BOTANISKA NOTISER 1951, HÄFTE 2. LUND

Beiträge zur Kenntnis der Flora von Süd-Rhodesia IX.

Herausgegeben von TYCHO NORLINDH und H. WEIMARCK.

(Meddelanden från Lunds Botaniska Museum, N:r 98.)

Scrophulariaceae (TYCHO NORLINDH).

Nemesia fruticans var. ***divergens*** (BENTH.) T. NORLINDH comb. nova.

Syn.: *N. divergens* BENTH. in HOOKER, Comp. Bot. Mag. II, 1836, 22; HIERN in THISELTON-DYER, Fl. Cap. IV: 2, 1904, 193.

Typus varietatis: ECKLON, Zwartehoogdens in Albany.

Differt a typo: calcare corollae breviore 3—4 mm modo longo.

Inyanga: 8 km meridiem versus a pago Inyanga ad viam prope rivulum Inyanori in campo graminoso, c. 1800 m s. m., flor. et fruct., 28. Jan. 1931 — n. 4633.

Verbreitung der Varietät: Südwest-Afrika, Süd-Rhodesia, Oranje-Freistaat und Kapland.

Unsere Exemplare stimmen vorzüglich mit der Beschreibung von *N. divergens* in der Flora Capensis überein. Der Sporn der Blumenkrone ist ungefähr 3 mm ($^1/_8$ inch) lang. HIERN gibt die Länge des Sporns bei *N. divergens* mit $^1/_8$—$^1/_6$ inch an, also ungefähr 3—4 mm. Bei der nahestehenden Art *N. fruticans* (THUNB.) BENTH. (syn. *N. foetens* VENT.) zeigt der Sporn nach HIERN eine Variationsamplitüde von $^1/_6$—$^1/_4$ inch, also ungefähr 4—6 mm. Betreffend die Länge des Sporns gibt es folglich keine scharfe Grenze zwischen den Formserien von *N. divergens* und *N. fruticans,* und ich kann auch keinen anderen haltbaren Charakter finden, um sie zu unterscheiden. Ich betrachte *N. divergens* als eine kurzgespornte Rasse von *N. fruticans* und reduziere sie darum zu einer Varietät.

Im Bestimmungsschlüssel der Gattung *Nemesia* in der Flora Capensis bildet die Länge des Sporns einen wichtigen systematischen Charakter, aber meiner Meinung nach ist dieser etwas überschätzt. Die äusseren Verhältnisse, Trockenheit oder Feuchtigkeit, unter denen die Blüten sich entwickeln, haben sicher eine beträchtlich modifizierende Einwirkung auf die Länge des Sporns. Ferner muss das Altersstadium des Blütenstandes in Betracht gezogen werden. Die ersten Blüten einer jungen Infloreszenz haben meistens einen bedeutend längeren Sporn als die allerletzten und zugleich obersten Blüten einer alten. Die letztgenannten Blüten sind ja in der Regel unterernährt, denn die Pflanze hat, wenn diese gebildet werden, bei der Produktion einer grossen Anzahl Kapseln und Samen fast all ihre Nahrung verbraucht.

Unsere Exemplare aus dem Inyanga-Distrikt haben lineal-lanzettliche oder fast lineale Blätter. Diese sind doch nicht ganz so schmal wie diejenigen bei THUNBERG's Originalexemplaren von *Antirrhinum capense*. Dieser Name ist ungültig, denn BURMANN hatte schon früher eine andere *Nemesia*-Art unter diesem Namen publiziert. Die Kombination *Nemesia capensis* (THUNB.) O. KTZE ist somit auch ungültig. Eine breitblättrige Form derselben Art mit lanzettlich-eirunden bis eirunden Blättern — die grössten ungefähr 15 mm lang und 8 mm breit — wurde von THUNBERG unter dem Namen *Antirrhinum fruticans* beschrieben und später durch BENTHAM zur Gattung *Nemesia* übergeführt. HIERN vereinigte später die beiden oben erwähnten Arten THUNBERG's zu einer Grossart, *Nemesia foetens* VENT. genannt. Nach den jetzt gültigen Regeln muss indessen diese Art *Nemesia fruticans* (THUNB.) BENTH. heissen.

Die Blattbreite ist ziemlich modifikativ bei dieser wie bei so vielen anderen mehrjährigen Kräutern, die in den Steppengebieten vorkommen. Verschiedene Feuchtigkeitsverhältnisse des Bodens während der Vegetationszeit, Steppenbrände etc. verursachen ohne Zweifel bedeutende Modifikationen in der Blattform bei *N. fruticans*. Es unterliegt doch keinem Zweifel, dass mit Rücksicht auf die Blattform die Art in zwei Rassengruppen zerfällt, eine breitblättrige, *N. fruticans* sens. str. [syn. *N. foetens* var. *latifolia* (BENTH.) HIERN] und eine schmalblättrige, *N. fruticans* var. **linearis** (VENT.) T. NORLINDH comb. nova. Von den ausgeprägt breitblättrigen bzw. schmalblättrigen Formen abgesehen, kann es schwierig sein, das Herbarienmaterial in Hauptart und Varietät zu klassifizieren. Ohne Kultivierungsexperimente oder ohne die betreffenden ökologischen Verhältnisse zu kennen, ist es mitunter unmöglich, sicher zu entscheiden, ob die breitere oder schmalere Blattform erblich bedingt ist oder nur eine Modifikation bildet.

Nemesia fruticans überdauert leicht Steppenbrände, davon zeugen alte, mehr oder weniger verkohlte Reste von Stengeln, die man bei manchem alten Exemplar am stark verholzten Rhizom zwischen wohlentwickelten Stengeln findet.

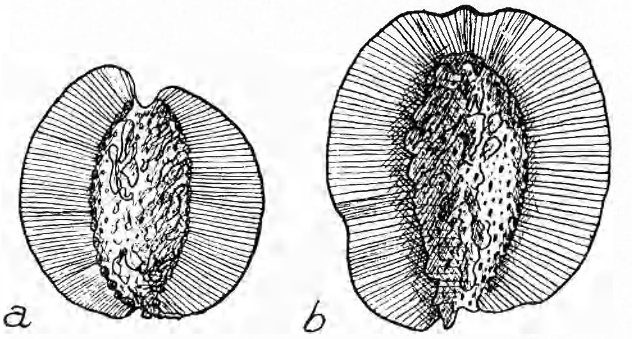


Fig. 1. Samen von *Nemesia*: *a N. zimbabwensis* RENDLE (FRIES, NORLINDH et WEIMARCK n. 2081 aus Zimbabwe); *b N. montana* T. NORL. (NORLINDH et WEIMARCK n. 4709 aus dem Inyanga-Gebirge). × 15.

Nemesia zimbabwensis RENDLE in Journ. Bot. 70, 1932, 95.

Icon.: Fig. nostra 1 a.

Victoria: ad ruinas Zimbabwe in »Acropolis», c. 1200 m s. m., flor. et fruct., 19. Oct. 1930 — n. 2081.

Inyanga: prope pagum Inyanga in colle Chemeo in umbra saxorum, c. 1750 m s. m., flor. et fruct., 24. Jan. 1931 — n. 4557.

Verbreitung: die Art ist bisher nur aus Süd-Rhodesia bekannt.

Diese Art wurde 1929 von RENDLE in Zimbabwe und im folgenden Jahr von unsrer Expedition am selben Ort eingesammelt. Unsere Exemplare stimmen ziemlich gut mit RENDLE's Beschreibung von *N. zimbabwensis* überein. Sie sind deutlich annuell, haben gestielte Blätter und einen fast 3 mm langen Kronensporn. Der einzige nennenswerte Unterschied ist, dass die Blütenteile etwas kleiner sind, als RENDLE angibt; die Oberlippe ist nämlich 4 mm mit den Seitenlappen 1,5 mm und den medianen Lappen 1 mm lang, die Unterlippe nur 3 mm lang. Als unsere Exemplare an einer trocknen Stelle unter den alten Festungsruinen Zimbabwes eingesammelt wurden, befanden sie sich in einem weit vorgeschrittenen Fruchtstadium. Nur einige wenige Blütenstellungen hatten noch eine oder zwei kleine unterernährte Blüten am Gipfel. Die ersten Blüten dieser Infloreszenzen waren ohne Zweifel grösser gewesen, ungefähr mit den Massen, die RENDLE angibt, nämlich die Oberlippe 4—5 mm mit den Seitenlappen kaum 2 mm und den medianen Lappen 2 mm lang, die Unterlippe 5 mm.

In der Nähe des Dorfes Inyanga sammelten wir Ende Januar, also in der Regenzeit, in einer alten Ruine auf dem Gebirgshügel Chemeo wieder einige Exemplare von *N. zimbabwensis* ein. Diese hatten grössere und vor allem breitere, aber weniger langgestielte Blätter und grössere Blüten als die Trockenzeitform, die wir im Oktober in Zimbabwe eingesammelt hatten. Die Wurzel ist deutlich annuell, und die Blütenteile haben ungefähr die Masse, die RENDLE in seiner Beschreibung angibt. In beiden Einsammlungen sind die Blüten weiss, bei der Inyanga-Form indessen mit blaulila Base.

Ich habe selbst nicht das Originalexemplar von *N. zimbabwensis* gesehen, aber Mr. MEIKLE in Kew hat die Freundlichkeit gehabt, Exemplare aus unsrer Kollektion n. 2081 aus Zimbabwe mit dem obengenannten zu vergleichen, wofür ich ihm sehr dankbar bin.

Nemesia **montana** T. NORLINDH spec. nova.

Spec. orig.: FRIES, NORLINDH et WEIMARCK n. 3586 in herb. Lund.

Icon.: Fig. nostrae 1 *b* et 2.

Herba perennis usque 8 dm alta; caules singulares vel saepius plures e rhizomate lignoso usque 2 cm crasso exeuntes erecti rigidi basi lignescentes parce ramosi, ramis patenti-ascendentibus vel suberectis, vel rarius simplices; caules et rami tetragoni glabri vel subglabri vel partibus junioribus sparse et breviter glanduloso-pilosi laxe foliati, internodiis usque 8 cm longis. Folia opposita sessilia vel infima breviter petiolata, petiolis 1—3 mm longis, membranacea glabra vel subtus in nervis sparse pilosa margine serrata vel deduplicato-serrata, dentibus c. 1 mm altis; folia inferiora et intermedia ovata vel ovato-lanceolata 2,5—5 cm longa 1,5—2,5 cm lata basi rotundata vel subcordata apice acuminata acuta vel subacuta, folia superiora sursum decrescentia ovato-lanceolata vel lanceolata; nervus medius subtus leviter elevatus albidus, nervi secundarii utrinque 2—3 anastomosantes e basi laminae ascendentes. Inflorescentiae ± laxae racemosae caulem et ramos terminantes in fructu usque 2 dm longae; bracteae oppositae, suboppositae vel superiores saepius alternantes lanceolatae—sublineares vel inferiores ovato-lanceolatae minute serratae vel subintegerrimae; pedicelli graciles glanduloso-puberuli c. 1 cm longi vel in fructu usque 2 cm longi; lobi calycis lineares vel lineari-oblongi subobtusi 1—3-nervii sparse glanduloso-puberuli 2,5—3 mm longi; corolla coeruleo-lilacina glabra, labio superiore (5—)6—8 mm longo 4-lobato, lobis laterioribus et medianis 2,5—4 mm longis et 2—3 mm latis rotundatis medianis angustioribus, labio inferiore 6—8 mm longo emarginato in faucibus papilloso sed palato glabro, calcare cylindrico 3—4,5 mm longo; capsula compressa 8 mm longa et 5 mm lata subcoriacea basi inaequaliter rotundata apice emarginata subtruncata haud conspicue bicornuta; semina foveolata et tuberculata 1,3—1,5 mm longa 2-alata, alis transverse striatis c. 0,5—0,8 mm latis.

Inyanga: in monte Inyangani inter saxa in campo fruticoso, c. 2400 m s. m., flor. et fruct., 7. Dec. 1930 — n. 3586; in montibus Inyanga Mts prope villam

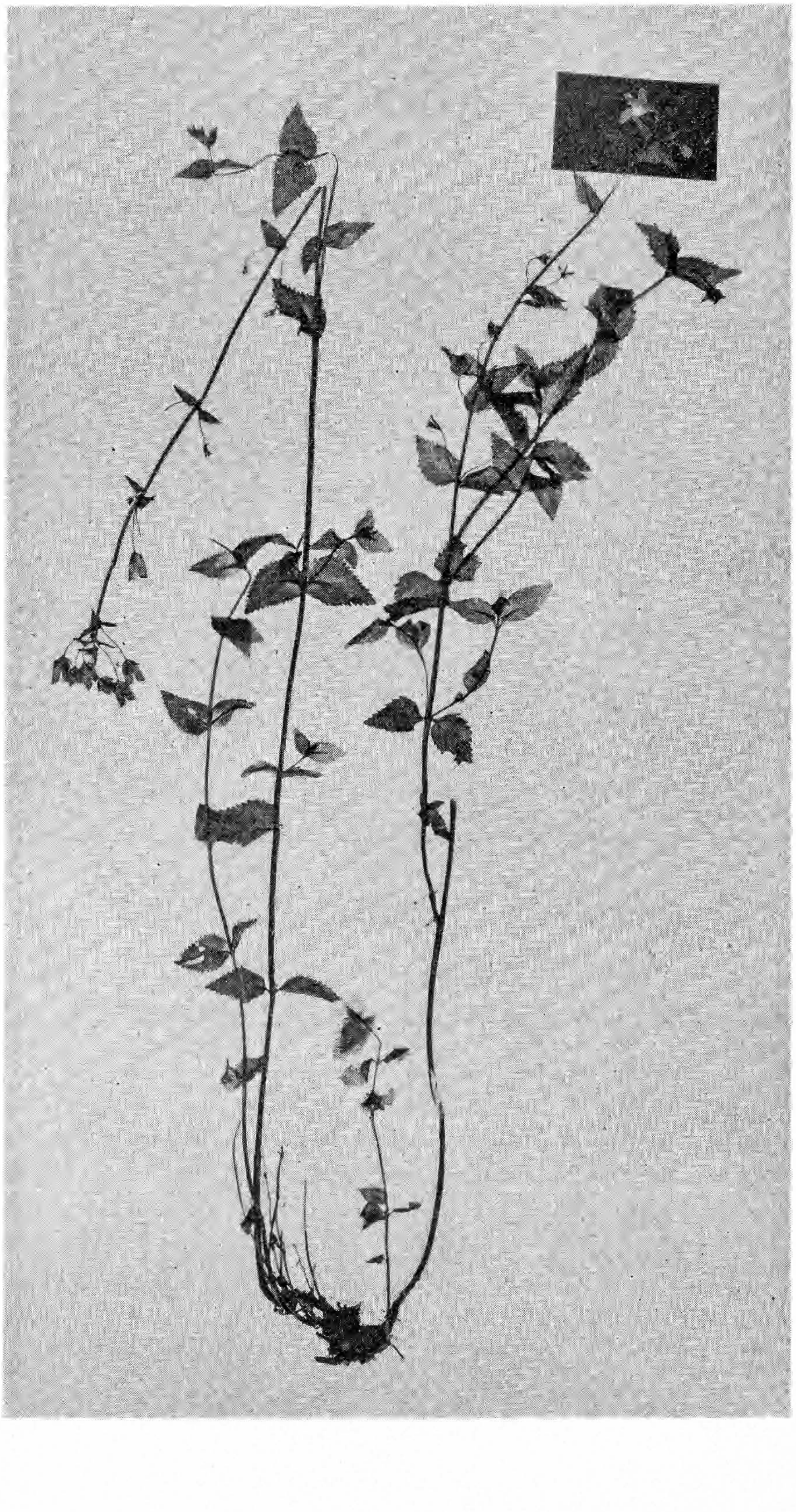


Fig. 2. *Nemesia montana* T. NORL. (FRIES, NORLINDH et WEIMARCK n. 3586 vom Inyangani, spec. orig. in herb. Lund.). × c. 1/3.

Inyanga Down in palude in campo graminoso, c. 2000 m s. m., flor. et fruct., 29. Jan. 1931 — n. 4709; in montibus Inyanga Mts orientem versus a pago Cheshire in campo graminoso, c. 2300 m s. m., flor. et fruct., 4. Febr. 1931 — n. 4863.

N. montana scheint eine ausgeprägte Hochgebirgspflanze zu sein. Auf dem Inyangani fanden wir sie in mehr als 2400 m Höhe, also nahe dem Gipfel, zwischen Felsblöcken zusammen mit *Viola abyssinica* STEUD. wachsend. Während unserer Exkursionen auf den hochmontanen Steppen des Inyanga-Gebirges sammelten wir sie an noch zwei Stellen ein.

Diese Art ist mehrjährig, und bei älteren Exemplaren findet man ein kräftiges, stark verholztes, bis 2 cm dickes Rhizom, von dem mehrere hohe Stengel ausgehen. Solche ältere Exemplare zeigen oft an der Base einige mehr oder weniger verkohlte Reste von Stengeln, was davon zeugt, dass die Pflanze bei Bränden, die sich mitunter bis auf die hochmontane Steppe verbreiten, ihre Lebensfähigkeit nicht verliert.

Sie ist nahverwandt mit *N. zimbabwensis* RENDLE, die indessen eine einjährige Art ist. Bei *N. montana* sind die unteren und mittleren Blätter beinahe unmerkbar gestielt, mit den Stielen nur 1—2(—3) mm lang. Bei *N. zimbabwensis* sind die entsprechenden Blätter langgestielt, (3—)4—10 mm, mit dem Stiel der unteren Blätter oft ebenso lang wie die Spreite. Sie scheinen sich bezüglich der Blütenfarbe voneinander etwas zu unterscheiden. Gemäss unseren Feldnotizen ist die Krone bei *N. montana* blaulila, aber bei *N. zimbabwensis* ist sie weiss, mitunter mit blaulila Base. Wenn es sich um die Bestimmung von Herbarienexemplaren handelt, hat man fast keine Hilfe von der Blütenfarbe, denn sie geht in der Regel beim Trocknen der Pflanze verloren. All unsere gepressten Exemplare von *N. montana* haben eine beinahe entfärbte gelbweisse Blumenkrone.

Diclis ovata BENTH. in HOOKER, Comp. Bot. Mag. II, 1836, 23; HEMSLEY et SKAN in DYER, Fl. trop. Afr. IV: 2, 1906, 287. *Linaria veronicoides* A. RICH., Tent. Fl. Abyss. II, 1851, 114.

Inyanga: prope pagum Inyanga in spelunca ad rivulum Niarawe, c. 1700 m s. m., flor. et fruct., 22. Jan. 1931 — n. 4535; in monte Inyangani in umbra saxorum, c. 2400 m s. m., flor. et fruct., 14. febr. 1931 — n. 5014.

Makoni: ad villam Duniden in muro lapideo in silva, c. 1800 m s. m., flor. et fruct., 9. Febr. 1931 — n. 4940.

Verbreitung: Kamerun, Abessinien, Uganda, Kenia, Tanganjika-Terr., Nyassaland, Port. Ostafrika, Nord- und jetzt auch Süd-Rhodesia sowie Madagaskar.

Die Blütenfarbe scheint bei dieser Art ziemlich variabel zu sein. Die Exemplare vom Inyangani haben gelbe, die aus Inyanga weisse und die aus dem Makoni-Distrikt weisse und schwach blaue Blüten. Die Samen sind c. 0,6 mm lang und 0,4 mm breit mit zahlreichen longitudinalen, kammähnlichen Erhebungen.

Diclis reptans var. *serratodentata* O. KUNTZE, Rev. Gen. Pl. III, 1893, 231; HIERN in THISELTON-DYER, Fl. Cap. IV: 2, 1904, 200.

Inyanga: in monte Inyangani in umbra saxorum in altifruticeto, c. 2400 m s. m., flor. et fruct., 7. Dec. 1930 — n. 3587.

Verbreitung: Natal (in Van Reenens Pass in den Drakensbergen) und jetzt auch Süd-Rhodesia.

Wie aus der Beschreibung HIERN's in der Flora Capensis hervorgeht, hat *Diclis reptans* eine grosse Variationsamplitüde. Die Art umfasst eine Serie Formen von solchen mit tief gezähnten bis solchen mit ganzrandigen Blättern. Ferner umfasst sie sowohl dicht behaarte als unbehaarte Rassen.

Wir fanden diese Pflanze in hoher Strauchvegetation nahe dem Gipfel des Berges Inyangani in einer Höhe von c. 2400 m zusammen mit *Viola abyssinica*. Unsere Exemplare vertreten eine stark behaarte Rasse mit sägezähnigen Blättern und stimmen gut mit *D. reptans* var. *serratodentata* überein, die von Dr. KUNTZE aus Van Reenens Pass in Natal beschrieben worden ist. Soweit ich weiss, kommt diese Varietät nur auf höheren Niveaus vor.

Diclis reptans hat unzweifelhaft ihr Hauptzentrum in den Drakensbergen. Sie ist nicht früher auf tropischem Gebiete aufgefunden worden. Da *D. reptans* durch eine Varietät im Inyangagebirge repräsentiert wird, hat man allen Grund zu erwarten, dass sie auch südlich davon im Melsettergebirge vorkommt.

Blüten weiss mit lila Anstrich und dunkleren Punkten.

Die Samen sind c. 0,7 mm lang und c. 0,5 mm breit mit zahlreichen kammähnlichen Längsrippen und niedrigen Querrippchen.

Halleria lucida L., Sp. pl., 1753, 625 excl. var. β; HIERN in THISELTON-DYER, Fl. Cap. IV: 2, 1904, 207; HEMSLEY et SKAN in THISELTON-DYER, Fl. trop. Afr. IV: 2, 1906, 295.

Inyanga: prope pagum Inyanga ad rivulum in declivi silvae, c. 1700 m s. m., ster., 7. Nov. 1930 — n. 2744; 3 km occidentem versus a monte Inyangani in convalle vegetatione *Cyatheae Dregei* obtecta, c. 2000 m s. m., ster., 6. Dec. 1930 —

n. 3507; in monte Inyangani in silvula ad rivulum, c. 2300 m s. m., flor., 7. Dec. 1930 — n. 3559.

Verbreitung: Abessinien, Kenia, Tanganjika-Territorium, Nyassaland, Angola, Nord- und Süd-Rhodesia, Transvaal, Oranje-Freistaat, Natal und Kapland.

H. lucida gehört zu den Charakterpflanzen in den Galeriewäldern des Inyangagebirges, und wir fanden sie von 1700 bis 2000 m Höhe. Sie tritt meistens als ein 3—5 m hoher Strauch auf.

Freylinia tropica S. MOORE in Journ. Linn. Soc., Bot. XL, 1911, 152.

Inyanga: prope pagum Inyanga ad flumen Nianoli in densa virgulta, c. 1700 m s. m., flor. et fruct., 20. Nov. 1930 — n. 3131; c. 3 km occidentem versus a monte Inyangani in valle ad rivulum, c. 2000 m s. m., flor. et fruct., 8. Dec. 1930 — n. 3660; supra dejectum fluminis Pungwe ad ripam, c. 1700 m s. m., fruct., 18. Dec. 1930 — n. 3832.

Verbreitung: Süd-Rhodesia und Transvaal.

Die Art scheint in den Galeriewäldern des Inyangagebirges von 1700 bis 2000 m Höhe allgemein zu sein, wo sie oft ungefähr 2 m hohe, heckenartige Gebüsche bildet. Nach unseren Notizen erreichten einzelne Sträucher eine Höhe von 4 m. Die Pflanze hat hellblaue Blüten. Die Samen sind fast 1 mm lang und c. 0,6 mm breit, etwas zusammengedrückt mit kleingrubiger oder etwas netzartiger Oberfläche.

Manulea parviflora BENTH. in HOOKER, Comp. Bot. Mag. I, 1835, 383; HIERN in THISELTON-DYER, Fl. Cap. IV: 2, 1904, 237. *Manulea rhodesiana* S. MOORE in Journ. Bot. XLIX, 1911, 156.

Inyanga: c. 35 km meridiem versus a pago Inyanga in campo graminoso in transitu haud multum infra limitem silvae *Brachystegiae Randii*, c. 1950 m s. m., flor., 13. Nov. 1930 — n. 3052; c. 9 km a pago Inyanga prope ripam fluminis Inyanori, c. 1700 m s. m., flor. et fruct., 28. Jan. 1931 — n. 4623.

Verbreitung: östliches Kapland (südlich bis Port Elizabeth), Natal, Oranje-Freistaat, Transvaal und Süd-Rhodesia.

Die Gattungen *Manulea* L. und *Sutera* ROTH. sind nicht ganz scharf voneinander getrennt. KUNTZE vereinigte sie darum 1893 zu einer Gattung unter dem ältesten Namen *Manulea*. Die Autoren in der Flora Capensis (1904) und der Flora of tropical Africa (1906) zogen es indessen vor, sie als selbständige Gattungen zu behandeln. PHILLIPS (Gen. S. Afr. Fl. Pl. 1926) ist den letzteren gefolgt. In seinem Bestimmungsschlüssel gab er folgende Gattungscharaktere an: bei *Manulea* der Kelch von schmalen Deckblättern umgeben, oder auch fehlen solche, die Blütenstellung eine zusammengesetzte, selten einfache Traube; bei *Sutera* der Kelch gewöhnlich von breiten Deckblättern umgeben, die Blüten allein oder, wenn die Pflanze eine Blütenstellung hat, so besteht diese gewöhnlich aus einer einfachen Ähre, Traube oder Kopf.

Exemplare von *Manulea parviflora* können sich bisweilen schon vor dem Anfang der Regenperiode zum Blühen entwickeln. Das ist auch der Fall mit mehreren andern perennen Kräutern in dem Inyanga-Gebiete. Wir brachten ein reiches Material sowohl der Trocken- wie der Regenzeitform von *Manulea parviflora* zusammen.

Die erstere (n. 3052), die Mitte November einige Tage vor den ersten Regen eingesammelt wurde, bestand aus verhältnismässig niedrigen Exemplaren (3—5 dm) mit einfachem oder schwach verzweigtem Stengel und schmalen (2—3 mm), linealen oder lineal-verkehrt-lanzettlichen Blättern. Die letztere (n. 4623), die Ende Januar, also gegen Ende der Regenperiode eingesammelt wurde, bestand aus hochgewachsenen Exemplaren (bis 1 m) mit stark verzweigtem Stengel und längeren und breiteren, lineal-verkehrt-lanzettlichen oder länglich-spatelförmigen Blättern, die basalen bis 1,7 cm breit. Bei der Regenzeitform findet man auch einzelne grossgezähnte Blätter, während die erstere ausschliesslich kleingezähnte Blätter hat. Die Blüten sind gelb.

Die Art, die SPENCER MOORE aus Victoria in Süd-Rhodesia unter dem Namen *Manulea rhodesiana* beschrieb, hat schmale, lineale Blätter und stimmt am engsten mit der Trockenzeitform aus dem Inyanga-Gebiet überein.

Nach der Flora Capensis ist die Variationsamplitüde der Blüten bei *M. parviflora* $^1/_6$—$^1/_4$ inch, also c. 4—6 mm. Die Kronröhre unserer Trockenform (n. 3052) ist c. 5—6 mm lang, aber bei der Regenzeitform (n. 4623) ist sie im allgemeinen länger, bis 7(—8) mm. Die Kelchsegmente werden bei *M. rhodesiana* als spatelig beschrieben, aber auch bei *M. parviflora* sind sie etwas erweitert und mehr oder weniger spatelig.

Soweit ich finden kann, lässt sich *M. rhodesiana* ohne Schwierigkeit in den Formenkreis der südafrikanischen Art *M. parviflora* einfügen.

Sutera Carvalhoi (ENGL.) SKAN in THISELTON-DYER, Fl. trop. Afr. IV: 2, 1906, 307. *Cycnium Carvalhoi* ENGL. in ENGLER, Pfl.-welt Ostafrikas C, 1895, 360.

Inyanga: prope dejectum fluminis Pungwe in campo graminoso montano, c. 1800 m s. m., flor. et fruct., 6. Nov. 1930 — n. 2741; c. 35 km meridiem versus a pago Inyanga in campo graminoso, c. 1700 m s. m., flor. et fruct., 13. Nov. 1930 — n. 3053; in monte Inyangani in fruticetis, c. 2400 m s. m., flor. et fruct., 7. Dec.

1930 — n. 3550; supra dejectum fluminis Pungwe in campo graminoso, c. 1700 m s. m., flor., 18. Dec. 1930 — n. 3804; prope villam Inyanga Down in valle fluminis Tanga, c. 1900 m s. m., flor., 30. Jan. 1931 — n. 4752; in monte Inyangani in campo graminoso, c. 2000 m s. m., flor., 15. Febr. 1931 — n. 5092.

Verbreitung: Port. Ostafrika und Süd-Rhodesia.

C. Carvalhoi ist ein gewöhnlich c. 1 m hoher, bisweilen mannshoher Strauch. Die Blätter variieren beträchtlich an Grösse. Exemplare, die wir kurz vor der Regenperiode einsammelten (z.B. n. 2741) waren kleinblättrig mit nur c. 1 cm langen Blättern. Exemplare, gegen das Ende der Regenperiode eingesammelt (z.B. n. 4752 und 5092), waren dagegen grossblättrig und hatten bis 4 cm lange Blätter. Die Blüten sind weiss mit braungelbem oder rostfarbigem Schlund, werden aber beim Trocknen fast ganz schwarz.

Sutera Burkeana (BENTH.) HIERN in THISELTON-DYER, Fl. Cap. IV: 2, 1904, 299; HEMSLEY et SKAN in THISELTON-DYER, Fl. trop. Afr. IV: 2, 1906, 308. *Lyperia Burkeana* BENTH. in DC., Prodr. Regn. Veg. X, 1846, 361.

Inyanga: ad viam inter pagos Rusapi et Inyanga (Makoni Distr.?), flor. et fruct., 26. Okt. 1930 — n. 2320; ad pagum Inyanga in campo graminoso, c. 1700 m s. m., flor. et fruct., 31. Okt. 1930 — n. 2509; eod. loco, in silva nuper usta, c. 1700 m s. m., flor., 15. Dec. 1930 — n. 3728; eod. loco, in campo graminoso, flor., 17. Febr. 1931 — n. 5097.

Makoni: ad viam inter pagum Rusapi et villam Maidstone in terra saxosa, c. 1450 m s. m., flor., 30. Dec. 1930. — n. 4035.

Verbreitung: Süd-Rhodesia, Transvaal und Zululand (Natal?).

S. Burkeana ist ein c. 1 m hoher Strauch, den wir in 1400—1700 m Höhe einsammelten. Im Inyanga-Gebirge scheint sie nicht auf höherem Niveau vorzukommen. Die Blüten, die beim Trocknen fast schwarz werden, sind in frischem Zustande weiss mit braunem Schlund. Die Samen sind c. 0,7 mm lang und c. 0,4 mm breit mit zahlreichen kleinen Grübchen in Längsreihen geordnet.

Sutera micrantha HIERN in THISELTON-DYER, Fl. Cap. IV: 2, 1904, 263; SKAN in THISELTON-DYER, Fl. trop. Afr. IV: 2, 1906, 303. *Lyperia micrantha* KLOTZSCH in PETERS, Reise Mossamb., Bot. I, 1862, 222. *S. fissifolia* S. MOORE in Journ. Bot., 1900, 467.

Makoni: ad villam Maidstone c. 9 km a pago Rusapi in loco aperto, c. 1450 m s. m., flor. et fruct., 29. Nov. 1930 — n. 3287 ; eod. loco, in campo graminoso, flor. et fruct., 4. Jan. 1931 — n. 4091.

Victoria: c. 40 km orientem versus a Fort Victoria in campo graminoso, flor. et fruct., 20. Okt. 1930 — n. 2139.

Verbreitung: Nord- und Süd-Rhodesia, Port. Ostafrika, Transvaal und Swaziland.

Sutera **pulchra** T. NORLINDH spec. nova.

Spec. orig.: NORLINDH et WEIMARCK n. 4994 in herb. Lund.

Icon.: Fig. nostrae 3 et 4 *a*—*c*.

Suffrutex vel frutex 0,5—0,7 m vel ultra altus; caulis erectus vel adscendens rigidus valde lignescens basi usque 0,5 cm crassus ± dense ramosus; caulis et rami teretes partibus junioribus dense glanduloso-puberuli partibus vetustioribus cortice glabro flavo-cinereo vel fusco-cinereo obtecti sat dense foliati, internodiis 1—3 cm longis. Folia opposita rigide membranacea, juniora minute glanduloso-puberula, adulteriora subglabra subsessilia vel breviter petiolata, petiolis usque 3(—5) mm longis; lamina elliptica—anguste ovata 1—2,5 cm longa 0,5—1,5 cm lata apice obtusa interdum subapiculata basin versus cuneatim in petiolum angustata margine serrato-dentata vel dentata vel saepe deduplicato-dentata, dentibus utrinque (3—)4—7 obtusis interdum subapiculatis usque 3 mm altis; nervi laterales utrinque 2—4 anastomosantes sicut nervus medius subtus leviter elevati. Flores racemosi vel cymosi vel rarius in axillis foliorum solitarii; racemi vel cymi breves pauciflori ad apices caulis et ramorum saepe in paniculam foliiferam dispositi; pedicelli graciles glanduloso-puberuli 2—7 mm longi; bracteae parvae anguste ellipticae—sublanceolatae paucidentatae c. 4—7 mm longae; calyx leviter glanduloso-puberulus c. 6 mm longus in segmenta 5 lineari-subulata c. 4 mm longa partitus; tubus cylindrico-infundibuliformis subluteus suberectus 12—13 mm longus extus leviter puberulus; limbus coeruleus vel coeruleo-lilacinus 12 mm diam. lobis obovato-oblongis 4 mm longis.

Inyanga: in monte Inyangani in saxeto, c. 2450 m s. m., flor., 14. Febr. 1931 — n. 4994; in monte Inyangani in umbra saxorum, c. 2400 m s. m., flor., 7. Dec. 1930 — 3579 (probabiliter).

Unsere beiden Kollektionen nn. 3579 und 4994 von *S. pulchra* rühren vom höchsten Teil des Berges Inyangani (2400 bzw. 2450 m Höhe) her. Die erstere, vom Anfang der Regenzeit, besteht aus alten Zweigen mit zahlreichen mehr oder weniger verwelkten Blättern, einigen Jugendsprossen mit frischen Blättern und wenigen blattwinkelständigen Blüten. Die letztere, vom Ende der Regenzeit, befindet sich in ihrem besten Stadium mit wohlentwickelten Blättern und Blüten.

Die Art gehört zur Sektion *Intermediae* und ist nahe verwandt mit *S. floribunda* (BENTH.) O. KUNTZE. *S. pulchra* unterscheidet sich von dieser Art u.a. durch ihre lockrere Blütenstellung (bisweilen die Blüten einzeln in den Blattwinkeln), durch einen nur schwach flaumhaarigen Kelch und durch ihre blauen oder blaulila Blüten. *S. floribunda* dagegen hat eine reiche Blütenstellung, einen gewöhnlich steifhaarigen Kelch und eine weisse Blumenkrone.

Nur mit Bedenken habe ich die Kollektion n. 3579 als *S. pulchra* bestimmt. Die Exemplare, die am Anfang der Vegetationsperiode eingesammelt wurden, sind in keinem guten Zustand, sondern z.T. verwelkt.

Die Blätter von *S. pulchra* sind schwachflaumhaarig oder fast unbehaart. Die Art ist habituell den Exemplaren, die ich von *S. floribunda* gesehen habe, ziemlich unähnlich.

Zaluzianskya maritima (L. f.) WALP., Repert. III, 1844—45, 307; HIERN in THISELTON-DYER, Fl. Cap. IV: 2, 1904, 335. *Erinus maritimus* L. f., Suppl. pl., 1781, 287.

Inyanga: 3 km meridiem versus a pago Inyanga in declivi montis, c. 1800 m s. m., flor., 13. Jan. 1931 — n. 4272; in montibus Inyanga Mts prope villam Inyanga Down in campo graminoso, c. 2000 m s. m., flor., 29. Jan. 1931 — n. 4691; prope pagum Cheshire in declivi montis, c. 1700 m s. m., flor., 4. Febr. 1931 — n. 4845; prope pagum Inyanga in silva nuper usta, c. 1700 m s. m., flor. et fruct., 6. Febr. 1931 — n. 4888 (f. *angustifolia*); in monte Inyangani in solo humido, c. 2200 m s. m., flor., 14. Febr. 1931 — n. 4962; ad radices montis Inyangani in solo humido ad rivulum, c. 2000 m s. m., flor., 14. Febr. 1931 — n. 5023.

Verbreitung: Kapland, Oranje-Freistaat, Basutoland, Natal, Swaziland, Transvaal und jetzt auch Süd-Rhodesia.

Diese biotypenreiche Art tritt nicht nur, wie der Artname *Z. maritima* angibt, in Küstengebieten auf, sondern kommt auch im Innern des Landes und sogar hoch oben auf Bergen vor. Sie hat eine bemerkenswert weite vertikale Verbreitung. Gemäss der Flora Capensis steigt *Z. maritima* von der Küste bis auf eine Höhe von c. 1300 m (4000 Fuss). Im Inyanga-Gebirge ist sie durch eine hochmontane Rasse vertreten, die fast das doppelte Niveau erreicht. Selbstverständlich haben die Küsten- und die hochmontanen Rassen dieser Art ziemlich verschiedene ökologische Forderungen, und morphologisch sind sie voneinander recht verschieden, aber diese Extreme sind durch eine kontinuierliche Reihe von Zwischenformen verbunden. Eine Zerspaltung der Grossart *Z. maritima* finde ich daher nicht motiviert.

Sie variiert besonders in bezug auf Behaarung, Blattbreite und Blütengrösse, und innerhalb ihres Formenkreises sind einige mehr oder weniger abweichende Typen als Arten und Varietäten beschrieben worden.

Fig. 3. *Sutera pulchra* T. NORL. (NORLINDH et WEIMARCK n. 4994 vom Inyangani, spec. orig. in herb. Lund.). × c. 1/3.

Im Inyanga-Gebiet tritt *Z. maritima* an ziemlich verschiedenen Standorten auf, und wir sammelten ein reichhaltiges Material davon ein, sowohl extrem breitblättrige als extrem schmalblättrige Formen nebst der ganzen Reihe von Zwischenformen. In diesem Fall unterliegt es kaum irgendwelchem Zweifel, dass die Schmal-, bzw. Breitblättrigkeit eine Standortsmodifikation ist. In den Einsammlungen nn. 5023, 4962 und 4691 von sehr feuchtem Boden an Bächen oder von feuchter Steppe, vom Ende der Regenperiode herrührend, waren die Exemplare breitblättrig, und einzelne Stengelblätter zeigten ein Format von bis auf 4×2 cm. In den Einsammlungen nn. 4272 und 4888 von verhältnismässig trocknen Standorten, z.B. abgebranntem Trockenwald, hatten die Exemplare dagegen schmälere, lineal-lanzettliche, lanzettliche oder schmal elliptische Blätter. Habituell erinnern einige schmalblättrige Formen in diesen Einsammlungen an *Z. capensis,* die lineale Blätter hat. Im Gegensatz zu dieser Art haben unsere Exemplare indessen einen kräftigen, perennen Wurzelstock, und die Blätter, die obersten ausgenommen, sind deutlich 3-nervig. Die breitesten Blätter können sogar deutlich 5-nervig sein.

Die ganze Pflanze wird beim Trocknen fast schwarz. Die Innenfläche der Blumenkrone ist weiss, äusserlich ist sie braunrot, wenigstens am oberen Teil. Die Blüten öffnen sich erst bei Einbruch der Nacht oder bei sehr trübem Wetter.

Mimulus gracilis R. BR., Prodr. Fl. Nov. Holl., 1810, 439; HIERN in THISELTON-DYER, Fl. Cap. IV: 2, 1904, 354; HEMSLEY et SKAN in THISELTON-DYER, Fl. trop. Afr. IV: 2, 1906, 310.

Inyanga: c. 10 km a pago Inyanga versus villam Cheshire ad rivulum, c. 1600 m s. m., flor. et fruct., 14. Jan. 1931 — n. 4303.

Makoni: in solo humido prope rivum ad villam Maidstone, c. 1450 m s. m., flor. et fruct., 4. Jan. 1931 — n. 4063.

Verbreitung: Australien, China, Indien, Abessinien, Nyassaland, Süd-Rhodesia, Angola, Port. Ostafrika und Südafrika.

Limosella major DIELS in ENGLER, Bot. Jahrb. XXVI, 1898, 122; HIERN in THISELTON-DYER, Fl. Cap. IV: 2, 1904, 357; HEMSLEY et SKAN in THISELTON-DYER, Fl. trop. Afr. IV: 2, 1906, 353; GLÜCK in ENGLER, Bot. Jahrb. LXVI, 1934, 547 et 559.

Inyanga: ad villam Cheshire in solo humido in campo graminoso, c. 1300 m s. m., flor. et fruct., 4. Febr. 1931 — n. 4853.

Verbreitung: Erythräa, Abessinien, Tanganjika-Terr., Nyassaland, Südwest-Afrika (Hereroland), Transvaal, Basutoland und jetzt auch Süd-Rhodesia.

Einige wenige Exemplare aus dieser Kollektion sind nicht typisch, sondern zunächst als Übergangsformen zu f. *terrestris* zu bezeichnen.

Limosella major f. *terrestris* GLÜCK in ENGLER, Bot. Jahrb. LXVI, 1934, 548 et 559.

Inyanga: prope pagum Inyanga ad rivulum, c. 1700 m s. m., flor. et fruct., 5. Nov. 1930 — 2639.

Verbreitung: Nyassaland, Transvaal, Basutoland, Natal und jetzt auch Süd-Rhodesia.

Die ganze Sammlung besteht aus ziemlich typischer f. *terrestris* mit kleinen Blattspreiten, relativ kurzen Ausläufern und kurzen Blütenstielen.

Craterostigma plantagineum HOCHST. in Flora, 1841, 669; HIERN in THISELTON-DYER, Fl. Cap. IV: 2, 1904, 361; HEMSLEY et SKAN in THISELTON-DYER, Fl. trop. Afr. IV: 2, 1906, 329.

Inyanga: c. 20 km a pago Inyanga versus villam Cheshire in loco aperto in silva, c. 1400 m s. m., flor. et fruct., 14. Jan. 1931 — n. 4283.

Verbreitung: Sudan, Erythräa, Abessinien, Somaliland, Uganda, Kenia, Tanganjika-Terr., Nyassaland, Angola, Süd-Rhodesia und Transvaal.

Diese Art wurde schon 1841 beschrieben. Zugrunde lag SCHIMPER's Einsammlung n. 310 vom Berge Scholoda in Abessinien. Unsere Exemplare, die in einer Waldlichtung am Fuss des Inyanga-Gebirges in c. 1400 m Höhe eingesammelt wurden, unterscheiden sich ganz unbeträchtlich von der Originalkollektion aus Abessinien. Die Blütenstellung ist eine Doldentraube mit bis 5 mm langen Blütenstielen. Nach SKAN's Bestimmungsschlüssel in der Flora of tropical Africa unterscheiden sich *C. plantagineum* und *C. nanum* mit Rücksicht auf die Blütenstellung. Bei dem ersteren wird sie als »a corymbose raceme», beim letzteren als »a spike-like raceme» beschrieben. *C. plantagineum* hat gewöhnlich 6—17 mm lange Blütenstiele. Bei *C. nanum* sind dagegen die Blütenstiele nur 2 mm lang oder kürzer. Unsere Exemplare haben bis 6 mm lange Blütenstiele und eine mehr oder weniger ausgeprägte Doldentraube. Bei einzelnen Individuen in unsrer Kollektion ist dagegen die Blütenstellung stark reduziert und die Blütenstiele sind verkürzt. Diese

Hungerformen können gewissen Formen von *C. nanum* täuschend ähnlich sein.

Craterostigma nanum (Benth.) Oliv. in Hooker, Icon. Pl. XV, 1885, 63, tab. 1479 (var. *elatior*); Hiern in Thiselton-Dyer, Fl. Cap. IV: 2, 1904, 360; Hemsley et Skan in Thiselton-Dyer, Fl. trop. Afr. IV: 2, 1906, 331. *Torenia nana* Benth. in DC., Prodr. Regn. Veg. X, 1846, 412.

Inyanga: prope pagum Inyanga in solo humido in saxis, c. 1700 m s. m., flor., 22. Jan. 1931 — n. 4529; in montibus Inyanga Mts ad villam Inyanga Down in rupibus humidis, c. 1850 m s. m., flor., 29. Jan. 1931 — n. 4645.

Verbreitung: Uganda, Kenia, Tanganjika-Terr., Nyassaland, Nord- und Süd-Rhodesia und Pondoland im östlichen Kapland.

C. nanum scheint im Inyanga-Gebirge, bis ungefähr 1700 m Höhe hinunter, ziemlich allgemein zu sein. Besonders während des letzten Teiles der Regenperiode findet man es oft blühend in Felsspalten oder auf feuchten Felsenplatten, wo sich eine Schicht Erde angesammelt hat. Nach unseren Notizen ist die Blüte weiss, die Lappen der Unterlippe mit einem rotlila Fleck versehen, der Rücken der Oberlippe mitunter rotlila, der Schlund mit lila Streifen versehen und das Knie der vorderen Staubblätter gelb.

C. nanum, das meistens auf sonnenexponierten Felsen auftritt, ist natürlich sehr dürreresistent. Im Inyanga-Gebirge sammelten wir mehrere sehr kleine blühende Exemplare, die zunächst als Hungerformen zu betrachten sind. Sie hatten sich auf Felsenplatten mit einer sehr dünnen Erdschicht und bei geringer Wasserversorgung entwickelt und waren nur ungefähr 3 cm hoch, gleichwie die Exemplare in Drège's Originalkollektion von *Craterostigma* (*Uvedalia*) *nanum* aus Natal. Wir stiessen auch auf luxurierende Formen, die ungefähr 1 dm hoch waren. Auch diese wuchsen auf Felsenplatten, aber in dicker Erde und bei reicher Wasserversorgung.

Craterostigma nanum var. *lanceolatum* Engl. in Engler, Pflanzenw. Ost-Afr. C, 1895, 357. *C. lanceolatum* (Engl.) Skan in Thiselton-Dyer, Fl. trop. Afr. IV: 2, 1906, 331.

Inyanga: prope pagum Inyanga in solo humido in saxis, c. 1700 m s.m., flor. et fruct., 22. Jan. 1931 — n. 4529 a.

Verbreitung: Nyassaland und jetzt auch Süd-Rhodesia.

In seinem Bestimmungsschlüssel in der Flora of tropical Africa benutzte Skan Blattcharaktere, um *C. nanum* und *C. lanceolatum* voneinander zu trennen. Nach ihm ist bei der ersteren Art die Länge der Blätter nicht mehr als dreimal die Breite. Bei der letzteren ist dagegen die Länge mehr als viermal die Breite. Im Inyanga-Gebirge sammelten wir ein reiches Material von *Craterostigma,* das eine kontinuierliche Reihe Blattformen aufweist: von solchen, die mit der Originalkollektion von *C. nanum* übereinstimmen (eirund mit dem Verhältnis von Länge zu Breite ungefähr 2 : 1), bis solche, die mit *C. lanceolatum* übereinstimmen (verkehrt-lanzettlich mit dem obigen Verhältnis ungefähr 6 : 1). Die Extreme sehen ziemlich verschieden aus, aber da es keine scharfe Grenze zwischen ihnen gibt, so ziehe ich es vor, ähnlich wie ENGLER, *C. lanceolatum* als eine Varietät aufzuführen. Ohne Kultivierungsexperimente dürfte es unmöglich sein, zu entscheiden, ob die letztgenannte eine schmalblättrige Rasse von *C. nanum* oder nur eine Modifikation davon ist.

Ilysanthes Muddii HIERN in THISELTON-DYER, Fl. Cap. IV: 2, 1904, 366.

Inyanga: prope pagum Inyanga in saxis humidis terrosis, c. 1700 m s. m., flor., 22. Jan. 1931 — n. 4531.

Makoni: ad villam Wick in saxis, c. 1800 m s. m., flor. et fruct., 9. Febr. 1931 — n. 4917.

Verbreitung: Süd-Rhodesia und Transvaal.

Diese winzige Art tritt besonders auf feuchten Felsenplatten mit einer mehr oder weniger dünnen Erdschicht sowie in Felsenrissen auf und ist äusserst unscheinbar, nur etwa 3—6 cm hoch. Die Blüten sind deutlich gestielt und die Kronröhre c. 5 mm lang. Auch in anderen Charakteren stimmt sie mit *I. Muddii* gut überein, die aus Transvaal beschrieben worden ist. Die Blüten haben eine gelbgrüne Oberlippe und ein gelbes Knie an dem Staubblatt, sind aber im übrigen blau.

Ilysanthes pulchella ssp. **rhodesiana** T. NORLINDH subspec. nova.

Spec. orig.: FRIES, NORLINDH et WEIMARCK n. 3255.

Icon.: Fig. nostra 4 *f* et *h*.

A typo differt: foliis densius hispidis; lobis calycis angustioribus et acutioribus.

Inyanga: prope pagum Inyanga in saxis (in associatione *Velloziae*), c. 1700 m s. m., fruct., 26. Nov. 1930 — n. 3255; eod. loco (in associatione *Velloziae*), flor. et fruct., 11. Dec. 1930 — n. 3255 a; eod. loco, in saxis humidis, flor. et fruct. — 3255 b.

Makoni: ad villam Wick in rupibus, c. 1800 m s. m., fruct., 9. Febr. 1931 — n. 4913.

Belingwe: ad pagum Mnene in saxis humidis, flor. et fruct., 26. Febr. 1931 — n. 5147.

Verbreitung: Hauptart im Nyassaland — Unterart in Süd-Rhodesia.

Unser Material von den Einsammlungen 3255, 3255 a und 3255 b aus Inyanga stimmt in den meisten Merkmalen gut mit dem Originalexemplare von *Ilysanthes pulchella* SKAN vom Mount Zomba im Nyassaland überein. Diese Pflanzen wachsen auf ungefähr gleicher Höhe des Mount Zomba und des Inyanga-Gebirges, nämlich c. 1700 m und etwas höher.

Die Samen der Mount Zomba- und der Inyanga-Kollektion sind einander sehr ähnlich. Sie sind fast ebenso breit wie lang und mit kleinen Grübchen und mikroskopisch kleinen, weissen, mehr oder weniger sternförmigen Haaren versehen (Fig. 4 *h*). Diese Härchen sitzen los und fallen bei Berührung leicht ab. Sie treten bei reifen Samen am deutlichsten hervor.

Betreffend den Grad der Behaarung und die Form der Kelchzähne finde ich Abweichungen von der typischen *I. pulchella* aus dem Nyassaland. Bei unserem Inyanga-Material sind die Blätter, besonders ihre Unterseite, der Stengel und die Zweige bedeutend dichter mit kurzen, steifen, weissen Haaren bekleidet. Die Kelchzähne sind mehr oder weniger deutlich spitz, mitunter aber etwas stumpf. Bei dem Originalexemplare von *I. pulchella* sind wenigstens einige Zähne des Kelches sehr stumpf. Unsere Exemplare können sowohl etwas stumpfe wie spitze Zähne am selben Kelch haben. Die Ränder der Kelchzähne sind oft mehr oder weniger eingebogen wodurch man leicht den Eindruck bekommt, dass sie spitz seien, auch wenn dies nicht der Fall ist. Beim Aufkochen des Kelches und Entfalten der Zähne habe ich bisweilen feststellen können, dass ein Kelch, der scheinbar nur spitze Zähne hat, auch ein paar stumpfe trägt.

Mit den Inyanga-Exemplaren stimmen auch unsere Einsammlung n. 4913 aus dem Makoni-Distrikt und n. 5147 aus dem Belingwe-Distrikt überein, letztere indessen weniger gut.

Die erwähnten Rhodesia-Einsammlungen von *Ilysanthes,* die von *I. pulchella* aus dem Nyassaland hauptsächlich in relativen Charakteren abweichen, vertreten nach meiner Ansicht eine geographische Rasse, eine Subspecies, dieser Art.

I. pulchella ist sehr nahe mit *I. Bolusii* HIERN aus Transvaal verwandt. Sie unterscheiden sich hauptsächlich in bezug auf das Aussehen der Samen und die Form der Staubgefässrudimente. Die letztere Art hat unbehaarte Samen. Dagegen kann die Form der Kelchzähne

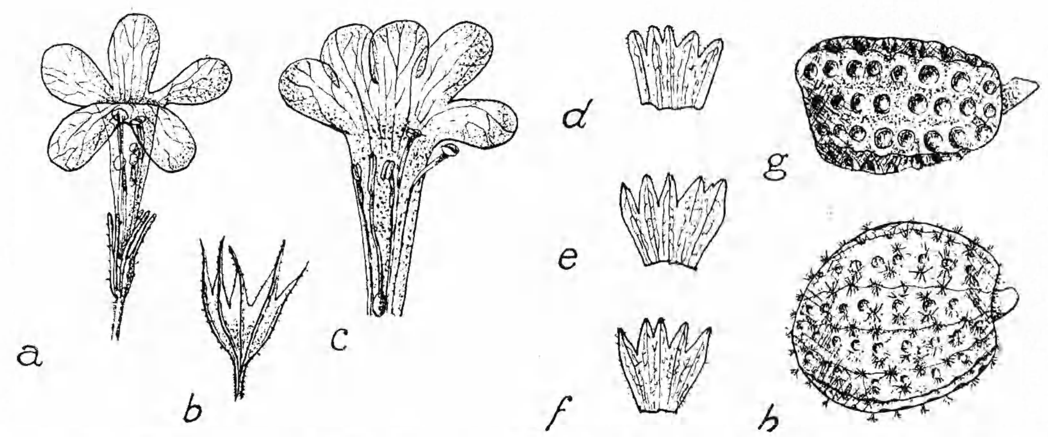


Fig. 4. *a—c Sutera pulchra* T. NORL. *a* Blüte *b* Kelch *c* Korolle, aufgeschlitzt (NORLINDH et WEIMARCK n. 4994). × 1 $^1/_2$; *d—e* Kelch von *Ilysanthes saxatilis* T. NORL. (NORLINDH et WEIMARCK n. 4969); *f* Kelch von *I. pulchella* ssp. *rhodesiana* (FRIES, NORLINDH et WEIMARCK n. 3255 b, nahe dem Dorf Inyanga). *d—f* × 1 $^1/_2$; *g* Samen von *I. saxatilis* (NORLINDH et WEIMARCK n. 4969); *h* Samen von *I. pulchella* ssp. *rhodesiana* (NORLINDH et WEIMARCK n. 4913 aus dem Makoni-Distrikt). *g—h* × 35.

nicht als arttrennender Charakter verwendet werden, denn ssp. *rhodesiana* kann ziemlich ausgeprägt spitze Kelchzähne haben, was mit *I. Bolusii* stets der Fall zu sein scheint.

Die Blumenkrone von ssp. *rhodesiana* ist meistens c. 8 mm lang, blau und weiss, aber etwas unregelmässig in bezug auf die Farbe. Die Kronröhre und der Schlund sind weiss und wenigstens die Unterlippe blau oder blaulila. Oft ist die ganze Oberlippe weiss (oder gelbweiss).

I. pulchella ssp. *rhodesiana* ist äusserst resistent gegen Dürre. Sie tritt auf Felsenplatten, oft in der *Vellozia*-Association, auf.

Ilysanthes ***saxatilis*** T. NORLINDH spec. nova.

Spec. orig.: NORLINDH et WEIMARCK n. 4969 in herb. Lund.

Icon.: Fig. nostrae 4 *d—e, g* et 5.

Herba perennis vel annua 3—10 cm alta; caules erecti singulares vel pauci e rhizomate usque 5 mm crasso exeuntes simplices vel rarius pauciramosi graciles vix 1 mm crassi tetragoni glabri vel glabriusculi laxe foliati; internodia 0,5—2,5 cm longa. Folia crassiuscula glabra vel subglabra integerrima vel interdum dentibus paucis remotis haud conspicuis instructa obtusa, folia radicalia rosulata obovata—spathulata—anguste elliptica—oblanceolata basin versus in petiolum angustata petiolo incluso 0,5—2,5 cm longa 0,2—0,3 cm lata, folia caulina opposita anguste elliptica—spathulata—oblanceolata sessilia vel subsessilia. Flores terminales et axillares in pedunculis glabris vel subglabris 1—

1,5 cm longis; pedunculi axillares in fructificatione elongati usque 2 cm longi patentes vel demum divaricati; calyx glaber vel subglaber 4—5 mm longus 5-dentatus, dentibus oblongo-ovatis apice rotundatis obtusis vel rarissime 1—2 subacutis margine ciliatis 1—1,5 mm longis; corolla coerulea (in sicco rosea—purpurea) 8—15 mm longa, labio superiore obovato-oblongo usque 5 mm longo bifido, lobis vel dentibus 1—2 mm longis obtusis vel acutis, labio inferiore usque 9 mm longo usque 10 mm lato, lobis lateralibus obovato-oblongis c. 3 mm longis, lobo mediano suborbiculari usque 4 mm longo usque 6 mm lato; capsula 8 mm longa 3 mm lata ellipsoidea apiculata; semina glabra foveolata c. 0,7 mm longa.

Inyanga: in monte Inyangani in saxis planis solo obtectis, c. 2400 m s. m., flor. et fruct., 14. Febr. 1931 — n. 4969.

Diese Art wuchs in der obersten Region des Inyangani neben oder auf flachen Felsenplatten. Die Blüten sind sehr hübsch, in frischem Zustand tief blau, aber beim Trocknen verlieren sie ihre natürliche Farbe. Bei unseren Exemplaren sind sie beim Pressen rosa- bis purpurfarbig geworden.

Mit Rücksicht auf die eigentümlichen Standorte, an denen die Pflanze vorkommt, ist es ja nicht zu verwundern, dass die Art an Blütengrösse, Höhe des Stengels etc. stark variiert. Bei den kleinen Hungerformen, die sich in einer sehr dünnen Erdschicht entwickelt haben und die zeitweise schwerer Dürre ausgesetzt worden sind, ist die Blüte in extremen Fällen nur ungefähr 8 mm lang. Normal scheint sie bei unserm Material von dem Inyangani 12—15 mm lang zu sein.

Hinsichtlich der Kelchzähne variiert *I. saxatilis* beträchtlich. Bei unseren Exemplaren hat der Kelch oft sehr stumpfe bis gerundete Zähne (Fig. 4 *d*), bisweilen sind aber nicht alle Zähne deutlich stumpf, sondern ein paar beinahe spitz (Fig. 4 *e*).

Die reifen Samen sind länglich-kugelrund, ungefähr 0,7 mm lang und mit in Reihen geordneten Grübchen. Die Blätter sind ganzrandig oder undeutlich und spärlich gezähnt.

I. saxatilis, die mit *I. pulchella* SKAN am nächsten verwandt ist, unterscheidet sich von dieser u.a. dadurch, dass die Samen mikroskopisch kleine, mehr oder wenig sternförmige Haare entbehren (Fig. 4 *g*), dadurch, dass die Blütenstiele im vorgeschrittenen Fruchtstadium stark abstehend oder ausgesperrt sind und dadurch, dass die Blätter unbehaart oder fast unbehaart sind.

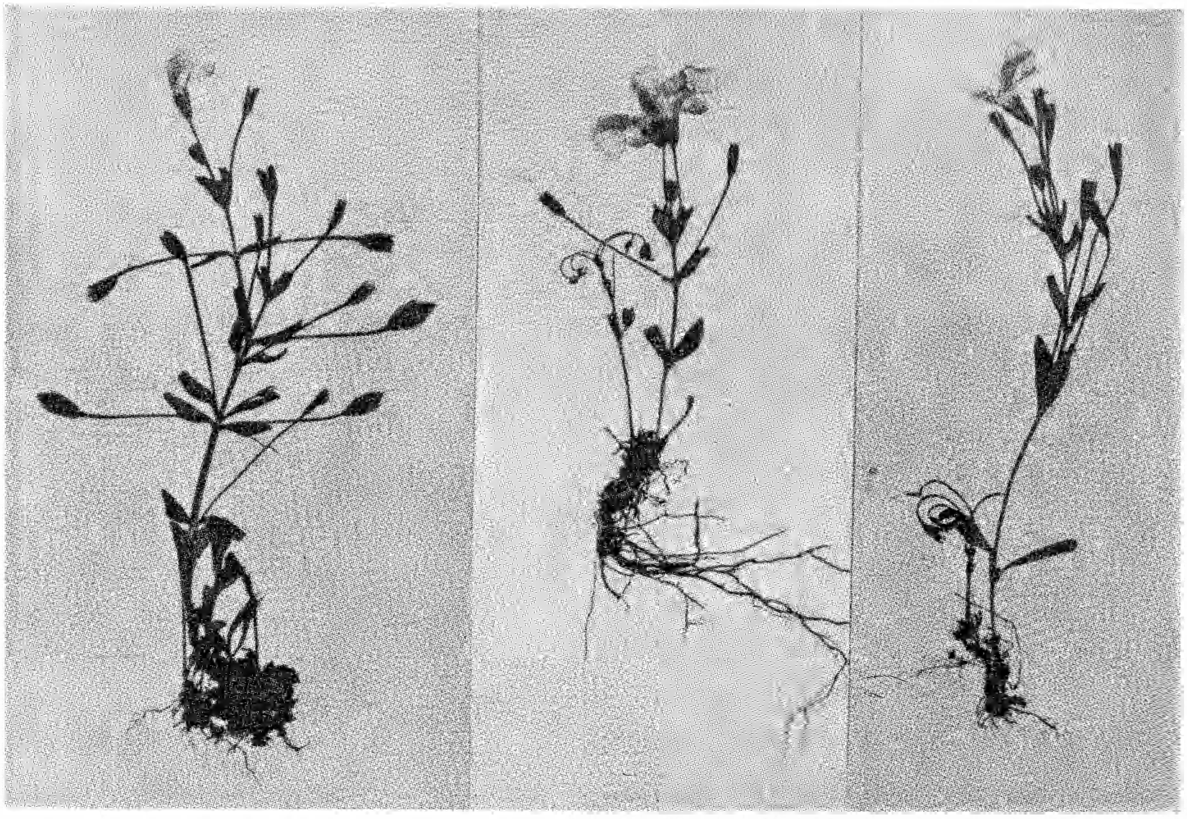


Fig. 5. *Ilysanthes saxatilis* T. NORL. (NORLINDH et WEIMARCK n. 4969 vom Inyangani, spec. orig. in herb. Lund.). × 0,7.

Hebenstreitia polystachya HARV. ex ROLFE in THISELTON-DYER, Fl. Cap. V: 1, 1901, 98.

Inyanga: 3 km occidentem versus a monte Inyangani in palude, c. 2000 m s. m., spec. juvenil., 6. Dec. 1930 — n. 3498; ad villam Inyanga Down in palude, c. 1950 m s. m., flor., 29. Jan. 1931 — n. 4674; in monte Inyangani in rupibus humidis, c. 2400 m s. m., flor., 14. Febr. 1931 — n. 4987; eod. loco, in campo graminoso ad rivulum, c. 2000 m s. m., flor., 14. Febr. 1931 — n. 5049.

Verbreitung: Natal, Transvaal und jetzt auch Süd-Rhodesia. Blüten weiss mit einem orangefarbigen Fleck.

Walafrida sp.

Im Inyanga-Gebiet brachten wir sieben Einsammlungen von Arten der kritischen Gattung *Walafrida* zusammen. Leider habe ich bisher keine Gelegenheit gehabt, die Originalexemplare der *Walafrida*-Arten zu studieren, welche sich auf Einsammlungen aus Rhodesia und angrenzenden Gebieten gründen. Die Gattung ist allzu schwierig, als dass man bei der Artbestimmung nur auf Grund von Beschreibungen zu einem sicheren Resultat gelangen könnte. Aus diesem Grunde warte ich mit der Veröffentlichung unseres Materials von *Walafrida* bis zu einem späteren Heft der Beiträge zur Kenntnis der Flora von Süd-Rhodesia.

Veronica javanica BLUME, Bijdr. Fl. Nederl. Ind., 1825—26, 742; HOOK. f., Fl. Brit. Ind. IV, 1885, 296. *V. chamaedryoides* ENGL., Pfl.-welt Ost-Afrikas C., 1895, 358.

Inyanga: supra dejectum fluminis Pungwe ad ruinas, c. 1800 m s. m., flor. et fruct., 16. Dec. 1931 — n. 3783.

Verbreitung: Asien: Java, Indien, Siam, Tonkin und Luchu-Inseln in Japan; Afrika: Erythräa, Abessinien, Somaliland, Uganda, Tanganjika-Terr. und jetzt auch Süd-Rhodesia.

Diese weitverbreitete Art trafen wir in alten Ruinen oberhalb der Pungwe-Fälle an. Ohne Zweifel ist sie anthropochor. Die Blüten sind hellblau.

Melasma calycinum (HIERN) HEMSL. in THISELTON-DYER, Fl. trop. Afr. IV: 2, 1906, 362. *Velvitsia calycina* HIERN in Cat. Afr. Pl. WELW. I: 3, 1898, 771.

Makoni: prope pagum Rusapi, c. 1450 m s. m., 26. Okt. 1930 — n. 2288.

Verbreitung: Tanganjika-Terr., Angola, Nord- und jetzt auch Süd-Rhodesia.

Unseren Notizen nach ist die Blumenkrone weiss, was mit der Originalbeschreibung von *Velvitsia calycina* HIERN übereinstimmt.

Melasma scabrum BERG., Descr. Pl. Cap., 1767, 162, tab. 3, fig. 4; HIERN in THISELTON-DYER, Fl. Cap. IV: 2, 1904, 372.

Inyanga: 9 km a pago Inyanga ad ripam fluminis Nianoli, c. 1700 m s. m., flor. et fruct., 28. Jan. 1931 — n. 4622.

Verbreitung: Kapland, Oranje-Freistaat, Natal, Transvaal und jetzt auch Süd-Rhodesia.

Die Blüten sind gelb mit braunem Schlund.

Gerardiina angolensis ENGL., Bot. Jahrb. XXIII, 1897, tab. 10, G-M; HIERN in THISELTON-DYER, Fl. Cap. IV: 2, 1904, 378; HEMSLEY et SKAN in THISELTON-DYER, Fl. trop. Afr. IV: 2, 1906, 373.

Inyanga: 3 km occidentem versus a monte Inyangani in palude, c. 2000 m s. m., flor., 6. Dec. 1930 — n. 3454; in montibus Inyanga Mts prope villam Inyanga Down in palude in campo montano graminoso, c. 2000 m s. m., flor., 29. Jan. 1931 —

n. 4704; in monte Inyangani in uligine, c. 2400 m s. m., flor. et fruct., 14. Febr. 1931 — n. 4978.

Verbreitung: Tanganjika-Terr., Nyassaland, Angola, Transvaal, Swaziland und jetzt auch Süd-Rhodesia.

Diese hübsche und interessante Art war früher nicht aus Rhodesia bekannt. Sie scheint nur auf höheren Niveaus des Inyangani, 2000—2400 m, aufzutreten, und wächst dort in Sümpfen und auf Mooren. Die Pflanze ist 4—6 dm hoch und hat grosse blaulila oder lila Blüten, die indessen beim Trocknen schwarz werden.

Graderia scabra (L. f.) BENTH. in DC., Prodr. Regn. Veg. X, 1846, 521 (excl. BURKE's Exemplare); H. MELCHIOR in Notizbl. Bot. Gart. u. Mus. Berlin-Dahlem XI, 1932, 602. *Bopusia scabra* (L. f.) PRESL, Botan. Bemerk., 1844, 91, nom. nud.; Hiern in THISELTON-DYER, Fl. Cap. IV: 2, 1904, 389. *Gerardia scabra* L. f., Suppl. pl., 1781, 279.

Inyanga: prope pagum Inyanga ad rivulum Kuhera in campo graminoso montano 100 m supra limitem silvae *Brachystegiae Randii,* flor. et fruct., 20. Nov. 1930 — n. 3108; ad radices montis Inyangani in campo graminoso, c. 2100 m s. m., flor. et fruct., 7. Dec. 1930 — n. 3611; supra dejectum fluminis Pungwe in campo graminoso montano, c. 1850 m s. m., ster., 19. Dec. 1930 — n. 3967; in montibus Inyanga Mts prope villam Inyanga Down in campo graminoso montano, c. 2000 m s. m., fruct., 29. Jan. 1931 — n. 4701.

Verbreitung: Kapland, Oranje-Freistaat, Natal, Transvaal und jetzt auch Süd-Rhodesia.

G. scabra ist ziemlich allgemein auf der hochmontanen Steppe des Inyanga-Gebirges und geht bis auf c. 1800 m Höhe hinunter. Von ihrem kräftigen, verholzten Stock gehen mehr oder weniger aufrechte oder mitunter kriechende Stengel aus. Sie hat grosse, hellrote Blüten.

Sopubia Dregeana BENTH. ex DC., Prodr. Regn. Veg. X, 1846, 522, pro parte; HEMSLEY et SKAN in THISELTON-DYER, Fl. trop. Afr. IV: 2, 1906, 453.

Inyanga: 10 km a pago Inyanga versus villam Inyanga Down in campo graminoso, c. 1800 m s. m., flor., 28. Jan. 1931 — n. 4637.

Verbreitung: Tanganjika-Terr., Nord- und Süd-Rhodesia, Transvaal, Natal und südwärts bis in Uitenhage im östlichen Kapland.

Sopubia Dregeana var. *tenuifolia* ENGL. et GILG in BAUM, Kunene-Samb. Exped., 1903, 365; HEMSLEY et SKAN in THISELTON-DYER, Fl. trop. Afr. IV: 2, 1906, 453.

Makoni: ad villam Valhalla prope pagum Rusapi in campo graminoso, c. 1450 m s. m., vix flor., 30. Dec. 1930 — n. 4039.

Verbreitung: Angola und jetzt auch Süd-Rhodesia.

Sopubia ramosa HOCHST. in Flora, 1844, 27; HEMSLEY et SKAN in THISELTON-DYER, Fl. trop. Afr. IV: 2, 1906, 449; *S. trifida* var. *ramosa* ENGL., Hochgebirgsfl. trop. Afr., 1892, 383.

Inyanga: prope pagum Inyanga ad collem Chemeo ad marginem paludis, c. 1800 m s. m., flor. et fruct., 26. Jan. 1931 — n. 4597; prope pagum Cheshire in declivi montis, c. 1500 m s. m., flor. et fruct., 4. Febr. 1931 — n. 4842.

Verbreitung: Franz. Guinea, Sierra Leone, Gold-Küste, Togo, Nigeria, Kamerun, Sudan, Abessinien, Uganda, Kenia, Tanganjika-Terr., Belg. Kongo, Angola, Nord- und Süd-Rhodesia, Nyassaland und Port. Ostafrika.

Die Blüten sind hellila.

Sopubia Buchneri ENGL. in ENGLER, Bot. Jahrb. XVIII, 1894, 66; SKAN in THISELTON-DYER, Fl. trop. Afr. IV: 2, 1906, 451.

Inyanga: in montibus Inyanga Mts ad villam Inyanga Down in campo graminoso, c. 2000 m s. m., flor. et fruct., 29. Jan. 1931 — n. 4682.

Verbreitung: Angola und jetzt auch Süd-Rhodesia.

Unsere Exemplare stimmen in allen wesentlichen Charakteren mit ENGLER's Beschreibung von *S. Buchneri* überein. Sie unterscheidet sich von *S. ramosa* durch ihre grossen Blüten, mehr als 2 cm im Durchmesser, und durch ihre 1,5—2 cm langen Blütenstiele. Die Blüten sind blaulila.

Sopubia simplex HOCHST. in Flora, 1844, 27; HIERN in DYER, Fl. Cap. IV: 2, 1904, 386, pro parte; HEMSLEY et SKAN in THISELTON-DYER, Fl. trop. Afr. IV: 2, 1906, 451.

Inyanga: infra dejectum fluminis Pungwe in valle, c. 1400 m s. m., flor. et fruct., 18. Dec. 1930 — n. 3942.

Makoni: prope pagum Rusapi, c. 1450 m s. m., flor. et fruct., 14. Nov. 1930 — n. 2994; ad villam Maidstone in solo humido in campo graminoso, c. 1450 m s. m., flor. et fruct., 5. Jan. 1931 — n. 4122.

Verbreitung: Franz. Guinea, Gold-Küste, Togo, Nigeria, Kamerun, Franz. und Anglo-ägypt. Sudan, Abessinien, Uganda, Tanganjika-Terr., Belg. Kongo, Angola, Nord- und Süd-Rhodesia, Nyassaland, Port. Ostafrika, Transvaal, Oranje-Freistaat, Natal und Kapland.

Buchnera Randii S. MOORE in Journ. Bot., 1900, 467; SKAN in THISELTON-DYER, Fl. trop. Afr. IV: 2, 1906, 387.

Inyanga: 3 km occidentem versus a monte Inyangani in palude, c. 2000 m s. m., flor., 6. Dec. 1930 — n. 3452.

Verbreitung: Nord- und Süd-Rhodesia.

Buchnera Randii und *B. pusilliflora* sind von S. MOORE aus Salisbury bzw. Mazoe, zwei nahgelegenen Orten in Süd-Rhodesia, beschrieben worden. Dieser hebt hervor, dass die letztere Art sich von *B. Randii* hauptsächlich durch unscheinbareren Habitus, deutlich weniger »hispid» Ähren, verschiedene Deckblätter und Brakteolen, sowie durch schmale Kronlappen unterscheidet. Die Deckblätter von *B. pusilliflora* werden als lineal oder lineal-lanzettlich beschrieben, die Brakteolen als pfriemlich und die Kronlappen als länglich; bei *B. Randii* dagegen die Deckblätter als eirund-lanzettlich, die Brakteolen als borstenartig und die Kronlappen als verkehrt-eirund bis länglich.

In einem Sumpf am Fuss des Inyangani sammelten wir ein blühendes Exemplar von *Buchnera* ein, das betreffend Deckblätter und Kronlappen am besten mit *B. Randii* übereinstimmt. Die untersten Blüten sitzen indessen c. 10 mm von den übrigen der Ähre getrennt, wie bei *B. pusilliflora*. Die Brakteolen sind lineal-lanzettlich. Meiner Meinung nach gehört unser Exemplar, trotz gewissen Abweichungen, zur Formserie von *B. Randii*. Es ist zweifelhaft, ob *B. pusilliflora* als eine selbständige Art aufrechtzuerhalten sein wird. Sie ist nur schwach von *B. Randii* abgegrenzt.

Buchnera Lastii ENGL. Pflanzenw. Ost-Afr. C, 1895, 359; SKAN in THISELTON-DYER, Fl. trop. Afr. IV: 2, 1906, 392.

Inyanga: prope dejectum fluminis Pungwe in campo graminoso montano, c. 1850 m s. m., flor., 6. Nov. 1930 — n. 2713; c. 30 km meridiem versus a pago Inyanga in campo graminoso, flor. et fruct., 19. Nov. 1930 — n. 3028; in monte Inyangani in campo fruticoso saxoso, c. 2200 m s. m., flor. et fruct., 7. Dec. 1930 — n. 3607.

Verbreitung: Nyassaland, Süd-Rhodesia und Port. Ostafrika.

Bei *B. Lastii* sind die Ähren unterbrochen. Nach SKAN sind die unteren Blütenpaare ungefähr 1,5—4 cm (8—18 lin.) voneinander entfernt. Bei der nahverwandten Art *B. tuberosa* sind die Ähren dagegen ununterbrochen, mitunter ist jedoch das allerunterste Blütenpaar von den übrigen ein wenig getrennt. In unserem Material aus dem Inyanga-Gebiet finden sich einige Grenzfälle, wo ich nicht weiss, ob die Ähre als unterbrochen oder ununterbrochen zu bezeichnen ist. Die unteren Blütenpaare sitzen indessen meistens deutlich, 1—1,5 cm oder bisweilen noch weiter, sogar 2 cm, voneinander getrennt. Ich bezweifle, dass *B. Lastii* und *B. tuberosa* in Zukunft als Arten auseinandergehalten werden können. Sie scheinen sich nur in quantitativen Charakteren voneinander zu unterscheiden.

All unser Material von nn. 2713, 3028 und 3607 habe ich als *B. Lastii* bestimmt, welcher Name die Priorität hat, wenn diese Arten vereinigt werden müssen. Unsere Exemplare stimmen in bezug auf die Länge der Kronröhre, des Stiftes und der Kapsel sowie die Grösse der Blätter ziemlich gut mit der Beschreibung dieser Art überein. Die Deckblätter sind dichter gewimpert und bei Kollektion n. 3607 etwas breiter, als die Beschreibung von *B. Lastii* angibt.

Die Pflanze hat einen kräftigen, bis auf 2 cm dicken, stark verholzten Stock, von dem eine mehr oder weniger grosse Anzahl Stengel ausgehen.

Nach unseren Notizen sind die Blüten hellgelb oder wachsgelb.

Im Inyanga-Gebiet ist sie allgemein auf Steppe in über 1800 m Höhe.

Buchnera Henriquesii ENGL. in ENGLER, Bot. Jahrb. XVIII, 1894, 69, tab. 3, fig. B; HEMSLEY et SKAN in THISELTON-DYER, Fl. trop. Afr. IV: 2, 1906, 396. *B. rhodesiana* S. MOORE in Journ. Bot. 1900, 468.

Makoni: prope pagum Rusapi, c. 1450 m s. m., flor., 26. Okt. 1930 — n. 2304; eod. loco, flor. et fruct., 14. Nov. 1930 — n. 2995.

Verbreitung: Angola, Nord- und Süd-Rhodesia.

Die Blüten sind in frischem Zustand schön blau oder violett, werden aber beim Trocknen schwarz.

Buchnera multicaulis ENGL. in ENGLER, Bot. Jahrb. XVIII, 1894, 69, tab. 3, fig. A; SKAN in THISELTON-DYER, Fl. trop. Afr. IV: 2, 1906, 396.

Inyanga: ad radices montis Inyangani, latere occidentali, in campo graminoso, c. 2000 m s. m., flor., 7. Dec. 1930 — n. 3558.

Verbreitung: Angola und jetzt auch Süd-Rhodesia.

Die Kollektion n. 3558 vom Fuss des Inyangani stimmt in allen wesentlichen Charakteren mit ENGLER's Beschreibung von *Buchnera multicaulis* überein. Die einzige nennenswerte Abweichung ist, dass die blühenden Stengel bei unseren Exemplaren nur 2—3 cm lang sind, während ENGLER die Länge der Stengel mit 7—8 cm angibt. Leider habe ich keine Gelegenheit gehabt, unser Material mit einem Exemplar von *B. multicaulis,* von ENGLER oder von SKAN in der Flora of tropical

Africa angeführt, zu vergleichen, sondern gründe meine Bestimmung nur auf ihre Beschreibungen.

Buchnera multicaulis var. ***grandifolia*** T. NORLINDH var. nova.

Spec. orig.: NORLINDH et WEIMARCK n. 4820 in herb. Lund.

Differt a typo: foliis majoribus usque 4 cm longis usque 1,5 cm latis, floribus numerosis.

Inyanga: prope villam »Rhodes Estate» versus flumen Pungwe in campo graminoso montano, flor. et fruct., 6. Nov. 1930 — n. 2665; in montibus Inyanga Mts orientem versus a pago Cheshire in campo graminoso, c. 2300 m s. m., flor. et fruct., 4. Febr. 1931 — n. 4820.

Unser Material der Kollektionen nn. 4820 und 2665 stimmt mit Rücksicht auf die Form und Grösse des Kelches und der Blumenkrone mit *B. multicaulis* ziemlich gut überein. Die Blätter sind indessen bedeutend grösser. Nach der Flora of tropical Africa sind die Blätter länglich-spatelförmig, nur c. 0,8—1,4 cm lang und 0,3—0,4 cm breit. Bei unseren Exemplaren sind sie länglich-spatelförmig, elliptisch oder verkehrt-eirund, gewöhnlich 1,5—4 cm lang und 0,5—1,5 cm breit. Die Infloreszenzen haben im allgemeinen zahlreiche Blüten, nach der obengenannten Flora sind sie aber ganz wenig bei *B. multicaulis*. Die Stengel und die Internodien sind bei den meisten Exemplaren länger, als die Beschreibung angibt. Soweit ich finden kann, unterscheiden sich unsere Einsammlungen nur in quantitativen Charakteren von *B. multicaulis*. Unsere Formserie ist von *B. multicaulis* nicht scharf abgegrenzt, mindestens nicht gemäss der Artdiagnose. Deshalb habe ich sie nicht als eine eigene Art beschreiben wollen, sondern ihr nur den Rang einer Varietät gegeben.

Die Blüten sind bei der Kollektion n. 4820 weiss, bei n. 2665 blauweiss, aber bei unserer Einsammlung der Hauptart, n. 3558, blau. ENGLER und SKAN geben an, *B. multicaulis* habe blaue Blüten. Beim Trocknen werden sie schwarz. Die nahestehende Art *B. Henriquesii* hat nach SKAN eine variierende Blütenfarbe: tiefblau, hellviolett, rosa oder weiss. Wahrscheinlich hat *B. multicaulis* eine ebenso stark variierende Blütenfarbe.

Es gibt keine Angabe über das Aussehen der Samen von *B. multicaulis*. Unsere Exemplare haben glänzend schwarze, c. 0,6 mm lange und c. 0,4 mm breite Samen mit netzartigen Erhebungen an der Oberfläche.

Buchnera hispida BUCH.-HAM. in D. DON, Prodr. Fl. Nepal, 1825, 91; HEMSLEY et SKAN in THISELTON-DYER, Fl. trop. Afr. IV: 2, 1906, 397.

Belingwe: ad pagum Mnene in silva, fruct., 27. Febr. 1931 — n. 5201.

Verbreitung: Senegambien, Franz. Guinea, Nigeria, Erythräa, Abessinien, Uganda, Kenia, Nyassaland, Angola, Nord- und Süd-Rhodesia, Port. Ostafrika, Südwest-Afrika, Madagaskar und Indien.

Blüten blau mit gelber Röhrenmündung.

Buchnera Eylesii S. MOORE in Journ. Bot. XLVI, 1908, 72.

Inyanga: prope pagum Inyanga in campo fruticoso ad collem Chemeo, c. 1800 m s. m., flor. et fruct., 24. Jan. 1930 — n. 4575.

Verbreitung: Süd-Rhodesia.

Ohne Zweifel gehört unsere Kollektion n. 4575 zur Formserie von *B. Eylesii,* aber die Exemplare weichen in gewissen Hinsichten von MOORE's Beschreibung ab. Nach ihm ist die Art ein aufrechtes Kraut, aber unsere Exemplare haben einen stark verholzten Stengel, und sowohl der Stengel wie die Zweige sind mehr oder weniger niedergebogen. In dem Entwicklungsstadium, worin wir die Pflanze fanden, war sie ein c. 1 m hoher Halbstrauch. Sie hat weisse Blüten, die beim Trocknen schwarz werden.

Eylesia buchneroides S. MOORE in Journ. Bot. XLVI, 1908, 310, Tab. 495 B.

Makoni: ad villam Duniden in solo humido ad rivulum, c. 1800 m s. m., flor., 9. Febr. 1931 — 4932.

Verbreitung: die Art ist bisher nur aus Süd-Rhodesia bekannt.

Die monotypische Gattung *Eylesia* steht *Buchnera* sehr nahe. Bei einer gründlichen Revision dieser Gattungen ist es wenig wahrscheinlich, dass man *Eylesia* als eine eigene Gattung aufrechterhalten kann. SPENCER MOORE gibt an, der Hauptcharakter für *Eylesia* sei der merkwürdige 2-lippige Kelch. Bei unserem Material von *Eylesia* ist diese 2-Lippigkeit nicht so stark ausgeprägt, wie das Bild in MOORE's Arbeit zeigt (Tab. 495 B, Fig. 3), und dadurch ist die Gattung nicht mehr so scharf von *Buchnera* abzugrenzen.

Eylesia buchneroides ist gewissen Formen von *Buchnera pusilliflora* und *B. Randii* täuschend ähnlich. Zum Unterschiede von diesen ist die Röhre der Blumenkrone bei *E. buchneroides* auf der Aussenseite unbehaart, und ausserdem ist der Kelch in 4 Lappen geteilt. Einige Arten der Gattung *Buchnera* haben, wie *Eylesia,* 4-zähligen Kelch.

Cycnium adonense E. MEY. ex BENTH. in HOOKER, Comp. Bot. Mag. I, 1835, 368; HIERN in THISELTON-DYER, Fl. Cap. IV: 2, 1904, 395; HEMSLEY et SKAN in THISELTON-DYER, Fl. trop. Afr., 1906, 431.

Inyanga: ad pagum Inyanga in campo graminoso, c. 1700 m s. m., flor., 30. Okt. 1930 — n. 2440; supra dejectum fluminis Pungwe in campo graminoso montano, c. 1850 m s. m., flor., 6. Nov. 1930 — n. 2687 (forma!); c. 30 km meridiem versus a pago Inyanga in campo nuper usta ad limitem superiorem silvae *Brachystegiae Randii,* flor., 19. Nov. 1930 — n. 3045; in monte Inyangani in campo fruticoso, c. 2400 m s. m., flor., 7. Dec. 1930 — n. 3606 (forma!); 3 km occidentem versus a monte Inyangani in campo graminoso, c. 2000 m s. m., flor., 8. Dec. 1930 — n. 3636.

Verbreitung: Uganda, Kenia, Tanganjika-Terr., Belg. Kongo, Nord- und Süd-Rhodesia, Nyassaland, Port. Ostafrika, Transvaal, Natal und östliches Kapland bis in Uitenhage.

Diese Art ist sehr variabel. Unsere Einsammlungen n. 2687 aus der Nähe der Pungwe-Fälle und n. 3606 vom Inyangani haben eine 9 bzw. 10 cm lange Kronröhre. Formen mit langer Röhre sind unter dem Namen *C. longiflorum* beschrieben worden. Die Exemplare von n. 2440, ein paar Wochen vor Beginn der Regenzeit auf einem trocknen Feld bei Inyanga eingesammelt, haben Blüten mit extrem kurzer, kaum 4 cm langer Kronröhre. Eine kontinuierliche Formserie verbindet diese Extreme. Ein paar Exemplare, der Einsammlung n. 3045 zugehörig, stimmen in bezug auf die Blütengrösse am nächsten mit *C. Camporum* überein, aber die Kelchlappen sind nicht so breit wie bei dieser Art.

Die Variation der Blütengrösse ist wahrscheinlich nicht erblich, sondern nur eine Modifikation. Die grossblütige Form von den Pungwe-Fällen wuchs auf feuchtem Boden, und die kleinblütige Form aus Inyanga hatte sich ja während der letzten Periode der Trockenzeit zum Blühen entwickelt. *C. adonense* hat oft einen stark verholzten unterirdischen Stammteil.

Die Blüten, die weiss oder als älter bläulich sind, werden beim Trocknen schwarz.

Rhamphicarpa montana N. E. BR. in Kew Bull., 1901, 129; HIERN in THISELTON-DYER, Fl. Cap. IV: 2, 1904, 400; HEMSLEY et SKAN in THISELTON-DYER, Fl. trop. Afr. IV: 2, 1906, 427.

Makoni: ad villam Maidstone in campo graminoso prope flumen, c. 1450 m s. m., flor., 6. Jan. 1931 — n. 4159.

Verbreitung: Abessinien, Kenia, Tanganjika-Terr., Uganda, Süd-Rhodesia und Basutoland.

Die Blüten sind in frischem Zustande weiss mit einem breiten Saum, bis auf 7 cm im Diameter.

Striga asiatica (L.) O. KTZE, Rev. Gen. Pl., 1891, 466; *Buchnera asiatica* L., Sp. pl. 1753, 630 pro parte. *Striga lutea* LOUR., Fl. Cochinch., 1790, 22; HIERN in THISELTON-DYER, Fl. Cap. IV: 2, 1904, 382; HEMSLEY et SKAN in DYER, Fl. trop. Afr. IV: 2, 1906, 409.

Inyanga: c. 20 km a pago Inyanga versus pagum Cheshire in campo graminoso, c. 1400 m s. m., flor., 3. Febr. 1931 — n. 4773; prope pagum Inyanga in colle Chemeo in campo fruticoso, c. 1750 m s. m., flor. et fruct., 12. Febr. 1931 — n. 4956. Makoni: ad villam Maidstone prope pagum Rusapi in campo graminoso, c. 1450 m s. m., flor. et fruct., 20. Febr. 1931 — n. 5102 (»witch seed», Parasit!). Belingwe: prope pagum Mnene in silva, flor. et fruct., 26. Febr. 1931 — n. 5180.

Verbreitung: trop. Asien und Afrika — Sierra Leone, Nigeria, Erythräa, Abessinien, Uganda, Kenia, Tanganjika-Terr., Belg. Kongo, Angola, Südwest-Afrika, Bechuanaland, Nord- und Süd-Rhodesia, Nyassaland, Port. Ostafrika, Transvaal, Natal und östl. Kapland.

Von *S. asiatica* wird behauptet, sie soll an Mais schmarotzen. Im Makoni-Distrikt sammelten wir sie bei einem Maisfelde ein. Die Blumenkrone ist auf der Oberseite karmin- oder scharlachrot, auf der Unterseite weissrot.

Striga elegans BENTH. in HOOKER, Comp. Bot. Mag. I, 1835, 363; HIERN in THISELTON-DYER, Fl. Cap. IV: 2, 1904, 382; HEMSLEY et SKAN in THISELTON-DYER, Fl. trop. Afr., 1906, 408. *Buchnera elegans* D. DIETR., Syn. pl. III, 1843, 525.

Inyanga: supra dejectum fluminis Pungwe in campo graminoso, c. 1700 m s. m., flor. et fruct., 16. Dec. 1930 — n. 3785; ad pagum Cheshire in campo graminoso, c. 1300 m s. m., flor., 4. Febr. 1931 — n. 4872.

Verbreitung: Angola, Tanganjika-Terr., Nyassaland, Süd-Rhodesia, Bechuanaland, Transvaal, Oranje-Freistaat, Swaziland, Natal und östl. Kapland.

Diese Art ist sehr allgemein auf der Steppe oberhalb der Pungwe-Fälle. Die Blüten sind mehr oder weniger klar rot.

Striga euphrasioides (VAHL) BENTH. in HOOKER, Comp. Bot. Mag. I, 1835, 364; HEMSLEY et SKAN in THISELTON-DYER, Fl. trop. Afr. IV: 2, 1906, 412; HOOKER f., Fl. Brit. Ind., 1885, 299. *Buchnera euphrasioides* VAHL, Symb. bot. III, 1794, 81.

Inyanga: ad pagum Cheshire in campo graminoso, c. 1300 m s. m., flor., 5. Febr. 1931 — n. 4878.

Verbreitung: Tanganjika-Terr., Nyassaland und jetzt auch Süd-Rhodesia sowie Indien, Ceylon und Java.

Die Blüten sind weiss.

Striga Thunbergii BENTH. in HOOKER, Comp. Bot. Mag. I, 1835, 363; HIERN in THISELTON-DYER, Fl. Cap. IV: 2, 1904, 380; HEMSLEY et SKAN in THISELTON-DYER, Fl. trop. Afr. IV: 2, 1906, 404.

Inyanga: ad pagum Cheshire in campo graminoso, c. 1300 m s. m., flor. et fruct., 15. Jan. 1931 — n. 4347.

Makoni: c. 17 km a pago Rusapi versus pagum Inyanga in campo graminoso, c. 1500 m s. m., flor., 2 Dec. 1930 — n. 3385; ad villam Duniden in campo graminoso et in silva, c. 1800 m s. m., flor. et fruct., 9. Febr. 1931 — n. 4944.

Verbreitung: Angola, Bechuanaland-Prot., Nord- und Süd-Rhodesia, Transvaal, Oranje-Freistaat, Basutoland, Natal und Kapland.

Bei dieser Art variiert die Blütenfarbe von rot bis lila, auf der Hinterseite ist sie blaulila.

BOTANISKA NOTISER 1951, HÄFTE 2. LUND

Marine algae from northern Norway I.

By ERIK JAASUND.
(Marine Botanical Institute, Göteborg.)

During August 1949 the author collected some marine algae in the vicinity of Tromsö, as well as in sheltered localities in the fjords and in the currents set up by the tides, as from most exposed localities outside the islands Kvalöy and Ringvassöy. These collections were the first step in a planned investigation of the marine algal flora north of 69 degrees north latitude, and were continued last summer. The material is being worked up at the Marine Botanical Institute in Gothenburg.

As will be known, literature on marine algae from the area concerned is rather scanty. KJELLMAN and FOSLIE, working here in 1877—1900, collected their material from some few stations in the district. Half a century has passed since then. New and more systematical studies of the marine algae in northern waters will probably prove most interesting.

Below are given some first results of an examination of the collections. As some epiphytes do not coincide with those described from southern waters, it seems desirable to describe them as new species, even though they may be ecological forms only. Later it is hoped to be able to throw more light upon the relations between the brown epi- and endophytic species now existing in the literature, and especially on those belonging to the genera *Myrionema* and *Streblonema* occurring in Scandinavian waters.

Scytosiphon lomentaria (LYNGB.) J. G. AG.

This species is common in northern Norway, growing in exposed as well as more sheltered positions. From the exposed coast on Sandvär some samples were collected in August, measuring only 5—10 cm in length and 1—2 mm in breadth. In more sheltered positions on the same island their size increased to respectively 20 cm and 2—3 mm,

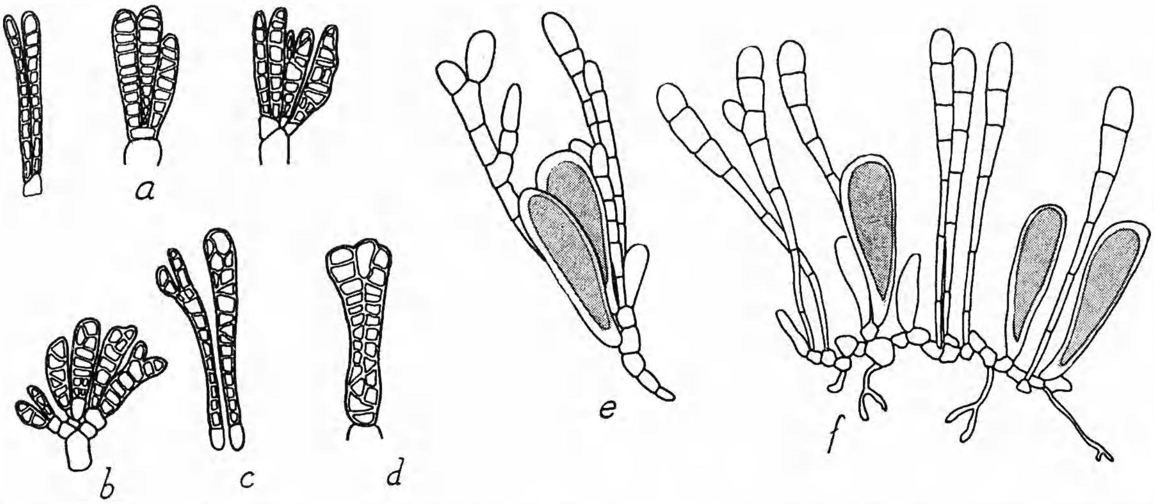


Fig. 1. *a—d Scytosiphon lomentaria* (Lyngb.) J. A. Ag. Plurilocular sporangia, *e—f Ulonema rhizophorum* Foslie. (*a—d* 300 ×; *e—f* 270 ×).

and they did not show the constrictions as did the former. Last summer work was carried out on Lauköy, north of 70° N. In Lauksund, some specimens were met with growing on small pebbles on sandy bottom some twenty cm below low water mark. The maximum length of these specimens was 125 cm, their breadth 6—7 mm (measured when dried). They showed more or less marked constrictions. The average length of the fronds was 70—80 cm. The most outstanding feature of these *Scytosiphon*s was the pronouncedly claviform shape of the generally pluriseriate sporangia found on some old specimens, as shown in fig. 1 *a—d.*

Longitudinal walls could be traced throughout the sporangium, dividing it longitudinally into two narrow sporangia about 3 μ broad. The result was clusters of sporangia on the same pedicel (fig. 1 *a*). The division was sometimes incomplete, thus yielding branching sporangia (fig. 1 *b* and *c*). Sporangia with top expansions as shown in fig. 1 *d,* with a breadth of about 18 μ, were also seen.

Many of these fasciculate sporangia were more or less stunted. Other specimens showed »normal» sporangia as pictured by Newton (fig. 111), Setchell and Gardner III (pl. 39 fig. 45, pl. 44 figs. 72 and 75) and others. In the specimens from Lauksund this »normal» sporangia measured about 70 μ, and up to 14 floors were counted. They were cylindrical or subcylindrical and uniseriate, thus agreeing with those described in Rosenvinge and Lund 1947 (pp. 28—29). The sporangia did not form a continuous layer but showed a spot-like distribution.

The paraphyses on the specimens here concerned measured 60—80 μ

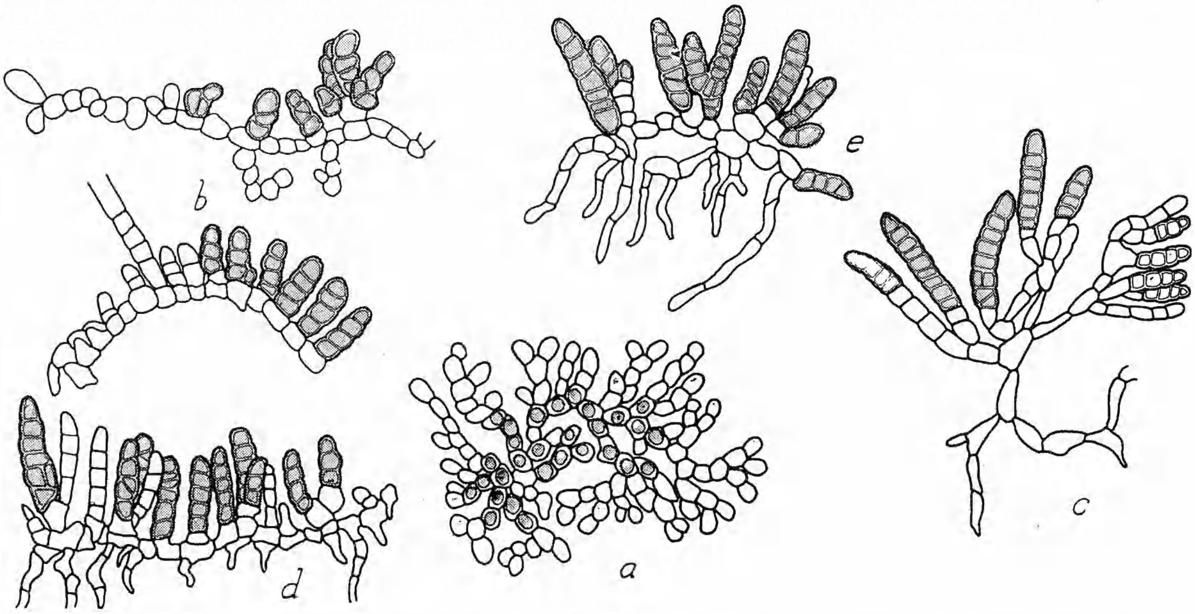


Fig. 2. *Myrionema irregulare* JAASUND. *a* Part of prostratum seen from above. *b* Marginal creeping projections with plurilocular sporangia. *c* Adult part of the frond. *d* Typical appearance. (250 ×).

in length and about 15 µ in breadth. They exceeded the sporangia by about a third in length, or had their tops at a level with the tops of the sporangia. Paraphyses as short as those pictured by ROSENVINGE and LUND were not met with.

Ulonema rhizophorum FOSLIE 1894 p. 132.

This species is common in northern waters and is met with on *Dumontia incrassata.* FOSLIE described it on material from Lyngöy (near Risöy-Sandvär) and found it also in Syltefjord. The author collected it in Ryströmmen and on Skjervöy. On account of the somewhat deviating appearance of the lastmentioned samples, it is illustrated in figure 1 *e* and *f*.

The erect filaments are markedly claviform, with inferior cells 3 µ wide, increasing to 6—9 µ near the apex. They often branch in the typical manner mentioned by FOSLIE (l.c., pp. 19—20, pl. III fig. 17). It appears desirable to keep it a separate species until it has been cultured. LEVRING (1937) considers it only a form of *Myrionema strangulans* GREV., and so does JÓNSSON. HAMEL writes: »Ressemble beaucoup au *M. strangulans,* en diffère surtout par la ramification éparse du thalle rampant, et les rhizoides, résultats possibles de l'adaptation d'un *Myrionema* au tissu mou d'un *Dumontia.*» According to the nature of the surface of the host, the prostrate filaments of a *Myrionema* are likely to show a variable appearance, sometimes uniting to form a parenchymatic disk and at others not touching each other at all, forming a net-like system. As emphasized below, the author considers the net-like structure of *Myrionema irregulare* merely as an effect of the substratum. Consequently, *Ulonema* should be a synonym of *Myrionema,* but it appears that *Ulonema rhizophorum* differs from *Myrionema strangulans.*

Myrionema irregulare JAASUND n. sp.

Thallus minutus, epiphyticus. Fila repentia, diametro 3—9 μ, frequenter et irregulariter ramosa cum rhizoidibus plus minusve elongatis, intra parenchyma hospitis penetrantibus. Fila erecta brevia, ramosa cum sporangiis terminalibus. Sporangia loculos uniseriatos continent, iuventute 9—10×15—30 μ, aetate adultiore 10×50—55 μ cum pedicellula longa. Pili genuini 8 μ lati.

This species is found creeping between the sporangia and paraphyses on the surface of *Scytosiphon lomentaria,* forming small patches not easily distinguished from the sporangia of the *Scytosiphon.* Through light pressure on the cover glass, it spreads out on the slide, showing a pectinate appearance as illustrated in fig. 2.

The basal part of the thallus consists of creeping, short-celled and rather densely branching filaments. From these, short, simple or not infrequently branching shoots arise, the length of which increase from the marginal parts of the prostrate layer of the frond towards the centrum, thus resembling a *Myrionema.* Moreover, irregular projections from the lower side of the prostratum with long and irregular cells penetrate into the substratum. In the older parts of the thallus they are more vigorous and better developed than those recorded in *Ulonema.* Seen from above, the basal filaments form a rather fine-meshed network (fig. 2 *a*). The young cells are isodiametric, the length of the cells increasing with age to about twice the diameter, this varying between 3 and 9 μ. The hairs of the common phaeophycae-type are set direct on the creeping filaments, and are 8 μ broad.

The erect filaments are early transformed into plurilocular sporangia and are consequently not often seen in the vegetative stage. Size of sporangia 9—10×15—30 μ. They are simple or branched, borne on an unicellular pedicel. In the older parts of the thallus the lengths of the sporangia may increase to 50—55 μ (average 30—40 μ). The pedicel then develops to a stalk of 3—5 elongated narrow cells.

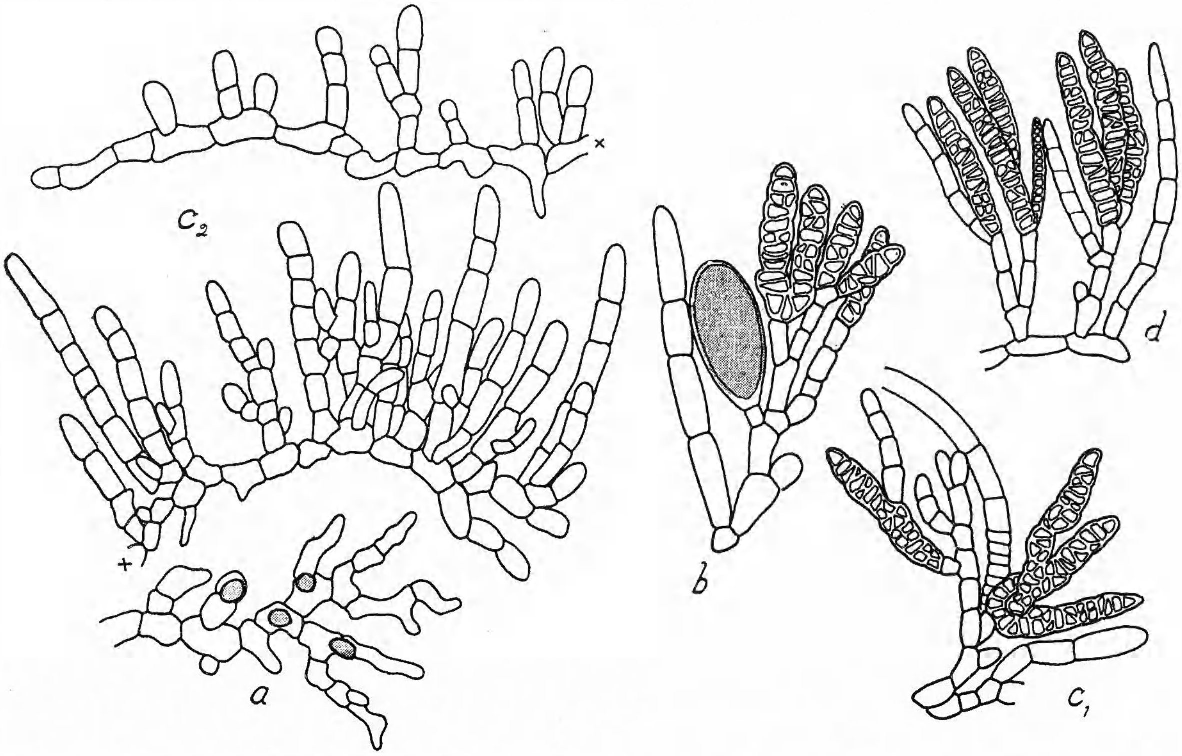


Fig. 3. *Myrionema furcatum* JAASUND. *a* Parts of prostratum. *b* Unilocular and plurilocular sporangia. *c1c2* Young portions of thallus. *d* Older portion of thallus. (300 ×).

The plurilocular sporangia are with few exceptions uniseriate, sometimes with oblique walls. Unilocular sporangia are not met with.

As far as can be judged from the alcohol material the vegetative cells contain 2—4 disk-like chromatophores.

Most of the characters here mentioned indicate that this alga belongs to the genus *Myrionema*. But because of the extremely well developed rhizoid-like threads in some parts of the frond, the alga concerned may show a *Streblonema-like* appearance (fig. 2 *c*). As to the net-like structure of the creeping part of the thallus, it appears to be merely a result of the substratum. On account of the papillose structure of the surface of the host, it would be impossible for the procumbent threads to join and form a parenchymatic disk, which HAMEL regards as an essential feature of the genus *Myrionema*.

Most of the characters of this alga coincide rather closely with those given by JÓNSSON 1903 for an epiphyte on *Laminaria Cloustoni* from Vestmannaeyjar. He calls it *Myrionema corunnae* SAUV. f. *filamentosa* JÓNSSON. The only difference seems to be in the longer stalks of the sporangia in the present specimens and the 2—4 chromatophores, while

JÓNSSON could see one only. As the investigations of the chromatophores were made on alcoholic material and are uncertain, the species here mentioned may prove to be identical on closer examination of living material.

Myrionema furcatum JAASUND n. sp.

Thallus maculiformis 1—3 millim. diam. Fila erecta conferta cylindrica, saepe ramosa. Cellulae 8—12 μ crassae, duplo diametro longiores. Longitudo filorum 100 μ.

Cum et sporangiis uniloculariis 30—40×45—55 μ. et sporangiis plurilocularìis 8×20—40 μ iuventute, aetate adultiore 8×50—90 μ.

Sporangia plurilocularia frequenter furcata. Pili genuini 10 μ lati.

Found, forming brownish spots on *Dumontia incrassata,* about 2 mm in diameter. The prostrate basal filaments unite to form a pseudoparenchymatic and monostromatic disk in the middle part only, being free and branching repeatedly at wide angles as shown in fig. 3 *a* in the main portion of the creeping part. Erect filaments emerge in a regular manner and increase in height towards the centrum, here reaching a mean length of 100 μ. They are simple or branching. Cells of the upright filaments 8—12 μ wide, and about 1 $^1/_2$—2 times as long as broad. True hairs present, about 10 μ broad.

Unilocular sporangia are developed from the creeping filaments or from the inferior cells of the upright filaments, and are usually stalked. They occur on the same thallus as the plurilocular sporangia (fig. 3 *b*). Size 30—40×45—55 μ, ovoid-blong.

Cylindrical plurilocular sporangia are formed in the upper part of the erect shoots. At first they are rather short and biseriate/uniseriate, 20—40×8 μ. Later on they increase in length to about 90 μ. Frequently they branch in a manner reminiscent of the sporangia of *Streblonema fasciculatum* THUR. (fig. 3 *c*). Two simple sporangia may also be borne on the same pedicel.

This alga partly appears low, compressed and short-celled, with rather short sporangia and difficult to press out on the slide, and partly as long and well separated shoots on the procumbent filaments, with elongated cells and sporangia, and easily spreading out on the slide. The absence of the short and compressed projections gives it a more simple structure (fig. 3 *d*). As they are growing together, the conclusion has to be drawn that the former represent only a juvenile stage of the latter. Furthermore, transitional forms are seen. Chromatophores seem to be irregular discoidal, but were not plainly discernible. As this alga seems not to have been previously described, it is considered a new species and named *Myrionema furcatum*. It differs from *Myrionema globosum* in the slender, branching sporangia and in the presence of unilocular sporangia.

Myrionema globosum (RKE) FOSLIE 1894 p. 17, REINKE 1889 p. 46, Tab. 17, ROSENVINGE 1898 p. 86 figs. 19—20, JÓNSSON 1903 p. 146.

On *Cladophora* from the littoral zone on Tromsöya, this epiphyte was found forming small globular cushions with characters agreeing well with those given by JÓNSSON (his third form on *Cladophora*). The specimens collected had one or two platelike chromatophores of irregular outline — (the sample has been stored on Karpetschenko's Modified Navashin Fluid) — in the vegetative cells of the frond. The prostrate filaments united in the central parts but were freely branching near the margin. Short upright filaments, irregulary branching bore plurilocular subcylindrical or fusiform sporangia, partly bi- and partly uniseriate, often with oblique walls. On each upright filament one to six sporangia (fig. 4 *a*—*e*) were found, sitting terminal or lateral. They measured 7—10×15—30 μ — the most common size was 9×27 μ. The usually nearly isodiametric cells of the prostratum measured 8—10 μ in diameter. The cells of the upright filaments were slightly elongated and were about 1—2 times as long as broad.

Hairs were common, attenuating somewhat towards the base. Diameter 6—7 μ. An enclosing basal sheath as shown by JÓNSSON was only occasionally discernible. By comparing the measurements here given with those in JÓNSSON (l.c.) the alga from Tromsöya proves to be a little coarser than the Icelandic sample, but otherwise it corresponds very well. In 1907 KYLIN described a new *Myrionema* called *Myrionema subglobosum* KYLIN growing in the same way and on the same host as the present specimens. His description also corresponds well with the description given above — with some exceptions, which KYLIN points out as the differences between *M. globosum* and *M. subglobosum*: A new sporangium is never observed to form in an emptied one. The hairs always arise from the basal layer, never laterally from the upright filaments. The chromatophores (examined in alcoholic material) are found to be roundish and probably 2—4 in each cell. These differences may by examinations on sufficient and living material prove to be illusory. In the present material the lateral hairs belong to the exceptions. The new shoots forming inside the emptied sporangia are not

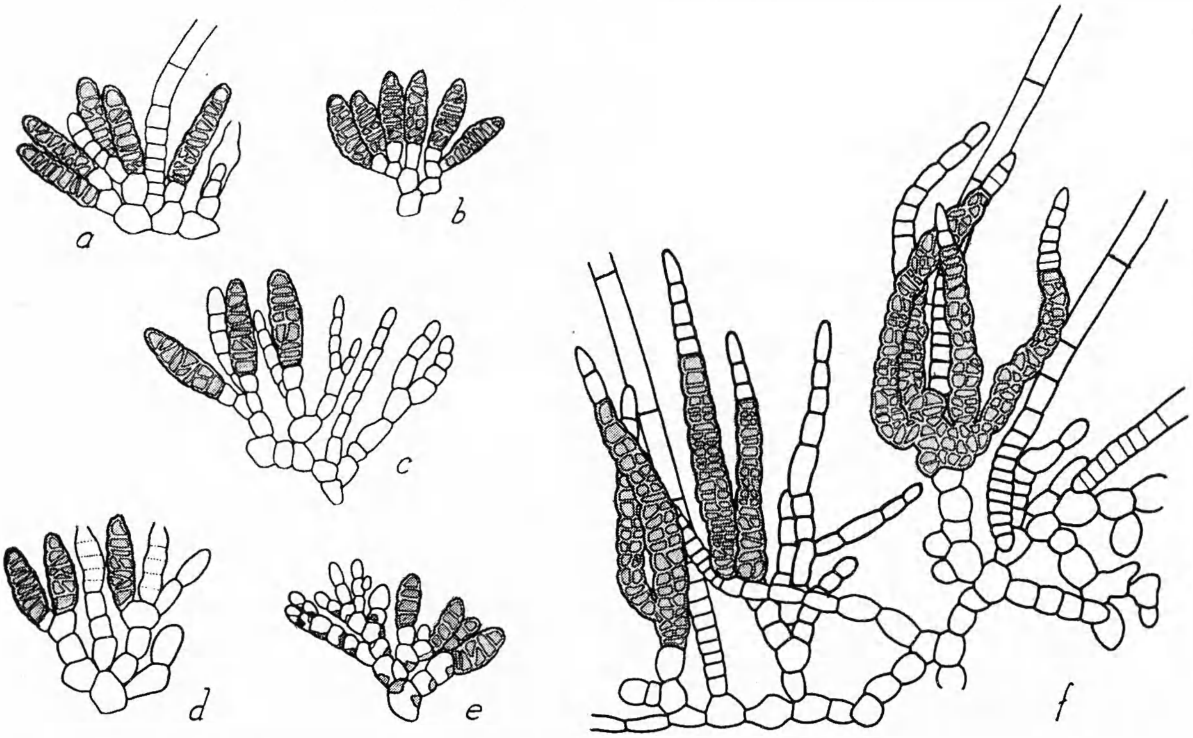


Fig. 4. *a—e Myrionema globosum* (Rke) Foslie, fragments of the frond showing the aggregation of the sporangia, *e* showing the chromatophores. *f Streblonema fasciculatum* Thur. (*a—e* 300 ×, *f* 230 ×).

often seen. Furthermore, some specimens from the same station and on the same substratum, but stored in alcohol, appeared to have two or more than two chromatophores. As regards time of fructification, *M. globosum* on the Swedish west coast fructifies in the springtime, *M. subglobosum* on the contrary during July—August (Kylin 1907, 1947). Jónsson reports *M. globosum* (Iceland) fruiting from April to September and Rosenvinge April to July (Greenland). It will be necessary to compare specimens from the Swedish west coast with specimens from northern Norway to decide this question. Until then Kylin's species is retained a separate species.

On *Ceramium*, the second form mentioned by Jónsson occurred, well agreeing with the figure 20 B in Rosenvinge 1898 and with Levring's statements on Swedish material (Levring 1935). The maximum length of the sporangia were 45 μ, thus being slightly shorter than on Levring's specimens.

Streblonema fasciculatum Thur. Le Jolis 1864 p. 73.

According to Norum (1913 p. 159), he collected this species near Haugesund in *Callithamnion arbuscula* (!). It has earlier been met with in *Nemalion* (REINKE 1889, ROSENVINGE and LUND 1941) and in *Eudesme* (NEWTON 1931, TAYLOR 1937) immersed between the cortical filaments. Apart from the above-mentioned finding by NORUM, which seems to be rather doubtful as the alga concerned has not been met with by KYLIN 1910, LEVRING 1937 and WENNBERG 1948—49, working on the same part of the Norwegian coast, and as the structure of *Callithamnion* is quite different from that of *Nemalion* and *Eudesme* — *Streblonema fasciculatum* has not earlier been found in Norway.

Some specimens of *Eudesme virescens* from Risöy proved to contain this endophyte well developed, with richly branching sporangia (fig. 4 *f*). One sporangium showed 7 »branches» or »fingers», similar to figure 133, p. 323 in RABENHORST: Kryptogamenflora 1885. Cells of the creeping filaments had a maximum thickness of 15 μ, the hairs were 8—10 μ in diameter, the sporangia to 160 μ long and 10—20 μ thick.

Streblonema oligosporum STRÖMF. 1884 p. 133 pl. I, fig. 4, 5, LEVRING 1935, 1937, 1940 fig. 3.

An endophyte growing in *Punctaria plantaginea* is referred to this species. It bore uniseriate simple plurilocular sporangia about 5—7 μ broad and 15—25 μ long. The specimen examined showed many emptied sporangia, with some emptied sporangia enclosing new sporangia. Hairs were 8 μ broad, filament cells 5—9 μ in diameter and 1—3 times as long as broad. Unilocular sporangia not met with.

Streblonema polycladum JAASUND n. sp.

Filamenta endophytica cum articulis longis, cylindricis, 4 $^1/_2$—6 μ latis, 1 $^1/_2$—3-plo diametro longioribus.

Thallus inter cellulas hospitis epidermicas erumpit et extra hospitem fasciculatos filorum ramosum formant. Sporangia plurilocularia cylindrica vel fusiformia, interdum ramosa, uniseriata, sessilia aut pedicellata. Sporangia 5×25—30 μ. Pili hyalini ex filis endophyticis, 6 μ latis.

While studying the *Scytosiphon* mentioned above, an endophytic alga was discovered, bearing slender, cylindrical, plurilocular sporangia forming small aggregations on the surface of the host. The endophytic part of the frond consisted of long-celled threads with subcylindrical or faintly barrel-shaped cells, about 4—6 μ in diameter and 1 $^1/_2$ to 3 times longer. The filaments bore terminal hairs, 6 μ wide, and penetrated among the cells of the host, giving rise to fasciculately branching erect and fructiferous filaments above. This external part of the frond was

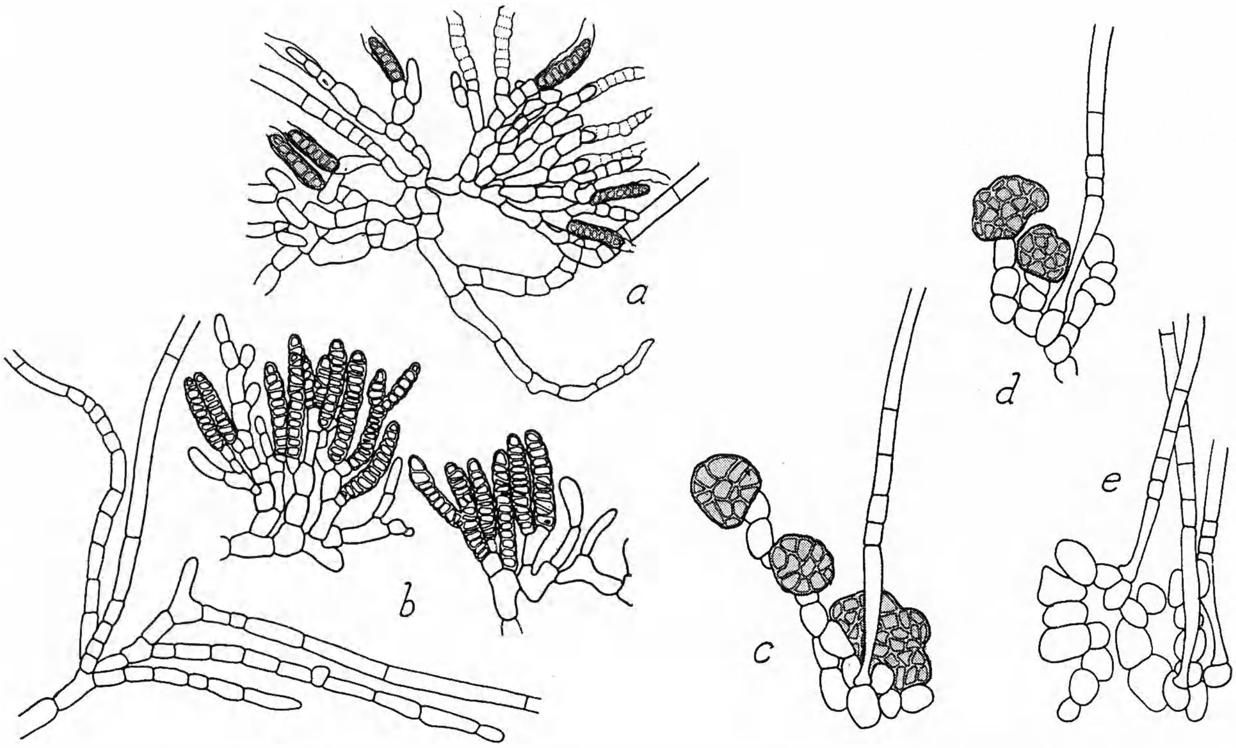


Fig. 5. *a Streblonema oligosporum* STRÖMF. *b Streblonema polycladum* JAASUND. *c—e Phaeostroma pustulosum* KUCK. See text. (*a—b* 250 ×, *c—e* 270 ×).

about 70 μ long with cylindrical plurilocular sporangia 27—37 μ long and about 5 μ broad. The sporangia were sometimes branching. They were borne terminally or laterally on unicellular pedicels. Loculi uniseriate, with dividing walls frequently oblique. This free part of the frond sometimes expands laterally through free procumbent branches (fig. 5 *b*).

The alga here described grows like *Streblonema rugosum* SETCHELL and GARDNER found in *Alaria tenuifolia* (S. and G. 1925 pl. 52, fig. 7). It differs from that species in the hairs not emerging from the erect filaments and in the longer sporangia of *S. polycladum.* More striking is its close correspondence to *Streblonema tenuissimum* HAUCK, met with in *Nemalion* in the Adriatic and the Danish waters. The present species seems to differ from this only in its shorter and sometimes branching sporangia. On account of the different milieu of the Danish and this north-Norwegian species, it seemed more correct to keep the latter separated from the former. With plurilocular sporangia in June. In *Scytosiphon.*

Phaeostroma pustulosum KUCK. 1895 p. 182, tab. VII, ROSENVINGE 1898 p. 68, JÓNSSON 1903 p. 165, KYLIN 1947 p. 25.

Many specimens of this epiphyte, not earlier met with north of 64° N, were found on *Scytosiphon* from Lauköy. PRINTZ (1926 p. 147) reports some finds in Trondhjemsfjorden. His specimens were hairless and non-fructiferous. He writes: »Ich habe sie nur im Frühsommer in den Monaten April Juni und zu dieser Zeit nur sterile Exemplare gesehen aus welchem Grunde eine sichere Artsbestimmung nicht möglich ist. Sie erinnert sehr an die auf *Zostera* epiphytische *Phaeostroma pustulosum,* doch habe ich niemals Haarbildungen an meinen Exemplaren gesehen.» — Consequently, the northernmost certain find of fructiferous specimens is that of LEVRING in the vicinity of Bergen 1937; according to him this was its first record for Norway (l.c.).

Prepared free from the host, the epiphyte from Lauköy partly showed the discoid structure pictured by KYLIN, but partly a more filamentous structure as shown in figure 5 *c*—*e* and also mentioned by JÓNSSON. Hairs were about 6—8 μ wide, sporangia 20—30×30—40 μ and the vegetative cells of most variable shape, about 12—15 μ in diameter. Chromatophores discoid.

Figure 5 *d* shows a most remarkable resemblance to that figured on *Streblonema aequale* OLTM. by KUCKUCK (1897). The filamentous structure is, no doubt, caused by the papillose surface of the host. I have not met with the regular form in *Chorda filum.* The discoid form occurred best developed on *Punctaria plantaginea* from Tromsöya, but was also seen on *Scytosiphon* (on some sporangia- and paraphysis-free parts of its frond).

The correspondence here mentioned led KUCKUCK (1897) to refer *Streblonema aequale* OLTM. to the genus *Phaeostroma.* JÓNSSON went a step further, regarding these species as forms of *Phaeostroma pustulosum* KUCK. only. LEVRING agrees with him 1937, but changes later (LEVRING 1940 p. 30. His figure 2 has true phaeophyceae-hairs instead of the characteristic *Phaeostroma*-hairs.)

On the basis of the material from Lauköy, the author is inclined to adopt the view of JÓNSSON.

Halonema JAASUND nov. gen.

Cylindrus centralis filamento ramoso et eius ramis elongatis compositus. Fila periferica, paulatim a cellulis periphericis axis evoluta, eum strato continuo densissime tegunt, cylindrico-clavata, simplicia, 2 vel 3 cellulas continentia. Sporangia plurilocularia piriformia vel cordata e transformatione articulorum. Pili cellulam inferiorem elongatam et meristema intercalare habent.

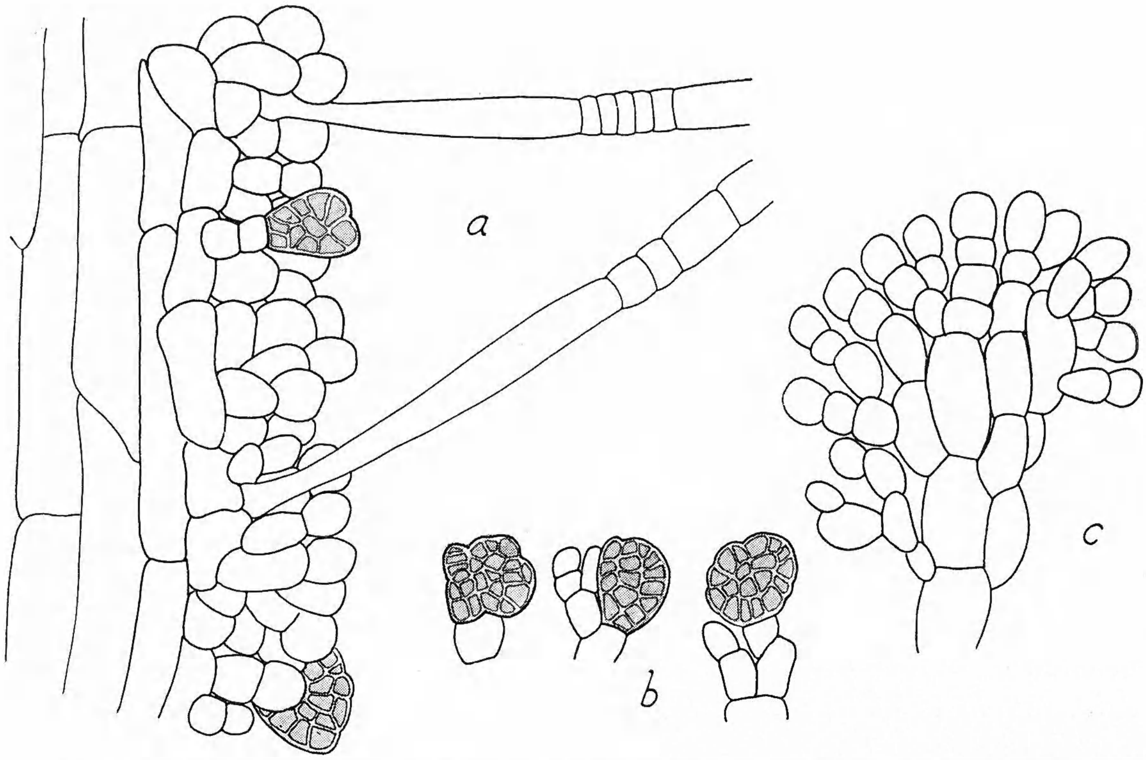


Fig. 6. *Halonema subsimplex* JAASUND. *a* Longitudinal section. *b* Plurilocular sporangia. *c* Tip of a branch. (300 ×).

Central axis a single monopodial branching thread. The central part of the frond shows a polysiphonous structure, consisting of the parallel running stem and main branches. Cortical layer formed by short two- or three-celled vegetative threads, with a slightly swollen apical cell, densely packed. Plurilocular sporangia formed by transformation of the upper cell of the vegetative threads, pear- to heartshaped, irregular roundish, often with lobed margin.

Hairs abundant, showing a long basal cell followed by an intercalary growing zone.

Halonema subsimplex JAASUND n. sp.

Frons filiformis, gelatinosa, sparsim ramosa, ramis simplicissimis. Cellulae axis centralis 150—180 μ longae, 15—18 μ crassae. Cellulae filorum assimilantium diametro 15—18 μ, globosae vel subglobosae.

Sporangia irregularia 15—30×25—30 μ. Pili basin versus attenuati, diametro ad basin 10 μ, diametro in medio 18 μ.

Epiphytic on *Chordaria flagelliformis* in the littoral zone.

Thallus filiform, gelatinous, sparingly branching, with branches of one order only. The branches scattered, 1—2 cm long and emerging at

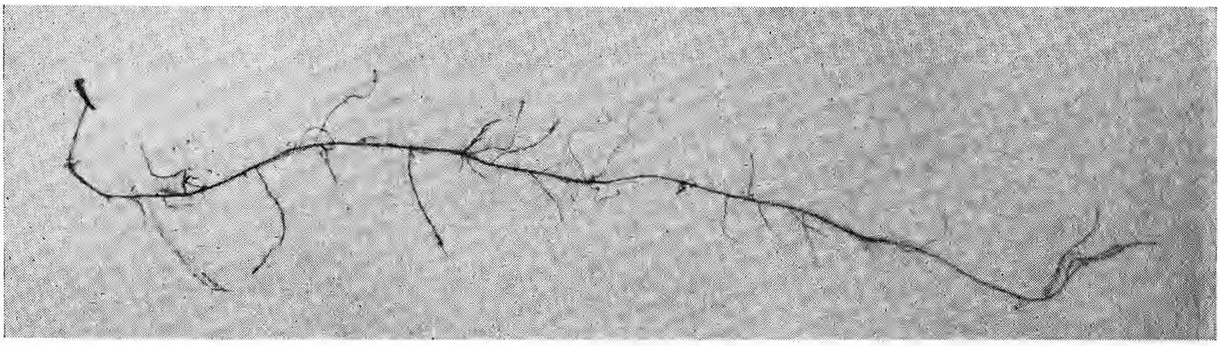


Fig. 7. *Halonema subsimplex* JAASUND. ($^6/_7$ ×).

right angles. Thallus about 13 cm long and 1—1 $^1/_2$ mm thick, yellow or light brown when dried. The polysiphonous part of the thallus consists of cells 150—180 μ long and about 10—18 μ broad. The length decreasing from the middle of the stem towards the cortical layer, and being about 50 μ just inside the cortex. The end-walls of the cells often oblique.

Cells hyaline. On this central cylinder, the two- or three-celled vegetative threads of 15—18 μ diameter are set transversely densely packed, forming a cortical layer.

The hairs show a striking resemblance to the hairs of *Phaeostroma* KUCK. The elongated basal cell has the same constriction near the lower end. The breadth measured in the narrow part is 10 μ, increasing to 15 μ near the top of the cell. Length 120 μ. Then follows a variable number of short, more or less barrel-shaped cells, from half as long to twice as long as broad. This growing zone is about 25—50 μ long. The following hair cells had a diameter of 18 μ.

Only plurilocular sporangia were met with extending somewhat beyond the surface of the frond, and showing the same correspondence to *Phaeostroma*. They tapered somewhat towards the base. Size 15—30×25—30 μ.

As far as could be judged from the scanty material available for this species, stored in glycerine, the chromatophores were discoid. Further information on this will be given later, when more material is available.

Because of the similarity of the structure of hairs and sporangia in this genus and in the genus *Phaeostroma,* — and the new genus here described shows *Chordariaceae*-characters, the conclusion may be drawn that the genus *Phaeostroma* KUCK. has to be removed from its present place among the *Ectocarpaceae* to the family *Chordariaceae.*

In the system set up by KYLIN in his *Chordariales*-monograph (KYLIN

1940) the genus *Halonema* JAASUND may belong to the *Sphaerotrichia*-group, as no intercalary growing zone is found below the uppermost branchlets of the central thread. On the other hand, according to KYLIN, no plurilocular sporangia have been met with in this group, as it only embraces the genus *Sphaerotrichia* KYLIN.

If the stress is laid upon the structure of the frond only, as KYLIN does (l.c. p. 57 and 60), the group should be maintained but widened to comprehend all genera showing the particular structure of the stem. The characters of this new and enlarged group will then be: Central axis a single monopodial branching thread. The intercalary growing zone is found beyond the uppermost branches of the central thread. Above this meristeme only 2—4 cells are found. The apical cell (or exceptionally the two apical cells) may be swollen and enlarged. Assimilative filaments short with somewhat swollen apical cells — enclosed in an enveloping jelly. True hairs occur.

References.

FOSLIE, M., New or critical Norwegian Algae. — Kgl. norske Vidensk. Selsk. Skrifter, Trondhjem 1894.

HAMEL, G., Phéophycées de France. — Paris 1931—1939.

JÓNSSON, H., The Marine Algae of Iceland II. — Reprint from Bot. Tidsskrift 25. Bind, Kjöbenhavn 1903.

KUCKUCK, P., Bemerkungen zur marinen Algenvegetation von Helgoland II. Wissenschaftliche Meeresuntersuchungen. Neue Folge. Bd 2. Leipzig 1897.

— Ueber einige neue Phaeosporeen der westlichen Ostsee. — Botanische Zeitung 1895.

KYLIN, H., Zur Kenntnis der Algenflora der norwegischen Westküste. Arkiv för Botanik, Bd 10. Stockholm 1910.

— Die Phaeophyceen der schwedischen Westküste. — Lunds Univ. Årsskrift N.F. Avd. 2 Bd 43, Nr 4. Lund 1947.

— Die Phaeophyceenordnung Chordariales. — Ibidem Bd 36, Nr 9. Lund 1940.

— Studien über die Algenflora der schwedischen Westküste. Uppsala 1907.

LE JOLIS, A, Liste des Algues marines de Cherbourg. Mém. de la soc. imp. des sciences naturelles de Cherbourg. 10. Paris et Cherbourg 1864.

LEVRING, T., Zur Kenntnis der Algenflora von Kullen an der schwedischen Westküste. — Lunds Univ. Årsskrift N.F. Avd. 2 Bd 31, Lund 1935.

— Zur Kenntnis der Algenflora der norwegischen Westküste. — Ibidem Bd 33, Lund 1937.

— Studien über die Algenvegetation von Blekinge, Südschweden. Akad. Abhandl., Lund 1940.

NEWTON, L., A handbook of the British seaweeds. — London 1931.

NORUM, E., Brunalger fra Haugesund og omegn. — Nytt Mag. for Naturvidensk., Bd 51, Christiania 1913.

PRINTZ, H., Die Algenvegetation des Trondhjemsfjordes. Skrifter utg. av det Norske Vidensk. Akad. i Oslo, I, Matem.-Naturvidensk. Kl. 1926, Nr 5. Oslo 1926.

REINKE, J., Algenflora der westlichen Ostsee deutschen Antheils. 6. Ber. d. Komm. z. wissensch. Unters. deutsch. Meere in Kiel. Berlin 1889.

— Atlas deutscher Meeresalgen. Herausgegeben von d. Komm. z. wissensch. Unters. deutsch. Meere in Kiel, Berlin 1889.

ROSENVINGE, L. KOLDERUP, Deuxiéme mémoire sur les algues marines du Groenland. Meddel. om Grönland, Bd 20. Köbenhavn 1898.

— and SÖREN LUND, The Marine Algae of Denmark. — Det Kgl. Danske Vidensk. Selsk. Biolog. Skrifter, Bd I Nr. 4, Bd IV Nr. 5, Köbenhavn 1941 and 1947.

SETCHELL, W. A. and GARDNER, N. L., The marine algae of the pacific coast of North America. III Melanophyceae. — Univ. Calif. Publ., Bot., Vol. 8, 1925.

STRÖMFELT, H. F. G., Om algvegetationen i Finlands sydvestra skärgård. Bidr. till kännedomen om Finl. natur och folk. Häft. 39. Helsingfors 1884.

TAYLOR, W. R. T., Marine algae of the northeastern coast of North America. Univ. of Mich. Stud. Scientific series Vol. XIII, 1937.

BOTANISKA NOTISER 1951, HÄFTE 2. LUND

Parthenogenesis in Allium.

By ARTUR HÅKANSSON.
Institute of genetics, Lund.

Introduction.

The embryology of the genus *Allium* is well known, a number of species having been studied. As early as 1879 STRASBURGER discovered a particular mode of embryosac development, later called the *Allium* type: the division of the e.m.c. results in two dyad cells; the upper cell degenerates, the chalazal dyad cell develops into an eight-nucleate embryosac of usual organization. The largest number of *Allium*-species has been investigated by WEBER (1929) and by MESSERI (1931). In all species the *Allium*-type was found, only occasional exceptions having been observed. WEBER once observed failure of dyad cell formation in *A. carinatum* and sometimes the forming of three macrospores in *A. paradoxum.* In commenting on these observations STENAR (1932) writes: »Selbst habe ich bei *Allium nutans* gesehen, dass die E.M.Z. drei Macrosporen hervorbringen kann». This statement is found in a paper on the embryology of *Nothoscordon,* a genus closely related to *Allium.* In *Nothoscordon* the *Allium*-type was found in *N. fragrans,* an agamosperm or apomict propagating through nucellus-embryony; sexual species formed three or four macrospores. A further difference between the two genera concerns the mode of endosperm formation. In *Allium* the endosperm is formed after the Nuclear, in *Nothoscordon* after the Helobial type (STENAR l.c.).

So far only one *Allium* species, *A. odorum,* can possibly be called agamospermous, the eggcell having the faculty to divide through parthenogenesis. This species has been investigated many times since TRETJAKOW 1895 first observed antipodal embryos. A summary of the investigations is given by GUSTAFSSON (1946). *A. odorum* has many modes of embryo formation. Embryos are formed from antipodals, synergids, the inner integument; they are formed through parthenogenesis of the haploid and of the diploid eggcell or after fertilization of these cells.

Thus parthenogenesis is known to occur only in one *Allium* species. As will be shown here, it occurs also in *A. nutans*. A large number of forms of *A. nutans* are in the cultures of Dr. ALBERT LEVAN. They have been collected in the field or procured from botanical gardens. In the »Proceedings of the eighth international Congress of genetics» LEVAN has made a communication concerning this material from which may be cited, »A material of the species group *Allium angulosum - senescens-nutans* was demonstrated. This group includes many closely related forms which have been described under various taxonomic denominations. The cytological analysis has shown that many chromosome numbers occur in nature and in culture. So far only diploid, tetraploid and hexaploid types are known from nature, but in my cultures most somatic numbers between 16 ($2x$) and 100 have been met with. . . . All these various forms are built up from largely the same genome. This is shown from the facility with which the different types intercross. All euploid numbers from $2x$ to $9x$ have been crossed in all directions. The crosses succeed readily and a viable offspring is obtained which is quite fertile. . . . The variability of this species complex, thus, must be seen in connection with the easy upsetting of the chromosome number constancy».

I have studied seed development in a number of plants of this material. The first fixations were made in 1941 and 1942. Later many collections were made from a form in which Dr. LEVAN had observed several peculiarities. Progeny tests indicated that most seeds were formed without fertilization, though a minority seemed to be the result of fertilization. The pollen was peculiar, most plants having about 100 % pollen dyads, that is, nearly all pollen grains had the somatic number of chromosomes (LEVAN 1935). The occurrence of a high number of pollen dyads is not restricted to this peculiar form of *A. nutans*. Several other *nutans*-plants investigated had also a rather high percentage.

Sexual Allium nutans.

The embryology of *A. nutans* shows similarities with other *Allium*-species. The ovule has two integuments, of which the outer is more persistent and forms the seed coat. The nucellus is rather small, and is partly destroyed when the embryosac is at the four-nucleate stage. However, the basal part of the nucellus is more resistant, the cell walls are thickened and with adjacent parts of the chalaza a sort of postament is formed, visible after fertilization.

Diploids ($2n=16$).

Plants from different 16-chromosome forms were investigated. One plant had a high percentage (92 %) dyad pollen. One plant belonged to a form growing wild in Switzerland. The wild form corresponds to *A. angulosum*; it oddly enough showed univalent chromosomes at the first metaphase; however, as only few observations have been made on meiotic stages, these univalents perhaps were accidental.

Fig. 1 *a* shows a nucellus after meiosis. The chalazal dyad cell has taken the appearance of a two-nucleate embryosac. The central vacuole of the embryosac was formed shortly after the division of the dyad nucleus. Other stages of the development in diploids are not figured. The nuclei at the chalazal end of the embryosac may be smaller than the micropylar nuclei. There is, however, no difference in chromosome number. This size difference does not occur in all embryosacs; in *A. angulosum* it was never observed. The organized embryosac is rather small, but increases gradually in size before fertilization. The micropylar half of the embryosac is broader than the chalazal. The antipodals were ephemeral. The polar nuclei are sometimes of different size, the nucleus from the chalazal group of nuclei being smaller. The upper polar nucleus migrates to the chalazal end of the embryosac, where one often finds the polar nuclei in contact. They may fuse forming a central nucleus, but this fusion probably does not always occur. Nor is a position near the antipodals constant, the polar nuclei having been observed in the vicinity of the egg-apparatus. The synergids are rather large. Sometimes they have equal size but in most cases there is a size difference which grows more pronounced as the embryosac grows older. Synergid nuclei undergo certain changes which will be described later.

The eggcell is rather small. After fertilization it lengthens before division; in this way the embryo becomes provided with a suspensor, the first wall being near the apical end of the eggcell. The length of the suspensor is largely dependent on the elongation of the eggcell. The eggcell divides later than the polar nuclei, the egg nucleus was observed in prophase stage when the embryosac had 16 or 32 endosperm nuclei. The development of the endosperm was after the Nuclear type; endosperm nuclei are at first gathered in the chalazal part of the embryosac.

Various abnormalities were observed, but it is difficult to prove differences in their frequency between the different plants. One would perhaps expect the formation of diploid embryosacs in the plant with 92 % pollen dyads. Meiosis stages could not be studied, but a high number of two- or four-nucleate embryosacs with an upper dyad cell indicates that the development is usually normal, a restitution nucleus had not been formed. The question of monokinetic meiosis remains open, however (see p. 173). One young embryosac was observed to have two micropylar and one chalazal nucleus, division of the latter having failed. Also remarkable was an organised embryosac with only four nuclei, in which there were one antipodal, two polar nuclei of different size and one large micropylar cell (Fig. 1 *b*); the last division in the embryosac had not occurred. Instances of abnormalities in a plant with normal pollen were (a) an aberrant embryosac with two extra nuclei above the egg-apparatus, and (b) an embryosac containing sixteen free nuclei but lacking egg-apparatus and antipodals. In another plant an embryosac was observed with an egg-apparatus at the chalazal and three undifferentiated cells at the micropylar end. This could hardly be considered as an instance of inverted polarity of the embryosac, because transformation of antipodals is comparatively frequent in *Allium*. A certain sterility must be the result of such abnormalities. A more important cause of seed sterility was in certain plants the absence of an embryosac in a number of ovules: the e.m.c. does not divide, the nucleus remains in an early prophase stage. Non-fertilization as well as zygotic sterility may also cause seed abortion.

Triploids (2n=24).

Plants with no pollen dyads as well as such having about 90 % dyads were investigated. The first metaphase showed trivalent, bivalent and univalent chromosomes, however, meiosis was not studied more closely. The two-nucleate embryosac of a triploid very often contains one or more microcytes. They are formed of chromosomes eliminated during meiosis. In rare cases such microcytes may persist and could be seen in the organized embryosac; usually they are more ephemeral. Fig. 1 *c* shows a four-nucleate embryosac with a supernumerary nucleus. The nuclei show prophase of the last division; it seemed that also the microcyte could divide. This must depend on this nucleus being rather large; it is formed of more than one chromosome. The difference of size between micropylar and chalazal nuclei is very conspicuous. The embryosac figured is from one of the plants with a high percentage of pollen dyads; these plants have perhaps more often than the usual triploids disturbed divisions in the embryosac. Irregular nuclei (Fig. 1 *c*), bridges between daughter nuclei, and »fusions» of daughter nuclei through including the chromosomes of two anaphase groups into one nucleus were seen in the developing embryosac.

The embryosacs are larger than in diploids. Fertilization was observed: a male nucleus was in contact with the egg nucleus.

Tetraploids (2n=32).

Wildgrowing tetraploid types from Switzerland and Sweden were *A. senescens* or (the Swedish form) *A. senescens* var. *calcareum* (*A. montanum*). A number of tetraploid plants from a garden form were also investigated. In the wildgrowing tetraploid from Switzerland there was no difference in size between the nuclei of the micropylar and chalazal end of the developing embryosac and the antipodals were well developed and persistent. In most embryosacs the antipodals were differentiated as an egg-apparatus, one antipodal having the appearance of an eggcell while two were more or less similar to synergids. Fig. 5 *a* shows an old embryosac. The close similarity of the two cell groups is striking. One synergid in each group has increased strongly in size, as is usual in unfertilized embryosacs of *Allium*. The nucleus and the cytoplasm of these antipodal cells are changed as in normal synergids. The position of the polar nuclei in old unfertilized embryosacs is remarkable. In most *nutans*-forms investigated here they move to a position in the vicinity of the egg-apparatus. In this form with an egg-apparatus at each end of the embryosac they do not move towards the micropylar end, being often found near the chalazal egg-apparatus or in the middle of the embryosac (as in *A. odorum*).

The antipodal cells do not always form a typical egg-apparatus. This cell group may contain two eggcells and one synergid or three eggcells. Sometimes the cells do not show any special differentiation, i.e. they remain »antipodes». Such a variability is not shown by the cells of the normal egg-apparatus. The embryosac very often remained unfertilized, probably because of failure of pollination. An embryo was never observed in such embryosacs. Nor was an antipodal embryo observed.

Disregarding the special structure of the antipodal cells the development was quite normal; once only an abnormality was observed, when it seemed that, besides the eight-nucleate embryosac, a second embryosac had been developed in the nucellus.

A. senescens var. *calcareum,* the wild tetraploid from Åhus, Sweden, had a similar embryology. The chalazal nuclei in the embryosac were large and the antipodals strongly developed. The latter were often similar to an egg-apparatus (Fig. 5 *b*). The polar nuclei were very large and had often a position near the chalazal egg-apparatus. The chalazal synergids were of different size, the smaller being more ephemeral, the larger more persistent, increasing in size. Few abnormalities were observed.

A second kind of tetraploid investigated here consisted of plants from a form carrying the field number 5034. Some plants had a rather high percentage of pollen dyads and in the progeny plants with an increased chromosome number, 48 or 64, occurred. Embryosacs with an increased chromosome number are to be expected but unfortunately no such embryosacs were observed, the investigated material being too small. Meiotic stages were absent.

The development followed the *Allium* scheme. Usually there is in these tetraploids a pronounced size difference between micropylar and chalazal nuclei. The mature embryosac is broad and no tendency to transformation of the antipodal cells into an egg-apparatus was observed. Fertilization occurs and the polar nuclei divide earlier than the eggcell. No case of parthenogenesis was observed.

In these plants one rather often finds abnormal embryosacs. An instance is shown in Fig. 1 *g*: the eight-nucleate embryosac has six nuclei at the micropylar and only two at the chalazal end. The mature embryosac was rather often incomplete or degenerating. The embryosac may degenerate at an earlier stage and many ovules lack an embryosac.

Higher euploids.

In the higher euploids there is usually an increased tendency to ovule sterility caused by failure of meiosis, failure of the young embryosac to reach the organized stage or abnormal organization of the embryosac. One heptaploid ($2n=56$), two octoploids ($2n=64$) and one decaploid ($2n=80$) were investigated.

The development of the embryosac is according to the *Allium* scheme. However, as Fig. 1 *f* shows, a restitution nucleus may be formed in the e.m.c. The e.m.c. figured is from the decaploid; in this plant the developing embryosac was rather weak, the organized embryosac was small compared with the large ovule. The embryosacs of the octoploid plant 5783-1 quite often had supernumerary nuclei. Fig. 1 *h* shows an embryosac with fifteen nuclei, lying in pairs and having the structure of late telophase. One would expect sixteen nuclei, but here one of the chalazal nuclei is large and is probably formed from a disturbed anaphase, two chromosome groups being included in one nucleus. There was no trace of an upper dyad cell; this might explain the larger number of nuclei, both dyad nuclei taking part in the further development. However, failure of dyad cell formation does not explain all cases of supernumerary nuclei. For instance in a nucellus with an aborted upper dyad cell still visible the developing embryosac had ten nuclei; one bridge and one »fusion» indicated perhaps supernumerary divisions in the eight-nucleate embryosac. Supernumerary synergids in the organized embryosac were evidence of such supernumerary divisions. For instance five synergids and an eggcell were once seen at the micropylar end. Another cause of the appearance of supernumerary cells at the micropylar end is an abnormal distribution of the nuclei of the young embryosac, a 6+2 distribution could result in two supernumerary cells. Embryosacs with supernumerary polar nuclei were rare.

The embryosac may also have a lesser number of nuclei than eight. Fig. 1 *e* shows a five-nucleate embryosac from the heptaploid. Here the chalazal nucleus of a two-nucleate embryosac had never divided, the embryosac thus containing egg-apparatus and two polar nuclei. The most frequent disturbance of the organisation of embryosac was through the absence of an eggcell. At the micropylar end only two synergids were formed while two nuclei remained free. It is perhaps the largeness of the nuclei that makes the forming of an eggcell more difficult. The micropylar nuclei were sometimes very large in such embryosacs (Fig. 1 *h*). At the chalazal end was an eggcell only occasionally seen.

Regular embryosacs are, however, more frequent than irregular. The octoploid 5783-1 in most cases showed normal development; early stages of formation of endosperm and embryo were observed in this plant. In contradistinction to diploids and tetraploids, this octoploid started embryo formation before or at about the same time as the division of the polar nuclei. Two- or three-celled embryos were observed together with undivided polar nuclei, or the first two endosperm nuclei had just been formed when the egg-nucleus showed prophase.

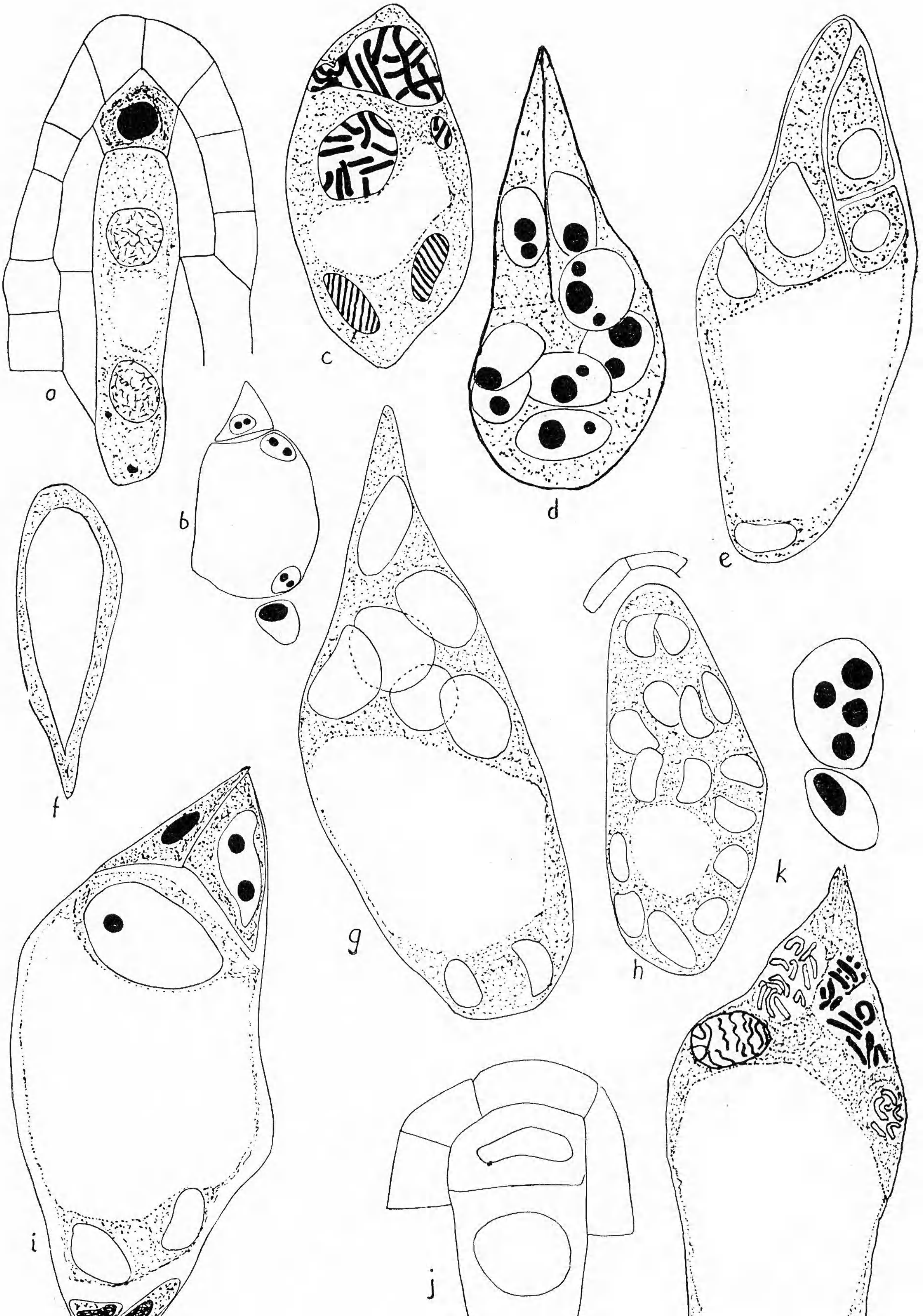
Aneuploids.

A peculiar embryosac from a plant with 28 chromosomes is shown in Fig. 1 *d*. Though it has the full number of nuclei, it is small and lacks a central vacuole; cell formation is still incomplete as only synergid cells have been formed. A plant with 17 chromosomes and 100 % pollen dyads had very often supernumerary nuclei of different size in the developing embryosac.

Plants with high aneuploid chromosome numbers have often a very large e.m.c., meiosis and the following stages being very belated. In other plants the developing embryosacs were small and in a bad condition giving the impression of being starved. However, there were high aneuploids which showed normal development in a large number of ovules. Such a plant was 5747-7 from which material was collected during two consecutive years. The plant had 93 chromosomes. The dyad cells are shown in Fig. 1 *j*. In several developing embryosacs supernumerary nuclei were seen; an extreme case showed at least four prophase nuclei lying together at the micropylar end and four resting nuclei more scattered in the embryosac. Probably there had been still more nuclei, as one section was defective. On the other side there may be too few nuclei: organized embryosacs with only egg-apparatus and upper polar nucleus occurred. Abnormal embryosacs thus are frequent, but many embryosacs are normal. The latter are readily fertilized. Fig. 1 *k* shows polar nuclei, the larger one which has four nucleoles is fertilized. The content of a young capsule was investigated. Most ovules were enlarged. A two-celled embryo was found in an embryosac having sixteen endosperm nuclei, the polar nuclei divide in relation to the eggcell earlier than in the octoploid. The endosperm nuclei near the chalaza were enlarged. Nuclei and cells of the young embryos observed were very large. Other large ovules in this capsule could not give a germinative seed. One had an »egg-apparatus» consisting of three synergids but lacking an egg-cell. No pollen tube had entered this embryosac, perhaps owing to this absence of eggcell. Other unfertilized

---

Fig. 1. Sexual *A. nutans*. *a*: nucellus with two-nucleate embryosac and upper dyad cell. (2n = 16). × 700. — *b*: organized e.s. with only four nuclei. (2n = 16). × 230. — *c*: prophase of the last division; supernumerary nucleus. (2n = 24). × 700. — *d*: eight-nucleate e.s. lacking vacuole. (2n = 28). × 700. — *e*: irregular e.s. with five nuclei. (2n = 56). × 700. — *f*: e.m.c. with restitution nucleus. (2n = 80). × 700. — *g*: irregular distribution of the nuclei in the e.s. (2n = 32). × 700. — *h*: irregular e.s. with fifteen nuclei. (2n = 64). × 230. — *i*: irregular e.s. lacking eggcell. (2n = 64). × 230. — *j*: nucellus with dyad cells. (2n = 93). × 700. — *k*: polar nuclei (2n = 93). × 700. — *l*: irregular e.s., at the micropylar end one prophase nucleus and three divisions; there was also a group of chromosomes in neighbouring section. At the chalazal end one large and three small nuclei. (2n = ?). × 700.


a
b
c
d
e
f
g
h
i
j
k
l

embryosacs had supernumerary polar nuclei or were irregular in other ways.

Fig. 1 *l* shows an interesting embryosac with supernumerary divisions of the four micropylar nuclei. The divisions are not strictly simultaneous and one nucleus still shows the prophase stage. Unfortunately the chromosome number of the plant having this embryosac is unknown (the collection seemed to be erroneously labelled).

Parthenogenetic Allium nutans.

As mentioned in the introduction Dr. LEVAN has a type of *Allium nutans* suspected to form seeds without fertilization. Dr. LEVAN has kindly informed the author that the chromosome number is 40 or 42; however, in the selfed progeny of 40 chromosome plants plants with higher numbers also occur, for instance with more than 60 chromosomes (triploids) or tetraploids with a chromosome number about 80. Intermediate numbers occur, but exact determinations have not been made. Although the basic number certainly is 8 as in other *nutans*-forms, it consequently being pentaploid or ± pentaploid, it is in this chapter called diploid for the sake of simplicity. The pollen consists in most plants almost entirely of »diploid» pollen grains. One may find plants with »haploid» grains from pollen tetrads, but such grains always are a minority and at the most amount to only 25 % of all grains (see also LEVAN 1935, p. 98—100).

In the material collected in 1941 and 1942 buds and flowers from two plants of this *nutans* type were included. In 1949 fixations had been made from twenty-one plants. From a number of these plants material labelled »not opened flowers» or »just opened flowers» had been collected, while ovaries of flowers which had been castrated and isolated two weeks before fixation were collected from three plants. New fixations of ovaries and fruits from castrated flowers were made in 1950. Thus a fairly large quantity of material has been studied, but certain early stages still need a closer investigation.

The development of the embryosac.

The e.m.c. has very often more chromosomes than the somatic tissue. This was observed in all plants (five), where meiosis could be studied. Increased chromosome number of the e.m.c. of this *nutans* type has also been observed by Dr. L. SACHS (p. 171). Thus there is no doubt of its regular occurrence. Probably the increase is not restricted to the e.m.c. of the ovule. Sometimes one or a few large cells with very large nuclei are observed in the nucellus. Mitosis was not observed and therefore increased chromosome number of somatic cells is hypothetical. Such large cells may occur in the epidermis at the top of the nucellus, or laterally at the side of the e.m.c. or below the e.m.c.

The appearance of the pachytene and diplotene nucleus shows that meiosis starts with the increased chromosome number. More reliable counts can only be made in anaphase-early telophase (Fig. 2 *a*—*d*). It seems that the e.m.c. has euploid chromosome numbers. Diploid, tetraploid and ± hexaploid e.m.c.'s have been observed. Tetraploid e.m.c.'s are more common than diploid; a hexaploid was observed once. Also octoploidy seems to occur. The manner in which the increase of chromosome number is brought about was not observed. A doubling or quadrupling of the chromosomes could occur through endomitosis in the nucleus of the young e.m.c. A hexaploid number cannot be explained in this way. MANTON (1950) has shown that in apomictic ferns tetraploid spore mother cells are formed through a disturbance of the last premeiotic division. Disturbances of the two last divisions lead to the forming of octoploid spore mother cells. It is more easy to understand the occurrence of hexaploid e.m.c.'s after disturbed premeiotic division than after endomitosis.

Pachytene and diplotene stages are rather well fixed and show clear bivalents in diploid as well as tetraploid nuclei. In the latter multivalents were observed but the large number of chromosomes renders observations difficult. Diakinesis and the first metaphase are less clear as the strong contraction of the chromosomes makes a correct interpretation of the configurations impossible: an analysis of the chromosome pairing could not be made. In diploid e.m.c.'s a regular metaphase plate is formed of bivalents, whereas multivalents are rare or absent. Also in tetraploid cells a plate was observed, but it is uncertain, if plate formation occurs in all such cells. In any case a plate with crowded bivalents and multivalents and few univalents was rather often observed. Other e.m.c.'s with increased chromosome number had more univalents and fewer multi- and bivalents; the univalents were not orientated in the equatorial plate, but were in the vicinity of this plate. Two or more of them were forming short longitudinal rows as if they were the disjuncted members of a bivalent or multivalent (Fig. 2 *e*). One may also observe many univalents at each side of the plate or more near the poles, only a low number of paired or unpaired chromosomes being in the plate. An e.m.c. with only univalents is shown in Fig. 2 *c*. All univalents could not be clearly seen but no doubt this is a tetraploid cell. The chromosomes have taken a telophasic appearance and at the chalazal end of the cell often chromatids are separated. A number of univalents still linger in the original plate. In Fig. 2 b_1 and b_2 80 univalents seem to form three groups. Fig. 2 d_1—d_2 show similar conditions but here at least 116 chromosomes could be counted, the actual number probably being somewhat higher (120). The absence of bivalents does not seem to be because of asyndesis. Another interpretation is perhaps truer. The univalents arise through the gradual separation of paired chromosomes which slowly assemble at the two ends of the e.m.c. The poles of the spindle seem to be broad; no »tassement polaire» of chromosomes is observed. In most cases two large interkinesis nuclei are formed in the polyploid e.m.c., a few micronuclei may occur formed of lagging chromosomes (Fig. 2 *f*). However, supernumerary interkinesis nuclei of intermediate size may be formed. Fig. 2 g_1 and g_2 show a cross section of an e.m.c. with two larger nucei between the normal interkinesis nuclei. A restitution nucleus is rarely formed. A very large restitution nucleus formed in an e.m.c. with scattered chromosomes was never observed. Only spherical nuclei were observed, formed of a group of chromosomes lying close together at the place of the metaphase plate (see Fig. 2 *e*). A few microcytes may be formed from peripheral univalents of such a group.

Formation of two separate dyad cells occurs in most ovules. Two- and four-nucleate embryosacs are often seen; as a rule they are accompanied by an upper dyadcell; the absence of an upper dyadcell showed that a restitution nucleus had been formed. The embryosac may have small or large nuclei (Fig. 2 *h* and *i*), perhaps indicating different chromosome numbers. Quite often one observes pro- or metaphase in the two- or four-nucleate embryosac. Exact determination of the chromosome number is difficult, but it cannot be doubted that the majority

---

Fig. 2. Parthenogenetic *A. nutans*. a_1—a_3: the chromosomes in a »diploid» e.m.c. Polar view. × 1500. — b_1—b_2: the chromosomes of a »tetraploid» e.m.c. in two sections. × 1500. — *c*: ana-telophase of the first meiotic division in a »tetraploid» e.m.c. × 1500. — d_1—d_2: the chromosomes of a »hexaploid» e.m.c. in two sections. × 1500. — *e*: the first metaphase. × 700. — *f*: interkinesis, two dyad cells have been formed. × 1500. — g_1—g_2: irregular interkinesis in polar view; at each end of the e.m.c. are one large and several small nuclei, in the middle are two nuclei of intermediate size. × 700. — *h*: two-nucleate e.s. and degenerated dyad cell. × 700. — *i*: ditto.


a_1
a_2
a_3
b_1
b_2
c
d_1
d_2
e
f
g_1
g_2
h
i

of embryosacs are ± diploid. On the contrary the first mitosis in the chalazal dyadcell was not observed. It seems very difficult to find this stage in *Allium*. There is sometimes a size difference between micropylar and chalazal nuclei. The newly organized embryosac is small but enlarges considerably. In many ovules there was no embryosac; the e.m.c. had not divided or the development of the embryosac had stopped.

The embryosac.

In ovules of »just opened flowers» the eggcell may be elongated as a prelude to division and in many embryosacs an embryo consisting of a few cells was already formed. There was no trace of a pollen tube or male cells. The polar nuclei were undivided and were near the antipodals or near the egg-apparatus.

A large quantity of material was investigated from three plants the flowers of which had been castrated and isolated two weeks before fixation. In the largest ovaries the ovules had grown considerably and the embryosac was enlarged and bent. It had often taken the form of V, the arms usually being of different length. In old embryosacs the polar nuclei usually were at the apex of the V on the inner (placental) side of the embryosac. Only in two ovules a few endosperm nuclei had been formed.

The eggcell has a rather variable appearance in this *nutans* form. It is sometimes very broad with a comparatively large nucleus. The form of the embryo is dependent on the eggcell. Broad eggcells form embryos with a less distinct suspensor (Fig. 3 a_2). In the castrated flowers most embryosacs contained an embryo which could have as many as forty cells. However, in a number of cases the eggcell »after two weeks» was undivided. The eggcell may be more or less similar to a synergid. In the latter case no embryo can be formed. Most embryos are no doubt diploid. The best prophase nuclei and metaphase plates showed about forty chromosomes. Exact counts were impossible. Haploid embryos seem to be rare; no clear case of haploidy was observed.

The synergids of old embryosacs mostly lack a vacuole, the nucleus is comparatively large and has a very dense content. Often one synergid is small, the other large. Larger synergids increase considerably in size if fertilization fails, the nucleus also becoming very large. Sometimes the structure of such large synergid nuclei is clearer. One observes individual chromosomes, their number being sometimes much more than forty. The enlarged synergid-nuclei may be polyploid; they must have undergone a kind of endomitosis. Increase of chromosome number through endomitosis has previously been observed in certain cells of the embryosac. GRAFL (1941) reports endomitosis in the large antipodal nuclei of *Caltha palustris*. It is expected to occur in highly enlarged nuclei belonging to cells with a nutritive or glandular function.

The antipodals are in most embryosacs ephemeral, but may sometimes be more persistent, they have often disappeared in the embryosacs of flowers which have just opened. The plant 49-1 had, however, more persistent antipodals: the rather old embryosacs of flowers castrated two weeks before fixation very often had antipodals. These antipodals were not enlarged but one or more may have the appearance of an eggcell (Fig. 3 *c*). As will be shown below, persistent antipodals were found in some other plants.

Irregular organization is not particularly frequent, considering the high chromosome number of the embryosac. The irregularities were similar to those already described. At the chalazal end there may be only two or, very rarely, one or no nucleus. An embryosac with twenty-four free nuclei may be mentioned; all but two formed a group in the upper part of the embryosac. An organized embryosac with supernumerary nuclei is shown in Fig. 3 e_1 and e_2. At the chalazal end one observed an antipodal egg-apparatus, at the micropylar end three large synergids, a two-celled embryo and a broad eggcell. There is still a nucleus in the micropylar egg-apparatus and two polar nuclei in the middle of the embryosac.

Ovules 3—5 weeks after castration.

In the ovaries from castrated, unpollinated flowers formation of endosperm had not occurred after two weeks and the polar nuclei, with one or two exceptions, were undivided in all ovules. However, the evidence of seed setting after castration experiments was somewhat conflicting. This necessitated investigation of ovaries fixed later than two weeks after castration to test the possibility that an autonomous endosperm formation started very late. In 1950 therefore fruits were fixed one, two, three, four and five weeks after castration. The fruits were collected from eight plants growing under different conditions. Two of them were growing in the field, two in the green-house, two at 10° C. and two at 18° C. The fruits from plants growing under field and green-house conditions showed the best development and were

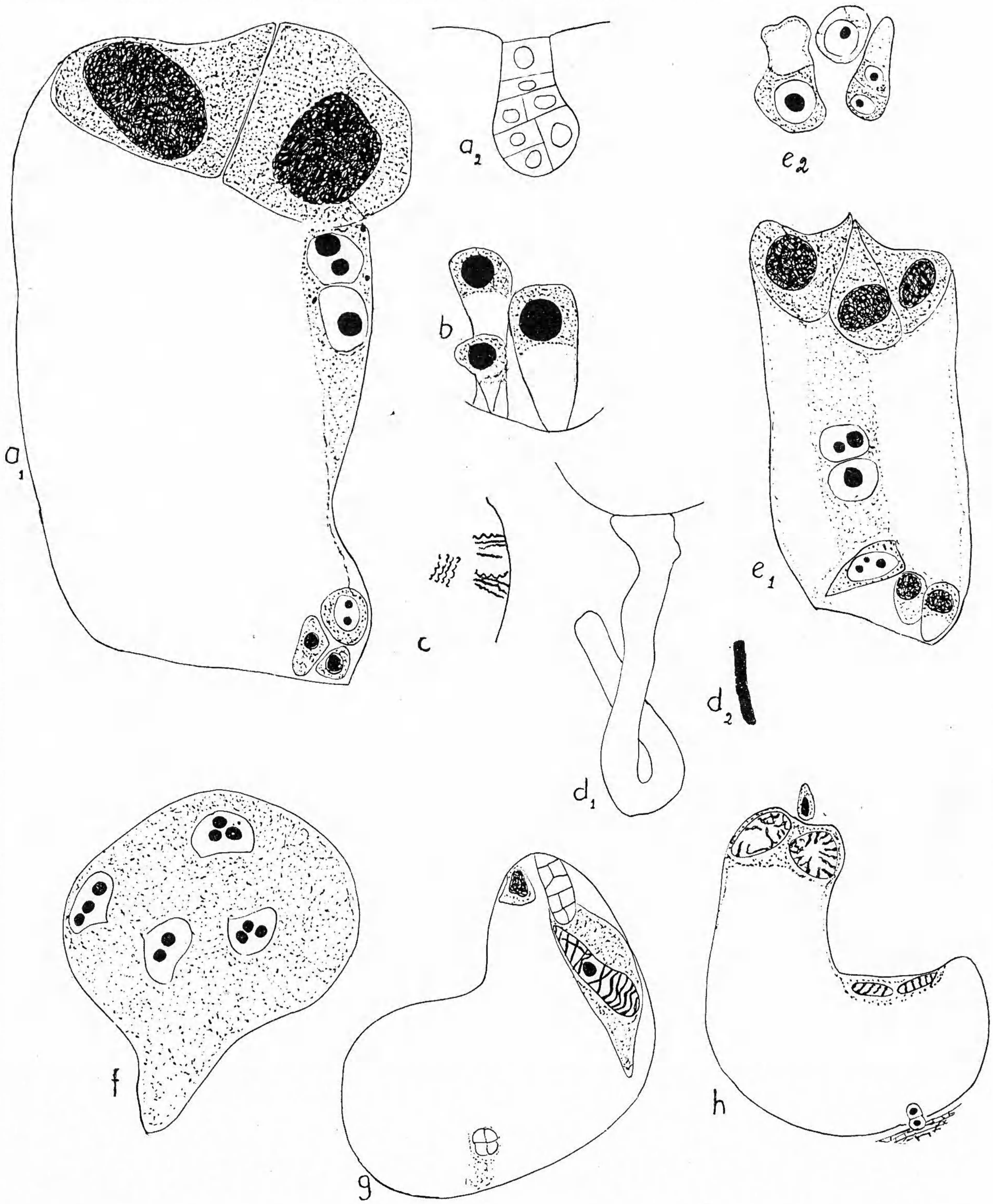


Fig. 3. Parthenogenetic *A. nutans*. a_1—a_2: e.s. two weeks after castration with enlarged synergids, polar nuclei, antipodes, a_2: the embryo of the e.s. × 230. — *b*: antipodes. × 700. — *c*: chromosomes in a synergid nucleus. × 1500. — d_1: a comparatively short giant chromosome from an old enlarged synergid nucleus four weeks after castration. × 1500. d_2: an ordinary chromosome at the same magnification. — e_1—e_2: e.s. with three synergids, eggcell, two-celled embryo, a »neutral» cell, polar nuclei, three antipodes showing some resemblance to a chalazal egg-apparatus. × 230. — *f*: endosperm nuclei. × 230. — *g*: e.s. four weeks after castra-

investigated more closely. At 10° the development was retarded. The chromosome numbers of the investigated plants were 42, ± 40 or ± 39 (oral communication of Dr. LEVAN).

Endosperm only very rarely was observed. As a rule the polar nuclei did not divide. They may be observed as late as four weeks after castration, but usually they degenerate earlier. In ovaries fixed after one week a rather large number of endosperm nuclei were found in two ovules, while sixteen such nuclei were observed in a third. Fig. 3 *f* shows endosperm nuclei from the chalazal part of the embryosac, the form of two of the nuclei figured indicate bridge formation during the preceding anaphase. In the ovaries fixed after two weeks one rather small ovule with a young endosperm tissue was found, as well as one with two endosperm nuclei, a third had an uncertain number of free endosperm nuclei.

After three to five weeks the ovaries are of very different size. In such ovaries which do not grow, all ovules abort; at five weeks they are dried up completely. In the enlarged ovaries one at three and four weeks may find some ovules that are definitely larger than the rest and seem to show normal development of the somatic parts. Their content is, however, different. After three weeks only one such ovule — belonging to the green-house series — was filled with endosperm tissue surrounding a large embryo, that is it showed normal development. Usually, however, the large seeds had a less advanced or irregular endosperm formation or no endosperm at all. For instance, in a large »four week» seed there was a number of dividing endosperm nuclei lying spaciously in the »Wandbeleg» of cytoplasm. A few large or a larger number of small free endosperm nuclei showed a development stage of the endosperm suggestive of that shortly after fertilization. Endosperm with a number of irregular nuclei was also observed, some of the nuclei being very large. The large seeds lacking endosperm had large polar nuclei or only one large nucleus in the cytoplasm. Finally, in a few large seeds the polar nuclei had disappeared and the content was a sac of cytoplasm and two very large synergids with giant chromosomes.

It is difficult to understand why a few of those seeds which do not form any endosperm, grow and show normal changes of the somatic

---

tion with hypertrophied synergid, normal embryo, chalazal embryo and normal synergid. × 50. — *h*: e.s. three weeks after castration. Two enlarged synergids have fused with the cytoplasm of the e.s. There are a third synergid, polar nuclei, and an antipodal embryo on the postament. × 50.

tissue, the outer integument becoming several layers thick, while nucellus and inner integument are destroyed. The large majority of the ovules, however, do not increase in size after two weeks. Also in such ovules which do not grow nucellus and inner integument degenerate. Only that part of the inner integument which surrounded the now invisible micropylar canal (Fig. 4 f_1) and the postament at the chalazal end of the embryosac (Fig. 3 *h*) were more resistant. Of the outer integument only two layers persist, namely the outer and inner epidermis. Parts of the embryosac, particularly synergids and embryos, are more persistent than the somatic tissue (compare MODILEWSKY 1931 concerning unfertilized ovules of *Allium odorum*).

In old endospermless ovules one or both *synergids* increase in size and may become very large (Fig. 3 *g*). Such large synergids may lose their wall and fuse with one another or with the cytoplasm of the embryosac (Fig. 3 *h*). Thus one may find free synergid nuclei in the embryosac. Sometimes a synergid loses its hold and becomes free from the wall of the embryosac. In such cases it takes a completely spherical form showing that it is only surrounded by a membrane and not by a true cell wall (Fig. 4 *a, b*). A few times a free synergid cell was found in a younger embryosac; in such cases the nucleus had not taken the structure of ordinary synergid nuclei but showed typical prophase. In Fig. 4 *a* a free synergid cell with a dividing nucleus is shown. The chromosomes could not be counted, but clearly the nucleus was not polyploid, perhaps because the cell had become free early. In old synergids the nucleus often has an irregular form, for instance the form of a horseshoe. Abortive mitosis and lack of space presumably cause such irregularities. The synergid in Fig. 4 *b* had two normal nuclei. The synergid in Fig. 4 *c* is very curious. It has about twenty free nuclei of different size, but also the ordinary synergid nucleus which, however, is of reduced size. As is seen from the irregular outline of the lower side of the cell there is probably no hindrance to immigration of nuclei into the cell. However, as the embryo was intact (compare below) the origin of the nuclei seems mysterious; one is perhaps forced to conclude that the nuclei have been formed from the ordinary synergid nucleus.

Enlarged synergid nuclei have a dense structure and contain much nucleolar substance. The structure of the strongly enlarged nucleus of hypertrophied synergids in certain endospermless seeds three and four weeks after castration is very interesting (compare the embryosacs in Fig. 3 *g* and 3 *h*). The large nucleus shows clear prophase with enormously enlarged chromosomes. Also the nucleoli are often of increased size.

Fig. 3 d_1 shows the circumference of an enlarged chromosome in contact with one of the nucleoles of the nucleus, in Fig. 3 d_2 a chromosome of ordinary size from a division in the embryosac is shown at the same magnification. The giant chromosomes have only been studied in microtome slides, their actual length therefore is difficult to determine, being larger than the diameter of the nucleus. The giant chromosomes have a uniform thickness which, however, is much increased. This increase has been brought about through polyteny, the chromosomes being divided in strands. Probably all the giant chromosomes are polytene chromosomes though this could not actually be observed owing to less satisfactory fixation or to other causes (as for instance the abnormal condition of the hypertrophied nucleus). Thus the polytene nature of the chromosomes is not visible everywhere in the nucleus and the number of strands could not be determined. Also the chromosomes of ordinary synergids seem to show polyteny (Fig. 3 *c*).

The endospermless seeds very often contain an *embryo* which after two weeks may have 40 cells, after three 200 cells. These are, however, extreme numbers of cells, usually the embryos are much smaller. As a rule the embryo seems normal and has a suspensor. In older seeds the embryo, however, may be irregular (Fig. 4 f_1). Sometimes its apical part is branched. One or more large cells may be attached to the embryo. These large cells are apical cells of the young embryo which have remained undivided and not taken part in the further development of the embryo. Embryos with groups of small and of larger cells may occur. In older seeds the embryo often becomes divided in several parts before disintegration. The walls between the embryo cells are often dissolved, the cytoplasms of different cells unite and form plasmodia containing embryo nuclei having a fresh appearance. Morphological differentiation of the embryo was never observed in endospermless seeds.

Many ovules lack egg-embryo. As late as four weeks after castration the micropylar cell group could contain an undivided eggcell. Very often the »egg-apparatus» consisted of three synergids. It looked as if in certain embryosacs the eggcell was unable to divide but could change and become similar to a synergid. This is supported by the rareness of undivided eggcells and the frequency of three synergids in very old embryosacs. Cells intermediate between a synergid and an eggcell, combining the structure of the cytoplasm and nucleus of the former with the apical position of nucleus and general form of the latter, are perhaps

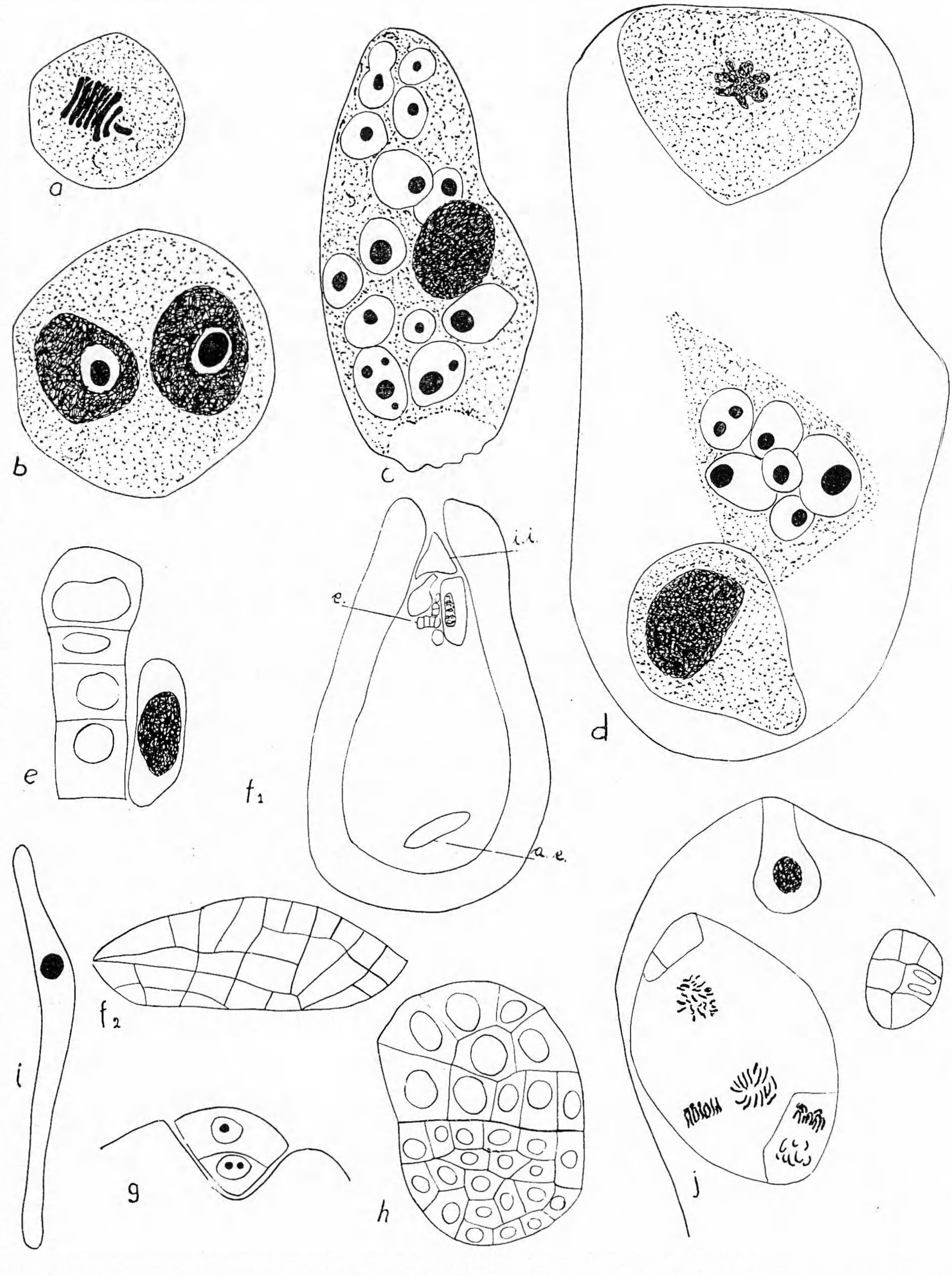


Fig. 4. Parthenogenetic *A. nutans,* old unfertilized e.s. *a*: free synergid with dividing nucleus. × 230. — *b*: free synergid with two nuclei. × 230. — *c*: synergid with many nuclei. × 230. — *d*: e.s. with one enlarged synergid at each end and six »polar nuclei», three weeks after castration. × 230. — *e:* antipodal embryo and synergid, three weeks after castration. A second antipodal synergid was in neighbouring

transformed eggcells. In ovaries from »just opened» flowers or one week after castration embryosacs with three synergids were much rarer. This seems to indicate a somewhat labile constitution of the eggcell. On the other hand the occurrence of more than one eggcell in the egg-apparatus seems very rare. This is probably the reason why no »synergid embryo» was observed. When two embryos are observed at the micropylar end of an embryosac, one of them is usually called synergid embryo. However, probably it has not been formed from a normal synergid but from an eggcell, the egg-apparatus having two eggcells and one synergid. A sure case of a synergid being transformed into an eggcell was not observed here but the egg-apparatus may contain supernumerary cells. Usually such cells have a synergidal or neutral appearance but once two synergids and three eggcells were observed.

The *polar nuclei* may enlarge considerably in old embryosacs and may long preserve a healthy appearance (compare Fig. 3 *h*). A very long polar nucleus is in Fig. 4 *i* shown at a rather modest magnification. It seems as if old polar nuclei may occasionally divide. The only observed case, from a green-house plant after three weeks, may be described. The two polar nuclei were not in contact, having presumably moved apart, one of them showed prophase of mitosis. The nucleus was very large and was in four sections of the slide, each having a thickness of 20 μ. The clearest though smallest section showed about 100 chromosomes, therefore this polar nucleus had more than 400 chromosomes. It was perhaps dodecaploid, instead of diploid as expected. This large increase in number of chromosomes must be through endomitosis; it has previously not been observed in polar nuclei. It seems improbable that a normal endosperm is formed after such late divisions, which must be autonomous, the formation of irregular nuclei appearing more probable. The observed prophase seems to be a pathological case.

The embryosac may have more than two polar nuclei, usually as a result of faulty cell formation (supernumerary divisions may perhaps sometimes have been the cause). Supernumerary polar nuclei were more frequent in the ovules of green-house plants than in the other material

---

section. × 700. — *f*1: rather small ovule three weeks after castration. i.i. = persisting part of the inner integument, e. = the ordinary embryo surrounded of the synergids, a.e. = antipodal embryo. × 50. — *f*2: the antipodal embryo at a higher magnification. × 230. — *g*: divided antipodal cell. × 230. — *h*: a chalazal embryo consisting of parts with different cell size. — *i*: polar nucleus of unusual size and form, four weeks after castration. × 230. — *j*: upper part of an e.s. with »tumours». A synergid is visible. × 230.

(Fig. 4 *d*). The high temperature obviously had been detrimental to cell formation.

The *antipodal* cells were in one plant more persistent than usual. »After one week» one usually observes antipodals in very few embryosacs, but here they were frequent. Persistent antipodal cells may have usual form and size or may be changed into eggcell or synergid. Fig. 4 *d* shows an embryosac at each end with a typical synergid of increased size; these were the only cells in this embryosac, there being six free nuclei near the chalazal synergid. Such a group of »polar nuclei» is more often found at the middle of the embryosac or near the micropylar egg-apparatus; its position here probably depends on the occurrence of a chalazal synergid. Once three antipodal synergids were observed at the chalaza end, usually there are two synergids and one eggcell.

Antipodal eggcells show parthenogenesis and form an embryo. In Fig. 4 *e* there are a synergid and an antipodal embryo. The second synergid was in a neighbouring section. The apical embryo cell had a large nucleus which probably had arisen after a disturbed anaphase and had doubled chromosome number. This embryo had no doubt been formed of an antipodal eggcell. However, only more rarely the embryo at the chalazal end was a typical embryo with suspensor, no doubt owing to the rareness of antipodal eggcells. Aberrant embryos are more frequent. Fig. 4 *h* shows that a part of the chalazal embryo may have larger nuclei and cells; this embryo is perhaps a chimaera, a disturbed mitosis may have been the starting point of the forming of a tetraploid part.

The plant 87-4 which had more persistent antipodal cells, had a chalazal embryo much more frequently. The typical antipodal embryo with suspensor was also here infrequent, but about half the embryosacs had some sort of chalazal embryo. Its most common form was a hemisphere, which could be of rather considerable size though it never showed any thrace of differentiation; this, however, may be due to the absence of endosperm. More often the chalazal embryo consisted only of a few cells (compare Fig. 3 *g*, *h*), which did not form a typical proembryo. The origin of a chalazal embryo — if formed from an antipodal or from the nucellus — is often impossible to settle. Usually there is only one such embryo which is placed on the postament. It therefore seems to be formed from an antipodal cell which has not taken the form of an eggcell. One could in 87-4 find one or two cells on the postament, the tissue surrounding the postament being disintegrated. Such cells which probably are persisting antipodes have a rather small nucleus with the structure of ordinary nuclei. Fig. 4 *g* shows two such cells, which may best be interpreted as daughter cells of a divided antipode. Here we have the beginning of an irregular chalaza embryo. Fig. 4 f_1 shows an ovule with a plate of several layers of meristematic cells near the chalaza. The plate is shown at a higher magnification in Fig. 4 f_2. This formation has little resemblance to an embryo, but as it is formed of rows of cells converging towards the middle of the postament, it may well have originated from antipodes such as those in Fig. 4 *g*. Thus, it seems that antipodal embryos may develop in a very different way, partly depending on the initial form of the cell. — Only in 87-4 irregular embryos could be studied more closely. In other plants they are rare.

Adventitious embryos, that is embryos formed of the nucellus or inner integument, may also occur though they are probably rare. When the somatic tissue of the ovule disappears after two or three weeks one may observe groups of a few cells which more or less resemble »embryos». Any further development of these groups does not seem to occur, however. Also in the chalazal region such a false embryo may be found. There is also a risk of confusion with an embryo formed from an eggcell having a lateral position in the embryosac. However, true adventitious embryos no doubt may occur. This is seen most clearly at the micropylar part of the ovule. Here one or two embryos were seen a few times lying above the synergids. They were no doubt formed from the calotte of the inner integument persisting here in the endospermless seeds. Thus, there is a tendency to form adventitious embryo in this form of *A. nutans,* though this tendency is weak.

Irregularities other than those described on the preceding pages occur, some of which may deserve a short notice. Sometimes the embryosac has an unusual appearance at the chalazal end, there being two or four very large nuclei. Once the embryosac had a small plasmodium with many free nuclei (compare the synergid on p. 160) of unknown origin. More frequent are certain tumour-like formations. Fig. 4 *j* shows the upper part of an embryosac largely filled by two cellular formations. In one were many mitotic figures, indicating rapid growth. A synergid cell is still visible. This embryosac was from a »two week» ovary. In still older ovaries one may find certain ovules with no, or a degenerated, embryosac but with the space usually occupied by the embryosac more or less filled by one or two larger formations. These seem more comparable to tumours than to adventitious embryos. Some of the cells were very large with enlarged nuclei. It is uncertain if the tumours are formed from the inner integument or from persisting parts of the nucellus. The larger cells are rather similar to large nucellus cells.

The investigation of castrated material fixed in 1950 confirmed the occurrence of parthenogenesis. Parthenogenesis is also shown by antipodal eggcells. It is curious that in old embryosacs also antipodes which have not the appearance of an eggcell may divide and give rise to embryo-like formations. Such behaviour of ordinary antipodes has not previously been observed and is not to be compared with the regular division of young antipodes in many angiosperms. It has also been confirmed that polar nuclei as a rule do not divide when fertilization is prevented. Certainly endosperm nuclei are formed in very rare cases. In some of them the endosperm formation was early and rapid and a chance pollination may have been the cause. More often endosperm formation was belated and very slow. In the latter cases there probably had occurred an autonomous division of the polar nuclei. Thus in very old unfertilized embryosacs potencies may become evident which normally cannot manifest themselves.

Allium odorum.

The embryology of *A. odorum* has been investigated by HEGELMAIER, TRETJAKOW, SCHÜRHOFF, WEBER, HABERLANDT (several papers), MODILEWSKY (several papers). DAHLGREN (1927) has made a statement concerning endosperm formation. There are diploid (2n=16) and tetraploid (2n=32) types of *A. odorum*; some of the conflicting statements one finds in the literature are explained by different chromosome number of the investigated material. Fertilization of egg nucleus and polar nuclei has been observed. MODILEWSKY (1930, 1931) has studied a tetraploid type. He has also investigated ovules of castrated flowers. There are diploid and haploid embryosacs and in both of these the ordinary as well as an antipodal eggcell divide and give rise to embryos. More rarely there is a synergid embryo or an adventitious embryo formed from the inner integument. All these embryos degenerate in castrated material, because no endosperm is formed. The polar nuclei cannot divide without fertilization. Comparing with previously known cases of parthenogenesis MODILEWSKY therefore writes of the parthenogenetic embryos here: »Aber, während bei den parthenogenetischen Pflanzen keimungsfähige Samen entstehen, gehen die Samenanlagen mit parthenogenetischen Embryonen bei *Allium odorum* ausnahms-

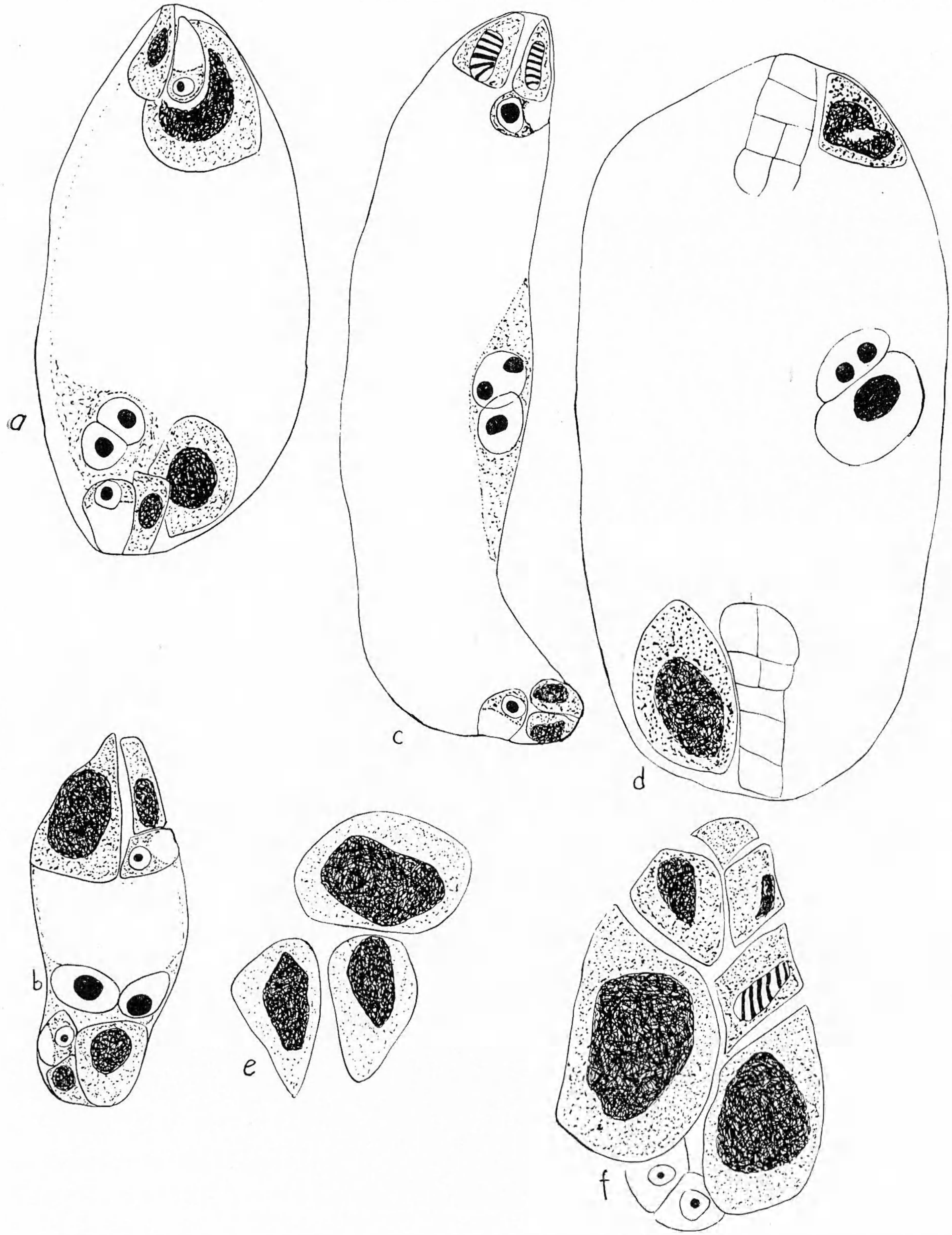


Fig. 5. *a*: *A. senescens*, old e.s. containing micropylar and antipodal egg-apparatus and polar nuclei. × 230. — *b*: *A. senescens* var. *calcareum*, ditto. — *c*—*f*: *A. odorum*; *c*: old e.s. × 230. — *d*: e.s. with ordinary and antipodal embryos; lacking synergids were in neighbouring sections. × 230. — *e*: antipodal group lacking eggcell. × 700. — *f*: four supernumerary synergid cells in the micropylar group, two embryocells are visible. × 700.

weise zugrunde, unabhängig davon, ob die Parthenogenese haploider oder diploider Natur ist» (1931, p. 40).

Clearly there are certain resemblances between the parthenogenetic *nutans*-type and *A. odorum*. The latter species was investigated to facilitate a comparison. From plants growing under field conditions flowers and young fruits were collected 1950. It was from a tetraploid type grown by Dr. LEVAN; the embryology of this type is very similar to that described by MODILEWSKY. From professor Å. GUSTAFSSON I have received two collections made 1944.

The organized embryosac is broad at the middle part, tapering towards the ends. At each end there is an egg-apparatus; the polar nuclei are in most cases at an equal distance from the ends of the embryosac. The embryosac in Fig. 5 *c* is somewhat atypical; it is very long because embryo formation has been delayed. The embryosac of the *odorum* type in the cultures of Dr. LEVAN had one antipodal eggcell or one antipodal embryo, once only two such embryos were observed. If fertilization fails synergid-like antipodes may undergo changes similar to the synergids of the normal egg-apparatus (Fig. 5 *d*). Thus, they ought to be considered true synergids; however, in most embryosacs the micropylar synergids are larger. As a matter of fact the antipodes have the same organization as in *A. senescens,* irrespective of the somewhat different appearance of the synergids. The eggcell, however, is more vigorous, enlarging as a prelude to division.

Rarely fertilization had occurred in the material collected in the field; pollination seemed to have failed. However, in most ovules an embryo was present at each end of the embryosac, while the polar nuclei were undivided or had disappeared (Fig. 5 *d*). The antipodal embryo may be larger than the normal embryo. For instance once it had 43 cells, while the normal had 33. Unfertilized ovules degenerate more rapidly than in *A. nutans,* the most resistant part being the embryo. One finds seeds with completely dried somatic tissue surrounding a rather large embryo still showing mitotic figures. Any outer or inner differentiation of the embryo in endospermless seeds was, however, not observed.

Some of the irregularities observed in *A. nutans* also occur in *A. odorum.* Several have been described by MODILEWSKY. Here mention may be made of the occurrence of a micropylar egg-apparatus consisting of three synergids, of supernumerary polar nuclei. Fig. 5 *e* shows one of the rare cases of an antipodal group lacking egg-cell. Irregularities were on the whole less frequent than in *nutans.*

The material procured from professor GUSTAFSSON consisted of castrated flowers. A 0,01 % solution of heteroauxin had been injected in a number of the ovaries. This strain of *A. odorum* showed a difference compared with that of Dr. LEVAN. The embryosac contained very often two antipodal embryos. Probably more than fifty % of the embryosacs contained more than one antipodal eggcell. The higher frequency of antipodal embryos could not be an effect of heteroauxin, as it was also observed in the ovules of untreated ovaries. In treated as well as in untreated material a normal embryo was formed from the eggcell but there was no endosperm; the polar nuclei were always undivided. Irregularities were rather frequent here. Fig. 5 *f* shows a case of four supernumerary cells in the egg-apparatus. It seems uncertain that irregularities were promoted by the treatment though it had begun rather early. The heteroauxin had a stronger effect on the ovaries which showed super-normal growth than on ovules or embryosacs.

The parthenogenetic embryos of *A. odorum* are no doubt in most cases diploid. Only once an egg embryo had about 16 chromosomes, usually 32 chromosomes are counted in egg- as well as in antipode embryos. Similar observations were made by MODILEWSKY. Embryo-producing embryosacs thus are usually diploid. This speaks against the view of MODILEWSKY that parthenogenesis is of no importance under natural conditions. A regular fertilization of diploid eggcells must result in a triploid progeny, but so far plants with more than 32 chromosomes have not been recorded.

Most investigations describe synergidal embryos in *A. odorum*. Such have not been observed here, probably because the investigated material was too limited. This circumstance may also explain the failure to find adventitious embryos. The origin of adventitious embryos from the inner integument has been described by HABERLANDT and an adventitious embryo is figured by MODILEWSKY (1931). SCHÜRHOFF even interpreted the antipodal embryos as adventitious embryos formed from the nucellus. One would perhaps expect a higher frequency of such embryos in ovaries treated with heteroauxin, but the embryosacs contained no adventitious embryos. Clearly synergid and adventitious embryos only rarely occur in the material investigated here. This is a new resemblance between the tetraploid *odorum* form cultivated by Dr. LEVAN and the one previously investigated by MODILEWSKY. MODILEWSKY mentions that synergid embryo, adventitious embryo and a second antipodal embryo certainly may occur but they are rare.

Conclusions.

There are many similarities between the forty-chromosome parthenogenetic *A. nutans* type and tetraploid *A. odorum.* 1) Parthenogenesis occurs easily. 2) Parthenogenesis is not restricted to the ordinary eggcell but is also shown by supernumerary eggcells with a lateral position in the embryosac or antipodal eggcells. Supernumerary embryos are more common in *A. odorum* because the antipodes as a rule form an egg-apparatus in this species. In *A. nutans* the antipodes usually are weak; however, certain plants had persistent antipodal cells which may form an egg-apparatus and embryo. The division of an antipodal eggcell occurs less readily in *nutans,* it has only been observed in old embryosacs of castrated flowers. Polyembryony probably does not occur under natural conditions while in *A. odorum* polyembryony is also established in germinating seeds (SCHÜRHOFF). 3) Adventitious embryos are formed from the inner integument in rare cases. 4) A further similarity is that most embryosacs are diploid, the embryos are diploid. In *A. nutans* the diploidy of the embryosac is caused by a peculiar mechanism, which so far has not been found in any other angiosperm. 5) A last similarity between parthenogenetic *nutans* and *odorum* is that the polar nuclei must be fertilized. In *A. nutans* they seem to divide autonomously in exceptional cases, perhaps only in very old embryosacs.

The first and last point of similarity, parthenogenetic formation of embryo but fertilization of polar nuclei characterizes many pseudogamous angiosperms. Does *Allium odorum* and the pentaploid *A. nutans* investigated here as a rule reproduce through pseudogamy? This point is perhaps not easily settled through embryological-cytological methods. As already pointed out concerning a *Poa alpina* hybrid the time of the penetration of the pollen tube into the embryosac may be of importance in cases where the eggcell may divide through parthenogenesis as well as after fertilization (HÅKANSSON 1942). In pseudogamous *Poa alpina* the eggcell divides very early and the embryosac contains already an embryo when the pollen tube arrives. The occurrence of small embryos in ovules of just opened flowers of parthenogenetic *A. nutans* indicates a rather early division of the eggcell compared with the sexual species. This makes it rather likely that under open pollination conditions many embryos are formed parthenogenetically. Concerning *A. odorum* MODILEWSKY, as mentioned on p. 167, seemed to ascribe a rôle in the seed reproduction of the plant only to embryos produced after fertilization. However, a regular fertilization of the eggcells of diploid embryosacs seems unlikely. Mature haploid embryosacs seem to be rare in the tetraploid *odorum* form (MODILEWSKY 1930). Thus one cannot escape the conclusion that parthenogenesis in *A. odorum* is not a freak of nature but a regular feature in seed production.

It is probable that parthenogenesis occurs in other *Allium* species than *nutans* and *odorum*. One could expect cases where a property of the eggcell to divide autonomously manifests itself very late, that is, only when fertilization has failed. An octoploid *nutans* investigated here showed embryo and undivided polar nuclei in rather old ovules. It may be that investigation of castrated material will prove parthenogenesis in this case. WEBER observed two embryos in some embryosacs of *A. zebdanense* and *A. rotundum*. In these species one synergid often looks like an eggcell. She also has observed supernumerary male cells in pollen tubes of these species and thinks it probable that one embryo has arisen after fertilization of the eggcell, the other after fertilization of the eggcell-like synergid. Generative apogamy »im Sinne WINKLERS» is thought less probable. However, as synergid embryo has been described from many agamosperms, the possibility of parthenogenesis should not be dismissed easily. Parthenogenesis cannot play any rôle in the reproduction of these two species; WEBER observed a regular meiosis and the embryosacs are haploid.

The mode of diploid making of the embryosac in *A. nutans* is very interesting. The e.m.c. is often tetraploid, but may have a still higher chromosome number. Dyad cells with the reduced number of chromosomes are formed but as a consequence of the earlier chromosome doubling the embryosac is diploid. Dr. L. SACHS has also observed tetraploid e.m.c's in this *nutans* form, with about 40 II instead of 20 II at diakinesis and first metaphase, and about 40 chromosomes in anaphase plates. There is no previous instance of such a reproduction in angiosperms. E.m.c.'s with a doubled chromosome number undergoing meiosis have been observed in *Lilium longiflorum,* the doubling having been caused by low temperature (ROSENBERG 1946), and in species hybrids of banana (DODDS and SIMMONDS 1947). In the latter case the place and time of the chromosome doubling was stated to be in the resting nucleus of the e.m.c. Doubling of the chromosomes of the e.m.c.'s, in connection with parthenogenesis was unknown.

A corresponding mode of reproduction is, however, known from certain flatworms. MELANDER (1949) states of a parthenogenetic flatworm of the genus *Polycelis* »that in the ovarian cells of the latter» (that is, an undescribed parthenogenetic species) »the number of chromosomes is doubled before the onset of meiosis by means of an endomitotical process». The parthenogenetic species has 21 chromosomes in somatic cells, the oocytes show, however, 21 II, and the nucleus of the mature egg has 21 chromosomes. LEPORI (1950) has in *Polycelis nigra* found 24 chromosomes in oogonial cells, but 24 II in many oocytes. A regular meiosis leads to diploid eggs developing through parthenogenesis. Also in a number of spermatocytes the chromosomes are doubled. Sperms penetrate into the egg but fertilization does not occur.

A number of apomictic ferns form diploid spores. These germinate to diploid prothallia which form diploid sporophytes through apogamy. In the sporangia there is a doubling process leading to the forming of tetraploid spore mother cells. Meiosis is regular. This kind of reproduction has been studied by STEIL, DÖPP, SR. THOMASINE (PATTERSON) and MANTON. MANTON (1950) has given a very convincing description of the different phases of the reproductive cycle.

The chromosome doubling is considered to take place through endomitosis in *Polycelis*. In apomictic ferns the last pre-meiotic division is disturbed: the chromosomes split in the metaphase plate but there is no anaphase movement, all daughter chromosomes are included in one nucleus. In a number of sporangia the two last divisions occur in this way, leading to the forming of octoploid spore mother cells. In other sporangia chromosome doubling fails and the spore mother cells are diploid. It is a curious fact that all mother cells of a sporangium are diploid, tetraploid or octoploid, i.e. a mixture of mother cells with different chromosome numbers does not occur. Diploid spore mother cells show an irregular meiosis with strong asyndesis, but in tetraploid and octoploid cells meiosis is regular and the chromosome pairing is good (MANTON 1950).

Chromosome doubling should lead to good chromosome pairing. If a doubling occurred in the resting nucleus daughter chromosomes are expected to form bivalents. As the bivalents are composed of identical chromosomes no segregation can occur. In a parthenogenetic angiosperm this results in a constant progeny. If the doubling occurs in a pre-meiotic division one would expect daughter-chromosomes often to lie at a greater distance in the nucleus. Competition of pairing would assert itself more, the result being multivalent formation and a limited segregation. The triploid and tetraploid plants occurring in the progeny of this *nutans* form have perhaps also arisen through parthenogenesis: hexaploid and probably octoploid e.m.c's occur.

Increased chromosome number of the e.m.c. was not observed in other forms of *A. nutans*; however, meiotic stages were seen only in a few of the investigated plants. Dr. SACHS who also investigated a *nutans*-form not forming pollen dyads also observed only diploid e.m.c's. Meiosis in *Allium odorum* has been investigated by MODILEWSKY (1930, 1931). He observed two kinds of meiosis. In certain ovules the diakinesis stage showed 16 II; a haploid embryosac was formed. In other ovules the e.m.c.-nucleus had 32 unpaired chromosomes and a diploid embryosac was formed. The description is somewhat obscure, on the one hand MODILEWSKY calls the nucleus with unpaired chromosomes a restitution nucleus and speaks of semiheterotypic division, on the other he expresses the opinion that meiosis begins normally, but the nucleus of the e.m.c. »verwandelt sich nach der heterotypischen Prophase im letzten Augenblick vor der Metaphase in einem Kern mit der somatischen Chromosomenzahl» (1930). Be that as it may, MODILEWSKY has obviously not observed any e.m.c. with 32 II. The mechanism existing in the parthenogenetic *nutans*-type does not seem to exist in *odorum*.

Restitution nuclei have been observed in e.m.c.'s of *Allium*. In the parthenogenetic *nutans*-type spherical restitution nuclei were as it seemed exceptionally formed from chromosomes lying close together in the place of the diakinesis nucleus and first metaphase. Very large restitution nuclei formed from scattered chromosomes were observed in certain high polyploid *nutans* plants. LEVAN (1935) describes pollen dyad formation in *Allium*: the first meiotic division is regular, the second is omitted. The dyad cells formed after the first division directly form pollen dyads. The chromosomes separating at the first anaphase reappear in the first mitosis of the pollen, where their chromatids, although entirely separated, are still arranged in pairs. This s.c. monokinetic meiosis which is the usual mode of pollen dyad formation and chromosome doubling on the male line cannot occur frequently in the ovules. This is of course difficult to prove through observations, but after a chromosome doubling in the e.m.c. there is no room for a further doubling at the second meiotic division. Thus, in the parthenogenetic form with 100 % pollen dyads and a very high percentage diploid embryosacs the doubling mechanism is different on the male and female side. The forming of a restitution nucleus may occur in anthers as well as in ovules but also here more exceptionally.

One may speculate why the mechanism observed in *A. nutans* has not been adopted as a regular propagation method in other apomictic angiosperms. Many »agamosperms» who form embryo through parthenogenesis use the e.m.c. when forming a diploid embryosac (diplospory). In such agamosperms the e.m.c. is diploid as usual, it is a change in the course of meiosis which makes the embryosac diploid (apomeiosis). The method of doubling the chromosomes of the e.m.c. and retaining the ordinary meiosis has not been accepted. It may be that the doubling may result in multivalent formation which tends to make meiosis irregular, causing the forming of aneuploid embryosacs and aneuploid plants in the progeny; this cannot be advantageous.

Autonomous division of the eggcell and fertilization of polar nuclei distinguishes many pseudogamous angiosperms, where the »pseudogamy» is the inability of the unfertilized polar nuclei to form endosperm. However, through chromosome counts in the endosperm of pseudogamous *Hypericum perforatum* NOACK (1939) showed that in exceptional cases this tissue is tetraploid instead of pentaploid indicating, that division of polar nuclei without fertilization may occur. An objection is that fertilization of a haploid embryosac with diploid male cells also results in tetraploid endosperm. Other cases of autonomous division of polar nuclei in pseudogams have been reported, but several of them were not confirmed by later investigators. Such an unconfirmed case is *Ranunculus auricomus*. HÄFLINGER (1943) claimed that both male cells degenerate in the embryosac, the endosperm is tetraploid, but RUTISHAUSER has later shown the necessity of fertilization of polar nuclei (Seventh inter. bot. congr.). FAGERLIND (1946) observed the behaviour of the male nuclei in the embryosac of *Rudbeckia laciniata,* and states that fertilization of polar nuclei often fails, BATTAGLIA (1947) finds that their fertilization invariably occurs. NYGREN (1950) in *Poa arctica* observed endosperms with 84, 112 or 140 chromosomes, and finds that the first and last number prove fertilization of polar nuclei in a haploid respectively a diploid embryosac, the number 112 indicates autonomous division in a diploid embryosac. In pseudogamous *Poa alpina,* however, unfertilized polar nuclei seem unable to divide (HÅKANSSON 1942). BÖCHER (1951) proved through castration pseudogamy in *Arabis Holbölli.* Here the polar nuclei divide autonomously. He observed the two male cells in the embryosac; eggnucleus and polar nuclei are, however, not fertilized, the endosperm is hexaploid in triploid, tetraploid in diploid forms. Autonomous endosperm formation seems to occur in a few % of the ovules of castrated flowers of parthenogenetic *Allium nutans.*

The embryosac develops after the *Allium* type in the different forms of *A. nutans* investigated here. Many irregularities of the organisation of the embryosac has been described above, they are of different kinds. The embryosac may have less than eight nuclei. A size difference between the chalazal and micropylar nuclei in the embryosac may be seen already in the two-nucleate embryosac, the chalazal nuclei being smaller. This difference is larger in polyploids. One or two divisions may fail at the chalazal end, in extreme cases embryosacs with only the micropylar group may be formed. They had egg-apparatus and upper polar nucleus, antipodals and lower polar nucleus were lacking. Such a reduction or inhibition of the chalazal nuclei has been described in several other angiosperms. More often there are more than eight nuclei in the organized embryosac. The supernumerary nuclei may have different origin. 1) In triploids, aneuploids and in certain other forms the developing embryosac may contain nuclei formed from chromosomes »eliminated» during meiosis. Small microcytes degenerate, but larger nuclei have been observed dividing. 2) The upper dyad cell may take part in the forming of the embryosac. Once a sixteen-nucleate embryosac seemed to have originated in this way. It is probably lack of space that in normal cases causes the nucleus of the upper dyad cell to remain undivided or, rarely, divide once. 3) In cases when the organized embryosac contains for instance ten or eleven nuclei one seems forced to assume supernumerary divisions of one or two nuclei in the developing embryosac. GERASSIMOWA (1930) observed in *Crepis capillaris* sometimes supernumerary eggcells. From their uniform size she concluded such an origin. Here we have actually observed supernumerary divisions in the micropylar part of the embryosac (p. 152, compare also p. 149). Supernumerary nuclei may take part in the egg-apparatus. 5) Disturbed divisions in the developing embryosac occur, and may perhaps also change the normal number of nuclei. 6) Fusion of two embryosacs.

Often the embryosac has the normal number of nuclei, but the organization is irregular. Supernumerary cells in the egg-apparatus may also be the result of a deviating distribution of the ordinary nuclei. The vacuole of the embryosac is sometimes formed very late; when it is formed at the four-nucleate stage three nuclei may be at the upper, only one at the lower side of the vacuole. In such cases an egg-apparatus of five cells may arise. Supernumerary cells in the egg-apparatus in most cases look like synergids, supernumerary eggcells are rare. Sometimes cells with a »neutral» appearance were formed next to the egg-apparatus. A common irregularity is deficient cell demarcation. It seems more common in polyploid embryosacs and often leads to supernumerary polar nuclei, the free nuclei forming a group with the two ordinary polar nuclei.

The frequency of irregularities seemed to be higher in certain plants. High polyploids and plants with a high percentage of pollen dyads may be mentioned as instances. WEBER investigated the ovaries of flowers from inflorescences with bulbills. In some bulbill-carrying *Allium*-species the embryosac degenerates early, but in other an egg-apparatus is formed. Irregular organization is frequent. In a few species an embryo was formed which invariably died; only after removal of the bulbills the seeds matured. The organization of the embryosac is also influenced by external factors, high temperature made the forming of cells more difficult in the parthenogenetic *nutans*-type.

The most important irregularity is antipodal eggcells or an antipodal egg-apparatus. Such have been observed in many other *Allium*-species than *A. odorum*. WEBER writes of the antipodes of *A. paradoxum* »Bei dieser Art ähneln sie in ihrer Ausbildung dem Eiapparatus». MODILEWSKY (1928) states that in *A. paniculatum* the antipodal cells form an egg-apparatus very similar to that in *A. odorum,* though the antipodal eggcell never divides. MESSERI (1931) observed in *A. schoenoprasum* and *A. subhirsutum* occasionally an »oosfera antipodiale», in *A. nigrum* an antipodal egg-apparatus may be formed. Here we have confirmed the regular occurrence of an antipodal egg-apparatus in *A. odorum*; it is also found in *A. senescens* and *A. senescens* var. *calcareum*. In some other forms an antipodal eggcell was seen more occasionally. The parthenogenetic *A. nutans* was peculiar in this respect: most plants had ephemeral antipodes, but a few had persistent antipodal cells and could form an antipodal egg-apparatus. In types with parthenogenesis the antipodal eggcell forms an embryo, showing that it is not the question of a superficial resemblance. In *A. senescens* an embryo was never observed in old unfertilized embryosacs; this is not a parthenogenetic species. Antipodal embryos are not to be expected in sexual species, the chance of the fertilization of an antipode seems very small, male cells being intercepted at the micropylar end. Cases of antipodal eggcells and embryos are discussed in MESSERI (1934) and MAHESHWARI (1950). It seems to us that a more frequent occurrence of an antipodal egg-apparatus is to be expected only in bi-sporangiate embryosacs of *Allium* type or tetra-sporangiate of *Peneaa* type. The large frequency of an antipodal egg-apparatus in *senescens* and *senescens* var. *calcareum* is of a taxonomical interest. However, a larger number of plants ought to be investigated (compare the circumstances in parthenogenetic *A. nutans*); *A. senescens* is among the species investigated by WEBER; she does not mention the occurrence of antipodal eggcell here.

The capacity to divide, however, was not restricted to antipodal eggcells, it was also shown, through rarely for undifferentiated antipodes. The tissue formed in such cases shows less resemblance to a normal embryo.

The behaviour of synergids in old unfertilized embryosacs is reminiscent of the antipodes in such embryosacs of *Poa alpina*. In both cases we have embryosac cells very well developed compared with other angiosperms; if fertilization fails the cells do not degenerate, but increase still more in size and seem hypertrophied. Concerning the antipodal cells of pseudogamous *Poa alpina* it was assumed that some of the nutriment normally consumed by the young developing endosperm now causes an excessive growth of the antipodes. This explanation may also be valid for the hypertrophied synergids in endosperm-less seeds of *Allium nutans*.

The nucleus of a moderately enlarged synergid has a dense structure and much nucleolar substance. In connection with the considerable growth of the nucleus of the hypertrophied synergid its content becomes less dense. The very large nucleus often shows prophase and has still larger nucleoli. The chromosomes are enormously enlarged, being veritable giant chromosomes. The chromosomes have a uniform, strongly increased diameter. As they are longer than the diameter of the nucleus their actual length must be determined in crushed material. The large chromosomes have a polytene structure; the place of the centromere was not visible.

Through a good technique it might be possible to study these enlarged chromosomes more closely. They may fittingly be compared with the giant chromosomes in the cells of the salivary glands of *Drosophila*. In *Diptera* the chromosomes increase in size to a great degree in certain tissues and attain their maximal size in the salivary glands of fullgrown larvae (WHITE 1945). As in salivary glands, the prophase with giant chromosomes in the synergid is not changed into a metaphase, the nucleus does not divide.

Summary.

Seed development of diploid, polyploid and aneuploid plants belonging to the *angulosum-senescens-nutans* group of species of the genus

Allium has been investigated. The plants were from the cultures of Dr. ALBERT LEVAN.

Parthenogenesis has been discovered in a pentaploid type of *Allium nutans* (2n=40—42). The embryosac is in most ovules »diploid», the eggcell divides autonomously giving rise to a »diploid» embryo.

After castration polyembryony was rather frequent in certain plants of the parthenogenetic type. The antipodes, as a rule ephemeral, were in these plants persistent and could form a second egg-apparatus; in ovules of flowers castrated three or four weeks before fixation a normal or irregular antipodal embryo had often been formed. Adventitious embryos are rare.

Most e.m.c's of the parthenogenetic *A. nutans* have increased chromosome number. They are often »tetraploid». The embryosac is formed in the same mode as in the sexual species, but is »diploid» as a consequence of the high chromosome number of the e.m.c.

The polar nuclei as a rule do not form any endosperm in castrated flowers of the parthenogenetic type. Rare exceptions seem to occur.

In old unfertilized embryosacs one or both synergids may become very large. The nucleus shows prophase but does not divide. The polytene chromosomes are enormously enlarged (giant chromosomes).

A. senescens and *A. senescens* var. *calcareum* had, in most embryosacs observed, the antipodal cells changed into a second egg-apparatus. These forms, however, do not show parthenogenesis and do not form antipodal embryos.

Some investigations were made on tetraploid *A. odorum*. The observations of MODILEWSKY on embryo and endosperm formation were confirmed. Meiosis and development of the embryosac was not studied.

Disturbed as well as supernumerary divisions were observed in the developing embryosac of certain forms of *A. nutans*. Irregular organization of the embryosac may be rather frequent.

Literature cited.

BATTAGLIA, E. 1947. Ricerche caryologiche e embriologiche sul genere *Rudbeckia* (Asteraceae). VIII. Semigamia in *Rudbeckia laciniata* L. — Nuovo gior. bot. ital., 53.

BÖCHER, T. W. 1951. Cytological and embryological studies in the amphi-apomictic *Arabis Holboellii* complex. — K. Danske Vid. Selsk. Biologiske Skrifter Bd. VI, nr. 7.

DAHLGREN, O. 1927. Die Morphologie des Nuzellus mit besonderer Berücksichtigung der deckzellosen Typen. — Jahrb. wiss. Bot. 67.

DODDS, K. S. and SIMMONDS, N. W. 1949. The cytogenetics of bananas. — Proc. eighth intern. congress of genetics.

FAGERLIND, F. 1946. Sporogenesis, Embryosackentwicklung und pseudogame Samenbildung bei *Rudbeckia laciniata* L. — Acta Horti Bergiani, 14.

GERASSIMOWA, H. 1933. Fertilization in *Crepis capillaris.* — La Cellule 42.

GRAFL, I. 1941. Über das Wachstum der Antipodenkerne von *Caltha palustris.* — Chromosoma 2.

GUSTAFSSON, Å. 1946. Apomixis in higher plants. I. — Lunds univ. årsskr. avd. 2, 42: 3.

HÅKANSSON, A. 1943. Die Entwicklung des Embryosacks und die Befruchtung bei *Poa alpina.* — Hereditas 29.

HÄFLIGER, E. 1943. Zytologisch-embryologische Untersuchungen pseudogamer Ranunklen der *Auricomus*-Gruppe. — Ber. schweiz. botan. Ges. 53.

JONES, H. A. and EMSWELLER, S. L. 1936. Development of the flower and macrogametophyte of *Allium cepa.* — Hilgardia 10.

LEPORI, N. G. 1950. Il ciclo chromosomico, con poliploidia, endomitose e citogenesi, in populazione italiane di *Polycelis nigra* EHRENBURG. — Caryologia 2.

LEVAN, A. 1935. Zytologische Studien an *Allium schoenoprasum.* — Hereditas 22.

— 1949. Demonstration in *Allium.* — Proc. eighth intern. congress of genetics.

MAHESHWARI, P. 1950. An introduction to the embryology of angiosperms. — New York.

MANTON, I. 1950. Problems of cytology and evolution in the pteridophyta. — Cambridge.

MELANDER, Y. 1949. Cytological studies on Scandinavian flatworms belonging to *Tricladia, Paludicola.* — Proc. eighth intern. congress of genetics.

MESSERI, A. 1931. Ricerche embriologiche e cariologiche sopra i generi »*Allium*» e »*Nothoscordon*». — Nuov. giorn. bot. ital. 38.

MODILEWSKY, J. 1928. Weitere Beiträge zur Embryologie und Cytologie von *Allium*-Arten. — Bull. Jard. botan. Kiew, Livr. 7—8.

— 1930. Neue Beiträge zur Polyembryonie von *Allium odorum.* — Ber. d. deutsch. bot. Gesellsch. 48.

— 1931. Die Embryobildung bei *Allium odorum* L. — Bull. Jard. botan. Kiew, Livr. 12—13.

NOACK, K. L. 1939. Über *Hypericum*-Kreuzungen. VI. Fortpflanzungsverhältnisse und Bastarde von *Hypericum perforatum* L. — Zeitschr. ind. Abst. u. Vererb.-lehre 76.

NYGREN, A. 1950. Cytological and embryological studies in arctic *Poae.* — Symb. bot. Upsal. X: 4.

ROSENBERG, O. 1946. The influence of low temperature on the development of the embryosac mother cell in *Lilium longiflorum* THUNB. — Hereditas 32.

STENAR, H. 1932. Studien über die Entwicklungsgeschichte von *Nothoscordon fragrans* KUNTH und *N. striatum* KUNTH. — Sv. bot. tidskr. 26.

WEBER, E. 1929. Entwicklungsgeschichtliche Untersuchungen über die Gattung *Allium.* — Bot. Archiv, 25.

WHITE, M. J. D. 1945. Animal cytology and evolution. — Cambridge.

BOTANISKA NOTISER 1951, HÄFTE 2. LUND

The embryo-sac development of Tridax trilobata.

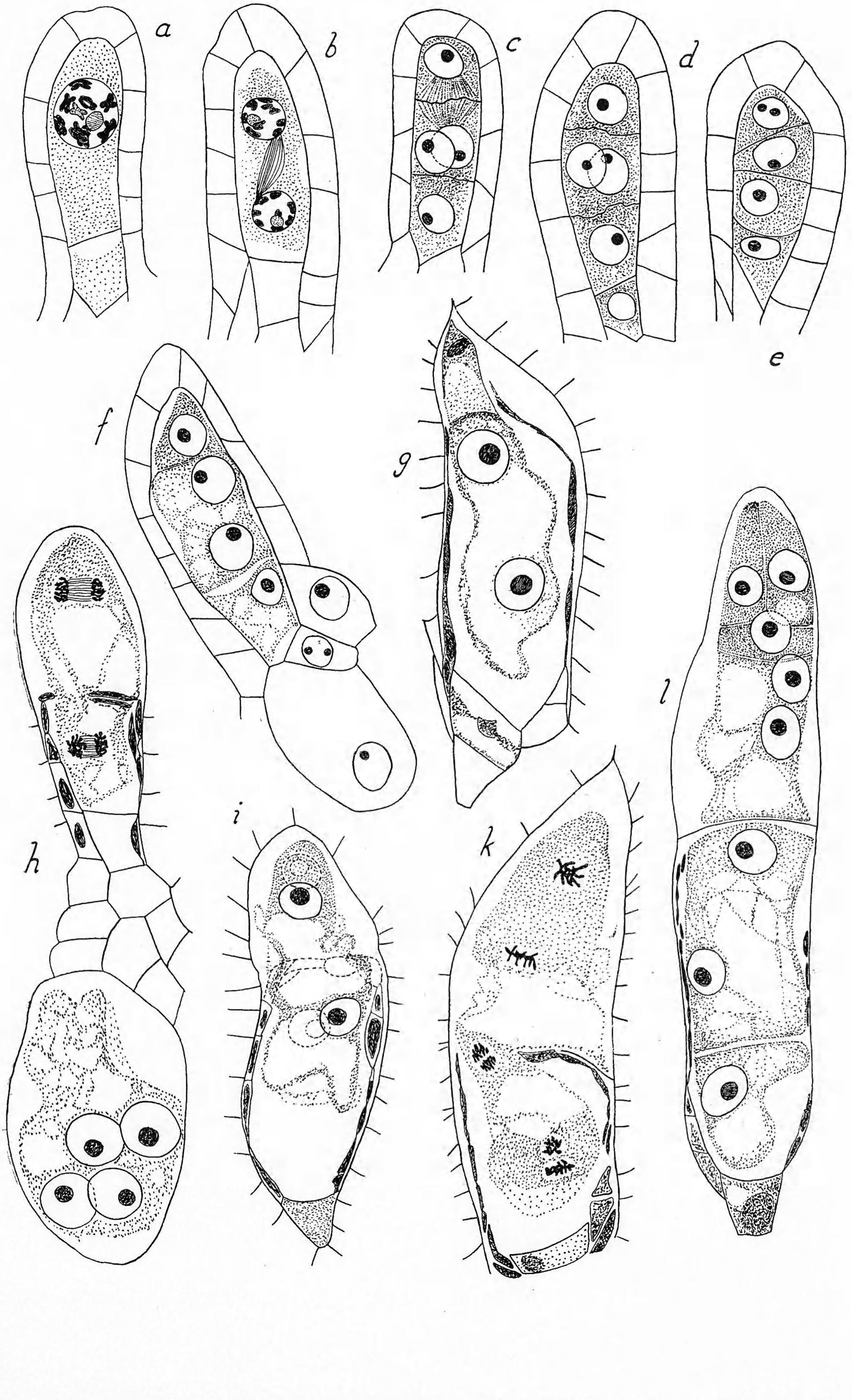
By H. HJELMQVIST.

The family *Compositae* exhibits many interesting features in the embryo-sac development. Several divergences from the normal development occur, as has been shown by various authors (most recently: HARLING, 1950—1951; further references given here). With regard to this fact preliminary investigations were made of the embryology of some *Compositae,* which apparently were not formerly investigated. One of these, *Tridax trilobata* (CAV.) HEMSL., proved to be of interest owing to deviations in some details, and for this reason a complete account is given in the following for the embryo-sac development of this species. Material was obtained from the Botanical Garden of Lund, the fixation was made with Zenker's fixative and the staining with iron-alum haematoxylin. The determination was controlled by the author; a specimen of the used material is preserved in the Herbarium of the Botanical Garden of Lund.

The macrospore mother cell is as in most other *Compositae* situated directly under the nucellar epidermis. Fig. 1 *a* shows a macrospore mother cell with the nucleus in diakinesis; the number of bivalents evidently is nine (also in the pollen mother cells the same number was counted), n is thus $=9$, while in another species of the genus, *Tr. procumbens* L., the number is stated to be $n=18$ (DARLINGTON and JANAKI AMMAL, 1945, according to RAGHAVAN and VENKATASUBBAN). Fig. 1 *b* shows a stage where the heterotypic division has been completed; the first nucleus has divided into two, which are now in interkinesis. Between the two nuclei a disappearing spindle is seen; there is no wall formed between them. In Fig. 1 *c* and *d* two macrospore tetrads are shown. In one of them (*c*) a phragmoplast is still visible, which has been formed after the homeotypic division. It is evident that this division contrary to the first one is accompanied by wall formation. Three cells are thus being formed, the central one containing two macrospore nuclei and the two other cells one each. The two central nuclei are usually situated at the same level, but at some distance from each other so that the four nuclei occupy to a certain extent a tetrapolar position. Such tetrads, with two nuclei in the mid-cell, were observed in about ten cases. In one case (Fig. 1 *e*) there was however a deviating development; here there are walls between all macrospore nuclei, but, on the other hand, these nuclei seem here to be only three in number; probably the homeotypic division has failed in the lower dyad nucleus and a wall has been formed detaching this nucleus.

The further development after the tetrad formation may proceed in two different ways. The one mode of development is illustrated by Fig. 1 *f* to *l*. In this case the two nuclei in the mid-cell of the tetrad increase and gradually migrate towards the poles (Fig. 1 *f* and *g*). The two outer cells are, already in the stage that is shown in Fig. 1 *f*, where the vacuolization has just begun, a little later in development and in the following stage (Fig. 1 *g*) they are more degenerated; their nuclei are disintegrating and especially the upper cell is soon destroyed; in Fig. 1 *g* a remnant of it is visible at the top of the embryo-sac. During this development the two nuclei increase greatly in size and the embryo-sac grows in length, breaking the epidermis, the cells of which also show signs of degeneration, and filling up the vacant space above the nucellus. Fig. 1 *h* shows the two nuclei in the course of division; the broken limit of the nucellus is clearly visible and it may also be seen how the space above it is nearly filled out by the embryo-sac. Fig. 1 *i* shows a 4-nucleate embryo-sac, two pairs of nuclei having been formed in the embryo-sac, now somewhat irregularly curved. These four nuclei divide in the usual way (Fig. 1 *k*), and then the development may be slightly earlier in the two lower nuclei. Even in this stage the remnants of the broken nucellar epidermis are clearly visible; it may also be seen that they form a ring around the bridge formed by the embryo-sac in the central part. Fig. 1 *l* shows a mature embryo-sac, just developed; the antipodal cells are here two, the lower one with one nucleus, the upper with two nuclei; the latter is of about the same size as the cell containing the two polar nuclei. The egg-apparatus has developed a little later than the opposite pole.

In addition to this development, which thus is bisporic, the embryo-sac may develop simply from the basal macrospore. This is illustrated by Fig. 2 *a*, which probably belongs to this development series, and Fig. 2 *b*, a later stage, that indubitably belongs here. In this case the


a
b
c
d
e
f
g
h
i
k
l

basal macrospore increases and the central, 2-nucleate cell of the tetrad degenerates gradually like the uppermost one. In this case, thus, the development follows the Normal type; the sole deviation is that the tetrad formation here as in the other case has taken place without wall formation after the first division. Judging from the number of cases belonging to the two types of development, they are apparently equally common, or perhaps the Normal type is a little more frequent. Both types may occur in the same individual.

The mature embryo-sac exhibits some variation in its organization. Generally, as in the case mentioned above (Fig. 1 *l*), the antipodal cells are two, one 2-nucleate and one 1-nucleate, but it also happens that there are three 1-nucleate antipodals, either forming a row or the two upper lying side by side. In the later development, after the fusion of the polar nuclei which takes place rather early (Fig. 2 *c*), the embryo-sac undergoes certain changes, as is shown by Fig. 2 *c,* illustrating an embryo-sac just after the fusion, and Fig. 2 *e,* an embryo-sac in a later stage. Firstly, the shape of the embryo-sac alters, as general in *Compositae,* so that the upper part swells up and is broadly rounded (Fig. 2 *e*). In connection with this the number of cells in the integumentary tapetum augments; from earlier having been about 12 to 14 at either side it may now be about 18. The cell containing the primary endosperm nucleus also extends up around the egg-apparatus, as is visible in Fig. 2 *c* and *e*. The egg-cell, which from the beginning was fairly short and attached considerably lower than the synergids, also increases in length, assuming an oblong-pyriform shape and reaching with its apex almost as high up as the synergids. Further the two upper antipodal nuclei, if situated in the same cell, coalesce with each other; sometimes also the wall between the cells is dissolved (Fig. 2 *c*). There is, however, no division of the nuclei, as in many other *Compositae,* but a certain tendency to division may be observed before the fusion in the irregular shape and the larger number of nucleoli (Fig. 2 *d*). In the quite mature embryo-sac (Fig. 2 *e*) the antipodals are strongly disintegrated and the synergids, which are of longer duration, also show a beginning degeneration of the nuclei.

Fig. 1. *a* macrospore mother cell in diakinesis, *b* interkinesis between the meiotic divisions, *c—d* tetrads, *e* tetrad with walls between all macrospores, *f* tetrad in later stage, with the central cell advanced, aposporic embryo-sacs growing out at the base, *g* 2-nucleate embryo-sac with degenerating tetrad cells, *h* embryo-sac with two nuclei in division, an aposporic embryo-sac in the nucellus, *i* 4-nucleate embryo-sac, *k* embryo-sac with four nuclei in division, *l* mature embryo-sac. Magnification 800 ×.

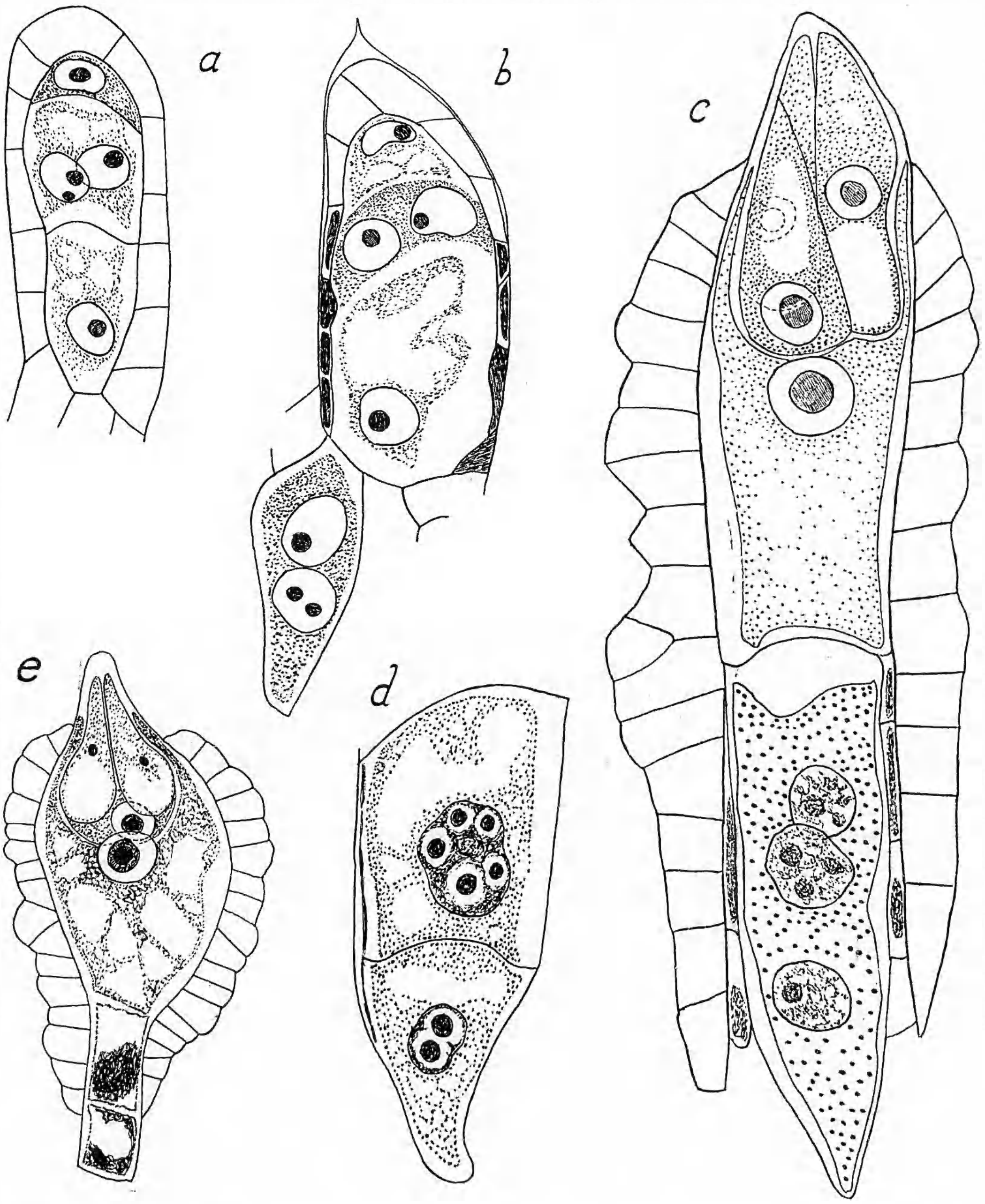


Fig. 2. *a* tetrad in later stage, the basal cell probably developing into embryo-sac, *b* tetrad with the two upper cells in beginning degeneration and a 2-nucleate aposporic embryo-sac, *c* mature embryo-sac with the polar nuclei fused and the upper antipodal nuclei in fusion, *d* antipodal part of an embryo-sac, the nucleoli increased in number, the upper nuclei in fusion, *e* mature embryo-sac in a later stage, the antipodals degenerated. Magnification *a*—*d* 800 ×, *e* 305 ×.

Round the base of the embryo-sac there are often large cells of a divergent appearance, with big nuclei, which have the possibility of growing out to aposporic embryo-sacs, as has also been observed in many other *Compositae* (cf. AFZELIUS, 1924; GELIN, 1934). Fig. 1 *f* shows two such cells, which are formed by the nucellus, immediately up to the base of the tetrad. Fig. 2 *b* shows how such a cell has given rise to a 2-nucleate embryo-sac, in Fig. 1 *h* a 4-nucleate embryo-sac is seen that has been formed rather deep down in the nucellus. Since in the two latter cases the aposporic embryo-sac has advanced further in its development than the legitimate one (this in the one case being 1-nucleate, in the other having two nuclei in division), it very possibly may in some cases distance and oust the latter; yet no quite developed aposporic embryo-sac has been observed.

The bisporic embryo-sac of *Tridax* must be considered as belonging to a deviating form of the *Allium* type (formerly called the *Scilla* type, cf. MAHESHWARI, 1950). It agrees with the *Allium* type in that the embryo-sac is formed by two macrospores that are not separated by walls from each other, while the other macrospores degenerate. The deviation consists in the position in the tetrad of the macrospores that form the embryo-sac. Generally the macrospore mother cell is divided into two dyad cells which are separated by a wall, and after division of the nucleus in one or both of them the lower, or sometimes the upper, dyad cell develops into an embryo-sac. In *Tridax,* however, the embryo-sac is formed by the two middle macrospores in the tetrad which are not separated by any wall. In the former case there is wall formation after the first division, but not after the second; in the latter case there is no wall formation after the first division, but it takes place after the second. This development occurs very rarely, although it is not quite unknown. In *Oxybaphus nyctagineus,* thus, ROCÉN (1927) observed tetrads with three cells, the middlemost of which was 2-nucleate. This however occurred in rare cases only; generally the tetrads consisted of four cells. Owing to the rarity of the deviating tetrads it was not possible to follow their further development; the majority developed according to the Normal type. Further, in three members of *Crassulaceae*: *Aeonium guttatum, Adromischus cristatus,* and *Echeveria amoena,* MAURITZON (1933) pointed out the occurrence of tetrads of the same structure; in addition there occurred in the same species also tetrads with a 3-nucleate cell above and a 1-nucleate below and, in the first-mentioned species, tetrads without any wall formation between the nuclei. MAURITZON observed that a further development of the 1-nucleate basal cell might occur, as well as of the 3-nucleate, but a development of the two middlemost macrospores into embryo-sac was not seen by him. Even in *Compositae* this tetrad type has been observed, though only in exceptional cases, viz. in the genus *Erigeron,* sect. *Euerigeron* (HARLING, 1950—1951). In three species belonging here, *E. ochroleucus, pulchellus,* and *simplex,* the development usually was tetrasporic, but exceptionally walls were formed after the homeotypic division so that tetrads of the *Tridax* type arose. Another species, *E. glabellus,* exhibits a great variation: it follows the Normal type or the common *Allium* type, or is tetrasporic, and sometimes also tetrads of *Tridax* type are formed. The further development of such tetrads seems not to have been observed in *Erigeron.* The investigated species of *Tridax,* thus, differs from these earlier instances in that the special tetrad type is not only exceptionally, but regularly occurring and that a bisporic development may often be observed.

It is difficult to elucidate the causes of the peculiar tetrad development occurring in *Tridax* and implying that wall formation occurs after the second division, but not after the first. Certain guidance for understanding the problem, however, is given by the fact that in all cases where such tetrads have been observed there are different, parallel modes of development of the embryo-sac. In *Tridax* the tetrad apparently always is of the same organization, but the later development may either consist in a growing-out of the lower macrospore or of the 2-nucleate cell in the middle. In the other species with tetrads of the same type as *Tridax* the variation extends even to the tetrad itself: This may also consist of four separate cells (*Oxybaphus, Erigeron glabellus*), of one basal, 1-nucleate cell and a second 3-nucleate (*Aeonium, Adromischus, Echeveria*), and of four nuclei without wall formation (*Aeonium, Erigeron*). These facts show that the embryological conditions of these species are very unstable; they may change in the same species and even in the same individual. With respect to this the organization should perhaps best be explained by different competing tendencies: on one hand a tendency to development according to the Normal type, on the other a tendency to development according to a type with more macrospores and abbreviated time of development. The absence of the wall-formation after the first division agrees with the latter tendency and is not prevented by the former; the wall formation in the homeotypic division between the lower pair of nuclei is caused by the Normal type tendency, and the occurrence in some cases of wall formation even between the upper pair may be due to the parallelism that often occurs between different divisions. This appears to be a probable explanation of the development, though other interpretations may also be possible.

If the genus *Tridax* is compared with other genera from an embryological point of view, great resemblances are found to *Galinsoga ciliata,* belonging to a genus that for morphological reasons is regarded to be closely related to *Tridax*. According to POPHAM's (1938) very thorough investigation of this species it exhibits many embryological details that agree with *Tridax*. Here also the outgrowing embryo-sac breaks the nucellar epidermis and fills out the vacant space above it. The mature embryo-sac has one 1-nucleate and one 2-nucleate antipodal cell, the latter nearly as large as the cell containing the polar nuclei. Later the antipodal nuclei occasionally divide so that at the most four nuclei arise in either cell, which finally fuse; POPHAM points out that the species differs from all other members of the group *Heliantheae* that have been investigated by only having two antipodal cells with such a small number of nuclei; *Tridax*, thus, shows the same difference, only still more pronounced. The development of the egg-apparatus is the same, too; in the beginning the two synergids fill out the apex of the embryo-sac and the short and broad egg-cell is attached considerably lower; later the egg-cell enlarges and extends farther in the direction of micropyle and the protoplasm of the cell containing the primary endosperm nucleus surrounds a great part of the egg-apparatus. Also with regard to the tapetum and other details there are great agreements. The tetrad formation and the first development of the embryo-sac, however, follows entirely the Normal type and in this respect there is thus a clear difference from *Tridax*. In this as in many other cases apparently certain details in the general organization of embryo-sac and ovule are of greater importance from a systematical point of view than the type of development followed by the embryo-sac; this may vary in closely related species, sometimes even in the same species.

References.

AFZELIUS, K.: Embryologische und zytologische Studien in Senecio und verwandten Gattungen. Acta Hort. Berg. 8: 7, 1924.

DARLINGTON, C. D. and JANAKI AMMAL, E. K.: Chromosome atlas of cultivated plants. London 1945.

GELIN, O. E. V.: Embryologische und cytologische Studien in Heliantheae - Coreopsidinae. Acta Hort. Berg. 11: 6, 1934.

HARLING, G.: Embryological studies in the Compositae I—III. Acta Hort. Berg. 15: 7, 1950; 16: 1, 1951; 16: 3, 1951.

MAHESHWARI, P.: An introduction to the study of the embryology of angiosperms. New York 1950.

MAURITZON, J.: Studien über die Embryologie der Familien Crassulaceae und Saxifragaceae. Diss. Lund 1933.

POPHAM, R. A.: A contribution to the life history of Galinsoga ciliata. Bot. Gazette 99: 3, 1938, p. 543—555.

ROCÉN, T.: Zur Embryologie der Centrospermen. Diss. Uppsala 1927.

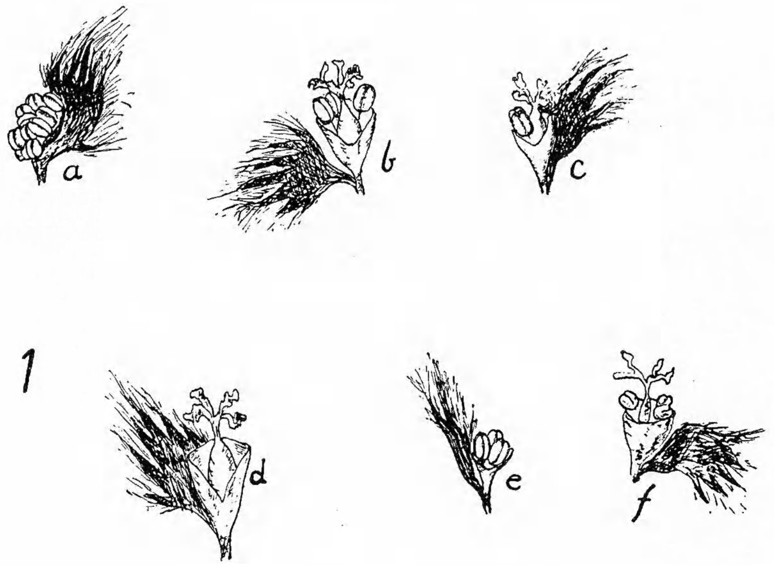
BOTANISKA NOTISER 1951, HÄFTE 2. LUND

Smärre uppsatser och meddelanden.

Ett fall av androgyna hängen hos Populus tremula L.

Inom släktet *Populus* råder som regel dioik könsfördelning, men ibland uppträda androgyna hängen och tvåkönade blommor. Ett sådant fall uppmärksammades våren 1950 hos en asp, från vilken kvistar intagits till drivning i växthus vid Föreningens för växtförädling av skogsträd Sundmo-filial. Kvistmaterialet härstammade från en hanlig klon nära Edsele kyrka i Ångermanland. I klonen, som består av 3 äldre träd, är det största trädet 69 år gammalt, 18 m. högt med 31,5 cm:s brösthöjdsdiameter.

Androgyni i normalt enkönade blomställningar är en företeelse, som är sällsynt, men ingalunda okänd i utlandet. Särskilt har BAIL (1869 a, b; 1870) ingående studerat könsfördelningen hos ett flertal arter. Han har därvid funnit androgyna inflorescenser bl.a. hos *Alnus incana, Carpinus betulus, Fagus silvatica, Populus alba* och *Populus tremula* samt hos *Picea excelsa* och *Pinus nigra*. Särskilt inom släktet *Betula* ha androgyna hängen och hermafrodita blommor påträffats. De androgyna hängena voro, enligt BAIL, hos *Betula alba* vid basen honliga och mot spetsen hanliga. Hos *Betula verrucosa* har NORD (1916) funnit androgyna hängen av samma typ, som BAIL fann hos *Betula alba*. SCHULZ (1892) har hos *Betula alba* tillfälligt funnit hermafrodita blommor vid hängenas bas. Samma fenomen har BAIL (1869 b; 1877) iakttagit hos *Betula humilis*. I de honliga hängena hos *Betula populifolia* har STEVENS (1894) påträffat förenklade hanblommor. Även hos hassel (*Corylus avellana*) ha någon gång tvåkönade blommor observerats (SCHULZ 1892). SCHULZ har även hos bok (*Fagus silvatica*) och ek (*Quercus robur*) funnit rudimentära ståndare i honblommorna. BAIL (1869 b) har hos de ovannämnda *Picea*- och *Pinus*-arterna iakttagit kottar, vilka vid basen varit hanliga och mot spetsen honliga. Hos *Populus alba* uppträda enligt MEEHAN (1880) i de hanliga hängena förenklade honblommor. Ibland ha också fullt utvecklade fruktämnen förekommit. Huruvida dessa sedan blivit befruktade och frö utvecklats, nämner MEEHAN dock ingenting om. GRAVES & WILLIAMS (1899) ha hos *Populus tremuloides* påträffat tvåkönade blommor. Inom denna art synes förekomsten av tvåkönade blommor ej vara så ovanlig, och i korsningsavkommor mellan arterna *tremula* och *tremuloides* uppträda tvåkönade blommor. BAIL (1869 a, b) har särskilt i trakten av Danzig efterforskat *Populus tremula* med androgyna hängen eller tvåkönade blommor. Han fann tvåkönade blommor hos


1

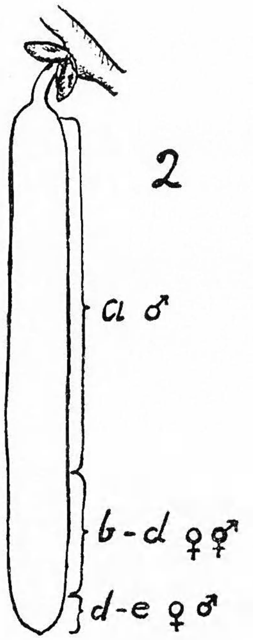

2

Fig. 1: a—f. a) normal hanblomma; b) tvåkönad blomma med väl utvecklad pistill o. 3 ståndarknappar; c) tvåkönad blomma med 1 ståndarknapp; d) normal honblomma i hanhänge; e) ren hanblomma med reducerat antal ståndare; f) tvåkönad blomma med svagt utvecklad pistill. C:a × 3. — Fig. 2: a—e. Hanhänge av Edseleaspen visande ungefärlig könsfördelning och blomtyp inom ett hänge. a) hanblommor med utseende som i fig. 1: a; b—d) blommor av typ som i fig. 1: b, c, d, f; d—e) blommor av typ som i fig. 1: d—e.

såväl honliga som hanliga aspar. Oftast sutto »bastardblommorna» i hängets spets. De hade fullt utvecklade fruktämnen och 1, 2 eller 3 normalt utbildade ståndare. Ibland voro blommorna ej normalt utvecklade utan innehöllo organ, på vilka delar av ståndare och pistiller observerades (BAIL 1869 a). Av den tillgängliga litteraturen framgår ej om frö utbildats i de beskrivna hängena. De av BAIL iakttagna förändringarna i könsfördelningen inom de androgyna hängena hos *Populus tremula* ha i allt väsentligt visat överensstämmelse med liknande fynd hos *Betula.* Ett fynd av intersexuella blommor hos hanlig *Populus tremula* beskrives av HJELMQVIST (1948).

Problemet intersexualitet har RAINIO (1927) ingående studerat hos *Salix.* Hans undersökningar ha resulterat i ett system med två huvudtyper: andro- resp. gyno-intersexualitet beroende på, om det är ståndarbladen eller fruktbladen som transformerats. Inom varje huvudtyp urskiljer han fem klasser. Till klass 1 för han könsorgan, där transformationen är svag, och till klass 5 sådana fall, då det primära könet, honligt eller hanligt, helt omvandlats till det motsatta. Enligt RAINIOs definition och klasskarakteristika skulle den undersökta aspen vid Edsele vara andro-intersexuell och tillhöra klass 5 samtidigt som den har flera hermafrodita blommor. Några övergångsfall hänförande sig till klasserna 1—4 ha ej funnits. De tvåkönade blommornas byggnad (fig. 1: b, c, f) visa god överensstämmelse med BAILs beskrivningar. Blommor liknande dem som HJELMQVIST (1948) återgivit i sin fig. 57: A—B ha ibland också påträffats. Däremot har parallellitet med hans övriga illustrationer ej konstaterats. Fördelningen av blommorna inom hängena hos Edseleaspen är däremot i många fall en annan än den Bail fann. I samtliga undersökta hängen hos Edsele-aspen finnas alltid i hängets spets (fig. 2: e) ett fåtal rena honblommor (fig. 1: d). Hängena äro i sin övriga del i regel rent hanliga eller androgyna (fig. 2: a—d; fig. 1: a—d). I ett flertal hängen ha blommornas fördelning varit ungefär sådan den framgår av fig. 2. Tvåkönade blommor i hängets spets — vilket Bail iakttagit — ha ej observerats hos Edseleaspen. I några få hängen ha tvåkönade blommor förekommit inom drygt halva hängets längd från spetsen räknat. I dessa fall har hänget ur nedvissningssynpunkt fungerat som ett honligt hänge. Hänget har sålunda, sedan ståndarknapparna släppt sitt pollen, ej vissnat utan behållit sin turgor lika länge som ett rent honhänge. Efter utförd inavel av ett sådant hänge den 7 mars 1950 utvecklade sig fruktämnena till frökapslar, men endast 11 frön av ungefär normal storlek erhöllos, vilket berodde på att hängeskaften torkade ihop. Denna företeelse är inte ovanlig vid drivning av pollinerade hängen på avskurna kvistar. Av de elva fröna grodde endast två. Plantorna dogo tyvärr på ett tidigt stadium. Vid ett besök på växtplatsen den 14 juni 1950 undersöktes förekomsten av androgyna hängen på asparna. De flesta hängena voro nedfallna, men två kvistar, på vilka sammanlagt 3 gröna hängen sutto, nedklipptes och sattes till drivning i växthus. I ett av dessa hängen fanns, inom ca 90 % av hängets längd, ett flertal väl utvecklade frökapslar, vilka gåvo 106 frön. Sammanlagt erhöllos från de 3 hängena 137 frön. Dessa såddes den 21 juni, varefter 39 frön grodde. Eftersom 4 fröplantor dogo inom kort, erhöllos endast 35 plantor, som omskolades den 21 juli. Vid mätning av planthöjderna den 19 sept. 1950 varierade dessa mellan 0,2 och 10,9 cm. Plantmedelhöjden var dock ej större än 2,6 cm. Samtliga plantor hade normalt utvecklade blad.

Fröplantorna måste anses vara resultat av inavel, ty den närmaste klonen, som står ca 700 m väster om träden med androgyna hängen blommade ej på våren 1950. De senare äro dessutom såväl i norr som öster och söder omgivna av hög tall- och granskog, varför främmande pollen knappast kan ha nått ifrågavarande klon, isynnerhet som avståndet till övriga aspkloner är mer än 2000 m.

En förklaring till detta egenartade uppträdande av tvåkönade blommor hos en dioik art är svår att lämna. En tänkbar orsak är en strukturell kromosomförändring eller närvaro av en trisomisk könskromosom.

Zusammenfassung.

Der Titel des Aufsatzes lautet: Ein Fall von androgynen Kätzchen bei *Populus tremula* L.

Früher hat man im Ausland andere Kätzchen oder Zapfen mit bisweilen auch zwitterigen Blüten gefunden, unter anderem bei folgenden Arten: *Alnus incana, Betula alba, B. humilis, B. populifolia, B. verrucosa, Carpinus betulus, Corylus avellana, Fagus silvatica, Picea excelsa, Pinus nigra, Populus alba, P. tremula, P. tremuloides* und *Quercus robur.*

Im Februar 1950 entdeckte ich in Nordschweden bei der Kirche von Edsele einen männlichen Klon von *Populus tremula* mit androgynen Kätzchen und zwitterigen Blüten. Der Klon bestand aus drei älteren Bäumen. In Fig. 1 a—f sind die angetroffenen Blütentypen wiedergegeben. Fig. 2 illustriert die ungefähre Verteilung der verschiedenen Blütentypen bei dem androgynen Kätzchen. In dem Gebiet von -a- in Fig. 2 kommen also nur rein männliche Blüten vor, die in Fig. 1 a etc. wiedergegeben sind. Drei selbstbestäubte Kätzchen, im Gewächshaus zum Treiben gebracht, ergaben 11 Samen. Zwei Samen keimten aus, doch gingen die Pflanzen frühzeitig ein. Einige vollbelaubte Reiser mit drei Kätzchen wurden am 14. Juni 1950 zur Fortsetzung ihres Treibens im Gewächshaus geworben. Eines von diesen Kätzchen enthielt nur eine geringe Anzahl von männlichen Blüten, aber manche entwickelte Samenkapsel. Wenn das männliche Kätzchen zu ca. 50 % oder mehr von seiner Länge aus weiblichen oder zwitterigen Blüten besteht, reagiert das Kätzchen wie ein weibliches und welkt sehr langsam, wie ein normales. Von den zuletzt eingesammelten 3 Kätzchen erhielt ich 137 Samen. Diese ausgesät, ergaben 35 Pflanzen. Alle hatten normale Blätter. Die Pflanzen wurden am 19. Sept. 1950 gemessen. Die Höhen variierten zwischen 0,2 und 10,9 cm. Die Pflanzen-Mittelhöhe betrug nur 2,6 cm.

Die Sämlinge sind wahrscheinlich das Resultat einer Selbstbestäubung, da fremder Pollen kaum heranlangen konnte, weil der Abstand zum nächsten Klon grösser als 2000 m ist. Ausserdem ist der betreffende Klon an drei Seiten von hohem Nadelwald umgeben.

Eine denkbare Erklärung für das Vorkommen von androgynen Kätzchen ist die Annahme einer strukturellen Chromosomenveränderung oder der Anwesenheit eines trisomen Geschlechtschromosoms.

Erik W. Runquist.

Litteraturförteckning.

Bail, Th. 1869 a. Über androgyne Blüthenstände bei solchen Monocöisten und Diöcisten, bei denen Trennung der Blüthenstände Regel ist. — Schr. d. Naturforsch. Gesell. in Danzig. Bd. 2; H. 2; p. 3—9.

— 1869 b. Über androgyne Blüthenstände bei solchen Monocöisten und Diöcisten, bei denen Trennung der Blüthenstände Regel ist. — Schr. d. Königlichen phys. ökonom. Gesellsch. Königsberg. X; p. 195—196.

— 1870. Schriften d. Königlichen phys.ökonom. Gesellsch. Königsberg. XI; p. 117.

— 1877. Neuere Beobachtungen der Androgynie bei Salicineen. — Schrift. d. Phys. oekon. Gesellsch. Königsberg. 18. Jahrg.; I. Abt.; p. 94—95.

Graves, F. M. & Williams, A. Th. 1899. Exceptions. — Asa Gray Bull. VII; p. 56.

Hjelmqvist, H. 1948. Studies on the floral morphology and phylogeny of the Amentiferae. — Bot. not.; suppl. vol. 2: 1.; p. 158—159. — Lund.

Meehan, Th. 1880. Changes of flowers normally of one sex to the other. — Proceed. of the Acad. of Nat. Sc. of Philadelphia.; p. 353.

Nord, F. 1916. Androgyne *Betula verrucosa* Ehrh. — Sv. Bot. tidskr. X.; p. 272.

Rainio, A. J. 1927. Über die Intersexualität bei der Gattung Salix. — Annales Soc. Zool.-Botan. Fennicæ Vanamo.; vol. 5 p. 165—276. — Helsinki.

Schulz, A. 1892. Beiträge zur Morphologie und Biologie der Blüthen. I, II. — Ber. Deutsch. Bot. Ges.; 6; p. 303 u. 395.

Stevens, F. L. 1894. Teratologie. — Bull Torrey Bot. Cl.; XXI; p. 490.

Ett märkligt kiselalgfynd i Kävlingeån.

Den i Lommabukten i Öresund mynnande Kävlingeån, en av Skånes mera betydande åar, har under en följd av år varit föremål för undersökning av vattnets beskaffenhet, bl.a. i biologiskt avseende, vid Fiskeristyrelsens Tillsynsavdelning, Drottningholm. Anledningen härtill är den tidvis starka föroreningen av åns vatten, som orsakas dels av den täta bebyggelsen, däribland samhällena Furulund, Kävlinge, Örtofta m.fl. dels av en rad industrier, varav kan nämnas Örtofta och Kävlinge sockerfabriker, Furulunds yllefabrik och glaceläderfabriken i Kävlinge. Även de till ån gränsande talrika jordbruksmarkerna med sina gödselförande avlopp bidraga i icke oväsentlig grad till föroreningen. Reningsanordningar ha vidtagits från både samhällenas och industriernas sida, men trots detta kan under ogynnsamma omständigheter såsom hög temperatur och lågt vattenstånd föroreningen på vissa sträckor bli så betydande, att fiskdöd inträffar, och det normala växt- och djurlivet i ån ersättes med för dylika föroreningar typiska smutsvattenformer. I övrigt har ån under sin huvudsakliga sträcka från Våmbsjön till mynningen en alltigenom starkt eutrof karaktär med tidvis rik vattenblomning av cyanophycéer och en i övrigt mycket artrik algflora såväl beträffande kiselalger som övriga algformer.

Under bearbetningen av en provserie från denna å, tagen i november 1950, har jag vid provstationen Getinge bro strax ovanför Örtofta gjort ett ovanligt fynd, i det att ett ett exemplar av den tydligen mycket sällsynta kiselalgen *Synedra montana* här anträffats. Denna alg finnes i litteraturen endast angiven från en enda lokal, nämligen Kaprun i Hohe Tauern i Tyrolen, där den tyske algologen KRASSKE 1932 fann den i en mosstuva i ett bäckvattenfall (»Sturzbach»). Han har beskrivit och avbildat den i en uppsats om kiselalger i Alperna, och samma beskrivning och bild har av HUSTEDT sedermera införts i hans under utgivning varande stora arbete över kiselalgerna i RABENHORSTS Kryptogamenflora von Deutschland (del 2, sid. 204, fig. 694). Någon ytterligare lokaluppgift kan ej heller HUSTEDT, som väl får anses vara den f.n. ledande diatomacékännaren, bidraga med, vilket tyder på att han själv aldrig funnit den. KRASSKES bild visar algen från skalsidan, med ett uppsvällt, tämligen kort och något insnört mittparti och smal, i mitten vidgad pseudoraf. Enligt HUSTEDTS bild är också gördelsidan på motsvarande sätt vidgad, dock ej sammansnörd i mitten. Längden anger HUSTEDT till ca 120 μ, bredden på mitten till 3 μ och vid ändarna till 1,5 μ. Strimmornas antal har han funnit vara 16 på 10 μ. Det av mig funna exemplaret överensstämmer till utseendet helt och hållet med KRASSKES art. Det är emellertid något längre och grövre, i det den totala längden här är 135 μ och bredden 4 resp. 2 μ. Även strimmornas antal med 14 st. på 10 μ tyder på en något kraftigare form, kanske beroende på andra ekologiska faktorer. Mitt exemplar saknar emellertid även strimmor i det insnörda mittpartiet, vilket KRASSKES form företer, men denna karaktär kan som bekant variera inom *Synedra*-släktet i övrigt och torde icke kunna tillmätas någon vidare betydelse i taxonomiskt avseende. Att det här verkligen är frågan om en *Synedra montana* torde vara höjt över allt tvivel, och jag har f.ö. fått mitt fynd verifierat av vårt eget lands mest framstående diatomacékännare, Fil. dr. ASTRID CLEVE-EULER.

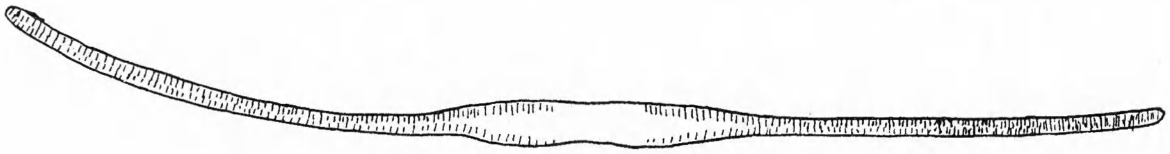


Fig. 1. *Synedra montana* från Kävlingeån.

Vad slutligen den ekologiska sidan av saken beträffar, står man här inför den både intressanta och svårbesvarade frågan hur det är möjligt, att denna alg, som förut endast blivit funnen i det renaste alpbäckvatten, plötsligt uppträder i en av Skånes mest eutrofierade åar. Och hur har den kommit dit? Någon mellanstation från Nordtysklands slätter är icke bekant. Har den följt med någon flyttfågel, någon resenär av andfåglarnas släkte, som pauserat i den med andmat rikligt begåvade Kävlingeån? Detta torde vara omöjligt att besvara. Kvar står det faktum, att »renvattenformen» *Synedra montana* från Centraleuropas alper funnit en för sin existens ingalunda olämplig miljö i Skånes Kävlingeå.

INGEBORG STJERNA-POOTH.

Litteratur: KRASSKE: Beiträge zur Kenntnis der Diatomeenflora der Alpen. Särtryck ur »Hedwigia», Bd LXXII 1932.

En för Skåne ny Hieracium-art.

Undertecknad insamlade sommaren 1948 på högar av bränd skiffer i Höganäs en *Hieracium*-art, som av lektor ERIK ALMQUIST bestämts till *Hieracium lissolepium* ZAHN (=*H. lineatum* AT.). Denna art är tidigare icke anmärkt för Skåne. K. JOHANSSON (Ark f. Bot. A: 12, 1929) uppger att den är utbredd från Västerbotten, Jämtland och Medelpad ned till Halland, Småland och Blekinge, samt att den även förekommer i Danmark och Norge. HEGI upptager i Illustrierte Flora von Mitteleuropa *H. lissolepium* såsom ssp. under *H. rigidum* (HARTM.) ZAHN och anger dess utbredningsområde från Västschweiz till Westfalen, Seeland och Böhmen. Förekomsten i Skåne är därför knappast överraskande.

Saltsjöbaden den 24/2 1951.

CARL-AXEL TORÉN.

BOTANISKA NOTISER 1951, HÄFTE 2. LUND

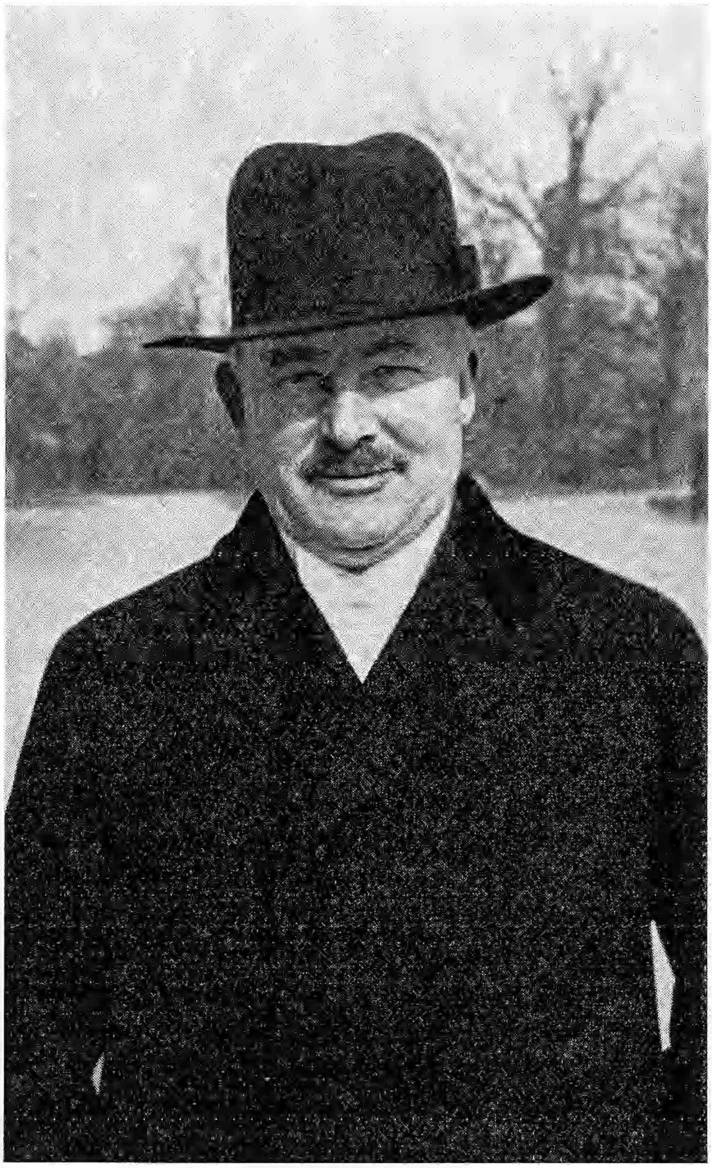
In Memoriam.

Otto Gertz.

20/5 1878—15/2 1948.

OTTO DANIEL GERTZ föddes i Malmö den 20 maj 1878. Fadern var dåvarande komministern JÖNS NILSSON GERTZ, slutligen kyrkoherde i Södervidinge, en man, som enligt en minnestecknare utmärktes av ett klart intellekt och en stor praktisk duglighet. I Malmö växte OTTO GERTZ upp och genomgick stadens högre allmänna läroverk. 1896 avlade han mogenhetsexamen. Hans håg var vid denna tid delad mellan intresse för de klassiska språken och för naturvetenskaperna — i någon mån lär han också ha lockats av den praktiska skogsmannabanan. Det blev emellertid de naturvetenskapliga intressena som segrade, och när han hösten 1896 påbörjade sina studier vid Lunds universitet, blevo botanik, zoologi och kemi hans viktigaste ämnen. Hela sitt liv behöll han dock vid sidan om sitt egentliga fack ett starkt humanistiskt intresse.

När GERTZ kom till Lund som student, var ARESCHOUG professor i botanik, BERGGREN e.o. professor, och BENGT JÖNSSON, som då var docent, var assistent vid laboratorieövningarna. Genom ARESCHOUGS dominerande inflytande stod floristiken på en central plats i undervisningen, och troligen var det under denna tid, som GERTZ' solida kunskaper i artsystematik grundades. Mest drogs han dock åt det anatomiska och fysiologiska hållet, och BENGT JÖNSSON var förmodligen den lärare, som hade mest betydelse för honom. 1900 var han färdig med sin fil. kand.-examen, 1905 med licentiatexamen, varvid S. MURBECK och BENGT JÖNSSON voro hans examinatorer i botanik, och 1906 disputerade han för doktorsgraden och blev docent i botanik. Under åren 1903—1905 var han e.o. amanuens vid botaniska institutionens fysiologiska avdelning, och under de följande åren hade han åtskilliga lärareförordnanden; bl.a. var han under två olika perioder förordnad att delvis uppehålla professuren i anatomisk och fysiologisk botanik. Då denna professur på kort tid två gånger var ledig, dels efter B. LIDFORSS' död, dels efter NILSSON-EHLES övergång till personlig professur, var GERTZ bland de sökande och blev vid båda tillfällena förklarad kompetent, vid det senare även uppförd i tredje förslagsrummet till professuren. Hans framtida uppgift blev dock ej universitetslärarens utan läroverkslärarens. Efter olika förordnanden vid skilda läroanstalter utnämndes han 1915 till lektor i biologi och kemi vid katedralskolan i Lund och kvarstod i denna befattning till år 1943, då han pensionerades. Samtidigt behöll han emellertid sin docentur och blev från 1924 även knuten till den botaniska institutionen som bibliotekarie, efter O. NORDSTEDT.



Otto Gertz.

Den gärning, som markeras av dessa yttre data, var fylld av ett hängivet forskararbete av stor omfattning och mångsidighet, resulterande i talrika publicerade skrifter. Här kunna endast de viktigaste av dessa beröras.

Gertz' första större arbete var gradualavhandlingen »Studier öfver anthocyan». Denna är närmast ett anatomiskt arbete, som utförligt behandlar anthocyanets förekomst och lokalisation i vegetativa organ hos de högre växterna. Framställningen innehåller en mängd omsorgsfulla detaljiakttagelser och kommer säkerligen alltid att vara en värdefull källa för dem som ägna sig åt studier på området. I ett par senare skrifter, »Några iakttagelser öfver anthocyanbildning i blad vid sockerkultur» och »Om anthocyan hos alpina växter» tog Gertz även upp mera fysiologiska frågor rörande anthocyanets bildning och betydelse. I den förra skriften bekräftar han Overtons upptäckt av sockertillgångens betydelse för anthocyanbildningen och visar, att även i panacherade blad kan det bildas anthocyan i de ofärgade delarna, om socker tillföres utifrån. I det senare arbetet diskuterar han bl.a. orsakerna till den rika anthocyanförekomsten hos alpväxter och kommer till den åsikten, att den beror på den starka assimilationen och den delvis försvårade tillförseln av vatten och närsalter, vilket under fjällens speciella förhållanden leder till en anhopning av socker och garvämnen i cellerna.

Av stor betydelse för GERTZ' senare forskning blev ett studiebesök, som han gjorde på W. PFEFFERS laboratorium i Leipzig sommaren 1906, strax efter sin disputation. Under ett par månaders tid arbetade han här under PFEFFERS ledning och påbörjade på hans initiativ två fysiologiska undersökningar, som han fortsatte under senare år och som resulterade i en rad skrifter. Den ena av dessa behandlade rötternas s.k. morfestesi. Termen hade skapats av NOLL i samband med hans iakttagelse, att krökta rötter alltid utbilda sidorötter på den konvexa sidan, något som enligt NOLL måste bero på en speciell form av retbarhet, morfestesi, för det egna organets ställning och form och ej på yttre impulser. Det blev nu GERTZ' uppgift att närmare experimentellt undersöka denna rotbildning och dess orsaker. Han gjorde för den skull ett stort antal experiment och kunde bl.a. påvisa, hur denna speciella rotbildning berodde på en mycket stabil tendens och ej lät sig rubbas av yttre påverkningar, och vidare, att den även i många fall kunde iakttagas vid stampartiernas birotbildning. Beträffande frågan om orsakerna till konvexpartiernas rotbildning kunde något definitivt svar ej lämnas. Dock ansågos experimenten visa, att den åtminstone för stampartierna ej kunde ha sin grund i spänningsförhållandena hos moderorganets vävnader, som man förut velat antaga, ej heller i geotropisk inverkan.

Den andra undersökning, som påbörjades under PFEFFERS ledning, gällde släktet *Cuscuta*s fysiologi, speciellt betingelserna för haustoriebildningen. I allmänhet bildas haustorierna här på stamvindlingarnas konkavsida, och GERTZ sökte nu genom en mängd olika försöksanordningar rubba deras lokalisering och lyckades även i ett av försöken, då han försett skotten med stanniolförband, att åstadkomma en allsidig haustoriebildning. I andra fall, då skotten nedsänktes i sand eller annat löst material, blev haustoriebildningen däremot alltjämt ensidig, men skotten befunnos då också ha utfört krökningsrörelser, i motsats till i föregående fall, och haustorierna bildades på konkavsidan. Vid undertryckande av deras rörelser genom sträckning av skotten bildades haustorier på undersidan; tyngdkraften syntes därför spela en viss roll jämte kontaktretningen. Andra detaljer belystes genom andra experiment, och i en serie odlingsförsök visades den giftverkan, som värdväxten kunde ha på parasiten; bl.a. påvisades, att en rik förekomst av oxalsyra, som hos *Oxalis* och *Begonia,* verkade giftigt på *Cuscuta,* medan däremot ingen skadeverkan förmärktes genom äpplesyra. GERTZ' undersökningar över *Cuscuta* publicerades som några uppsatser i Botaniska Notiser av tämligen ringa omfång, men genom sina många belysande experiment äro de utan tvivel bland hans intressantaste arbeten.

Genom de båda nämnda undersökningarna hade GERTZ' intresse kommit att dragas till den experimentella morfologiens område, och åtskilliga senare arbeten voro mer eller mindre starkt anknutna härtill. Så behandlade han i ett par skrifter en del anomalier i klyvöppningarnas morfologi, vilka dels kunde framställas experimentellt, genom odling i hög värme och fuktighet, dels iakttogos på postfloralt tillväxande blomorgan och på gallbildningar. Han anser dem alla beroende på abnorma ändringar av turgorn i klyvöppningscellerna eller angränsande vävnader. En annan undersökning gäller utvecklingen av *Lunularias* groddknoppar, speciellt rhizoidbildningen på dessa under olika betingelser. Arbetet påbörjades på det av G. KLEBS ledda växtfysiologiska institutet i Heidelberg och omfattar en mängd rikt varierade försök med inverkan på olika sätt av ljus, tyngdkraft, näringslösningar o.s.v. och klarlägger åtskilliga intressanta detaljer i utvecklingen.

I samband med GERTZ' verksamhet inom den experimentella morfologien stod väl hans intresse för bildningsavvikelser av olika slag, varom han skrivit ett stort antal smärre meddelanden, liksom hans mångåriga forskningar på cecidiologiens område. På detta gebit utbildade han sig till en framstående kännare och hopbragte stora samlingar av gallbildningar. I ett stort arbete om Skånes zoocecidier (1918) lade han fram en del av sina resultat, och i andra skrifter redogör han för cecidier från andra områden, däribland åtskilliga för Sverige nya. Med sin mångsidiga läggning undersökte han f.ö. cecidierna från flera olika utgångspunkter och beskriver bl.a. anatomiska egendomligheter, kemiska förhållanden, fossila cecidier, cecidier i gamla klassiska herbarier och cecidiologiens historia.

En annan linje i GERTZ' vetenskapliga gärning representeras av hans biokemiska undersökningar. Redan i sina anthocyan-arbeten hade han varit inne på det biokemiska området, och han återvände sedermera ofta till detta. En undersökning behandlar bladens äggvitereaktioner (1917). Han använde i denna de av MOLISCH kort tidigare beskrivna metoderna, bekräftade denne forskares iakttagelser och utvidgade undersökningen till att gälla även panacherade blad, där han påvisade en stor skillnad mellan de gröna och de klorofyllfria partierna; de förra gåvo stark reaktion, de senare svag eller alls ingen. En annan undersökning gällde växternas oxidationsenzym, speciellt jodidoxidaserna, som avklyva fri jod ur alkalijodider. Han utarbetade en egen, enkel och säker metod att påvisa jodidoxidaser och undersökte med denna en stor mängd växter, alger, svampar, andra kryptogamer och ej mindre än c:a 1200 fanerogamer. Det visade sig, att det fanns vissa olikheter mellan olika systematiska grupper: rödalgerna gåvo t.ex. vanligen positiv reaktion, brunalgerna reagerade negativt. GERTZ anser, att detta ej beror på att enzymen helt saknas t.ex. hos brunalgerna utan att det kan ha sin anledning i att vissa hämmande ämnen, t.ex. garvämnen, extraheras tillsamman med oxidaserna. På senare år återkom han till ett område, som låg nära hans första större arbetsfält, då han ägnade några undersökningar åt det gula färgämne, anthoklor, som liksom anthocyan förekommer löst i cellsaften och är besläktat med denna färgämnesgrupp. I detta fall undersökte han ett stort antal arter inom familjen *Compositae* enligt en speciell metod och påvisade, att förekomsten av en anthoklormodifikation var ganska väl bunden till en systematisk grupp, *Coreopsidinae*. En annan undersökning gällde MÄULEs vedreaktion hos en mängd olika lignoser och gav också en del resultat av systematiskt intresse; bl.a. påvisades den nära överensstämmelsen mellan *Gnetales* och angiospermerna i deras reaktion. GERTZ utbildade sig till en skicklig mikrokemist och har bl.a. meddelat åtskilliga nya metoder för den botaniska mikrokemien, dels i en serie »Laboratorietekniska och mikrokemiska notiser», dels även i andra smärre skrifter.

Något vid sidan om hans övriga botaniska produktion lågo de arbeten, som GERTZ publicerade om växtlämningar i Skånes torvmossar. De grundade sig på fältarbeten, som utfördes redan 1902—1904 och 1907, och lämna utförliga listor över hans fynd av arktiska växtlämningar, *Dryas, Salix reticulata* och *polaris* o.s.v., och dessutom speciella redogörelser för mera intressanta arter, som t.ex. *Trapa natans*.

På senare år blev GERTZ starkt engagerad i de skånska naturskyddssträvandena, vilket påverkade hans produktion. Från år 1919 var han sekreterare i Skånes naturskyddsförening, och 1932 övertog han — efter WALDEMAR BÜLOW redigeringen av föreningens årsskrift, Skånes Natur. I denna var han själv en av de flitigaste bidragsgivarna och utfyllde ibland större delen av årsboken med egna artiklar. En del av dessa behandlade floran i olika områden, t.ex. på Måkläppen, Ven, Kullaberg och ön Lybeck i Krageholmssjön. Andra uppehöllo sig vid ur naturskyddssynpunkt intressanta föremål, gamla träd o.s.v., ibland vid sällsynta arter, som *Asplenium Ruta-muraria, Viscum album* och *Acer campestre*. Utmärkande för alla uppsatser är den starka historiska orienteringen; man får alltid utförliga redogörelser för äldre tiders iakttagelser eller förhållanden, ofta av stort intresse. Hans sista uppsats, om växtligheten i Lund, vilken utkom postumt 1949, är ganska karakteristisk för honom; han lämnar en mängd intressanta uppgifter om äldre tiders flora efter gamla källor, som han letat upp, men om de på senaste tiden inkomna amerikanska arterna som *Erigeron canadensis* och *Galinsoga quadriradiata* nämner han ingenting; han rörde sig, kanske mest på äldre dagar, helst i det förflutna.

Ett område, där GERTZ gjorde en betydande insats, är botanikens historia. Han hade stora förutsättningar härför genom sitt starka historiska intresse, sin omfattande kännedom om äldre litteratur och sitt goda spårsinne. Det är förvånande, hur många fynd han kunnat göra endast på Lunds universitetsbibliotek och på Botaniska institutionens bibliotek av gamla handskrifter och marginalanteckningar, som belysa botanikens historia, bl.a. av OLOF CELSIUS d.ä., J. FISCHERSTRÖM, C. A. AGARDH, ELIAS FRIES. På Malmö läroverks bibliotek anträffade han en handskrift, som innehöll anteckningar efter LINNÉs föreläsningar, säkerligen gjorda av P. OSBECK, och från andra håll drog han ur glömskan fram annat material, som belyste särskilt LINNÉ och hans lärjungar. Av stort intresse är hans lilla skrift »Linné i Lund». Ännu längre tillbaka i tiden gick han i sin redogörelse för den första botaniska forskningsfärden i Skåne, vilken företogs 1622—23 av J. FUIREN och O. SPERLING men vars resultat blivit undangömda på en svårupptäckt plats som bilaga till en medicinsk avhandling av BARTHOLINUS 1662. Också bland Lunds botaniska institutions gamla herbarier gjorde han fynd av stort historiskt intresse; bl.a. påträffade han ett herbarium av år 1610, som hade tillhört CHRISTOPHER ROSTIUS, den förste professorn i praktisk medicin i Lund. GERTZ fastställde, att det var Nordens äldsta »herbarium vivum».

Inom ytterligare ett område var GERTZ verksam, nämligen inom språkvetenskapen. Han behandlade en del växtnamns etymologi och tolkade ett stort antal medeltida namn; på grund av sin sakkunskap på området blev han knuten till Svenska akademiens ordboksredaktion som granskare av botaniskt-filologiska artiklar.

Otto Gertz' vetenskapliga produktion spänner alltså över mycket vidsträckta områden. Han var en polyhistor med djup lärdom på många olika fält. Han var väl inte någon av de stora banbrytarna i sin vetenskap, hans namn är inte knutet till någon betydande upptäckt, utan han gick mera i de fotspår, som andra trampat upp. Han var emellertid en omsorgsfull detaljiakttagare, som outtröttligt samlade uppgift till uppgift och på detta sätt vidgade vårt vetande. Av stort värde äro också de utförliga litteratursammanställningar, som man möter i hans arbeten. Dessa voro alla försedda med rikliga litteraturanvisningar; ofta nog togo noterna större plats på sidan än själva texten; intet fick utelämnas, som kunde ha något intresse i samband med framställningen. Och i sin historiskt-botaniska forskning, där han beträdde ett område, som förut var föga omhuldat i Sverige, visade Gertz en obestridlig originalitet. Måhända gjorde han på detta fält sin största vetenskapliga insats.

Gertz' verksamhet som läroverkslärare fick helt naturligt en ganska stark akademisk prägel. Han traggade inte elementerna med de elever, som inte följde med; han gick igenom den föreskrivna kursen, och ville någon inte tillgodogöra sig den, så fick han skylla sig själv. På grund av hans mångsidiga intressen och kunskaper blev hans undervisning i hög grad allmänbildande, inte blott inom biologiens område utan också i alla möjliga andra ämnen. Kanske avlägsnade han sig ibland litet väl långt från det egentliga ämnet. När han ville, kunde han dock ge mycket intressanta exposéer över biologiska frågor. Han uppträdde med ganska stor värdighet gentemot sina elever och tålde inte, att någon såg tvivlande ut inför hans uppgifter. »Tro mej, jag vet det» eller »Tro mej, jag är lektor, jag», hette det då. Dessa ofta återkommande uttryck gåvo upphovet till att han en tid av skolpojkarna helt enkelt kallades »Tro-mej». Sin lärareverksamhet torde han ha betraktat som något, som kom i andra hand; för honom var forskningen hans största uppgift. Att han emellertid hade ett ej ringa intresse också för undervisningen, visas av de läro- och handböcker för skolor, som han utgav, delvis tillsamman med andra författare.

Man kan kanske beklaga, att Gertz inte fick någon professur, som kunde ha möjliggjort för honom att helt ägna sig åt forskningen. Själv torde han dock inte ha bekymrat sig mycket om den saken. För honom var huvudsaken att han fick vara i en universitetsstad och ha dess möjligheter till vetenskapligt arbete. Han yttrade på tal om denna sak någon gång, att professorer finns det i fyra städer, men universitet finns det endast i två. I en universitetsstad ville han vara, och någon annan än Lund kom ej ifråga för honom. Hur fast knuten han var till Lund, visas av att han brukade kalla den tid, då han hade lärarplats i Malmö, för sin »babyloniska fångenskap», detta trots att Malmö var hans gamla hemstad.

Om också Gertz' arbete till stor del var förlagt till bibliotek och institutioner, så var han dock också en intresserad friluftsmänniska och deltog gärna i olika exkursioner. Han var under yngre år också en ivrig jägare. Troligen var det väl härvidlag kringströvandet i skog och mark, som var huvudsaken för honom. Ett annat intresse, som han hade vid sidan av vetenskapen och som man f.ö. ofta tyckes återfinna hos botanici, var musiken. Hans första amanuensförordnande var i själva verket inte det ovan omtalade vid botaniska institutionen, utan redan tidigare hade han varit amanuens vid akademiska kapellet (1897—99). Han var en skicklig violinist och givetvis kände han också väl till »det ädlaste instrumentets» historia och egenskaper under olika perioder.

I Lunds Botaniska förening var GERTZ sedan lång tid tillbaka en intresserad och verksam medlem, som ofta bidrog med smärre meddelanden om sina undersökningar. Under en följd av år var han föreningens vice ordförande, och till dess 65-årsjubileum 1923 författade han en utförlig historik över dess öden, vilken inflöt i hans bok »Linnéstudier, minnesteckningar och botaniskt kulturhistoriska uppsatser». Vid 90-årsjubileet 1948 var det meningen, att han skulle väljas till föreningens hedersledamot, frågan var redan behandlad och tillstyrkt i styrelsen, men genom hans död i februari detta år fick föreningen ej tillfälle att bringa honom denna hedersbevisning, som han så väl hade förtjänat. Hans insatser i Skånes naturskyddsförening, där han under en lång tid var den drivande kraften, ha ovan berörts. Också i Svenska Linné-sällskapet var han självfallet en intresserad medlem, och i dess tidskrift publicerade han flera av sina lärdomshistoriska uppsatser. I Fysiografiska sällskapet i Lund blev han invald redan 1916. Det kan inte vara något tvivel om att han högt värdesatte denna utmärkelse. För honom var Fysiografiska sällskapet inte en nutida professorsförening utan i främsta rummet ett gammalt, förnämligt sällskap, som grundats på 1700-talet av ANDERS JAHAN RETZIUS och som räknat LINNÉ bland sina första medlemmar. På sällskapets anmodan skrev han år 1940 en historik över dess verksamhet.

I sitt yttre uppträdande framträdde GERTZ liksom i tal och skrift med en viss sober elegans. Personligen var han älskvärd och tillmötesgående — särskilt stod han gärna till tjänst med sin rika litteraturkännedom — och en angenäm sällskapsmänniska. Sällan förlorade han sitt goda lynne. Stridigheter undvek han helst. När det gällde naturskyddssträvandena, kunde han visserligen gå till kamp för att rädda hotade värden, men eljest höll han sig gärna neutral. I striderna kring BENGT LIDFORSS vid seklets början tog han ingen del; han hörde inte till LIDFORSS' falang, och heller inte till hans motståndare. Vad han innerst tänkte och trodde, sade han inte mycket om, det var svårt att komma honom nära. I yngre år torde han närmast ha varit agnostiker; han bekymrade sig inte om andra ting än dem, som han kunde fastställa med sina empiriska metoder. På äldre dagar hade han dock kanhända en annan inställning.

Genom sin omfattande lärdom och stora allmänbildning tillhörde GERTZ en forskartyp, som i vår specialiserade tid blir alltmera sällsynt. I viss mån kan man säga, att han erinrade om de Linné-lärjungar, som han så gärna skildrade, genom sin grundliga kännedom om naturens tre riken — och åtskilligt därtill, genom sin forskariver och upptäckarglädje, även då det gällde till synes obetydliga detaljer, och genom sitt stora intresse för hemlandets natur och kultur. De områden, som han utvalde för sin forskning, kommo visserligen att delvis bli andra än i gamla tider, men i viss mening kan man säga, att han var en sentida linnéan, som vandrade i den store mästarens fotspår och pietetsfullt vårdade och odlade traditionerna från vår vetenskapliga storhetstid. Med respekt och beundran skola vi minnas hans trogna och trägna verksamhet i vetenskapens tjänst.

H. HJELMQVIST.

Bibliografi.

En fullständig förteckning över Otto Gertz’ tryckta skrifter fram till 1940 återfinnes i Lunds universitets matrikel 1939, Lund 1940, ett supplement för senare år är under utarbetande av A. Hässler. I det följande upptages endast ett urval av hans skrifter, huvudsakligen sådana som omnämnts eller berörts i minnesteckningen.

Studier öfver anthocyan. Akad. avh. I—LXXXVII och 1—412. Lund 1906.

Fysiologiska undersökningar öfver slägtet Cuscuta 1—2. Bot. Not. 1910, 65—80, 97—136; 1912, 1—32, 49—80, 97—110.

Om anthocyan hos alpina växter. Bot. Not. 1911, 101—132, 149—164, 209—229; 1914, 1—16, 49—64, 97—126.

Några iakttagelser öfver anthocyanbildning i blad vid sockerkultur. Ark. f. bot., Bd 11: 6, 1912, 1—45.

Om rotkrökningars orienterande inflytande på anläggningen af sidorötter. Studier öfver morphaesthesi. 1. Ark. f. bot., Bd 13: 12, 1913, 1—69.

Om stamkrökningars orienterande inflytande på anläggningen af birötter. Studier öfver morphaesthesi. Lunds univ. årsskr., N.F., avd. 2, Bd 10: 9, 1914, 1—123.

Archiater Carl Linnaei Föreläsningar uti Botaniquen. (Ett kollegiehäfte från den Linnéanska tiden.) Bot. Not. 1915, 65—70.

Untersuchungen über septierte Thyllen nebst anderen Beiträgen zu einer Monographie der Thyllenfrage. Lunds univ. årsskr., N.F., avd. 2, Bd 12: 12, 1916, 1—47.

Laboratorietekniska och mikrokemiska notiser. 1—10. Bot. Not. 1916, 263—272; 1918, 49—58; 1919, 185—199; 1921, 139—143, 165—173; 1922, 69—76, 113—122, 245—256; 1923, 65—98.

Makrokemiska ägghviteprof å blad. Bot. Not. 1917, 1—35.

Några nya fyndorter för arktiska växtlämningar i Skåne. Geol. för. i Stockh. förh. 39, 1917, 503—561.

Christopher Rostii Herbarium vivum i Lund. En studie till herbariernas äldsta historia. Bil. t. Redog. f. Lunds h.a. lärov. 1917—18, 1918, I—XLI.

Skånes zoocecidier. Ett bidrag till kännedomen om Sveriges gallbildande flora och fauna. Lunds univ. årsskr., N.F., avd. 2, Bd 14: 26, 1918, 1—72.

Studier öfver klyföppningarnas morfologi med särskild hänsyn till deras patologiska utbildningsformer. Ibid., Bd 15: 7, 1919, 1—85.

Olof Celsius d.ä. och Flora Uplandica. Ett blad till Uppsalabotanikens historia. Sv. Linné-sällsk. årsskr. 3, 1920, 36—56.

Jörgen Fuiren, Ottho Sperling och den första naturvetenskapliga forskningsfärden i Skåne. Skånes natur 9, 1921, 1—7.

Linnéanska herbarieväxter i domprosten Celsii herbarium. Sv. Linné-sällsk. årsskr. 5, 1922, 106—113.

Otto Nordstedt. En minnesteckning. Bot. Not. 1924, 97—125.

Olof Celsius d.ä. och hans fyndortsuppgifter i Flora Uplandica. Ibid. 1925, 113—149.

Über die Jodidoxydasen der Algen. Ibid. 1925, 185—199.

Undersökningar över bromstärkelse och dess kemi. Ibid. 1926, 349—378.

En Linnéhandskrift. Linnés första kända anteckningar till Smålands och Skånes flora. Studier tillägn. J. Mjöberg, Lund 1926, 61—92.

Sperling, Stobæus, Linné o. Leche och de första undersökningarna över Skånes flora. Sv. Linné-sällsk. årsskr. 9, 1926, 100—141.

Stratigrafiska och paleontologiska studier över torvmossar i södra Skåne. 1—2. Bil. t. Redog, f. Lunds h.a. lärov. 1925—26, 1926, 1—64; 1926—27, 1927, 65—134.

Über die Oxydasen der Algen. Biochem. Zeitschr. 169, 1926, 435—448.

Zur Physiologie der Rhizoidenbildung bei den Brutkörpern von Lunularia cruciata (L.) Dum. Lunds univ. årsskr., N.F., avd. 2, Bd 22: 3, 1926, 1—63.

Untersuchungen über die Verbreitung der Jodidoxydasen. Bot. Not. 1927, 1—59.

En promemoria av Elias Fries år 1829 angående Skånes flora. Skånes natur 15, 1928, 52—57.

Linné i Lund. Föredrag i K. Fysiografiska sällskapet den 2 december 1927. Lund 1928. 1—18.

Linné såsom cecidolog. En studie till cecidologiens äldre historia. Lunds univ. årsskr., N.F., avd. 2, Bd 24: 5, 1928, 1—115.

Linné och cecidologien. I—III. Sv. Linné-sällsk. årsskr. 12, 1929, 149—167; 13, 1930, 69—108; 19, 1936, 121—128.

Über die Jodidoxydasen der Angiospermen, ihre Verbreitung und Eigenschaften. Biochemische Studien. Lunds univ. årsskr., N.F., avd. 2, Bd 25: 14, 1929, 1—61.

Linnéstudier, minnesteckningar och botaniskt kulturhistoriska uppsatser. Lund 1935. 1—179.

Om postmortal mörkfärgning av växtdelar. Bot. Not. 1938, 345—377.

Über die Verbreitung des Anthochlors bei den Compositen. Fys. Sällsk. i Lund förh., Bd 8: 6, 1938, 1—9.

Alexis Eduard Lindblom. Botaniska Notisers grundare och förste utgivare. Minnesteckning. Bot. Not. 1939, 273—290.

Botaniken på de gamla örteböckernas tid. Herbarius och herbarium. Lychnos 1939, 193—221.

Kungl. Fysiografiska Sällskapet i Lund. 1772—1939. Historisk överblick och personförteckningar. Lund 1940, 1—463.

Göran Wahlenbergs botaniska anteckningar under resan i Skåne 1822. Bot. Not. 1942, 113—152. (Bidrag till Skånes Flora. 11.)

Zur Kenntnis der Holzreaktion nach Mäule. Einschliesslich einige phylogenetische Bemerkungen. Bot. Not. 1943, 203—218.

Flora Farhultensis. En återfunnen ungdomsskrift av Johan Wilhelm Zetterstedt. Bot. Not. 1944, 223—236. (Bidrag till Skånes Flora. 26.)

Förekomsten av Viscum album i Skåne. Ibid. 1944, 270—280 (Bidrag till Skånes Flora. 27.)

Pehr Osbeck och Skånefloran. Ibid. 1945, 317—329. (Bidrag till Skånes Flora. 32.)

Växter ur Peter Forsskåls herbarium å Lunds botaniska institution. Sv. Linné-sällsk. årsskr. 28, 1945, 77—89.

Carl Adolph Agardhs anteckningar till Hallands flora. Bot. Not. 1946, 315—321.

Einige bemerkenswerte Pilzformen aus den Kohlengruben Schonens. Fys. Sällsk. i Lund förh. Bd 16: 11, 1946, 1—14.

Dömestorps flora. En hittills okänd växtförteckning från år 1754. Bot. Not. 1947, 305—316.

Gipsinkrustation hos mossor. Ibid. 1947, 335—349.

Växtligheten i Lund. Lundensia, utgiven av föreningen Lundensare i Stockholm. Lund 1949, 37—54.

BOTANISKA NOTISER 1951, HÄFTE 2. LUND

Litteratur.

P. MAHESHWARI. An introduction to the study of the embryology of angiosperms. — Mc-Graw-Hill book company. New York 1950. 453 sid. Pris 6 doll.

Professor MAHESHWARI vid universitetet i Delhi har utgivit ett stort antal avhandlingar i växtembryologi och har i Botanical Review givit översikter av 30- och 40-talens embryologiska litteratur. Han är alltså synnerligen väl rustad att skriva en ny växtembryologisk bok. En dylik är välbehövlig, det är nu 20 år sedan SCHNARFS förträffliga böcker kom ut och den växtembryologiska forskningen har ingalunda stått stilla. I Indien är den mycket livlig och många tropiska släkten och familjer ha undersökts. Den italienska växtembryologien har liksom tidigare en mycket hög kvalitet med BATTAGLIA och D'AMATO som de ledande forskarna. I Sverige ha de växtembryologiska traditionerna väl bevarats och vi glädja oss åt FAGERLINDS och MAURITZONS insatser. I Förenta staterna finnes ökat intresse för växtembryologi särskilt i samband med artkorsningar (BRINK och COOPERS undersökningar).

Man öppnar alltså denna bok med förväntan att det är en god bok och blir ej besviken. Den är indelad i 13 kapitel. Det första är en »historical sketch», men är jämförelsevis långt (25 sid.) och har bilder från HOFMEISTER, SCHACHT, AMICI samt fotografier av några av heroerna. Så följa kapitel som behandla mikrosporangiet, makrosporangiet (fröämnet), den honliga gametofyten (embryosäckens byggnad och utveckling), den hanliga gametofyten (pollenutvecklingen), befruktning, endosperm och embryo. Kapitlet över embryosäckutvecklingen är som sig bör längst (70 sid.) och är mycket bra; klar och koncis är författarens skildring. Utom de så att säga ordinarie typerna av embryosäckutvecklingen behandlar författaren några som han kallar aberranta typer (*Limnanthes Douglasii, Balsamita vulgaris, Chrysanthemum cinerariaefolium).* Dessa behandlas utförligt så att läsaren blir fullständigt klar över utvecklingsförloppet. Kapitlet som behandlar apomixis står ej på samma nivå, författaren har ej själv undersökt fröutvecklingen hos någon agamosperm växt. I kapitlet med överskriften polyembryoni behandlas ej adventivembryoni som fått sin plats i apomixis-kapitlet.

Slutligen innehåller boken tre kapitel av mera allmänt innehåll. I »Embryology in relation to taxonomy» lämnar författaren ett antal exempel på en dylik relation men ingen utförligare allmän diskussion. Kapitlet »Experimental embryology» refererar undersökningar över bl.a. experimentell parthenokarpi, odling av unga embryoner på näringssubstrat, ympning av stift. Man skulle gärna sett ett kapitel med genetiskt-embryologiskt innehåll. T.ex. BRINK och COOPERS, KIHARAS, FAGERLINDS och andra forskares undersökningar över embryo- och endospermabort i artkorsningar och i autopolyploida korsningar borde refererats. BRINK och COOPERS visserligen obekräftade men intressanta hypotes om antipodernas betydelse för normal endospermutveckling hos korn och deras stimulering genom spermakärnan kunde omnämnts i detta sammanhang. DARLINGTON och LA COURS mera »sophisticated» deduktioner av embryosäckutvecklingstypernas genetiska betydelse, RENNER-effekt och annat kunde ha behandlats i ett dylikt kapitel. Avslutningskapitlet bär överskriften »Theoretical conclusions». Beträffande frågan om den åttakärniga embryosäckens uppkomst fäster man sig vid författarens skarpa avvisande av PORSCHska arkegonieteorien. *Gnetales*-teorien finner han även möta svårigheter men anser den vara en acceptabel arbetshypotes. Beträffande det sekundära endospermets uppkomst refereras teorier om betydelsen av att denna vävnad är av hybrid eller heterozygotisk natur (heterosis m.m.). Men det förtjänar att framhållas, att det måste vara en fördel att fröets näringsvävnad först bildas i samband med befruktningen. Primär endosperm bildad innan befruktningen (som hos gymnospermerna), är ju till ingen nytta om befruktning uteblir, en massa näring har förbrukats i onödan. Vid riklig pollentillgång och trädväxt är detta mindre betydelsefullt men om det blir ont om pollen, försvårad pollinering, svagare moderplantor, blir läget ett annat.

MAHESHWARIS bok är tryckt på gott papper och synnerligen rikt illustrerad, mycket bättre än SCHNARFS böcker. Den är en mycket bra introduktion till angiospermernas embryologi.

ARTUR HÅKANSSON.

F. E. CLEMENTS, E. V. MARTIN, F. L. LONG. Adaption and origin in the plant world. The role of environment in evolution. — Chronica botanica Co. Waltham, Mass. 1950. 332 sid. 6 doll.

Även denna bok är tryckt på mycket bra papper och har ej mindre än 80 planscher med fotografier och 2 färgplanscher. CLEMENTS är ett mycket känt namn; han har i mera än 40 år arbetat vid Carnegie institution med transplantation av växter, och flera klimatträdgårdar ha stått till hans förfogande med möjlighet till experimentella studier. Han har en stor produktion som dock (av ganska tydliga skäl) ej funnit någon uppskattning hos moderna evolutionsforskare. Han avled 1945 liksom medarbetaren Dr. LONG. Manuskriptet var då nästan färdigt och det är Mrs. CLEMENTS som har utgivit denna bok och sörjt för dess illustrering. Den vittnar om CLEMENTS' intresse och entusiasm men tyvärr också om hans svagheter. Han har gjort odlingsförsök under växlande betingelser med omkring 200 släkten och fyra gånger så många arter och kommit till uppfattningen att form- och artbildning sker genom en process kallad ekogenesis, definierad som »the origin of new forms under the influence of the environment». Det tycks vara Lamarckism i dess krassaste form. I första hand klimatet framkallar förändringar som sedan fixeras, alltså bli ärftliga (enligt definition i »Glossary»), »time and intensity of dosage appear to be the essence of fixation» heter det. Selektionen spelar ingen roll. Han citerar (som stöd?) uttalande av DARWIN där denne uttrycker ånger över att ha tillskrivit naturlig selektion alltför stor vikt och direkt inverkan av föda och klimat alltför liten betydelse vid arternas uppkomst.

Det kan här ej bliva fråga om en närmare granskning av denna bok. För den som önskar taga kännedom om CLEMENTS' undersökningar och lära sig hans terminologi är den mycket betydelsefull men som någon introduktion till artbildningsläran kan den ej tjäna. Bokens »Glossary» innehåller några betänkliga definitioner. En sådan är: *meiosis* — same as mitosis: nuclear division.

ARTUR HÅKANSSON.

ALFRED GUNDERSEN: Families of Dicotyledons. Waltham, Mass. 1950. Chronica Botanica Co. 238 s., doll. 4.75.

Sedan RENDLES, HUTCHINSONS och SWINGLES arbeten på 1920- och 1930-talen har ingen ny handbok i de högre växternas systematik och klassificering utkommit på engelska. Den norskfödde amerikanske systematikern GUNDERSEN kan därför i sitt nyligen utkomna verk bygga på en mängd nytillkomna fakta och giva en modernare framställning; dessutom avviker hans bok till sin uppläggning i viss mån från tidigare författares.

Boken inledes med en del kortfattade allmänna kapitel, behandlande paleontologi, vedanatomi, gyneciets morfologi, embryologi, cytotaxonomi och växtgeografi, vilka äro skrivna av specialister på de olika områdena. Särskilt betydelsefullt är kanske O. TIPPOS bidrag om vedanatomien, då det behandlar de anatomisk-systematiska undersökningar, som på senare tid gjorts i Amerika; dessa undersökningar ha nämligen i många fall tydligen varit bestämmande för den systematiska indelningen i bokens senare del. Författaren själv skriver också ett par inledande kapitel om dikotyledonernas morfologi, tidigare system och principerna för hans egen indelning.

I den speciella delen, som givetvis upptager bokens största del, är framställningen mycket koncentrerad. För varje ordning och familj gives en kortfattad diagnos för de viktigaste karaktärerna, ofta åtföljd av belysande figurer, vidare upplysningar om kromosomtalen, i den mån de äro kända, samt litteraturanvisningar. De senare bestå ej endast av uppräkningar av skrifter utan också av kortfattade uppgifter om dessas huvudresultat, något som naturligtvis är värdefullt. På grund av den schematiska framställningen har ett stort antal fakta kunnat sammanbringas på ett begränsat utrymme, och framställningen har fått en ganska stor överskådlighet.

Vid sin systematiska indelning ställer förf. ordningen *Magnoliales* först och uppför monochlamydéerna högre upp i systemet, som reducerade typer, alltså i överensstämmelse med BENTHAM-HOOKERS system. Förf. har vidare dragit konsekvenserna av den numera allmänna uppfattningen, att de gamla grupperna *Choripetalae* (*Archichlamydeae*) och *Sympetalae* ej äro naturliga enheter utan artificiella grupper, och frångått denna indelning. I den speciella delen upptages över huvud taget inga större systematiska enheter än ordningar, men i inledningen och innehållsförteckningen har en gruppering verkställts av ordningarna i 10 olika grupper. Några av dessa ha uppkommit genom sammanslagning av ordningar som tidigare förts till sympetaler och choripetaler; så har *Umbellales* och *Rubiales* båda förts till *Rubiflorae, Caryophyllales* och *Primulales* till *Dianthiflorae* och *Theales* och *Ericales* till »*Thea*-gruppen». Dessa sammanslagningar kunna nog vara motiverade med hänsyn till de släktskapsförhållanden, som otvivelaktigt äro för handen, men inplaceringen av andra ordningar i de nämnda grupperna, som t.ex. *Plantaginales* i *Dianthiflorae,* är kanske mera osäkert grundad, och en stor grupp, *Jasminiflorae,* består helt av gamla »sympetaler»; i detta fall har någon anslutning till andra ordningar tydligen ej kunnat åstadkommas. Det synes därför som om tiden kanske ej vore riktigt mogen för en radikal omgruppering av de gamla enheterna; utan tvivel är det dock något som bör eftersträvas, och det föreliggande arbetet är av intresse som ett försök i den riktningen. Författaren är själv medveten om att hans arrangemang är »only tentative, not to be accepted but to be improved».

H. HJELMQVIST.

Botaniska Notiser 1951, Häfte 1. Lund

Notiser.

Docentförordnande. Till docent i ärftlighetslära vid Lunds universitet förordnades 17/4 1951 fil. lic. Gunnar Östergren.

Doktorsdisputationer. På Stockholms högskola försvarade fil. lic. H. Virgin 11/5 1951 en gradualavhandling med titeln: »The effect of light on the protoplasmic viscosity», fil. lic. G. Harling 16/5 1951 en avhandling över ämnet: »Embryological studies in the Compositae I—III» och fil. lic. G. Lindstedt 26/5 1951 arbetet: »Constituents of pine heartwood».

I Uppsala försvarade fil. lic. V. Slankis 25/5 1951 avhandlingen: »Über den Einfluss von β-Indolylessigsäure und anderen Wuchsstoffen auf das Wachstum von Kiefernwurzeln. 1» och fil. lic. M. Fries 26/5 1951 arbetet: »Pollenanalytiska vittnesbörd om senkvartär vegetationsutveckling, särskilt skogshistoria, i nordvästra Götaland».

Forskningsanslag. Statens naturvetenskapliga forskningsråd har för främjande av naturvetenskaplig forskning utdelat bl.a. följande anslag: Till professor S. Ekman, docent G. Lohammar, laborator W. Rodhe och laborator H. Skuja 1800 kr. för fortsatta undersökningar av vattendrag i Torne Lappmarks fjälltrakter med särskild hänsyn till deras produktionsbiologi; till Institutionen för systematisk botanik, Uppsala, 5000 kr. för fortsatt arbete med att färdigställa en svensk-finsk diatomacéflora; till Lunds Botaniska förening 6000 kr. för fortsatt arbete med registrering av material i samband med växtgeografiska undersökningar över Skåne; till fil. kand. N. Nybom 3300 kr. för arbeten med inducerade mutationer hos encelliga grönalger; till fil. lic. M. Ryberg 2800 kr. för insamlande av material för anatomiska och systematiska studier inom fam. *Fumariaceae*; till docent C. Weibull 6500 kr. för undersökningar över bakteriernas submikroskopiska struktur och kemiska byggnad. — K. Vetenskapsakademien har från Hierta-Retzius' stipendiefond utdelat bl.a. följande anslag för vetenskapliga ändamål: Till fil. lic. O. Andersson 1000 kr. för undersökningar av gräshedarnas flora och vegetation på Öland och Falbygden; till fil. lic. M. Fries 700 kr. för pollenanalytisk undersökning av vegetations- och kulturutvecklingen på Falbygden; till fil. lic. V. Gillner 800 kr. för undersökningar över havsstrandängarna vid Sveriges västkust samt tyska nordsjökusten; till fil. mag. T. Wennberg 1000 kr. för algologiska undersökningar vid Norges sydkust; till fil. kand. H. Runemark 1000 kr. för en undersökning av de gula arterna av släktet *Rhizocarpon* i Skottland; till fil. lic. M. Ryberg 1690 kr. för en resa till Franska Nordafrika och Pyreneiska halvön för undersökningar inom fam. *Fumariaceae*. — K. Vetenskapsakademiens Lindahlska nämnd har utdelat ett stipendium à 5000 kr. till fil. lic. O. Hedberg för cyto-taxonomiska undersökningar av botaniskt material från Östafrika. — Från stiftelsen Lars Hiertas minne har fil. lic. G. Arrhenius erhållit 3000 kr. för undersökning av de senkenozoiska storleksvariationerna hos diatomacéarten *Coscinodiscus nodulifer* i djuphavslagerföljder från Stilla havet, lektor H. Stenar 1000 kr. för embryologiska undersökningar inom *Liliiflorae* med särskild hänsyn till fam. *Liliaceae* och *Amaryllidaceae,* docent Birgitta Norkrans 2000 kr. till undersökningar över cellulosans enzymatiska nedbrytning och lektor B. Halden 400 kr. för växtekologiska undersökningar i Ångermanland och Dalarna. — K. Fysiografiska sällskapet i Lund har utdelat 800 kr. till kommissionen Skånes flora för fortsatt inventeringsarbete, 550 kr. till fil. lic. O. Andersson för undersökning av de skånska bokskogssvamparna och 130 kr. för inventering av den högre svampfloran på Kullaberg samt 2500 kr. till amanuens A. Nilsson för studier av fauna och flora på Kullens submarina sluttningar med dykareteknik. — Ur Herman Nilsson-Ehle-fonden har utdelats 1000 kr. till fil. lic. A. Hagberg och fil. kand. N. Nybom för undersökning av morfologiska mutationer hos korn, 700 kr. till fil. kand. Berta Santesson för undersökning rörande polyploidi inom *Prunus,* 900 kr. till assistent G. Julén för undersökning rörande tetraploid rödklövers fertilitet, 900 kr. till professor Heribert Nilsson för undersökning rörande självfertilitet hos råg, 1500 kr. till fil. kand. A. Lundquist för undersökning av självsterilitet och inavelseffekt hos råg, 1400 kr. till fil. kand. N. O. Bosemark för undersökning angående accessoriska kromosomer hos *Festuca pratensis* och 1100 kr. till fil. kand. S. Fröst för undersökning angående accessoriska kromosomer hos *Centaurea.*

Bengt Jönssons pris i botanik har av Fysiografiska sällskapet i Lund tilldelats fil. lic. O. Andersson för hans arbete över skandinaviska storsvampars systematik och utbredning.

Ny botanisk tidskrift. På en kongress i Bangalore i Indien i jan. 1951 grundades en internationell förening för växtmorfologi, »International society of plant morphologists», vilken skall utgiva en ny tidskrift, kallad »Phytomorphology». Föreningens »convenor» är professor P. Maheshwari, Delhi.

Lunds Botaniska förenings nya stadgar föreligga nu i tryck och kunna erhållas efter rekvisition hos föreningens sekreterare.