av en rad krävande arter.

Ängsvegetationen

Längs Älmhultsåsen har tydligen tidigare funnits betydande arealer torrängar. Linné talar ju om »Loshulta ängebackar», där *Veronica spicata* växte »ömnogare än någon annerstädes i riket». Av dessa ängsbackar vid Loshults by finns nu endast små fragment kvar, och *Veronica spicata* fanns 1954 i ett tiotal exemplar, 1955 endast i två. Även på andra ställen längs åsen finns liknande, delvis mera betydande rester av denna vegetationstyp, som dock i stort sett ödelagts genom uppodling, grustäkt, färbeetning eller på annat sätt. Delvis har också, på grund av minskad betning och rensning, ljung, buskar och träd spritt sig över de förut öppna områdena. Ängsbackarna är ju, åtminstone i denna trakt, en kulturbetingad biotop, för sin existens beroende av en måttlig betning och uppröjning. Tidigare har man ställvis försökt uppnå denna röjning genom svedjning, varigenom så småningom erhöles en mera hedartad vegetation. Linné skildrar också i sin »Skånska resa» vådan av detta förfaringsätt, som till slut resulterade i enbart ljung och »pipehven» (*Agrostis tenuis?*). Karaktärsarter för torrängarna på åsen är framförallt *Viscaria vulgaris*, *Pimpinella saxifraga* och *Anemone pulsatilla*. På en eller några få lokaler har också observerats: *Arrhenatherum pubescens*, *A. pratense*, *Carex montana*, *Ranunculus bulbosus*, *Filipendula vulgaris*, *Geranium sanguineum*, *Helianthemum nummularium* och *Primula veris*.

Fuktängarna intager endast obetydliga arealer. De är likaledes beroende av slätter eller annan regelbunden röjning, som numera endast

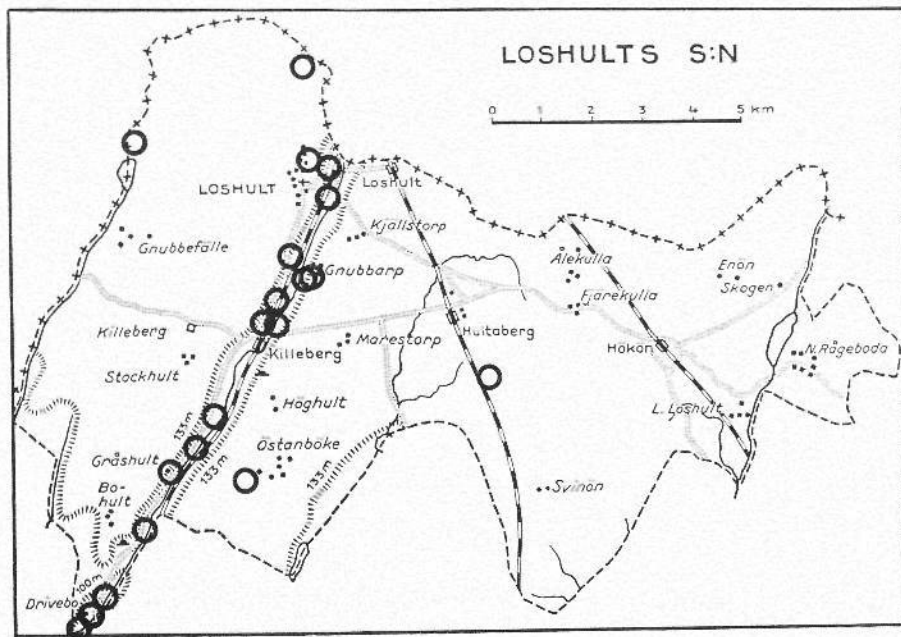


Fig. 3. *Viscaria vulgaris* följer i sin utbredning Älmhultsåsens sträckning. Den har hållit sig kvar bättre än övriga representanter för ängsbackarnas flora.

kommer till stånd, där man kan använda slåttermaskiner. En relativt stor äng ligger 400 m SSV Killeberg stn., en annan S Höghult. Annars rör det sig mest om små bitar vid gårdar och byar, och alla övergångar finns mellan ren äng och de på liknande lokaler förekommande övergångsrikkärren. Fuktängarna domineras alltid av *Molinia*. Dessutom förekommer följande arter i större mängd: *Luzula multiflora*, *Poa pratensis*, *Deschampsia caespitosa*, *Holcus lanatus*, *Anthoxanthum odoratum*, *Carex echinata*, *C. nigra*, *C. pallescens*, *C. tumidicarpa*, *Rumex acetosa*, *Stellaria graminea*, *Ranunculus acris*, *R. repens*, *Potentilla erecta*, *Viola palustris*, *Peucedanum palustre*, *Rhinanthus minor*, *R. serotinus*, *Galium palustre*, *Succisa pratensis* och *Achillea ptarmica*.

En del rester finns ännu kvar av de lövängar, som tidigare hölls i bruk flerstädes i trakten. De har tydligen varit mycket olika starkt röjda, troligen mest beroende på stenvärdet. Man har nämligen kastat samman stenen till rösen, vanligen omkring större block. I dessa rösen, som i denna stenrika trakt ofta kom att uppta en tredjedel av ytan, har man låtit träd och buskar växa. Buskarna kom dock att hållas efter

genom betningen och genom lövtäkt. Vid denna hamlades ofta också träden. Lövängarna användes oftast för slätter, och först efter slättern släpptes kreaturen dit för höstbetning. Genom frånvaron av vårbetning fick en rik vårflora möjlighet att utveckla sig såväl i som mellan rösen. Detta förhållande har dock överallt ändrats för flera årtionden sedan. Ingen bedriver längre slätter med lie, och slättermaskinen kan inte användas mellan stenrösen. Lövängarna har nu drabbats av två olika öden. I ena fallet har betningen utsträckts till hela året och ofta blivit mycket hård, då skogsbetningen samtidigt alltmer frångås. Framförallt under våren, då kreaturen länge saknat färskt foder, blir lövängsvegetationen hårt åtgången, detta i rak motsats till vad som förr var fallet. När man sedan, som på många håll varit sed, även släpper dit får, så rensar dessa bort, vad de andra ratat. Den rika vårfloran utrotas fullständigt, och betet kommer efter hand att bestå av mera tåliga gräs som *Agrostis tenuis*, *Festuca ovina* och *Deschampsia flexuosa*. Dock sprider sig ris och mossa allt mer i den tidigare ängsvegetationen, och området mister även sitt värde som betesmark. Slutet blir då samma öde, som mera direkt drabbat andra lövängar — helt upphörande skötsel och igenväxning till skog. Därvid visar granen stark tendens att tränga in och småningom ta överhand över de ädla lövträd, som tidigare växte i vångarösen. I några fall har man även påskyndat denna utveckling genom plantering.

Träden i rösen utgöres till största delen av ek och lind, med inslag av björk, rönn, asp, alm, ask och lönn. Bland buskarna finns, förutom ungplantor av dessa arter, en, hassel, hägg och olvon. I fältskiktet märks *Polypodium vulgare*, *Poa nemoralis*, *Anemone nemorosa*, *Rubus saxatilis*, *Geranium robertianum*, *Chamaenerion angustifolium*, *Aegopodium podagraria*, *Vaccinium myrtillus* och *Veronica officinalis*. Vid Gråshult växer *Polygonatum verticillatum* i några rösen.

Något bättre har ängsfloran bevarats i de fall, då området mellan rösen och slätter använts som åkermark. Driften har då oftast fortsatt fram till nu, och kreaturen släpps inte dit förrän efter skörden. I åkeröarna finner man ofta *Polygonatum odoratum*, som enligt äldre personers uppgift förr även var vanlig i lövängarnas rösen. Bland andra arter som tagit sin tillflykt till dessa lokaler märks *Calamagrostis arundinacea*, *Thalictrum aquilegifolium*, *Trollius europaeus*, *Aegopodium podagraria* och *Valeriana officinalis*. På dessa ställen finns oftast en kraftig återväxt av ädla lövträd, som på mera regelbundet betade lokaler förhindras av kreaturen. En slänt vid Gnubbarp analyseras närmre i kapitlet om ängsskogen.

Skogarna

Största delen av socknen är beväxt med skog, som täcker c:a 60 % av dess yta. Området ligger i sin helhet inom det södra barrskogsområdet, och lövskog förekommer i stort sett endast som kulturprodukt kring byar och gårdar samt vid någon riklokal.

Barrskogen. — Ännu för hundra år sedan torde tallen ha varit dominerande inom hela eller största delen av området. På moränmarkerna finns ännu kvar en del bestånd av tät, högväxt tallskog. I denna består den rätt glesa undervegetationen mest av *Deschampsia flexuosa*, *Vaccinium vitis-idaea*, *V. myrtillus*, *Empetrum nigrum*, *Calluna vulgaris*, *Trientalis europaea* och *Pteridium aquilinum*. I glesare bestånd dominerar ljungen. På torra backar finns även mycket lavar i bottenkiktet. *Arctostaphylos uva-ursi* finns på en skogslokal 1,5 km N Killeberg stn. Tallen upptar även en stor del av myrmarkerna, och här får den behålla sin dominans över granen, som inte trivs i alltför fuktig miljö. Granen befinner sig annars för närvarande på kraftig frammarsch. Även i gamla rena tallbestånd består återväxten till största delen av gran, liksom i blandskogarna och i tidigare björkdungar och lövängar. På de smärre områden, där granen på grund av markens fuktighet sår sig dåligt och i alltför livskraftiga lövskogar, lämnar beskäftiga skogsmän hjälp. Man planterar gran och hugger bort »ogräs» som ek, björk, avenbok, lind och enbuskar. På sista årtiondet har det också blivit allmänt brukligt med plantering på avverkade skogsområden, och denna sker i stort sett endast med granplantor. Granskogarna är överallt hedartade med mycket sparsam undervegetation av ris, mossor och *Deschampsia flexuosa*. I gammal, tät granskog finner man ofta ansenliga bestånd av *Lycopodium annotinum*, *L. clavatum*, *Ramischia secunda* och på ljusare fläckar *Linnaea borealis*. På två lokaler i sektionerna 3 och 4 har även noterats *Goodyera repens*.

Lövskogen. — Lövskogens tillbakagång beror inte bara på övermäktig konkurrens från granens sida. I själva verket torde den i stor utsträckning ha varit en kulturprodukt, som försvinner, när människans stöd upphör. Ek- och bokdungarna kring byarna skyddades noga, och andra trädslag gallrades undan. Detta berodde på ollonens betydelse som svinfoder, men även ekvirkets goda egenskaper torde ha bidragit till favoriseringen av detta trädslag. Även björken har gynnats, därigenom att man i tider av mindre rationellt skogsbruk högg bort gran och tall till virke, medan björken fick stå kvar, då man mest eldade med hygges-

avfall och torrakor. Sentida skogsmän ha nu börjat kalla björken för ogräs och förordat dess utrotande, även om man inte här gått till sådana ytterligheter som längre norrut. Under de gångna kristiderna logo emellertid bönderna tillfället i akt att omsätta björkskogen i välbetald ved. Och på hyggena tog snart den snabbväxande granen överhand.

Lövskogarna äro nästan uteslutande av hedskogstyp. Ängslövskog finns blott på ett litet område vid S. Hulta, i spridda småfläckar vid L. Loshult samt här och var på slänter vid åkrar.

Ängslövskogen vid S. Hulta sträcker sig i sin typiska utformning endast över den norra och nordvästra slänten 150 m NNV—NV p. 165,62. Området är c:a 100×25 m i utsträckning. Trädskiktet utgöres huvudsakligen av ek, lind, lönn och asp, med inslag av rönn, björk, sälg, avenbok och bok, den sistnämnda endast i få, yngre exemplar. I buskskiktet finns *Corylus avellana*, *Viburnum opulus*, *Malus domestica*, *Juniperus communis*, *Prunus padus* och *Lonicera xylosteum* samt tyvärr också talrika yngre exemplar av *Picea abies*. I fältskiktet märks följande arter, vilka inom socknen endast anträffats på denna lokal: *Milium effusum*, *Lathraea squamaria*, *Paris quadrifolia*, *Lathyrus vernus* och *Polygonatum multiflorum*. För övrigt har här observerats:

Lycopodium selago, *Athyrium filix-femina*, *Lastrea dryopteris*, *L. phegopteris*, *Dryopteris filix-mas*, *Polypodium vulgare*, *Maianthemum bifolium*, *Convallaria majalis*, *Luzula pilosa*, *Poa nemoralis*, *Deschampsia flexuosa*, *Calamagrostis arundinacea*, *Urtica dioeca*, *Rumex acetosella*, *Stellaria graminea*, *Mochringia trinervia*, *Actaea spicata*, *Anemone hepatica*, *A. nemorosa*, *Thalictrum aquilegifolium*, *Rubus saxatilis*, *R. idaeus*, *Fragaria vesca*, *Potentilla erecta*, *Lathyrus montanus*, *Oxalis acetosella*, *Geranium robertianum*, *Viola riviniana*, *V. canina*, *Aegopodium podagraria*, *Pyrola minor*, *Ramischia secunda*, *Vaccinium myrtillus*, *V. vitis-idaea*, *Trientalis europaea*, *Glechoma hederacea*, *Satureja vulgaris*, *Scrophularia nodosa*, *Veronica chamaedrys*, *V. officinalis*, *Melampyrum pratense*, *Galium saxatile*, *Solidago virgaurea* och *Lactuca muralis*.

Längre söderut i samma backe växer mycket *Acer platanoides*, som bitvis rent av är dominerande i trädskiktet. Här saknas dock alla de typiska arterna från ängsskogen på nordkanten, och risen spela större roll i undervegetationen. Skogen är här en igenväxningsprodukt av tidigare löväng. I några av rösena finns *Polygonatum odoratum*.

Ovanför riklokalen ligger en tidigare åker, vilken nu användes som betesmark. Betning förekommer även över hela lokalen, dock mest på sommaren och hösten. En sådan betning torde i själva verket vara av



Fig. 4. Ängslövskog vid S. Hulta. Moränen innehåller här talrika block av storkornig, lättvittrad hyperit. I fältskiktet märks bl.a. *Anemone hepatica* och *Lathyrus vernus*. — Foto: G. Weimarck, 1954.

vikt för lokalens bestånd, då därigenom uppväxande buskar hålls efter och en fullständig igenväxning förhindras. Betning kan dock inte stoppa de inträngande granarna, och det kan också bli fråga om granplantering, åtminstone av inägan ovanför, vilket även skulle inverka menligt på den smala sluttningen. Därför kommer troligen en fredning att åstadkommas av såväl ängsskogen som en bit av betesmarken ovanför. Området skulle då genom fortsatt betning och undanhuggning av granar samt normal gallring bibehållas i oförändrat skick för framtiden.

Samtidigt stoppas också plundrandet av de sällsynta arterna för skolherbarier, varigenom särskilt *Lathraea squamaria* blivit hårt åtgången.

Vid L. Loshult förekommer ingen sammanhängande ängsskog av nämnvärd utsträckning, bara utsplittrade bitar mellan åkrar och mera hedartad skog. Bland de växter, som här noterats, kan nämnas följande mer eller mindre krävande arter: *Cystopteris fragilis*, *Polygonatum odoratum*, *Melica nutans*, *Poa nemoralis*, *Thalictrum aquilegifolium*, *T. simplex*, *Actaea spicata*, *Anemone hepatica*, *Primula veris*, *Satureja vulgaris*, *Valeriana officinalis*, *Campanula trachelium*, *C. persicifolia*. Den svagt eutrofa prägelns beror utan tvivel på moränmaterial från hyperiten norr därom. Träd- och buskskikten sammansätts av ek, lind, björk, avenbok, hassel, asp, rönn, olvon och hägg.

Som exempel på de ängsskogspartier, som här och var återfinnes på slänter mellan åkrarna, skall nämnas ett sådant väster Gnubbarp södra. Den relativa näringsrikedomen på denna lokal beror väl på att den ligger på en del av det tidigare nämnda åskomplexet, men man kan inte heller utesluta en viss näringsstillförsel från ovanför liggande åkrar och bebyggelse. Vegetationen hade här följande sammansättning. Träd- och buskskikt: *Juniperus communis*, *Populus tremula*, *Salix aurita*, *S. caprea*, *Carpinus betulus*, *Corylus avellana*, *Betula verrucosa*, *B. pubescens*, *Quercus robur*, *Prunus padus*, *Sorbus aucuparia*, *Malus* sp., *Rhamnus frangula*, *Tilia cordata*, *Daphne mezereum*, *Viburnum opulus*.

Fältskiktet: *Pteridium aquilinum*, *Lastrea phegopteris*, *L. dryopteris*, *Dryopteris filix-mas*, *D. spinulosa*, *Polypodium vulgare*, *Maianthemum bifolium*, *Polygonatum odoratum*, *Convallaria majalis*, *Luzula pilosa*, *L. multiflora*, *L. campestris*, *Sieglingia decumbens*, *Molinia coerulea*, *Festuca ovina*, *F. rubra*, *Poa pratensis*, *P. nemoralis*, *Dactylis glomerata*, *Deschampsia flexuosa*, *D. caespitosa*, *Holcus lanatus*, *H. mollis*, *Calamagrostis arundinacea*, *Agrostis stolonifera*, *A. tenuis*, *Anthoxanthum odoratum*, *Elytrigia repens*, *Carex contigua*, *C. leporina*, *C. nigra*, *C. pallenscens*, *C. pilulifera*, *C. caryophylla*, *C. montana*, *Rumex acetosa*, *R. acetosella*, *Stellaria media*, *S. graminea*, *Cerastium holosteoides*, *Mochringia trinervis*, *Thalictrum aquilegifolium*, *Anemone nemorosa*, *Ranunculus acris*, *R. repens*, *Rubus saxatilis*, *R. idaeus*, *Fragaria vesca*, *Potentilla erecta*, *Alchemilla glaucescens*, *A. filicaulis*, *Medicago lupulina*, *Trifolium dubium*, *T. medium*, *T. repens*, *Lotus corniculatus*, *Vicia cracca*, *V. angustifolia*, *Lathyrus montanus*, *Oxalis acetosella*, *Geranium sanguineum*, *G. robertianum*, *Hypericum maculatum*, *H. perforatum*, *Viola riviniana*, *V. canina*, *Chamaenerion angustifolium*, *Aegopodium podagraria*, *Vaccinium myrtillus*, *V. vitis-idaea*, *Calluna vulgaris*, *Trien-*

talis europaea, *Ajuga pyramidalis*, *Glechoma hederacea*, *Satureja vulgaris*, *Scrophularia nodosa*, *Veronica serpyllifolia*, *V. officinalis*, *V. chamaedrys*, *Melampyrum pratense*, *M. silvaticum*, *Rhinanthus minor*, *Plantago lanceolata*, *Galium boreale*, *G. saxatile*, *G. verum*, *Succisa pratensis*, *Campanula rotundifolia*, *C. persicifolia*, *Solidago virgaurea*, *Arnica montana*, *Hypochaeris maculata*, *Leontodon autumnalis*, *Scorzonera humilis*, *Lactuca muralis*.

Hedlövsskogarna är av betydligt större utsträckning, och återfinnas i större eller mindre omfattning kring alla byar och gårdar.

Bokskogen är föga utbredd. Den största förekomsten är vid Killeboda och Klinten inom sektionerna 3 och 2. Mindre dungar finns i samtliga sektioner, t.ex. vid Gråshult, Fjärikulla, Ällekulla och St. Trånghyltan. I dessa bokdungar anträffas oftast *Poa nemoralis* men för övrigt inga krävande arter. Dominerande i fältskiktet är *Vaccinium myrtillus* och *Deschampsia flexuosa*.

Eken bildar oftast inte egna bestånd, utan innehåller större eller mindre inslag av björk, lind, rönn, asp m.fl. Ekskogen är ju ljusare än bokskogen, och där förekommer också en örtrikare vegetation med bl.a. *Pteridium aquilinum*, *Polypodium vulgare*, *Maianthemum bifolium*, *Convallaria majalis*, *Calamagrostis arundinacea*, *Luzula pilosa*, *Anemone nemorosa*, *Geranium robertianum* och *Melampyrum pratense* men dominerad av *Vaccinium vitis-idaea*, *V. myrtillus*, *Calluna vulgaris* och *Deschampsia flexuosa*.

Björken ingår mest som underordnad komponent i blandskog. Slutna bestånd förekommer dels på torrlagd mossmark, dels på av brand eller på annat sätt blottlagd mark, men på ingetdera stället förmår den hålla de snabbare växande barrträden stången någon längre tid.

Myrarna

Myrarna utgör, vid sidan av hedskogen, det mest iögonenfallande elementet i Loshults vegetation. De utgöra c:a 30 % av den totala ytan, eller över 30 km², häri ej inräknat uppodlade partier. Därav utgöra mossarna c:a 25 och kärren c:a 5 %.

Mossar. — Mossarna äro till största delen starkt påverkade genom dikning och torvtäkt. Dikningen är delvis av mycket gammalt datum och avsåg då i regel uppodling av hela eller en del av mossen. Redan tidigt tycks man emellertid också ha kommit underfund med möjligheten att genom dikning få till stånd en tallskog på mossen. Denna

form av dikning har på senare år fått ny fart och bedrivits i en helt annan skala än tidigare. Ofta har även en ofrivillig utdikning skett vid framdragande av vägar. Torvtäkt har också av gammalt bedrivits för utvinande av husbehovsbränsle. Under krigen har torvtäkten tagit ny fart och bedrivits i mycket stor skala, framför allt på de stora högmossarna i socknens östra del, som innehåller god brännortv. Även utanför det område, där torven grävts bort, fås en kraftig dikningsverkan. Ofta har man dragit särskilda stora diken för att torrlägga mossen, så att den blir bärig för torvmaskiner och lätt att bearbeta. En torvströfabrik i Killeberg har sedan länge framställt torvströ av torv från Ry-narpa myr, varigenom denna tydligen från början mäktiga högmosse snart fullständigt urgrävts. Mossarna är av såväl tallmosses- som kalmossetyp.

Tallmossen förekommer dels som rand kring kalmossarna, dels som små separata tallmossar. I det förra fallet är den oftast mycket torr, speciellt kring dikade mossar, som ju utgör majoriteten. Här utgöres fältskiktet mest av *Calluna* med inslag av *Rubus chamaemorus*, *Eriophorum vaginatum*, *Empetrum nigrum*, *Vaccinium uliginosum* och *V. vitis-idaea*. I ett senare skede av utdikningen, som på den lilla mossen 600 m VNV Gråshult, tar *Vaccinium vitis-idaea* och *V. myrtillus* överhanden jämte *Calluna* och skogsmossor som *Pleurozium*. Mossen övergår då till hedtallskog, vilket ju också var avsikten med dikningsingreppet. Medan tallarna på den orörda tallmossen växer enormt långsamt, blir vresiga och kortvuxna, skjuter de god fart på den dikade mossen och lämna normalt virke. I de blötare, orörda små tallmossarna är *Eriophorum vaginatum* oftast dominerande. Dessutom finns även *Calluna vulgaris*, *Andromeda polifolia*, *Vaccinium vitis-idaea*, *V. oxycoccus*, *V. uliginosum* och *Rubus chamaemorus*. En sådan mosse finner man 400 m NV Drivebro, en annan 300 m SV Gräseltasjö. Till tallmossarnas arter får man även räkna *Ledum palustre*. Denna art har anträffats på 17 lokaler inom socknen. Den visar här inte alls den östliga fördelning, som annars konstaterats, t.ex. i Örkened (Weimarck 1939) och i Glimåkra (Norlindh 1953). Detta bör emellertid ses mot bakgrunden av tallmossarnas fördelning i socknen. Dessa är mera utbredda i västra delen, beroende dels på äldre utdikningar, dels på landskapets mera brutna karaktär. I den östra, flackare delen har kala mossar brett ut sig över större delen av ytan, och dessa utgör inga lämpliga lokaler för *Ledum*. Dess fördelning måste alltså bero på ståndortsekologiska snarare än klimatiska faktorer. Man kan också förmoda, att den stora lokalen norr om Killeboda fungerat som spridningscentrum och gett upphov till en

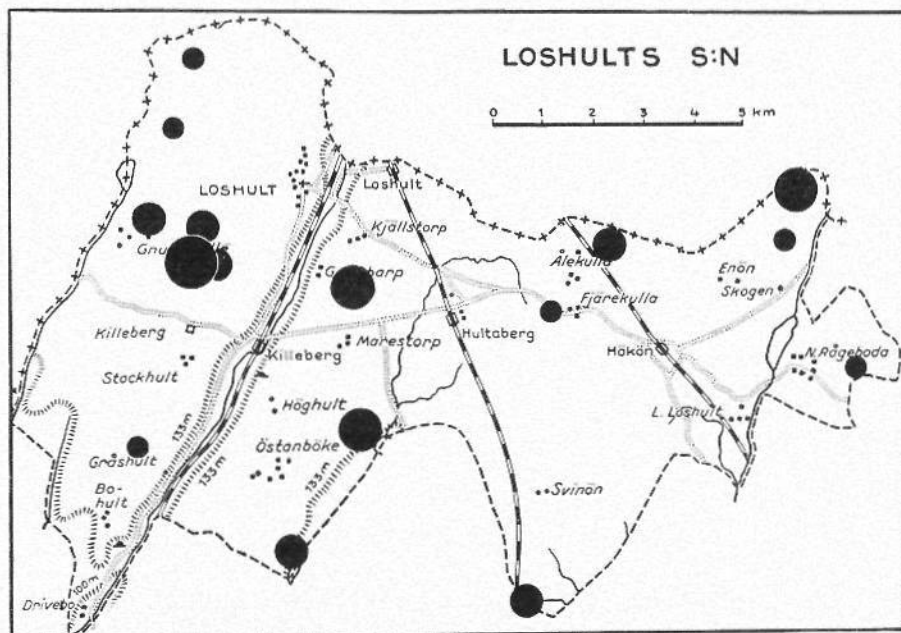


Fig. 5. Utbredning och frekvens för *Ledum palustre*. Cirklar med 2,5 mm diameter representerar lokaler om 0—5 m², 4 mm cirklar motsvarar 6—15 m², 5,5 mm cirklar 16—25 m² och 7 mm cirklar mer än 25 m². *Ledum* växer i tallmossarna och i de större mossarnas randskog. Den har starkt gynnats av dikningsföretag och växer ofta vid dikeskanterna.

del av de mindre, troligen nyare lokalerna i närheten. Arten tycks nämligen vara på frammarsch och visar även tecken på att vara kulturgynnad. Den växer på inte mindre än 6 av lokalerna i eller nära gropkanter och på 4 andra i starkt dikningspåverkade myrar. I åtminstone flertalet av dessa fall torde *Ledum* ha invandrat efter dikningens tillkomst. Detta beror troligen på att på dessa ställen erhålls den bättre genomluftning av marken som är ett av *Ledums* främsta miljökrav.

Kalmössarna upptar som tidigare påpekats framförallt en stor del av de östra sektionerna, främst 5, 7, 8 och 10. Men betydande arealer finns även i östra delen av sektion 6, i västra delen av sektion 4 och norr Killeboda i sektion 3. Av Rynarpa myr i sektion 2 återstår endast en mindre bit i sydost. I sektion 1 finns en liten kalmosse nordväst Bohult. Samtliga socknens kalmossar måste hänföras till Komossetypen, som ju främst karakteriseras av *Erica* på mosseplanet. Denna art finns på alla mosseplan, men i synnerligen växlande mängder. Ställvis täc-

ker den stora områden, så t.ex. på mossen väster Gungekulla och i Vysslemysrs östra del nordväst Svinön. För övrigt domineras mosseplanen av *Calluna vulgaris*, *Empetrum nigrum*, *Trichophorum caespitosum* ssp. *austriacum*, *Rubus chamaemorus*, *Andromeda polifolia*. I höljorna, där sådana fortfarande finns, växer *Eriophorum vaginatum*, *Vaccinium oxycoccus*, *Drosera rotundifolia* och *Rhynchospora alba*. På nakna torvtytor finner man i regel *Drosera intermedia*. Martallarna är flerstädes talrika, utom på de områden där de dödats av brand. Främst på grund av kulturpåverkan måste nu flertalet av mossarna betecknas som stagnationsmossar.

Fattigkärren. — Fattigkärren spelar stor roll och upptar bl.a. helt myr-laggarna. Dessa är ofta utbildade som extremfattigkärren, dock av högst växlande karaktär. De mest extrema fattigkärren ligger på sådana ställen, som inte genomströmmas, och som sålunda får sitt mesta vatten genom nederbörden och från mossen. Dessa lokaler karakteriseras av de starkt oligotrofa arterna *Scheuchzeria palustris* och *Carex magellanica*. Den förra växer i pölar och fuktiga avsnitt, *Carex magellanica* växer ofta i tuvor, som höjer sig över omgivningen. Så är t.ex. fallet vid den största förekomsten, invid Killeboda gyl (på kartan Hästskogylet). På dessa de mest oligotrofa kärrelokaler finner man även *Carex limosa*, *C. pauciflora*, *Vaccinium oxycoccus*, *Eriophorum vaginatum*, *Rhynchospora alba* och *Drosera rotundifolia*. Särskilt vid de stora mossarna kommer oftast laggarna att vara svagt genomströmmade och tjänstgöra som avvattinare för fastmarken runt omkring. I en sådan lagg finner man täta bestånd av *Eriophorum angustifolium*, *Carex rostrata* och *C. lasiocarpa*. Den sistnämnda är sporadisk i sin förekomst, men dominerar ofta helt på de lokaler, där den förekommer. Dess bestånd består i regel till största delen av sterila skott. Andra komponenter i dessa laggar är *Equisetum fluviatile*, *Narthecium ossifragum*, *Agrostis canina*, *Rhynchospora alba*, *Carex limosa*, *C. echinata*, *C. nigra*, *Menyanthes trifoliata* och *Potentilla palustris*. I tuvorna finns *Eriophorum vaginatum*, *Carex pauciflora*, *Vaccinium oxycoccus* och *Andromeda polifolia*.

De starkare genomströmmade och de genom dikning eller annorledes kulturpåverkade laggarna måste hänföras till övergångsfattigkärren, som sålunda uppta en stor del av laggarna. Här inkommer en del mera krävande arter, och den viktigaste skiljearten är *Carex dioeca*, som kommer in i tuvorna. Dessutom märks *Carex panicea*, *C. canescens*, *Potentilla erecta* och *Galium palustre*. Ingen av dessa sistnämnda är ju någon



Fig. 6. Svinamyrr, SO St. Svinön. Denna myr avbrändes vid loshultsbranden, och man ser ännu några kvarstående stammar av de brända martallarna. Den skarpt avsatta laggen är också typisk för de brända mossarna. — Foto: G. Weimarek, 1954.

skiljeart, men då flera av dem finns och tillsammans utgör en dominerande del av vegetationen, så kan man inte längre tala om extremfattigkärr.

I samband med fattigkärren bör också nämnas något om de talrika torvgravarna. Dessa utvecklas olika beroende på vattenmängden. I torra gravar tränger först på den nakna torven in *Drosera intermedia*, som ofta bildar massvegetation, så t.ex. ställvis på Rynarpa myr. Sedan kommer *Eriophorum vaginatum*, *Calluna vulgaris*, *Rubus chamaemorus* och *Empetrum nigrum*. I fuktigare gravar brukar först bli mass-

vegetation av *Rhynchospora alba* och *Juncus bulbosus*. Senare intränger med *Sphagna Drosera rotundifolia*, *Carex rostrata*, *C. limosa*, *Eriophorum angustifolium* och *E. vaginatum*. I några mycket gamla gravar väster Gungekulla norra finns *Scheuchzeria palustris*, *Carex magellanica* och *Drosera anglica*. I vattenfyllda torvgravar har följande arter noterats: *Equisetum fluviatile*, *Typha latifolia*, *Calla palustris*, *Potamogeton polygonifolius*, *P. natans*, *Carex rostrata*, *Potentilla palustris*, *Menyanthes trifoliata*, *Utricularia vulgaris*, *U. intermedia*, *U. minor*.

Som övergångsfattigkärr måste betecknas en mycket utbredd typ av små skogskärr, karakteriserade av svällande *Polytrichum*-tuvor. De är oftast bevuxna med småväxta tallar och björkar samt *Salix aurita*. I fältskiktet märks, t.ex. i det lilla kärret 500 m VNV Bohult, *Equisetum silvaticum*, *Juncus effusus*, *Agrostis canina*, *Eriophorum vaginatum*, *Carex echinata*, *C. nigra*, *C. canescens*, *Potentilla erecta* och *Galium palustre*.

En annan form av övergångsfattigkärr är de betydligt artrikare genomsilningskärren, d.v.s. de som genomdragas av någon bäck, vilken inom kärret helt eller delvis saknar bestämd fåra. I ett sådant 1 km V t. S Östanböke ha följande arter observerats: *Equisetum fluviatile*, *E. silvaticum*, *Calla palustris*, *Potamogeton polygonifolius*, *Juncus effusus*, *J. articulatus*, *J. bulbosus*, *J. filiformis*, *Molinia coerulea*, *Glyceria fluitans*, *Deschampsia caespitosa*, *Holcus lanatus*, *Calamagrostis canescens*, *Agrostis canina*, *Eriophorum angustifolium*, *Carex canescens*, *C. echinata*, *C. nigra*, *C. panicea*, *C. rostrata*, *C. lasiocarpa*, *Dactylorhiza maculata*, *Salix aurita*, *Betula pubescens*, *Alnus glutinosa*, *Ranunculus repens*, *Potentilla erecta*, *P. palustris*, *Viola palustris*, *Epilobium palustre*, *Angelica silvestris*, *Peucedanum palustre*, *Vaccinium oxycoccus*, *Lysimachia vulgaris*, *L. thyrsoflora*, *Menyanthes trifoliata*, *Scutellaria galericulata*, *Galium palustre*, *Valeriana dioeca* och *Cirsium palustre*. Visserligen förekommer här på ett ställe några exemplar av *Angelica silvestris*, men detta kan knappast ändra hela kärrets natur av övergångsfattigkärr, och denna art synes i denna trakt vara dåligt begränsad till rikkärr.

En annan typ av övergångsfattigkärr är översvämningmaderna. Sådana finns främst utefter Drivån från Killeberg söderut, men även på den f.d. Rågebodasjön, vid Krusån syd Massasjö och vid gamla kvarndammar norr Massasjö och vid L. Loshull. Slätter och betning har bidragit till att hålla dessa mader fria från buskvegetation, men vid stenar och vattenhål finns snår av *Alnus glutinosa*, *Salix aurita*, *Myrica gale*, *Betula pubescens* och *Rhamnus frangula*. Fältskiktet består där mest av *Molinia*, *Calluna* och *Salix repens*. På de fuktigaste partierna

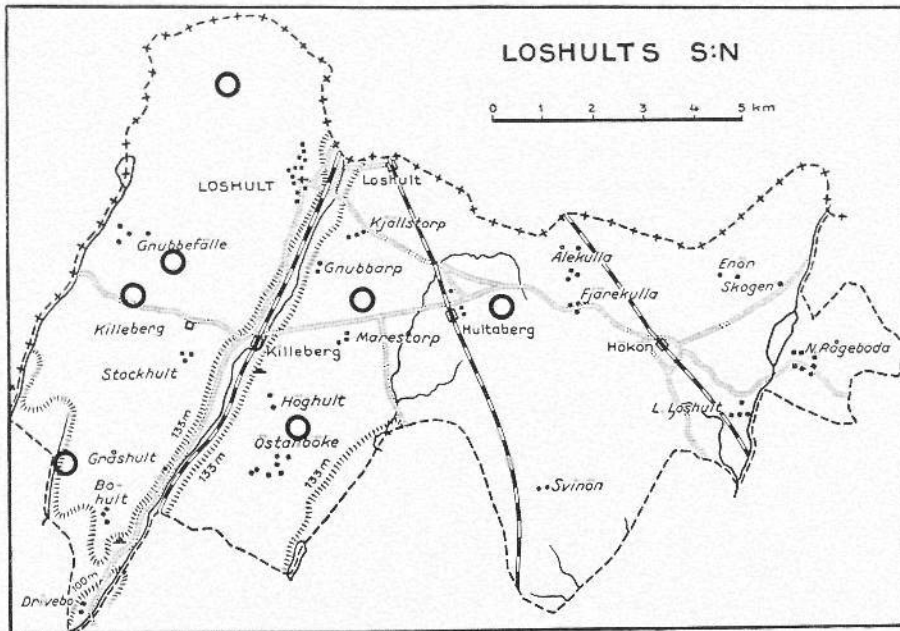


Fig. 7. *Carex magellanica* tillhör extremfattigkärren. Den växer i mosselaggar samt i gungflyn vid gölar. Flertalet sådana lokaler, framför allt i socknens östra del, äro dock alltför starkt påverkade av dikning torvtäkt eller brand för att lämpa sig för denna extremt näringskyende art.

växer *Equisetum limosum*, *Carex rostrata*, *Eriophorum angustifolium*, *Potentilla palustris* och *Menyanthes trifoliata*, men annars dominerar kortväxla graminider som *Carex nigra*, *C. panicea*, *C. echinata*, *C. tumidicarpa*, *C. canescens*, *Juncus filiformis*, *J. articulatus*, *J. bulbosus*. Bland örterna märkes *Valeriana dioeca*, *Viola palustris*, *Galium palustre* och *Potentilla erecta*. Vid vattenhål växer *Hydrocotyle vulgaris* och *Lycopus europaeus*, på torrare ställen *Juncus squarrosus*, *Festuca ovina*, *Erica tetralix*, *Pedicularis silvatica* och *Galium saxatile*. I tuvor växer ofta *Nardus stricta*.

Till fattigkärrens växter hör *Narthecium ossifragum*, vars miljökrav dock tycks vara föga bestämda. Den växer i de mest extrema fattigkärren och till och med på mossar, men har även anträffats på stenar i den förorenade Drivån nedom Killeberg. Arten förekommer rikligt ehuru sporadiskt över hela området med undantag för en lucka i sektion 9. Den största förekomsten är i nordvästra Fjärekullamyren, där flera hektar färgas i gult under blomningen.

Rikkärren. — Dessa spelar en mycket liten roll, upptar endast små ytor och är föga utpräglade. Samtliga måste betecknas som övergångsrikkärren. Några av rikkärren ligger intill gårdar och kan vara kulturpåverkade. De flesta ligger vid källor eller andra ställen med fram-brytande grundvatten. Men även på sådana lokaler uppkommer rikkärr blott vid de ställen, där hyperit eller annan kalkrik bergart anträffats samt nedom åkrar och gårdar, där gödslingsverkan från dessa kan göra sig gällande. En god bild av deras fördelning ger utbredningskartan för *Trollius europaeus*. På så gott som samtliga ställen finns också *Carex pulicaris*, *C. hostiana*, *Triglochin palustre*, *Briza media*, *Filipendula ulmaria*, *Galium uliginosum*. *Pinguicula vulgaris* synes mera bunden till platser med starkt rörligt vatten. Här skall nu nämnas några av de mest utpräglade rikkärrlokalerna.

VNV N. Hulta, norr om landsvägen, ligger den frodigaste av dem alla. Kärret är delat i två avdelningar, en övre mera lutande med starkt rörligt vatten och blandad, örtrik vegetation, och en nedre, flackare, med stark dominans av graminider. I sydöstra kanten av den senare delen har professor Weimarck år 1941 observerat steril *Epipactis palustris*. Denna har dock icke senare kunnat återfinnas, och då kärrets nedre del 1954 utsatts för dikning, finns väl knappast något hopp att så skall ske framdeles. Troligen var denna art endast tillfällig och lyckades aldrig acklimatisera sig på lokalen. Men lokalens natur av rikkärr markeras klart genom närvaron av följande krävande arter: *Triglochin palustre*, *Briza media*, *Eriophorum latifolium*, *Scirpus silvaticus*, *C. hostiana*, *C. pulicaris*, *Urtica dioeca*, *Stellaria palustris*, *Thalictrum aquilegifolium*, *Trollius europaeus*, *Lychnis flos-cuculi*, *Chrysosplenium alternifolium*, *Geum rivale*, *G. urbanum*, *Filipendula ulmaria*, *Prunus padus*, *Lathyrus pratensis*, *Angelica silvestris*, *Myosotis palustris*, *M. laxa* ssp. *caespitosa*, *Scrophularia nodosa*, *Galium uliginosum*, *G. boreale*, *Viburnum opulus*. För övrigt har följande arter noterats: *Equisetum silvaticum*, *E. fluviatile*, *E. arvense*, *Athyrium filix-femina*, *Lastrea phegopteris*, *L. dryopteris*, *Dryopteris filix-mas*, *D. spinulosa*, *Polypodium vulgare*, *Maianthemum bifolium*, *Polygonatum odoratum*, *Convallaria majalis*, *Juncus bulbosus*, *J. bufonius*, *J. articulatus*, *J. conglomeratus*, *J. effusus*, *J. filiformis*, *Luzula multiflora*, *Molinia coerulea*, *Nardus stricta*, *Glyceria fluitans*, *Festuca ovina*, *Poa annua*, *P. pratensis*, *Dactylis glomerata*, *Deschampsia caespitosa*, *Holcus lanatus*, *Calamagrostis arundinacea*, *Agrostis canina*, *A. tenuis*, *Alopecurus geniculatus*, *Anthoxanthum odoratum*, *Eriophorum angustifolium*, *Carex tumidicarpa*, *C. pallescens*, *C. panicea*, *C. leporina*, *C. Oederi*, *C. caryo-*

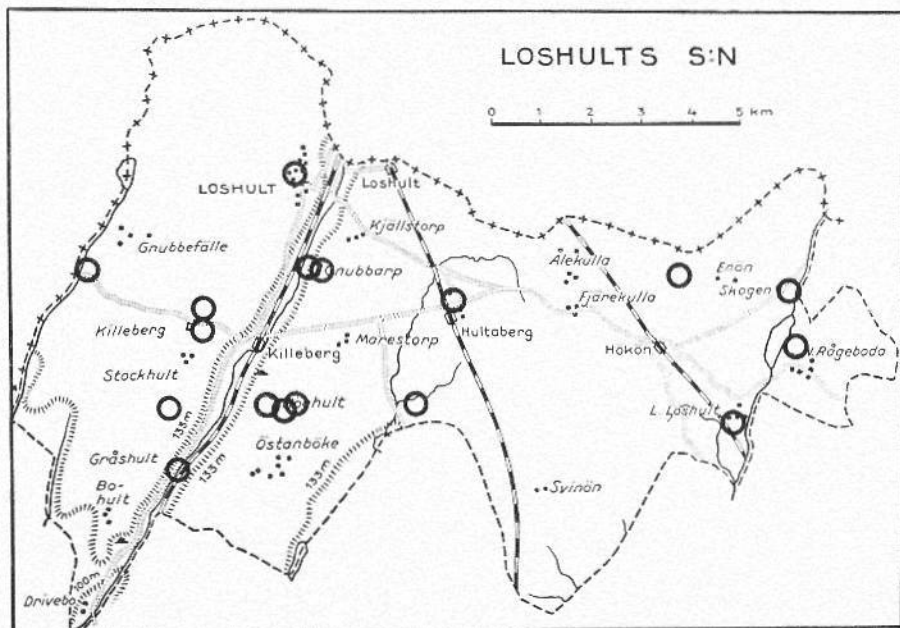


Fig. 8. *Trollius europaeus* uppträder i många av socknens rikkärr och visar den ungefärliga fördelningen av dessa. Arten är som synes relativt allmän inom socknen och förekommer på flera av lokalerna i riklig mängd.

phyllea, *C. nigra*, *C. canescens*, *C. dioeca*, *C. echinata*, *C. rostrata*, *Dactylorhiza maculata*, *Salix aurita*, *S. repens*, *Corylus avellana*, *Betula pubescens*, *Alnus glutinosa*, *Ulmus glabra* ssp. *scabra*, *Rumex acetosa*, *R. acetosella*, *Polygonum hydropiper*, *Stellaria graminea*, *S. alsine*, *Cerastium holosteoides*, *Caltha palustris*, *Anemone nemorosa*, *Ranunculus repens*, *R. acris*, *R. flammula*, *Cardamine pratensis*, *Fragaria vesca*, *Potentilla erecta*, *P. palustris*, *Alchemilla glabra*, *A. filicaulis*, *Sorbus intermedia*, *Medicago lupulina*, *Trifolium repens*, *Vicia cracca*, *Lathyrus montanus*, *Oxalis acetosella*, *Geranium robertianum*, *Polygala vulgaris*, *Rhamnus frangula*, *Tilia cordata*, *Hypericum maculatum*, *Viola riviniana*, *V. tricolor*, *V. palustris*, *V. canina*, *Epilobium montanum*, *E. palustre*, *Peucedanum palustre*, *Vaccinium oxycoccus*, *V. uliginosum*, *V. vitis-idaea*, *Calluna vulgaris*, *Lysimachia vulgaris*, *L. thyrsiflora*, *Tridentalis europaea*, *Menyanthes trifoliata*, *Glechoma hederacea*, *Prunella vulgaris*, *Plantago lanceolata*, *Lycopus europaeus*, *Mentha arvensis*, *Veronica serpyllifolia*, *V. officinalis*, *V. chamaedrys*, *Melampyrum pratense*, *Pedicularis silvatica*, *Pinguicula vulgaris*, *Galium palustre*, *G.*

verum, *G. saxatile*, *Valeriana dioeca*, *Succisa pratensis*, *Knautia arvensis*, *Campanula rotundifolia*, *Gnaphalium uliginosum*, *Achillea ptarmica*, *A. millefolium*, *Cirsium palustre*, *Hypochaeris radicata*, *Leontodon hispidus* och *L. autumnalis*. Mitt i detta kärr ligger ett stort block av samma lättvittrade grönsten som finns vid S. Hulta, och som tidigare nämnts finns även hyperitbrott i närheten.

Ett annat rikkärr ligger 175—200 m NV p. 165,62 vid S. Hulta. Det ligger nedom den förut omtalade ängsskogslokalen och påverkas tydligen av frammbrytande vatten från denna sluttning. I detta kärr finns bl.a. följande arter: *Triglochin palustre*, *Scirpus silvaticus*, *Eleocharis pauciflora*, *Carex hostiana*, *C. pulicaris*, *Cardamine amara*, *Chrysosplenium alternifolium*, *Filipendula ulmaria*, *Angelica silvestris*, *Galium uliginosum*, *Pinguicula vulgaris*.

150 m NO Västretorp ligger ett kärr, som vattnas från en källa. Där ovanför har anträffats block av en lättvittrad, om hyperit påminnande sten. Men dessutom är marken ovanför uppodlad, och där ligger två gårdar. Kärrret har av landsvägen delats i två delar, av vilka den norra sålunda avskurits från det direkta källflödet och dessutom genomdragits av ett dike. I denna norra del finner man *Pinguicula vulgaris* och *Trollius europaeus*. I den södra delen växer *Eriophorum latifolium*, *Carex hostiana*, *C. pulicaris*, *Chrysosplenium alternifolium*, *Galium uliginosum*, *Triglochin palustre* och *Briza media*.

Vid Höghult, sydost om byn, finns vid sluttningen nedom åkrarna ett rikkärrsparti. Här ha bl.a. noterats: *Triglochin palustre*, *Scirpus silvaticus*, *Eleocharis pauciflora*, *Carex hostiana*, *C. pulicaris*, *Dactylorhiza incarnata* (1 ex. 1955), *Trollius europaeus*, *Pinguicula vulgaris* och *Galium uliginosum*.

Nordost Skogen, i sektion 9, finns på sluttningen ett kärr med bl.a. *Carex hostiana*, *C. pulicaris*, *Triglochin palustre*, *Trollius europaeus*, *Pinguicula vulgaris* och *Galium uliginosum*.

Öster Gråshult, intill gården, ligger ett litet, mycket blött kärr. Här kommer en kraftig vattenström uppifrån, via gårdens gödselstad och hönsgård, och resultatet blir givetvis en kraftig gödsling. Här märks följande intressanta arter: *Triglochin palustre*, *Carex pulicaris*, *Rumex obtusifolius*, *Lychnis flos-cuculi*, *Ranunculus sceleratus* (1 ex. 1955), *Filipendula ulmaria*, *Lathyrus pratensis*, *Epilobium Lamyi*, *Myosotis palustris*, *M. laxa* ssp. *caespitosa*, *Veronica beccabunga*, *V. scutellata*, *Galium uliginosum*.



Fig. 9. Rikkärr vid N. Hulta, det mest utpräglade i socknen med bl.a. *Eriophorum latifolium*. Här växte *Epipactis palustris* 1941. Kärrret har nu utsatts för dikning och kommer därigenom troligen att fördärvas. — Foto: G. Weimarck, 1951.

Loshultsbranden

Denna stora brand, som ännu omtalas i trakten, utbröt den 12 juni 1921. Den förorsakades av tåget på linjen Älmhult—Kristianstad, som antände en mosse öster järnvägen norr Hultaberg. Branden rasade sedan fram till den 22 med speciellt svåra framstötarna den 14 och 21 i samband med stormar. Men även senare skedde uppflammanden från de jordbränder som uppstått i mossar och mossodlingar och som släcktes slutgiltigt först av vinterfrosten.

De botaniska aspekterna av denna katastrof borde väl ha undersökts långt tidigare, men man kan fortfarande se en del av dess verkningar. På fastmarken skedde ju en avsevärd avbränning av myllan, och man kunde då vänta sig hedstruktur på den uppkommande vegetationen. De hårdast brända områdena äro också fortfarande beväxta med ljung, ställvis tät och frodig, ställvis med nakna grusfläckar emellan. Av skogs-träden har tall och björk visat störst förmåga att invandra på brand-fälten. Där gran planterats, har dock denna växt bra.

Värst avbrända blev utan tvivel myröar och uddar i Fjärcullamyren. Här brann det månadtals, och elden svepte gång på gång upp över myröarna, som ingen försökte släcka. Till slut återstod där bara grus och sten. På dessa ställen har också en typisk hedväxt som *Arctostaphylos uva-ursi* vandrat in. Denna för övrigt i trakten ganska sällsynta art täcker här tusentals kvadratmeter mark. Av utbredningskartan framgår hur väl dess massförekomster håller sig inom det brända området. Mattorna är ställvis mycket täta och frodiga, men på andra håll håller den tydligen på att förkvävas av ljung och tät tallskog. Av de övriga förekomsterna i socknen ligger tre stycken på ett annat, tio år gammalt brandfält. Den gången tände låget på samma ställe som 1921 men på andra sidan järnvägen, varvid dock endast ett par hektar avbrändes. Ytterligare en lokal, den relativt stora 900 m NNO Killeberg stn., visar spår efter brand. Även flera av de andra ligger på genom kulturpåverkan öppnade ställen vid grustag och vägslänter. Förekomsten på myröarna torde vara den största i Skåne. Bland övriga invandrare på brandfälten märks *Lycopodium complanatum* som här antecknats från sex lokaler, därav tre stora. Denna art har jag ännu inte kunnat anträffa inom övriga delar av socknen, ehuru jag erhållit uppgift om en lokal vid Massatorp, där den dock synes vara utgången. Även *Lycopodium clavatum* förekommer i stor mängd, i mindre utsträckning däremot *Lycopodium annotinum*. Vidare lägger man märke till *Antennaria dioeca*, *Deschampsia flexuosa*, *Pteridium aquilinum* och *Hypochaeris maculata*. Även lingonris tycks invandra snabbt och överta mjölonets plats, så snart en tätare vegetation bildats.

I myrarna gick branden mycket olika fram. I allmänhet uppstod de allvarligaste jordbränderna, där myrmarken blivit ytterligare uttorkad på grund av odling eller torvtäkt. På en del ställen brändes hela myren bort ända ned till moränen, så t.ex. i en del mossepartier mellan Björnön och Hökon och några småmyrar 1 km SO St. Svinön. På dessa ställen har växt upp buskvegetation av huvudsakligen *Betula pubescens* och *Salix aurita* med mycket *Calluna* och *Molinia* i fältskiktet, på blöta

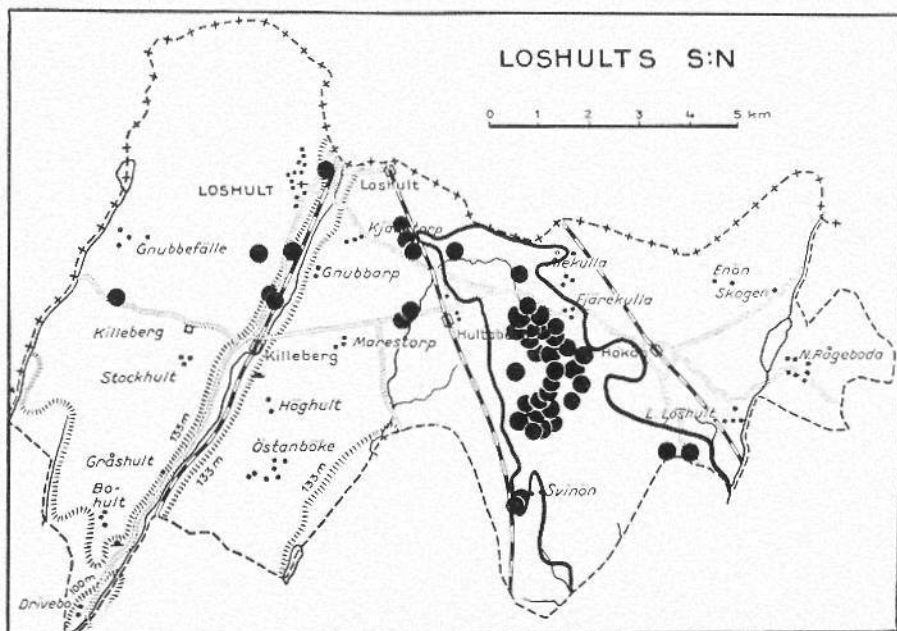


Fig. 10. *Arctostaphylos uva-ursi* visar stark koncentration till de brända områdena. Den heldragna linjen markerar gränsen för det område, som avbrändes vid loshultsbranden 1921. Av lokalerna inom brandområdet ha 6 en utsträckning av mer än 1000 m² och 7 mellan 100 och 1000 m². Alla övriga förekomster äro av mindre omfattning.

ställen ofta massvegetation av *Eriophorum angustifolium*, i pölar *Utricularia intermedia*. Rätt djupt har branden gått i nordvästra Fjärekullamyren, där den förut omtalade stora *Nartheicum*-lokalen finns. Mossen har här gröpts ur så att en kärrartad vegetation uppstått. I pölarna finns mängder av *Scheuchzeria palustris* och *Rhynchospora alba*. *Carex magellanica* har däremot endast uppdagats i ett fåtal exemplar.

På största delen av mosseytorna gick elden endast ytligt fram. Här skedde dock en mobilisering av näringsämnen via askan. Visserligen torde gödningseffekten ha varit ringa, men den gjorde sig dock märkbar på mossen. Sålunda har *Myrica gale* vandrat in på stora arealer av mosseplanet i södra Fjärekulla- och nordöstra Vysslemyr. *Rubus chamaemorus* sägs också ha brett ut sig enormt på mossarna, t.ex. SO St. Svinnö, men har nu i stort sett redan trängts tillbaka. På en del bottenbrända ställen i mossekanterna, t.ex. i västra Fjärekullamyren har vegetationen ännu inte hunnit sluta sig, och där växer *Drosera intermedia*.

Även i laggarna märks en viss eutrofiering vid jämförelse med orörda områden i trakten. Sålunda växer flerstädes *Carex dioeca* och dessutom förekommer i större mängder *Carex nigra*, *C. canescens*, *C. panicea*, *C. echinata*, *Potentilla erecta* och *Galium palustre*. Däremot saknas *Scheuchzeria palustris* och *Carex magellanica* helt i de brandberörda laggarna, som genomgående måste betecknas som övergångsfattigkärr. Av *Carex dioeca* märks en massförekomst mellan några myröar 1 km SO N. Hulta.

Kulturbetingade arter

I en mager och artfattig socken som Loshult kommer helt naturligt de kulturbetingade arterna att spela stor roll. Sålunda är av de hittills funna 497 arterna 50 rent kulturspridda, och minst 100 andra förekommer enbart på kulturpåverkad mark. Bland de kulturspridda märkes några ogräs vid gårdar. Av dessa skall bl.a. nämnas följande.

Chenopodium glaucum, vid gödselstäder i Loshult och Massatorp, på kolningsplatsen 1,5 km SV Hökön.

Chenopodium rubrum, vid gödselstäder 1300 m S t. O Hökön och vid Bohult, trädgårdsland vid torpet 1100 m VNV Ällekulla.

Atriplex patula, vanlig vid gödselstäder.

Amaranthus retroflexus, vid hönsgård i L. Loshult.

Solanum nigrum, vid Enön.

En annan grupp är de med kommunikationsmedlen spridda. Av dessa har flera blivit allmänna och åtminstone till synes bofasta utmed vägar och järnvägar. Bland dessa märks *Teesdalia nudicaulis*, *Cardaminopsis arenosa*, *Arrhenatherum elatius*, *Bromus inermis*, *Calamagrostis epigejos*, *Spergula rubra* och *Carduus crispus*.

Följande arter har inkommit som ruderalväxter på en eller ett fåtal lokaler:

Chenopodium bonus-henricus, vid gatan i Killeberg.

Melandrium album, tillfällig vid åker vid Gungekulla.

Thlaspi alpestre, vid Höghult, järnvägen S Killeberg, kolningsplatsen SV Hökön.

Berteroa incana, stationsområdet i Killeberg.

Rorippa islandica, i grustag mellan Killeberg och Loshult.

Sisymbrium officinale, vid Killebergs och Hököns stationer, vid Gråshult, kolningsplats SV Hökön.

Descurainia sophia, vid gatan i Killeberg, Hökön stn., kolningsplatsen SV Hökön, svinhage i Loshult.

Lepidium rudemale, vid Loshult stn.

Potentilla norvegica, tillfällig på fyra lokaler.

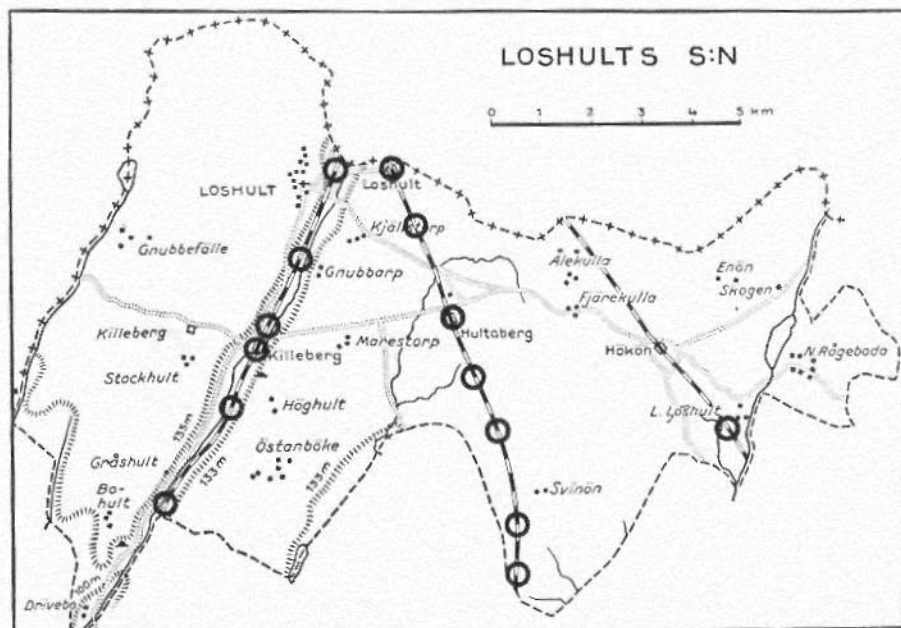


Fig. 11. *Cardaminopsis arenosa* är ett exempel på sådana arter, som spritts till Loshult med kommunikationsmedlen. Dess utbredning följer helt järnvägslinjerna.

Ononis repens, järnvägen vid Svinön.

Melilotus albus, järnvägen vid Svinön, Loshult stn.

Geranium pyrenaicum, vid Killeberg stn.

Oenothera biennis, järnvägen vid Svinön, järnvägen mellan Loshult och Hultaberg, vägen vid Loshult.

Chaenorhinum minus, vid samtliga fyra järnvägsstationer.

Odontites verna, vid järnvägen vid Svinön, rågåker vid Kongstorp.

Filago arvensis, stenbrottet vid St. Trånghylltan.

Filago minima, Hökon stn., stickspår NNO Hökon, stenbrottet vid St. Trånghylltan, grustag 2 km NNO Killeberg.

Senecio viscosus, vid vägen N Killeberg, järnvägen vid Svinön.

Artemisia campestris, järnvägen vid Svinön.

Centaurea scabiosa, järnvägen vid Svinön, vägslänt nära Drivebro, åkerkant vid Killeboda.

Övriga intressanta fynd

Lycopodium inundatum, vid sågdammen N Massasjö, vid Hamsarpasjö, i gamla torvgravar vid Hökon.

Botrychium matricariifolium, funnen vid Björketorp av professor Weimarck och A. Hall, men tydligen utgången.

Osmunda regalis, vid sågdammen N Massasjö.

Lastrea thelypteris, vid sågdammen N Massasjö.

Dryopteris cristata, vid Östanböke.

Blechnum spicant, vägskålet 700 m O t. N Massatorp.

Asplenium trichomanes, stenmur vid vägen N Massasjö, i övertäckt brunn 600 m N Björketorp.

Taxus baccata, på åsen NO gården S Hammarbäck, nära de tidigare bekanta, fridlysta exemplaren på holmarna i Drivån.

Sparganium erectum ssp. *microcarpum*, i Drivån vid Gråshult och Drivebro, fiskdammen V L. Stockhult, nordänden av Massasjö samt i Krusån N därom.

Acorus calamus, vattenhål vid ödetorp i L. Svinön och vid St. Trånghyltan.

Allium oleraceum, väg- och åkerkant 100 m O t. S Killebodagården.

Gagea lutea, vid Hammarbäck, St. Stockhult, Massatorp och Marestorp.

Juncus tenuis, på väg 700 m VSV Höghult.

Glyceria declinata, på körväg 1 km SV Östanböke.

Eleocharis mamillata, vid fiskdammen V L. Stockhult.

Carex digitata, på åsen vid Killeberg.

Herniaria glabra, vid uppkørseln till Gråshult, på stengärdet.

Turritis glabra, på gamla bron vid Drivebro.

Radiola linoides, på vägar vid Fornahässle, Östanböke och Allekulla samt mellan S. Hulta och St. Svinön.

Cornus suecica, vid St. Svinön och S. Hulta.

Torilis japonica, vid ödetorp SV Killebodagården.

Apium inundatum, i liten göl vid N. Rågeboda.

Daucus carota, V Killeberg stn samt vid vägen 1 km NNO därom.

Pyrola media, på åsen vid Killeberg.

Pyrola chlorantha, i granskog 2,5 km V Karhult.

Stachys silvatica, i snår NO Gråshult.

Linaria repens, på 6 lokaler i sektion 9 och vid Ekön i sektion 8.

Veronica agrestis, som ogräs vid Gråshult och Fornahässle.

Crepis paludosa, nedom gamla bron vid Drivebro.

Litteratur

ARESCHOUG, F. W. C. 1881. Skånes Flora (2 uppl.). — Lund.

HYLANDER, N. 1955. Förteckning över Nordens växter. — Lund.

HÅRD AV SEGERSTAD, F. 1924. Sydsvenska florans växtgeografiska huvudgrupper. — Malmö.

NORLINDH, T. 1953. Bidrag till Skånes Flora 47—48. Flora och vegetation i Glimåkra socken I—II. — Bot. Notiser. Lund.

WEIMARCK, H. 1939. Bidrag till Skånes Flora 1. Vegetation och flora i Örkeneds socken. — Bot. Notiser. Lund.

New European Lichens

By A. H. MAGNUSSON.

Acarospora hostilis H. Magn. n. sp.

Thallus areolatus, rufofuscus, areolae dispersae, alios lichenes saepius invadentes, irregulares, interdum incisae, applanatae, KOH—, CaCl—, Pd—, subtus pallidae. Apothecia in quavis areola saepe confluentia, opaca, impressa, minuta, disco thallo concolori. Cortex thalli tenuis, cellulis minutis. Thecium subaltum, superne obscure rufofuscum. Sporae minutissimae, numerosae.

Austria. S. Tirol, "Adamella-Gruppe, Blöcke am Tonale-pass, bei über 1800 m," May 18, 1955 J. Poelt (in herb.).

Areolae 0.5—1.5 mm wide, about 0.3 mm thick, appressed with often slightly raised edges which are incised to sublobate, opaque with uneven surface, largely attached. — Upper cortex 20—25 μ thick, colourless, but exterior 6—10 μ red-brown with a thin, diffuse, necrotic layer, cortical cells rather indistinct, about 2 μ diam. Algal stratum continuous, thick, often as much as 100 μ , medulla poorly developed, hyphae densely intertexted.

Apothecia immersed, 0.2—0.4 mm wide, concave, contiguous to crescent, sometimes only 0.1 mm. Exciple laterally to 12 μ thick, often \pm indistinct, I+ bluish. Hypothecium poorly developed, to 35 μ thick at centre. Thecium 100—120 μ high, 10—18 μ thick surface dark red-brown, often uneven with a \pm necrotic layer, sometimes fissured. Paraphyses contiguous, 1.5—1.7 μ thick, tips in KOH slightly widened, dark brown or brownish. Asci about 70 \times 17 μ large. Spores at least 100, 2—3.5 \times 1.5 μ , almost punctiform.

The new species suggests *A. veronensis* at first sight but is distinguished from this one by the irregular outline of the areolae, the numerous discs, the small cortical cells, the high thecium and the small spores.

Acarospora pycnidophora H. Magn. n. sp.

Thallus squamulosus, pallide rufofuscus, effusus, squamulae irregulares, saepe lobatae, marginibus \pm adscendentibus, superficie undulato, \pm late affixae, subtus pallidae, KOH—, Pd—. Cortex superior CaCl + cinnabarinus. Apothecia deficientia, sed pycnidia in quavis areola sita, vertice saepe dilatato, intus plicata.

Spain. Andalusia, prov. Jaén, southern foot of Sierra Morena between Bailén and S^a Elena, April 1953, H. Doppelbauer, silicicolous. (in hb.).

Thallus forming diffusely delimited patches, those seen up to 4×1.5 cm, squamules 1–2 mm wide, 0.5–0.6 mm thick, often very dense, even subimbricate when lobate, very irregular in shape, surface very uneven from the dense pycnidia and the slightly raised margins and at the same time undulate. — Cortex 25–30 μ thick, hyaline, upper 6–9 μ red-brown, most part CaCl + red. Cells indistinct, 2–3 μ wide. Algae 8–10 μ diam., stratum 100–150 μ thick. Medulla densely intricate with thin-walled, short or long, indistinct hyphal cells.

Pycnidia visible as fissures or as rough, \pm rounded areas up to 0.5 mm broad. Sterigmata dense upon infolded or plicate parts of the wall. Conidia punctiform, 1–2 \times 0.5 μ .

In the absence of apothecia it is impossible to suggest the nearest relative of the new species. The abundance and shape of the pycnidia is remarkable.

Lecidea (Eulecidea) matildae H. Magn. n. sp.

Thallus inconspicuus, obscurus, tenuissimus, haud continuus. Apothecia valde minuta, adpressa, nigricantia, tenuia, \pm dispersa, disco plano, rotundato, margine tenui leviter prominente cincto. Thecium valde tenue, superne subcaerulescens. Excipulum marginale superne crassum, CaCl rubescens. Hypothecium incoloratum. Thecium valde tenue, superne caerulescens. Paraphyses contiguae. Sporae pro rata majusculae.

Ireland. Wicklow Co., Lugnaquilla Mt, 1500–3000 ft, on granite boulders, 1926, Matilda C. Knowles (in hb. Magn. without name).

Between the dense small granules of the stone thin traces of a blackish hypothallus are visible, real thallus probably deficient. Apothecia 0.3–0.35 mm wide, \pm densely dispersed, not constricted at base, at first deeply sunk, finally surrounded by a prominent like the disc opaque margin, disc sometimes faintly pruinose. No algae observed.

Apothecia 0.1—0.14 mm thick. The exciple about 50 μ broad at the margin, brownish blue-green, in KOH more intense, in CaCl red, laterally very thin, at base somewhat thicker, dark. Hypothecium 25—35 μ thick, colourless, its limitation to thecium and exciple distinct. Thecium 45—50 μ high, colourless, like hypothecium I + dark blue; upper 7—10 μ sordid blue-green. Paraphyses coherent, tips in KOH about 3.5 μ , clumsily swollen, still contiguous, brown-green. Asci about 35 \times 8—10 μ . Spores 8, 9—12 \times 5—6.5 μ , ellipsoid.

The new, little obvious species may resemble several other species, according to Miss Knowles's opinion *sublatypea* Leight., *tabidula* Nyl. or *polyantha* Tayl., but all of them have a dark hypothecium. According to my opinion it is more like *L. nigrificans* Nyl. (Flora 59: 307, 1876). This species was collected by Larbalestier at Killary Bay, Connamara and has also dark, thin thallus, small apothecia and pale hypothecium. But its apothecia are mostly 0.5 mm wide and 0.3—0.4 mm thick, immersed in the thallus. The exciple is indistinct or colourless with the algal stratum touching the thecium. The paraphyses are lax with 4—5 μ thick, sordid brown apices in KOH, and the spores 11—12 \times 6—7 μ (Nylander) as young 1-septate and also as old sometimes septate. There is a distinct thallus, KOH— with brown cortex and thick-walled, 3—3.5 μ thick, intricate hyphae. This species is perhaps a *Lecania* species.

Lecidea (Eulecidea) saxonica H. Magn. n. sp.

Thallus cinereo-rufofuscus, tenuis, areolatus, I—, KOH—, CaCl—, Pd—. Apothecia superficialia, arcte adnata, minuta, crassiuacula, disco atro, convexo, saepe ruguloso, margine tenui, concolori, demum \pm excluso. Excipulum superne crassum, nigricanti-purpureo-fuscum, subtus pallidior. Hypothecium pallidum, \pm sordidum. Thecium tenue, superne violaceo-atrum, apicibus paraphysium arcte conglutinatis. Sporae octonae, subellipsoideae.

Germany. "Sachsen, Erzgebirge, Altenberg, auf Basaltblöcken einer Steinbrücke am N. W. Fuss des Geising, 740 m," 1928 G. A. Schade (1926) among *Lecanora polytropa*. (hb. Magn.).

Two pieces of stone, 2 \times 1 cm large, covered by the lichen, but no thallus edge present. Areolae uniform, 0.5—0.8 mm wide, unevenly convex, separated by thin cracks. Apothecia dense, sometimes \pm contiguous, 0.5—0.8 mm wide, not constricted at base, about 0.3 mm thick. — Exciple at edge 50 μ thick, apparently black, in reality dark purplish brown, in KOH more purplish with outflowing solution, below hypothecium \pm sordid, effuse. Hypothecium 50 (70) μ high, colourless or down-

wards \pm sordid, hyphae perpendicular. Thecium 50—60 μ high, colourless, upper 15—18 μ violet-black, in KOH blackish violet. Paraphyses contiguous, 1.5 μ , apices firmly contiguous also in KOH or HNO₃, clumsily thickened, 4—6 μ , in HNO₃ blackish purple. Asci 35—40 \times 14 μ . Spores 9—12 \times 5—6 μ , ellipsoid or subcylindric.

The new species approaches *L. subobscura* in appearance and structure, both with the exciple violet-coloured in KOH, a low thecium and small spores. But *Lecidea saxonica* has uneven and thinner areolae, higher thecium coloured dark violet in KOH at surface, perpendicular hyphae in the hypothecium and larger spores.

Lecidea (Eulecidea) badensis H. Magn. n. sp.

Thallus cinereo-fuscus, tenuis, continuus. Apothecia numerosa, minuta, adpressa, rotundata, disco plano, atro, margine leviter prominente, concolori cincto. Excipulum extus caerulescens, intus pallidum, nubilatum. Hypothecium incoloratum. Thecium mediocre, superne viridi-fuscum. Sporae ellipsoideae, minutae, octonae.

Germany. Baden: "Kreis Buchen-Odenwald, Breitenbach, Rothklänge, Blöcke am Wege." On sandstone at 400 m 1952, O. Behr (in hb. Magn. and Behr).

The specimen seen 3.5 \times 1 cm diam., smooth, not areolate, extenuated towards the diffuse margin, I—, KOH—, CaCl—, Pd—. Apothecia 0.35—0.45 mm wide, prominent, the persistent margin slightly paler than the black disc. — Apothecia about 0.2 mm thick with clumps of yellow-green algae at base. Exciple about 35 μ thick laterally, extenuated at edge, exterior 8—10 μ caerulescent, the interior greyish nubilated, in HNO₃ more distinctly so, CaCl—, KOH+ translucent and faintly bluish-green, hyphae radiating, thick-walled. Hypothecium 50—70 μ thick, colourless, variously inspersed, hyphae mainly perpendicular. Thecium 50—60 μ high, colourless, I+ dark blue; upper 10—12 μ olivaceous-fulvous. Paraphyses contiguous, also in KOH 1.5 μ thick, tips clumsily swollen, 3.5—4.5 μ , KOH+ green-brown, in HNO₃ with a pale violet-brown shade, exciple surface darker violet-brown.

The new species resembles several other little obvious species with colourless hypothecium, low, at surface \pm blue-green thecium and small spores. As important characters I consider the thin, grey-brown thallus, the small regular apothecia, the inspersed, grey inner part of the exciple and the absence of the usual reactions.

Lecidea (Eulecidea) goniophiliza Stnr.

Ann. Mycol. 17: 1, p. 8, 1919. Zahlbr., Catal. Lich. 3: 592, 1925.

Italy. Lombardia, Stilfserjoch, at 2950 m, on hard slaty rock, collected by me 1927 (hb. Magn. 10744 b). New to Europe. Described from Transkaukasia E. of Tiflis; Jelisavetpol prov. "in jugo infra montem Muro-v-dagh, cux, 2900 m, coll. Schelkovnikov."

Thallus whitish, areolate, in small parts thin, mostly 0.7 (1) mm thick, consisting of verruciform areolae, 1—3 mm wide, separated by narrow cracks, often constricted at base and easily loosening, surface densely verruculose, I—, CaCl—, Pd—, KOH+ faintly yellow. — The interior of the thallus consists of a very lax tissue of long-celled, about 3.5—5 μ thick, thin-walled hyphae. Upper 70—80 μ filled with algae, 7—10 μ diam., in a dense stratum. Cortex partly developed, hyaline, effuse.

Apothecia numerous, 1—1.5 mm wide, appressed to the thallus, irregular in shape, even lobate, disc black, plane at first and with prominent margin, then \pm convex and immarginate, slightly pruinose. — Pale part of apothecium 200—250 μ deep, medulla below it darkened by dense, small granules, dissolving in HNO₃ but not in KOH. Exciple margin 50—80 μ thick, very dark, not translucent, in KOH bright blue-green, in HNO₃ purplish, exciple soon disappearing laterally. Hypothecium 100—150 μ thick, colourless, hyphae perpendicular in upper part. Thecium 60—70 μ high, I+ blue; upper 9—12 μ dark blue-green, in KOH pale greenish, in HNO₃ sordid purplish. Paraphyses \pm contiguous in water, 1.5 μ thick, in KOH subdiscrete with hardly thicker ends and few remaining granules between them, persistent however in HNO₃. Asci about 50 \times 12 μ , clavate. Spores 8, 9—11 \times 7—8 μ , broadly ellipsoid.

Pyrenidia immersed, subglobose with \pm brown wall. Conidia 15—18 \times 0.5 μ , slightly and variously bent.

The species must be placed in the "*goniophila*-group" on account of the rather lax paraphyses, broad spores and long conidia. It is undoubtedly a high-alpine species, both specimens being collected at 2900 m altitude. I have not seen the type but the description of it agrees very well with mine.

Lecanora phaeobola Tuck.

Genera Lich.: 115, 1872, note; Synops. N. Amer. Lich. 1: 190, 1882. Hasse in Bryolog. 16: 1, 1913; Contrib. U. S. Nation. Herb. 17: 93, 1913. Zahlbr., Catal. Lich. 5: 507, 1928. — *Lecanora granvinensis* Vain. apud Havaas in Bergens Mus. Aarbog 1: 19, 1909 (no descript.).

Exs.: Hav. Lich. Norv. *Exs.* 104, 720; Lich. Norv. Occid. *Exs.* 235, 285.

Tuckerman's description runs thus: "thallus papillate-granulose, the minute granules polished, olivaceous brown; apothecia smallish, appressed; disc reddish-brown, shining, soon turgid, and the thin, entire thalline margin disappearing. Spores fusiform-ellipsoid, $9-15 \times 3-5$ mic." *Synops.* l.c.

During a visit to Uppsala in 1954 I noticed in the herbarium there a corticolous *Lecanora* species with thallus and apothecia bright red-brown. It struck me that I had seen it before and in Hav. Norv. *Exs.* 104 I found the same plant. And then I found in my herbarium three specimens of it sent to me by Havås but never determined.

I will add the following items from the specimen on birch bark collected in Granvin, Hardanger, Norway 1942. The dark red thallus covers here an area, 6.5×6 cm wide interrupted by some naked parts of the bark. It is "papillate-granulose" and shining. Apothecia rather numerous, 0.4–0.7 mm wide, prominent with constricted base, disc red-brown to pitch-brown, concave, with thick, concolorous margin. — Apothecia 0.25–0.3 mm thick, KOH–, CaCl–, Pd–, pale part down to the algae 200 μ deep. Algal stratum 30–55 μ thick, contiguous all round to near edge, lax, obscured by air. Outside it lies a cortex, at edge 35 μ , at base 50 μ thick of gelatinous, intricate, 10–12 μ thick hyphae. Exciple inside at edge 50 μ thick, laterally 35 μ , gelatinose, radiating, I–. Hypothecium at centre 100 μ thick, hyaline, its hyphae \pm intricate, I+ very pale blue. Thecium 55–70 μ high, pale, I+ dark blue, upper 17 μ pale brown-yellow, in KOH sordid brown. Paraphyses contiguous also in KOH, the tips 2.5–4 μ . Spores 8, $7-8.5 \times 2.5$ μ , oblong to \pm fusiform.

Another specimen on birch bark is from Åsene in Granvin at 34 m alt. and has some apothecia larger and immarginate. The third specimen is from Kalhagefossen in Granvin and collected 1950 on base of old fir-trunks. It has many apothecia 1 mm wide, convex and intensely shining. These are the hitherto known localities in Europe.

In America it is collected only in California, the authentic specimen on bark of *Libocedrus* and *Abies* by H. N. Bolander (specimen in Uppsala). Hasse records it from bark of "*Lebocedrus*" *decurrens* at "Pinecrest", San Bernardino Mts at 1600 m alt. (in Bryologist) and in Lich. flora of S. Calif. from Sierra Nevada near Wauwona at 1400 m alt. on dead *Pinus lambertiana*. According to Tuckerman (1872) the "spermo-

gones are black, spermatia staff-shaped, on simple sterigmas." He also points out that the spores resemble those of *Lecanora badia*.

Ramalina lusitanica H. Magn. n. sp.

Thallus foliaceus, erectus, cinereo- vel sordido-flavescens, opacus, laciniae a puncto affixo solitariae, irregulares, valde dilatatae, crassiusculae, superne incisae vel lobatae, sat molles, superficie ruguloso, venoso vel parce reticulato, KOH—, CaCl—, Pd—. Apothecia sat frequentia, apicalia, majuscula, disco pallide carneo, subnudo, laevigato, saepe undulato, mox subtus reticulato, margine prominente, persistente, inflexo. Sporae ellipsoideae, paucae curvatae.

Lusitania. Estremadura: Serra da Arrabida, between Setubal and Torre de Outão on trees, May 1, 1931. G. Nilsson Degelius (in hb.).

Laciniae 2—3 cm high, about 1 cm broad, with one affixing point, irregularly divided into two broad or a few less broad lobes with irregular, sometimes dentate outlines, their surface very rough from ridges, veins and impressions, soft and partly subtomentose, both sides equally uneven and coloured. — Sections of the thallus difficult to obtain on account of its softness, but thallus cortex 10—12 μ thick with thick-walled, intricate hyphae as in most other *Ramalina*-species. Mechanical tissue little developed.

Apothecia 2—4 mm wide, underside coarsely rough, in older apothecia resembling the cup of an oak-fruit. — Lower cortex of the apothecia 20—40 μ thick, translucent, under surface covered by granules, KOH+ yellowish (no mist), hyphae densely intricate, thick-walled, mainly perpendicular in exterior part. Medulla very lax, hyphae thick-walled, 3—4 μ thick, densely covered by granules, nubilitating the medulla, \pm dissolving in KOH, more rapidly in HNO₃. Algae dense, 7—10 μ diam., in a \pm continuous stratum inside the cortex. Hypothecium about 15 μ thick, colourless. Thecium 50 μ high, upper 8—10 μ interspersed with granules. Asci about 40 \times 12 μ , narrowly clavate. Spores 8, 11—13 \times 4.5—5 μ , many curved.

The new species must be a near relative of *R. evernioides* but can not be considered a variety of that species on account of the absolute absence of sorediate parts and of distinct reticulation. The many well developed apothecia also strengthen my opinion of its position as a new species.

Ramalina mediterranea H. Magn. n. sp.

Thallus caespites densos formans, olivaceo-glaucescens, late adnatus, brevis, laciniae erectae, parallelae, applanatae vel varie compressae,

inaequales, latiusculae vel angustae, parce ramosae, apicibus obtusis, KOH—, CaCl—, Pd—. Apothecia numerosa, saepe superficiem caespitis subtegentia, omnia in altitudine communi sedentia, dilatata, primum concava, mox plana, dense glauco-pruinosa, margine tenui haud prominente cincto, subtus laevigata. Sporae mediocres, ellipsoideae, saepe leviter curvatae.

Greece. Attika: Hymettos, "an ausgesetzten Felsen (Silikat), ± 7 —800 m" (291, holotype); Aegina, "bei Monastiri, sterile, staubige Felsen (155)"; "Felsgruppe (159)", sterile, young, low, half-globose tufts, all collected 1954 by J. Poelt (in hb.). No 155 also in half-globose tufts of densely packed laciniae, fert. — Spain. S part. "Granithügel zwischen Algeciras und Tavita, Vertikalfläche am Gipfel" 1953, J. Poelt (in hb.).

Caespites up to 4×2 cm wide, 1—1.3 cm high, laciniae widening upwards, 1—2 mm broad, stout, fragile, very uneven, rugulose, irregularly branched with narrow, blunt apices. — Apothecia apical, seen from above almost covering the surface, apparently fistulose and sometimes lacking the inner part of the medulla. They are up to 0.5 mm thick, their lower cortex 50—80 μ thick, colourless or pale fulvous in exterior part, in KOH colourless, exterior 30 μ with subintricate to perpendicular hyphae and 0.5 μ thick lumina, inner part with \pm parallel and horizontal hyphae, limitation to lower algal stratum even. Algae 8—10 μ diam. in a continuous stratum of uneven thickness. Medullary hyphae 5—7 μ , thick-walled, covered by \pm granules dissolving in KOH. Upper gonidial stratum 40—60 μ thick, dense, continuous. Exciple + hypothecium 40—50 μ , diffusely delimited, their hyphae inconspicuous. Thecium 40—50 μ high, surface with an 8—10 μ layer grey from granules, lasting in HNO₃, dissolving in KOH. Thecium and hypothecium I+ dark blue to the algae. Paraphyses 1.5 μ to the tips, unbranched. Spores 8, 11—14 \times 4.5—5 μ , mostly slightly curved.

The new species has the appearance of a densely fertile *fastigiata*, but has a broad base of the tufts on the stone and does probably not belong to Sect. *Fistulosae*. No perforations are visible and there is always medulla present in the laciniae, only occasionally lacking in the interior of the apothecia.

Ramalina protecta H. Magn. n. sp.

Thallus flavescenti-albidus, brevis, suberectus, laciniae dispersae, squamuliformes, applanatae, profunde divisae, superne dilatatae, subflabelliformes, laevigatae, apicibus dilatatis, soraliis labriformibus ornatis, Pd—, CaCl—, KOH+ leviter flavescens. Sterilis.

Hispania. El Escorial, Castilla la nueva 1931, G. Degelius. On granitic rock, under overhang.

Laciniae usually 3—5 mm high, solitary or in groups, from a central base divided into ascendant branches, much incised or denticulate in upper part, without pseudocyphellae or glebulae. Soralia at the ends beginning on the underside, spreading on the recurved ends and well visible from above, 2—3 mm broad, subfarinose. — Sections of thallus about 200 μ thick. Upper 35—40 μ thick layer above algal stratum is in its uppermost part \pm yellow granular, translucent in KOH, the outermost layer consisting of densely intricate, thin hyphae but below it more loosely intertexted hyphae. Algal stratum varying, 25—35 μ thick with undulating surface and 9—12 μ large algae. Medulla below it about 100 μ thick, the lowest 20—30 μ densely granular, translucent in KOH, the intricate hyphae here resembling those immediately above the algal stratum and forming a somewhat diffuse under surface which in water is smooth and well delimited by a gelatinous cover. The cortical structure is thus of *Ramalina*-type.

The new species may be related to *R. capitata* (with \pm globose, coarse soralia) and still more to *digitellata* Nyl. (with partly sorediate underside) but has much broader, recurved soralia of the same type as *Physcia ascendens*.

Buellia (Diploicia) hypoleuca H. Magn. n. sp.

Thallus squamulosus, squamulae viridi-glaucæ vel pallide ochroleucæ, subconvexæ, lobatæ, undulatæ, \pm contiguæ, sæpius partim albo-pruinosæ, I—, KOH—, Pd—, sed cortex CaCl sordide rubescens, subtus obscuræ, arcte adnatæ. Apothecia adpressa, basi innata, primum subconvexa, dein convexa, immarginata, atra. Hypothecium crasum, incoloratum, cum thecio oleo-inspersum. Thecium superne fuscoluteum. Paraphyses arcte contiguæ, apicibus clavatis. Sporæ mediocres, obscuræ, uniseptatæ, pariete uniformi, leviter incrassato.

Wintschgau (in Südtirol): "Trockene Felsen oberhalb Graun am Reschensee", on earth 1955, J. Poelt (in herb.).

Squamules 1—2 mm wide, very irregular in shape, flattened or raised and congested upon the turfy earth, forming a continuous crust, sometimes entirely pruinose, usually only in part covered by a bluish white pruina. — Thallus about 200 μ thick, base 25 μ dark brown, continuing also below the apothecium. Medulla colourless, 35—40 μ thick, its cells with oily content as also the cortical cells. Algal stratum 40—50 μ thick, dense, continuous, algae 8—10 μ diam. Cortex 35—40 μ thick, colour-

less, cellular, surface $7\ \mu$ is pale yellow-brown and covered by $8\text{--}12\ \mu$ thick necrotic layer. Cortex in CaCl pale dull orange and hypothecium also \pm coloured, cortical cells now distinct, $3\text{--}3.5\ \mu$ diam.

Apothecia numerous, occasionally contiguous, uniformly $0.6\text{--}0.8\ \text{mm}$ wide. — Section of an apothecium $0.7\ \text{mm}$ broad, $0.3\ \text{mm}$ thick, half globose. Exciple poorly developed, \pm excluded, below margin with $25\ \mu$ thick, dark brown surface, K+ faintly yellowish. Hypothecium colourless, about $100\ \mu$ thick, greyish from the oily content. Thecium $100\ \mu$ high, colourless but nubilated from oil, I+ dark blue; upper $10\text{--}12\ \mu$ brown-yellow, rough. Paraphyses about $2\ \mu$ thick in KOH, tips firmly contiguous, $5\text{--}6\ \mu$, pale brown yellow, in HNO_3 brown-red. Spores 8, $16\text{--}18 \times 7.5\text{--}8.5\ \mu$, \pm dark brownish green, when older slightly constricted, wall moderately and uniformly thickened without halo.

The new species is perhaps best placed in Sect. *Diploicia* Stiz. although the squamules do not form a radiating thallus, but they are distinctly corticate. The most obvious interior characteristics are the pale hypothecium and the oily content both in thallus and apothecia.

A Plant Collection from SW Yukon

By DORIS LÖVE and N. J. FREEDMAN

In his "History of Botanical Exploration in Alaska and Yukon Territories from the time of their discovery to 1940", Hultén (1940) gives an excellent survey of the plant collections made by professional and amateur botanists in this part of the world. The first collection made in the Yukon Territory seems to have been that of W. J. S. Pullen in 1848—50, a member of the Franklin Searching Expeditions, who collected along the Arctic coast. Since then many collections have been made in different parts of this country. But in spite of this, Yukon is



Fig. 1. Location of the Quill creek area in the Yukon Territory.

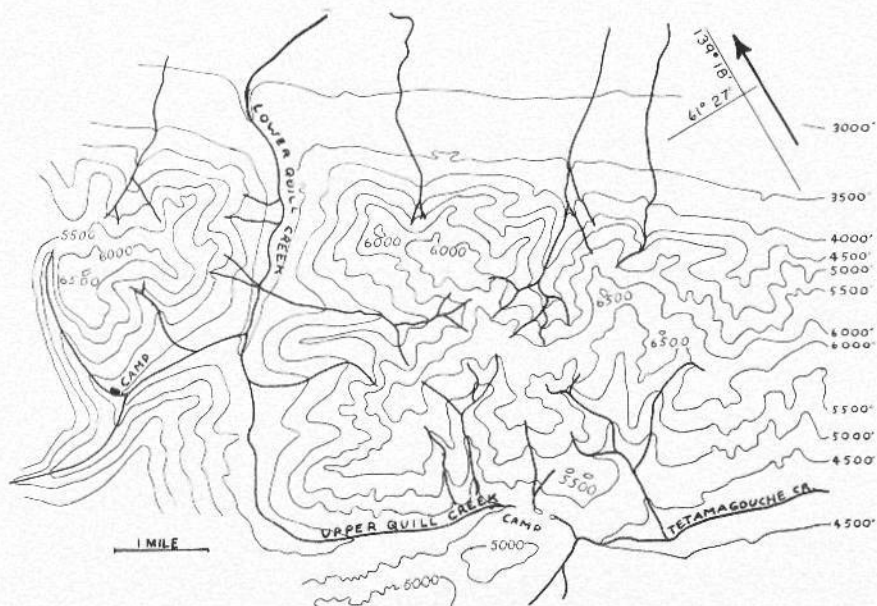


Fig. 2. The Quill creek area, showing elevations and river systems.

far from well known botanically, and every collection seems to bring some new contribution to our knowledge of the flora of this territory.

During the summer of 1953, while working for the Hudson Bay Exploration and Development, a subsidiary of Hudson Bay Mining and Smelting Co. Ltd., the junior author was assigned to the holdings of this company in SW Yukon (Fig. 1). During the four months spent there, the opportunity to collect plants presented itself. Most of the collecting was done within a radius of three to four miles of the main camp, below named "the Quill creek camp". This was situated near one of the small tributaries to the Quill creek, approximately half way between Shakwak valley and Donjek river, at an elevation of about 4000 ft. Collections were also made around a second camp, situated in the Tetamagouche pass, the divide between Quill creek and Tetamagouche creek, at an elevation about 4600 ft. Excursions were made into the mountains northward of both Quill creek camp and the Upper Quill creek valley, as well as along the Lower Quill creek towards the Alaska highway (Fig. 2).

The total area concerned lies between $139^{\circ}20'$ — $139^{\circ}35'$ W. long. and $61^{\circ}24'$ — $61^{\circ}30'$ N. lat. The mountain system belongs to the Kluane range, which forms the northeastern front of the St. Elias Mountains

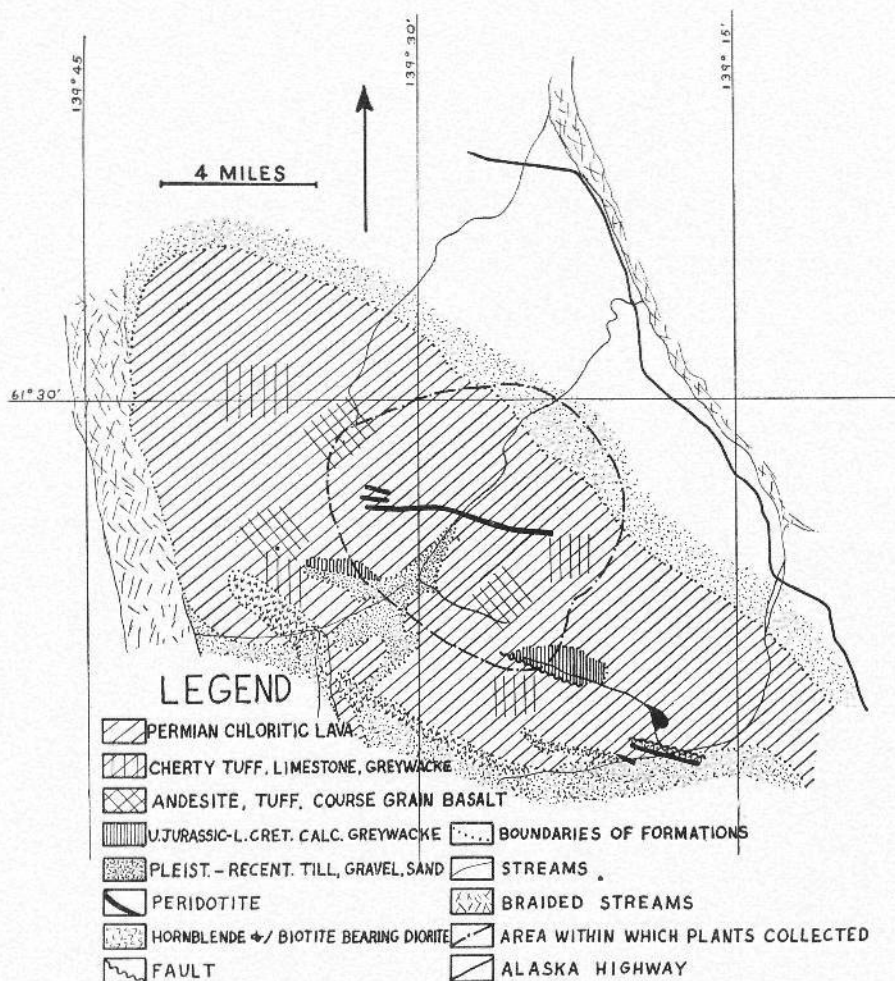


Fig. 3. Geology of the Quill creek area, based on Muller 1954.

adjacent to Shakwak valley. The peaks of the Klauane range average 6000 to 8000 ft. in elevation. The nearest town is Burwash Landing, which can be reached from the camp by travelling ten miles on a bulldozed road along Lower Quill creek north-eastwards to the Alaska Highway, and then ten miles southeast along the highway.

Quill creek and its tributaries are normally narrow braided streams with boulders, gravel and sand making up by far the major proportion of the stream beds. A heavy rainfall or continuous rain for several days can swell the streams to raging torrents, three to four times as

broad as usual and capable of grinding two foot wide boulders against each other.

Geologically (Bostock 1952, Muller 1954) the area is mainly of Permian age. Most of the exposed rock is chloritic lava and tuff with interspersed altered sedimentary and volcanic rocks. Fossils may be found in most of the limestone encountered, and are in some sections quite plentiful, tetracorals being most frequent. Andesite and coarse grained basalt are also common throughout the area. An east-west band of peridotites bisects the area. Across the Quill creek camp and along the Tetamagouche creek there is a small fault, which is the limit of an area of Mesozoic calcareous greywacke and argillites (Fig. 3).

The mountains of the area are often very steep with slopes covered by talus slides, either open (and then often crossed by trails of mountain sheep and goats) or covered by a thin layer of turf. The profile of the peaks is not too rugged and when the slopes have been climbed, the going is generally easy along the smooth ridges.

Forests occur only along the streams and in the valleys mainly up to 4500 feet elevation, except for some moist and sheltered draws, where trees may grow somewhat further up. Most of the trees are coniferous but several kinds of deciduous trees are also met with.

The most extensive meadows are to be found in the Tetamagouche valley but at the highest part of the Tetamagouche pass are two small lakes from which water seeps out over the surrounding grassland turning it into more of a sedge bog than a meadow.

All snow disappears from the area during the warmth of the summer, but some snow fields remain till fairly late in ravines and draws. From these there is a steady trickle of melt-water, which seems to go on even after the visible snow has gone, and then may come from thawing ground below the talus.

Records of daily maximum and minimum temperatures were kept during 1953 and 1954 at the main camp, (cf. graphs, Fig. 4). The average temperature for the area during June, July and August was about 55° F (12° C) for both years. However, during the day the temperature can rise considerably, and it reached peaks of 89° to 90° F (32° C) on several occasions in 1953. In 1954, it was as a rule 10° to 15° F (5° C) colder. The extreme high for this part of Yukon from 1921 to 1950 is 90° to 95° F (32°—35° C) (Thomas 1953). Lowest temperatures recorded during June—August 1953 were 26° (−3.3° C) and 28° F (−2.2° C). During the winter, records were not kept constantly at the camp, but it is known that the average January temperature for

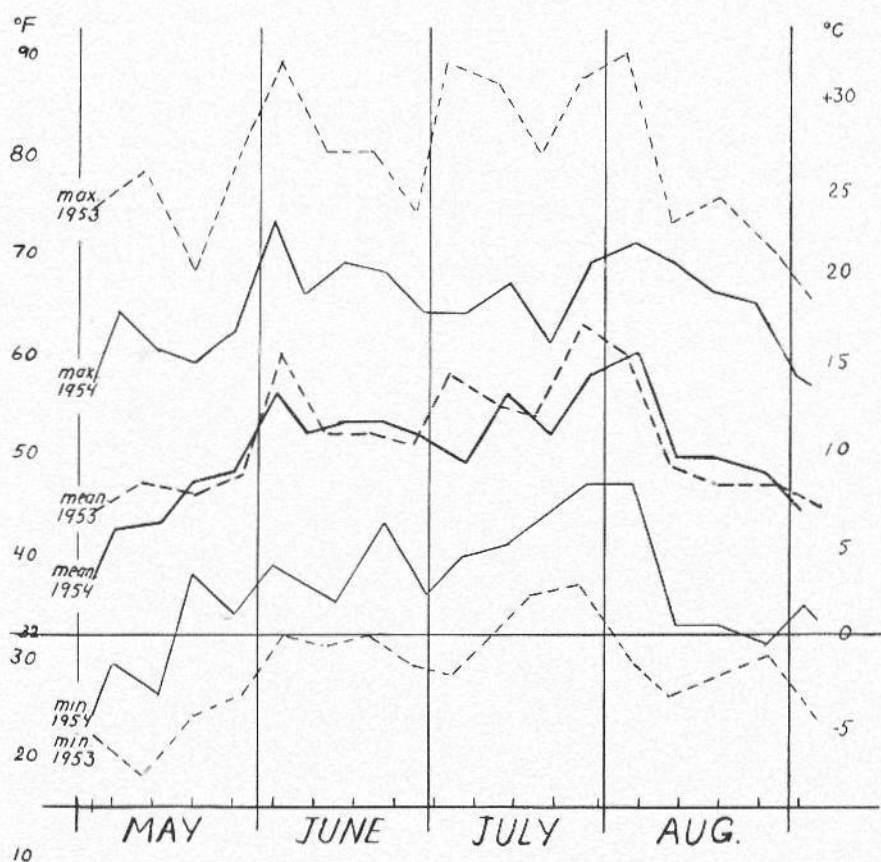


Fig. 4. Graphs showing maximum, minimum and mean temperature at Quill creek camp during the summers of 1953 and 1954 (courtesy Mr. J. Haskins).

this part of Yukon is about -10°F (-23°C) with extreme lows as far down as to -60° to -70°F (-51° — -56°C) (Thomas 1953).

The frostfree period during the summer varies considerably. During the two years recorded at the camp, 1953 had a frostfree period of only about 3 weeks from July 12 to August 2, whereas 1954 experienced no frosts between May 16 and August 22. This of course also means that the vegetation period varies from year to year and that seedsetting some years will be light, other years abundant, a condition which is well known from all alpine and arctic regions. Also to be noted is the fact, that the Quill creek area is definitely south of the permafrost region in Yukon.

The heaviest rainfalls occur during the summer (e.g. in 1953, the

area had a 10 day steady drizzle towards the end of June), and the average precipitation is 10 to 15 inches (250—380 mm) from April to October. During the winter months about 80 inches (ca. 2 m) of snow falls, thus making the average precipitation over the year (=total rainfall + $\frac{1}{10}$ of snow) about 15—20 inches (380—500 mm) (Thomas 1953).

The winds are prevailing westerly, averaging 10 miles per hour (5 m/sec).

One of the questions of unending interest to anyone who concerns himself with the flora of this part of the continent, is the problem of the connection between the present distribution of plants and the glaciation of the Ice Age. We know that in the central part of Yukon and Alaska there is a large region which was never covered by glaciers during any of the Glacial periods, and which acted as a refugium where plants from earlier geological periods had a chance to survive. There is no doubt that only the hardiest of the preglacial plants succeeded in doing so, since the climate even in unglaciated areas must have been severe; and we have been able to find plants there, the distribution of which indicate that they are remnants from as early as a Tertiary flora. One such species is e.g. *Smelowskia borealis* (Greene) Drury & Rollins (cf. Hultén 1945, Porsild 1951, Drury and Rollins 1952).

Among the plants collected in the Quill creek area, there are a large number belonging to other species also considered to be survivors from pre-glacial times. The Quill creek area is however not within the limits of the unglaciated refugium in central Yukon-Alaska, and, according to Dr. H. S. Bostock of the Geological Survey of Canada (in litt.), our area has most likely been completely covered by ice during the maximum Pleistocene glaciation. On the other hand, during the later not-so-heavy Wisconsin glaciation, there may have been nunatak tops and ridges around Quill, Tetamagouche and Halfbreed creeks, where plants which had migrated there during the interglacial might have survived. Such nunatak-areas are found all around the big refugium as far south-east as the Cassiar Mountains in SE Yukon.

Nevertheless it is difficult to establish to what extent the mountains on the SE flank of St. Elias range were glaciated even during the last advance of the ice. The precipitation in this region is relatively light and ice might have accumulated locally without much movement. Therefore lack of till and erratics, and of deep weathering of bedrock etc. does not necessarily mean a definite absence of glaciation in a specific area. Neither does the presence of a large number of plant species considered as preglacial relicts definitely mean that this area



Fig. 5. V-shaped valley in the Quill creek area, indicative of water- rather than ice-erosion. In the foreground *Picea glauca* v. *albertiana*.

has been ice free and that these plants have survived *in situ*. The distance from the Quill creek area to the refugium is a bare hundred miles to the north, and plants could in the period since the ice retreated have had time to disperse into our area. It will therefore be left an open question whether these plants really did survive the glacial age on the Quill creek area nunataks. (Fig. 5).

A number of plants not previously reported in the literature from Yukon were also found in the Quill creek area: *Cystopteris Dickieana* Sim., *Acetosa alpestris* (Scop.) Löve, *Stellaria alaskana* Hult., *Saxifraga punctata* L. ssp. *pacifica* Hult., *Campanula uniflora* L.

In addition to these there is a specimen close to *Cerastium alpinum* L. As it is unlikely, however, that we have anything of *C. alpinum* L. proper in Yukon (Hultén, personal communication), this specimen has been sent to Prof. Hultén for study in connection with his review of the American *Cerastium alpinum* complex.

The *Papaver*-problem has been given special attention below, for it proved to be of considerable interest. Three kinds of poppies of the "radicatum"-group collected by the junior author belong to types not previously described, and have accordingly been described as the following new species: *Papaver kluanensis* D. Löve, *P. nigroflavum* D. Löve, *P. Freedmanianum* D. Löve.

Still another type of the *radicatum*-group was collected, a single, white-flowered specimen. It could not be established, if it was the same or not as *P. alboroseum* Hult., but it may as well represent a new taxon.

In connection with the discussion of the poppy problem, the following *Papaver*-species from outside the Quill-creek area have also been described as new: *Papaver cornwallisensis* D. Löve from the Arctic Archipelago; and *P. Scammanianum* D. Löve from the interior Alaska.

The senior author is alone responsible for the determination and discussion of the plants listed below. The same system has been followed as in Hultén's Alaska-flora (Hultén 1941—1950). The collections were all made by the junior author in 1953. They do not represent the entire flora of the area, but are rather random samples of what is found growing there. The dates were noted at the time of collecting, but the elevation has been estimated from the maps afterwards. Only in cases where definitely known has the environment (ridge, meadow etc.) been given.

The symbols (M) and (F) in connection with the collection data given

in the list below mean that the specimen in question is stored in the Herbarium of the University of Manitoba (M), or in the private collection of the junior author (F).

Lower plants were not collected, but *Cetraria islandica*, *C. nivalis*, *Peltigera aphthosa*, and *Alectoria ochroleuca* were found among the specimens.

We wish to express our gratitude for unflinching assistance given to us in the course of the preparation of this paper by a number of fellow scientists and friends, among whom we would mention especially Dr. H. S. Bostock, Geological Survey of Canada, Ottawa, Dr. A. Cronquist, New York Botanical Garden, New York, Prof. Eric Hultén, State Museum of Natural History, Stockholm, Sweden, Dr. H. J. Scoggan, National Museum, Ottawa and Mr. Marcel Raymond, Jardin Botanique, Montreal. We are also indebted to Mr. J. Haskins for the temperature graphs, to Mr. J. A. Proudfoot for certain geological literature and to Mr. E. Piitz and Mr. K. Abel for the use of their photographs. Acknowledgement is also made to the National Research Council of Canada for generous support of the taxonomical work.

1. *Cystopteris Dickieana* Sim.

New to Yukon. — Coll. June 9. (M), July 23, (F), N of Quill creek camp, elev. ca. 4000—4600 ft.

For nearly a century this species, which was described by Sim (1848) from a locality near Aberdeen, Scotland, has been almost completely neglected. Since its best distinguishing character, separating it from *C. fragilis*, is the form of the spores, the taxon was regarded as only a variety by Moore (1848). It was, however, again described as a species, *C. Baenitzii*, by Dörfler (in Baenitz 1891), this time from Norway, and once more reduced to a variety by Warnstein (in Ascherson and Graebner 1896) and to only a form by Ascherson and Graebner (1912). On the basis of geographical distinctiveness, Hylander (1941, 1945, 1953) named it a subspecies, while Fomin (1930, 1934), Hadač (1944), Manton (1950), Larsen (1952), Flora of Murmansk (1953), Wiggins (1954), and Wagner (1955) regard it as a species separate from *C. fragilis* (L.) Bernh.

Until recently, *C. Dickieana* was known only from Eurasia, i.e. from Spitzbergen and Novaya Zemlya in the north, to the mountains of Algier, Asia Minor, Iran and Himalaya in the south, and from Scotland in the west to Bering Sea in the east (Fomin, 1934, Hadač, 1944, Flora of Murmansk, 1953). The first report from North America seems to be that of Hadač (1944) who mentions it from NE Greenland and Ellesmereland. Raymond (1950) lists it without further comment as an Atlantic species of Labrador, on the basis of a report by Huustich and Petterson (1944). The distribution of this species in Greenland was mapped by Larsen (1952), who also reports it from Iceland, and Wiggins (1954) reports it from arctic Alaska.

C. Dickieana is a very variable species, and is, in spite of several distinguishing characteristics, very difficult to separate not only from *C. fragilis* but also sometimes from *Woodsia glabella*. The only absolutely reliable distinction

between the first two is the character of the spore surface, which in *C. fragilis* is spiny, in *C. Dickieana* reticulate-verrucose. The existence of hairs among the sporangia in *Woodsia glabella* and the complete lack of hairs in *C. Dickieana* is a good mark for the separation of these two species. The leaf-shape alone varies from anything similar to a small *Woodsia* to that of a middle sized *C. fragilis* and is usually not very reliable. This is even more difficult because *C. Dickieana* seems to grow not only in approximately the same areas as *C. fragilis* and *Woodsia glabella*, but also sometimes practically in the same clump. It is therefore always advisable to check the spores in identifying any of the above species.

The fern collected in the rocks north of Quill Creek camp proved to be the true *Cystopteris Dickieana* Sim. This agrees well with Wiggins' (1954) observations from Alaska. In order to check if any more localities could be found, material of *C. fragilis* was borrowed from the National Herbarium of Ottawa, and of the 14 collections studied, the following five proved to be *C. Dickieana*:

1. Seward peninsula, Nome, Anville Hill and Dexter Creek, $64^{\circ}30' N$, $165^{\circ}20' W$, elev. sea-level — 1000 ft, Aug. 6—10, 1926, A. E. and R. T. Porsild no. 1301 (Nat. Mus. no 608).

2. Seward peninsula, S. coast near Bluff, $64^{\circ}33' N$, $163^{\circ}45' W$, elev. sea-level — 1500 ft., Aug. 5—6, 1926, A. E. and R. T. Porsild no 1174 (Nat. Mus. no 609).

3. Norton Sound: Low volcanic hills at Quiquertariaq, $63^{\circ}35' N$, $161 W$, elev. 1000 ft., July 27, 1926, A. E. and R. T. Porsild, no 1032 (Nat. Mus. no 610).

4. Alaska Range: Richardson's Highway between Summit and McCarthy, $63^{\circ}10' N$ — $64^{\circ}10' N$, $145^{\circ}40' W$, elev. 1—3000 ft., June 28, 1926, A. E. and R. T. Porsild no 379 (Nat. Mus. no 612).

5. Central Alaska, White Mts, Fossil Creek, O. Gjaerevoll, 26. VII. 53 (Nat. Mus. 225310).

This suggests that *C. Dickieana* can be expected in many more localities in Alaska and probably also in Yukon. Unfortunately material of *Woodsia* from this region could not be checked, but it is not unlikely (cf. Wiggins 1954), that there as well it may be possible to identify some *C. Dickieana* in older collections. Our specimens seem to be the first identified from Yukon.

Outside Alaska-Yukon, the species has recently been collected on Southampton Island by Dr. J. C. Ritchie, Winnipeg (personal communication) in 1954, at Fort Churchill, Manitoba, also by Dr. Ritchie (1954) as well as at The Pas, Manitoba (Rock Lake, July 1953) by Mrs. Louis Bird and the same locality (July 1954) by Mr. Walter Krivda (specimens in the Herbarium of the University of Manitoba).

A collection of *Cystopteris fragilis* and *Woodsia glabella* from the Department of Botany and Plant Pathology of the Science Service, Ottawa, was also studied. The *Woodsia glabella* were all correctly identified, but among the *Cystopteris fragilis* the following specimens proved to be *C. Dickieana*:

1. Melville Peninsula, Avatapatsiak, Havilland Bay, $66^{\circ}35' N$, $85^{\circ}25' W$ Aug. 16, 1950, coll. P. F. Bruggeman, no 132.

2. Southampton Island, N.W.T., Bear's Cove, calcareous gravel, July 20, 1951, D. K. Brown, no 807.



Fig. 6. Map of the known distribution of *Cystopteris Dickieana* in the Western Hemisphere (Greenland after Larsen 1952).

3. Hudson Strait, Diana Bay, lat. 61° , 17—8—1939. G. Gardner, no 38570.
4. Lac Tashwak, à la source de la rivière Kogaluk, à environ 95 mi. de la baie d'Hudson, sur rocher granitique vertical. 27 juillet 1948, Jacques Rousseau, no 592.
5. Post de Payne Bay, vers $70^{\circ}1'$ long W, rochers schisteux de la berge. 14 août 1948. Jacques Rousseau, no 1294.
6. Baie Payne, sur la rive opposée au poste vers $70^{\circ}1'$ long. W: sur rocher ferrugineux. 16 août 1948. Jacques Rousseau, no 1425.
7. Fort Chimo area, Quebec, $58^{\circ}07' N$, $68^{\circ}23' W$, Aug. 10, 1948. J. A. Calder, no 2489.
8. Frobisher Bay, Baffin Island, $63^{\circ}45' N$, $68^{\circ}32' W$, July 10, 1948, H. A. Senn, J. A. Calder, no 3871.
9. Minnesota, U.S.A., Kaketogama lake, opposite Pine Island, July 18, 1952, Olga Lakela no. 15 253 (det. as *C. Dickieana* by O. L.).
10. Greenland, Clavering Island, Green valley, $74^{\circ}17' N$, $20^{\circ}28' W$, 20. VII 1930, leg. Seidenfaden, no 772.
11. Greenland, "Sletten i Klipper". Aug. 20, 1937. Johs. Grøntved, no 681.
12. Greenland, Disko, Godhavn, lat. $69^{\circ} N$, Tabita Broberg.
13. Greenland, Scoresbysund, $71^{\circ}20' N$, $25^{\circ}05' W$, Aug. 15, 1937. Thorv. Sørensen, no 207.

Though scanty in number, these finds give the impression that *Cystopteris Dickieana* is a circumpolar, arctic-alpine species, probably of very old origin. In Greenland, *C. Dickieana* reaches further north than *C. fragilis* (Larsen 1952), and in Spitzbergen there is no *C. fragilis* at all (Hadač 1944). We do not know yet how far north, nor south *C. Dickieana* reaches in North America, but the localities so far known have been indicated on the map (fig. 6). After this paper was sent to the press the following new localities have been found:

- 1) Mt. Bohemia, Michigan (cf. Wagner 1955),
- 2) Tod Lake, Manitoba, No 1263, 1955, J. C. Ritchie,
- 3) Mt. Temple, Alberta, 12.VII.55, A. & D. Löve, and
- 4) Yoho Valley, British Columbia, 13.VII.55, A. & D. Löve.

2. *Equisetum arvense* L. ssp. *boreale* (Bong) Löve

Coll. June 19, in the vicinity of Quill creek camp, elev. 4000—4500 ft. (M).

Our specimens agree completely with the description of Bongard's *E. boreale* (cf. Marie-Victorin 1927; Löve, 1948), have triangular instead of quadrangular branches, are smooth, not scaberulous, etc. The subspecies seems to be dominant in Alaska (Trelease 1904), and probably also in Yukon.

3. *Equisetum pratense* Ehrh.

Coll. July 10, near junction of Quill creek road and Alaska highway elev. ca. 3500 ft. (M). — A common species.

4. *Hippochaete variegatum* (Schleich.) Börner

(Syn.: *Equisetum variegatum* Schleich.). — Coll. June 26, in Upper Quill creek valley, elev. 4000—4500 ft. (M).

In naming this species we prefer to follow the nomenclature by Rothmaler (1944), separating the two distinct *Equisetum*-sections as genera. Our specimens belong to the typical race and are quite small, so that they cannot be referred to Hultén's *Equisetum variegatum* Schleich. ssp. *alaskanum* (Hultén 1941).

5. *Huperzia Selago* (L.) Bernh. ssp. *appressum* (Desv.) D. Löve comb. nova

It is based upon *Lycopodium Selago* L. f. *appressum* Desvaux, 1827, in Ann. Soc. Linn. Paris VI, p. 180. — Coll. July 16, in the mountains NW of Quill creek camp, elev. ca. 5000 ft. (M).

In accordance with the nomenclature of Rothmaler (1944), who separates the genus *Huperzia* from *Lycopodium*, it becomes necessary to transfer the ssp. *appressum*, which can be looked upon as an arctic-alpine race of the species *Huperzia Selago*.

6. *Picea glauca* (Moench) Voss var. *albertiana* (S. Brown) Sarg.

Coll. June 28, in Upper Quill creek valley, elev. ca. 4500 ft. (M).

Forests grow in this area only along rivers and streams (Fig. 7), and ascend to an elevation of ca. 4500 ft., or occasionally higher in sheltered draws. The most common tree is *Picea glauca* (Moench) Voss only represented by its variety *albertiana* (S. Brown) Sarg. in the Quill creek area.

7. *Juniperus communis* L. ssp. *nana* (Willd.) Arcang.

Coll. June 3, near Quill creek camp, elev. ca. 4000 ft. (M).

The juniper is fairly common all over the entire area on southfacing slopes in the wooded zone.

8. *Festuca altaica* Trin.

Coll. June 16, in the Tetamagouche valley, elev. ca. 4500 ft. (M).

This specimen, though fragmentary, was adequate for identification by Drs. Boivin and Dore of the Science Service, Ottawa. The species seems to be common throughout southern Yukon often reaching high altitudes.

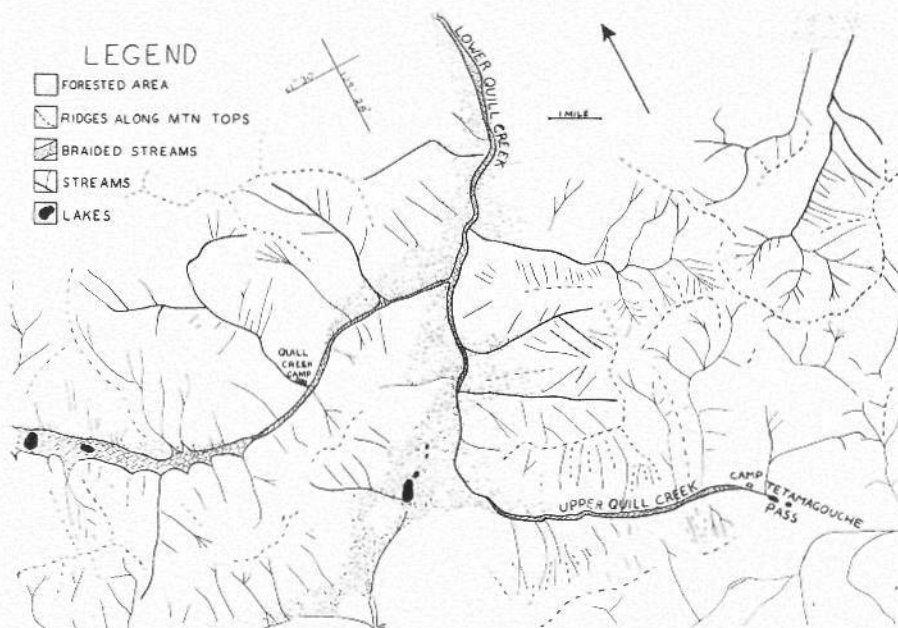


Fig. 7. Distribution of forests in the Quill creek area.

9. *Hordeum jubatum* L.

Coll. July 10, near Alaska Highway, elev. ca. 3500 ft. (M).

This is a rapidly spreading weed along roads and in clearings in Yukon and Alaska.

10. *Calamagrostis canadensis* R.Br.

Coll. July 10, near the junction of Quill creek road and Alaska Highway elev. 3500 ft. (M).

This specimen agrees well with the species proper and cannot be referred to any of the varieties or subspecies.

11. *Calamagrostis purpurascens* R.Br.

Coll. June 15, near Quill creek camp, elev. ca. 4000 ft. (M), and July 23 in the Upper Quill creek valley, elev. ca. 4500 ft. (F).

Common all over the area.

12. *Eriophorum vaginatum* L.

Coll. June 2, near Quill creek camp, elev. ca. 4000—4600 ft. (M).

The single specimen of this species is far from a typical *E. vaginatum* L. and has several characteristics in common with what is called *E. spissum* Fern. as we find it in Manitoba. However, according to Mr. Marcel Raymond of the Montreal Botanical Garden (in litt.), who has kindly studied our spe-

cimen, the head does not "have the depressed globose shape, that our ssp. *spissum* usually assumes." He would not hesitate to call it *E. vaginatum* and as it was collected in an area, which according to both Hultén (1942) and Porsild (1951) is occupied by only *E. vaginatum* we accept this identification. The true *E. vaginatum* seems to be confined to the interior of Alaska-Yukon, *E. spissum* on the contrary, to the coastal zones.

13. *Carex podocarpa* R.Br.

Coll. June 9, around Quill creek camp, elev. 4000—4600 ft. (M).

The specimen, a mere fragment, was kindly identified by Mr. Marcel Raymond. It seems to be common all over the mountains of Alaska and Yukon.

14. *Carex scirpoidea* Michx.

Coll. July 5, near the Tetamagouche pass, elev. 4—4500 ft. (M).

MacKenzie (1935) thinks that this species is restricted to "calcareous areas", and there are many such present in our area. Porsild (1951) however, maintains that the species also grows on acid rocks. It has been impossible to find out if this specimen was collected on acid or basic rock in the Tetamagouche pass. The species is common throughout our area, as in all Yukon.

15. *Tofieldia pusilla* (Michx.) Pers.

Coll. July 5, near the Tetamagouche pass, elev. 4—4500 ft. (M).

According to both Hultén (1943) and Porsild (1951), this species is common inland in Alaska and Yukon.

16. *Zygadenus elegans* Pursh

Coll. June 26, and July 15, in the Tetamagouche pass, elev. ca. 5000 ft. (M).

Another common inland species. Our specimens are rather low, but otherwise typical.

17. *Lloydia serotina* (L.) Sweet.

Coll. June 9, near Quill creek camp, elev. 4000—4600 ft. (M).

Evidently *Lloydia serotina* is a rare species in Yukon. In the literature it is reported only from Herschel Island on the Arctic coast. In Alaska however, it has been collected in several localities, both along the coast and in the inland. The localities in Alaska closest to the Yukon-Quill creek area are: Chitina river glacier, coll. Laing (in the Alaska range district) and Summit and Middle lakes, coll. Bolton as well as N. of Thlenini, coll. Krause, in the Eastern Pacific Coast district (cf. Hultén 1943). Therefore it is likely, that this species is found in more localities on the eastern slopes of the St. Elias range, but since it flowers very early and is hard to find later, it may be easily missed by collectors. Porsild (1951) did not find it in SE Yukon.

18. *Salix reticulata* L.

Coll. June 10 and July 23, around Quill creek camp, elev. 4000—4600 ft. (M).

A common species all over Alaska and Yukon.

19. *Salix glauca* L. s. lat.

Coll. June 28, in the Tetamagouche pass, elev. ca. 5000 ft. (M).

This willow does not entirely agree with Scandinavian material of *S. glauca* L.

20. *Salix longistylis* Rydb.

Coll. June 2, near Quill creek camp, at the creek, elev. ca. 4000 ft.

This is the most common willow in our area, generally growing along creekbeds. Porsild's key (1951) eliminates the difficulty of distinguishing this species from *S. alaxensis*, since the blue bloom on the glabrous twigs is easily seen, and the black bracts are prominent. However *S. longistylis* is considered merely a variety of *S. alaxensis* by Schneider (1920) and Hultén (1943).

21. *Populus balsamifera* L.

No collection was made, but identification was possible from colorphotos taken in the area. It grows along creeks.

22. *Populus tremuloides* Michx.

This species also can be identified from colorphotos. It is apparently common along the creekbeds. No specimen was collected.

23. *Betula* sp.

It is possible to recognize a *Betula* in colorphotos of the area, but impossible to determine the species.

24. *Alnus* sp.

An *Alnus* is to be seen in a photograph of a slope just above the Quill creek camp. It was not yet in leaf, when the photograph was taken, but cones of the previous year are visible. Identification as to species is impossible.

25. *Acetosa alpestris* (Scop.) Löve

New to Yukon. — Coll. June 26, in the Upper Quill creek valley, elev. 4000—4500 ft. (M).

Our specimens closely resemble plants from Scandinavia and Iceland. This species has not previously been reported from Yukon, and its nearest Alaskan locality, according to Hultén (1944) is McKinley Park (coll. Scamman) in the Alaska Range District. Without doubt it will be found in future in other locations in SW Yukon and British Columbia.

26. *Oxyria digyna* (L.) Hill.

Coll. June 9, near Quill creek camp, elev. 4000—4600 ft. (M), and July 15, N of the Tetamagouche pass on mountain ridges, elev. ca. 5000 ft. (F).

The earlier collection (June 9) is a very short plant, but the later (July 15) is a fully mature plant of the normal Scandinavian size. The species is common in Yukon.

27. *Polygonum alaskanum* (Small) Wight.

Coll. July 10, near the junction between Alaska Highway and Quill creek road, elev. ca. 3500 ft. (M).

Our specimen definitely belongs to the species proper, having ciliated leaf-margins, ciliate hairs in the inflorescence as well as on the margins and nerves of the ochrea. It seems to occupy inland Yukon and reaches westwards to the coast of Alaska.

28. *Bistorta plumosa* (Small) D. Löve comb. nova

It is based upon *Polygonum plumosum* Small 1901, in Bull. New York Bot. Garden 2: 6, p. 166. — Coll. June 16, in the Upper Quill creek valley, elev. 4000—4500 ft. (M).

This is the Arctic-Asiatic-W. American taxon named *Polygonum ellipticum* Willd. by Komarov in Flora SSSR and distinguished by its smaller growth and the cuneate bases of its basal leaves (cf. Hultén 1944) from the European-W. Siberian *Bistorta major* S. F. Gray. Hultén (l.c.) regards it only as a major geographical race, and names it a subspecies of *Polygonum Bistorta* (*B. major*) while the senior author finds it more accurate to give it a specific status as did Komarov (l.c.). The name *P. ellipticum* Willd. is, however, based upon a mixture of this plant and leaves of another plant, as already pointed out by Chamisso (1828) and Hultén (l.c.), and is therefore not valid. The only legitimate name is thus *Polygonum plumosum* Small. But since the group *Bistorta* is sufficiently different from other taxa of *Polygonum* s. lat. to constitute a genus of its own (cf. Hedberg, 1946; Löve and Löve, 1948), the correct name of this species should be *Bistorta plumosa* (Small) D. Löve.

According to Porsild (1951) the species seems to be fairly rare in SE Yukon, but otherwise it is rather well spread over most of Alaska and the rest of Yukon (Hultén 1944). It is common in the valley bottoms and on the lower parts of the slopes throughout our entire area.

29. *Bistorta vivipara* (L.) S. F. Gray.

Coll. June 15, in the Upper Quill creek valley, elev. ca. 4000 ft. (M), July 16, W of Quill creek camp, elev. ca. 5000 ft. (F), July 24, N of Quill creek camp, elev. ca. 5000 ft. (F) and Aug. 1, at Quill creek camp, elev. ca. 4100 ft. (F).

The specimens of this taxon show some slight variation as to the width of leaf from a very narrow, almost linear blade (July 16) to a fairly broad one (July 15, Aug. 1), but the color of the flower is constantly a pale whitish pink and the size of the spike ca. 2—3 cm. Whatever bulblets were present are small. The species is common all over Yukon.

30. *Chenopodium capitatum* (L.) Asch.

Coll. Aug. 8 (M) and 11 (F), along a bulldozed road in lower Quill creek valley, elev. ca. 3500—4000 ft.

Hultén (1944) is of the opinion that this plant is indigenous to interior Alaska-Yukon, while Porsild (1951) holds that it was brought in by human activity. Wahl (1954) mentions that the species is apparently more common in the northern part of its range, but does not say anything about how it spreads. The present writers can only state that the specimens from the Quill creek area grew on newly disturbed soil.

31. *Claytonia Bostockii* Porsild.

Coll. June 15, in the Upper Quill creek valley, elev. 4000—4600 ft. (M), and June 16 (M) and 28 (F) in the Tetamagouche pass, elev. 4600—5000 ft.

This species was first described by Porsild (1951) from specimens collected by Bostock at the headwaters of Klaza river, Dawson range, July 1933. A collection from Ketchumstock creek, Alaska (July 1921, coll. Muir) mentioned as *Claytonia* sp. by Hultén (1944) undoubtedly belongs to this species. Both these localities are well within the big unglaciated area of Alaska-Yukon, and the new localities in the Quill creek area may be looked upon as belonging to the same region, though perhaps rather to a nunatak area south of it. More difficult to interpret is the find in the National Herbarium of Ottawa of a sheet from Mile 349 on the Hudsons Bay Railroad in Manitoba, with a fragment of a *Claytonia* which closely resembles the Yukon-Alaska species (coll. P. A. Taverner, July 1936, according to Porsild 1951).

32. *Claytonia sarmentosa* C. A. Mey.

Coll. June 27, in the Tetamagouche pass, elev. ca. 4600 ft. (M), and Aug. 4, in the NW corner of our area, on a mountain ridge, elev. ca. 5000 ft. (F).

The species has hitherto been found only in a few localities in Yukon, two of them along Canol road (Porsild 1951) and one along Haines road, near the Yukon-B.C. border. In the southeast interior of Alaska as well as at the coast of Bering Sea it seems to be fairly common according to Hultén (1944). It will probably be found in more localities in the interior Yukon in the future.

33. *Stellaria alaskana* Hult.

New to Yukon. — Coll. June 10, near Quill creek camp, elev. ca. 4600 ft. (M), and July 16, in the NW corner of our area, elev. ca. 5000 ft. (F).

These are two very typical specimens of this species. They differ from *S. longipes* in their large flowers (about 15 mm in diam.) and from *S. ciliatosepala* by their completely glabrous sepals, which are very long and acuminate, distinctly longer than the petals. Their large scarious bracts distinguish them clearly from *S. ruscifolia*, which they resemble slightly in other respects.

As far as can be seen, this is the first report of *S. alaskana* from Yukon. Our locality is about halfway between the Alaska Range locality at Rapids and the Canyon city locality in the Eastern Pacific Coast district (cf. Hultén 1944).

34. *Stellaria monantha* Hult. var. *monantha*

Coll. June 26, in the Upper Quill creek valley, elev. ca. 4000—4500 ft. (M).

It is clear from Porsild's (1951) discussion of the *Stellaria longipes*-complex, that he has somehow misinterpreted Hultén's species *S. monantha*, since he states at the bottom of page 163 (Porsild l.c.): "Still another segregate, *S. monantha* Hult., like *S. laeta*, lacks the scarious bracts in the inflorescence but is said to have pubescent sepals", in spite of the fact that Hultén (1943) in his paper about "*Stellaria longipes* Goldie and its allies" describes the sepals of *S. monantha* with the following words: ". . . sepala glabra, acuta scarioso-marginata c. 4 mm longa margine eciliata; . . .". Porsild (l.c.) finds difficulty

in separating *S. monantha* from *S. longipes* according to Hultén's key, but our specimen, though only a fragment, agrees well with the description. Prof. Hultén himself has also kindly determined this specimen to *S. monantha*. It is a very low (ca. 3 cm high) loosely caespitose, one-flowered specimen with broad-ovate leaves and foliaceous bracts. According to Hultén (1944 and in litt.) the species has been previously found in SW Yukon.

34 a. *Stellaria monantha* Hult. var. *altocaulis* Hult.

Coll. June 16, in the Tetamagouche pass, elev. ca. 4600 ft (M), and July 15, in the mountains N of Upper Quill creek, elev. ca. 5000 ft. (F).

This variety of *S. monantha* is even more like *S. longipes* than the type variety, but it is nevertheless easy to determine by means of Hultén's key (1943). Compared with the specimens of *S. longipes* from Manitoba the difference is striking. Our Yukon-specimens are definitely one-flowered, have no scarious bracts and reach a height of from 8 to 10 cm., whereas Manitoba specimens all are many-flowered, have distinctly scarious bracts and are mostly taller. It is quite likely that var. *altocaulis* is more common in SW Yukon than the typical variety.

35. *Cerastium alpinum* L. s. lat. (?)

(New to Yukon?). — Coll. June 10, N of Quill creek camp, elev. ca. 4600 ft. (M).

The specimens are very small and almost fragmentary, and therefore difficult to determine, but they seem to agree best with *C. alpinum* L. Even a close examination fails to disclose viscid glands on calyx or leaves, which might place this material in the closely related *C. Beeringianum* Cham. et Schlecht. However, Prof. Hultén (in litt.) holds that we have no true *C. alpinum* in Arctic America, and he has our specimens for study.

36. *Minuartia arctica* (Stev.) A. et G.

Coll. June 26, in the Upper Quill creek valley, elev. 4000—4500 ft. (M), July 16, in the NW corner of our area, elev. ca. 5000 ft. (F) and July 24, N of Quill creek camp, elev. ca. 4600 ft. (F).

The genus *Arenaria* deserves to be divided into the several smaller genera, which have long been used in European literature and are well defined from *Arenaria* s. str. on both morphological and cytological grounds.

The first two collections of *Minuartia arctica* from the Quill creek area (June 26 and July 16) seem to conform quite well to Hultén's description of the species s.str. (Hultén 1944). They have glabrous leaves, 10—15 mm. long, and large flowers, 15—20 mm. wide. The July 24 specimens, however, have about 10 mm. long leaves, ciliate at the base but glabrous about $\frac{1}{3}$ from the tip, their flowers less than 15 mm. wide. Generally these specimens are somewhat smaller than the others, in some respects intermediate between *M. arctica* and *M. obtusiloba*. Hultén (l.c.) also found similar types, and included them provisionally in *M. arctica*. — The species is rare in Yukon.

37. *Minuartia verna* (L.) Hiern.

Coll. June 26, in the Upper Quill creek valley, elev. 4000—4600 ft. (F) and July 24, N of Quill creek camp, elev. ca. 4600 ft. (M).

According to the key in Hultén (1944) our specimens should be *Minuartia rubella* (Wahlenb.) Hiern., since Hultén includes all material of *M. rubella* as well as *M. verna* under this heading. Porsild (1951), however, regards *Minuartia rubella* as a synonym for *Arenaria verna* L. var. *pubescens* (Cham. et Schlecht.) Fern.

Our specimens do not quite agree with the University of Manitoba Herbarium specimens of the true *M. rubella* from Churchill, Man. These are densely tufted and fairly low, whereas the Yukon specimens are loosely caespitose and up to 10 cm tall. Following the key in Lid's "Norsk Flora" (1952) they fall distinctly into *Minuartia verna* and agree very well with the illustration there. The petals are longer than the sepals, and the whole plants more delicate than *M. rubella*. Hultén (l.c.) sees no essential difference between specimens from the coast, which match Eurasiatic *M. rubella*, and the taller inland specimens. Unfortunately there are no seeds on our Yukon plants, whose characteristics could prove, that our plants are *M. verna*.

38. *Silene acaulis* L. ssp. *subacaulescens* Hitchk. et Maguire.

Coll. June 9, N of Quill creek camp, elev. ca. 4600 ft. (F), and July 16 in the NW corner of our area, elev. ca. 5000 ft. (M).

All our specimens belong definitely to the ssp. *subacaulescens* with long leaves and tall peduncles. Hultén (1944) regards this subspecies as an inland race, but Porsild (1951) finds this and ssp. *acaulis* (= "ssp. *excapa*", cf. Löve and Löve 1956) often growing side by side, and he suggests that ssp. *subacaulescens* is connected with unglaciated areas.

39. *Silene repens* Patrin.

Coll. July 16, in the NW corner of our area, elev. ca. 5000 ft. (M), and July 23, around Quill creek camp, elev. ca. 4500 ft. (F).

This species, specimens of which were kindly identified by Prof. Hultén, seems to be restricted to unglaciated parts of Alaska-Yukon, according to both Hultén (1944) and Porsild (1951). Therefore its occurrence in our area provides another hint of the possibility that this has been a nunatak area with unglaciated parts.

40. *Melandrium apetalum* (L.) Fenzl. ssp. *arcticum* (Fries) Hult.

Coll. July 15, in mountains N of Upper Quill creek, elev. ca. 6000 ft. (M) and Aug. 2, in the NW corner of our area, elev. ca. 5000 ft. (F).

Our specimens differ distinctly from Scandinavian material by their drooping flowers and slightly exerted, deep purple petals. They must therefore be referred to the ssp. *arcticum*. The species seems to be restricted to the Arctic Coast and to alpine habitats in the interior (in SE Yukon on mountains 5000—7200 ft high, according to Porsild 1951). The plants from the Quill creek area were found on exposed talus slopes just below the tops of the mountains.

41. *Aquilegia brevistyla* Hook.

Coll. July 10, near junction between Alaska highway and the Quill creek road, elev. ca. 3500 ft. (M).

This species seems to be limited to the southwestern parts of Yukon and adjacent parts of Alaska. All our specimens were in fruit on July 10.

42. *Delphinium glaucum* Wats.

Coll. July 16, in the NW corner of our area, elev. ca. 5000 ft. (M).

Our specimens, from a wooded draw in the mountain, seem to be of the common type in Yukon with glabrous follicles, but are fairly small, approximately 20–25 cm. tall. On July 16 they had immature fruits.

43. *Aconitum delphinifolium* DC.

Coll. July 10, near junction between Alaska highway and Quill creek road, elev. ca. 3500 ft. (M).

As far as is possible to see on our specimens from a meadow near the highway, they belong to the species proper. The leaflobes are not broad, and their nectaries are not hooked (cf. Hultén 1944). It seems to be a common species in Yukon.

44. *Anemone multifida* Poir. f. *sanguinea* (Pursh) Fern.

Coll. July 5 in the area S of Tetamagouche pass, elev. ca. 4600 ft. (M).

All our specimens have small, dark red flowers, but a varying number of pedicels. The plants are apparently tall, since although complete specimens were not collected, the upper parts preserved measure over 20 cm. each. The species seems to be common in the southwestern parts of Yukon and adjacent parts of Alaska and British Columbia.

45. *Anemone narcissiflora* L.

Coll. June 4, near Quill creek camp, elev. 4000–4600 ft. (M), and July 5, in the Tetamagouche pass, elev. ca. 4600 ft. (F).

This species is common to abundant everywhere in our area, particularly in grassy slopes above the timberline. There is considerable variation in the specimens collected: one looks like ssp. *interior* Hult., one-flowered with rhomboid petals and ternate leaves; another specimen agrees well with the description of ssp. *villosissima* (DC) Hult. since it is densely hairy and has three flowers with more broad-oval than rhomboid petals, and quinate leaves; and a third collection from the same spot is intermediate between the other two, one-flowered, medium hairy and tall. Thus all kinds of variations occur within a very limited area, and it seems impossible to distinguish them here as real subspecies. A fruiting specimen was collected on July 5.

46. *Anemone parviflora* L.

Coll. June 4 (M) and 25 (F), around Quill creek camp, elev. 4000–4600 ft., and July 5, in the Tetamagouche pass, elev. ca. 4600 ft. (M).

This species, like the preceding is common over our entire area, as over all Yukon. It has a very large flower, 3–4 cm in diameter. A fruiting specimen was collected on July 5.

47. *Anemone Richardsonii* Hook.

Coll. June 18, in mountains N of Upper Quill creek, elev. ca. 6000 ft. (M) and June 20, around Quill creek camp, elev. 4000—4600 ft. (F).

A typical and common species.

48. *Ranunculus nivalis* L.

Coll. June 4, around Quill creek camp, elev. 4000—4600 ft. (M).

Our specimens all seem to be typical *nivalis* with dense black hairs on sepals and peduncles. The species is not very frequent in Yukon.

Papaveraceae

The poppies from the Quill creek area proved to be of utmost interest and the problem involved in determining them introduced a lot of questions.

Hultén (1945) recognizes certain species like *Papaver alaskanum* Hult., *P. alboroseum* Hult., *P. Macounii* DC., *P. McConellii* Hult., and *P. Walpolei* Porsild as well as *P. nudicaule* L. (from Central Yukon), which are all distinct, but groups the rest of the poppies under *P. radicum* Rottb. as one large, but very variable species.

Porsild (1945) adds to the above mentioned also *P. Keelei* Porsild, but points out later (Porsild, 1951) the "multitude of highly perplexing races" of *P. radicum* in Alaska-Yukon, which he contrasts to the suggested uniformity of this species in the eastern part of its distribution area: ". . . *P. radicum* is common from West Greenland to Mackenzie and from the tree-line extends to the northern extremity of Ellesmere Island and Greenland. Within this large area *P. radicum* is the only species of *Papaver* and, moreover, excepting the white-flowered var. *albiflora*, shows a remarkable lack of ecotypes." (Porsild 1951, p. 184). After looking through a couple of hundred herbarium sheets of Arctic poppies, the senior author was almost overwhelmed by the variety of types within the so-called *P. radicum*, not only in the Alaska-Yukon region, but also just as much in the rest of its area all the way east to Greenland.

Studying the literature dealing with the *Scapiflora*-section of the genus *Papaver*, where opinion stands against opinion, the uncertainty as to what is what is most prominent. Gradually, however, it is possible to distinguish between two big main groups, the "*nudicaule*"-complex and the "*radicum*"-complex (cf. also Lundström 1923, Tolmatchev 1927), the main characteristics of which can be compared as below:

"*nudicaule*"-complex:

Loosely caespitose;
sheaths dark brown;
leaves glabrous or sparingly hairy;
scape with few, appressed hairs;
scape often slender and tall;
flower with more than 30 stamens;
stamens longer than the pistil;
capsule often large and longish, with scattered to dense bristles.

"*radicum*"-complex:

Densely caespitose;
sheaths light greyish brown;
leaves more or less densely hairy;
scape with dense, spreading hairs;
scape often stout and short;
flower with less than 30 stamens;
stamens as long as, or shorter than, the pistil;
capsule often short and broad, often densely covered with stiff hairs and bristles.

The color of the petals in both groups varies considerably, and it seems impossible to rely on "green spots" appearing on the yellow petals on poppies of the "*radicatum*"-group only, though it is true, that in *P. radicatum* Rottb. s.str. hardly a specimen is seen without these spots. Otherwise the petal color varies from pure white, white with a yellow basal spot, pink, orange, red, red with white or yellow spots, clear yellow, sulphur yellow down to pale yellow within both groups. In the "*nudicaule*"-complex, there may be a stronger tendency towards the reddish colors, whereas in the "*radicatum*"-complex it leans more towards pure yellow, but neither tendency is constant enough to be of a decisive nature.

On the other hand, a knowledge of the color of the milk-sap in the American poppies, can certainly serve in helping to solve the problem of the limits of the two groups, as it has already done in the *Scapiflora* taxa of Scandinavia. Future collectors of poppies are strongly advised to note the milk-sap color at the time of collecting.

In Alaska-Yukon the previously known poppies may be divided roughly into the two groups in the following manner:

"*nudicaule*"-complex:

- P. "nudicaule"*
- P. "microcarpum"*
- P. Macounii*
- P. Walpolei*
- P. Keelei* (?)

"*radicatum*"-complex:

- P. radicatum* s. lat.
- P. alboroseum*
- P. McConellii*

The position of *P. alaskanum* is not quite clear. It has some characteristics in common with the "*nudicaule*"-complex (e.g. the large flower with many stamens), but others in common with the "*radicatum*"-complex (e.g. densely caespitose growth, color of the sheaths and general hairiness). Its previous inclusion under *P. microcarpum* DC (cf. Porsild 1939), calls for its belonging to the former group, but Hultén's (1945) treatment and the picture in his "Aleutian Flora" (Hultén 1937) seems to fit the latter group better, and Porsild (1939, 1951) also stresses its affinities to this group.

The existence in Alaska-Yukon of a native *P. nudicaule* L. s.str. seems highly problematic. Porsild (1951) thinks that the "*nudicaule*"-specimens of Alaska-Yukon may be more closely related to *P. Macounii* Greene than to *P. nudicaule* proper from inner Asia. At least the specimens from Klondike river islands, Yukon, collected by Macoun in 1902 and labelled as *P. nudicaule* by Hultén in 1943, can easily be included in *P. Macounii*. The easiest way to decide this would be to learn the chromosome numbers of the Yukon-"*nudicaule*", since the true *P. nudicaule* has $2n=14$ chromosomes (Ljungdahl 1922, 1924; Sugiyura 1940, Fabergé 1942, 1944) whereas *P. Macounii* has $2n=28$ (Horn 1938). Unfortunately the chromosome numbers of the Alaskan poppies are not yet known, and the question must remain open.

Consideration must be given, however, to the fact, that the true *P. nudicaule* L. is grown in gardens in Alaska and Yukon, and seems to escape easily into the wild. Certainly these garden plants are very distinct, and cannot be confused with the very different, yellow-flowered "*nudicaule*" of Hultén. There

is, however, the possibility that the escaped plants cross with native poppies and form local hybrid populations. This impression arose in observation of a herbarium sheet from Dept. of Agriculture, Science Service, Ottawa (no. 4176, Halfway lakes, 15 mls N of Mayo, coll. J. A. Calder, J. M. Gillett et. al., Aug. 3, 1949, det. [as *P. nudicaule* L.] J. A. C. 1950). Besides a typical tall, orange-flowered and glabrous-leaved *P. nudicaule* L. there is on the same sheet a not-so-tall, pale-pink-flowered specimen with a spreading-hairy scape and sparingly hairy leaves. It may be of hybrid origin.

There also seems to be a question whether or not we have *P. microcarpum* DC s.str. in Alaska-Yukon. In his Kamtschatka Flora, Hultén (1928) gives the geographical distribution of this species as Kamtschatka and Unalaska, but in his later work (Hultén 1937, 1945) he treats it as synonymous with *P. alaskanum* Hult. Porsild (1939) named a group of poppies *P. microcarpum* DC. but in his Yukon-flora (1951) he divided that species into *P. alaskanum* Hult., *P. Keelei* Porsild and *P. Macounii* Greene. Judging from the description given *P. microcarpum* DC. in the Flora of SSSR, it does not resemble our tall, yellow-flowered, American poppies, (most of which seem to be *P. Macounii* Greene), but should be a plant more like Hultén's *P. alboroseum* (cf. Flora of SSSR, Papaveraceae). Therefore it appears advisable to exclude *P. microcarpum* from American floras till it is better known.

The following collections from the Quill creek area seem to belong to the "*nudicaule*"-complex:

50. *Papaver Macounii* Greene.

Coll. June 16, in the Tetamagouch pass, elev. ca. 4600 ft. (M), June 19 (M), 23 (M) and 25 (M) in the neighborhood of Quill creek camp, elev. ca. 4600 ft.

Four collections of yellow-flowered poppies all agree very well with the description of *P. Macounii* Greene var. *Macounii* (not its var. *discolor* Hult.). All specimens have evenly and sparingly pubescent leaves and petioles, rather large flowers with many stamens and more or less appressed hairy scapes. The young capsule is longish with a distinctly top-shaped stigma. Some of the specimens have greenish spots on the petals, others not. According to the junior author this may be due to the fact, that the former took abnormally long time to dry after the collection.

A still more complex situation meets us in the "*radicatum*"-group. There the basic question is: precisely what is *Papaver radicatum* Rottb. s.str.?

Rottböll's (1767) description is not very detailed, but it is now assumed (cf. Hultén 1945, A. Löve 1955 a), that his type material is the specimen depicted in Flora Danica, originating from Greenland and identical with *P. radicatum* ssp. *occidentale* Lundström (1923) as described from Sabine Island and Pendulum Island in Eastern Greenland. It is quite different from material from both Iceland and Scandinavia.

There seems to be little doubt, also, that Lundström's *P. radicatum* ssp. *occidentale* is synonymous with *P. radicatum* var. *labradoricum* (Fedde) Rousseau et Raymond (Fedde 1909, Rousseau and Raymond 1952), since this variety agrees completely with the figure in Lundström (1923). Besides, it is a very widespread and surprisingly uniform species of the Canadian Eastern

Arctic and Greenland. It seems to be the dominating species in Labrador and Ungava (and parts of Baffinland?), and collections have been made as far west as Southampton Island. It is probably this species and its distribution that Porsild (1951) had in mind when he called *P. radicum* of the east uniform. But immediately north of Hudson's Strait, different types occur, which cannot be included in the main type, and on the western side of Hudson's Bay still other types take over, and their affinity to *P. radicum* s.str. is unknown.

Papaver radicum Rottb. s.str. has $2n=56$ chromosomes (Horn 1938, Fabergé 1944, Holmen 1952, A. Löve 1955 a).

On Southampton Island there are found various poppies which cannot be included in *P. radicum* Rottb. s.str. One of these is a very characteristic type and undoubtedly a good species. It is found exclusively on the limestone part of Southampton Island, and is very common also on Cornwallis Island, and has been collected as well on Somerset Island, Boothia Isthmus (Spence Bay) and northeast Ellesmere Island. In all cases (possibly with the exception of the last locality) these plants grew on limestone gravel. The name *Papaver cornwallisensis* seems appropriate, since it has been most often collected on the Island of Cornwallis.

Papaver cornwallisensis D. Löve nova species.

Planta perennis, dense caespitosa. Folia radicalia vaginis griseo-brunneis densis et ciliatis, petioli reliquis petiolorum foliorumque pristinorum imbricatis oblecti. Folia brevissima, 1—2 cm longa, lamina c. $\frac{1}{2}$ —1 cm, pinnatilobata segmentis 3(—5), rotundatis, saepissime obtusatis, raro seta mucronatis; segmentum ultimum saepe subpartitum, ulteriora ultima propinqua. Lamina petiolusque pilis longis et flavis pilosi. Scapi plures, 4—7 cm alti, pilis patentibus dense vestiti, basi brunneo-flavibus, sensim nigrescentibus ad summum scapiorum pilis longioribus collum facientibus. Flos 2 $\frac{1}{2}$ —3 cm in diam.; petala 4, membranacea laeviaque, coloribus variabilibus a flavo profundo vel pallido ad candidum (raro modice puniceo). Stamina pauca, quam pistillum tam longa. Pistillum globosum, aliquid latius quam longum, setis nigris et rigidis obtectum. Discus stigmatigerus latissimus, planus, flavus; radii stigmatici in dissepimentis ad tertiam partem decurrentes. Capsula item globosa et lata. Videtur invenire tantum in solo calcareo.

Typus: ex Insula Cornwallis, in Archipelago Arctico Americae, coll. J. Ritchie, no. 663, Julio 31, 1954; in Herbario Universitatis Manitobensis conservatus.

Distributio: Insulae Cornwallis, Somerset, Southampton et Ellesmere, item Isthmus Boothia.

Papaver cornwallisensis is a very compact, caespitose plant with short, densely packed and ciliate sheaths. The leaf-rosette is mixed with old, dried leaves. The individual leaf is very short, 1—2 cm only, and the short petiole is almost invisible in the mass of fresh and old leaves; the blade is from $\frac{1}{2}$ cm to slightly over 1 cm long; the lobes are short, close, roundish, and mostly obtuse, rarely tipped with a bristle; they number 3, occasionally 5, and the top-lobe is often subdivided. Petiole and blade are covered with long, yellowish hairs. The scapes, usually several for each plant, are 4—7 cm high, densely



Fig. 8. *Papaver cornwallisensis* D. Löve, type specimen.

covered with spreading hairs, yellowish brown at the base, gradually turning black further up; towards the top of the scape, these are very dense, forming, under the capsule, a cuff of long black hairs. The flower is 2 1/2—3 cm in diameter, the 4 petals fairly thin and smooth, in color varying from deep yellow to pale yellow or almost pure white, sometimes even with a pinkish

tint. The stamens are few. The pistil is globose, or rather broader than long, and densely covered with stiff black hairs. The stigma is very broad, flat and yellow with fringed rays running down the seams ca. $\frac{1}{3}$ of their length. The capsules are also round and broad. It seems to be confined strictly to limestone. The type locality is Cornwallis Island, and the type specimen (Fig. 8, coll. Dr. J. C. Ritchie, July 31, 1954) is found in the Herbarium of the University of Manitoba.

Besides *P. cornwallisensis* and *P. radicum* there are a number of poppies in the Eastern Arctic and the Arctic Archipelago which may be distinct species or variations of either of the two mentioned above. Pending further investigation they will not, however, be taken into consideration in this paper.

When comparing the eastern and northern poppies belonging to the so-called "*radicum*"-complex with the poppies of this group in Alaska-Yukon, we can definitely establish that there is no *Papaver radicum* Rottb. s.str. in this area. Instead, we have a great many seemingly local types, generally shorter than *P. radicum*, but not as low as *P. cornwallisensis*.

The "*radicum*"-complex seems also to have been strongly influenced in its distribution pattern by the Ice Age. This has been shown clearly in Scandinavia (Nordhagen 1931, 1939, 1940) and closer investigation would certainly reveal similar evidence in America.

There is little doubt that an enormous variation of species occurs in the big unglaciated area in Alaska-Yukon, and that a large number of different species are also isolated in nearby nunatak areas, both in Alaska and Yukon as well as further south in the Rocky Mountains. When the poppies are better known, it may be possible to find several nunatak-areas, today disjunct, but once part of one big area with the same flora.

In the Quill creek area there are at least four different types of poppies belonging to the "*radicum*"-complex, all very distinct from each other. Three of them do not agree with any previously described poppies, and are therefore considered as new species. The status of the fourth, a single specimen, is less certain.

51. *Papaver kluanensis* D. Löve spec. nova

Coll. June 19 and 25, in the mountains N of Quill creek camp, elev. ca. 5000 ft. (M).

Planta perennis, dense caespitosa, 6—9 cm alta. Vagina foliorum griseo-brunnea, longa, marginibus ciliatis et dorsis longe-pilosis. Folia brevissima, ca. 3 cm longa, lamina petiolusque pilis longis albis pilosi; lamina c. $1\frac{1}{2}$ cm longa, pinnatilobata, segmentis in numero 5, ovato-lanceolatis, obtusatis, raro seta c. $\frac{1}{2}$ mm longa mucronatis; segmentum ultimum saepe subpartitum. Scapi erecti vel suberecti, pilis patentibus a basi albis sensim ad summum scapiorum in pallide brunneo-flavum mutantibus. Alabaster ovatus, pilis brevibus et profundo-brunneis obtectus. Flos $2\frac{1}{2}$ —3 cm in diam.; petala in numero 4, sulphureo-flava, sicca pallide viridescens. Stamina in numero c. 25, quam pistillum tam longa. Pistillum ovatum, 7—10 mm longum, 6—8 mm latum. setis brunneis et rigidis obtectum. Discus stigmatigerus convexus; radii stigmatici in numero 5, caerulei, membrana commissuralis conjuncti.

Typus: e montibus septentrionalibus ab "Quill creek camp" (alt. 1700 m),

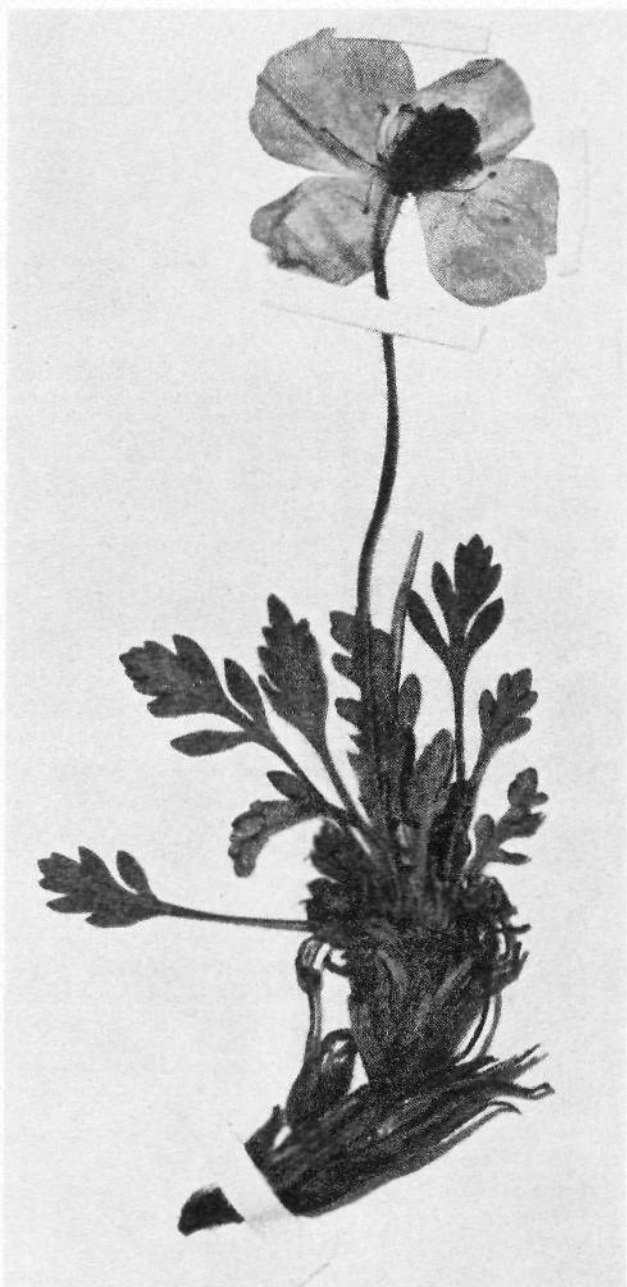


Fig. 9. *Papaver kluanensis* D. Löve, type specimen.

Regione Yukonensi, coll. N. J. Freedman, Junio 19. 1953; in Herb. Univ. Manitob. conservatus.

Distributio: Montes Kluanensis, Regione Yukonensi, et prope Banff, Montes Saxosi, Alberta.

The name *P. kluanensis* was chosen for this species because it was first found in the Kluane range, and may be common there.

P. kluanensis is a short, only 6—9 cm tall, densely caespitose plant with long, light greyish-brown sheaths, long-ciliate and long-hairy on the back. The leaves are short, about 3 cm, the blade about half of that, and both petiole and blade are set with long, white hairs; the blade is divided into 5 ovate-lanceolate rather obtuse lobes, only rarely mucronate with a $\frac{1}{2}$ mm long bristle; the top-lobe is usually subdivided (Fig. 10). The scapes are erect or sub-erect, with spreading white hairs, which towards the top become pale yellowish brown. The oval bud is covered with short, dark brown hairs. The flower is $2\frac{1}{2}$ —3 cm in diameter; the sulphur-yellow petals dry to a pale green shade. There are about 25 stamens about as tall as the pistil. The pistil is oval, 7—10 mm long, 6—8 mm broad, dark and covered with stiff brown bristles. The stigma is vaulted; it has 5 bluish rays connected by a yellowish membrane. The type specimen (Fig. 9) was collected on June 19, 1953 and is found in the Herbarium of the University of Manitoba.

In addition to the specimens from Quill creek, this type has been found in the following earlier collections:

1. West side of Slim's river about 5 mls SW of the mouth of Bullion creek. Mile 1060 Alaska Highway. Elev. ca. 6500 ft. Alpine. July 12, 1953, J. O. Wheeler, no 32.

This herbarium sheet was loaned by the Department of Agriculture Science Service, Ottawa. The locality is situated about 40 miles southeast of the Quill creek area in the Kluane range. The plant was determined previously as *Papaver* sp.

2. Lake Minniwanka vicinity. On bare rock. 9000—10,000 ft. July 1924. E. S. Dowding.

This plant belongs to the herbarium of the University of Alberta and was loaned by Dr E. Moss. It was determined as *Papaver alpinum*, and later corrected to *P. radicum*. The locality is near Banff, Alberta.

It is thus likely, that this is a fairly widespread as well as distinct species, which will probably be found in more localities in Yukon and the Rocky Mountains in the future.

52. *Papaver nigro-flavum* D. Löve spec. nova

Coll. June 25, N of Quill creek camp, elev. ca. 5000 ft. (M), and July 5, N of the Tetamagouche pass, elev. ca. 5000 ft. (M).

Planta perennis, dense caespitosa, c. 12 cm alta. Vagina foliorum griseo-brunnea, nec pilosissima necque marginibus ciliatis. Folia 5—6 cm longa; lamina 1—1 $\frac{1}{2}$ cm, pinnatilobata segmentis in numero 3—5, inferioribus ab ulterioribus remotis, ulterioribus ultimo propinquis et saepe subpartitis, ultimo semper subpartito. Lamina petiolusque pilis densis, flavis, patentibus pilosi; segmenta fere semper seta c. 1 mm longa et nigra mucronata. Scapi pilosi, pilis densis, patentibus, raro appressis, ad summum densioribus et nigris. Alabaster ovato-



Fig. 10. Leaf of *Papaver kluanensis*
D. Löve.



Fig. 11. Leaf of *Papaver nigro-flavum*
D. Löve.

globosus, pilis longis densis et nigris obtectus. Sepala interdum in anthesi persistentia. Flos c. 3 cm in diam.; petala 4, rotundata, colore flavo profundo et puro. Stamina in numero c. 30, quam pistillum tam longa. Pistillum fere globosum, aliquid latior quam longum, setis densis, nigris nitidisque obtectum. Discus stigmatigerus planus radiis caeruleis in numero 5. Membrana commissuralis videre non poterat.

Typus: e montibus septentrionalibus ab saltu Tetamagouche (alt. c. 1700 m) Regione Yukonensi, coll. N. J. Freedman, Iulio 5, 1953; in Herb. Univ. Manitob. conservatus (Fig. 12).

Distributio: locus classicus et prope ad rivulum Klondike septentrionalem, Regione Yukonensis.

The name *Papaver nigro-flavum*, was chosen because of the beautiful and striking contrast between its yellow petals and the coal-black pistil and scape.

It is somewhat taller plant than *P. kluanensis*, reaching about 12 cm in height, being densely caespitose with greyish brown, neither very hairy nor ciliate sheaths. The leaves are 5–6 cm long; the blade is 1–1½ cm with 3–5 lobes, the lowest distant, the topmost always subdivided, the side-lobes sometimes also so; petioles and blades are set with dense yellowish spreading hairs, and almost every lobe is mucronate with a black bristle, about 1 mm long (Fig. 11). The scape is densely hairy with spreading, rarely appressed, hairs, denser and black towards the top. The round-oval bud is covered with

dense, long black hairs. The bud-scales are sometimes persistent during anthesis. The flower is about 3 cm in diameter; the petals almost round in outline, their color a clear, deep yellow. There are about 30 stamens, as long as the pistil is tall. The pistil is almost globose, or rather broader than long, covered with dense, shiny black bristles. The stigma is flat with five bluish rays. The membrane could not be seen.

Besides the specimens from the Quill creek area, there is a collection in the National Herbarium, Ottawa, of apparently the same type (no. 23, W. E. Cockfield, July 1919, N. Klondike River, Yukon). The petals of these plants, though, are not quite as round as those of the Quill creek plants, but seem to have been on the verge of wilting, when collected, and are therefore more difficult to judge. Otherwise they match our collections very well. It is to be expected that future collectors will find more of this type in SW and W Yukon. In the Quill creek area, this was the most common poppy of the "*radicatum*"-complex.

53. *Papaver* sp.

Coll. July 15, in the mountains N of Upper Quill creek, elev. ca. 6000 ft. (M).

This is a single specimen (Fig. 13), the only one seen by the junior author. Following Hultén's key (1945) it comes very close to *P. alboroseum* Hult., though it is unlikely that it is this species. Our specimen is 15 cm high, is densely caespitose with light greyish brown sheaths. The leaves are about 5–6 cm long, the petiole about twice as long as the blade, which is pinnate with 5 lanceolate lobes; the toplobe is always divided into 3 small, broad lobes, the two pairs of side-lobes sometimes also subdivided; both petioles and blades are covered with long, silky, white hairs, and most of the lobes are mucronate with a yellowish bristle, about 1 mm long (Fig. 14). The scape is suberect, densely hirsute with patent, rarely spreading hairs, which gradually darken from almost white at the base to a medium brown towards the top of the scape. The flower is 3 cm in diameter, the petals a creamy white with a pale yellow basal spot. There are 25 stamens. The pistil is barrelshaped, 8 mm long, 5 mm broad, covered with stiff, brown, shiny bristles, the bases of which are not swollen. The almost flat stigma has 5 rays with the connecting membrane not clearly visible.

Our specimen deviates from the description of *P. alboroseum* (Hultén 1928) among others by having a larger flower and an almost flat stigma. Also the size of our plant, and the shape of its leaves fit the red-flowered specimens of Hultén's species and not the smaller, white-flowered ones. Besides, the Quill creek site is very far from the previously known localities of *P. alboroseum* in Kamtschatka and the Seward Peninsula, Alaska. One hesitates therefore to identify our plant with *P. alboroseum* Hult.

In the same area as this white-flowered poppy, three specimens with red- and yellow petals were collected. No other specimens of this type were seen in any part of the Quill creek area. Though these poppies have brick-red petals with a clear yellow basal spot, they agree less well with Hultén's *P. alboroseum* than the white-flowered type, and are besides very different from that one. They are regarded as the distinct species *P. Freedmanianum*.



Fig. 12. *Papaver nigro-flavum* D. Löve, type specimen.

54. *Papaver Freedmanianum* D. Löve spec. nova

Coll. June 18, in the mountains N of Upper Quill creek, elev. ca. 6000 ft. (M).

Planta perennis, dense caespitosa, parva, c. 8 cm alta. Vagina foliorum griseo-brunnea, fere tota marginibus ciliatis et dorsis longe-pilosis. Folia brevissima, c. 3—4 cm longa; lamina 1—1½ cm, lato-ovata, lobata, segmentis in numero 3 (ultimum 3 partibus subpartitum) cacumina obtusa et non-setacea. Lamina petiolusque pilis albis tenuibusque pilosi. Scapi erecti vel suberecti, pilosi basi pilis albis, ad summum sensim in flavo-brunneum mutantibus. Flos c. 2½ cm in diam.; petala 4—5, saepius longiores quam lata, colore rubro-latericio, ad basin in maculam flavam puram mutanti. Stamina in numero 20—25, quam pistillum tam longa. Pistillum c. 8 mm longum et c. 5 mm latum, in forma dolii, setis brunneis obscuris, non multum rigidis et basi non-tumescens, obtectum. Discus stigmatigerus planus; radii in numero 5—6. Membrana commisuralis videre non poterat.

Typus: e montibus septentrionalibus a rivulo Quill superiore, (alt. c. 2000 m), coll. N. J. Freedman, Iunio 18, 1953; in Herb. Univ. Manitob. conservatus (Fig. 16).

Distributio: Montes Kluanensis, Regione Yukonensis.

Papaver Freedmanianum has been so named in honor of the collector, the junior author of this paper.

The plants are small, all our three specimens being exactly 8 cm tall. They are densely caespitose and have light greyish-brown sheaths, most of them with long ciliate margins and long hairs on the back. The leaves are very short, only about 3—4 cm, the blade measuring 1—1½ cm, in outline broad-ovate, divided into 3 major lobes, the top-lobe further subdivided into 3 smaller parts, the obtuse tips of which are not mucronate; both petiole and blade are covered with fine, white hairs (Fig. 15). The scapes are erect or sub-erect covered at the base with white hairs, towards the top gradually darkening, finally yellowish brown at the top. The flower is about 2½ cm in diameter and has 4 or 5 petals, which seem to be longer than broad. Our specimens were beginning to wilt when collected, but even so it is unlikely that the petals were ever as broad as long. Their color is a rather saturated brick-red, fading towards the base into a clear yellow spot. There are 20—25 stamens, as long as the pistil. The pistil is 8 mm long and 5 mm broad, barrel-shaped, and covered with dull, brown, not so stiff bristles without swollen bases. The stigma is flat, has 5 to 6 rays, but the membrane could not be seen.

Porsild (1951) describes under the name of *P. alboroseum* Hult., a collection made by Cairnes (62° N, 141° W, in Yukon, no. 85872 of National Museum, Ottawa), which, he says, in its leaf-segmentation, color of petals and shape of capsules, closely simulates the rare *P. pygmaeum* Rydb. of British Columbia, Alberta and Montana. It must be said about our *P. Freedmanianum*, that they do not even faintly resemble *P. pygmaeum*, which (as Porsild [l.c.] also points out) has almost completely glabrous leaves. In addition *P. pygmaeum* has dark brown sheaths with a few yellowish hairs, and its leaf-blade is almost always cleft into 5 short and rounded lobes, all of which are subdivided into smaller round lobes. Their scapes are set with long, spreading



Fig. 13. *Papaver* sp. from the Quill creek area.



Fig. 14. Leaf of *Papaver* sp. from the Quill creek area.



Fig. 15. Leaf of *Papaver Freedmanianum* D. Löve.

yellowish hairs and the capsules with coarse, pale yellow bristles with distinctly swollen bases. The color of the petals is a pale pink, sometimes yellowish near the base. The diameter of the flower is 1—1 1/2 cm only. *P. pygmaeum* has 42 chromosomes (Fabergé 1944). Most likely it represents a complex completely separate from the "*radicatum*"-group. Though we have had no opportunity to see Cairnes' collection, it is highly probable that his plants are the same taxon as our Quill creek plants, for his locality is situated only 50 mls to the north-west of the Quill creek area and in the same mountain range.

In the addenda to his Alaska-flora, Hultén (1950, p. 1744) mentions a collection by Spetzman (lake Peters, 145° W 69° N), which sounds similar to our plants, having red petals with a yellow basal spot and hairiness as the "*radicatum*"-group. Hultén thinks this may be a cross between *P. alboroseum* and *P. radicatum*.

In a personal communication, Dr Bostock of the Geological Survey of Canada, Ottawa (cf. also Porsild 1951, p. 185) mentions, that he has seen a poppy similar to the description of our Quill creek plants ca. 20 mls southeast of Burwash landing, on the very peak of a mountain northwest of Halfbreed creek, at an elevation of about 6000 ft. Unfortunately he did not collect the plant; thus it is now impossible to say if it was identical with the ones described above, although this is very likely.

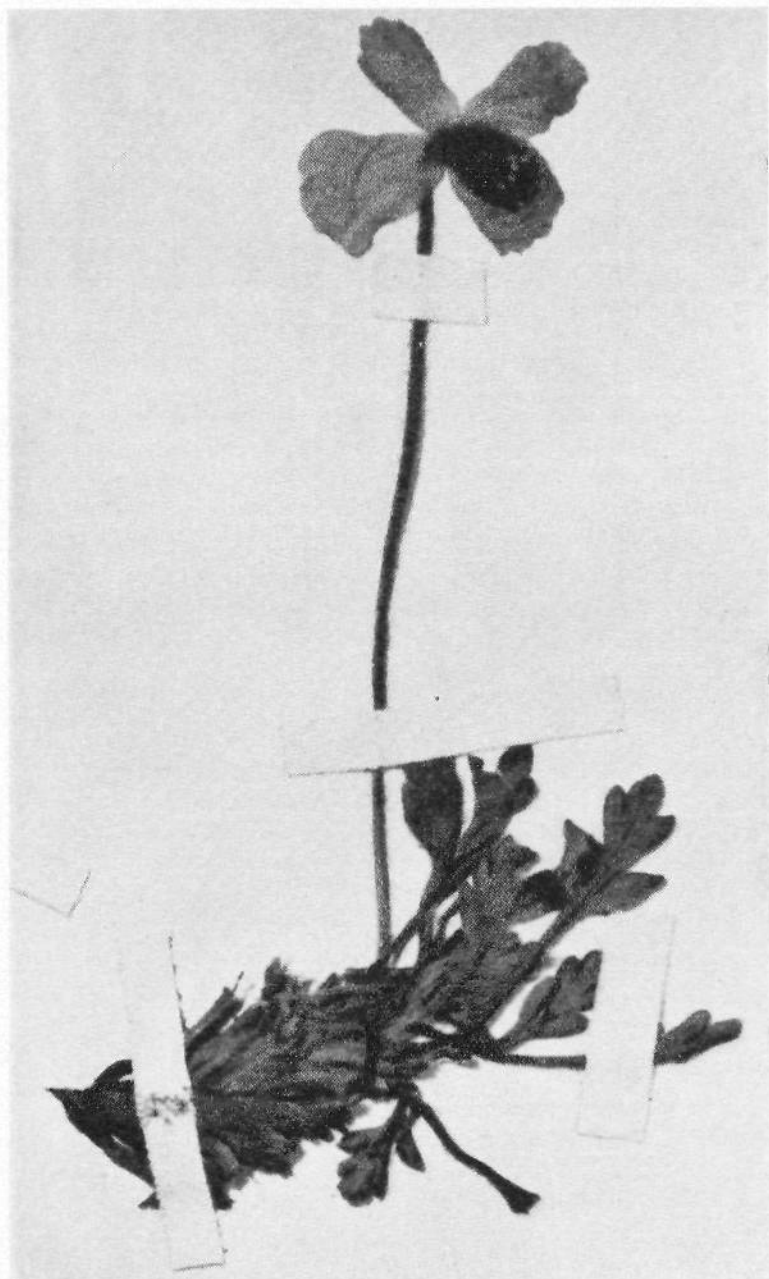


Fig. 16. *Papaver Freedmanianum* D. Löve, type specimen.

Hultén (1945) mentions another red- and white-flowered poppy, collected by Miss E. Scamman at Eagle summit, Alaska, in 1936. At that time only one specimen was found, but in June 1945, Miss Scamman collected the same kind of poppy again on Eagle summit. This type is not at all like *P. Freedmanianum* and seems to belong to the "nudicaule"-complex rather than to the "radicatum"-group. The only specimen Hultén saw is quite small, about 12 cm tall and with only 25 stamens, but the later collection (Fig. 17) is larger, about 20 cm tall, and with over 75 stamens. Both specimens have brown sheaths, are loosely caespitose and have scapes with relatively sparse, appressed hairs. The leaves are 5–6 cm long, have 5 to 7 lobes, of which the top-lobe, and sometimes also the side-lobes are subdivided; the blade is on both sides set with sparse whitish hairs (Fig. 18). The color of the flower, according to Miss Scamman, is pink with a white center, but the pressed specimens have discolored, so that the pink is blackish and the white is yellowish (cf. also Hultén l.c.). It seems, that this type is a good species, and may be most suitably named *Papaver Scammanianum* in honor of the collector, Miss Edith Scamman.

Papaver Scammanianum D. Löve spec. nova

Planta perennis, laxe caespitosa, c. 15–20 cm alta. Vagina foliorum brunnea, dorsis sparsim pilosa pilis flavo-brunneis. Folia 5–6 cm longa pinnatilobata; segmenta lanceolata in numero 5–7, ultimum semper, ulteriora saepe, subpartitum. Lamina pilis albis sparsim obiecta. Scapus tenuis, erectus, pilis sparsim appressis pilosus. Flos c. 3 cm in diam.; petala 4, rotundata, colore puniceo ad basi in macula alba mutante; in flore sicco color puniceus in nigrescentem, color albus in flavescentem mutatur. Stamina c. (25–)75 vel plura, longiora quam pistillum. Pistillum longius quam latum, setis brunneis et rigidis obiectum. Discus stigmatigerus aliquid convexus; radii in numero 4–5, in dissepimentis ad secundam partem decurrentes. Mensa commissuralis videre non poterat.

T y p u s: ex Eagle Summit, 109 miles septentrionali a Fairbanks, Alaska, in itinere ad Porcupine Dome (alt. c. 1250 m) coll. Edith Scamman, no. 3530, Iunio 23–30, 1945; in Gray Herbarium, Universitatis Harvardensis conservatus.

D i s t r i b u t i o: Locus classicus.

55. *Eutrema Edwardsii* R.Br.

Coll. June 4, near Quill creek camp, elev. 4000–4500 ft. (M).

The species has previously been found along the Arctic coast as well as on mountains of the interior. It seems to prefer limestone, which occurs frequently in the Quill creek area.

56. *Cardamine purpurea* Cham. and Schlecht.

Coll. June 9, near Quill creek camp, elev. 4000–4500 ft. (M), and July 16, in the NW corner of our area, ca. 5000 ft. (F).

This species is common in the mountains north of the Quill creek camp.

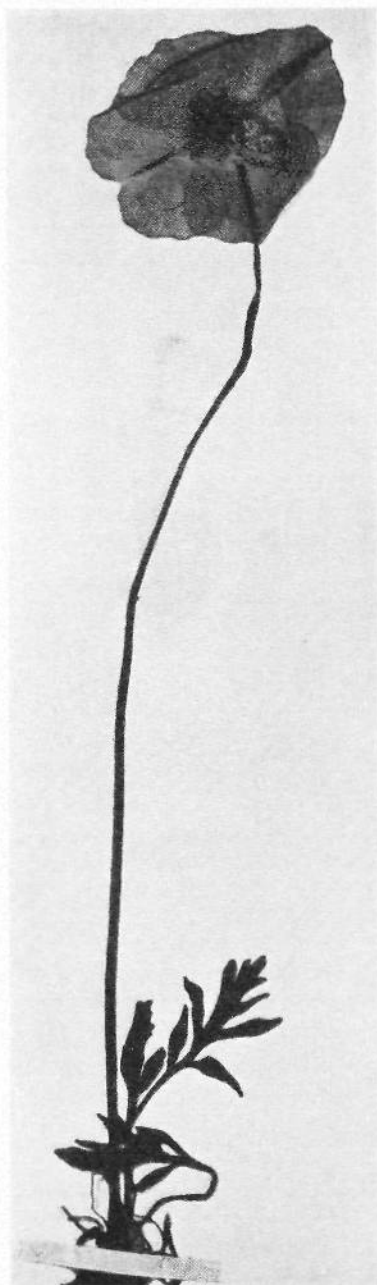


Fig. 17. *Papaver Scammanianum*
D. Löve, type specimen.

which is well within its previously known distribution range. All specimens collected are purple-flowered.

57. *Draba alpina* L. var. *nana* Hook.

Coll. June 10, N of Quill creek camp, elev. ca. 5000 ft. (M).

A number of small specimens (averaging 4 cm in height) of a plant, at first glance similar to *Draba alpina* were collected on a mountain slope. A closer investigation showed that these plants were distinct from typical Scandinavian specimens of *Draba alpina* L. Following Fernald (1934) one finds the closest description to be that of *Draba alpina* L. var. *nana* Hook.

The use of the key in Hultén (1945) places the plants in *Draba macrocarpa* Adams on account of their hairiness; but on being compared with the description of this species in Ekman (1931) our plants are found to differ in having a short style and glabrous pistil, while *D. macrocarpa* has a sessile stigma and hairy siliques.



Fig. 18. Leaf of *Papaver Scammanianum*
D. Löve.

Studying Ekman's paper further, one comes to *D. Bellii* Holm, which Fernald (l.c.) regards as a synonym for *D. alpina* var. *nana*. The description given in Ekman (l.c.) for this species and especially the var. *gracilis* Ekm., as well as the picture of this variety (Ekman l.c., Plate V, Fig. 5) are fairly close matches for our specimens, except for the hairless pistils. The short but distinct style is a feature of *D. Bellii*, which supports the identification. Ekman, however, mentions that lack of hairs on a pistil does not necessarily mean, that the silique will be glabrous, and there are no mature siliques in our material to judge by. Ekman also states, that *D. Bellii* and *D. macrocarpa* "are nearly allied" (Ekman l.c., p. 476).

Fernald (l.c., p. 286) gives a list of several names used for plants of this type, but concludes that *D. alpina* L. var. *nana* Hook. "seems safe, at least." I will therefore use this name though I have a strong feeling that *D. Bellii* Adams var. *gracilis* Ekm. might later prove correct.

Draba alpina L. as well as *D. alpina* var. *nana* have previously been reported from the neighborhood of Quill creek, at Wolf creek (this name has been changed to Steel's creek on recent maps) about 10 mls southwest of Quill creek camp by Bakewell (1943).

58. *Draba aurea* M. Vahl.

Coll. June 26, in the Upper Quill creek valley, elev. ca. 4500 ft. (M).

This rare species was previously collected in this vicinity by Muller 1920 (Kluane lake to Donjek river; cf. Hultén 1945), perhaps along the same trail where our specimen was found, since this route has been used by trappers and miners for a very long time.

59. *Draba cinerea* Adams

Coll. June 9, around Quill creek camp, elev. ca. 4600 ft. (M).

Previously this species had been found in Yukon only on the Arctic Coast (cf. Hultén 1945), but it was later collected by Porsild (1951) along the Canol road in a couple of high-alpine localities. Our locality is also in the alpine zone.

60. *Draba nivalis* Liljebl.

Coll. June 26, in the Upper Quill creek valley, elev. 4000—4500 ft. (M).

Our specimen represents a true *Draba nivalis* with stellate pubescence on the basal leaves as well as on scapes and petioles. Thus, it can not be confused with *D. lonchocarpa* Rydb. with glabrous scapes (cf. Porsild 1951). The collection was made in a sandy, gravelly bed alongside the river.

61. *Smelowskia borealis* (Greene) Drury et Rollins.

Coll. June 27, N of Upper Quill creek, on a talus slope, elev. ca. 6000 ft. (M).

The identity of this rare species, first named *Melanidion boreale* by Greene (1912) and later transferred to the genus *Ermania* by Hultén (1945), seems now to be definitely settled as *Smelowskia borealis* (Greene) Drury et Rollins (cf. Drury and Rollins 1952). A specimen of this species has previously been collected at the south end of Kluane lake (coll. Stuart K. Harris, 1944) not far from our locality. Drury and Rollins (l.c.) are unable to refer this immature specimen to any of their varieties of *Smelowskia borealis*, and unfortunately our collection is also too young for a detailed identification. It is very small

and compact and a perfect match for the pictures of the same species in Hultén's Alaska-flora (1945, p. 880—881, Fig. 3—4). It is much smaller than the specimens collected by Porsild (in National Museum, Ottawa), though these are in the fruiting stage and thus not directly comparable to our flowering specimen.

Hultén (1945) stated that this species is apparently a remnant of a Tertiary flora, that has survived in unglaciated areas only in Alaska. Our locality is slightly south of the big unglaciated refugium in Alaska-Yukon. The appearance of the locality, where the plant was found, indicates that the mountain may have been a nunatak during the last glaciation. If our species has survived *in situ* or if it dispersed to here after the glaciation remains an open question.

62. *Erysimum inconspicuum* (S. Wats.) MacMillan.

Coll. June 9, near Quill creek camp, elev. ca. 4000 ft. (M).

Our specimen is very small, about 10 cm high only, and has leaves 1—2 mm broad, cinerous, with stiff appressed hairs. It thus belongs to the first of the two groups of this species mentioned by Porsild (1951), a group which seems to be restricted to dry, calcareous slopes. Such localities are common in our area. Outside it, the species seems to be confined to the mountains of the interior in Alaska and Yukon.

63. *Parrya nudicaulis* (L.) Regel

Coll. June 4, in the mountains N of Quill creek camp, elev. ca. 4500 ft. (M).

This species is common in all the Quill creek area and occurs in a multitude of variations. Our specimens have leaves varying from ovate, almost entire, to deeply toothed, almost pinnate. The flowers vary from deep purple to pure white and from 15 to 30 mm in diameter. Within the one locality where all our specimens were collected, we thus have representatives of the coastal *P. nudicaulis* s.str., of its ssp. *interior* Hult., as well as of its ssp. *interior* var. *grandiflora* Hult. (cf. Hultén 1945). Porsild (1951) also finds a lot of variation in this species.

64. *Rhodiola integrifolia* Raf.

Coll. June 9 (M) and July 24 (F), in the mountains N of Quill creek camp, elev. ca. 4600 ft., and July 15, in the mountains N of Upper Quill creek, elev. ca. 5000 ft. (M).

The specimens collected north of Quill creek camp are all male, whereas the ones from the mountains N of Upper Quill creek are all female. The height of the plants varies from 10 to 20 cm. The filaments of the stamens are dark purple as are the petals. All specimens grew on rock ledges.

65. *Saxifraga bronchialis* L. ssp. *Funstonii* (Small) Hult.

Coll. June 10 (M) and July 24 (F), in the mountains N of Quill creek camp, elev. ca. 4600 ft., July 26, in the Upper Quill creek valley, elev. ca. 4500 ft. (M) and July 15, in the mountains N of Upper Quill creek, elev. ca. 5000 ft. (F).

This taxon, otherwise rare in Yukon, is common in alpine situations throughout the area.

66. *Saxifraga flagellaris* Willd.

Coll. June 4, near Quill creek camp, elev. 4000—4500 ft. (M).

Only one specimen of this beautiful species was collected. It is 7 to 8 cm tall and has flowers about 2 1/2 cm in diameter. Several of the typical long runners extend from the leaf-rossette.

67. *Saxifraga hieraciifolia* Waldst.

Coll. June 9, near Quill creek camp, elev. ca. 4600 ft. (M).

A typical specimen, about 35 cm tall.

68. *Saxifraga Hirculus* L.

Coll. June 4, near Quill creek camp, elev. 4000—4500 ft. (F), and June 28, in the Tetamagouche pass, elev. ca. 4600 ft.

Our specimens have all oblong petals, two to three times longer than the sepals. They thus seem to belong to var. *Hirculus* (=var. *typica* Hook. fil.; cf. Hultén 1945). They grew in wet, mossy soil.

69. *Saxifraga Lyallii* Engler.

Coll. June 9 and 10, near Quill creek camp, elev. ca. 4600 ft. (F), and June 26, in the Upper Quill creek valley, elev. ca. 4500 ft. (M).

Our specimens were kindly identified by Mr. Marcel Raymond, Montreal Botanical Garden. He states that the specimens are smaller than the usual ones from the Rocky Mountains. Hultén (1945) also mentions some remarkably small types of this species (White pass, coll. Eastwood; Juneau, coll. Anderson 1857 B), but regards them merely as an alpine form. It is quite likely that our specimens belong to this type, because they differ distinctly from other specimens of *S. Lyallii*, e.g. those collected by Porsild along Canol road (cf. Porsild 1951). His plants, which I have seen, are very uniform and tall. Our specimens are all dwarfed, hardly exceeding 10 cm even in fruit, and the lowest branches are slender but firm. The undersides of the leaves, the scapes and the pedicels are deep purplish red, and the flowers are white with a faint reddish tint. The sepals are completely bent backwards. The whole plant reminds one somewhat of *S. stellaris* from Scandinavia, except for the leaves, which have more slender, cuneate to petiolate bases, (Fig. 19).

70. *Saxifraga oppositifolia* L.

Coll. June 4, (F), 19 (F), 23 (M) and 25 (F), all N of Quill creek camp, elev. 4000—5000 ft.

A fairly common species at high altitude on rocky ledges. Our specimens have small and rather closely packed leaves but in spite of this cannot be considered *S. pulvinata* Small.

71. *Saxifraga punctata* L. ssp. *pacifica* Hult.

New to Yukon. — Coll. June 10, in the mountains N of Quill creek camp, elev. 4500—4600 ft. (M).

This is just one fragmentary specimen, kindly identified by Mr. Marcel Raymond. There is no doubt, that our plant is the ssp. *pacifica*, since the



Fig. 19. Specimen of *Saxifraga Lyallii* Engler from the Quill creek area.

leaves are thin and ciliate, the young follicles purplish black, and the remaining petals white. Its existence here on the northeast slopes of the St. Elias Range is, however, not so astonishing, for it seems to be fairly well distributed on the southwest side of this mountain chain. It seems to be the first time that this race of *S. punctata* has been collected in Yukon.

72. *Saxifraga reflexa* Hook.

Coll. June 9, near Quill creek camp, elev. ca. 4600 ft. (M).

The specimens collected seem to be typical though fairly small.

73. *Saxifraga serpyllifolia* Pursh

Coll. June 20, near Quill creek camp, elev. ca. 4500 ft. (F), and July 16, in the NW corner of our area, elev. ca. 5000 ft. (M).

This very rare saxifrage has been collected previously in this area by Muller 1920, and by Bakewell (1943) (cf. Hultén 1945). Porsild found it on the eastern slope of Mackenzie Mountains, N.W.T. (cf. Porsild 1951), and one locality is known from North Fork of Klondike river (coll. Cockfield, no 29). It is quite likely a glacial relict. Our specimens measure two to three centimeters in height.

74. *Saxifraga tricuspidata* Rottb.

Coll. June 9, (F), July 23 (M) and 24 (F), around and N of Quill creek camp, elev. ca. 4500 ft.

Common and typical all over the Quill creek area, as well as over the rest of Yukon.

75. *Chrysosplenium tetrandrum* (Lund) Th. Fries

Coll. July 16, in the Tetamagouche pass, elev. ca. 4600 ft. (M).

Our two specimens were found in a boggy area and are quite small, two and five centimeters respectively.

76. *Parnassia Kotzebuei* Cham. et Schlecht.

Coll. July 1, in the Tetamagouche pass, elev. ca. 4600 ft. (M).

These typical specimens were found in a wet boggy area. They are less than 10 cm tall.

77. *Parnassia multisetata* (Ledeb.) Fern.

Coll. June 16, in the Tetamagouche pass, elev. ca. 4600 ft. (M), and July 27, N of Quill creek camp, elev. ca. 5000 ft. (M).

There seems to be a considerable variation in size of the flower of our specimens, but otherwise they are alike. For the discussion of the nomenclature, cf. Å. Löve (1955 b).

78. *Rubus Chamaemorus* L.

Coll. June 10, near Quill creek camp, elev. ca. 4000 ft. (M).

A common species throughout Yukon. In the Quill creek area in all boggy localities.

79. *Pentaphylloides floribunda* (Pursh) Löve

(Syn.: *Potentilla fruticosa* Am. auth., non L.)

Coll. June 4, around Quill creek camp, elev. ca. 4000 ft. (M), and June 16, in the Tetamagouche pass, elev. ca. 4600 ft. (M).

This species is very common in all valleys in the Quill creek area and flowers profusely all summer long. According to the Code of International nomenclature the generic name is *Pentaphylloides* (cf. Schwarz, 1949), and since the European species, described by Linnaeus (1753) from the island of Öland, Sweden, is different from the American one, described from the Great Lakes by Pursh (1814), the specific name of the latter must be *P. floribunda* (cf. A. Löve 1954).

80. *Potentilla nivea* L. var. *tomentosa* Nilsson-Ehle.

Coll. June 2 and 4, near Quill creek camp, elev. 4000—4500 ft. (F), and June 16, in the Tetamagouche pass, elev. ca. 4600 ft. (M).

This apparently rare species has been reported from Yukon proper only by Bakewell (1943) and Porsild (1951) (from Lower Lapie crossing, coll. Porsild, June 12, 1944, no 9444). A locality from south of the Alaska-Yukon border has also been reported previously (cf. Hultén 1946). Since the species seems to have its main distribution in Asia it is likely it will be found elsewhere in Alaska in the future.

81. *Potentilla monspeliensis* L.

Coll. July 10, along Alaska highway near junction with Quill creek road, elev. ca. 3500 ft. (M).

It is difficult to say if this specimen represents a native or an introduced plant. It grew in disturbed soil.

82. *Dryas octopetala* L.

Coll. June 4, near Quill creek camp, elev. ca. 4500 ft. (M), and July 5, in the Tetamagouche pass, elev. ca. 4500 ft. (M).

After much consideration we have come to the conclusion that our specimens all belong to the rare *Dryas octopetala*, which in Yukon grows in alpine localities only, and not to the more common *D. punctata* Juz. The species is common all over the Quill creek area, and fruiting material was collected in the Tetamagouche pass in the beginning of July.

83. *Rosa acicularis* Lindbl. s. lat.

Coll. June 20, along the road from Quill creek camp to Alaska Highway, in a wooded area, elev. 3500—4000 ft. (M).

A "typical" sample of the American taxon of the species.

84. *Lupinus arcticus* S. Wats.

Coll. June 26, in the Upper Quill creek valley, elev. ca. 4000 ft. (F) and July 5, in the Tetamagouche pass, elev. 4600—5000 ft. (M).

The beautiful blue lupins are common everywhere on the slopes between 4000 and 5000 feet throughout the Quill creek area.

85. *Astragalus alpinus* L.

Coll. June 27, in the Tetamagouche pass, elev. 4600—5000 ft. (M).

No difference is detectable between these plants and Manitoba material. Since they are neither overly tall nor with pale flowers, they do not belong to the ssp. *alaskanum* Hult. but to the type species itself. They are common in our area.

86. *Astragalus umbellatus* Bunge.

Coll. June 16, in the Tetamagouche pass, elev. 4600—5000 ft. (M).

Though this is a mere fragment, there is no doubt that the identification is correct.

87. *Oxytropis Huddelstonii* Porsild.

Coll. June 4, N of Quill creek camp, elev. ca. 5000 ft. (M).

This species (cf. Porsild 1951) is closely related to *O. nigrescens* (Pall.) Fisch. from which it differs by having glabrous pistils and pods. Our material was flowering, and no pods were present for use in identification. However, it was found, that the pistils were completely glabrous, and it was thus assumed that the pods would be so as well. Our specimens also agree well with specimens from the National Museum, Ottawa, identified as *O. Huddelstonii* by Porsild. The plants grew on an exposed talus-slope.

88. *Oxytropis Maydelliana* Trautv.

Coll. July 7, in the Upper Quill creek valley, elev. ca. 4500 ft. (M), and July 23, around Quill creek camp, elev. 4000—4500 ft. (F).

Though apparently rare in Yukon, this species is reasonably common in alpine localities over our entire area. The specimens were kindly identified by Dr. H. J. Scoggan, Ottawa.

89. *Oxytropis viscidula* (Rydb.) Tidestr. ssp. *sulphurea* Porsild.

Coll. July 4, in the Tetamagouche pass, elev. ca. 4600 ft. (M).

It was rather difficult to determine the specimens since they have not yet developed pods, but according to Hultén's key (1947), they come close to *O. viscidula* (Rydb.) Tidestr. *O. viscidula* s.str. has, however, purple, and purple-drying, flowers, whereas our specimens have pale yellow flowers, drying whitish. Neither do the plants have yellowish hairs at the base, but long whitish strigose ones. They also agree well with dried material of *O. viscidula* ssp. *sulphurea* Porsild from the National Museum, Ottawa.

90. *Hedysarum alpinum* L. ssp. *americanum* (Michx.) Fedtsch. var. *grandiflorum* Rollins.

Coll. June 10, N of Quill creek camp, elev. ca. 5000 ft. (M).

This specimen has flowers well over 15 mm long, their color a deep purple, the keel reaching far in front of the other floral parts. It is therefore easily determined as var. *grandiflorum* Rollins.

91. *Hedysarum Mackenziei* Richards.

Coll. June 16, in the Tetamagouche pass, elev. ca. 4600 ft. (M).

This species was only observed once, in the Tetamagouche pass.

92. *Empetrum hermaphroditum* (Lge) Hagerup

Coll. June 10, N of Quill creek camp, elev. 4500—4600 ft. (M).

The two species *Empetrum nigrum* and *E. hermaphroditum* are biologically well separated, since they have different chromosome numbers, *nigrum* $2n=26$, *hermaphroditum* $2n=52$ (Hagerup 1927). Also, they have different ecological requirements in Alaska-Yukon, *E. nigrum* generally being more southern and coastal, and *E. hermaphroditum* more northern and interior. Overlapping occurs though, and it is difficult to separate sterile herbarium specimens. But specimens with flowers or berries are never difficult, the bisexual flowers or the berries with persistent stamens being good characteristics for *E. hermaphroditum* (cf. Hultén 1947, Porsild 1951). Also the number and distribution of berries on the shrubs, few and distant in *E. nigrum*, usually many and dense in *E. hermaphroditum*, is a good indicator of the species.

E. hermaphroditum is not abundant in the Quill creek area, but occurs here and there in the wooded area, often near the tree limit.

93. *Shepherdia canadensis* (L.) Nutt.

Coll. June 28, in the Tetamagouche pass, elev. ca. 4600 ft. (M).

This shrub is common in the spruce-willow areas along creeks and streams.

94. *Chamaenerium angustifolium* (L.) Scop.

Coll. July 10, along the Quill creek road towards Alaska Highway, elev. 3500—4000 ft. (M).

This is a fairly common species along trails and roads, as well as river banks. The plants vary much, but most of the collections are tall, none small enough to warrant the name var. *intermedium* (Wormskj.) Fern. One white-flowered specimen (f. *albiflorum* (Dum.) Hausskn.) was collected.

95. *Chamaenerium latifolium* (L.) Sweet

Coll. July 11, 20, and 23, all around Quill creek camp, elev. 4000—500 ft. (M).

This species is rather common all over the Quill creek area, and it seems to prefer moist draws, reaching sometimes quite high altitudes.

96. *Bupleurum americanum* Coult. et Rose

Coll. July 23, near Quill creek camp, elev. ca. 4600 ft. (M), and July 31, N of Quill creek camp, elev. ca. 4500 ft. (F).

This species is common in Yukon, possibly with the exception of the south-east corner, where it has not yet been collected. Our two specimens are rather low, measuring 6 to 11 cm in height respectively.

97. *Pyrola grandiflora* Radius.

Coll. June 9, near Quill creek camp, elev. ca. 4000—4500 ft. (M).

All our specimens belong to *P. grandiflora* s.str. with few, but large flowers, 2 to 2 1/2 cm in diameter, and bright yellow anthers. They are common all over the area, but only in wooded parts.

98. *Ledum groenlandicum* Oeder.

Coll. June 9, near Quill creek camp, elev. ca. 4000 ft. (M).

For separating *Ledum groenlandicum* from *L. decumbens* the characteristics of the inflorescence as given by Porsild (1951) are most reliable. The species is common in the wooded valleys all over the Quill creek area.

99. *Rhododendron lapponicum* (L.) Wahlenb.

Coll. June 4, N of Quill creek camp, elev. ca. 5000 ft. (M).

This rare high-alpine species was found only on rocks at ca. 5000 ft. altitude, but was already flowering on June 4. Our plants match perfectly Scandinavian specimens of this species.

100. *Cassiope tetragona* (L.) D. Don.

Coll. June 9, around Quill creek camp, elev. 4000—4600 ft. (M).

Our specimens belong with certainty to *C. tetragona* s.str. with long-peduncled flowers overtopping the branches. The species was everywhere abundant on slopes from 4000—6000 ft.

101. *Andromeda polifolia* L.

Coll. June 10, near Quill creek camp, elev. ca. 4000 ft. (M).

This rare species was collected in a boggy area. The specimens are quite small, only 2 to 3 cm high. They were in flower on June 10.

102. *Arctous rubra* (Rehd. et Wils.) Nakai

(Syn.: *Arctostaphylos rubra* (Rehd. et Wils.) Fern.)

Coll. June 29, in the Tetamagouche pass, elev. ca. 4600 ft. (F), and July 23, near Quill creek camp, elev. ca. 4000 ft. (M).

By 1889 Niedenzu had already distinguished the genus *Arctous* from *Arctostaphylos*, and this separation has been generally adopted by modern European taxonomists. The name *Arctous* is, however, in spite of its -us ending a feminine word, and the species name must thus be *A. rubra*, not *A. ruber* (cf. Fernald 1914).

It is difficult to distinguish between non-fruiting specimens of *Arctous alpina* and *A. rubra*, but as pointed out by Porsild (1951), the absence of cilia on the leaf margins of *A. rubra* is a fairly good characteristic of this species. Our specimens have no cilia on the leaf margins at all, and the fruiting specimen from the 23rd of July has beautifully red berries. The species is common everywhere in the low spruce land, and is an appreciated food for the bears of the area.

103. *Uva-ursi procumbens* Moench var. *adenotricha* (Fern. et MacBride) D. Löve comb. nova, based upon *Arctostaphylos Uva-ursi* (L.) Spreng. var. *adenotricha* Fernald et MacBride in *Rhodora* 16: 213 (1914).

Coll. June 10, and 23, near Quill creek camp, elev. ca. 4000 feet. (M).

Since Duhamel (1755) published the name *Uva-ursi* with a hyphen (cf. Schwarz 1949), it antedates *Arctostaphylos* Adans. (1763) for this genus in the strict sense. Consequently our common bearberry must be named *Uva-ursi*

procumbens Moench (Moench 1794), and the varietal name *adenotricha* (Fern. et MacBride) must be transferred to this name.

It is with some hesitation that our specimens are identified as var. *adenotricha*, but though the pubescence is short it is definitely glutinous, and can thus hardly belong to var. *coactilis* (Fern. et MacBride) D. Löve (comb. nova, based upon *Arctostaphylos Uva-ursi* (L.) Spreng. var. *coactilis* Fernald et MacBride, in *Rhodora* 16: 212, 1914). (cf. also Hultén 1948, Porsild 1951).

104. *Vaccinium microphyllum* (Lge) Hagerup

Coll. June 10 and 23, near Quill creek camp, elev. ca. 4000 ft (M).

There seems to be a slight disagreement between Hultén (1947) and Porsild (1951) regarding the existence of the so-called *V. uliginosum* L. var. *alpinum* Bigel. in Alaska-Yukon. Hultén (l.c.) maintains that it is common, Porsild (l.c.) that there is a type of *V. uliginosum* there, which does not correspond to var. *alpinum*. Both, however, agree that their plants have berries which are sweeter and more palatable than those of *V. uliginosum* s.str. It therefore seems likely that both are referring to the species *V. microphyllum* (Lge) Hagerup which has very sweet berries. Furthermore, several herbarium sheets of *V. uliginosum* from the National Museum, Ottawa, are actually specimens of *V. microphyllum*, since they are stunted in growth and have smaller leaves.

V. microphyllum (Lge) Hagerup is an arctic-alpine species, in Alaska-Yukon probably often found at high altitudes in the mountains of the interior and along the Arctic Coast. It has $2n=24$ chromosomes (Hagerup 1933). *V. uliginosum* L. is a more southern species more often found in the lowland. It has $2n=48$ chromosomes (Hagerup 1933). Without doubt, where the two species meet, they are mixed, but do not hybridize.

105. *Vaccinium Vitis-Idaea* L. ssp. *minus* (Lodd.) Hult.

Coll. June 26, in the Upper Quill creek valley, elev. 4000—4500 ft. (M).

Common in the spruce wood valleys and bogs.

106. *Androsace Chamaejasme* Host. ssp. *Lehmanniana* (Spreng.) Hult.

Coll. June 4, N of Quill creek camp, elev. ca. 5000 ft. (M).

Our specimens are densely stiff-hairy and have large creamy-white flowers. They were found at high altitude. The ssp.-name seems preferable (cf. Hultén, 1948) to the name var. *arctica* R. Knuth used by Porsild (1951).

107. *Dodecatheon frigidum* DC.

Coll. June 10, N of Quill creek camp, elev. ca. 5000 ft. (M), and June 15, in the Upper Quill creek valley, elev. 4500—5000 ft. (M).

There is a certain variation in the material collected. The specimen from Upper Quill creek valley is smaller, has a deeper blue flower with shorter, rotundate petals, and shorter and broader, almost triangular leaves, contrasting to the taller, more slender type with long narrow paler petals, and longer ovate-lanceolate leaves found in the mountains north of Quill creek camp. Nevertheless they all seem to belong to *D. frigidum*. The species is fairly common in our entire area along streambeds at 4000 to 4500 ft. altitude.

Gentiana

Pending further cytotaxonomical studies on the division of the genus *Gentiana* s. lat., it will in this paper be retained as such in its widest sense, including also the genus *Gentianella* (cf. D. Löve 1953).

108. *Gentiana algida* Pall.

Coll. July 4 and 15, in the mountains N of Upper Quill creek valley, elev. ca. 5000 ft. (M).

The beautiful snow-gentian is rare in Yukon, and was seen only in the high mountains north of the Upper Quill creek valley in our area. It is fairly short, 10—15 cm high only, and has 1 to 3 flowers. According to Hultén (1948) it is characteristic of unglaciated areas.

109. *Gentiana prostrata* Haenke

Coll. July 16, in the NW corner of our area, elev. ca. 5000 ft. (F), July 24, in mountains N of Quill creek camp, elev. ca. 5000 ft. (M), and July 26, near Quill creek camp, elev. ca. 4600 ft. (F).

This little plant is very common all over our area in moist situations. When collecting it the junior author observed that the flowers were sensitive to the touch. He found that a few seconds after being lightly touched, the petals of an open flower folded up into a bulblike state. The movement from fully expanded to completely closed took ca. 15—20 seconds and it took not less than half an hour before the flower was fully open again. It is likely that this movement serves to trap small insects and so ensure pollination, though the closing time seems rather prolonged for this purpose and might allow the insect to get away. It may also be, that the mechanism works faster if some special trigger point, likely to be set off by an insect, were found. Since we have not been able to find any previous reports of gentians as insect trappers, this is probably the first time it has been observed.

Both four- and five-merous corollas were found on the plants collected, as is also reported by Porsild (1951) from other collections.

110. *Gentiana propinqua* Richards

Coll. July 16, in the NW corner of our area, elev. ca. 5000 ft. (M), and July 23, in the mountains N of Quill creek camp, elev. ca. 4600 ft. (F).

Our specimens are stunted, about 10 cm tall, and very densely branched. They are common on meadow-like slopes.

111. *Phlox sibirica* L.

Coll. June 17 and July 4, in the Tetamagouche pass, elev. ca. 4600 ft. (M).

Our plants have almost woolly leaves and the flowers vary from 5 to 10 mm in width. They dry blue. The species is apparently rare in Yukon. It seems to be restricted to unglaciated areas.

112. *Polemonium acutiflorum* Willd.

Coll. June 10, near Quill creek camp, elev. ca. 4600 ft. (F), and June 16 and July 2, in the Tetamagouche pass, elev. ca. 4600 ft.

The pale blue, large-flowered *P. acutiflorum* Willd. is fairly common all over our area, usually growing in the bottom of the valleys. There is hardly any variation between the plants collected.

113. *Polemonium pulcherrimum* Hook.

Coll. June 16, in the Tetamagouche pass, elev. ca. 4600 ft. (M).

Of the two plants collected, one specimen has certain characteristics (the large corolla and exerted stigma) in common with *P. rotatum* Eastw. Porsild (1951) also noted such variation among his plants. However, both he and Hultén (1948) point out the wide variation within *P. pulcherrimum* and till this species is studied further both our specimens are best placed under this name. The species has been previously collected from southern and western Yukon.

114. *Myosotis alpestris* F. W. Schmidt ssp. *asiatica* Vestergr.

Coll. June 19 (M) and July 24 (F), near and N of Quill creek camp, elev. ca. 4000—5000 ft.

This beautiful plant is common in the entire area on alpine meadows up to 6000 ft. altitude.

115. *Mertensia paniculata* (Ait.) G. Don

Coll. June 9 (M) and July 24 (F), near and N of Quill creek camp, elev. 4000—4500 ft.

None of the specimens collected here belongs to var. *alaskana* (Britt.) Williams (cf. Hultén 1949), but are all of the main race with hairy sepals and leaves strigous on the lower sides. The plant grows everywhere in wooded areas, sometimes luxuriantly.

116. *Castilleja hyperborea* Pennell

Coll. June 26, Upper Quill creek valley, elev. 4000—4500 ft. (M), July 4, in the Tetamagouche pass, elev. ca. 4600 ft. (M), and July 16, in the NW corner of our area, elev. ca. 5000 ft. (M).

All the collections were made in slopes above the timberline. The species is apparently rare and thus far known only from unglaciated parts of Yukon. Porsild (1951) failed to find it along Canol road in southeast Yukon.

Our specimens vary quite a deal as to the color of the flower (greenish yellow, clear yellow, purplish yellow) but the bracts vary only slightly in the degree of purpleness.

The specimens were kindly indentified by Dr. H. J. Scoggan, National Museum, Ottawa.

117. *Pedicularis capitata* Adams

Coll. June 28, in the Tetamagouche pass, elev. ca. 4600 ft. (F), and July 10, along the Quill creek road towards Alaska Highway, elev. ca. 4000 ft. (M).

This species prefers mossy, wooded valleys. It was the least common of the five *Pedicularis* species found in our area, though not rare.

118. *Pedicularis labradorica* Wirsing

Coll. June 26, in the Upper Quill creek valley, elev. 4000—4500 ft. (M).
This species is found everywhere in the wooded areas.

119. *Pedicularis lanata* Cham. et Schlecht.

Coll. June 4, near Quill creek camp, elev. 4000—4600 ft. (M).
This species is locally abundant in alpine meadows between 4000 and 4600 ft. altitude throughout the area. On June 4th it was in full bloom.

120. *Pedicularis Oederi* Vahl.

Coll. June 10, in the mountains N of Quill creek camp, elev. ca. 4500 ft. (M).
Though considered rare and restricted to the unglaciated western parts of Yukon (cf. Porsild 1951), this species is fairly common in our area. Our specimen agrees well with material of the same species from Scandinavia (cf. Hultén 1949).

121. *Pedicularis verticillata* L.

Coll. June 15, in the Upper Quill creek valley, elev. 4000—4500 ft. (M), July 7, in the Tetamagouche pass, elev. ca. 4600 ft. (F), July 23 and 24, near and N of Quill creek camp, elev. 4000—4600 ft. (F).

Most of our specimens are slender and gracile. Though this species seems to be very rare in Yukon, reaching it from the west and along the Arctic Coast, it is the most common *Pedicularis* in our area. Also Bakewell (1943) found it in several places between Burwash landing and Wolf (Steel's) creek glacier.

122. *Galium septentrionale* R. et S.

Coll. July 10, along the Quill creek road to Alaska Highway, elev. 3500—4000 ft. (M).

As pointed out by Löve and Löve (1954), the American species, which corresponds to the European *G. boreale* L., has a typical growth, hairy nodes and larger anthers. It is common along roads and often seen in meadows, though not above the timberline.

123. *Linnaea borealis* L. ssp. *americana* (Forbes) Hult.

Coll. June 15, in the Upper Quill creek valley, elev. ca. 4500 ft. (M).

This species is common everywhere in the wooded area. The specimens collected are all typical ssp. *americana* with funnel-shaped corollas, indistinguishable from specimens from Manitoba (cf. Hultén 1949, Porsild 1951).

124. *Valeriana capitata* Pall.

Coll. June 26, in the Upper Quill creek valley, elev. ca. 4500 ft. (M).

Our specimens were collected in a wet, sandy locality along the creek. They belong to the type variety of the species, and cannot be referred to var. *bracteosa* Hult. (Hultén 1949). It is one of the species belonging to the unglaciated parts of Alaska and Yukon and has not yet been found east of the Yukon river (cf. Porsild 1951).

125. *Campanula lasiocarpa* Cham.

Coll. Aug. 4, in the NW corner of our area, elev. 5500—6000 ft. (M).

This low, large-flowered blue-bell with its deep blue, wide open corolla was found on the very peak and the highest ridges of the mountain. According to Porsild (1951) it is restricted to acid rocks.

126. *Campanula uniflora* L.

(New to Yukon.) — Coll. June 26, in the Upper Quill creek valley, elev. ca. 4500 ft. (M).

Macoun (1899) reports that Tyrrell has found *Campanula uniflora* at Forty-mile river, Yukon, but the find has been impossible to verify. It does not seem unreasonable that the plant should grow in the Forty-mile river district, since it has been found in several other places inside the big unglaciated area of Alaska. Another locality close to the Alaska-Yukon border is White river, where Eaton collected this species in 1909 (cf. Hultén, 1949). This locality is not very far from our Quill creek area (ca. 60 miles W), and in the same general region on the eastern slopes of the St. Elias-Wrangel Mountains-chains. One may therefore expect to find more of this species in the southwestern corner of Yukon, especially in nunatak areas.

Our specimen, a single plant only, is very typical with a hairy calyx and a small, narrow corolla.

127. *Solidago multiradiata* Ait.

Coll. June 26, in the Upper Quill creek valley, elev. ca. 4600 ft. (F), July 5, in the Tetamagouche pass, elev. ca. 4600 ft. (M), and July 31, near Quill creek camp, elev. ca. 4000—4500 ft. (F).

This species is not very rare in the area, found generally in wooded valleys.

127 a. *Solidago multiradiata* Ait. var. *scopolorum* Gray.

Coll. July 5, in the Tetamagouche pass, elev. ca. 4600 ft. (M), July 10, along the Quill creek road to Alaska Highway, elev. ca. 4000 ft. (F), and July 31, near Quill creek camp, elev. 4000—4500 ft. (F).

The tall, sturdier and dark green, compact-headed variety is more often met with than the typical race in the Quill creek area. It always seems to be well separated from the typical variety and may possibly be a distinct species.

128. *Aster alpinus* L. ssp. *Vierhapperi* Onno.

Coll. July 15, in the mountains N of Upper Quill creek valley, elev. ca. 5000 ft. (M), and July 23, N of Quill creek camp, elev. ca. 4600 ft. (F).

All our specimens have pink rays, which, according to Porsild (1951) is common when the plants grow on a calcareous ground. Their pubescence is not very dense, though all the specimens are somewhat viscid.

129. *Aster sibiricus* L.

Coll. July 10, along the Quill creek road, towards Alaska Highway, elev. ca. 4000 ft. (M).

Our specimens were kindly identified by Dr A. Cronquist of the New York Botanical Garden. He ascribes them to var. *meritus* (A. Nels.) Raup. They are

about 15 cm tall and have serrate leaves, the underside of which is tomentose as are also the stems. The number of heads varies from one to three.

130. *Erigeron angulosus* Gaud. var. *kamtschaticus* (DC) Hara.

Coll. July 10, on a meadow along the road to Alaska Highway, elev. 3500—4000 ft.

For the discussion regarding the correct name of this species, cf. Hara (1939), Cronquist (1947) and Hultén (1950).

Our specimen grew on a moist meadow and had immature fruits at the date of collecting.

131. *Erigeron grandiflorus* Hook.

Coll. June 26, in the Upper Quill creek valley, elev. 4000—4500 ft. (M), and July 31, near Quill creek camp, elev. 4000—4600 ft. (F).

After thorough consideration we dare to name our plants *E. grandiflorus* Hook. and not *E. yukonensis* Rydb. It seems that Porsild (1951) considers all plants from Yukon previously identified as *grandiflorus* to be *yukonensis*. However, our plants are all under 15 cm high, have yellowish, woolly hairs on the involucre and have lanceolate, not linear-lanceolate, stem-leaves. They are distinctly different from *E. glabellus* var. *pubescens*, which *E. yukonensis* seems to approach. The rays are longer, broader and fewer in our *E. grandiflorus* than in *E. glabellus* var. *pubescens*. *E. grandiflorus* seems to be fairly rare both in Alaska and Yukon.

132. *Erigeron humilis* Grah.

Coll. June 28, in the mountains N of Upper Quill creek valley, elev. ca. 5500 ft. (M), July 15, in the mountains N of the Tetamagouche pass, elev. ca. 5500 ft. (M), and Aug. 1, N of Quill creek camp, elev. ca. 5000 ft. (F).

In using the name *E. humilis* Grah. for the species previously called *E. unalaschkenses* (DC.) Vierh. we follow Cronquist (1947) and Hultén (1950).

This species was collected on ledges and summits of the mountains, and all are of the stunted alpine type mentioned by Porsild (1951). They measure not over 8 cm in height, are densely caespitose, and have small heads with bluish-black involucre.

133. *Antennaria megacephala* Fern.

Coll. June 27, N of the Tetamagouche pass, elev. ca. 5000 ft. (M).

The plants were found on a talus slope, are all very small, only 3 to 4 cm. and monocephalic. The species seems to be rare in Yukon, and is previously reported only from southeast Yukon and northern British Columbia.

134. *Achillea borealis* Bong.

Coll. July 10, along Alaska Highway near junction with Quill creek road, elev. ca. 3500 ft. (M).

The name *A. borealis* Bong. is without doubt correct for the W. American population, which is biologically and geographically different from the E. American (Greenland-Iceland) population. (cf. Clausen, Keck and Hiesey

1948). Our plants, which are common in meadows along the road, include also *f. rosea*, which is scattered sparsely everywhere, especially in alpine situations.

135. *Achillea sibirica* Ledeb.

Coll. July 10, near Alaska Highway and its junction to Quill creek road, elev. ca. 3500 ft. (M).

This species seems limited to the interior more or less unglaciated parts of Alaska-Yukon. Porsild (1951) did not see it along Canol road, southeast Yukon. Our specimen grew in a meadow together with *Achillea borealis*.

136. *Artemisia arctica* Less.

Coll. Aug. 2, in the NW corner of our area, elev. ca. 5000 ft. (M).

Our specimen is short with a simple, spikelike inflorescence, hardly lanate at all. The leaves are completely glabrous.

137. *Artemisia Kruhsiana* Bess.

Coll. July 15, in the Upper Quill creek valley, elev. ca. 4500 ft. (M), and July 19, near Quill creek camp, elev. ca. 4500 ft. (F).

Hultén (1950) regards *A. Kruhsiana* as identical with *A. Tyrrellii* Rydb. whereas Porsild (1951) holds that the latter is identical with *A. alaskana* Rydb. Hultén's (l.c.) key and picture (on p. 1563) places our specimens in *A. Kruhsiana*, characterized by leaves which are cleft into three main parts with end-lobes widening towards the obtuse tip, and silvery-silky pubescence. They are definitely not *A. alaskana* which has its leaves cleft into 5 parts with narrow endlobes and a tomentose pubescence.

The general distribution of the two species, *A. Kruhsiana* and *A. alaskana*, is similar and seems restricted to the high mountains of the interior of Alaska and southwestern Yukon, reaching south into the Rocky Mountains. They undoubtedly exist side by side.

138. *Artemisia Tilesii* Ledeb.

Coll. July 19, near Quill creek camp, elev. 4000—4500 ft. (M).

The specimens have leaves that are somewhat suggestive of the ssp. *Gormanii* (Rydb.) Hult. (cf. Hultén 1950, Fig. 2 c, p. 1575), but the flower heads are rather big and it is preferable to identify the material for the time being as the species in its wider sense. The species has previously been collected in this area (Hultén 1950, Porsild 1951).

139. *Petasites frigidus* (L.) Fries

Coll. June 10, near Quill creek camp, elev. 4000—4500 ft. (M).

A common, but very variable species. The leaves were collected at a later date.

140. *Arnica alpina* (L.) Olin ssp. *angustifolia* (Vahl.) Maguire

Coll. July 16, in the NW corner of our area, elev. ca. 5000 ft. (M), and July 19, near Quill creek camp, elev. 4000—4500 ft. (M).

140 a. *Arnica alpina* (L.) Olin ssp. *attenuata* (Greene) Maguire

Coll. July 16, in the NW corner of our area, elev. ca. 5000 ft. (M).

Specimens of this subspecies were kindly identified by Dr. A. Cronquist, New York.

When Hultén (1950) wrote his Alaska flora, the ssp. *angustifolia* had been found only on the Arctic Coast of Yukon and in the northern part of Alaska. Porsild (1951), however, collected it in southeast Yukon, and our specimens of ssp. *angustifolia* were found growing side by side with ssp. *attenuata* at high altitude in the Quill creek area.

141. *Arnica Lessingii* Greene.

Coll. July 15, in the mountains N of Upper Quill creek valley, elev. ca. 5000 ft. (M).

Looking at the distribution of this easily recognizable species with its drooping head (cf. Hultén 1950, Porsild 1951), one is not at all surprised by finding it in the Quill creek area. The plants were not common, but certainly far from being rare.

142. *Arnica louiseana* Farr. ssp. *frigida* (Meyer) Maguire

Coll. July 16, in the NW corner of our area, elev. ca. 5000 ft. (M).

This subspecies seems to be very rare in Yukon and has been collected only twice before, once at Klwane Lake, (Clarke, no 292; cf. Porsild 1951). Our specimens were identified by Dr. A. Cronquist.

143. *Senecio atropurpureus* (Ledeb.) Fedtsch. ssp. *frigidus* (Rich.) Hult.

Coll. June 10, N of Quill creek camp, elev. ca. 4500 ft. (M).

The specimens of this race are quite typical, and plants both with and without radiate heads were collected. The ligules when present are pale yellow. This seems to be the most common race of *S. atropurpureus* in Alaska-Yukon.

144. *Senecio fuscatus* (Jord. et Fourr.) Hayek

Coll. July 16, in the NW corner of our area, elev. ca. 5000 ft. (M).

Our specimens were kindly identified by Dr. A. Cronquist. The species does not seem to be well known in Yukon, and according to Hultén (1950) it has been collected only on the Arctic Coast. However, it has also been found at White river (coll. Eaton 1909; cf. Hultén l.c.), which is only about 60 miles west of Quill creek, and in the same general region.

145. *Senecio hyperborealis* Greenm.

Coll. July 16, in the NW corner of our area, elev. ca. 5000 ft. (M).

Dr. A. Cronquist identified our only specimen of this rare species. In Yukon it was previously known only from Dawson and Whitehorse (cf. Porsild 1951).

146. *Senecio Kjellmanii* Porsild.

Coll. June 26, in the Upper Quill creek valley, elev. ca. 4000—5000 ft. (M).

According to Hultén (1950) *S. Kjellmanii* is synonymous with *S. atropurpureus* (Ledeb.) Fedtsch. var. *tomentosus* (Kjellm.) Hult. Porsild (1951), how-

ever, holds that it is "abundantly distinct" from both *S. atropurpureus* and its var. *Ulmeri* (Steff.) Porsild. Our specimens from the Upper Quill creek valley agree exactly with herbarium sheets from the National Museum, Ottawa, determined by Porsild as *S. Kjellmanii*. It was previously collected at Kluane lake by Clarke (no. 284; cf. Porsild 1951).

147. *Senecio lugens* Rich.

Coll. June 20, in the Tetamagouche pass, elev. ca. 4600 ft. (M).

A common species throughout Yukon. Our specimens, identified by Dr. A. Cronquist, are very vigorous, about 30 to 40 cm tall.

148. *Senecio resedifolius* Less.

Coll. June 26, in the Upper Quill creek valley, elev. 4000—4500 ft. (M), and July 16, in the NW corner of our area, elev. ca. 5000 ft. (F).

Our specimens were identified by Dr A. Cronquist. They represent a rare calciphile species in Yukon, more common, it seems, towards the north, but also previously collected at Kluane lake (cf. Porsild 1951) and Wolf (Steel's) Glacier (Bakewell 1943).

149. *Saussurea viscida* Hult. var. *yukonensis* (Pors.) Hult.

Coll. Aug. 11, along the Quill creek road towards Alaska Highway, elev. ca. 3500 ft. (M).

This peculiar species was collected in a bushy area along the road. The plants are dwarfed and arachnoid, but only slightly viscid. They are identical with Hultén's picture (Hultén 1950, p. 1628) of this species, and very different from the pictures of *S. angustifolia* on the same page. The species is rare in Yukon.

150. *Taraxacum flavovirens* Haglund (?)

Coll. June 9, near Quill creek camp, elev. ca. 4000 ft. (M).

As *Taraxacum* generally is a very difficult genus we do not dare to be too definite regarding the identity of our material. Still it agrees well with Haglund's (1948) description as well as his pictures of this species, and furthermore it has previously been collected at Whitehorse and at Haines, which is not far from Quill creek.

151. *Taraxacum* sp.

Coll. July 15, in the mountains N of Upper Quill creek valley, elev. c. 5000 ft. (M).

This is a low, caespitose type of *Taraxacum* with a 5—10 cm long and about 1 cm broad leaf, the upper part of which (about $\frac{1}{3}$ to $\frac{1}{2}$ of the blade) is entire and broad-obtuse, the lower part deeply dentate with lobes somewhat pointing towards the cuneate base and confluent winged petiole. The flower-head is 2—2 $\frac{1}{2}$ cm broad, the outer involucre short with a wide base and almost triangular in outline, the inner involucre about 1—1 $\frac{1}{2}$ cm high, narrow and with cartilaginous tips. The ligules are clear yellow. The achenes have spiny tops and a crooked beak. We have not been able to identify it with

any previously described species. Our specimen has been forwarded to the State Museum of Natural History, Stockholm.

152. *Crepis elegans* Hook.

Coll. July 10, along Quill creek road, towards Alaska Highway, elev. ca. 3500—4000 ft. (M).

Our specimens were identified by Dr H. J. Scoggan, National Museum, Ottawa. They are over 20 cm tall, slender, with an elongated inflorescence, and short petioled, elliptic-linear leaves. It is not very common in Yukon.

153. *Crepis nana* Richards

Coll. July 10, along the Quill creek road towards Alaska Highway, elev. ca. 3500—4000 ft. (M).

Porsild (1951) considers this a rare arctic-alpine species, limited to calcareous slide-rock, but our specimens were collected on a meadow close to *Crepis elegans*. It is a low, tufted plant, only about 4 cm tall, very compact and with a taproot almost 15 cm deep. The leaves are long-petioled and broadly ovate.

Literature cited

- ADANSON, M. 1763. Familles des plantes. — Paris.
- ASCHERSON, P. and GRAEBNER, P. 1896. Synopsis der mitteleuropäischen Flora. I. — Leipzig.
- — 1912. Synopsis der mitteleuropäischen Flora. I. 2 Aufl. — Leipzig.
- BAENITZ, C. 1891. Herbarium europaeum. No. 6510. — Königsberg.
- BAKEWELL, A. 1943. Botanical collections at the Wood Yukon expeditions of 1939—41. — *Rhodora* 45: 305—316.
- BOSTOCK, H. S. 1952. Geology of Northwest Shakhwak valley, Yukon Territory. — *Geol. Survey Canada Mem.* 267.
- CHAMISSE, A. v. and SCHLECHTENDAL, D. F. L. 1828. De plantis in expeditione speculatoria Romanzoffiana observatis. — *Linnaea* 3.
- CLAUSEN, J., KECK, D. D. and HIESEY, W. M. 1948. Experimental studies on the nature of species. III. Environmental responses of climatic races of *Achillea*. — *Carnegie Inst. Wash. Publ.* 581: 1—129.
- CRONQUIST, A. 1947. Revision of the North American species of *Erigeron*, north of Mexico. — *Brittonia* 6: 121—302.
- DESVAUX, 1827. (*Lycopodium Selago* var. *appressum*.) — *Ann. Soc. Linn. Paris* 6: 180.
- DRURY, W. H. & ROLLINS, R. C. 1952. The North American representatives of *Smeilowskia* (*Cruciferae*). — *Rhodora* 54: 85—119.
- DUHAMEL DU MONCEAU, H. L. 1755. *Traité des arbres et arbustes, qui se cultivent en France en pleine terre.* — Paris.
- EKMAN, ELISABET. 1931. Contribution to the *Draba* flora of Greenland. III. — *Svensk Bot. Tidskr.* 25: 465—494.
- FABERGÉ, A. C. 1942. Genetics of the *Scapiflora* section of *Papaver*. I. The garden Iceland poppy. — *Journ. of Genet.* 44: 169—193.

- 1944. Genetics of the *Scapiflora* section of *Papaver*. III. Interspecific hybrids and genetic homology. — Journ of Genet. 46: 125—149.
- FEDDE, F. 1909. Papaveraceae. — In ENGLER: Das Pflanzenreich IV: 1—430.
- FERNALD, M. L. 1914. The alpine bearberries and the generic status of *Arctous*. — *Rhodora* 16: 21—33.
- 1934. *Draba* in temperate northeastern America. — *Rhodora* 36: 285—305.
- FERNALD, M. L. and MACBRIDE, J. F. 1914. The North American varieties of *Arctostaphylos Uva-ursi*. — *Rhodora* 16: 211—213.
- Flora of Murmansk, I. Leningrad 1953.
- FOMIN, A. 1930. Pteridophyta. 1. Filices. — *Flora Sibiriae et Orientis extremi* 5: 1—218.
- 1934. *Cystopteris*. — *Flora SSSR* I: 24—26.
- HADAČ, E. 1944. Die Gefäßpflanzen des "Sassengebietes" Vestspitzbergen. — *Norges Svalbard- og Ishavsunders.*, Skrifter 87: 1—72.
- HAGERUP, O. 1927. *Empetrum hermaphroditum* [LGE] HAGERUP, a new tetraploid, bisexual species. — *Dansk Bot. Arkiv* 5, 2: 1—17.
- 1933. Studies on polyploid ecotypes in *Vaccinium uliginosum* L. — *Hereditas* 18: 122—128.
- HAGLUND, G. E. 1948. Further contributions to the knowledge of the *Taraxacum* flora of Alaska and Yukon. — *Svensk Bot. Tidskr.* 42: 297—336.
- HARA, H. 1939. Some notes on the botanical relation between North America and Eastern Asia. — *Rhodora* 41: 385—392.
- HEDBERG, O. 1946. Pollen morphology in the genus *Polygonum* L. s. lat. and its taxonomical significance. — *Svensk Bot. Tidskr.* 40: 371—404.
- HOLMEN, K. 1952. Cytological studies in the flora of Peary Land, North Greenland. — *Medd. om Grönl.* 128, 5: 1—40.
- HORN, K. 1938. Chromosome numbers in Scandinavian *Papaver* species. — *Avhandl. Norske Vidensk.-Akad. Oslo. I. Mat.-Nat. Kl.* 1938, No. 5: 1—13.
- HULTÉN, E. 1928. Flora of Kamtschatka and the adjacent islands. II. — *Kungl. Svenska Vetensk. Akad. Handl. Tredje Serien, Vol. 5, No. 2*: 1—218.
- 1937. Flora of the Aleutian Islands. — Stockholm.
- 1940. History of botanical exploration in Alaska and Yukon Territories from the time of their discovery to 1940. — *Bot. Notiser* 1940: 289—346.
- 1941—1950. Flora of Alaska and Yukon. I—X. — *Acta Univ. Lund, N.F.* II, 37—46: 1—1902.
- HUSTICH, I. and PETTERSON, B. 1944. Notes on the vascular plants of the east coast of Newfoundland-Labrador. — *Mem. Soc. Fauna et Flora Fennica* 19 (1942—43).
- HYLANDER, N. 1941. Förteckning över Skandinavians växter I. Kärleväxter. — Lund.
- 1945. Nomenklatorische und systematische Studien über nordische Gefäßpflanzen. — *Uppsala Univ. Årsskr.* 1945, 7: 1—337.
- 1953. Nordisk kärleväxtflora. I. — Uppsala.
- KOMAROV, V. L. 1936. Polygonaceae. — *Flora SSSR* V.
- LARSEN, K. 1952. Udbredelsen i Grönland af *Cystopteris fragilis* coll. med piggede og vortede sporer. — *Bot. Tidsskr.* 49: 39—44.
- LID, J. 1952. Norsk flora. 2 utg. — Oslo.
- LINNAEUS, C. 1753. *Species plantarum*. — Holmiae.

- LJUNGDAHL, H. 1922. Zur Zytologie der Gattung *Papaver*. Vorläufige Mitteilung. — Svensk Bot. Tidskr. 16: 103—114.
- 1924. Über die Herkunft der in der Meiosis konjugierenden Chromosomen bei *Papaver*-Hybriden. — Svensk Bot. Tidskr. 18: 279—291.
- LÖVE, Å. 1948. Gróður nyrzt á Hornströndum. — Náttúrufr. 18: 97—112.
- 1954. Cytotaxonomical remarks on some American species of circumpolar taxa. — Svensk Bot. Tidskr. 48: 211—232.
- 1955 a. Cytotaxonomical notes on the Icelandic *Papaver*. — Nytt Magasin f. Bot. 4 (in press).
- 1955 b. Biosystematic remarks on vicariism. — Acta Soc. pro Fauna et Flora Fennica 17 (in press).
- LÖVE, Å. and LÖVE, D. 1948. Chromosome numbers of Northern plant species. — Icelandic Univ. Inst. Appl. Sci., Dept. of Agric. Rep. B. 3: 1—131.
- and — 1954. Cytotaxonomical studies on the Northern Bedstraw. — Amer. Midl. Natural. 52: 88—105.
- and — 1956. Cytotaxonomical conspectus of the Icelandic flora. — Acta Horti Gotoburgensis (in press).
- LÖVE, D. 1953. Cytotaxonomical remarks on Gentianaceae. — Hereditas 39: 225—235.
- LUNDSTRÖM, E. 1923. Über *Papaver nudicaule* L. and *P. radicum* ROTTB. in Fennoskandia und Arktis sowie über einige mit *P. nudicaule* verwandte Arten. — Acta Horti Bergiani 7: 403—430.
- MACKENZIE, K. K. 1935. Cyperaceae. — North Am. Flora 18, Part 4: 169—240.
- MACOUN, J. 1899. List of plants collected by J. B. Tyrrell in the Klondyke region 1899. — Ottawa Naturalist 13: 209—218.
- MANTON, I. 1950. Problems of cytology and evolution in the Pteridophyta. — Cambridge.
- MARIE-VICTORIN, FR. 1927. Les Equisetines du Québec. — Contr. Lab. Bot. Univ. Montréal 9: 1—137.
- MOENCH, K. 1794. Methodus plantas horti botanici et agri Marburgensis a stamineum situ describendi. — Marburgi Catorum.
- MOORE, T. 1848. Handbook of British ferns. — London.
- MULLER, J. 1954. Preliminary map. Kluane Lake (west half). Yukon Territory. — Geol. Survey of Canada Paper 53: 20.
- NIEDENZU, F. 1889. Ueber den anatomischen Bau der Laubblätter der Arbutoideae und Vaccinioideae in Beziehung zu ihrer systematischen Gruppierung und geographischen Verbreitung. — Engl. Bot. Jahrb. 11: 134—263.
- NORDHAGEN, R. 1931. Studien über die skandinavischen Rassen des *Papaver radicum* ROTTB. sowie einige mit denselben verwechselte neue Arten. Vorläufige Mitteilung. — Bergens Mus. Årsbok 1931, Naturvidensk. Rekke, Nr. 2: 1—50.
- 1939. Bidrag til fjellet Pältsas flora. Ett nytt funn av *Stellaria longipes*. — Bot. Notiser 1939: 691—700.
- 1940. Norsk flora. — Oslo.
- PORSILD, A. E. 1939. Contributions to the flora of Alaska. — Rhodora 41: 141—183, 199—254, 262—301.
- 1945. The alpine flora of the east slope of the Mackenzie Mountains, N.W.T. — Bull. Nat. Mus., Canada 101: 1—35.
- 1951. Botany of southeastern Yukon, adjacent to the Canol Road. — Bull. Nat. Mus., Canada 121: 1—400.

- PURSH, F. 1814. *Flora Americae Septentrionalis*; or, a systematic arrangement and description of the plants of North America. — London.
- RAYMOND, M. 1950. *Esquisse phytogéographique du Québec*. — *Mém. Jard. Bot. Montréal* 5: 1—147.
- ROTHMALER, W. 1944. *Pteridophyten-Studien, I.* — *Feddes Repert.* 54: 55—82.
- ROTBÖLL, C. F. 1767. *Afhandling om en Deel enten gandske nye eller vel forhen bekendte, men dog for os rare Planter, som i Island og Grönland ere fundne, tilligemed en kort Indledning om Urtelærens Tilstand i Danmark.* — *Kbh. Vidensk. Selsk. Skr.* 10: 393—468.
- ROUSSEAU, J. and RAYMOND, M. 1952. *Quelques entités nouvelles du nord du Québec.* — *Natural. Canad.* 79: 81—84.
- SCHNEIDER, C. 1920. *Notes on American willows. VIII.* — *Journ. Arnold. Arb.* 1: 211—232.
- SCHWARZ, O. 1949. *Beiträge zur Nomenklatur und Systematik der mitteleuropäischen Flora.* — *Mitt. Thüring. Bot. Ges.* 1: 82—119.
- SIM, J. 1848. (*Cystopteris Dickieana* SIM.) — *Gardeners' Journal* 1848: 308.
- SMALL, J. K. 1901. *Contributions to the botany of the Yukon Territory.* — *Bull. New York Bot. Garden* 2: 101—186.
- SUGIURA, T. 1940. *Chromosome studies on Papaveraceae with special reference to the phylogeny.* — *Cytologia* 10: 558—576.
- THOMAS, M. K. 1953. *Climatological map of Canada.* — *Nat. Res. Council Publ. no. 3151.*
- TOLMACHEV, A. 1923. *Über die europäischen Rassen von Papaver radicum* ROTTB. — *Not. Syst. Herb. Hort. Bot. Petrop. t. IV fasc. 11—12.*
— 1927. *Über die Formen von Papaver radicum* ROTTB. und ihre Verbreitung in Skandinavien. — *Svensk Bot. Tidskr.* 21.
- TRELEASE, W. 1904. *The ferns and fern allies of Alaska.* — *Wash. Acad. Sci. Harri-man, Alaska Exp.* 5: 375—398.
- WAGNER, W. H. 1955. *Cytotaxonomic observations on North American ferns.* — *Rhodora* 57: 219—240.
- WAHL, H. A. 1954. *A preliminary study of the genus Chenopodium in North America.* — *Bartonia* 27: 1—46.
- WIGGINS, I. L. 1954. *Cystopteris dickieana* and *Woodsia glabella* in arctic Alaska. — *Amer. Fern. Journ.* 44: 97—108.

Morphological terminology relating to female charophyte gametangia and fructifications

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In spite of the considerable number of investigations devoted to the female reproductive bodies and fructifications of the Charophyta, there is no generally adopted system of terms. This statement applies less to fossil remains — though the terminology of students working in this field is far from complete agreement — than to developing and mature female gametangia and fructifications of recent Characeae, in respect of which the terminologies present considerable difficulties.

In this paper the writer will suggest a morphological terminology which deviates considerably from the terms usually employed in textbooks. Terminological changes are always inconvenient, but they seem necessary in the present case seeing that several frequently used terms either do not agree with the morphological concepts of these terms as applied to other large groups of algae, or are used in rather different senses by authors in describing charophytes.

In choosing between alternative terms — and there are usually several — the term which is most commonly used for a given morphological concept has as a rule been selected in order to avoid unnecessary alterations. Another, equally important point has been to fix upon terms that are unambiguous, *i.e.* have not been commonly applied to other morphological concepts in other algal groups or have not in descriptions of charophytes been used for other organs or tissues. The terminology suggested in this paper is a compromise between these — sometimes rather contrasting — points of view. No attempt has on the other hand been made to apply any principle of priority when selecting the terms, although I have in most cases tried to trace each chosen term back to its first appearance in the literature.

I am aware that there are other — especially old — terms that relate to the morphology of the female gametangia and fructifications of the

Characeae, and likewise that more literature references to the various terms mentioned might have been offered. No morphological charophyte glossary like that of Groves & Bullock-Webster (1920, pp. 72—76) is, however, attempted. Older synonyms have moreover been summarized by Bischoff (1842, pp. 739—742). Other dictionaries used with profit in writing the present paper are Linsbauer (1917), Jackson (1928), and Moll (1934). Completeness of references has not been attempted. Important morphological investigations on charophytes are generally cited, as well as the commonly used textbooks on morphological and systematical botany, but the wealth of taxonomic papers relating to recent stoneworts have been included only exceptionally, since they have generally adopted the morphological terms given by Groves & Bullock-Webster (1920, 1924) or Migula (1897). The first interpretation of charophyte morphology from a modern point of view was undertaken by Braun in papers published in 1852—1853, and I have accordingly made these my "terminological starting point". Most older terms are nowadays of merely historical interest, since they were established in connection with identifications and comparisons of gametangia with angiospermous flowers; with few exceptions, they have therefore been omitted from the discussions; representative assortments of such obsolete terms are to be found in some old treatises, of which especially Kaulfuss (1825) and Bischoff (*op.c.*) give detailed information and references. The former moreover gives a useful historical review of the various uses of the terms.

1. Sporophydium and oosporangium

The considerable uncertainty as to the morphological interpretation of the female gametangium of the Characeae apparently caused some denominational confusion.

Early students of this group interpreted the gametangium as a complete female flower, and named it correspondingly (see Kaulfuss *op.c.*, Bischoff *op.c.*). Bischoff himself (*op.c.*, p. 739) chose the term *weibliche Blüthe* or *Fruchtnaenge*. Hofmeister (1852) who compared the female gametangium of the Characeae to the female sexual structure of bryophytes, termed it *Archegonium* (*cf. also e.g.* Unger 1855, p. 382). This was later adopted by some English writers (*e.g.*, Bennett 1878, p. 206, Vines 1878, p. 356, Bennett & Murray 1889, p. 179), as by Schimper (1869, p. 219), and recently by Andrews (1947, p. 213, expl. of fig.).

In his first detailed description of these structures Braun (1853) termed the female gametangium alternately *Sporenknöspchen* or *Sporophyas* (p. 51), and *Sporensprösschen* (p. 68). These terms have been widely

used (*e.g.* by Nordstedt 1866, p. 1, Sachs 1868, p. 263, de Bary 1871, p. 227, Schimper & Schenk 1879, p. 41, Overton 1890, p. 10, Migula 1897, p. 33, Wille 1897, p. 170, Linsbauer 1917, p. 659, Printz 1927, p. 423) and form, together with the similar term *Eiknospe* (de Bary 1871, p. 237, Goebel 1882, p. 68, 1902, p. 283, 1918, p. 365, Stache 1889, p. 128, Kaiser 1896, p. 74, Goetz 1899, p. 1, Losch 1912, p. 518, Oltmanns 1922, p. 453, Walther 1929, p. 33, Wallner 1932, p. 285), the most common expressions in the German descriptions of charophytes.

In his later studies (first in 1857, p. 338), Braun changed over to the non-committal *Sporangium* (see also *e.g.* Stache *op. c.*, p. 128, who alternatively uses *Eiknospe*, *Sporangium* and *Oogonium* as synonymous concepts). The French equivalent of this term, *sporange*, has been used by Le Maout & Decaisne (1868, p. 672) and others. The expression *Sporangium* has also been used for fossil Characeae remains (Unger 1850, p. 31). Velenovský (1905, p. 80) introduced the term *Cystokarpium*, "wodurch zugleich die Homologie mit den Rotalgen angedeutet wird". The homology is, however, less complete than Velenovský supposed (this will to some extent be dealt with elsewhere) and his term is accordingly apt to cause misunderstandings. Logically, it ought moreover to apply to the fructification rather than to the gametangium. In his translation of Braun's paper of 1853, Henfrey (Braun & Henfrey 1853, p. 302) introduced the terms *spore-bud* or *sporophysa* (orthographical error?). T. F. Allen (1888, p. 10, footnote) finally re-introduced Braun's expression *Sporophyas* in the slightly altered variant *sporophydium*. This seems a practical, appropriate, and unambiguous term, well worth general adoption.

Čelakovský (1878, p. 49) on the other hand, proceeding from another morphological interpretation of the female gametangium, opposed Braun's terms and suggested the expression *behülltes Oogonium* (as to the use of *oogonium* for the female reproductive organ, see below). A somewhat similar terminology with application to Quaternary remains of the Characeae was developed by Woloszynska (1938, p. 184), who employed the term *berindetes Oogonium* of structures, that morphologically seem to correspond to female gametangia (see section 5 of this paper).

Most of the above expressions are characterized by the interpretation of the complex female gametangium of the Characeae as an organ *sui generis*, which cannot be perfectly homologized with the female gametangia of other algae. Another usage, *viz.* of the term *oogonium* (Germ. *Oogonium*, Fr. *oogone*) of the entire female gametangium of the Characeae, seems to be due to a misinterpretation of the gametangium as corresponding to the oogonium of other algae, *i.e.* the unicellular egg-cell in oogamous algae. The use of the term *oogonium* with respect to the Characeae can be traced back to de Bary (1871, p. 237), but he used it only to designate the egg-cell and its sterile sister-cells (see p. 219). Some students, Stache (1889, p. 128), Debski (1897, p. 229, 1898, p. 641), and van Tieghem (1891, p. 1262), misapplied this term to the whole female gametangium. This usage was adopted in important morphological investigations (Ernst 1901, p. 1, Sluiter 1910, p. 136, Tuttle 1924, p. 413, 1926, p. 228, Schmucker 1927, p. 781, Stewart 1937, p. 179), in several textbooks (*e.g.* Seward 1898, p. 223,

Constantin 1918, p. 149, Goebel 1928, p. 156, Fritsch 1935, p. 455, Wettstein 1935, p. 190, Chapman 1941, p. 110 ff., Kräusel 1950, p. 25, Iyengar 1951, p. 54, Mc Lean & Ivimey-Cook 1951, p. 384, Haupt 1953, p. 65, Gothan & Weyland 1954, p. 51, Beger 1954, p. 108), and is used by most of the leading taxonomists dealing with recent charophytes (*e.g.* by Groves & Bullock-Webster 1920, 1924). Its inaccuracy was hinted at by Coulter (1914, p. 58), and has later also been pointed out by Moll (1934, p. 117), Smith (1938, p. 130), Wood (1947, p. 241), and Croft (1952, pp. 192—193). Smith and Wood recommend the term *nucule* instead of *oogonium* (in analogy with *globule* as an appropriate term of the male gametangium). *Nucule* is said to have been introduced by Sachs (1875; not available to the writer); *nucula* was introduced for female Characeae gametangia as early as by Wallroth (1815, p. 162), however, and has since been used by Berkeley (1857, p. 428) and others. Moll (1934, p. 118) proposes *nucule*, *sporophydium*, and *spore-bud* as suitable English terms for female gametangia. Croft (*l.c.*) recommends the term *egg-bud*, stated to have been recently introduced (Maslov 1947) as a literal translation of *Eiknospe*; Maslov does not mention this term, however, but uses *spore-bud* and *oogonium* alternately. In 1875 Hemsley introduced the term *ovule-bud* (de Bary & Hemsley 1875, p. 299); the writer knows of no reference to later uses of that expression. Tilden (1935, p. 396), finally, has used the simple, but rather inappropriate term *egg* to designate the whole female gametangium.

The present writer prefers the term *sporophydium* as the most appropriate English term of the female gametangium. It means a "spore-bud" and accordingly expresses well present ideas of the morphological nature of the charophyte gametangium. The German and French equivalents (*Sporenknospe*, *sporophyde*) also appear unexceptionable. The terms *Sporenknöspchen*, *Sporensprösschen*, *Sporophyas*, *Eiknospe* (*egg-bud*) could also possibly be accepted. *Nucule* (= "small nut") is noncommittal, but rather inappropriate; in its German form (*Nüsschen*) it is moreover restricted by some writers to designate the fructification only (*e.g.* Migula 1897, p. 48, Wille 1897, p. 171, Linsbauer 1917, p. 659, Printz 1927, p. 424), and should therefore be rejected. The terms *Sporangium* (*sporangium*), *Cystokarpium*, *ovule-bud*, and *Oogonium* (*oogonium*, *oogone*) are misleading and unacceptable.

After fertilization, the egg-cell develops into a zygote, while the entire sporophydium at the same time changes a good deal externally and internally, finally developing into a fructification. This fructification too, lacks an appropriate, generally accepted designation.

As a rule, the early students of the Characeae did not distinguish the sporophydium from the resulting fructification. In an otherwise fairly useful

memoir (1826, p. 91) Lyell, for instance, uses the terms *seed-vessel* or *pericarpium* rather indiscriminately. One of the first to make the distinction was Bischoff (1842, p. 740); he terms the zygote with its envelopes simply *Frucht* or *fructus*. The English equivalent *fruit* has later been taken up by several paleobotanists (see below), and by G. O. Allen (1937, p. 153). Braun (1853, p. 74, 1857, p. 338) as also Overton (1890, p. 36), simply call the fructification *Spore*. Pringsheim (1863, p. 294) and Sachs (1868, p. 265) introduced the term *Sporenfrucht*. This very appropriate designation had been used before — alternatively with the Latin equivalent *Sporocarpium* — by Bischoff (1828, p. 25), and later *e.g.* by Schleiden (1846, p. 50), but as a name common to both sporophytia and fructifications. The term — since Sachs' time used by for instance Nordstedt & Wahlstedt (1875, p. 94), and quoted in Groves & Bullock-Webster's glossary (1920, p. 76) as a synonym of "oospore" — has the disadvantage of being in use to designate the whole spore-producing tissues of heterosporous ferns (*e.g.* by Wettstein 1935, p. 438), a structure which of course is not at all homologous with the fructifications of the Characeae, and is for that reason — although from other points of view perhaps the best existing — unfortunately less suitable. The term *Eifrucht* (Schussnig 1938, p. 149) has comparatively recently been introduced.

Walther (1929, p. 69 ff.) uses the noncommittal *zygote* to designate the entire fructification, but it should (*cf.* Linsbauer 1917, p. 795), be restricted to the direct result of the uniting gametes, as Oltmanns (1922, p. 456) and Smith (1938, p. 133) have done with reference to the Characeae. *Kern* or *Nüsschen* — the French equivalent of the latter term, *nucule*, has been adopted by Schimper (1869, p. 220) in this particular sense, but must not be confounded with the *nucula* of Wallroth (1815, p. 162) and later authors (see p. 215) — have often been used in papers written in German to designate the whole fructification (Migula 1897, p. 48, Wille 1897, p. 171, Sluiter 1910, p. 136, Linsbauer 1917, p. 659, etc.), sometimes alternatively with *Oospore* (Printz 1927, p. 424). This last term appears to have been introduced in this sense by mistake in Hemsley's translation of de Bary's paper of 1875 (de Bary & Hemsley 1875, p. 298); it has since been used rather extensively in several well-known textbooks (Velenovský 1905, p. 78, Oltmanns 1922, p. 456, Moll 1934, p. 101, Wettstein 1935, p. 190, Chapman 1941, p. 113, Mc Lean & Ivimey-Cook 1951, p. 386, Beger 1954, p. 108) as well as in Groves & Bullock-Webster (1920, p. 56) and most recent taxonomical papers. Woloszynska (1938, p. 184) has moreover applied *oospore* to Quaternary remains of Characeae fructifications, although another of her morphological categories, *viz.*, *unberindetes Oogonium*, may also have to be referred to fructifications (see section 5). But the term *Oospore* was originally introduced to designate the zygote, *i.e.* the fertilized egg-cell, of the Characeae (de Bary 1871, p. 237, 1875, p. 381), and has also been so defined by some later authors (Goebel 1882, p. 66, Wille 1897, p. 171, Linsbauer 1917, p. 659); it therefore does not seem quite correct to amplify its original meaning to include also tissues that are not formed by the egg-cell.

In 1888, T. F. Allen introduced *nucleus*, a literal translation of the German *Kern*, for the fructification. Neither this, nor — fortunately —

the particularly inappropriate *oeuf* (van Tieghem 1891, p. 1264, Costantin 1918, p. 147), has been much used since. The term *spermocarp* for the fructification of the Characeae was introduced by Bennett & Murray (1889, p. 180), but has apparently never been much used since; the same authors also use *spermocarp* on the corresponding structure of *Coleochaete*, this term has been used in the same sense in recent treatises, *e.g.*, by Smith (1938, p. 53). It should finally be noted that some terms originally applied to the sporophydium have also been used for the fructification.

If the noncommittal fructification should be deemed a too general designation there are, as far can be ascertained, only three terms that might be used as alternatives, *viz.* *sporocarp* (Bischoff 1828, p. 25), *spermocarp* (Bennett & Murray 1889, p. 180) or *sporangium* (so far never known to have been used for the fructifications of living Characeae, but applied to the sporophydium by Braun 1857, p. 338, and later, and sometimes, *e.g.* by Unger 1850, p. 31, and Stache 1889, p. 128 used for fossil remains). To specify the last, perhaps too general, of these expressions the term *oosporangium* might possibly be used although, so far the writer knows, this has never been applied to the fructifications of the Characeae.

Sporocarp is from a linguistic point of view appropriate, but has been generally adopted for the particular spore-bearing tissues of the Hydropteridales (*cf.* above), and is for that reason perhaps less suitable. *Spermocarp*, meaning "seed-fruit" is inappropriate from a logical point of view, but its application to the fructifications of the Coleochaetaceae, which show points of similarity to those of the Characeae, might perhaps be an argument in favour of its adoption also for the latter group. The term *sporangium* seems too general, as it is used for structurally rather different organs in large parts of the vegetable kingdom. The use of *oosporangium*, finally, is contingent on whether the term *oospore* can, *sensu stricto*, be applied to the zygote of the Characeae. Linsbauer (1917, p. 656) defines oospores as "Sporen, welche sexuell befruchtete Eier sind". According to this definition, the zygote of the Characeae could — except in the case of *Chara canescens* with its reproductive complexities — rather appropriately be termed oospore. Jackson (1928, p. 356, 257) defines *sporangium* as "a sac endogenously producing spores", and *oosporangia* as "the sacs or sporangia which produce oospores". According to these definitions — adopted by most recent morphologists — there seems to be no objection to the application of the latter term to the fructification of the Characeae. It is true that oospore is in recent textbooks also applied to a particular spore-typus of the Fungi, and has sometimes been used to indicate

"the immediate product of fertilization in an oophore" (= "the oophyte in Archegoniatae") (Jackson *op.c.*, p. 257). As regards the former, the production of oospores is in some respects similar in oogamous green algae and oogamous Phycomycetes, and this term might reasonably be applied to the zygotes of both groups; the use of oospore to designate a certain organ and stage in the embryology of the Archegoniatae is obsolete, and has not been generally adopted.

For the reasons given above, I would suggest the term *oosporangium* for the fructification of the Characeae.

2. The developing sporophydium

One of the basal cells of the male gametangium, or, in dioecious taxa, of a first rank lateral, functions as the *sporophydial initial* (Fig. 1a).

This is the *Mutterzelle der Sporenknospe* of Sachs (1868, p. 270); the *Basilarknotenzelle* of Losch (1912, p. 518); the *initial of nucule* of Smith (1938, p. 132); by Tuttle (1924, p. 413) it is inappropriately termed the *primordium of the oogonium*, and by Stewart (1937, p. 179) the *oogonial initial* (*cf.* below).

The sporophydial initial divides horizontally into two derivatives; the upper is the *oogonial initial*, (Fig. 1b—e), which gives rise to the central sexual tissues; the lower divides almost immediately once more horizontally into one upper cell, the *sporostegial initial* (Fig. 1b—d), which later on forms the peripheral cells and cell-tissues and one lower, the *pedicel cell* (Fig. 1c), which usually does not divide any more; in a few taxa it is divided into two cells, however (Fig. 1a—b, d—h). The latter forms the base of the sporophydium.

The oogonial initial is the *primäre Kernzelle* of Braun (1853, p. 72), the *Scheitelzelle* of Sachs (1868, p. 268), Goebel (1882, p. 68), Wille (1897, p. 170), Ernst (1901, p. 5), Linsbauer (1917, p. 659), the *Eizelle* of de Bary (1871, p. 237, *p.p.*), and Losch (1912, p. 518 *p.p.*), the *zentrale Scheitelzelle* of Goetz (1899, p. 3), the *Endzelle* or *Eimutterzelle* of Debski (1898, p. 636), the *Centralzelle* of Stache (1889, p. 128, *p.p.*), the *Endzelle* of Migula (1897, p. 44), Oltmanns (1922, p. 453), the *Terminalzelle* of Velenovský (1905, p. 78), *Oogoniummutterzelle* (Walther 1929, p. 33), *Eimutterzelle*, *Oogoniummutterzelle*, or *Oogonium* (Wettstein 1935, p. 190), the *cellule terminale* or *oogone proprement dit* or *oosphère* (van Tieghem 1891, p. 1263 *p.p.*, Costantin 1918, p. 149 *p.p.*, as alternative also *cellule centrale*), *terminal cell* (T. F. Allen 1888, p. 32 *p.p.*), *oosphere* (Groves & Bullock-Webster 1920, p. 51 *p.p.*, Mc Lean & Ivimey-Cook 1951, p. 384 *p.p.*), *archegonium* or *carpo-*

gonium (Vines 1879, p. 177 *p.p.*), oogonium (Fritsch 1935, pp. 459—460 *p.p.*), oogonial mother cell (Smith 1938, p. 132), oogonial cell (Chapman 1941, p. 112), oocyte (Tuttle 1924, p. 413 *p.p.*), and primary oocyte (Tuttle 1926, p. 228, Stewart 1937, p. 179).

The sporostegial initial has been termed primäre Knotenzelle (Braun 1853, p. 68), Knotenzelle (de Bary 1871, p. 231, *p.p.*, Goebel 1882, p. 68 *p.p.*, Stache 1889, p. 128 *p.p.*, Migula 1897, p. 44, *p.p.*, Debski 1898, p. 636 *p.p.*, Goetz 1899, p. 3 *p.p.*, Ernst 1901, p. 5, Losch 1912, p. 518 *p.p.*, Walther 1929, p. 34 *p.p.*), node cell (Groves & Bullock-Webster 1920, p. 50), node (Fritsch 1935, p. 460), nodal cell (Tuttle 1924, p. 413, 1926, p. 228 *p.p.*, Stewart 1937, p. 180 *p.p.*, Mc Lean & Ivimey-Cook 1951, p. 384 *p.p.*), and middle cell (Chapman 1941, p. 112).

Synonyms of the pedicel cell (*e.g.*, of Bennett & Murray 1889, p. 179, Smith 1938, p. 132) are: Stielzelle (*e.g.*, Braun 1853, p. 67, de Bary 1871, p. 231, Goebel 1882, p. 64, Stache 1889, p. 128, Overton 1890, p. 10, Wille 1897, p. 170, Debski 1898, p. 636, Goetz 1899, p. 3, Ernst 1901, p. 5, Losch 1912, p. 518, Linsbauer 1917, p. 659, Printz 1927, p. 423, Wettstein 1935, p. 190, Walther 1929, p. 34, Wallner 1932, p. 285), Trägerzelle (Sachs 1868, p. 268, Goebel 1882, p. 68, Beger 1954, p. 109), cellule basilaire or pied (van Tieghem 1891, pp. 1263, 1271, Costantin 1918, p. 149), spore pedicle (T. F. Allen 1888, p. 33), basal cells (Stewart 1937, p. 180), stalk cell and stalk (Seward 1898, p. 223, Tuttle 1926, p. 228, Moll 1934, p. 118, Fritsch 1935, p. 460, Chapman 1941, p. 112) — not stalk cell (cells) of Smith 1938, p. 132, or of Tuttle 1924, p. 413 (see below).

Suitable German equivalents of sporophydial initial, oogonial initial, sporostegial initial, and pedicel cell seem to be Sporenknospe-Mutterzelle (*cf.* Sachs 1868, p. 270), Eimutterzelle (Debski 1898, p. 636, Wettstein 1935, p. 190; *cf.* Walther 1929, p. 33), Sporenhülle-Mutterzelle (*cf.* Braun 1853, p. 51, Migula 1897, p. 45, Linsbauer 1917, p. 659), and Stielzelle (Braun 1853, p. 67, and most later German descriptions).

By a number of divisions — varying in different genera — the oogonial initial forms one large apical cell, the egg-cell or oosphere (Fig. 1 f—h), and one to three small basal derivates, the sterile oogonial cells (Fig. 1 c—g). The oosphere and the sterile oogonial cells, *i.e.* the derivates of the oogonial initial, form between them the oogonium, a term which has been inappropriately used in several morphological descriptions of stoneworts.

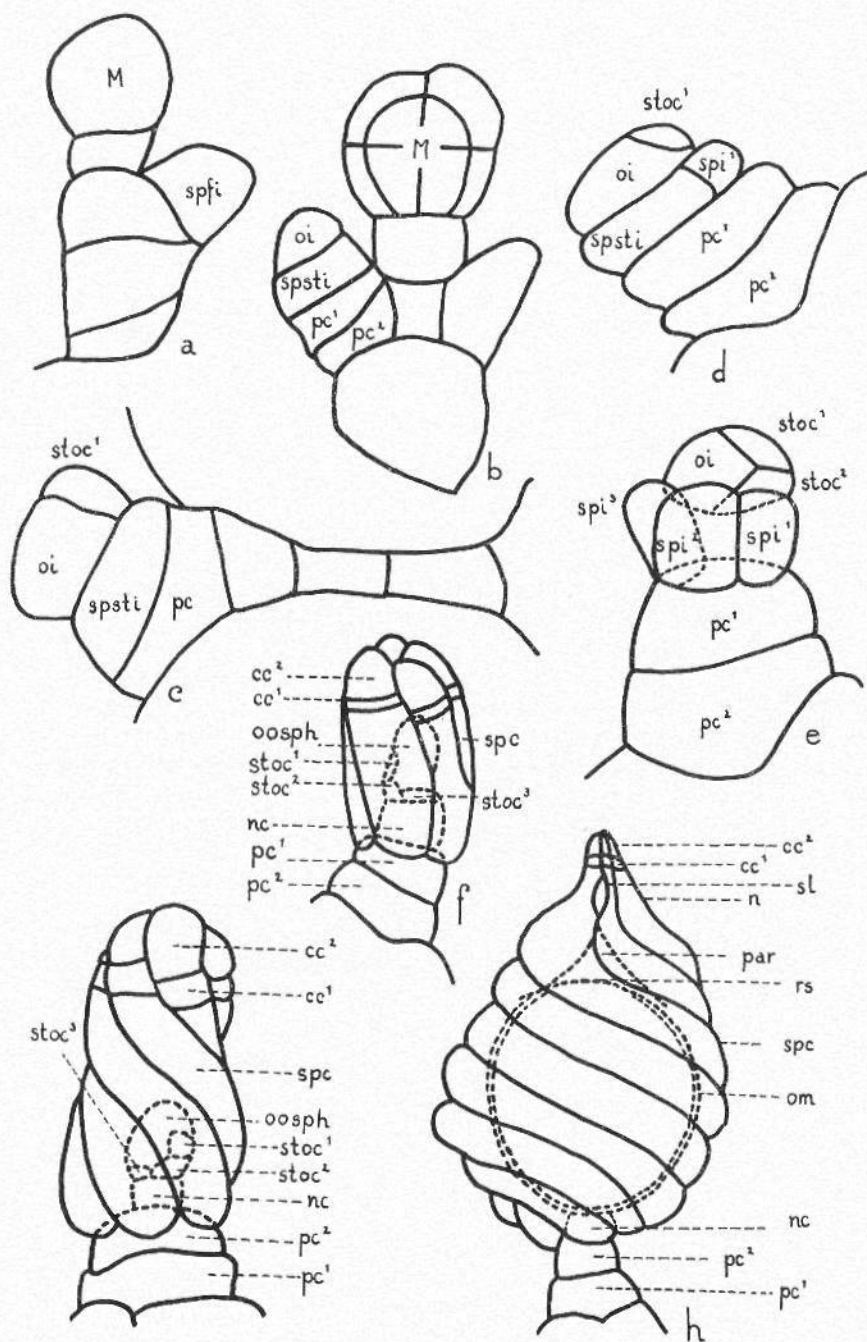
The writer has noted the following synonyms of the oosphere (Seward 1898, p. 223, Groves & Bullock-Webster 1920, p. 51 *p.p.*, Stewart 1937, p. 180, Mc Lean & Ivimey-Cook 1951, p. 384 *p.p.*): Endogonium or Kern des Fruchtknopfes (Bischoff 1842, p. 740), Spore (Schleiden 1846, p. 50; also the French equivalent — spore — Le Maout & Decaisne 1868, p. 672), Quaternäre Kernzelle (Braun 1853, p. 73), Centralzelle (Sachs 1868, p. 269, Stache 1889, p. 128 *p.p.*), Eizelle (de Bary 1871, p. 237 *p.p.*, Goebel 1882, p. 68, Overton 1890, p. 10, Migula 1897, p. 44, Wille 1897, p. 171, Debski 1898, p. 639, Goetz 1899, p. 3, Ernst 1901, p. 5, Losch 1912, p. 518 *p.p.*,

Linsbauer 1917, p. 659, Printz 1927, p. 423, Walther 1929, p. 34, Wallner 1932, p. 287, Wettstein 1935, p. 190), Oogonium (de Bary 1871, p. 237, Goebel 1918, p. 365, Oltmanns 1922, p. 453) and the English equivalent, oogonium (Moll 1934, p. 118, Fritsch 1935, pp. 459—460 *p.p.*, Smith 1938, p. 132 as oögonium, Chapman 1941, p. 112 — the term is used of the sporophydium and the oosphere —, Andrews 1947, p. 212, as oögonium), das eigentliche Oogonium (Velenovský 1905, p. 78), egg (Haupt 1953, p. 65) ovule (T. F. Allen 1888, p. 32), oocyte (Tuttle 1924, p. 413 *p.p.*), secondary oocyte (Tuttle 1926, p. 228), germ-cell (Bennett & Murray 1879, p. 179), and oogone proprement dit or oosphère (van Tieghem 1891, p. 1263 *p.p.*, Costantin 1918, p. 149 *p.p.*).

The sterile oogonial cells were by Braun (1853, pp. 72—73), owing to a misinterpretation of their formation, termed Wendungszelle resp. erste-secundäre-tertiäre Wendungszellen, a terminological usage that has been followed by several later authors (*e.g.*, Sachs 1868, p. 268, de Bary 1871, p. 231, Goebel 1882, p. 68, Wille 1897, p. 170, Goetz 1899, p. 3, Linsbauer 1917, p. 659, Oltmanns 1922, p. 454, Printz 1927, p. 423, Wettstein 1935, p. 190), sometimes with minor orthographic changes as Wendezelle (n) (Stache 1889, p. 128, Overton 1890, p. 10, Migula 1897, p. 44, Debski 1898, p. 637, Ernst 1901, p. 6, Losch 1912, p. 518, Oltmanns 1922, p. 454, Walther 1929, p. 34, Wallner 1932, p. 287, Woloszynska 1938, p. 185), or Wandungszellen (Velenovský 1905, p. 78). Goebel (1902, p. 291) proposed a more correct expression: sterile Zellen. In general, authors writing in English use a translation of Wendungszellen, *viz.* turning cells (*e.g.*, T. F. Allen 1888, p. 32, Groves & Bullock-Webster 1920, pp. 52—53, Jackson 1928, p. 472, Moll 1934, p. 118, Chapman 1941, p. 112 in expl. of fig., Mc Lean & Ivimey-Cook 1951, p. 384), but also polar bodies (Tuttle 1924, p. 413), or polocytes (first, etc.) (Tuttle 1926, p. 228) have been used, as moreover the inadequate expression stalk cell (Smith 1938, p. 132, not stalk cells of other authors, see pedicel cell and node cell). A French term is cellules basilaires de la cellule terminale (van Tieghem 1891, p. 1267).

Appropriate German terms seem to be of oosphere: Eizelle (de Bary 1871, p. 237, *p.p.*, and most later German morphological treatises); and of the sterile oogonial cells: sterile Eimutterzelle-Derivate.

Fig. 1. Sporophydium development in some species of *Nitella* Agardh. — *a—b* *N. confervacea* (Bréb.) Braun *ex v.* Leonh. — *c* *N. syncarpa* (Thuill.) Chev. — *d—h* *N. hyalina* (DC) Agardh, var. *engelmanni* Braun. — Considerably changed after Walther (1929) and Stewart (1937). — *a—c* 720/1, *d* 425/1, *e* 440/1, *f* 240/1, *g* 240/1, *h* 90/1. — The following abbreviations have been used in the drawings: *cc*¹, *cc*², lower respectively upper coronula cells; *M*, male gametangium; *n*, neck; *nc*, node cell; *oi*, oogonium initial; *om*, oogonium membrane; *oosph*, oosphere; *par*, primary apical receptacle; *pc*, *pc*¹, *pc*², pedicel cells; *rs*, receptive spot; *sl*, slit; *spc*, spiral cells; *spfi*, sporophydium initial; *spi*¹, *spi*², *spi*³, spiral initials; *spsti*, sporostegium initial; *stoc*¹, *stoc*², *stoc*³, sterile oogonial cells. — For further explanation, see the text.



The sporostegial initial gives rise to the peripheral covering of the oosphere, consisting of a basal and central, isodiametrical node cell (Fig. 1 f—g), and five peripheral cells, the spiral initials (Fig. 1 d—e), which stretch upwards, finally covering the oosphere. The spiral initials, at first growing straight upwards, soon turn to the left — at the same time as the oosphere increases in volume — becoming sinistrally spiralled. Moreover they divide horizontally once or twice — different in different genera — forming basally one tier of very long, curved cells, the spiral cells (Fig. 1 f—h), and apically one or two tiers of five small cells each, the coronula cells (Fig. 1 f—h), together forming a protruding apical structure, the coronula. In the same way as the derivatives of the oogonial initial, *viz.*, the oosphere and the sterile oogonial cells, constitute the oogonium, the derivatives of the sporostegial initial, being of common origin, form the sporostegium.

The synonymies of the sporostegial initial derivatives are somewhat confused because several authors have not kept apart the sporostegial initial from the node cell and the spiral initials from the spiral cells. Among the synonyms of the node cell are the following: Centralzelle or secundäre Knotenzelle (Braun 1853, p. 68), Knotenzelle (mostly including also the sporostegial initial, *e.g.*, Sachs 1868, p. 268, de Bary 1871, p. 231, Goebel 1882, p. 68, Stache 1889, p. 128, Overton 1890, p. 10, Migula 1897, p. 45, Wille 1897, p. 170, Debski 1898, p. 636, Goetz 1899, p. 3, Linsbauer 1917, p. 659, Oltmanns 1922, p. 453, Printz 1927, p. 423, Walther 1929, p. 34, Wettstein 1935, p. 190, Woloszyńska 1938, p. 185), Knotencentralzelle (Ernst 1901, p. 5), cellule nodale (van Tieghem 1891, p. 1263, Costantin 1918, p. 149), and nodal cell (except in Chapman 1941, p. 112, *expl.* of *fig.*, also including the sporostegial initial, Tuttle 1926, p. 228, Stewart 1937, p. 180, Mc Lean & Ivimey-Cook 1951, p. 384). Tuttle (1924, p. 413) uses the term stalk cell which is, however, not the same as the stalk-cell of Seward (1898, p. 223) and some later authors, a synonym of the pedicel cell; or of Smith (1938, p. 132), that is synonymous to the sterile oogonial cell of *Chara*. The expressions node of Fritsch 1935, p. 460, and node cell of Groves & Bullock-Webster 1920, p. 50, apply exclusively to the sporostegial initial (see above).

The spiral initials have been termed Hüllschlauchanlagen (Sachs 1868, p. 268, Goebel 1882, p. 68), or peripherische Segmentzellen (Ernst 1901, p. 5). Other German expressions, Hüllschläuche (*e.g.*, Goetz 1899, p. 3, Oltmanns 1922, p. 453, Printz 1927, p. 423), Hüllzellen (*e.g.*, Migula 1897, p. 45, Debski 1898, p. 637, Wettstein 1935, p. 190), or Rindenschläuche (Stache 1889, p. 128), include the spiral cells, too. The English designations vary: peripheral cells (Fritsch 1935, p. 460, Chapman 1941, p. 112), lateral initials (Smith 1938, p. 132), sheath primordia (Tuttle 1926, p. 228, Stewart 1937, p. 180). The

term enveloping cells or envelope cells of Groves & Bullock-Webster (1920, p. 50), Chapman (1941, p. 112, expl. of fig.), and Mc Lean & Ivimey-Cook (1951, p. 384), also refer to the spiral cells.

Krönchen and Krönchenzellen, sometimes with the alternative Coronula, are the most commonly used expressions of the coronula and coronula cells in papers written in German (*e.g.*, Bischoff 1842, p. 740, Braun 1853, p. 69, Sachs 1868, p. 265, de Bary 1871, p. 232, Schimper & Schenck 1879, p. 41, Goebel 1882, p. 65, Stache 1889, p. 128, Overton 1890, p. 10, Migula 1897, p. 45, Wille 1897, p. 170, Debski 1898, p. 637, Goetz 1899, p. 3, Ernst 1901, p. 7, Velenovský 1905, p. 78, Sluiter 1910, p. 136, Losch 1912, p. 518, Linsbauer 1917, p. 659, Oltmanns 1922, p. 453, Printz 1927, p. 423, Walther 1929, p. 34, Wallner 1932, p. 286, Wettstein 1935, p. 190, Beger 1954, p. 108). The usual French expressions are coronule (*Le Maout & Decaisne* 1868, p. 672) and couronne (*van Tieghem* 1891, p. 1271, *Costantin* 1918, p. 149). In English descriptions there is some alternation between coronula and coronula cells on the one side (*e.g.*, *T. F. Allen* 1888, p. 31, *Groves & Bullock-Webster* 1920, p. 53, and most recent taxonomists, *Jackson* 1928, p. 93, *Moll* 1934, p. 118, *Mc Lean & Ivimey-Cook* 1951, p. 384), and corona and coronal cells on the other (*Seward* 1898, p. 224, *Tuttle* 1924, p. 413, *Fritsch* 1935, p. 460, *Stewart* 1937, p. 181, *Smith* 1938, p. 133, *Chapman* 1941, p. 112). *Henfrey* introduced the term coronet (*Braun & Henfrey* 1853, p. 300). *Bennett & Murray* (1889, p. 179) and *Haupt* (1953, p. 65) use the expression crown; *Seward* and *Stewart* use this as alternative to corona, *Jackson* (*l.c.*) and *Moll* (*l.c.*) seem to give precedence to coronule before coronula.

The mature spiral cells were by *Schleiden* (1846, p. 50) termed umschliessende Zellen, and by *Braun* (1853, p. 67) involucrialblätter. The common German designation is, however, Hüllschläuche — sometimes Schläuche only — (*e.g.*, *Sachs* 1868, p. 268, *de Bary* 1871, p. 232, *Goebel* 1882, p. 64, 1918, p. 375, *Overton* 1890, p. 10, *Wille* 1897, p. 170, *Debski* 1898, p. 637, *Goetz* 1899, p. 3, *Losch* 1912, p. 518, *Linsbauer* 1917, p. 659, *Oltmanns* 1922, p. 453, *Printz* 1927, p. 423, *Schmucker* 1927, p. 781, *Walther* 1929, p. 34, *Wallner* 1932, p. 285), or the often alternatively used term Hüllzellen (*e.g.*, *Migula* 1897, p. 45, *Debski* 1898, p. 637), *Ernst* 1901, p. 5, *Wettstein* 1935, p. 190, *Woloszynska* 1938, p. 185). Hüllschläuche and Hüllzellen, as also Rindenschläuche (*Stache* 1889, p. 128), are by most of the quoted authors used rather indiscriminately also to include the spiral initials. *Velenovský* (1905, p. 78) uses the term Spiralzellen. These cells have furthermore been denominated Hüllblätter (*e.g.*, *Schimper & Schenk* 1879, p. 41) and Hüllzweige (*Beger* 1954, p. 108). Alternative French expressions are tubes, tubes enroulés, or tubes de l'enveloppe (*van Tieghem* 1891, p. 1271, *Costantin* 1918, p. 149). There are several English terms: tubes (*e.g.*, *Bennett & Murray* 1889, p. 179), tube cells (*Moll* 1934, p. 118, *Smith* 1938, p. 133), enveloping cells (*e.g.*, *T. F. Allen* 1888, p. 10, *Groves & Bullock-Webster* 1920, p. 50, *Mc Lean & Ivimey-Cook* 1951, p. 384), enveloping threads (*Fritsch* 1935, p. 460), investing threads (*Chapman* 1941, p. 113), spiral cells (*e.g.*, *Groves & Bullock-Webster* 1920, p. 54), sheath-cells

(Tuttle 1924, p. 413, 1926, p. 228, Stewart 1937, p. 181), and filaments (Andrews 1947, p. 212). According to the usage of some of the authors quoted, some of the listed English expressions include the spiral initials, too (*cf.* above). The commonest English terms seem to be spiral cells and enveloping cells, which are often used alternatively by most recent taxonomists, and several paleobotanists.

The entire sporostegium was termed *Fruchtknopfdecke* or *Epigonium* by Bischoff (1842, p. 739). The term *Sporostegium* (or *Sporen-Hülle*) was introduced already by Braun (1853, p. 51) and has been employed *e.g.* by Nordstedt (1866, p. 1), Migula (1897, p. 45), Ernst (1901, p. 5), Linsbauer (1917, p. 659) and Woloszynska (1938, p. 185); the English equivalent *sporostegium* or *spore-capsule* was introduced by Henfrey in 1853 (Braun & Henfrey 1853, p. 302) and has been used *e.g.* by T. F. Allen (1888, p. 10), Jackson (1928, p. 358), and Moll (1934, p. 118). The latter author gives as alternative *peridium*. Stache (1889, p. 128) denominates this tissue *Eihülle*. Shorter German expressions are *Mantel* (Schimper & Schenk 1879, p. 41) and *Hülle* (*e.g.* de Bary 1871, p. 233), and a corresponding English term *sheath* (*e.g.*, Smith 1938, pp. 132—133).

German expressions that seem suitable are: of node cell, *Knotenzelle* (Sachs 1868, p. 268, and later authors), emended not to include the sporostegial initial, however; of spiral initials, *Hüllschlauch-Mutterzellen*; of coronula and coronula cells, *Krönchen* and *Krönchenzellen* (Bischoff 1842, p. 740, and later authors); of spiral cells, *Hüllschläuche* or *Spiralzellen* (Sachs 1868, p. 268, and later authors; Velenovský 1905, p. 78); and of sporostegium, *Sporenhülle* (Braun 1853, p. 51, and later authors).

When the sporophydium has attained full size, changes occur in its summit part before fertilization. The spiral cells prolong apically, thereby constricting the upper part of the sporostegium below the coronula into a neck (Fig. 1 h). At the same time the upper parts of the spiral cells become attenuated, and slits are formed between them (Fig. 1 h). An apical cavity is formed between the sporostegium and the upper part of the oosphere, and this is by a horizontal diaphragm extending from the adaxial walls of the spiral cell-tips divided — like an hourglass — into two compartments, an (upper) secondary and a (lower) primary apical receptacle (Fig. 1 h). The absence below the latter of the thin oogonium membrane (Fig. 1 h) forms the receptive spot (Fig. 1 h).

As the apical sporophydium region is generally not described in much detail by morphologists, there are but few terms relating to the last-mentioned morphological concepts.

The neck is by German authors termed *Hals* (*e.g.*, de Bary 1871, p. 233. Goebel 1882, p. 69, Migula 1897, p. 46, Wille 1897, p. 171, Linsbauer 1917, p. 659, Printz 1927, p. 423). The English term *neck* seems generally adopted

(*e.g.*, T. F. Allen 1888, p. 33, Bennett & Murray 1889, p. 179, Groves & Bullock-Webster 1920, p. 54, Fritsch 1935, p. 460, Chapman 1941, p. 113, Mc Lean & Ivimey-Cook 1951, p. 384).

The apical cavities between the sporostegium and the oosphere have usually not been terminologized in detail. Some authors use circumlocutions, such as *ein enger unter dem Krönchen liegender Raum* (Goebel 1882, p. 69). German designations of both cavities are *e.g.* *Scheitelraum* (de Bary 1871, p. 232), *Intercellularraum* (Stache 1889, p. 128), and *Halscanal* (alternatives *Kanal* or *Canal*) (*e.g.*, Sachs 1868, p. 268, Migula 1897, p. 46, Oltmanns 1922, p. 455). English terms, common to both receptacles, are *apical cavity* (Bennett & Murray 1889, p. 179), *cavity* (*e.g.*, Groves & Bullock-Webster 1920, p. 54), and *chamber* (*e.g.*, Stewart 1937, p. 181).

The oosphere membrane — if at all specified — is generally termed *membrane* or *Membran*.

The common German designations of receptive spot are *Empfängnisfleck* or *Keimfleck* (de Bary 1871, p. 237, Stache 1889, p. 128, Goebel 1882, p. 68, Wille 1897, p. 171, Printz 1927, p. 423). *Receptive spot* has been used *e.g.* by Bennett & Murray (1889, p. 179), Fritsch (1935, p. 460), Stewart (1937, p. 181); Bennett & Murray (*l.c.*) give as an alternative *apical papilla*.

Suitable German equivalents of the English terms applying to the apical structures of the sporophyidium are: of neck, *Hals* (de Bary 1871, p. 233, and later authors), of slit, *Spalte* (de Bary *l.c.*, and later authors), of diaphragm, *Diaphragma*, of secondary apical receptacle, *sekundärer Scheitelraum* (*cf.* de Bary 1871, p. 232), of primary apical receptacle, *primärer Scheitelraum* (*cf.* de Bary *l.c.*), of oogonium membrane, *Eizelle-Membran*, and of receptive spot, *Empfängnisfleck* (de Bary 1871, p. 237, and later authors).

3. The mature sporophyidium

Using the terminology proposed in the previous section, the mature sporophyidium consists of the following cells and cell tissues (Fig. 1 h):

- a) one or two basal cells — the *pedicel cell(s)*.
- b) a *sporostegium*, comprising a central cell, the *node cell*, between the pedicel cell and the oosphere, five peripheral cells — surrounding the oosphere, and one or two tiers of five or ten small cells terminating the spirals — the *coronula cells* — forming between them the *coronula*. — The upper parts of the spiral cells are prolonged and attenuated so as to form a *neck*, with *slits* between the individual cells. Inside the neck is left a cavity which usually is divided by a *diaphragm* from the spiral cells into two hour-glass compartments: a lower *primary apical receptacle*, and an upper *secondary apical receptacle*.

e) an oogonium, comprising a large terminal cell, the oosphere, and one or three basal derivatives from the oogonial initial, the sterile oogonial cells, but these have usually been resorbed by the oosphere at the sporophyidium maturity; the whole oogonium is surrounded by an oogonium membrane which is very thin or absent apically, forming the receptive spot.

Before proceeding further, some basic concepts must be defined. The polar axis (abbr. PA) of a sporophyidium is defined as an imaginary line perpendicular to a circle through its center, and passing through its poles (*cf.* Turrell 1946, p. xii). The largest equatorial diameter (abbr. LED) means the largest diameter of the sporophyidium that can be measured perpendicularly to its polar axis. The equatorial axis (abbr. EA) is an imaginary line perpendicular to the polar axis at its centre (*cf.* Turrell *l.c.*), which consequently intersects the polar axis halfway between the sporophyidium poles. The apical pole of a sporophyidium is defined as its distal end, bearing the coronula, while the basal pole, with the pedicel cell, is its proximal end. As applied to the sporophyidium structures, the expressions adaxial and abaxial always refer to the polar axis, and mean turned towards respectively from this.

Uniformity of terminology and morphological analyses allowing direct comparisons of sporophyidium — and oosporangium — descriptions would be of great advantage. For this purpose a somewhat standardized methodology is advisable. When describing a mature sporophyidium, the following concepts might suitably be used: size (of the coronula, of the oogonium, of the sporophyidium excluding the coronula, width of the spiral cells at the equator and at the apex), shape (of the sporophyidium excluding the coronula), number (of convolutions formed by the spiral cells as seen in lateral view of the sporophyidium), and angle (of convolutions to the equator plane).

a) Size of the coronula. This is measured as the height of the coronula, *i.e.* the height of the one or the two tiers of coronula cells, and the width of the coronula where it is broadest, *i.e.* the width of the coronula tier (tiers).

b) Size of the oogonium. This is expressed by the length of its polar axis and by its largest equatorial diameter, measurements to be taken from the outer edge of the oogonium membrane on one side of the oogonium to its outer edge on the other side. Since the spiral cells are generally more or less translucent, these measurements are usually easily taken.

c) Size of the sporophyidium. This is expressed by the length of its

polar axis and by its largest equatorial diameter. The PA measurement is taken from the basal wall of the pedicel cell to the basal wall of a coronula cell — or in the Nitelleae to a coronula cell base in the lower coronula tier — the LED between the abaxial walls of the spiral cells. The length of the entire polar axis of a sporophydium is easily calculated by adding the height of the coronula to the polar axis length of the sporophydium.

d) Diameters of the spiral cells. These are always measured as the widths between their lateral cell walls. In order to get some idea of their variations, the diameter may advantageously be measured at the equator, 1—2 convolutions from the coronula, and close to the coronula.

e) Shape of the sporophydium excluding the coronula. Most descriptions of charophyte gametangia and fructifications, among them my own paper of 1954, use a rather vague shape terminology, and it seems we had better adopt the more clearly circumscribed shape indications used by present day palynologists (Erdtman 1943, p. 45, 1952, p. 16, Iversen & Troels-Smith 1950, p. 17, and others). The mathematical definitions of these terms are given *e.g.* by Turrell (1946, pp. ix—xi). The basis of the shape expressions used by palynologists is the percentage PA/LED rate, *i.e.* the length of the polar axis expressed in per cent of the largest equatorial diameter. The following shape classes are derived from the varying values of this rate, the isopolarity index (abbr. ISI):

	PA/LED in %
peroblate	< 50
oblate	50—75
suboblate	75—88
oblate spheroidal	88—100
prolate spheroidal	100—114
subprolate	114—133
prolate	133—200
perprolate	> 200

In the above cases, the sporophydia are isopolar — *i.e.* the two halves in which they are divided by their equatorial axes are alike — but more frequently, however, they are anisopolar, *i.e.* their largest equatorial diameters do not coincide with their equatorial axes, but are nearer one of the poles. In that case another set of terms, based upon the anisopolarity index (ANI) is required to complete the above indicative terminology. This index expresses the distance (abbr.

AND) from the apical pole to the largest equatorial diameter, calculated in per cent of the polar axis. The following classes of anisopolarity have been recognized:

	AND/PA in %
perovoidal	< 15
ovoidal	15—29
subovoidal	29—43
ellipsoidal	43—57
subobovoidal	57—71
obovoidal	71—85
perobovoidal	> 85

f) Number of convolutions of the spiral cells as seen in lateral view of the sporophydium. The spiral cells make 1—3 turns in the distance from the node cell to the coronula. Each turn visible in side view of the sporophydium is termed a *convolution*. The counting of the convolutions requires no particular explanation, except perhaps that the partly visible convolutions at the apical and basal poles should also be included.

g) Angle of convolutions to the equator plane. This is most conveniently measured on photographs. The angle of the convolution nearest to the equator is always measured.

Since detailed investigations of mature sporophydia have not been undertaken to any large extent, no synonyms besides those listed in the preceding section are given (on fossil remains, see below). At best, taxonomists have noted "length" and "width" of the sporophydium, height and width of coronula, and number of spiral cell convolutions.

4. The oosporangium

Changes in the oogonium and in the sporostegium occur after fertilization, some of which aim at forming a resistant coating round the zygote. These changes result in a fructification rather unlike the mature sporophydium. In spite of the differences between sporophydia and oosporangia, several early students of the Characeae mixed up the two categories with the result of some confusion (*cf.* the section 1). However, since the oosporangia have never been the subject of as intense morphological investigations as the developing sporophydia, the existing oosporangium terminology is not as evolved or confusing as that of the sporophydia. The present writer has accordingly had to adopt a more detailed oosporangium terminology, including some new terms intro-

Table 1. Terminological scheme of sporophydia and oosporangia.

The developing sporophyidium	The mature sporophyidium	Oosporangium
<p>Sporophyidial initial</p> <p> { Oogonial initial Sporostegial initial Pedicel cell(s)} </p> <p> { Oosphere Sterile oogonial cells Node cell Spiral initials Coronula cells} </p>	<p> Oosphere Sterile oogonial cells Node cell Spiral cells Coronula cells Pedicel cell(s) </p> <p> { Oogonium Sporostegium Sporophyidium} </p>	<p> { Oospore Sporangiogram Calcine} </p> <p> { Nucleus Plasma Sporine Endo-sporine Ecto-sporine} </p> <p> { Sporostine Endo-sporostine Ecto-sporostine} </p>

duced for this purpose. For lack of specifications in earlier terminologies, fewer synonyms can be given than in the second section.

The three main parts of the sporophydium — the pedicel cell, the sporostegium, and the oogonium — are rather differently affected by the changes resulting from the development of the gametangium to a fructification.

The pedicel cell disintegrates, and disappears completely in most cases.

The coronula cells of the sporostegium also disappear. The abaxial, and parts of the lateral, walls of the spiral cells dissolve and disappear, but their plasmatic contents, adaxial walls, and what is left of the lateral walls help to form the outermost coatings of the fructification, the sporangium wall or *sporangioderm*. The outermost layer — formed only in some genera — of the sporangioderm consists of calcareous concretions (calcite) formed by the plasma of the spiral cells. This is the *lime-shell* or *calcine*. The two inner, suberized layers of the oosporangium wall are designated *sporostine*. The outer of these, the *ectosporostine*, is a characteristically decorated membrane formed by the spiral cell plasma; inside this lies the *endosporostine*, which is a product of the residual cell walls. Besides the spiral cells, the node cell also contributes to the formation of *sporostine*, but does not calcify.

In becoming the *oospore*, the fertilized oosphere forms two membranes of its own to constitute the oospore wall, or *sporine*. The outer sporine membrane, the *ectosporine*, is the result of a thickening of the original oogonium membrane, whilst the inner, the *endosporine*, is after fertilization formed by the oospore plasma.

Some synonyms of the terms relating to the stratification of the fructification walls are quoted below. From these it will be seen that no established nomenclature exists in this particular field. A terminology not previously used for the Characeae must therefore be adopted. There were mainly three alternatives: one of the nomenclatural systems, developed for pollen and spores in general, adopted by recent palynologists; descriptive terms applied to other algal fructifications; and a terminology especially created for these particular organs.

Charophyte fructifications are oosporangia and cannot for that reason be directly compared with pollen and spores of cormophytes. Moreover, a homologization of the oospore membranes *sensu stricto* with the membranes of spermatophyte pollen and of pteridophyte and bryophyte spores has so far met with difficulties and can for the present not be made absolutely certain. It appears therefore less correct to apply the elaborate terminologies of palynologists to the Characeae oosporangia.

Algal vegetative membranes have been much studied in recent years — present knowledge has been summarized in for instance the textbooks of Fritsch (1935), Schussnig (1938), and Smith (1951) — but investigations on algal fructification membranes, including terminologies, have been less extensive. Czurda's classical studies (1931, pp. 265—268) of zygnemallean zygote membranes are an exception in this respect, but here, too, comparisons with the charophyte fructification walls meet with difficulties. Terminologies applicable to the fructification walls of algae are on the whole very scarce.

For all these reasons, and until further investigations on charophyte and other algal fructifications allow direct comparisons, it would seem the most correct policy to adopt a terminology particularly created for the Charophyta. Should it be proved later, however, that a convincing and binding homologization between the charophyte oosporangium membranes and the walls of other fructifications can be carried out, the parietal terminology adopted here is only a temporary tool which can be dropped when a better one is available.

The term *sporangioderm* and its equivalents *sporangium wall* and *Sporangienhaut*, are in current use for the walls of all kinds of sporangia. *Lime-shell* is the common designation of the outermost sporangioderm layer in charophyte fructifications, and is used by most paleobotanists (*cf.* below); the alternative *calcine* conforms linguistically to the other parietal layers of the fructification. The term seems handy, and the writer has seen no references to its previous use as a morphological designation; according to recent unpublished investigations, the calcareous concretions in the sporangioderm are pure calcite, from which the term *calcine* is formed. *Sporostine* (leading to *ectosporostine* and *endosporostine*) are also new terms, formed from *sporostegium* with the suffix *-ine*, and given the respective prefixes *ecto-* and *endo-*. There seem to be no references to their previous use. *Sporine* is a so self-evident and easily formed common designation of the parietal oospore layers, that one would think that it would have been used before, but no efforts to trace any previous use of it in morphological connections have been successful. A somewhat similar term, *Sporonin*, was introduced by Zetzsche & Huggler (1928, p. 94) for a chemical compound in the exosporium of *Lycopodium* spores. If *sporine* should prove to have been used before in a way that confusion is likely to arise by applying it to charophyte fructifications, the term *oosporine* might possibly be used. Linguistically, *ectosporine* and *endosporine* conform to the two sporostine membranes (*cf.* above).

The following terms have been used as designations common to all the parietal layers of the Characeae fructifications: *Sporenhaut* or *Sporodermis* (Bischoff 1842, p. 741, Müller 1845, p. 394, but the application in the last-mentioned case somewhat uncertain); *Hartschale* (*e.g.* Nordstedt 1889, p. 2, Migula 1897, p. 48, Wille 1897, p. 171, Linsbauer 1917, p. 659, Woloszynska 1938, p. 185); *Sporenmembrane* (n) (Overton 1890, p. 36); *épispore* (Schimper 1869, p. 220); *pericarp* (Bennett & Murray 1889, p. 180); and *shell* (de Bary & Hemsley 1875, p. 299).

The calcine layer has been designated *Kalkablagerung* or *krusten-*

artige Hülle (Braun 1853, p. 74); Kalkschale (de Bary 1875, p. 383, Overton 1890, p. 37); Kalkmantel (Migula 1897, p. 48); indusium (Schimper 1869, p. 221); lime-shell (Groves & Bullock-Webster 1920, p. 61, and several students of fossil charophytes, *cf.* below); and chalk shell (de Bary & Hemsley 1875, p. 301).

The sporostine is the Aussenhaut of Walther (1929, p. 77 ff.). The exact applications of some previous designations are uncertain. Sporenhaut of Müller (1845, p. 395) may apply to the sporostine, but perhaps to all parietal membranes; it seems furthermore doubtful whether Müller's specimens were oosporangia or mature sporophydia (see above). Bischoff's äussere Sporenhaut (1842, p. 741) may include one or both sporostine layers, and possibly also the ectosporine. It is also uncertain whether the stein- oder nussartige Hülle (Braun 1853, p. 74) and verholzte Membrane (de Bary 1875, p. 382) refer to the sporostine *in toto* or to the ectosporostine alone. The terms äusserste Membranschicht of Overton (1890, p. 37) and outer coloured membrane (Groves & Bullock-Webster 1920, p. 59) are definitely applied to the ectosporostine, just as their respective mittlere Haut (Overton 1890, p. 37) and inner coloured membrane (Groves & Bullock-Webster 1920, p. 60) are to the endosporostine.

A designation common to both sporine-layers is the Cellulosewand of de Bary (1875, p. 381). Expressions probably applied to the sporine-membranes (*cf.* above, however) are Haut des Nucleus (Müller 1845, p. 395) and innere Sporenhaut (Bischoff 1842, p. 741). The Mittelhaut of Walther (1929, p. 77 ff.) and the third membrane or outer colourless membrane of Groves & Bullock-Webster (1920, pp. 56, 61) are in this paper called the ectosporine, while the Innenhaut (Walther, *l.c.*) and the fourth membrane or inner colourless membrane (Groves & Bullock-Webster, *l.c.*) correspond to the endosporine. The membrana propria of Overton (1890, p. 37) is probably also applied to this last sub-layer.

The most appropriate German equivalents of the adopted terms seem to be: of all parietal layers of the fructification, Hartschale (Nordstedt 1889, p. 2, and later authors); of sporangioderm, Sporangienwand; of calcine, Kalkschale (de Bary 1875, p. 383, and later authors) or Kalcin; of endosporostine and ectosporostine, respectively Endosporostin and Ektosporostin; of the two sporine-layers, Sporenwand or Sporin; of endosporine and ectosporine, respectively Endosporin and Ektosporin.

The way in which the calcine is formed produces characteristic structures, termed laminations. These, which are of particular importance in fossil specimens, will be discussed in the next section.

The sculpture of the sporostine-layers is characteristic, that of the ectosporostine in particular even diagnostic. The terminology adopted for its description is in principle based on that used by Groves & Bullock-Webster (1920, pp. 69—71), although it has been considerably

modified. The scheme below comprises the main ectosporostine sculpture types:

Types of simple sculpture

Max. diameters of individual sculpture elements, seen from above,
 $< 2 \times$ their smallest diameter

Max. diameters of individual sculpture elements, seen from above,
 $< 1 \mu$ granulate

Max. diameters of individual sculpture elements, seen from above,
 $> 1 \mu$ tuberculate

Max diameters of individual sculpture elements, seen from above,
 $> 2 \times$ their smallest diameter, elements forming a network

reticulate

Types of combined sculpture

Sculpture elements forming a network

Max. diameters of individual sculpture elements, seen from above,
 $< 1 \mu$ granulate-reticulate

Max. diameter of individual sculpture elements, seen from above,
 $> 1 \mu$ tuberculate-reticulate

Sculpture elements forming no network of varying sizes

granulate-tuberculate

In quite a few cases, where the sculpture elements are rather indistinct, this is indicated by the prefix *semi-* (*e.g.*, semi-granulate). In some others there are no sculpture elements, and the ectosporostine is then termed smooth or psilate. The sculpture of ridges and of fossules often differ considerably.

As will be pointed out elsewhere, the above classification of ectosporostine sculptures is highly artificial, but no better alternative seems available.

Sculpture elements of the ectosporostine may also vary in other ways, *e.g.*, in shape in side view, in their equal or unequal distribution over the surface, and in frequency in a given area. The last-mentioned variation appears to be most suitably expressed in the same way as by Groves

& Bullock-Webster (*l.c.*), *i.e.* when the decoration is granulate, tuberculate or granulate-tuberculate, by counting the number of elements along a 10 μ long line, and when simple or combined reticulate by measuring the max. diameters of its meshes.

Ectosporostine sculptures are usually described as seen from above; it is generally difficult to study them in lateral view (*cf.* below). Varying microscope adjustments will naturally present slightly different pictures of the sculpture (*cf.* below). For conventional descriptions, it seems expedient, however, to concentrate on an adjustment intermediate to those giving clear views of the highest and lowest levels of the sculpture.

The endosporostine is less varying in sculpture than the ectosporostine, usually granulate or semi-granulate, but sometimes smooth.

The endosporine and the ectosporine are so far known always smooth.

The thickness of the calcine, sporostine, and sporine layers are measured in sections, always in the middle of a fossule as near to the equatorial axis as possible. Complementary measurements may be taken in fossules at the basal and apical poles.

Leading palynologists of today have created an elaborate system of terminology for the sculptural types of pollen and spores (Erdtman 1943, pp. 49—52, 1952, pp. 19—21, Iversen & Troels-Smith 1950, p. 46). I regret that I have for various reasons felt unable to adopt this palynological terminology with its exact and excellent definitions of terms. My own investigations — discussed elsewhere — and other studies of the Characeae oosporangium decoration (*e.g.* Nordstedt 1889, Groves & Bullock-Webster 1920, Walther 1929) indicate that the sculpture elements are more simply built than for instance the complicate sexine elements of spermatophyte pollen. So far, no “drumstick” rods (*pila*) with heads and stalks like those found as basic elements in the pollen sculptures of flowering plants have been observed in the Characeae ectosporostines, which moreover do not usually form sub-layers (*tegilla*) as described by Erdtman (1952, pp. 19—21). Ectosporostine sculpture seems to have only two basic elements. One comprises variously arranged, small or large wart-like protuberances, approximately isodiametrical when viewed apically or laterally, with acute, subacute, or obtuse to rounded apices. The other is simply rod-shaped, straight or curved elements, forming an intricate network, which when seen from above, give a reticulate appearance to the surface.

The palynological sculpture terminology is primarily based upon an analysis of the individual elements in lateral view. The size of the Characeae fructifications and the parietal membrane structure make routine analyses of a similar kind difficult. Attempts — described elsewhere — at studying the

sculpture elements in side view seem to show that their lateral shapes vary far less than the said elements of spermatophyte pollen (*cf.* above). An ectosporostine sculpture terminology on palynological lines is therefore at present not possible.

An analysis of spermatophyte pollen sculpture at different microscopical adjustments has recently been evolved (LO-analysis of Erdtman 1952, pp. 21—22). The interesting and valuable results attained by LO-analysis are intimately connected with the varied morphology of sculpture elements in the higher plant pollens and the resulting formation of tegilla as mentioned above. LO-analysis is less illustrative with respect to ectosporostine sculpture elements owing to their simpler shape.

Apart from the calcine structure and sculpture of the ectosporostine, the mature oosporangia possess some other morphological elements, mostly derived from the sporostegium. I have already pointed out that the lower (adaxial) parts of the lateral spiral-cell walls do not disintegrate, as do the upper parts, but are incorporated in the sporostine formation. According to the extent and intensity of this formation, these lower parts will stand out from the oosporangium as low or high, sometimes wing-like ridges, the *intercellular ridges*. The space between two ridges (*i.e.* the lumen of a spiral cell) is termed *fossule*. The intercellular space between two adjacent spiral cells, the *intercellular suture*, is usually clearly visible as a line along the middle of the ridge. The intercellular ridges meet at a point, or along a short broken line forming an eccentric pattern, at the apical end of the oosporangium; the ridges are sometimes higher here than in the equatorial region, and then form an *apical crest*.

The walls of the node cell disintegrate completely in some groups, in others they — except the proximal wall — take part in the formation of sporostine. In the latter case, structures will appear, which according to the extent to which the node cell contributes to the formation of sporostine are termed *basal claws* — when the formation of sporostine is incomplete — or — when the shape of the whole node cell is reproduced in the sporostine — a *basal cage*. Transitions between the two extremes also occur. These basal structures are sometimes covered by calcine from the spiral cells. In some taxa the node cell, too, produces calcine and forms a *basal plug* covering its distal wall sporostine and filling up the pentagonal basal opening — the *basal pore* — into the oospore interior. When no calcareous basal plate is developed, the basal pore is closed by the distal sporostine of the node cell.

Several of the terms defined above are adopted from paleobotanical terminologies, since the fructifications of fossil Charophyta have been studied in rather more detail than those of the living Characeae. Some terms were introduced by Groves & Bullock-Webster (1920), however, and apply originally to fructifications of living species. There are practically no synonyms of these.

The terms *intercellular suture*, *basal pore*, and *basal plug* are taken from the paleobotanical terminology; for synonyms, see next sub-chapter.

Intercellular ridge, too, has been introduced for paleobotanical purposes, but this structure has also been described or mentioned by some students of recent Characeae. It has for instance been termed *Leiste* in some papers written in German (*e.g.* de Bary 1875, p. 381, Migula 1897, p. 48, Nordstedt 1889, p. 3, Walther 1929, p. 37), *ridges* by Groves & Bullock-Webster (1920, p. 58), and *raised stripes* by de Bary & Hemsley (1875, p. 300). The term *fossule* to designate the cellular spaces between ridges in the oosporangia of the Characeae was introduced by Groves & Bullock-Webster (1920, p. 69); the term has been used in other connections, too, *e.g.* of diatoms and pollen (see among others Jackson 1928, p. 151; Iversen & Troels-Smith 1950, p. 22) but since its application to the Characeae cannot possibly cause misunderstanding or confusion, I have adopted it in the present paper. The expressions *apical crest*, *basal claws*, and *cage*, likewise introduced by Groves & Bullock-Webster (*op.c.*, p. 58), appear suitable; no synonyms are known to me, though these structures have also been described by other authors (*e.g.* de Bary 1875, p. 381, de Bary & Hemsley 1875, p. 300, Woloszyńska 1938, p. 184—186).

When describing the oosporangium, the same morphological concepts as for the mature sporophydium (see p. 226 ff.) are appropriately used. The terms *polar axis*, *largest equatorial diameter*, *equatorial axis*, *apical pole*, *basal pole*, *adaxial*, and *abaxial* are thus defined and employed in the same ways as of the sporophydium (see p. 226).

The dimensions measured are: sizes of the oosporangium and oospore, widths of the fossules and heights of the apical crest, the basal claws, or cage, thicknesses of the calcine and other parietal layers. The shape of the oosporangium, the number of convolutions of the spiral cells visible in lateral view of the oosporangium, the angle of the intercellular ridges to the equator plane, and the structure and sculpture of the calcine and of other parietal layers of the oosporangium are also noted and analysed.

a) The size of the oosporangium is given as the length of its polar axis and largest equatorial diameter. The former is measured from the outermost apical crest to the proximal end of the basal claws or cage or to the basal plug, the latter by the length between the abaxial surfaces of its intercellular ridges.

b) The size of the oospore is also given as the lengths of its polar axis and largest equatorial diameter. These are measured — in this case only in sections — between the outer sides of the ectosporine membrane.

c) The fossule width is measured between the intercellular sutures at the equatorial axis, 1—2 convolutions from, and immediately at, the apical point.

d) The diameter of the basal pore is the transverse lumen of the node cell.

e) The height of the apical crest is that of the intercellular ridges at the apical point, whilst the height of the basal claws or cage is given as that of the preserved remnants of the lateral node-cell walls.

f) The shape of the oosporangium is expressed in the terms used for the mature sporophyidium (see pp. 227—228).

g) The number of convolutions of the intercellular ridges seen in lateral view of the oosporangium should also include the partly visible ridges at the apex and base.

h) The angle to the equator plane of the intercellular ridges is most conveniently measured on photographs. It always applies to the ridge nearest to the equator plane.

i) The calcine thickness is measured at the middle of a fossule, at the apex, and at the equator, and also includes a measurement taken of the basal plug, if this is present. It is measured in sections, where its structure is also observed. The sculpture of the calcine, if any, is analysed on whole specimens.

j) The thicknesses of other parietal layers are measured in sections, at the middle of an apical as well as an equatorial fossule. Structure observations are also made in sections. Types of sculpture are analysed in sections and on whole specimens.

5. Fossil remains

The need of a separate terminology for fossil charophyte sporophydia and oosporangia is mainly due to its having not always been possible to identify — at least not with complete certainty — the often fragmentarily preserved fossil organs, cell-tissues and cells with the corresponding structures of the living plant. Students of fossil charophytes have therefore developed an elaborate terminology which, at least partly, is more exact and more detailed than the denomination systems previously adopted for the gametangia and fructifications of the recent Characeae. A total application — as far as compatible with scientific

accuracy — of the recent sporophydium and oosporangium terminology to the fossil remains would of course be desirable. Since the modern methods of analysing fossil charophyte remains have made most morphological elements observed in the fossils identifiable with the corresponding recent structures, the need of a separate terminology is admittedly reduced. Most of the terms used here in describing fossil charophytes accordingly correspond to those listed and defined in the above four sections, but, in some cases, further comments are necessary.

I have previously briefly discussed the terms applied to fossil charophytes (Horn af Rantzien 1954, pp. 23—26). As stated there, the denominations are based mainly on Peck's glossary (1934, p. 104) — with some important changes proposed by Mädler (1952, pp. 3—4). Some minor modifications have been made, mainly to make the terminology more uniform with that applicable to the sporophydia and oosporangia of living plants. In that connection the history of how each term has been applied to fossil charophytes was traced back as far as possible.

As in the preceding sections, space does not allow every paper containing one or more terms to be cited. The literature on fossil Charophyta is rather large, and for that reason a selection has been attempted covering first the important treatises, but also such papers in which new terms are introduced, or in which terms are bettered or the concepts changed. In still other cases, papers are quoted to demonstrate the more or less frequent usage of a term in a particular period.

At the beginning of the nineteenth century, French paleontologists (Lamarck 1804, p. 355, Brard 1809, p. 438, Bigot de Morogues 1810, p. 86, Alex. Brongniart 1810, p. 381, Desmarest 1810, p. 275, De-france 1820, p. 476 and others) introduced the term *gyrogonite* to designate the spiralled fossil remains first interpreted as shells of extinct molluscs, the identity of which with charophyte fructifications was first established by Leman (1812, p. 208). This term was also used in German papers by for instance Bischoff (1828, p. 22) and in English by Lyell (1826, p. 91) and others. The last-named author gave an exact and still applicable definition of gyrogonite: "It may be convenient to retain the term Gyrogonite, which was first used, when the true nature of these bodies was unknown, to express the fossil or mineralized state of the pericarpium of *Chara*" (Lyell *op.c.*, pp. 91—92). It was very sporadically used during the remaining part of the nineteenth century (*e.g.*, by Jones 1874, p. 479) but was revived by Harris in 1939, though in a somewhat more restricted sense, meaning "the calcareous inner

part of the oogonium" [=sporophydium] (Harris 1939, p. 12). In recent years the term gyrogonite has been used in this restricted sense by Rásky (1945, p. 11), Carozzi (1948, p. 135 ff., also in the modification *gyronite*). Croft (1952, p. 192), Mägdefrau (1953, p. 105), and Peck (1953, p. 210). Mädler (1952, p. 4) who also uses this designation, objected to Harris' restriction, and defined gyrogonite as the entire petrification originating from the sporophydium, regardless of the extent of calcification. In other words, he means by gyrogonites fossil charophyte sporophydia and fructifications, as further used by Grambast & Grambast (1953, p. 289, and later), Horn af Rantzien (1954, p. 24), and Mädler (1955, p. 271), and also so used in the present paper.

In a particular group of fossil Charophyta, *viz.* the Clavatoraceae, the gyrogonites are surrounded by outer coverings, which originally probably consisted of interwoven extra-sporophydial segments of the thallus. These are usually termed *utricles*.

The commonest designation of the Characeae gyrogonites has been *oogonium* (equivalents: *oogone*, *Oogonium*). It has been used for instance by Karpinsky (1906, p. 126), Dollfus & Fritel (1920, p. 246), Bell (1922, p. 160), Fritzsche (1924, p. 28), Groves (1925, p. 12, as well as in subsequent papers on fossil Characeae), Peck (1934, p. 104, and in most later papers except in 1953), Rao & Rao (1939, p. 2, alternating with *fruit*), Harris (1939, p. 36, in a particular sense, *cf.* above), Rásky (1941, p. 297, alternating with *Frucht*), Sahni & Rao (1943, p. 216, alternating with *nucule*), Lu (1945, p. 34), Arnold (1947, p. 47, as *oogonium*), Carozzi (1948, p. 135 ff.), Kräusel (1950, pp. 25—26), Papp (1951, p. 280, alternating with *Frucht*), Loranger (1951, p. 2357, "*oogonium*"), Straub (1952, p. 464), Beger (1954, p. 108), Gothan & Weyland (1954, p. 51), and Mägdefrau (1954, p. 87). For several reasons this designation is inappropriate. First, gyrogonites probably include both sporophydia and oosporangia (Horn af Rantzien 1951, p. 660, 1954, p. 24, Mädler 1952, p. 10), although only oosporangia have been identified with absolute certainty. Even if the term *oogonium*, as interpreted by several authors (see above), is considered synonymous with *sporophydium*, it is unsuitable, since at least most gyrogonites are oosporangia. The *oogonium*, as defined in this paper, is moreover only part of the *sporophydium*, and the two designations are accordingly not synonymous.

Various other designations, of which but a selection is given below have been given to gyrogonites. A rather common expression is *fruit* (*Frucht*) (Bosquet 1859, p. 26; Heer 1855, p. 23; Unger 1860, p. 49; Knowlton 1888, p. 156, alternating with *sporostegium*, 1902, p. 72; Reid & Groves 1921, p. 181; Groves 1920, p. 126, 1924, p. 72, and in later papers, also *oogonium*). Wieher (1939, p. 9) speaks of *Characeenfrüchte*. Some writers (*e.g.*, Tuzson 1914, p. 233, and Hofmann 1934, p. 34) use *Oospore*, which is inappropriate for the same reasons as *oogonium*, and Solms-Laubach (1887,

p. 38) the term *berindete Oosporen*. Some other terms are apparently only used occasionally: *Sporangium* (Unger 1850, p. 31), *sporebud* (Maslov 1947, p. 88, alternating with *oogonium*), *capsule* (Ad. Brongniart 1822, p. 321), and *grain* (Gaudin 1856, p. 28, Watelet 1866, p. 50). For lack of any generally accepted terminology, some authors use several alternatives in describing gyrogonites of fossil Characeae; Lyell (1826, p. 92) employs three terms (*gyrogonite*, *pericarpium*, *seed-vessel*) and Stache (1889, p. 121 ff.), no less than four (*Eiknospe*, *Oogonium*, *Sporangium*, *Fruchtkapsel*). Woloszynska (1938, p. 184) recognizes three states of preservation of Quaternary Characeae, *viz.* *unberindete Oogonien*, *berindete Oogonien*, and *Oosporen* or *Kerne* (see p. 214).

The term *utricle* (Fr. *utricle*, Germ. *Utriculum*) was introduced in this particular sense as early as by Reid & Groves (1916, p. 255); it has become the common designation of this organ (employed by *e.g.*, Groves 1924, p. 79, Harris 1939, p. 15, Peck 1941, p. 290, 1946, p. 277, 1953, p. 217, Carozzi 1948, p. 138, alternating with *coque*, Mädler 1952, p. 16). Other terms are *äussere Hülle* (Pia 1927, p. 91, Beger 1954, p. 109, Gothan & Weyland 1954, p. 52), and *Fruchthülle* (Kräusel 1950, p. 26).

What has preserved the gyrogonites in the fossil state is the ability of the plasmatic contents of the living sporophydial spiral cells to form a calcine cover which results in a more or less complete reproduction of the living sporophydium or oosporangium. For that reason, only such cells and cell-tissues as take part in the formation of calcine are in most cases preserved. This generally excludes the coronula and the pedicel cell, occasionally also the node cell. The oogonium itself, which does not secrete calcite, is usually dissolved, leaving a cavity in the gyrogonite; its plasmatic contents are, however, often replaced by post-mortem petrifications (calcite or pyrite). Such post-mortem deposits have sometimes also been observed in the lumina of the spiral cells, or on the surface of the calcine layer.

A gyrogonite accordingly consists of a lime-shell, and sometimes also of post-mortem petrifications. Traces of the sporostline — mainly of its outer part, the ectosporostline — are often found inside the calcine. The ectosporostline is sometimes well enough preserved for its sculpture to be studied when the lime-shell has been dissolved.

The above statements refer to the overwhelming majority of fossil Characeae remains. It should be noted, however, that in some instances specimens of Characeae have been found preserved by silification — not only their gyrogonites but sometimes the whole plants. These have provided the so far only chances of studying the coronula, the pedicel cell, and the insertion of this, in a fossil member of the Characeae (Sahni & Rao 1943). Silicified remains of other Charales families are also known, and studies of them have given

important results in respect of the reproductive and vegetative structure of extinct groups (Stache 1889, Harris 1939). In this connection it is finally worth mentioning that the subgenus *Karpinskya* of *Trochiliscus* (Trochiliscales) is characterized by calcified, and thus generally preserved, coronula cells (Croft 1952; see also Peck 1934).

Gyrogonites are of rather varied appearances due to their respective degrees of calcification. Judging by their external appearance and comparing them with the gametangia and fructifications of living stoneworts, they are similar to more or less mature sporophydia, oosporangia, and types which might be classified as transitional stages between sporophydia and oosporangia. A closer morphological inspection and an understanding of the calcification process reveals, however, that the gyrogonites — at least in the overwhelming majority of cases — are oosporangia of various degrees of maturity.

With regard to the morphology of the lime-shell, three artificial main types of charophyte gyrogonites, connected by intermediate forms, can be distinguished:

1) gyrogonites in which the entire spiral cells have been preserved by formation of calcine and the outer limits of the lime-shell are more or less truly reproducing the abaxial walls of the spiral cells. Such specimens resemble mature sporophydia or immature oosporangia up to the dissolution of the abaxial spiral-cell walls. The spiral cells are represented by more or less rounded ridges (cellular ridges), separated by grooves, in the bottom of which the lateral walls of adjacent spiral cells and the intercellular spaces between these (intercellular sutures) may be observed. This stage of gyrogonite preservation probably always represents fully mature oosporangia.

2) gyrogonites, in which the calcification of the sporostegium has failed to reproduce the whole spiral cells, and of which only the adaxial halves are preserved. Such specimens are like calcified mature oosporangia of some groups of recent Characeae. The spiral cells are represented by slightly convex, flat or slightly concave spaces, between which the remnants of the adaxial halves of their lateral cell walls (intercellular ridges) and the intercellular spaces between these (intercellular sutures) may or may not be visible. The calcine sculptures of such gyrogonites are often indistinct. Morphologically, the lime shells of specimens of this type are intermediate between types 1) and 3). This stage of gyrogonite preservation may represent immature oosporangia of groups whose mature oosporangia are represented by gyrogonites of type 1); more often, however, type 2)

represents mature oosporangia of groups in which the calcification of the spiral cells does not proceed further, *i.e.* where the calcification does not fill up more than the adaxial half of the cell lumen.

3) gyrogonites with thin lime-shells more or less truly reproducing the adaxial halves of the lateral walls and the adaxial walls of the spiral cells, and resembling but slightly calcified oosporangia. The spiral cells are here represented by more or less strongly concave spaces (fossules), separated by the protruding lateral cell walls and the intercellular spaces between adjacent cells (intercellular ridges, intercellular sutures). Like type 2) this third stage of preservation may also represent varying degrees of immaturity in oosporangia, the wholly ripe fructifications of which are represented by gyrogonites of types 1) or 2); or they may represent mature oosporangia of taxa with normally very slight spiral cell calcification.

This division of gyrogonites into three types is entirely based on the degree of spiral cell calcification. By considering other morphological characters of these fossils, another morphological classification corresponding to some extent to the systematic arrangement of fossil Charophyta as at present understood, may be found. Since this morphological grouping will be discussed in detail elsewhere, definitions of the terms relating to it will be postponed until then.

Besides the above main elements characterizing various types of lime-shell development, *viz.*, cellular ridges, fossules, intercellular ridges, and intercellular sutures, some other structures may sometimes be represented on the surface of the calcine layer. The varying formation of calcine in different taxa of fossil charophytes may produce various structures, which have been termed cellular tubercles, intercellular tubercles, cellular sutures, and spiral channels. Cellular tubercles may be found in all the said three main types of gyrogonites; this term seems to include structures of rather varied types as regards both origin and morphology. They are generally rounded, obtuse, or acute protuberances distributed at regular or irregular intervals along the middle of the spiral cells. Intercellular tubercles are apparently rarer; they may occur on or along the intercellular ridges and intercellular sutures, and seem to be mainly confined to gyrogonites of types 2) and 3). Cellular sutures — small grooves or lines in the middle of the spiral cells — are mostly seen on gyrogonites of types 2) and 3), but apparently only in a few taxonomic groups. They are due to peculiarities in the growth of the calcine which begins on the adaxial and lateral walls of the spiral cells

and proceeds inwards, leaving a small part of the lumen uncalcified at the last. Cellular channels originate and develop in about the same way as the cellular sutures; they are cellular sutures that have been hemmed in and finally entirely enveloped by calcine, and have so far been found in a few taxa represented by gyrogonites of type 1). Occasionally, fine, narrow and low ridges may be found midway in the fossules of gyrogonites of type 2) and 3). These are termed secondary ridges, and their origin is probably related to that of the cellular tubercles.

In discussing the basic lime-shell structure, it might in this connection be noted that a particular term, meridional units, has been introduced to denote such straight cellular ridges of the Sycidiales as apparently correspond to the spiral cells of other charophytes.

The structural conditions at the basal (proximal) and apical (distal) poles are somewhat involved. As said above, the coronula disappears completely (except in *Trochiliscus*, subgenus *Karpinskya*), as its cells do not secrete any lime. Morphologically, the apical pole resembles in other respects either that of a sporophydium or of an oosporangium of the recent Characeae. If the former — mainly in gyrogonites of type 1) or sometimes type 2) — the apical ends of the spiral cells are wholly reproduced in the lime-shell. The shapes of the apical tips vary in different taxa, as will be described elsewhere; distally, they join in a point, along a short broken line or system of lines, or leave an apical pore. In some groups the apical periphery has developed into a line of weakness along which the whole apical hood breaks away at the germination of the oospore. When the gyrogonite is of type 3), or a specimen of type 2) with concavely reproduced spiral cells, the apical tips of these are represented by fossules separated by intercellular ridges and intercellular sutures. The ridges are sometimes more raised on the apical tips than in other parts of the gyrogonite because larger surfaces of the spiral cell walls have taken part in forming the calcine there; the result is a crown-like structure, an apical crest. The same alternatives as when the gyrogonite is of type 1) apply to the apical junction of the spiral cells, there may also be a breakage line along the periphery.

The structure of the basal pole is mainly contingent on the extent to which the node cell is calcified. As said above, the pedicel cell disappears for the same reason as the coronula. With regard to the preservation of the node cell, two main types, corresponding to those described above for the apical pole, can be distinguished.

As the node cell of a living sporophydium is at the same level as the

surrounding spiral cells, remains of it may in a gyrogonite, the whole spiral cells of which are calcified (type 1) be found in about the same plane as the cellular ridges. The calcification of the node cell, may take one or two different forms. From the discussion in the previous subchapter it will be remembered that the proximal wall of the node cell has no far never been known to secrete calcine. Its distal wall may on the other hand develop a lime plate, the basal plug. In several taxa, the lateral walls of the node cell also calcify. If calcine has only been secreted from the distal wall, the node cell will present the aspect of a regularly pentagonal hole in the lime-shell, leading to the interior of the gyrogonite, but closed at the bottom by the basal plug. If the lateral walls have also been calcified, the orifice will be smaller, more rounded, and less regularly pentagonal. If the preservation is less complete, the basal plug has often disappeared as it is generally rather loosely attached to the rest of the lime-shell. In all these cases the orifice in the place of the node cell is termed the basal pore. It may be worth mentioning that this is sometimes, like the interior of the gyrogonite, filled by post-mortem lime deposits.

If, instead, the gyrogonite is of type 2) or 3), *i.e.* if its spiral cells are represented only by lime deposits on their adaxial and parts of their lateral walls, the basal pole will be of rather different appearance. The calcareous node cell plug said above to bottom a hole, will in that case be at the level of the fossules. If the lateral walls of the node cell, too, have been calcified, they will protrude from the body of the gyrogonite as the basal cage or basal claws described in section 4.

The various external structures on the lime-shell have long been known and studied by paleobotanists. For lack of specifications, however, the terminology is somewhat confused, and synonyms are many. But a selection will be listed below. It should be noted that only terms used of fossil remains are quoted; for other terms readers are referred to sections 3 and 4.

The term *lime-shell* is commonly used (Groves 1920, p. 126, Reid & Groves 1921, p. 181, Groves 1924, p. 74, Croft 1952, p. 193, Horn af Rantzien 1954, p. 24, etc.). Other expressions are *fossilized integument* (Lyell 1826, p. 91), and *capsule of spirals* (Maslov 1947, p. 87). Gaudin (1856, pp. 28—30), terms it *sporidie*; Karpinsky (1906, pp. 126—127), *Kalkschale* or *Kalksporostegium*; Solms-Laubach (1887, p. 38) uses *Kalkschale* throughout; and Gothan & Weyland (1954, p. 51), Hülle. The terminological equivalent *calcine* is a new term (see p. 231).

Cellular ridge was, with many other useful terms, introduced by Peck (1934, p. 104); it has been used by Peck and by Peck & Reker in later papers, and also by Croft (1952, p. 193) and Horn af Rantzien (1954, p. 24). There are several synonyms, but the respective applications of these are some-

what uncertain, seeing that some authors are confusing the cellular ridges *sensu stricto* — of which there are normally 5 in all fossil and recent Characeae (except *Palaeochara*) — with the convolutions (1—3) of each cellular ridge (spiral cell) on its way from the basal pore to the apical point or pore (see below). The exact sense in which some of the following terms are used is accordingly often impossible to decide with absolute certainty. Most of them probably mean the same as cellular ridge, however. The commonest expressions are enveloping cell or spiral cell (with their equivalents *Spiralzelle* and *cellule spirale*): Reid & Groves (1921, p. 181), Groves (1925, p. 12, 1926, p. 165, 1933, p. 3), Harris (1939, p. 12), Rásky (1941, p. 297, 1945, p. 33), Sahni & Rao (1943, p. 216), Lu (1945, p. 34), Arnold (1947, p. 47), Carozzi (1948, p. 135 ff.), Mädler (1952, p. 7, 1955, p. 277), Straub (1952, p. 466). Some other linguistically reminiscent terms have also been used, though less frequently: spiral valves (Lyell 1826, p. 91); valves spirales (Ad. Brongniart 1822, p. 321, Bosquet 1859, p. 26, etc.); bandes spirales (Gaudin 1856, p. 28); Spiren (Unger 1860, p. 49); Spiralarippen or Kalkspiralen (Karpinsky 1906, p. 130, although it is a little doubtful whether Karpinsky applies these to the cellular ridges only, or originally meant them to include also intercellular ridges); and Spirälwülste (Pia 1927, p. 88). Some other designations of the same type are: Röhrrchen (Heer 1855, p. 24); Rindenzellen or Hüllzellen (Stache 1889, p. 123 ff.); Kalkbänder (Pia 1927, p. 89); Hüllschläuche (Kräusel 1950, pp. 25—26, alternating with Rindenzellen or Kalkbänder, Mägdefrau 1954, p. 87); Spiralarbänder or Spirälwindungen (Gothan & Weyland 1954, p. 51); and investing cells (Bell 1922, p. 160).

Terms more or less clearly applicable to the convolutions (Reid & Groves 1921, p. 187, Groves 1925, p. 12, 1933, p. 5, Sahni & Rao 1943, p. 216, Lu 1945, p. 34, Horn af Rantzien 1951, p. 667, 1954, p. 25), whether referring to the turns of cellular or intercellular ridges, are: Windungen (Heer 1855, p. 24; Unger 1860, p. 49; Tuzson 1914, p. 233; Rásky 1941, p. 298, and 1945, p. 33; Mädler 1952, p. 18, 1955, p. 277; Straub 1952, p. 466; etc.), Hüllzellsegmente (Stache 1889, p. 121 ff.) Spirälwindungen (Papp 1951, p. 280); Rindenzellschläuche (Fritzschke 1924, p. 28); tours de spire (Dollfus & Fritel 1920, p. 246; Grambast & Grambast 1953, p. 289 and also later); spirals (Knowlton 1888, p. 156 and 1902, p. 72; Peck 1937, p. 87, and in later papers, Rao & Rao 1939, p. 2, alternating with convolutions; Maslov 1947, p. 89, alternating with volutions of spirals; Loranger 1951, p. 2359); and turns (Peck 1934, p. 108).

The term intercellular ridge was introduced by Peck (1934, p. 104); it has since been used by Peck, and by Peck & Reker, by Croft 1952, p. 193), and by Horn af Rantzien (1954, p. 24). Synonyms are spiral ridges (Bell 1922, p. 160; Loranger 1951, p. 2359), spiral flanges (Harris 1939, p. 40; Sahni & Rao 1943, p. 216), Ränder (Heer 1855, p. 25), Kiele or Leisten (Stache 1889, p. 121 ff.), Spiralarippen or Kalkspiralen (Karpinsky 1906, p. 130, with some doubt as to their exact application, see above), Grate (Pia 1927, p. 88), Rippen (Rásky 1945, p. 32); Kanten (Woloszynska 1938, p. 189 ff.), Spiralleisten (Papp 1951, p. 286),

Nahtrippen (Straub 1952, p. 466), and interzelluläre Rippen (Mädler 1952, p. 10).

Intercellular sutures (Horn af Rantzien 1954, p. 24) have been termed simply sutures (or the French equivalent sutures) by for instance Dollfus & Fritel (1920, p. 244), Reid & Groves (1921, p. 182), Rao & Rao (1939, p. 3), Lu (1945, p. 34), and Grambast & Grambast (1953, p. 290, and later). By Peck (1934, p. 104), and in his or Peck & Reker's later papers, they are called intercellular furrows. Bell (1922, p. 160) uses a circumlocution: narrow grooves on spiral ridges. Corresponding German expressions are: Nahtlinien (Stache 1889, p. 121; Fritzsche 1924, p. 28; Papp 1951, p. 280; Mädler 1955, p. 279) and Nähte (Pia 1927, p. 88; Rásky 1941, p. 297, and 1945, p. 33; Mädler 1952, p. 10).

Fossule was first introduced by Groves & Bullock-Webster (1920, p. 69), but appears to have been forgotten since. Some authors have used the expressions cellular furrows, or merely furrows (Groves 1920, p. 126; Peck 1934, p. 104, and later; Lu 1945, p. 34; Croft 1952, p. 193; Horn af Rantzien 1954, p. 24). Fossule seems appropriate and handy, and has been reintroduced in this paper with a view to better conformity to the terminology in respect of living oosporangia. The same structures have been termed Täler (Pia 1927, p. 88), and Furchen (Rásky 1945, p. 33; Mädler 1952, p. 5). Bischoff's old terms Windungen or Spiralbänder (1828, p. 22) probably refer to the fossules when applied to fossil specimens, but their exact meanings are somewhat doubtful.

The cellular tubercles — first described by Lyell (1826, p. 94) — have generally been termed tubercles (Reid & Groves 1921, p. 184 — on p. 182, they use the expression papilliform processes — Groves 1924, p. 78 and 1933, p. 41; Harris 1939, p. 36; Rao & Rao 1939, p. 3; Peck & Reker 1947, p. 4, and later by Peck and Peck & Reker: Horn af Rantzien 1951, p. 664, and 1954, p. 24), tubercules (Dollfus & Fritel 1920, p. 246), and Tuberkeln (Rásky 1941, p. 302, 1945, p. 46, alternating with Zapfen). Mädler (1952, p. 5), who pointed out the important difference between tubercles occurring in the middle of spiral cells and those distributed along intercellular ridges and emphasized the value of these two types to systematic classification, used a circumlocution when speaking of the former: in der Furchen oder auf den konvexen Spiralen stehende Papillen. Cellular tubercles is a new term, formed in conformity with intercellular tubercles, which is also new, in order to differentiate the two types in descriptions. Other German designations are Warzen (Tuzson 1914, p. 234) and Knoten (Pia 1927, p. 90).

Intercellular tubercles have been described as wellenförmige Erhebungen der Nahtlinie by Rásky (1945, p. 38), and as Papillen auf den interzellulären Rippen by Mädler (1952, p. 5).

Cellular suture is a term introduced by Horn af Rantzien (1954, p. 24), synonymous with Zwischennaht (Mädler 1952, p. 10).

Spiral channels is a new term synonymous with the earlier tubular hollows (Groves 1920, p. 127), tubular spaces (Croft 1952, p. 216), and cavities in the form of curved spirals (Maslov

1947, p. 88). Mädler (1952, p. 10) speaks of *Höhlungen im Inneren der Spiralzellen*.

The term *secondary ridge* was introduced by Peck & Reker (1948, p. 87). No synonyms are known to me.

The term *meridional unit* was introduced by Peck (1934, p. 104).

The *apical pore* (Horn af Rantzien 1954, p. 25, alternatingly with *apical opening* or *apical orifice*) is the apical opening of Croft (1952, p. 193), the *summit opening* of Peck (1937, p. 87, and later papers), and Loranger (1951, p. 2359), and the *Gipfelöffnung* of Mädler (1952, p. 18).

Apical crest was introduced by Groves & Bullock-Webster (1920, p. 59), and applied to the oosporangia of recent Characeae. This structure has usually not been called by any special name by students of fossil Characeae; in her paper on Quaternary charophyte remains, however, Woloszynska (1938, p. 185) speaks of *leistenförmig verdickte Ränder* in the apical area.

The *basal plug* is the calcareous plate or plug of Maslov (1947, p. 87), Croft (1952, p. 217), and Horn af Rantzien (1954, p. 26), and the *Basisplatte* of Mädler (1955, p. 279).

The *basal pore* (Horn af Rantzien 1954, p. 25) is synonymous with the *foramen basilare* (Reid & Groves 1921, p. 182), the *basal orifice* (Groves 1925, p. 12, and 1933, p. 5), and the *basal opening* (Peck 1934, p. 104, and in later papers by Peck and Peck & Reker; Maslov 1947, p. 89; Croft 1952, p. 193). Some German designations of the basal pore are: *Insertionsstelle* (e.g., Heer 1855, p. 25), *Ablösungsstelle der Stengelzelle* (Rásky 1941, p. 298), *Ablösungsstelle des Stiels* (Rásky 1945, p. 43 ff.), *Basalöffnung* (Papp 1951, p. 285), *Öffnung der Stielzelle* (Mädler 1952, p. 18), and *Stielloch* (Straub 1952, p. 466, Mädler 1955, p. 279).

The *cage* and *basal claws*, which as far as fossil specimens are concerned represent the extremes of the node cell calcification, are usually lumped together under a common designation. The terms were introduced for application to oosporangia of the living Characeae by Groves & Bullock-Webster (1920, p. 58). These structures have also been called *cohors basilaris* (Reid & Groves 1921, p. 182), *cages* (Harris 1939, p. 39, Croft 1952, p. 193, Horn af Rantzien 1954, p. 26), and *verdickte Leisten oder kurze Zipfelchen* (Woloszynska 1938, p. 185).

The most suitable German designations seem to be: of lime shell or calcine *Kalkschale* (Solms-Laubach 1887, p. 38) or *Kalcin*; of cellular ridges *zelluläre Rippen*; of convolutions *Windungen* (Heer 1855, p. 24, and later authors); of intercellular ridges *interzelluläre Rippen* (Mädler 1952, p. 10); of intercellular sutures *interzelluläre Nähte*; of fossules *Furche* (Rásky 1945, p. 33, Mädler 1952, p. 5); of cellular tubercles *zelluläre Tuberkeln*; of intercellular tubercles *interzelluläre Tuberkeln*; of cellular sutures *zelluläre Nähte*; of spiral channels *Spiralzellen-Kanäle*; of secondary ridges *Sekundärrippen*; of apical pore *Apikalöffnung* or *Gipfelöffnung*

(Mädler 1952, p. 18); of apical crest *Apikalkamm* or *Gipfelkamm*; of basal plug *Basalpropf*; of basal pore *Basalöffnung* (Papp 1951, p. 285); of cage *Basalgitter*; and of basal claws *Basalkamm*.

I have up to now mainly discussed the morphological sculpture of the calcine, and the pertinent terminology. Some remarks shall also be devoted to the anatomical structure of the lime-shell. In most gyrogonites, and so far known also in calcine-producing oosporangia of living stoneworts, the calcine is structurally homoplastic, and characterized by a concentric lamination (Croft 1952, p. 194, Horn af Rantzien 1954, p. 25). In these respects no further terminological differentiations of the shell seem necessary. In a few instances, however, only the inner, thicker part of the lime-shell is so laminated, while the thin outer layer is structureless. For such cases it is expedient to differentiate the *endocalcine*, characterized by lamination (the inner layer of Maslov 1947, p. 88 and Croft 1952, p. 216), from the outer, structureless *ectocalcine* (the outer layer of Maslov *l.c.*, Croft *l.c.*).

As mentioned above (p. 240), parts of the sporostine — mainly the ectosporostine — which is the most resistant membrane, are in fossil specimens not infrequently preserved inside of the calcine. The parietal gyrogonite layers and the sculpture of the sporostine membranes are then designated as in the previous section (see pp. 230—233).

Inside the sporostine layers lies the *oospore*. Since the sporine layers — being little resistant — are rarely preserved in gyrogonites, the terms *oospore contents* or *vesicular contents* are practically synonymous with *oospore*. If originally a sporophydium, the central part of the gyrogonite would contain remnants of the *oosphere*, or be a cavity left by this.

In the literature on fossil Characeae, the parietal layers of the gyrogonites, apart from the calcine, are generally included in a common term, *e.g.*, the *oospore membrane* (Groves 1925, p. 12, Peck 1934, p. 104, and later papers, Harris 1939, p. 12, Croft 1952, p. 193, Horn af Rantzien 1954, p. 24), *membrane* (*e.g.*, Lyell 1826, p. 92), *Sporonmembran* (Mädler 1952, p. 10), *äussere Hartschale* (Karpinsky 1906, p. 129, probably also including the calcine); or *Hartschale* (Woloszynska 1938, p. 186).

When applied to fossil specimens, the following expressions are synonymous with the *oospore* (used by Groves 1920, p. 126, Reid & Groves 1921, p. 182, Sahni & Rao 1943, p. 216, Rásky 1941, p. 297, Papp 1951, p. 280, and others): *Fruchtkerne* or *Nucleus* (Stache 1889, p. 121 ff.); *Steinkern* (Mädler 1952, p. 4, 1955, p. 279); *egg* (Harris 1939, p. 12), *inner cavity* or *inner mould* (Maslov 1947, pp. 87—88); and *vesicular contents* (Croft 1952, p. 193, Horn af Rantzien 1954, p. 24).

The methods and measurements described in sections 3 and 4 are suitably employed in general descriptions of gyrogonites. It should be noted, however, that since the coronula and pedicel cells are usually not represented in the fossil material, no descriptions or measurements of them can of course be included. For convenience, a brief summary of the data required for the morphological analysis of a gyrogonite is given also in this section, omitting all definitions, which are the same as those already given:

- a) The size of the gyrogonite, expressed by the length of its polar axis and largest equatorial diameter.
- b) The sizes of the oosphere, oospore, or cavities left by them, also expressed by the lengths of their polar axes and largest equatorial diameters.
- c) The widths of the fossules or cellular ridges at the equator and at the apex.
- d) The diameters of the apical (if any) and basal pores.
- e) The heights of the apical crest and basal claws or cage.
- f) The shape of the gyrogonite, expressed in the two sets of terms defined on pp. 227—228.
- g) The number of convolutions of the fossules or cellular ridges in lateral view of the gyrogonite.
- h) The angle to the equator plane of the intercellular ridges or sutures.
- i) The respective thickness and structures of calcine (midway in the fossules at the apex and at the equator, and in the basal plug) and corresponding observations on the ectocalcine and endocalcine, if differentiated.
- j) The thickness and sculptures of other parietal gyrogonite layers.
- k) Any other morphological observations of lime-shell characters (apical breakage-zones, cellular and intercellular sutures, cellular and intercellular tubercles, or secondary ridges).
- l) Any other anatomical observations of lime-shell characters (spiral channels, and post-mortem deposits in these).
- m) notes on the state of preservation of the oospore, and on post-mortem calcifications in the oosporal cavity and polar orifices.

Summary

A review of the morphological terminology pertinent to female charophyte gametangia and fructifications and to corresponding fossil remains reveals that several designations are misleading and even erroneous, while quite a few characteristic structures have got no proper denominations at all. Somewhat different terminologies have moreover been applied to the said living organs and to the corresponding fossil ones. The present paper primarily attempts to provide a basis for the settling of the relevant terminology.

1. The female charophyte gametangium — usually termed “oogonium” — should be termed *sporophydium*, while the fructification — the “oospore” of authors — should be designated *oosporangium*.

2. The terms below are suggested for cells and tissues in the developing sporo-

phydium. The sporophydial initial gives rise to the oogonial initial, the sporostegial initial, and the pedicel cell (cells). The oogonial initial forms the egg-cell or oosphere and 1–3 sterile oogonial cells. The sporostegial initial gives rise to the central node cell and 5 peripheral spiral initials which divide into one tier of spiral cells and one or two tiers of coronula cells.

3. The mature sporophydium is basally attached to the mother plant by 1–2 pedicel cells. — Its central part — derivatives of the oogonial initial — is the oogonium and consists of the oosphere and 1–3 sterile oogonial cells, usually already resorbed at maturity; the oogonium is surrounded by the oogonium membrane, the absence of which apically forms the receptive spot. — The covering of the sporophydium is the sporostegium — derivatives of the sporostegial initial. It comprises the central node cell and 5 peripheral spiral cells which are terminated by 5 or 10 coronula cells, forming between them the coronula. The spiral cells are attenuated apically so as to form a neck with slits between the cells. Inside of the neck is left a cavity divided by a diaphragm into a lower primary and an upper secondary apical receptacle.

4. The carrying out of morphological analyses of sporophydia and oosporangia and of fossil gyrogonites is described in detail. In that connection the concepts of polar axis (PA), largest equatorial diameter (LED), equatorial axis (EA), isopolarity index (ISI, *i.e.* PA/LED %), and anisopolarity index (ANI, *i.e.* AND/PA %), where AND is the distance between apical pole and LED) are discussed and defined, as also the terms apical and basal, abaxial and adaxial as relative to the pertinent morphology. Size and shape indications and measurements are also dealt with to some extent.

5. The development of the fertilized sporophydium to an oosporangium is briefly described. The fructification wall comprises 5 layers of which the 3 outer constitute the sporangioderm. The outermost is the lime-shell or calcine — in fossil specimens sometimes an outer ectocalcine and an inner endocalcine. Inside is the sporostine, consisting of ectosporostine and endosporostine. The two innermost strata are the ectosporine and the endosporine, forming between them the spore wall or sporine. The ectosporostine has a diagnostic sculpture, terminologized on p. 233. — The lateral sporophydial spiral-cell walls form on the oosporangium intercellular ridges, separated by spiral-cell lumina, fossules, and provided along the ridge middles with intercellular sutures, *i.e.* spaces between adjacent spiral cells. The ridges are often higher apically and form here the apical crest. The sporophydial node cell gives rise to oosporangium structures termed basal claws, basal cages, basal plugs, and basal pores.

6. Gyrogonites are, at least in most cases, fossil fructifications. What is preserved of these is the calcine and occasional ectosporostine remnants. In the Clavatoraceae gyrogonites are surrounded by outer coverings, utricles. — The three artificial main types of lime-shell developments are: a) with convex spiral cells (cellular ridges); b) with approximately flat spiral cells; c) with concave spiral cells (fossules). These differences cause a rather varied apical and basal pole morphology. — The gyrogonite terminology corresponds principally to that of living Characeae sporophydia and oosporangia. Fossules, intercellular ridges

and sutures, apical crests, and the basal structures: pores, plugs, claws, and cages are accordingly similarly defined as of recent oosporangia. But the varying calcine formation in fossil Charophyta may produce particular structures not known from recent stoneworts, *i.e.* cellular and intercellular tubercles, cellular sutures, spiral channels, and secondary ridges, discussed and defined on pp. 242—243. Meridional units are cellular ridges of the Sycidiales. In several fossil taxa the spiral cells do not join each other apically but leave the apical pore.

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Postscripts

Some recent papers have come under my notice after the manuscript conclusion. Sundaralingam (Jour. Ind. Bot. Soc., 33 (1954): 272—297) describes the sporophytia and oosporangia of *Chara zeylanica*, the terminology agreeing with American textbooks of algae. Papenfuss in a very interesting paper (Classification of the algae, in A century of progress in the natural sciences, 1853—1953: 115—224, San Francisco 1955) introduces the term *zygospore* (p. 130) of the Characeae oosporangium. As to parietal oosporangium stratigraphy zygemalean spore walls have been discussed by Transeau (The Zygnemataceae, Columbus 1951), and Erdtman (Sv. Bot. Tidskr., 50 (1956): 135—141) has given a further account of LO-analysis.

Bibliography

- ALLEN, G. O., 1937: Notes on the outer covering of Charophyte fruits. — Jour. Bot., 75: 153—155, London.
- ALLEN, T. F., 1888: The Characeae of America. Part I, p. 1—64, fig. 1—54. — New York.
- ANDREWS, HENRY N., Jr., 1947: Ancient plants and the world they lived in, p. i—xii, 1—279, fig. 1—166. — Ithaca, N. Y.,
- ARNOLD, CHESTER A., 1947: An introduction to paleobotany, p. i—xii, 1—133, fig. 1—187, frontisp. — New York & London.
- BARY, [HEINRICH ANTON] DE, 1871: Über den Befruchtungsvorgang bei den Charen. — Monatsber. Preuss. Akad. Wiss., 36 (1871): 227—239, Fig. 1—9, Berlin.
- 1875: Zur Keimungsgeschichte der Charen. — Bot. Zeitung, 33: 378—385, 393—401, 409—420. Taf. V—VI, Leipzig.
- BARY, A. DE & HEMSLEY, W. B., 1875: On the germination of *Chara*. [Engl. transl. by W. B. HEMSLEY of »Zur Keimungsgeschichte der Charen]. — Jour. Bot., 4: 298—313, Tab. 167—168, London.
- BEGER, H., 1954: IX. Abteilung: Charophyta, Armleuchtergewächse. In: A. ENGLER'S Syllabus der Pflanzenfamilien, etc. 12., Aufl. von H. MELCHIOR & E. WERDERMANN. I. Band, p. 108—109, Fig. 37. — Berlin.
- BELL, W. A., 1922: A New Genus of Characeae and New Merostomata from the Coal Measures of Nova Scotia. — Trans. Roy. Soc. Canada, ser. 3, 16: 159—167, pl. 1, Ottawa.

- BENNETT, ALFRED W., 1878: On the structure and affinities of Characeae. — *Jour. Bot.*, 16: 202—207. London.
- BENNETT, ALFRED W. & MURRAY, GEORGE, 1889: A Handbook of Cryptogamic Botany. p. i—viii, 1—473, fig. 1—382. — London.
- BERKELEY, M. J., 1857: Introduction to Cryptogamic Botany. p. i—ix, 1—604, fig. 1—126. — London.
- BIGOT DE MOROGUES, P. M. S., 1810: Note sur les gyrogonites trouvés dans le département de la Sarthe. — *Bull. Acad. Sci. Phys. Med. Agric. Orléans*, II: 86—89. Orléans. [Not seen; quoted according to GROVES 1933].
- BISCHOFF, GOTTL. WILH., 1828: Die kryptogamischen Gewächse mit besonderer Berücksichtigung der Flora Deutschlands und der Schweiz organographisch, anatomisch, physiologisch und systematisch bearbeitet. Erste Lieferung: Chareen und Equiseteen. p. i—x, 1—60, Tab. I—VI. — Nürnberg.
- 1842: Handbuch der botanischen Terminologie und Systemkunde. 2. p. i—x, 583—1047, 45—90 [expl. of plates], Tab. XLVIII—LXXVII. — Nürnberg.
- BOSQUET, J., 1859: Recherches paléontologiques sur le terrain tertiaire du Limbourg Néerlandais. — *Verh. d. Kon. Akad. van Wetensch., Afd., Naturkunde*, 7: 1—30, pl. I—II. Amsterdam.
- BRAUD, P., 1809: Mémoire sur les coquilles fossiles du genre *Lymnée* qui se trouvent aux environs de Paris, etc. — *Ann. Mus. Hist. Nat.*, 14: 426—440, pl. 27. Paris.
- BRAUN, [ALEXANDER], 1853: Über die Richtungsverhältnisse der Saftströme in den Zellen der Characeen. Fortsetzung und Schluss. — *Monatsber. K. Akad. Wiss. Berlin aus dem Jahre 1853*: 45—76. Berlin.
- 1857: Über Parthenogenesis bei Pflanzen. — *Abh. Kön. Akad. Wiss. Berlin*, 1856: 311—376, 1 Taf. (unnumb.). Berlin.
- BRAUN, AL. & HENFREY, ARTHUR, 1853: On the "Nucleus" of the Characeae. [Engl. transl. by ARTHUR HENFREY of "Über die Richtungsverhältnisse der Saftströme in den Zellen der Characeen"]. — *Ann. Nat. Hist.*, ser. 2, XII (71): 297—302. London.
- BRONGNIART, [ALEXANDRE], 1810: Sur des Terrains qui paroissent avoir été formés sous l'eau douce. — *Ann. Mus. Hist. Nat.*, 15: 357—405, pl. 22—23. Paris.
- BRONGNIART, ADOLPHE, 1822: Sur la classification et la distribution des végétaux fossiles en général, et sur ceux des terrains de sédiment supérieur en particulier. — *Mém. Mus. d'Hist. Nat.*, 8: 203—240, 297—348, pl. I (12)—VI (17). Paris.
- CAROZZI, ALBERT, 1948: Etude stratigraphique et micrographique du Purbeckien du Jura suisse. — *Arch. Sci.*, 1 (2): 211—375, fig. 1—56, pl. I—VI. [Also Thèses Fac. Sci. Univ. Genève, 1122]. Genève.
- ČELAKOVSKÝ, LAD., 1878: Ueber die morphologische Bedeutung der sog. Sporensprösschen der Characeen. — *Flora*, 61: 49—57, 73—76. Regensburg.
- CHAPMAN, V. J., 1941: An introduction to the study of algae. p. i—x, 1—387, fig. 1—209, Tab. I—XXIV. — Cambridge.
- COSTANTIN, J., 1918: PH. VAN TIEGHEM: *Eléments de Botanique*. II. Botanique Spéciale. Ed. 5, reman. et augm. de J. COSTANTIN. p. i—xx, 1—743, fig. 1—326. — Paris.
- COULTER, JOHN MERLE, 1914: The evolution of sex in plants. — *Univ. Chic. Sci. Ser.* p. i—ix, 1—140, fig. 1—46. Chicago, Ill.

- CROFT, W. N., 1952: A new *Trochiliscus* (Charophyta) from the Downtonian of Podolia. — Bull. Brit. Mus. (Nat. Hist.), Geol., I (7): 189—220, fig. 1—7, pl. 18—19. London.
- CZURDA, VIKTOR, 1931: Zur Morphologie und Systematik der Zygnemalen. — Beih. z. Bot. Centralbl., XLVIII (II) (1): 238—285, Abb. 1—17. Dresden.
- DEBSKI, BRONISLAW, 1897: Beobachtungen über Keratheilung bei *Chara fragilis*. — Jahrb. Wiss. Bot., 30: 227—248, Taf. IX—X. Berlin.
- 1898: Weitere Beobachtungen an *Chara fragilis* Desv. — Ibid., 32: 635—670, Taf. XI—XII. Berlin.
- DEFRANCE, 1820: Fruits (foss.). — In: Dict. Sci. Nat., 17: 472—479. Strasbourg & Paris.
- DESMAREST, A. G., 1810: Mémoire sur la Gyrogonite. — Nouv. Bull. Sci. Soc. Philom. Paris, II: 275—277, pl. II. Paris.
- DOLLFUS, G.-F. & FRITTEL, P.-H., 1920: Catalogue raisonné des Characées fossiles du Bassin de Paris. — Bull. Soc. Géol. France, sér. 4, XIX (1919): 243—261, fig. 1—23 [24 figs.; fig. nr 18 occurring twice], 1 tab. [unnumb. p. 261]. Paris.
- ERDTMAN, G., 1913: An Introduction to Pollen Analysis, p. i—xv, 1—239, fig. 1—15, pl. I—XXVIII+3 pl. at the end of the book. — Waltham, Mass.
- 1952: Pollen Morphology and Plant Taxonomy. Angiosperms. (An Introduction to Palynology, I), p. i—xii, 1—539, fig. 1—261, 1 col. pl. — Uppsala.
- ERNST, ALFRED, 1901: Ueber Pseudo-Hermaphroditismus und andere Missbildungen der Oogonien von *Nitella syncarpa* (Thuill.) Kützing. — Flora, 88: 1—36, Taf. I—III. Marburg.
- FRITSCH, F. E., 1935: The structure and reproduction of the algae. I. p. i—xvii, 1—791, fig. 1—245, frontisp. — Cambridge.
- FRITZSCHE, C. H., 1924: Neue Kreidefaunen aus Südamerika (Chile, Bolivia, Peru, Columbia). — Neues Jahrb. Min. Geol. Paläont., L. Beil. Bd: 1—56. 313—334, Fig. 1—9, Taf. I—IV. Stuttgart.
- GAUDIN, CH., 1856: Sur une nouvelle espèce de *Chara* fossile et sur la structure de ces fruits pétrifiés. — Bull. Soc. Vaud. Sci. Nat., (1854) IV (32): 28—30. Lausanne.
- GOEBEL, K., 1882: Grundzüge der Systematik und Speciellen Pflanzenmorphologie nach der vierten Auflage des Lehrbuchs der Botanik von J. SACHS neu bearbeitet, p. i—viii, 1—550, Fig. 1—407. — Leipzig.
- 1902: Morphologische und biologische Bemerkungen. II. Ueber Homologien in der Entwicklung männlicher und weiblicher Geschlechtsorgane. — Flora, 90: 279—305, Fig. 1—9. Marburg.
- 1918: Zur Organographie der Characeen. — Flora, 110 (3—4): 344—387, Fig. 1—21. Jena.
- 1928: Organographie der Pflanzen. 3. Aufl. I. Allgemeine Organographie, i—ix, 1—642, Fig. 1—621. — Jena.
- GOETZ, GEORG, 1899: Ueber die Entwicklung der Eiknospe bei den Characeen. — Bot. Zeitung, 57: 1—13, Fig. 1—3, Taf. I. Leipzig.
- GOTHAN, WALTHER & WEYLAND, HERMANN, 1954: Lehrbuch der Paläobotanik, p. 1—535, Abb. 1—419, frontisp. — Berlin.
- GRAMBAST, LOUIS & GRAMBAST, NICOLE, 1953: Revision de quelques Charophytes tertiaires du Bassin de Paris. — C. R. S. Soc. Géol. France, 1953 (14): 289—291. Paris.

- GROVES, JAMES, 1920: A Curious Fossil Charophyte Fruit. — *Geol. Mag.*, LVII: 126—127, fig. 1. London.
- [J. G.], 1924: A sketch of the geological history of the Charophyta. — In: JAMES GROVES & GEORGE RUSSELL BULLOCK-WEBSTER, *The British Charophyta*, II: 72—90, fig. 26—31, pl. XLV. London.
- 1925: Fossil Charophyte-fruits from Texas. — *Amer. Jour. Sci.*, ser. 5, 10: 12—14, fig. 1—3. New Haven, Conn.
- 1926: Charophyta. — In: ELEANOR MARY REID & MARJORIE ELIZABETH JANE CHANDLER, *The Bembridge Flora* (*Brit. Mus. Cat. Cain. Pl.*, I): 165—173, fig. 16—20, pl. XII. London.
- 1933: Charophyta. — *Fossilium Catalogus*, II, *Plantae*, ed. W. Jongmans, 19: 1—74. Berlin.
- GROVES, JAMES & BULLOCK-WEBSTER, GEORGE RUSSELL, 1920: *The British Charophyta*. Vol. I. Nitelleae. p. i—xiv, 1—141, fig. 1—25, pl. I—XX. — London.
- 1924: *The British Charophyta*. Vol. II. Chareae. p. i—xii, 1—129, fig. 26—31, pl. XXI—XLV. — London.
- HARRIS, THOMAS MAXWELL, 1939: *British Purbeck Charophyta*. p. i—ix, 1—83, fig. 1—16, pl. I—XVII. — *Brit. Mus. (Nat. Hist.)*, London.
- HAUPT, ARTHUR W., 1953: *Plant Morphology*. p. i—ix, 1—464, fig. 1—338. — New York, Toronto, London 1953.
- HEER, O., 1855: *Flora Tertiaria Helvetiae*, I. p. i—vi, 1—117, Taf. 1—L. — Winterthur.
- HOFMANN, ELISE, 1934: *Paläohistologie der Pflanze*. p. i—vii, 1—308, Abb. 1—153. — Wien.
- HOFMEISTER, W., 1852: Ueber die Stellung der Moose im System. — *Flora*, 35: 1—10. Regensburg.
- HORN AF RANTZIEN, HENNING, 1951: On the fossil Charophyta of Latin America. *Sv. Bot. Tidskr.*, 45 (4): 658—677, Tab. I. Uppsala.
- 1954: Middle Triassic Charophyta of South Sweden. — *Opera Botanica*, I (2): 1—83, fig. 1—3, Tab. I—III, pl. I—VII. Lund.
- IVERSEN, JOHS. & TROELS-SMITH, J., 1950: Pollenmorfologiske definitioner og typer. — *D. G. U., IV. R.*, Bd 3 (8): 1—54, Tav. 1—XVI. København. (*Germ. Summ.* p. 27—49: *Pollenmorfologische Definitionen und Typen*).
- IYENGAR, M. O. P., 1951: Chlorophyta. — In: G. M. SMITH (ed.), *Manual of Phycology*, etc.: 21—67, fig. 1—17. Waltham, Mass.
- JACKSON, BENJAMIN DAYDON, 1928: A glossary of botanic terms with their derivation and accent. Ed. 4. p. i—xii, 1—481. — London.
- JONES, T. RUPERT, 1874: Gyrogonites, etc., in the London Clay. — *Geol. Mag.*, ser. 2, Decade II, I (1): 479. London.
- KAISER, OTTO, 1896: Ueber Kerntheilungen der Characeen. — *Bot. Zeitung*, 54: 61—79, Taf. II: 1—62. Leipzig.
- KARPINSKY, A., 1906: Die Trochiliskten. — *Mém. Com. Géol. St. Pétersb.*, n. s., 27: i—viii, 1—86 (Russian), 87—166 (German), fig. 1—59, pl. I—III. St. Pétersbourg.
- KAULFUSS, GEORG FRIEDRICH, 1825: Erfahrungen über das Keimen der Charen nebst andern Beyträgen zur Kenntniss dieser Pflanzengattung mitgetheilt von Dr. GEORG FRIEDRICH KAULFUSS. p. [i—vi], 1—92, 1 Taf. — Leipzig.

- KNOWLTON, F. H., 1888: Description of a new fossil species of the genus Chara. — Bot. Gaz., XIII (6): 156—157, fig. 1—2. Crawfordsville, Ind.
- 1902: Description of a new fossil species of Chara. — Torreya, 2 (5): 71—72, 1 fig. Lancaster, Pa.
- KRÄUSEL, RICHARD, 1950: Versunkene Floren. Eine Einführung in die Paläobotanik. p. 1—152, Abb. 1—28, Taf. 1—64. — Frankfurt am Main.
- LAMARCK, [J. B. A. P. MONET DE], AN XIII [1804]: Suite des Mémoires sur les Fossiles des environs de Paris. — Ann. Mus. National Hist. Nat., V: 349—357. Paris.
- LÉMAN, S., 1812: Note sur la Gyrogomite [sic!]. — Nouv. Bull. Sci. Soc. Philom., III: 208—210. Paris.
- LE MAOUT, EMM. & DECAISNE, JH., 1868: Traité général de Botanique descriptive et analytique. p. i—x, 1—745, 5500 [unnumb.] figs. [according to title page]. — Paris.
- LINSBAUER, KARL, 1917: C. K. SCHNEIDERS illustriertes Handwörterbuch der Botanik. 2. umgearb. Aufl. p. i—xxi, 1—824, Fig. 1—396. — Leipzig.
- LORANGER, D. M., 1951: Useful Blairmore Microfossil Zone in Central and Southern Alberta, Canada. — Bull. Amer. Ass. Petrol. Geol., 35 (11): 2348—2367, fig. 1—3, pl. 1—3, Menasha, Wis.
- LOSCH, HERMANN, 1912: Über das Vorkommen eines zweiten Hüllquirls an den Eiknospen von Chara foetida. — Ber. Deutsche Bot. Ges., XXX: 516—522, Fig. I—X. Berlin.
- LU, YEN-HAO, 1945: The Charophyta from the Kucha Formation near Kucha, Sinkiang. — Bull. Geol. Soc. China, XXIV (1944) (1—2): 33—36, pl. 1, Pehpei.
- LYELL, CHARLES, 1826: On a recent Formation of Freshwater Limestone in Forfarshire, and on some recent Deposits of Freshwater Marl; with a Comparison of recent with ancient Freshwater Formations; and an Appendix on the Gyrogonite or Seed-vessel of the Chara. — Trans. Geol. Soc., ser. 2, II (I): 73—96, pl. X—XIII. London.
- MASLOV, V. P., 1947: Materials for the Investigation of Fossil Algae of the USSR. Fossil Chara — their Importance, Anatomy and the Methods of their Study. — Bull. Soc. Nat. Moscow, 52 (Sér. Géologique, 22, 3): 73—90, fig. 1—15. Moscow. [In Russian; Engl. Summ. p. 87—90].
- MC LEAN, R. C. & IVIMEY-COOK, W. R., 1951: Textbook of Theoretical Botany. Vol. I. p. i—xv, 1—1069, fig. 1—1941, frontisp. — London, New York & Toronto.
- MIGULA, W., (1890—)1897: Die Characeen Deutschlands, Oesterreichs und der Schweiz. — In: L. RABENHORST, Kryptogamen-flora von Deutschland, Oesterreich und der Schweiz. 2. Aufl., Bd 5: i—xiii, 1—765, Fig. 1—149. Leipzig. [Spec. issue 1900].
- MOLL, J. W., 1934: Phytography as a fine art. p. i—xix, 1—534. — Leyden.
- MÜLLER, KARL, 1845: Zur Entwicklungsgeschichte der Charen. — Bot. Zeitung, 3: 393—398, 409—413, 425—433, 441—447, Taf. III. Berlin.
- MÜDLER, KARL, 1952: Charophyten aus dem Nordwestdeutschen Kimmeridge. — Geol. Jahrb., 67: 1—46, Abb. 1—8, Taf. A—B. Hannover.
- 1955: Zur Taxionomie der tertiären Charophyten. — Geol. Jahrb., 70: 265—328, Tab. A—C, Taf. 23—26. Hannover.

- MÄGDEFRAU, KARL, 1953: 6. Paläobotanik. — In: Fortschritte der Botanik, herausg. von E. GÄUMANN & O. RENNER. XIV. Band. p. 99—161, Abb. 35—59. Berlin.
- 1954: 6. Paläobotanik. — Ibid., XV. Band. p. 85—113, Abb. 2—7. Berlin.
- NORDSTEDT, O., 1866: Några iakttagelser öfver Characernas groningen. — Lunds Univ. Årsskr., 1865, III (VIII): 1—11. Taf. 1. Lund.
- 1889: De Algis et Characeis. 3—6. — Ibid., 1888—89, XXV (IV): 1—41, Tab. 1. Lund.
- NORDSTEDT, O. & WAHLSTEDT, L. J., 1875: Ueber die Keimung der Characeen. — Flora, 58: 94—95. Regensburg.
- OLTMANN, FRIEDRICH, 1922: Morphologie und Biologie der Algen, 2. Aufl., 1: Chryso-phyceae-Chlorophyceae. p. i—vi, 1—159. Fig. 1—287. — Jena.
- OVERTON, [C. E.], 1890: Beiträge zur Histologie und Physiologie der Characeen. — Bot. Centralbl., XLIV (1—2): 1—10, 33—38. Taf. I. Cassel.
- PAPP, A., 1951: Charophytenreste aus dem Jungtertiär Österreichs. — Sitz. Ber. Österr. Akad. Wiss., Math.-naturw. Kl., Abt. I, 160 (3—4): 279—293, Abb. 1, Taf. 1—4. Wien.
- PECK, RAYMOND E., 1934: The North American Trochiliscids, Paleozoic Charophyta. — Jour. Paleont., 8 (2): 83—119, fig. 1—2, pl. 9—13. Menasha, Wis.
- 1937: Morrison Charophyta from Wyoming. — Ibid., 11 (2): 83—90, pl. 14. Menasha, Wis.
- 1941: Lower Cretaceous Rocky Mountain nonmarine microfossils. — Ibid., 15 (3): 285—304, pl. 42—44. Menasha, Wis.
- 1946: Fossil Charophyta. In: TH. JUST a.o., Symposium on Paleobotanical Taxonomy. — Amer. Midl. Naturalist, 36 (2): 275—278, fig. 1—6. Notre Dame, Ind.
- 1953: Fossil Charophytes. — Bot. Rev., 19 (4): 209—227. Lancaster, Pa.
- PECK, RAYMOND E., & REKER, CARL C., 1947: Cretaceous and Lower Cenozoic Charophyta from Peru. — Amer. Mus. Novit., 1369: 1—6, fig. 1—27. New York.
- 1948: Eocene Charophyta from North America. — Jour. Paleont., 22 (1): 85—90, pl. 21. Menasha, Wis.
- PIA, JULIUS, 1927: Thallophyta. — In: MAX HIRMER, Handbuch der Paläobotanik, I: 31—136, Fig. 14—129. München & Berlin.
- PRINGSHEIM, N., 1863: Ueber die Vorkerne und die nacktfüssigen Zweige der Charen. — Jahrb. Wiss. Bot., III (2): 294—324, Taf. IX—XIII. Berlin.
- PRINTZ, HENRIK, 1927: Charophyta. — In: ENGLER & PRANTL, Die Natürlichen Pflanzenfamilien, 2. Aufl., 3: 412—429. Fig. 316—337. Leipzig.
- RAO, K. SRIPADA & RAO, S. R. NARAYANA, 1939: The Fossil Charophyta of the Deccan Inter-Trappeans near Rajahmundry (India). — Mem. Geol. Surv. India, Palaeontologia Indica, n.s., XXIX (2): i—ii, 1—14, pl. I—III. Calcutta.
- RÁSKY, KLÁRA, 1941: Über die Früchte fossiler Chara-Arten aus der Tiefbohrung Nr. II im Stadtwaldchen von Budapest und aus den Bohrungen auf Trinkwasser in Pécs. — Földtani Közlöny, LXXI (7—12): 297—305, Taf. VII. Budapest.
- 1945: Fossile Charophyten-Früchte aus Ungarn. — Ungar. Naturwiss. Mus., Naturwiss. Monogr., II: 1—74, pl. I—III, 1 map. Budapest.
- REID, CLEMENT & GROVES, J., 1916: Preliminary Report on the Purbeck Characeae. — Proc. Roy. Soc., B, 89: 252—256, pl. 8. London.

- REID, CLEMENT & GROVES, JAMES, 1921: The Charophyta of the Lower Headon Beds of Hordle (Hordwell) Cliffs (South Hampshire). — *Quart. Jour. Geol. Soc.*, LXXVII (3): 175—192, pl. IV—VI. London.
- SAHNI, B. & RAO, S. R. NARAYANA, 1943: On *Chara sausari* sp. nov., a *Chara* (sensu stricto) from the Intertrappean Cherts at Sausar in the Deccan. — *Proc. Nat. Acad. Sci. Ind.*, 13 (3): 215—223, fig. 1—8. Allahabad.
- SACHS, JULIUS, 1868: *Lehrbuch der Botanik nach dem gegenwärtigen Stand der Wissenschaft*, p. i—xii, 1—632, Fig. 1—358. — Leipzig.
- 1875: *Text-book of botany, morphological and physiological*. [Engl. transl. by A. W. BENNETT of "Lehrbuch der Botanik", etc.]. 858 pp., 461 figs. [Not seen; quoted according to SMITH 1938].
- 1882: *Text-book of Botany*. [Engl. transl. by S. H. VINES of "Lehrbuch der Botanik", etc.]. Ed. 2. — Oxford. [Not seen; quoted according to GROVES & BULLOCK-WEBSTER 1924].
- SCHIMPER, W. PH., 1869: *Traité de Paléontologie Végétale ou la flore du monde primitif dans ses rapports avec les formations géologiques et la flore du monde actuel*. T. I: 1—740. — Paris.
- SCHIMPER, W. PH. & SCHENK, A., 1879: *Palaeophytologie*. — In: KARL A. ZITTEL, *Handbuch der Paleontologie*, II, p. i—xi, 1—959, Fig. 1—433. München & Leipzig. [ed. 1879—1890; p. 1—152 printed in 1879].
- SCHLEIDEN, M. J., 1846: *Grundzüge der wissenschaftlichen Botanik*. 2. Morphologie. Organologie. 2. Aufl. p. i—xvi, 1—614, Fig. 104—239, + I—XVI, Taf. I—IV. — Leipzig.
- SCHMUCKER, TH., 1927: Über Bildungsanomalien bei *Chara*. — *Planta*, 4: 780—787, Abb. 1—5. Berlin.
- SCHUSSNIG, BRUNO, 1938: *Vergleichende Morphologie der niederen Pflanzen. Eine Einführung in deren Formbildung und Formwechsel auf entwicklungsgeschichtlicher Grundlage*. 1. Formbildung. p. i—viii, 1—382, Abb. 1—470. — Berlin.
- SEWARD, A. C., 1898: *Fossil Plants for Students of Botany and Geology*. I. p. i—xviii, 1—452, fig. 1—111. — Cambridge.
- SLUITER, CATHA P., 1910: Beiträge zur Kenntnis von *Chara contraria* A. Braun und *Chara dissoluta* A. Braun. — *Bot. Zeitung*, 68: 125—168, Fig. 1—21, Taf. IV—VIII. Leipzig.
- SMITH, GILBERT M., 1938: *Cryptogamic Botany*. I. Algae and Fungi. p. i—viii, 1—545, fig. 1—299. Mc Graw-Hill Publ. Bot. Sci. — New York & London.
- 1951: The classification of algae. — In: G. M. SMITH (ed.), *Manual of Phycology. An Introduction to the Algae and their Biology*. A New Series of Plant Science Books ed. by FRANS VERDOORN, XXVII: 13—19. Waltham, Mass.
- SOLMS-LAUBACH, H. Grafen zu, 1887: *Einleitung in die Paläophytologie*. p. i—viii, 1—416, Fig. 1—49. — Leipzig.
- STACHE, GUIDO, 1889: Die Liburnische Stufe und deren Grenz-Horizonte. Eine Studie über die Schichtenfolgen der cretacisch-eocänen oder protocänen Landbildungsperiode im Bereiche der Küstenländer von Österreich-Ungarn. Erste Abtheilung. Geologische Übersicht und Beschreibung der Faunen- und Florenreste. — *Abh. K. K. Geol. Reichsanst.*, XIII (1): 1—170, Taf. 1—VI, 1 map. Wien.

- STEWART, LAURIE M., 1937: Studies in the life history of *Nitella hyalina* Agardh. — Jour. Elisha Mitchell Sci. Soc., 53: 173—190, fig. 1, pl. 16—19. Chapel Hill, N. C.
- STRAUB, ERNST WILHELM, 1952: Mikropaläontologische Untersuchungen im Tertiär zwischen Ehingen und Ulm a.d. Donau. — Geol. Jahrb., 66: 433—523, Abb. 1—24, Texttaf. A—C, Taf. 4. Hannover.
- TIEGHEM, PH. VAN, 1891: *Traité de Botanique. II. Botanique Spéciale.* p. 1035—1855, fig. 651—1213. — Paris.
- TILDEN, JOSEPHINE E., 1935: The algae and their life relations. *Fundamentals of Phycology.* p. i—xii, 1—550, fig. 1—257, pl. I—IX, 1 col. pl., tables. — Minneapolis, Minn.
- TURRELL, FRANKLIN MARION, 1946: Tables of surfaces and volumes of spheres and of prolate and oblate spheroids, and spheroidal coefficients. p. i—xxxiii, 1—153. — Berkeley & Los Angeles. [Photoprint].
- TUTTLE, ALBERT H., 1924: The reproductive cycle of the Characeae. — *Science N. S.*, 60: 412—413. New York.
- 1926: The location of the reduction divisions in a charophyte. — *Univ. Calif. Publ. Bot.*, 13 (12): 227—231, pl. 22—23. Berkeley, Cal.
- TUZSON, J., 1914: Beiträge zur fossilen Flora Ungarns. (Additamenta ad Floram Fossilem Hungariae III). — *Jahrb. K. Ungar. Geol. Reichsanst.*, XXI (8): 233—261, pl. XIII—XXI. Budapest.
- UNGER, FR., 1850: *Genera et Species Plantarum Fossilium.* p. i—xl, 1—627. — Vindobonae.
- 1855: *Anatomie und Physiologie der Pflanzen.* p. i—xix, 1—461. Fig. 1—139. — Pest, Wien & Leipzig.
- 1860: Die Pflanzenreste der Lignit-Ablagerung von Schönstein in Unter-Steiermark. — In: FRIEDRICH RÖLLE, *Die Lignit-Ablagerung des Beckens von Schönstein in Unter-Steiermark und ihre Fossilien.* Sitz. Ber. K. Akad. Wiss., Math.-naturw. Cl., XLI (13): 47—52, Taf. IV—V. Wien.
- VELENOVSKÝ, JOS., 1905: Vergleichende Morphologie der Pflanzen. 1. Teil. p. 1—277, fig. 1—182, Taf. I—H. — Prag.
- VINES, SYDNEY H., 1878: The "pro-embryo" of *Chara*: an essay in morphology. — *Jour. Bot.*, 16: 355—363. London.
- 1879: Note on the morphology of the Characeae. — *Ibid.*, 17: 176—177. London.
- WALLNER, FRANZ, 1932: Die Beeinflussung der Gametangienbildung bei den Characeen. — *Flora*, 126: 249—293, Fig. 1—33. Jena.
- WALLROTH, FRIDER. GUIL., 1815: *Annus Botanicus, sive Supplementum Tertium ad CURTH SPRENGELH Floram Halensem.* p. i—xxx, 1—200, Tab. I—VI. — Halae.
- WALTHER, ERNST, 1929: Entwicklungsgeschichtliche und zytologische Untersuchungen an einigen Nitellen. — *Archiv Julius Klaus-Stiftung f. Vererb. Forsch.*, IV: 23—121, Fig. 1—20, Taf. I—VII. Zürich.
- WATELET, AD., 1866: *Description des Plantes Fossiles du Bassin de Paris.* p. i—ii, 1—264, with Atlas, p. 1—30, pl. 1—60. — Paris.
- WETTSTEIN, RICHARD, 1935: *Handbuch der Systematischen Botanik.* 4. Aufl., herausgeg. v. FRITZ WETTSTEIN. p. i—x, 1—1152, Abb. 1—709, frontisp. — Leipzig & Wien.

- WICHER, C. A., 1939: Neues aus der angewandten Mikropaläontologie (Buntsandstein, Senon, Tertiär). — *Petroleum*, XXXIV (33): 7—8. Berlin.
- WILLE, N., 1897: Characeae. — In: ENGLER & PRANTL, Die Natürlichen Pflanzenfamilien, I, 2: 161—175, Fig. 109—128. Leipzig.
- WOLOSZYNSKA, JADWIGA, 1938: Ramienice plejstocenijskie z Rostok kolo Jasla. — *Acta Soc. Bot. Polon.*, XV (2): 157—198, Tab. I—VI, Taf. X—XIII. Warszawa. Deutsche Zusammenf. p. 183—198: Pleistocäne Charen von Rostoki bei Jaslo.
- WOOD, R. D., 1947: Characeae of the Put-in-Bay Region of Lake Erie (Ohio). — *Ohio Jour. Sci.*, XLVII (6): 240—258, pl. I—IV. Columbus, Ohio.
- ZETZSCHE, FRITZ & HUGGLER, KARL, 1928: Untersuchungen über die Membran der Sporen und Pollen. I. *Lycopodium clavatum* L. — *J. Liebigs Ann. d. Chemie*, 461: 89—108. Berlin.

On the variation of *Micrasterias mahabuleshwarensis* f. *Wallichii*

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The present author has had the opportunity of collecting plankton in the little lake Trysjön situated in the community of Zinkgruvan in the southern part of the province Närke. The plankton contained *Micrasterias mahabuleshwarensis* f. *Wallichii* which as a plankter is very rare. Its richness in deviating forms as well as its abundance inspired to a detailed investigation of this interesting desmid.

The biotope is a little lake, being part of a former lake that has been divided up and partly filled by the waste stone refuse from a zinc mine. The lake is about 500 m long, 150 m broad and 4 m deep.

The phytoplankton association is characterized by a striking poorness in *Myxophyceae*, a moderate proportion of green algae (*Chlorophyceae* and *Desmidiaceae*) and periodical high production of *Asterionella formosa*, *Rhizosolenia longiseta*, *Tabellaria flocculosa* var. *asterionelloides* (sensu Knudsen), *Mallomonas fastigiata* var. *Kriegeri* Bourr., and *Peridinium cinctum*. The trophic character is moderately eutrophic. The pH-value was 6.9—7.1 until 1947, at the end of that year a laundry was brought into play and the pH-value increased to 7.3. An analyze of zinc in solution showed about 0.6 mg per litre. The lake is without visible affluences and the supply of water from habitation and cultivated soil is small except from the laundry. The littoral vegetation consists of *Phragmites*, *Scirpus lacustris* and *Nuphar luteum* on about half the extent of the shore.

The plankton samples were collected in the summers of the years 1943—1945 and 1947—1948 and the specimens of the actual desmid examined are distributed as follows: in 1943: 592, in 1944: 285, in 1945: 152, in 1947: 35, and in 1948: 174, total number: 1238 specimens.

Introduction to the morphology and the terminology

The clone here dealt with belongs to the type called var. *europaea* Nordst. (1888). The marginal denticulation is very poor and restricted to the middle third of the processes, to judge from the literature it is most agreeing with the pictures of Stange 1908, Tab. 1: 1, 2, and Yamagushi & Hirano 1953, fig. 3. See further the taxonomical discussion, p. 271. The semicell of *Micrasterias mahabuleshwariensis* f. *Wallichii* consists of a corpus with three processes on each side and a polar lobe with two lateral and two apical processes of the same structure as the distal parts of the corporal processes, i.e. cylindrical with an obtuse end bearing 2—5 small spines on the edge.

In order to facilitate the discussion the processes are signed with Roman figures, beginning at the base of the semicell. Thus, the three corporal processes are signed I, II, and III, the lateral and apical processes of the polar lobe are signed IV and V. In the following some abbreviations are used: proc. means process, *Micr.* means *Micrasterias* and *mahab.* means *mahabuleshwariensis*.

In *Micr. mahab. f. typica* there are only two lateral processes, viz. proc. I and II. Proc. III derives from the proc. II, a circumstance clearly visible in the ontogenetic development and in the many transitional forms, in which proc. III forms a series from a faint spine to a complete process of the same size as proc. II. Usually it is curved outwards in the interspace between proc. II and the polar lobe. In the clone investigated proc. III may be lacking on one or more of the four possible places, fig. 22. If it is lacking in one of the semicells, the result is a dichotypical specimen, consisting of f. *typica*+f. *Wallichii*, fig. 2. In four specimens found proc. III was quite lacking, i.e. f. *typica*.

Micr. mahab. f. Wallichii appears in the material in two types: *gracilis* and *robusta*. The former has long, conical processes and especially the long almost straight proc. IV give a striking appearance. The *robusta* type has shorter processes, somewhat like a champagne bottle and faintly curved proc. IV. The two types were connected by a complete series of intermediate forms. Most of the specimens were of the *robusta* type but in 1944 the *gracilis* type was strongly dominating. Dichotypical specimens (Teiling 1948, p. 51) consisting of one semicell of each type, were not uncommon, fig. 9. It is possible that the difference is caused by varying light conditions. The planktonts heavier than the water are always in a state of sinking and are brought upwards by the turbulent currents caused by the changes of temperature and wind circumstances.

Thus, at the propagation the younger semicell will be formed under different conditions than the elder semicell. In the cases where two cells, dichotypical in this regard, were found still attached to each other, the juvenile semicells always belonged to the same type.

The variability

Variability in *Micr. mahab. f. Wallichii* is earlier recorded, in Sweden by Lundell (1871, p. 15) who found doubled proc. V, and by West (1905, p. 123, Tab. 55: 1—3) in Scottish lakes, where they found both doubling and lacking of proc. III and supernumerary apical processes.

The variation concerns the proportions of the cell, the spinous ornamentation and especially the lateral processes. The proportions of the cell vary in giving rise to the types *gracilis* and *robusta*, which have not been subject of statistical investigation. The pattern of the spinous ornamentation has been quite neglected. The author has confined his investigation to the lateral processes as a matter of basic systematics, the frontal process just above the isthmus is neglected.

All the processes are subject of variation but to very different extent. The variation of a separate process seems to be independent of the variation of the other processes; each of the processes I, II or III may be changed into two or three and proc. III may be lacking without corresponding changes of other processes in the same cell; absence and multiplication of the processes seem to appear quite by chance. By this. Nature had created a very great number of combinations and a statistical investigation of their eventual conformity to a biological law would require much more extensive material than the present one. The author has tried to give a statistical survey of the separate variation of the processes I, II, and III, especially.

For a preliminary comprehension of the supernumerary and also

Fig. 1—20. *Micrasterias mahabuleshwarsensis*. — 1 proc. V lacking in one semicell. 2 dichotypical specimen *f. typica* + *f. Wallichii*. 3 *f. Wallichii*: proc. I bilaterally tripled, proc. II unilaterally doubled and one proc. V added symmetrically. 4 supernumerary proc. II + III and apical verrucae. 5 *f. typica*: proc. I and II doubled. 6 proc. II branched bilaterally. 7 *f. Wallichii*: doubled and supernumerary processes. 8 proc. II doubled. 9 dichotypical specimen *gracilis* + *robusta*. 10 apex with normal verrucae. 11 apex with verrucae in stages towards processes. 12 proc. IV and V doubled unilaterally. 13 three supernumerary proc. V. 14 proc. V doubled. 15 proc. IV doubled and supernumerary proc. V. 16 two supernumerary proc. V. 17 *f. Wallichii*: proc. III rudimentary unilaterally. 18 the same: bilaterally. 19—20 *f. typica*: opposite branches on proc. II, rudimentary, faintly, and well developed.

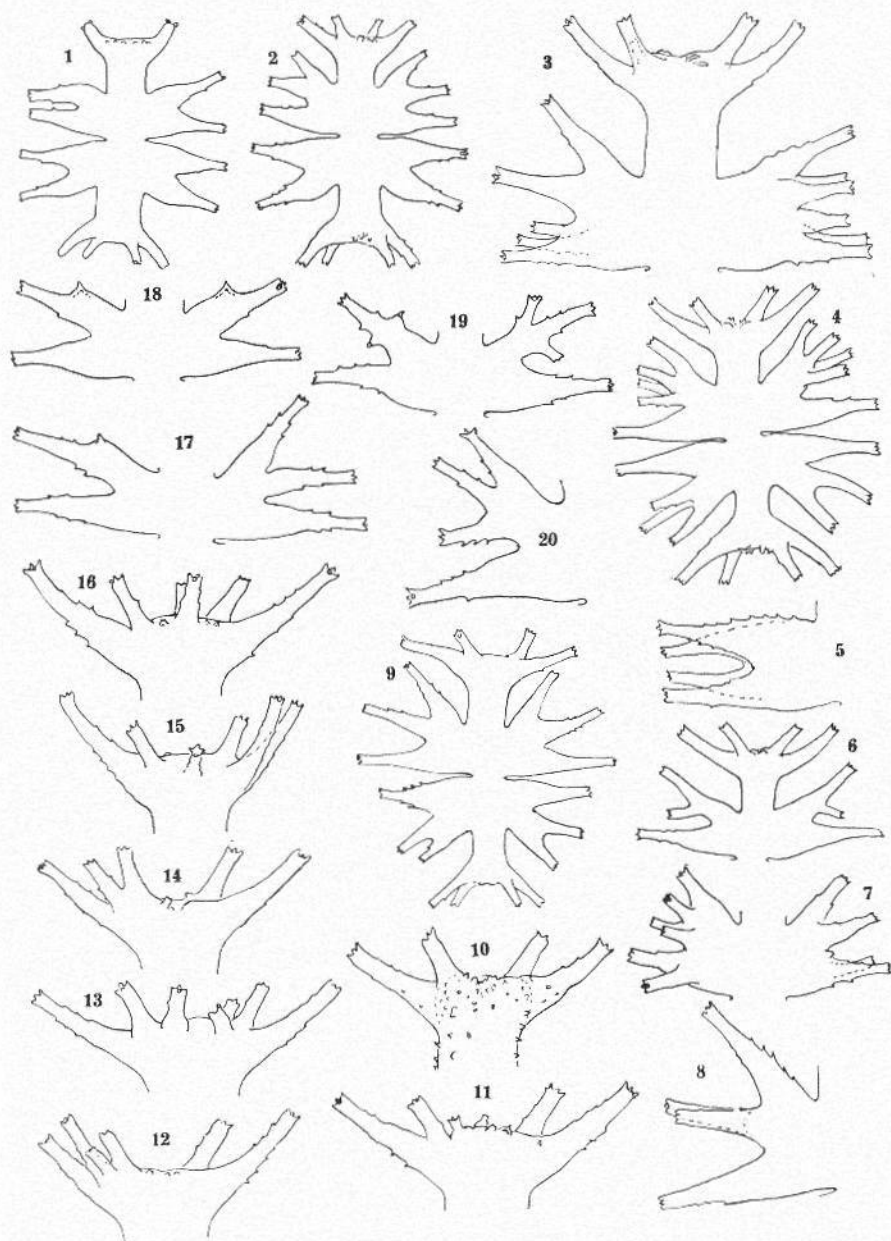


Fig. 1—20.

the lacking processes it is necessary to examine their origin. The earlier ontogenetic stages of this desmid are shown in the figs. 29—31. The primary vesicle of the semicell in the beginning is soon differentiated into three lobes, two lateral and one central polar lobe. The edges of the lateral lobes divide into two or three lobes and these grow out to the processes. The present author (1950, p. 317) has initiated the concept of the *meristematic organel*, i.e. the part of the protoplast that grows more rapidly than the surrounding parts, thus forming protuberances of any kind. In the higher plants the architecture, leaves and emergences are the result of meristematic tissues and the morphological differentiation of unicellular plants must depend on a corresponding differentiation of the activity in the protoplasm, although the specific kind of protoplasm forming the meristematic organel as yet has not been cytologically discerned.

By rational arguments we see that the meristematic organel of the lateral lobes divide into two (fig. 30) and that one of these viz. the vertical one may divide (fig. 31 to the right). In the first case the two lobes normally grow out to processes I and II, characteristic of *Micr. mahab. f. typica*, in the latter case the result will be the three processes characteristic of *f. Wallichii*. If more bipartitions of a meristematic organel occur during the growing stage supernumerary processes bulge out and the altered structure of the original process indicates how many meristematic organel have been formed, and, the place of the secondary processes reveal at which phase of the development the new meristematic organel has been born.

The doubling may be total, i.e. from the base of the processus, for instance proc. II and III of a normal specimen of *f. Wallichii*, or the new meristematic organel may have been formed when the process has grown out to a certain extent, in this case the result is a smaller branch. Sometimes proc. II has developed two opposite branches, diverse degrees of this phenomenon are shown in fig. 19. In certain cases the secondary meristematic organel has been formed and begun

Fig. 21—33. *Micrasterias mahabuleshwariensis*. — 21 proc. II tripled, verrucae on the apex. 22 *gracilis* type laterally dichotomous, small spines on the apex. 23—24 *Micr. americana*. 25 *f. Wallichii* with one semicell reminding of the *americana* type. 26 proc. I and II of *Micr. americana* (after Prescott). 27 of *Micr. mahab.* subsp. *europaea* (after West), 28 of *Micr. mahab.* subsp. *indica* (after Wallich). 29—31 three stages of development of a semicell, in 31 the primitive vesicle II on the right side if tripled. 32 *Micr. mahab.*: strongly reduced specimen, 33 the same: triradiate facies.

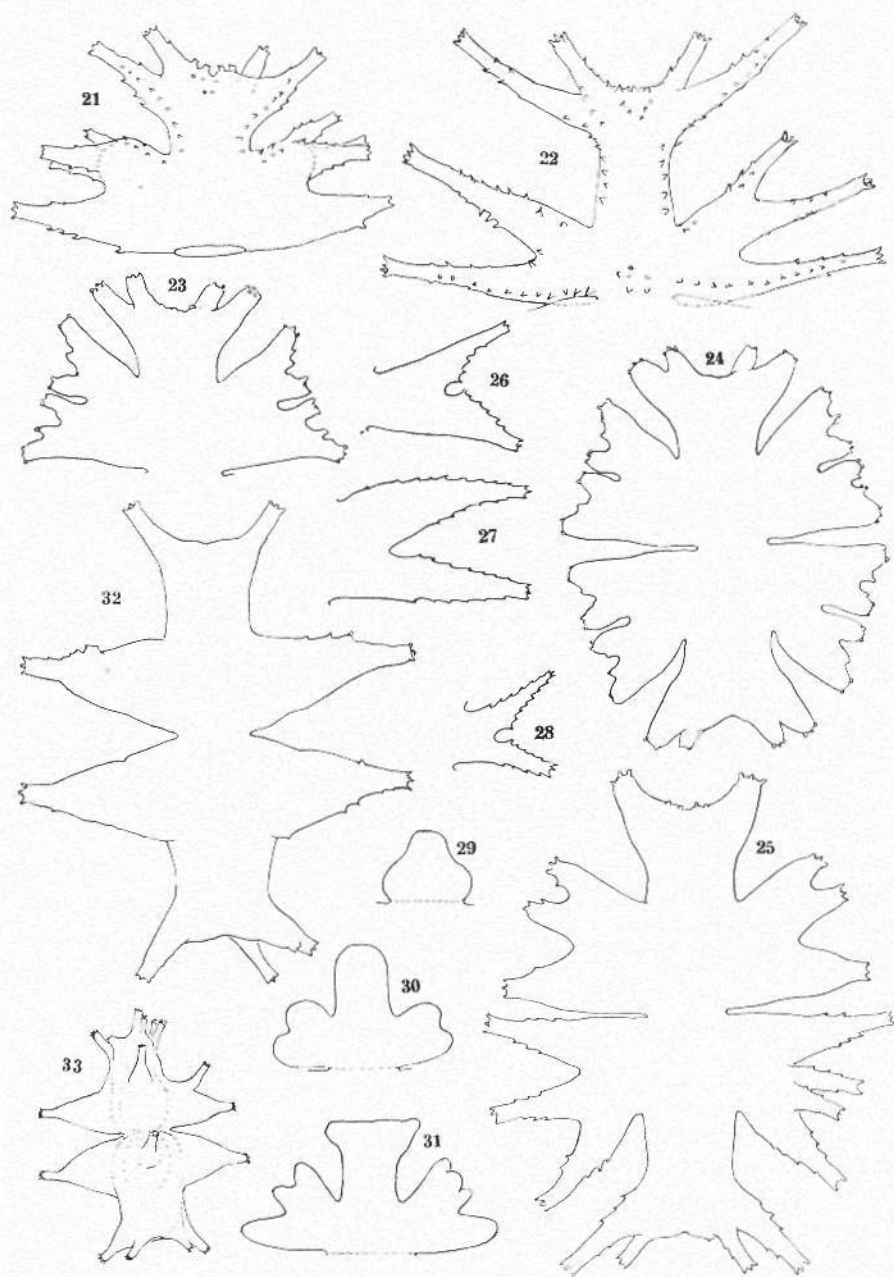


Fig. 21—33.

Table 1.

Category	1943		1944		1945		1947		1948		Total	
	no.	%	no.	%	no.	%	no.	%	no.	%	no.	%
C e l l s												
a ²	149	25	29	10	10	7	2	—	37	22	227	18.3
an	232	39	62	22	42	28	8	—	65	38	409	33
n ²	210	36	194	68	99	65	25	—	70	40	598	48.4
f. <i>typica</i> ..	1	—	—	—	1	—	—	—	2	—	4	0.3
Total	592	100	285	100	152	100	35	—	174	100	1238	100
S e m i c e l l s												
a	530	45	120	21	62	21	12	—	139	40	863	35
n	652	55	450	79	240	86	58	—	209	60	1605	65
Total	1184	100	570	100	304	100	70	—	348	100	2476	100

to grow out just when the semicell was developed to its full size and the accomplishment of the cell-wall prevented the further growth; the result is a rudimentary spine. Examples of such cases are given in figs. 17, 18, 19.

By retarded and supernumerary formation of the meristematic organs in processes II and III, these are sometimes changed into a conglomeration of up to six processes which is impossible to allocate to proc. II and III, figs 4, 7, 21.

The basic material was carefully examined and every specimen was noted as to its structure, if normal or abnormal. The latter were depicted in a simplified manner with the occurrence and general shape of each process clearly visible. Many representative or especially interesting specimens were depicted with the aid of the camera lucida. The material is not equally distributed on the five years (see Table 1) depending on the number of samples and the abundance of the desmid.

The material is assorted into four categories:

n²=normal f. *Wallichii* (n means a normal semicell),

an=dichotypical cells composed of one normal and one abnormal semicell (a means one abnormal semicell),

a²=specimens composed of two abnormal semicells.

f. *typica* means *Micr. mahab.*

Dichotypical specimens of f. *Wallichii*+f. *typica* are counted as n².

Table 1 shows the distribution of the four categories during the years. The importance of the non-specific feature is more pronounced and correctly expressed in the semicells instead of the cells, this is shown in the lower part of the table.

The figures from the two consecutive years 1943 and 1944 show a

Table 2. Absence of proc. III

	number	%
on 1 place unilaterally in semicells of <i>f. Wallichii</i> normal	27	21
" 1 " " " " " " " " supernumerary ..	20	16
" 2 places bilaterally in dichtypical cells of <i>f. Wallichii</i> normal + <i>f. typica</i>	40	31
" 2 places bilaterally in dichtypical cells of <i>f. Wallichii</i> supernume- rary + <i>f. typica</i>	28	21
" 2 places unilaterally in <i>f. Wallichii</i> normal	4	3
" 2 " " " " " " " " supernumerary	1	1
" 3 " " in <i>f. Wallichii</i>	6	4
" 4 " " = <i>f. typica</i>	4	3
Total	130	100

striking increase of the normal cells (and semi-cells), the reliability of this change is, in spite of the smaller statistical basis, confirmed by the agreeing percent numerals of 1945. The numerals of 1948 indicate a return to the proportions of the year 1943. The average proportion of abnormal cells and semicells reveals a very great tendency of variation; every other cell and one third of all semicells were abnormal, i.e. non-specific.

The deviations from *f. Wallichii*, here labelled *normal* are of two kinds: 1) the absence, and 2) the multiplication of a process. The absence is confined almost exclusively to proc. III, but it is noted also in two cases on proc. V. As mentioned, the absence of proc. III is specific for the *f. typica* of *Micr. mahab.* described by Hobson in 1863. Its occurrence was known in *Micr. alata* already in 1860 and was found in 1865 in *Micr. Wallichii* by Grunow, now a variety of *Micr. mahab.* according to West 1905, a transfer proposed by Nordstedt (1888, p. 30).

The 130 specimens found with proc. III lacking make 10 % of all cells examined. The absence is more common in normal specimens, 55 %, than in supernumerary cells, 38 %. Semicells of *f. typica* occurred in 59 % of the specimens.

Proc. I has not been found lacking and, being the first process constituted, it may never be absent except in extreme teratological spe-

Table 3. Process I double and triple in cells

	specimens
double unilateral in one semicell with supernumerary proc. II and III	13
" " " " " " normal " " " " " "	10
" bilateral " " " " " " supernumerary " " " " " "	3
" " " " " " normal " " " " " "	1
" unilateral in both semicells	1
triple bilateral in one semicell with abnormal proc. II and III	1
Total	29

Table 4, showing the distribution of supernumerary structure of proc. (II + III) together, unilaterally and bilaterally developed

	1943	1944	1945	1947	1948	Total
unilaterally in one semicell	126	33	28	4	36	227
bilaterally " " "	84	10	8	3	19	124
unilaterally in two semicells	27	2	2	—	5	36
" " one and	54	4	1	1	15	75
bilaterally " " semicell						
" " two semicells	12	—	1	—	3	16
Total	303	49	40	8	78	478
% of cells examined	50	18	26	23	44	39
unilateral semicells	234	41	33	5	61	374
bilateral "	162	14	11	7	40	231

cimens. It has been found doubled or triple in 29 specimens, representing 2 % of the statistic material.

The trend of multiplication of proc. I seems to be more pronounced in semicells with supernumerary proc. II or III, viz. 17 cases, than in semicells with normal proc. II and III, viz. 11 cases.

Process II and III. As mentioned before, proc. II is the most variable of all processes and appears in numerous forms, depicted in figs. 3, 4, 5, 6, 7, 8, 19, and 21. As a rule proc. II and III are separate, even when abnormal, but often the formation of the meristematic organel giving rise to proc. III is delayed and this process is represented by a little fork-branch on the upper side of proc. II, sometimes only a faint rudiment, figs. 17, 18. There are also cases where 3—6 processes have grown out from a common base in which is impossible to discern processes II and II, figs. 4, 7. Because of this fact derivation of a common origin, supernumerary II and III have been dealt with as a unit in table 4. When comparing the figures of this table with those of table 1, it must be kept in mind that table 1 concerns all deviating forms from the normal structure, including those of proc. I, IV, and V.

In order to obtain an approximative estimation of the supernumerary tendency that may be allotted to proc. II compared with proc. III, the author has made a chance combination of a part of the material, table 5:

Table 5

specimens with	unilateral	bilateral	total
proc. II double	137	81	298
" " triple	9	—	9
" III double	35	—	35
" " triple	2	—	2
" II+proc. III double	5	4	13
" II triple+proc. III double	3	2	5

This survey suggests that the supernumerary tendency occurs about six times more frequently in proc. II than in proc. III and, further, that bilateral supernumerary proc. III is very rare but, combined with abnormal proc. II, it occurs and actually almost as often uni- as bilateral. The more pronounced tendency of proc. II is not surprising; from the ontogenetical point of view proc. III is a supernumerary of proc. II.

Possibly it would had been of interest to make a more complete statistical survey of the distribution of all the five processes but, regarding to the omission, doubling and tripling of five processes on their four positions on the cell, it would be such a great number of combinations that the author found this extensive work not proportionate to the result, notwithstanding the insufficient material.

The "somatic heredity"

The investigation of this variation which concerns the two elements, omission and multiplication of the processes, steadily returning in the many generations during six years, spontaneously gives rise to the question how the deviations are transferred. Zygospores are not found and are unknown in this species; the propagation is a simple cell-division. The multitude of dichotypical specimens often show very great differences between the adult and the juvenile semicell, but which semicell is the adult one?

This question can be answered by culture which, however, is difficult to arrange with conditions identical with the natural ones. Since desmids in culture often give abnormal cells and here the task is to study abnormal cells under natural conditions, culture investigation probably would increase the abnormalities and give a wrong result. The simplest method available was to examine 29 cases of division where the two acting cells still were connected, each of them giving two examples of a true determination of the age.

It was good luck that this small material contained such a great diversity, indicating that the new-combinative forces act both rapidly and comprehensively. It shows that the normal semicells of the variety produce semicells with supernumerary processes quite as often as it produces normal semicells and, further, that a supernumerary semicell produces an abnormal or a normal semicell in about the same proportions. The same is valid for the transition from *f. typica* into a supernumerary form and the reverse course. A detailed examination of this latter case shows that a semicell with two double proc. II and one

Table 6. New combinations during the propagation

adult semicell	juvenile semicell	number
normal f. <i>Wallichii</i>	→ supernumerary	16
" " "	→ normal	15
supernumerary "	→ "	9
" " "	→ supernumerary	9
f. <i>typica</i>	→ "	3
supernumerary "	→ f. <i>typica</i>	3
normal f. "	→ "	1
f. <i>typica</i>	→ "	1
f. <i>Wallichii</i> lacking one proc. III	→ "	1
	Total	58

double proc. III can produce a semicell of f. *typica* (!) and that a semicell of the variety can produce a semicell with double proc. I, II, and III. Doubling in the apical region (proc. V) is in this collection represented only by one specimen.

Processes IV and V. The processes on the head of the polar lobe are very seldom lacking, more often they are supernumerary though not in the extent and the manner characteristic for proc. I—III:

The basic material of this table is somewhat difficult to delimit. On the apical surface, especially in the middle of it, there is a varying number of small prominences, mostly granules and verrucae (figs. 2—4, 10, 12, 16, 21, 22, 25) but not seldom prominences of all sizes up to the size of the normal processes (figs. 11, 13—16). In the author's opinion, these prominences are not to be considered homologous to the ordinary processes. The reason is that the processes IV and V are confined to constant positions on the head of the polar lobe and this not only in *Micr. mahab.* but also in several other species, viz. *americana*, *Hardyi*, *muricata*, *Berganii*, and *Nordstedtiana*. This will be dealt with in a separate paper.

The table shows that the lateral proc. IV never is lacking and also that the doubling of it is extremely rare. Abnormal development of proc. IV and V is not delimited to semicells with abnormalities in the

Table 7.

	proc. IV	proc. V
doubling of one proc.	3	55
" " two "	1	12
tripling " one "	—	1
absence " " "	—	3
" " two "	—	2

corporal processes. A curious case of "mirror" development of two adjacent juvenile semicells was found in the material of table 6; a specimen with double proc. II on three places developed by its propagation two semicells f. *typica*, both *without* prov. V (fig. 1, the upper semicell).

Taxonomic discussion

The result of the investigation has to the full confirmed West's opinion that *Micr. Wallichii* must not be considered a separate species. Especially the often unilateral development of proc. III prevent the concept variety, as hitherto is done; in my opinion it must be regarded as a *forma*.

During the examination of the samples there were found five specimens of *Micr. americana*, all of them in a sample taken the 19 of August 1948. This was an interesting find because of the discussion about its relations to *Micr. mahab.* G. M. Smith (1922, p. 345, Tab. 9: 12—14, Tab. 10: 1) described a f. *dichotoma* of *Micr. mahab.* having small protuberances on the adjacent margins of proc. I and II. Later (1924 a, Tab. 16: 3) he published a similar desmid with more pronounced accessory processes under the name of *Micr. americana*. These desmids are by Krieger 1939 (p. 51, Tab. 110: 4) labelled *Micr. mahab.* var. *dichotoma* because of the dichotypical specimens depicted in Smith 1922. Under this name pictures are published by Bergan (1951, fig. 3), Irénée-Marie (1939, Tab. 40: 2, 3), Prescott & Magnotta (1935, Tab. 26: 16), Prescott & Scott (1942, Tab. 1: 8, 10, Tab. 6: 6 and 1952, Tab. 6: 3). The latter authors express their opinion that it would seem logical to combine *Micr. mahab.* and *americana* on the basis of these transitional forms.

When comparing the many pictures of *Micr. mahab.* and its many varieties, there is a striking diversity visible in certain details by which these taxa may be allotted to two types: the *europaea*-type and the *indica*-type. The most prominent features of difference are:

europaea: the sinus between proc. I and II is open, with acute or faintly rounded angle, the edges of these processes are slightly denticulate in many cases only on the middle third, and proc. II has a curved vertical margin, fig. 27;

indica: the proximal part of this sinus is oval and more or less delimited by the basal part of the denticulation which is very well developed, and the vertical edge of proc. II is straight, fig. 28.

The *europaea*-type (=var. *europaea* Nordst.) is found in Europe and Northern Asia up to Japan. The *indica*-type (= *Micr. mahab.* sensu

stricto) "scheint in Europa zu fehlen" (Krieger 1939, p. 50) and including almost all the varieties this diverse type has a distribution all over the world outside the temperate zone of Eurasia and the polar districts. In these two types the modern concept of *subspecies*, signifying regionally differentiated parts of a species, is to be used. The var. *europaea* Nordst. is not on a par with the other varieties of Krieger's disposition and can not be considered a variety but a taxon rank with the rest of the species. Of course the areas of distribution are somewhat overlapping; *Micr. mahab.* of *europaea*-type is found in USA and var. *americana* is not uncommon in the temperate part of Europe, e.g.

In *Micrasterias* there is a very natural group represented by *mahab.*, *anomala*, *alata*, *tropica*, *Berganii*, *robusta*, *Hardyi*, *muricata*, *Nordstedtiana*, and *americana*. The last-mentioned species holds an exceptional position by its broad and lacinate processes of the same structure as, for instance, *crux-melitensis* and similar.

By the aid of this exposition the question of the transitional forms between *Micr. americana* and *mahab.* may be elucidated by the following comparative series:

	<i>americana</i>	var. <i>dichotoma</i>	<i>mahab.</i>
Prescott 1931, Tab. 36:9	+	—	—
G. M. Smith 1924, Tab. 63:5	+	—	—
Prescott & Scott 1942, Tab. 1:8	—	+	—
" " " 1952, Tab. 6:3	—	+	—
G. M. Smith 1924, Tab. 64:2	+	—	—
Prescott & Scott 1942, Tab. 6:6	—	—	+
G. M. Smith 1922, Tab. 9:13, 14	—	+	—
" " " 1922, Tab. 9:12	—	+	—
Prescott & Scott 1942, Tab. 1:12	—	—	+
" " " 1942, Tab. 1:9	—	—	+
" " " 1952, Tab. 6:1	—	—	+

According to this, the forms of this series ought to be assigned to *Micr. americana*, being forms reduced in the direction to the simple processes characteristic of the *mahabuleswarensis*-group. This reduction has affected the adjacent parts of the proc. I and II, the lappets are rudiments, and has resulted in *Micr. mahab.* of *indica*-type, fig. 26. This is an interesting evidence of the relations between two species of a group, the internal relation of which is morphologically proved, and may be apprehended as a hint on the path of evolution from flattened, lacinate processes into simple ones. This does not, however, necessitate

¹ In this connection it may be communicated that the proposal of using the term of subspecies by indicating the different numbers of radiation (Teiling 1948) is rejected and the term *facies* (Teiling 1950) is to be used.

any other change of the nomenclature but a transfer of var. *dichotoma* to *Micr. americana*.

The five specimens of *Micr. americana* in the actual material (all of them occurred in one sample together with 170 specimens of *Micr. mahab. f. Wallichii*) appear quite spontaneously. I have examined practically every specimen of *Micrasterias* in the whole material and have not found any intermediate form like the forms cited above. The five specimens lack marginal dentation (fig. 23) and one of them shows a peculiar stout structure, fig. 24. A very curious dichotypical specimen, found in July 1943, is depicted in fig. 25, the upper semicell gives the impression of *Micr. americana* in proc. II (+proc. III?) and lacks proc. V.

Van der Werff (1955, p. 266) has given a report of the changes of the algal flora in some fens originally oligotrophic but in 1950 auxotrophied (a term proposed by Thunmark 1948, p. 33 instead of eutrophied) by water from cultivated soil. In one of these fens Heimans (1942, p. 61) in 1916 and several following years has found *Micr. mahab. f. Wallichii* and also facies *triquetra*. This species has not been refound but instead of it *Micr. americana* was found by Heimans in 1952, at then a novelty for the Netherlands. According to a picture kindly sent to me by professor Heimans, it possesses the normal denticulation, in this respect different to the specimens from Trysjön. The factor common to both biotopes is the change of the water chemistry towards more eutrophic quality. That this has been the condition of an immigration is uncertain; the distribution of *Micr. americana* in Sweden is to the favour of oligotrophic biotopes as stated by Krieger (1939, p. 46), in Norway it is general in the high mountains, according to Ström (1923, p. 473).

In this connection three new localities of planktonic *Micr. mahab.* may be recorded: *gracilis* in Nästasjön, prov. Småland, Kärda parish and Lake Bråten, Berg parish, and *robusta* in Storsjön, prov. Hälsingland, Forsa parish. It is previously recorded as a plankton from three lakes in the province Dalarna (Lundberg 1931, p. 287). In a sample from the alpine lake Singijaure, kindly given by Dr. G. Lundqvist, a reduced form of *Micr. mahab.* (fig. 32) was found and also its facies *triquetra*, fig. 33. The reduction has affected the processes II, III, and V (pro parte). A similar reduction is known in *Micr. americana* (Taylor 1935, p. 775, Tab. 3: 4—6) also from an alpine biotope. Both the Singijaure desmid and Taylor's desmid suggest an influence of unfavourable conditions. *Micr. Berganii* Hauge (Bergan 1951, p. 21, Tab. 1) makes the impression of a constant taxon; the single lateral processes (I) are

well developed and the six processes on the polar lobe are identical to the corresponding processes of *Micr. mahab.* and *americana*.

I am greatly indebted to my friends Hannah Croasdale for correcting the manuscript, to Engineer Ulf Wikström for chemical analyses, to the Chief Geologist Dr. Gösta Lundqvist for plankton samples from Swedish alpine lakes, and to Dr. Alan Brook for plankton samples from Loch Bhac in Scotland.

Literature cited

- BERGAN, G. 1951: Desmidiaceae from Tisleia, Central Norway. — *Nyt Magasin f. Naturvitensk.* 88.
- GRUNOW, A. 1865: Über die von Herrn Gerstenberger in Rabenhorsts Decaden angegebenen Süßwasserdiatomeen und Desmidiaceen von der Insel Banka. — *Hedwigia* 4.
- HEIMANS, J. 1942: Triquetrous forms of *Micrasterias*. — *Blumea*, Suppl. 2.
- HOBSON, J. 1863: Notes on Indian Desmidiaceae. — *Quart. Journ. Micr. Sc.* 5.
- IRÉNÉE-MARIE, F. 1939: Flore desmidiale de la région de Montreal. — *Laprairie*.
- KRIEGER, W. 1939: Die Desmidiaceen. — *Rabenhorsts Kryptogamenflora* Bd. 13: 2.
- LUNDBERG, F. 1931: Über das Phytoplankton einiger Seen in Dalarna. — *Bot. Not.*
- LUNDELL, P. M. 1871: De Desmidiaceis quae in Suecia inventae sunt. — *Acta Reg. Soc. Sci. Upsala*, Ser. III.
- NORDSTEDT, O. 1888: Freshwater Algae, collected by Dr. S. Berggren in New Zealand and Australia. — *K. Sv. Vet. Ak. Handl.* 22: 8.
- PRESCOTT, G. W. 1931: Iowa Algae. — *Iowa Studies in Natural History* 13: 6.
- and MAGNOTTA, A. 1934: Notes on Michigan Desmids. — *Mich. Acad. Sci. Arts & Lett.* 20.
- and SCOTT, A. M. 1952: The Desmid genus *Micrasteris* Agardh in S South-eastern United States. — *ibid.* 28.
- — 1952: Additions to our Knowledge of the Desmid genus *Micrasterias* 2. — *Trans. Amer. Micr. Soc.* 71.
- SMITH, G. M. 1922: The Phytoplankton of the Muskoka region, Ontario, Canada. — *Trans. Wisconsin Acad. Sci. Art & Lett.* 20.
- 1924: Phytoplankton of the Inland Lakes of Wisconsin II. — *Bull. Wisconsin Geol. Nat. hist. Survey* 57: 2.
- 1924 a: Ecology of the Plankton Algae in the Palisade Interstate Park. — *Syracuse Univ. Bull.* 23.
- STANGE, B. 1908: *Micrasterias*-Formen. — *Arch. f. Hydrobiol.* 3.
- TAYLOR, WM. R. 1935: Alpine Algae from the Santa Maria mountains, Columbia. — *Am. Journ. Bot.* 22.
- TEILING, E. 1948: *Staurodesmus* genus novum. — *Bot. Not.*
- 1950: Radiation of Desmids. — *Bot. Not.*
- THUNMARK, S. 1948: Sjöar och myrar i Lenhovda socken. — *Lenhovdaboken*.
- VAN DER WERFF, A. 1955: The biological results of fen-clearing in the South-eastern part of the Netherlands. — *Proc. Intern. limnol. Congress XII.*
- WEST, W. & G. S. 1905: Monograph of the British Desmidiaceae II. — London.
- YAMAGUSHI, H. & HIRANO, M. 1953: Plankton Desmids from Lake Biwa 3. — *Acta Phytotax. Geobot.* 15: 5.

Studies on the genus *Vaucheria* III

Remarks on some species from brackish water

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Vaucheria erythrospora nom. n.; syn. *V. hamata* sensu Goetz f. *salina* Rieth 1956.

This species is rather common in Sealand salt marshes. The author knew it from 9 stations when publishing his first list (1952), but left it unmentioned because he did not want to enter the problems of the *hamata* group yet, and found it out of place to describe a new species before giving a more precise account of the known species related to it. As the paper by Blum (1953) justified an isolated description, the author, after finding the species also in Germany and Sweden (cp. the text to fig. 2 a and b), decided to devote a separate note to its description, and this was just being prepared when Rieth (1956) announced his find of the same plant at Artern west of Leipzig, describing it as a brackish water form of *V. hamata* sensu Goetz, which is the known species it resembles most. On the basis of his personal observations the author thinks this *Vaucheria* deserves the rank of a species. The epithet applied by Rieth to his new form is occupied as a specific epithet, so a specific name is introduced above which refers to another character mentioned in the description of the type material.

As stated by Rieth, the most distinctive features of *V. erythrospora* are the empty apical part of the fertilised oogonium and the reddish colour of the oospore wall.

With regard to the former it should be noticed that the difference between *V. erythrospora* and *V. hamata* in this respect is conditioned by a different shape of the oogonium (cp. fig. 1 a), and does not come out just by a contraction of the oospore at fertilisation, which might perhaps have been caused by environmental factors. The mature spores

break off very easily and accumulate on the bottom of the jar where the material is kept. Such sedimented oospores are seen in fig. 2 c, which should be compared with the drawings given by Blum (1953 p. 480). The difference from *V. hamata* appears great enough to warrant, in itself, a specific independence, provided that no intermediate forms fill out the gap which separates the spores of *V. erythrospora* from those of *V. hamata*. Material from a single station has not allowed Rieth to form an estimate of this, but the author's collection now comprises material from 12 different localities, and shows full constancy.

The reddish brown colour of the mature oospore contrasts very strikingly with the greyish tint seen in *V. hamata*. It may be added to Rieth's description that the colour is confined to a relatively thin layer in the oospore wall, surrounded by a colourless layer on either side. Fig. 2 d—e show some unstained sections cut from fresh material and photographed in glycerine. With $K_4Fe(CN)_6$ and HCl the brown layer turns blue, while the rest of the wall takes little or no colour.

A third character distinguishing *V. erythrospora* from *V. hamata* is afforded by the coiling of the antheridium and part of the fruiting branch beneath it. The spiral is a good deal more open in *V. erythrospora* than in *V. hamata*. Rieth has measured no less than 120 antheridia, and in a diagram (fig. 7) compares his results with those found for *V. hamata* and *V. terrestris* by Blum (1953). From the diagram Rieth concludes that his material must belong to *V. hamata* rather than to *V. terrestris*. The author should find it correcter to conclude that the Artern material belongs to neither of the two species, since the peak for this material nearly coincides with the line which delimits the domain of *V. hamata* from that of *V. terrestris*, and usually is not passed by any of these species.

Ecologically, *V. salina* differs from *V. hamata* in at least three respects. First, it is bound to slightly brackish water. Secondly, it has a greater demand for humidity than this species and, on the other hand, grows all right not only on moist soil, but also submerged, resembling in this respect *V. terrestris* more than *V. hamata*. Thirdly, it normally fruits in the colder seasons only. In a crude culture the author has observed fruiting organs in August, but all his samples of material fruiting in nature are collected in the months of March, September, October, November and December, and most of them in March and October.

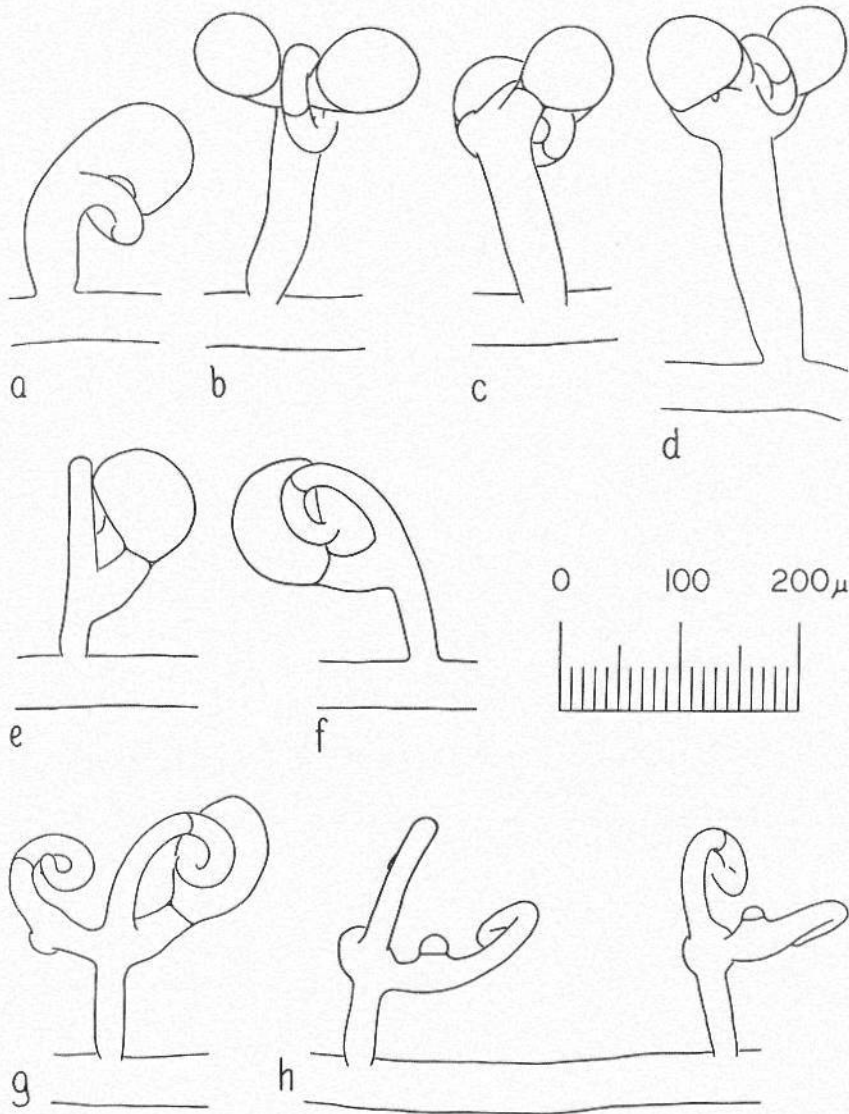


Fig. 1. — a *V. erythrospora*, no. 2568: 15-3-1945, submerged in shallow pool in the salt marsh of Avedøre Holme southwest of København; Denmark: top.-bot. distr. no. 45 a. — b-d *V. erythrospora*, no. 2557: 9-3-1945, submerged in broad ditch covered with ice, in the salt marsh of Hestefælleden west of Kongelunden, Amager; Denmark: top.-bot. distr. no. 46. — e-h *V. longata*, no. 6556: 9-3-1945, mingled with the preceding no. 2557.

Vaucheria longata Blum 1953.

When the author's oldest sample of *V. erythrospora* was produced to serve as type of the new species since then described by Rieth, the material was found to contain one more species, unnoticed until then. This second species, which is shown in fig. 1 e—h, fits with Blum's description and figures of *V. longata* in most respects, the diverse differences being most likely due to environmental or racial differences, or to the fact that *V. longata* was described on dried material. It is to be hoped that more samples will become available for a study of the variation, but in one respect the author feels rather sure that his observations, though made on a single sample, involve an emendation of the description of *V. longata*, and this point, therefore, should be particularly mentioned at the present stage: — The diagnosis includes some extraordinary exceptions from the general rule that the antheridium of racemose *Vaucheriae* is single and terminal on the fruiting branch. Such observations find their explanation by a consideration of the proliferation stages shown in fig. 1 g—h. It is seen that the branch of the first order is a good deal thinner than its lateral which bears the single oogonium. Proliferation takes place from the swelling at the insertion of this lateral, and results in another fruiting branch with a terminal antheridium quite as usual in all racemose species. In fig. 1 g the primary antheridium is opened and its oogonium fertilised, while the antheridium terminating the fruiting branch of the second order is closed at the tip. In fig. 1 h the mature oospores produced by the two fruiting branches of the first order have both fallen off. The fruiting branches of the second order have formed normal antheridia but only small rudimentary oogonia. A few more examples have been observed of similar half-developed oogonia, and another small number of proliferations with the second oogonium represented only by a swelling. Supplementary finds must show whether the latter stage is transitional or represents another, perhaps the commoner, final product of incomplete proliferation, but however this may be, there is little doubt that proliferating fruiting branches, whether quite like those pictured here or not, have formed the basis of the observation of supernumerary antheridia.

Vaucheria sescuplicaria Christensen 1952; *V. dichotoma* (L.). Ag. f. *arternensis* Rieth 1953.

After the establishment of this species two authors have given mutually contradictory opinions as to its proper position: Rieth (1954) questions the specific distinctness of *V. sescuplicaria* and *V. dichotoma*,

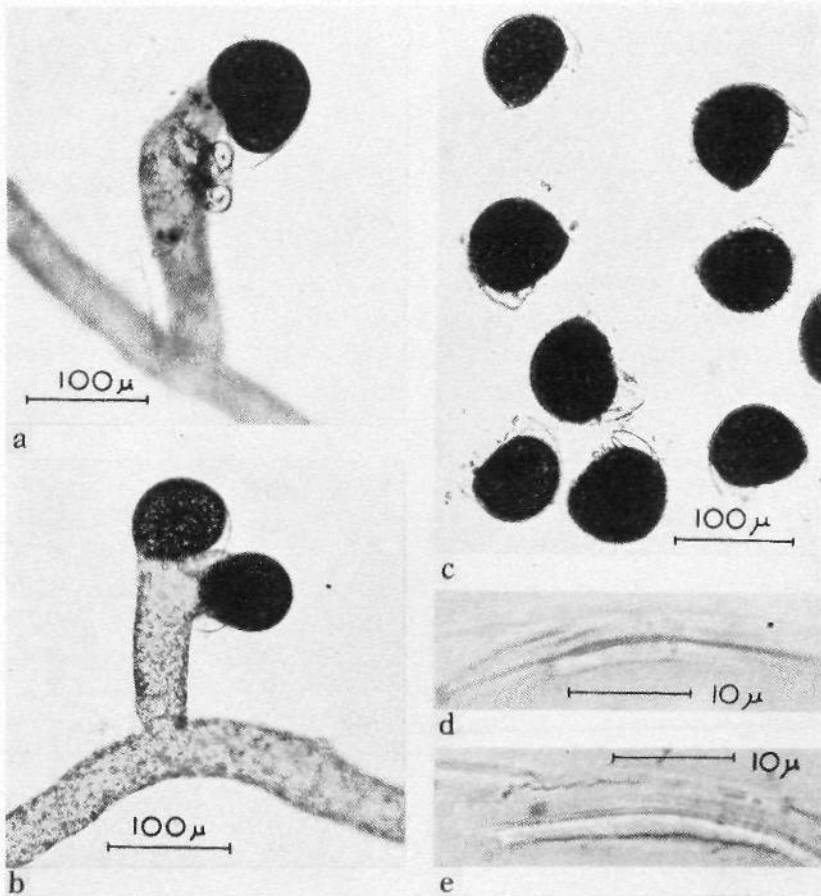


Fig. 2. — a *V. erythrospora*, no. 6381: 2-8-1954, mingled with *V. synandra* and *V. intermedia* under *Puccinellia maritima* in salt marsh southwest of Grossenbrode on the Baltic coast south of Fehmarn, Germany; fruiting material from a crude culture. — b—e *V. erythrospora*, no. 6548: 20-11-1955, under *Juncus gerardi*, etc. beside path through low and open growth of *Phragmites* on the shore immediately north of Landskrona, Skåne, Sweden; d—e show sections through the oospore wall.

while Erady (1954) finds their points of mutual resemblance "so meagre that it is difficult to understand their close similarity". As to Erady's statement it should be remembered that the young oogonium is filled up with protoplasm by the same peculiar process in *V. sescuplicaria* as in *V. dichotoma*, a process that has not been observed in any other species. This common feature is the main reason why the author regards

the two species as rather closely allied. Against the opinion given by Rieth (1954), on the other hand, arguing is probably unnecessary, as this author now (1956) adopts the name of *V. sescuplicaria* without comment, at the same time correcting his former conception of *V. dichotoma* (cp. Rieth 1953 fig. 12) which formed the basis of his statement.

V. sescuplicaria has now been found in Denmark, Spain, Germany, France (Christensen 1955), Tunis, Algeria (Gauthier-Lievre 1955) and, lately, in Sweden. The Swedish find was made by the author on Oct. 31st 1954. The species was mingled with *V. intermedia*, *V. synandra* and *V. compacta*, just covered with water between hummocks on a salt marsh much trodden by cattle, situated immediately northeast of Sölvesborg, Blekinge.

Summary

Vaucheria erythrospora nom. n., syn. *V. hamata* f. *salina* Rieth, is recorded from Denmark and Sweden, *V. longata* Blum from Denmark, and *V. sescuplicaria* Christensen from Sweden. Comments are given on various characters of the species mentioned.

Bibliography

- BLUM, J. L. 1953. The Racemose Vaucheriae with Inclined or Pendent Oogonia. — Bull. Torrey Bot. Club 80: 478—497.
- CHRISTENSEN, T. 1952. Studies on the Genus *Vaucheria* I. A list of finds from Denmark and England with notes on some submarine species. — Bot. Tidsskr. 49: 171—188.
- 1955. Études sur le genre *Vaucheria* II. — Quelques trouvailles à l'Étang de Salses (Roussillon). — Vie et Milieu 6: 286—288.
- ERADY, N. A. 1954. A new Terrestrial Species of *Vaucheria* from South India. — Phytomorphology 4: 329—334.
- GAUTHIER-LIEVRE, L. 1955. Le genre *Vaucheria* en Afrique du Nord. — Bull. Soc. d'Hist. Nat. de l'Afrique du Nord 46: 309—339.
- RIETH, A. 1953. Eine neue *Vaucheria* der Sektion *Woroninia* aus dem Arterner Salzgebiet. — Arch. Protistenk. 98: 327—341.
- 1954. Beobachtungen zur Entwicklungsgeschichte einer *Vaucheria* der Sektion *Woroninia*. — Flora 142: 156—182.
- 1956. Zur Kenntnis halophiler Vaucherien. — Ibid. 143: 127—160.

Smärre uppsatser och meddelanden

Dennstaedtia punctilobula funnen i Nordhalland

Under somrarna 1952—55 har jag inventerat ett område i norra Halland. Undersökningarna omfattar förutom Ölmevalla sen även SW delen av Fjärås sen med halvön Tjolöholm.

Den rika florán på Tjolöholm kontrasterar skarpt mot områdets för övrigt tämligen torftiga hedflora. Till följd härav blev exkursionerna till halvön talrika. Under en sådan, som företogs under pingsthelgen (29/5) 1955, antecknade jag en »*Dryopteris*», som jag inte kände, och fjorton dagar senare insamlade jag två exemplar av ormbunken.

Mina misstankar, att det rörde sig om en för vårt floraområde ny art, bekräftades av intendent Degelius vid Göteborgs botaniska museum. De båda exemplaren bar inga sporgömmesamlingar, varför jag på nytt besökte lokalen i mitten av augusti och gjorde en ny kollekt. I Göteborg bestämde jag arten till *Dennstaedtia punctilobula* (Michx.) Moore (10, 15 o. 30). Arten fanns även planterad i botaniska trädgården, och bestämningen kunde där verifieras.

Lokalen för *D. punctilobula* är belägen 300 m NÖ om Tjolöholms slott. Ormbunken växer här i en från N till S gående ravin, som i sin södra och högre belägna del mynnar ut på en platå. I platåns mitt ligger en liten damm, vilken avvattnas av en mindre, mot söder rinnande bäck. Mot norr övergår dammen i ett smalt, långsträckt kärr, resten av ett tidigare utlopp. Vid dettas övre ände finner man ormbunksbeståndet.

Höjden över det blott 250 m avlägsna havet är ca 15 m. På alla sidor utom den norra är lokalen omgiven av skyddande höjder.

Berggrunden är av en i trakten vanlig gnejstyp. Den täcks av en grusrik morän, som i sin tur är överlagrad med ett 30 cm tjockt humusskikt. Närmare kärret täckes moränen av lövkärrs- och lågstarrstov.

D. punctilobula förekommer blott i ett enda bestånd inom Tjolöholmsområdet. Det är ganska stort, enhetligt täckande en areal av 16—17 m², dessutom finns några exemplar på andra sidan av en stig, som tangerar beståndets östra sida. Antalet individer uppgick till i runt tal 500. Bladen står mycket tätt och har genom skuggning och en tydligen stor konkurrenskraft nästan fullständigt undanträngt all annan vegetation. Översta markskiktet är helt genomkorsat av talrika, långt krypande rhizom.

Ståndortstypen är en något fuktig, artfattig ekblandskog. Den övriga vegetationen i beståndet är mycket gles med talrikast förekomster i de perifera delarna. Vad man vid en analys av kärllväxterna från lokalen främst observerar, är den starka representationen av olika bräkenarter.



Fig. 1. *Dennstaedtia punctilobula*, detalj ur beståndet. — Foto: Ö. Nilsson.
Tjolöholm 6/9 1955.

Arterna i själva beståndet (17): *Anemone nemorosa*, *Dryopteris dilatata*, *Festuca rubra*, *Oxalis acetosella*, *Quercus petraea*, *Veronica chamaedrys*.

Arterna inom en radie av c:a 15 m från beståndets centrum: förutom alla de ovan nämnda *Aesculus hippocastanum*, *Athyrium filix-femina*, *Betula pubescens*, *Carex nigra*, *C. panicea*, *C. pilulifera*, *C. remota*, *Convallaria majalis*, *Cornus suecica*, *Deschampsia caespitosa*, *Dryopteris filix-mas*, *Fagus sylvatica*, *Festuca gigantea*, *F. ovina*, *Geranium robertianum*, *Iris pseudacorus*, *Luzula multiflora* ssp. *congesta*, *L. multiflora* ssp. *occidentalis*, *Melica uniflora*, *Molinia coerulea*, *Pinus silvestris*, *Poa nemoralis*, *Polypodium vulgare*, *Rhamnus frangula*, *Silene rupestris*, *Lastrea dryopteris*, *Vaccinium myrtillus*, *Veronica officinalis*.

Några av de uppräknade arterna förekommer endast i enstaka individ; bland dem märks *Festuca gigantea*, *Luzula* **congesta*, *Aesculus*, *Silene* och *Athyrium*.

Förutom ormbunksdominansen lägger man märke till flera i vårt land västliga, atlantiska arter, såsom *Silene*, *Luzula* **congesta* m.fl. (16).

Inom 15-metersgränsen faller det ovan beskrivna kärret, som berikar artlistan med tio arter, och en bergssluttning, från vilken tillskottet blir sex arter.

Släktet *Dennstaedtia* omfattar omkr. 60 arter, med huvudutbredning i tropikerna. Flertalet har påträffats i tropiska Amerika, främst i Ecuador och Vené-



Fig. 2. *Dennstaedtia punctilobula*. Bilden visar en del av ormbunksbeståndet vid Tjolöholm. Det täcker utan några luckor en yta av 16 m². —

Foto: Ö. Nilsson, 6/9 1955.

zuela. Blott två representanter för släktet förekommer inom de tempererade klimatzonerna. Inom den södra zonen växer *D. davalloides* på Tasmanien och inom den norra *D. punctilobula* i Nordamerika (5 o. 22).

Dennstaedtia punctilobula (Michx.) Moore (= *Dicksonia pilosiuscula* Willd. 1809) beskrevs från Kanada av Michaux 1803 (3, 7 o. 12).

D. punctilobula har en lång (max. 35 cm), tämligen grunt krypande, oftast förgrenad, 1,5—2,5 mm tjock jordstam. Denna är svartbrun till färgen och glest besatt med hår eller hårrester. Jordstammens skottspetsar är gulvitt ludna av den på dessa synnerligen täta hårbeklädnaden. De trådlika rötterna skjuter ut från rhizomets alla delar.

Bladen är tämligen glest ställda, en viss sammangyttrad gruppering kan dock förekomma. Längden varierar mellan 50 och 90 cm. Det upp till 22 cm långa bladskافتet är kalt i sin nedre, hårda del. Resten är tätt besatt med hår och glandler. Bladskافتsbasen är kastanjebrun till c:a 5 cm:s höjd över marken. Denna färgning övergår så småningom från grönt till vitgrönt i bladets spå-dare del. Skافتet är dock ofta i sin övre del punkterat med rödbruna fläckar. Två kärllsträngar genomdrager skافتet, som i sin mitt har en djup reffla.

Bladskivan är hos exemplar i ungstadium liksidigt triangulär, medan den hos den spormogna plantan är utdraget triangulär — lansettlik. Bredden överstiger ej 25 cm. På såväl över- som undersidan är den besatt med glandelhår. Färgen är klart grön.

Primärsegmenten är 17—18 par, som sitta antingen motsatta eller alternerande. De 13 cm långa och 4,5 cm breda, 14—25 paren sekundärsegment, vars

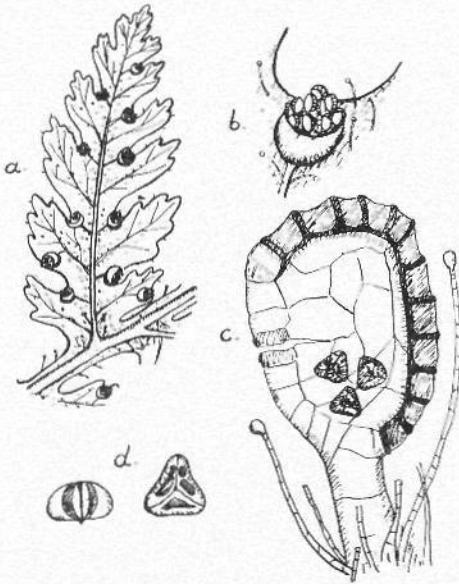


Fig. 3. *Dennstaedtia punctilobula*. Detaljskisser av a. sekundärsegment med sporangiesamlingar, b. sporangiesamling med kvarsittande indusium, c. sporangium och d. sporer från ovan och från sidan. Delin.: Ö. Nilsson.

baser förenats, är lineärt lansettlika och trubbiga. De 4—8 paren tertiärsegment är trubbigt sågade med 2—4 tänder på varje sida (2).

Sporangiesamlingarna sitta vid tertiärsegmentens yttre kant, stundom, speciellt hos välutvecklade exemplar, även på tertiärsegmentens tänder. Sporangiesamlingarna är små (0,7 mm i diameter) och runda. Indusiet är grönvitt till färgen, kalt, hinnartat och halvklotformigt. Vid mognaden lossnar det vid den utåt riktade kanten. Det kvarsitter en kortare tid skårformigt omslutande sporangierna. På de svenska exemplaren når sporererna mognad i slutet av augusti.

Sporangierna är få, 13—16 stycken, men stora och tätt ställda. Ibland dem sitter glandelhår skyddande det korta, av en rad celler bestående skaftet. Annulus innehåller 10—19 celler (på Tjolöholms-exemplaren oftast 12, på nordamerikanska 18). Sporererna är tetraedriska, plattade och släta (6 o. 21).

Till det yttre liknar *D. punctilobula* mest *Dryopteris spinulosa*.

I Nordamerika har *D. punctilobula* ett utbredningsområde helt isolerat från de övriga, ofta trädformiga, i släktet ingående arterna (1, 3 o. 22). Den förekommer på nordamerikanska ostkusten, i ett bälte från New Foundland och Nova Scotia i norr till Alabama och Arkansas, väster ut når den Ontario och Minnesota (4, 8, 26 o. 31).

I hemlandet undviker den fuktig mark och växer ofta i stora, täckande bestånd av samma typ som vid Tjolöholm (6).

I Amerika kallas *D. punctilobula* »the hay-scented fern» på grund av sin starka kumarindoft. Denna avsköndras från glandelhåren och består även hos den pressade växten. Ett passande svenskt namn kunde hödoftråken vara (20).

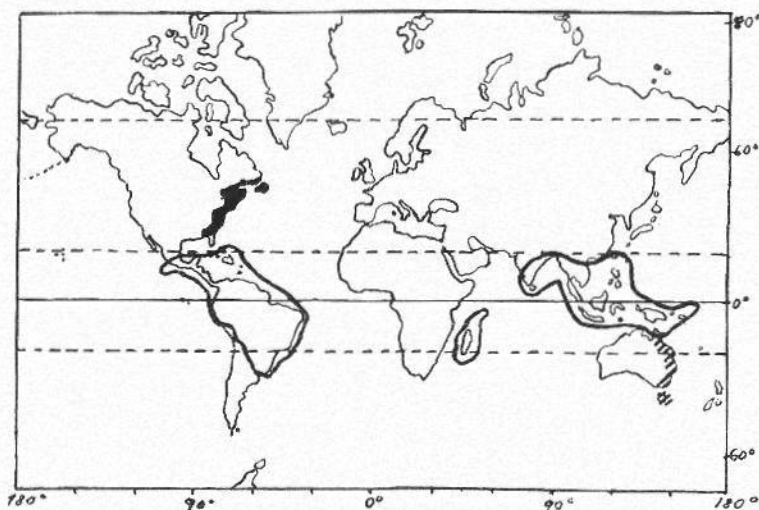


Fig. 4. Skiss visande *Dennstaedtia*-släktets huvudutbredning, begränsad av en grov linje. *D. dawalloides*, snedstreckat område i Australien och *D. punctilobula*, helsvart område i Nordamerika. Delin: Ö. Nilsson.

De flesta ormbunkssporer är mycket lätta och kan föras lång väg med vinden. Förekomsten av just ormbunkssporer har påvisats från mycket stora höjder i atmosfären.

Prof. C. Skottsberg uttalar sig för en teori om långspridning beträffande *Asplenium adiantum-nigrum* vid Åsa i Ölmevalla s:n, 6 km S om Tjolöholm (25). Närmaste fyndort för denna art är Kullaberg i Skåne. Från Kullaberg tror han dock inte, att den kommit, utan från de mera avlägsna, men talrikare lokalerna på norska västkusten. Ännu ett exempel på en troligen långspridd ormbunke finns i närheten. Det är *A. scolopendrium* på Mönster utanför Onsalahalvön, föga mer än en mil från Tjolöholm. Även härvidlag är nog de väst-norska lokalerna spridningskällan.

Fågelvägen blir det en sträcka på 500—600 km från Nordhalland till de båda ormbunksarternas utbredningscentra i Västanorge. Från *D. punctilobulas* utbredningscentrum i staten New York i USA blir avståndet till svenska västkusten c:a 5.000 km. Tages blott hänsyn till avstånden, blir möjligheterna för en lufttransporterad spor endast c:a 10 gånger mindre för *D. punctilobula* än för de båda andra.

När det gäller så stora avstånd, som det här är frågan om, måste även hänsyn tagas till nederbördsförhållanden, temperaturen i de högre luftlagren, som kan påverka sporens grobarhet, luftströmmarnas riktning, styrka och kontinuitet. Under den aktuella tiden för spormognaden i Amerika, under månaderna juli och augusti, är vinden riktad mot NO från nordamerikanska ostkusten. Över Atlanten sker sedan en vindkantring, och luftströmmen blir i det närmaste rakt västlig (27). Naturligtvis spelar även det nykoloniserade områdets lämplighet en avgörande roll.

Utbredningsområdet för *D. punctilobula* är, som ovan angivits, ganska stort, och arten finns där tämligen allmänt. Om parallellen med *A. adiantum-nigrum* och *A. scolopendrium drages* vidare, så har *D. punctilobula* en förmån i en betydligt större sporproduktion fördelad på en vidare yta.

D. punctilobula odlas som trädgårdsväxt sparsamt i hemlandet, där den dock har lätt att finna trivsel även på mager jord. Till England infördes den 1811 och till Tyskland något senare (29). Som förvildad eller naturaliserad i någon park har den ej angivits från något västeuropeiskt land (9 o. 13). Av släktet odlas några arter i drivhus i Sverige, där liksom i de övriga nordiska länderna *D. punctilobula* ej nämns som odlad (24). Vanligen är de i Sverige odlade ormbunkarna av en annan typ, tuvade med bladen struttformigt utbredda.

Tjolöholm är känt sedan 1231 och nuvarande ägare är grevinnan Blanche Bonde (28). En ombyggnad av slottet företogs i början av 1900-talet av J. Dickson. I samband med denna gjordes vissa ändringar i trädgården efter engelskt mönster, medan parken lämnades orörd. Fru Dickson, som var av engelsk härstamning, har låtit plantera några *Rhododendron*-buskar i parken. I sin tjänst hade hon en trädgårdsmästare Vinblad, som inflyttat från London. En tidigare ägare var R. Dann, som varit engelsk arméofficer. Han dog vid 50-års ålder 1857. Vid utredningen, om och när en inplantering av ormbunken skett, behöver man knappast gå längre tillbaka i tiden, då den blev känd i Amerika 1803 och för första gången planterades i England 1811.

Om *D. punctilobula* blivit inplanterad från England, förefaller det sannolikt, att detta skett antingen under Danss tid före 1857 eller under fru Dicksons tid, emedan hon hade engelska förbindelser och en engelsk trädgårdsmästare. Några svensk-amerikanska ägare till slottet eller grannar, som kan tänkas ha medfört ormbunken från Amerika, finns ej.

D. punctilobula växer nu i fullt naturlig miljö, och några tecken på att platsen tidigare varit föremål för planteringar, har ej kunnat iakttagas. Det övriga växtsambället är typiskt för platser på området med likartad karaktär, om man bortser från *Aesculus hippocastanum*. Detta träd är vanligt i den lägre delen av slottsparken V om »grindstugan», och det har självspritt upp i ravinen, där man hittar flera unga plantor av olika ålder. Den stig, som löper förbi beståndet, är nyupptagen och har använts under röjningsarbeten i parken.

På kanten av dammen står några *Rhododendron*-buskar. Hade en plantering av ormbunken skett, tycker man, att detta borde gjorts invid dammen nära buskarna, för att höja den platsens redan givna skönhetsvärde, och inte i den mera oländiga terräng, där ormbunken nu växer. Beståndets storlek tyder på, att den är äldre på platsen än de 60 år, som förflutit sedan buskarna inplanterades, under förutsättning, att den eventuella planteringen av ormbunken skett med blott några få exemplar.

Övriga parkväxter och växter, som inkommit vid parkens anläggning (18), finner man inom ett område närmare anslutet till slottet och dess trädgård. Vid ett studium av dessa främmande floraelement, kan man inte undgå att lägga märke till flera arter, som uppskattas i engelska trädgårdsanläggningar; exempelvis »the blue bells» (*Scilla non-scripta*) och järneken (*Ilex*). Här bör även påpekas, att engelsmännen tycker om att använda ormbunkar i sina träd-

gårdar. Har en inplantering av *D. punctilobula* kommit till stånd, varför har då denna inte anslutits till de övriga planteringarna?

Ibland kan rhizomdelar, frön eller sporer medfölja bland rötterna hos prydnadsväxter från en trädgård till en annan.

Omkring den lilla dammen växer några prydnadsbuskar. Det är *Rhododendron catawbiense* Michx och *Pieris floribunda* Benth (14). De har blivit planterade av fru Dickson under 1900-talets första årtionde, åtminstone gäller detta *Rhododendron*. Av de jättelika exemplaren att döma tycks de trivas mycket bra. Båda buskarna är nordamerikanska. *P. floribunda* är i sin utbredning inskränkt till östra delen av USA och sydöstra Kanada (29).

Jämför man utbredningen hos de båda buskarna med utbredningen av *D. punctilobula*, tycks sambandet vid Tjolöholm klart, om man utgår från, att sporer eller rhizom-bitar medföljt buskarnas rötter från Amerika. När en inplantering av en utländsk växt görs i en anläggning, är det emellertid inte vanligt, att den hämtas direkt från dess naturliga växtplats i hemlandet. Man brukar istället köpa den från en plantskola el.dyl. Vad *Rh. catawbiense* och *P. floribunda* beträffar är det ej känt, om de kommit från någon svensk trädgårdsanläggning eller från utlandet. Eftersom det är fru Dickson, som låtit plantera dem, kan det tänkas, att de tagits från England. Är detta fallet, så kan ormbunkens sporer eller rottdelar ha följt med vid inplanteringen, om den odlats i samma trädgård som buskarna och i dessas närhet.

Den närmaste av de planterade buskarna står ca 50 m från platsen, där *D. punctilobula* växer, och det ovan nämnda kärret ligger emellan. En fråga, som man genast ställs inför, är, varför inte ormbunken växer invid buskarna, om den nu medföljt deras rötter, utan så långt därifrån. *D. punctilobulas* rhizom kryper ganska snabbt, men ändå är det föga troligt, att de slingrat sig från buskarna, runt kärret och bildat det nuvarande beståndet på föga mer än 50 år. Varför har den inte lämnat några exemplar efter sig på vägen, som går inom ett i stort sett enhetligt område, lika lämpligt för arten som dess nuvarande växtplats?

Det är ej nödvändigt, att spridningen skett på vegetativ väg utan genom sporer. Dessa skulle då bildats hos en numera död planta, som vuxit i närheten av buskarna.

Till sist kan ormbunken kommit in med en buske, som planterats på den nuvarande lokalen. Busken har sedan gått ut och ej lämnat några rester. Jag har ej kunnat få några uppgifter på hur många *Rhododendron*, som utplanterats, varför teorin är omöjlig att kontrollera. Ej heller är det möjligt, att få reda på var planteringarna gjorts. Eftersom de andra buskarna står omkring dammen, varför skulle då ett exemplar sättas i den estetiskt mindre tilltalande ravinen?

I Göteborgs botaniska museum finns exemplar av *D. punctilobula*, insamlade av fil. dr C. Blom i institutionens trädgård 1928. Från prof. G. Rosendahls ormbunksodlingar i Stocksund härrör exemplar från 1923 i Lunda-herbariet. I detta finns även några tagna i Botaniska trädgården i Berlin. Som redan nämnts, odlas den, visserligen sällsynt, i England och Tyskland.

Från dylika planteringar kan det tänkas, att denna bräkenart spritt sig till

Tjolöholm med hjälp av vindburna sporer. För detta talar de mindre avstånd, jämförda med avståndet till östra Nordamerika. Avståndet är exempelvis till Göteborg 32 km.

Mot denna teori riktar sig förhållandet, att *D. punctilobula* gör intryck av att ha vuxit på den svenska lokalen under lång tid. Den göteborgska trädgården anlades först 1916. Märkligt är också, att ormbunken ej anträffats förvildad eller naturaliserad i England, som kan erbjuda lika goda levnadsvillkor och där den odlats i närmare 150 år.

Det finns några växter, som har en begränsad utbredning kring de norra oceana områdena. De kallas cirkumpolära, suboceana växter av E. Hultén och ingår i hans 22-dra grupp (16). De tre arter, som räknas hit, är *Cornus suecica*, *Montia fontana* ssp. *lamprosperma* och *Myrica gale*. Hulténs grupp 31 skulle också kunna komma i fråga. Växterna i den gruppen är utbredda dels över ett område i Västeuropa dels över ett i östra Nordamerika. Av dessa är många kända från Tjolöholm och trakten däromkring.

De klimatiska förhållandena i sydöstra Kanada och i New England-staterna är ganska lika dem på svenska västkusten, även om temperaturextremerna är mera accentuerade i Amerika (32). Omedelbart efter sista istiden låg Tjolöholm under havsytans nivå, men höjde sig vid Ancylustidens slut och bildade en ögrupp skild från fastlandet genom ett sund. Tiden, som området legat över havsytan, är således lång, c:a 7.500 år.

Är det tänkbart, att *D. punctilobula* haft en tidigare större utbredning kring Nordatlanten, men att den sedan dött ut till följd av klimatiska störningar på alla dess andra lokaler i Europa utom på den i Halland, där den stannat utan att sprida sig i omgivningen? Finns möjligheten, att den tidigare blivit förbi-sedd på grund av likheter med *Dryopteris*-arter?

D. punctilobula tycks trivas väl med de svenska förhållandena, trots att den inte sprider sig ut över det område, där den nu växer. Hur det än förhåller sig med dess svenska hemortsrätt, bör denna vackra och intressanta ormbunke skyddas och aktas. Beståndet ligger inom Tjolöholms slottspark, där det är förbjudet att på något sätt skada växtligheten och naturen.

Tidigare meddelanden om *D. punctilobula* har publicerats som notiser i Ulricehamns Tidning den 20 sept. och i Göteborgs-Tidningen den 6 okt.

Summary

This summer (29/5 1955) I found a fern species on the west coast of Sweden at Tjolöholm in the rural district of Fjärås that has never before been found in Europe. Its name is *Dennstedtia punctilobula* (Michx) Moore.

The locality is a ravine 330 yards to the NE of Tjolöholm Castle, quite near the coast, 45 feet above sea level. The underlying igneous rocks consist of common ferruginous gneiss.

The native land of *D. punctilobula* is the east coast of North-America, an area stretching from Nova Scotia to Alabama and Minnesota.

The hay-scented fern (so called in America) occurs only in one dense patch about 15 feet in diameter. The number of fronds is rather great, about 500.

A light green colour and dense pubescence combine to give this fern a soft, feathery appearance. The leaves are from 20 to 36 inches high, lanceolate and three times pinnatifid. The glandular hairs exhale a delicate fragrance — hence the common name. The rhizomes are 2—7 inches beneath the surface of the soil, and are long, slender and much branching.

The place where the fern grows is a shadow wood of *Quercus petraea* a vegetation type rather common on the Swedish west-coast. The number of other species is rather poor, but one must notice the great dominance of other ferns.

At the end of this article I have discussed from various aspects how this fern has come to reach this area far away from its growing places in North-America.

Litteratur

1. BOWER, F. O., The Ferns, II o. III. — Cambridge 1926.
2. BRITTON, N. L. and H. A. BROWN, Illustrated Flora of the Northeastern States and Canada, I pag. 14. — New York 1913.
3. CHRIST, H. DR., Die Farnkräuter der Erde, sid. 312. — Jena 1897.
4. — Die Geographie der Farne, sid. 150 o. 175. — Jena 1910.
5. CHRISTENSEN, C., Index Filicum. — Köpenhamn 1906.
6. CONARD, H. SH., The Structure and Life-History of the Hay Scented Fern. — Washington 1908.
7. COPELAND, E. B., Genera Filicum. — Waltham (Mass.) 1947.
8. DEAM, C. C., Flora of Indiana. — Proc. Indiana Acad. Sci., 34, pag. 39—53. 1925.
9. DRURY, CH. T., British Ferns and their Varieties. — London 1911.
10. ENGLER, A.-PRANTL, Die natürlichen Pflanzenfamilien, I: IV. — Leipzig 1902.
11. GLEASON, H. A., The New Britton and Brown Illustrated Flora, vol. I, pag. 28. — New York 1952.
12. HEGI, G., Illustrierte Flora von Mittel-Europa, I. — München 1935.
13. HOLZHAUSEN, A., Svenskt Trädgårdslexikon, I, sid. 363. — Stockholm 1943.
14. HOOKER, sir W. J., Species Filicum, I. — London 1860.
15. HULTÉN, E., Atlas över växternas utbredning i Norden. Fanerogamer och ormbunksväxter. — Stockholm 1950.
16. HYLANDER, N., Förteckning över Nordens växter. 1 Kärlväxter. — Lund 1955.
17. — Die Grassameneinkömmlinge Schwedischer Parke. — Symb. Bot. Upsal. VII: I. Uppsala 1913.
18. LYTTEKENS, A., Svenska växtnamn, III. — Stockholm 1912—15.
19. MANTON, I., Problems of Cytology and Evolution in Pteridophyta. — Cambridge 1950.
20. MOORE, TH., Index Filicum. — London 1857—62.
21. PEDERSEN, A., Nordisk illustreret havebrugs leksikon, I, sid. 432. — Köpenhamn 1948.
22. SKOTTSBERG, C., Asplenium Adiantum-nigrum L. i Halland. — Medd. Göteb. Bot. trädg., XI.
23. SMALL, J. K., The Pteridophyta of the South-eastern States. — New York 1938.
24. STRAHLER, A. N., Physical Geograpy. — New York 1951.

28. Svensk uppslagsbok, 2 uppl. — Malmö 1954.
29. The Royal Horticultural Society; Dictionary of Gardening, II, pag. 660—661. — Oxford 1951.
30. VERDOORN, FR., Manual of Pteridology. — The Hague 1938.
31. WHERRY, E. F., American Fern Journal. Index 1—25, pag. 49. — Lancaster.
32. ÅNGSTRÖM, A., Sveriges klimat. — Stockholm 1946.

Lund den 24 februari.

ÖRJAN NILSSON

Notiser

Botanikprofessuren i Uppsala. Sakkunnigutlåtandena rörande den lediga professuren i botanik, särskilt fysiologi och anatomi, vid Uppsala universitet brötos den 16 april. De sakkunniga, professorerna E. Melin och H. Lundegårdh, Uppsala, samt H. Burström, Lund, placerade enhälligt docent Nils Fries, Uppsala, i första rummet, laborator Börje Åberg, Uppsala, i andra, och lektor Torsten Hemberg, Stockholm, i tredje rummet. De båda återstående sökandena, laborator Gösta Fähræus, Uppsala, och professor Torsten Wikén, Zürich, jämställdes av professorerna Melin och Lundegårdh i fjärde rummet, medan prof. Burström placerade laborator Fähræus i fjärde och professor Wikén i femte rummet.

Hedersdoktorer. Professor F. K. Skoog, Wisconsin universitet, har promoverats till fil. hedersdoktor vid Lunds universitet och assistenten vid Bergianska stiftelsen E. S. Söderberg till fil. hedersdoktor vid Stockholms högskola.

Doktorsdisputationer. Följande gradualavhandlingar ha under vårterminen ventilerats vid Lunds universitet: A. Lima-de-Faria, Fine structure of the kinetochore and of the arms and its bearing on chromosome organization (d. 9 maj), O. E. V. Gelin, Problems relating to plant breeding by means of mutation (d. 16 maj), N. Nybom, Studies on radiation-induced mutations in barley (d. 18 maj), H. Runemark, Studies in *Rhizocarpon* (d. 25 maj). Vid Uppsala universitet ha följande doktorsavhandlingar försvarats: Lisbeth Fries, Studies in the physiology of *Coprinus* (d. 28 april), O. Mårtensson, Bryophytes of the Torneträsk area, northern Swedish Lappland (d. 17 maj) samt O. Gjærevoll, The plant communities of the Scandinavian alpine snow-beds (d. 22 maj).

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