# THE RESEDACEAE

*A taxonomical revision of the family*

M. S. ABDALLAH

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*A taxonomical revision of the family*

(MET EEN SAMENVATTING IN HET NEDERLANDS)

PROEFSCHRIFT

TER VERKRIJGING VAN DE GRAAD
VAN DOCTOR IN DE LANDBOUWKUNDE
OP GEZAG VAN DE RECTOR MAGNIFICUS, IR. F. HELLINGA,
HOOGLERAAR IN DE CULTUURTECHNIEK,
TE VERDEDIGEN TEGEN DE BEDENKINGEN
VAN EEN COMMISSIE UIT DE SENAAT
VAN DE LANDBOUWHOGESCHOOL TE WAGENINGEN
OP VRIJDAG 7 JULY 1967, TE 16.00 UUR

DOOR

M. S. ABDALLAH

H. VEENMAN & ZONEN N.V. – WAGENINGEN – 1967

# STELLINGEN

I

Norris's view concerning a possible phylogeny in Resedaceae rests on too narrow a basis.

(TH. NORRIS in Amer. Journ. Bot. 28 (2), 1941, p. 101–113).

II

Sernander's conclusion concerning the influence of myrmecochory on the size and number of the seeds in Reseda L. is defeated by his own experiments.

(R. SERNANDER in Kungl. Sv. Vet. Akad. Handl. 14 (7), 1906, p. 44–49, 295–296, et in Nov. Acta Reg. Soc. Sc. Upsal. 1927, p. 91).

III

The distribution of the genus Oligomeris Camb., which contains vicarious species, agrees to the distributional pattern of two vicarious genera in Oleaceae (i.e. Menodora Humb. et Bonpl. and Jasminum L.).

(This thesis).

IV

The presence of Reseda lutea L. in medieval times in northeastern England needs further proof.

(R. GODWIN, Hist. Br. Flora 1956, p. 86).

V

The origin of Reseda odorata L. is an unsolved problem.

(P. ASCHERSON in Naturwissensch. Wochenschr. N. F. 9 (16), 1910, p. 241-3).

VI

Chromosome counts, which are not illustrated by adequate herbarium specimens preserved in an institutional herbarium are, for that reason, of restricted value, if of any value at all.

VII

Plant-geographical data are only accessory evidence to plant taxonomy.

M. S. ABDALLAH
Wageningen, 7th July 1967

VIII

Members of The Volunteer (Peace) Corps, who intend to direct their efforts to agriculture and horticulture in the (sub)tropics, ought to receive some training in plant systematics and -morphology.

IX

Although the vital importance of nature conservation in vast areas of Africa is recognized more and more, and national parks, nature reserves, and game reserves are established in all African countries, Governments tend to over-exploit these parks and reserves for tourism. Neglect of other aspects of nature conservation will ultimately lead to lasting damage to African civilisation, to the productivity of the land, and to science in general.

X

The High Dam Lake, south of Aswan, U.A.R. (Egypt), will not only provide water to the area north of the Dam, but will also influence the conditions of plant growth south of the Dam favourably.

(SADD-EL-AALI Project. Ministry of Sadd-El-Aali Publication, 9th Jan. 1963).

# VOORWOORD

Een onderzoek over de anatomie van het genus *Jasminum* ter verkrijging van de M.Sc.-graad aan de Cairo Universiteit in 1960 toonde mij aan, dat een verdere studie in plantentaxonomie niet kon worden gemist. Plantentaxonomisch onderzoek kan slechts voldoende diepte en reikwijdte verkrijgen, wanneer dit in Europa, of eventueel Amerika, wordt uitgevoerd, omdat de onontbeerlijke literatuur en herbarium exemplaren slechts daar bereikbaar zijn.

Onder de gegeven omstandigheden viel de keus voor een voortgezette studie in plantentaxonomie op Nederland. Omdat mijn vooropleiding een graad had opgeleverd in landbouw-wetenschappen en omdat aan de Landbouwhogeschool te Wageningen (Laboratorium voor Plantensystematiek en -geografie) de studie van de Afrikaanse flora is gecentreerd, begon ik medio 1963 mijn onderzoek te Wageningen.

Onder leiding van Prof. Dr. H. C. D. De Wit bestudeerde ik de familie *Resedaceae*. Bij mijn aankomst trof ik al een aantal soorten in cultuur aan ter voorbereiding van mijn werk en daarnaast kon de studie van herbarium materiaal beginnen. In de loop der jaren overschreed het geleende materiaal 20.000 vel en een zeer grote hoeveelheid literatuur werd met medewerking van vele instituten bijeengebracht.

Mijn dank gaat uit naar Prof. De Wit, die dagelijks contact met mij onderhield en die de weg door zo veel verwarde en soms moeilijke problemen hielp vinden.

De uitzonderlijk fraaie illustraties van deze revisie der *Resedaceae* dank ik aan mej. L. Th. M. E. van der Riet. Ik prijs mij bijzonder gelukkig haar als medewerkster te hebben gevonden, omdat haar toewijding en bekwaamheid een serie tekeningen tot stand hebben gebracht, die voorbeeldig mag heten. Ik ben haar in de hoogste mate dankbaar. Jarenlang heeft de heer M. R. Mouthaan mij geholpen bij het registreren van de herbarium exemplaren, etiketteren, lezen van de bijschriften enz. Ik ben hem zeer verplicht, terwijl ik bij mijn dankbaarheid gaarne de overige leden van de technische staf van het Herbarium insluit, die op zo vele manieren en zo dikwijls mij terzijde stonden.

Het opsporen der literatuur werd vooral door de heer G. Boelema verzorgd. Zijn warme belangstelling en ijver hebben in hoge mate bijgedragen tot het bereikte resultaat, t.w. dat vrijwel alle gezochte publikaties in mijn bezit kwamen, hetgeen een opmerkelijk succes mag heten.

Prof. Dr. F. A. Stafleu en Dr. W. Stearn hebben bij herhaling geadviseerd over nomenclatuur en literatuur, Dr. O. A. Leistner over *Oligomeris*.

Mej. P. van der Weijden en mej. M. J. R. van den Brink hebben met aandacht en geduld het ingewikkelde manuscript getypt. De heer W. Grotenbreg kweekte een aantal soorten en droeg daardoor bij tot een betere kennis van de morfologie van de levende planten, terwijl hij zijn gaven als kweker, die tot ver buiten Wageningen erkend worden, opnieuw bewees. Mijn dank gaat zeker ook naar hem uit.

De Landbouwhogeschool dank ik ten zeerste voor de verleende gastvrijheid en voor de hulp, financieel zowel als anderszins, bij het drukken van mijn proefschrift. Men stelde mij bovendien nog in staat enige Europese herbaria te bezoeken en ik zal mij de jaren, waarin ik te Wageningen gewerkt heb, steeds met grote erkentelijkheid herinneren.

Omdat mijn vrouw tezelfdertijd aan de Universiteit van Utrecht voor een promotie werkzaam was, zagen wij ons gedwongen de kinderen buitenshuis onder te brengen. Het hartelijke begrip van mej. P. A. Allersma, directrice van het 'Zonnehoogt' kinderhuis te Driebergen, zullen wij steeds blijven zien als een bijdrage aan ons gezin, waarvoor wij niet dankbaar genoeg kunnen zijn. Mijn twee kleine dochters, Hanaan en Dalaal, zijn door haar genegenheid en moederlijke zorg deze moeilijke jaren goed doorgekomen. Wij zullen hetgeen mej. Allersma voor ons heeft gedaan nimmer vergeten.

Een woord van bewondering en waardering ten aanzien van mijn echtgenote, die ongetwijfeld in moeilijker omstandigheden moest werken en leven dan ik, mag hier niet ontbreken.

In de hoogste mate dankbaar en erkentelijk ben ik tevens mijn regering, mijn land, en mijn familie, die mijn studie mogelijk hebben gemaakt. Ik heb gepoogd door mijn beste krachten in te zetten en mijn tijd ten volle te benutten het in mij gestelde vertrouwen en het offer, dat mijn familie, die deel uitmaakt van een landbouwende plattelandsgemeenschap heeft gebracht, ten volle waardig te zijn. Het Ministerie van Landbouw van de Verenigde Arabische Republiek in het bijzonder dank ik voor de goede zorgen en belangstelling, getoond bij het oplossen van veel administratieve en financiële problemen. De Ambassade in Den Haag hielp mij bij herhaling met grote belangstelling en doeltreffendheid.

# SAMENVATTING

Honderdentien jaar geleden verscheen 'Monographie de la famille Résédacées' door JEAN MUELLER (1857). Het was het eerste grote werk van deze voortreffelijke botanicus; het vestigde zijn naam als geleerde en werd met een gouden medaille bekroond. Hij wordt, ter onderscheiding van andere MUELLERS, vele malen in dit boek genoemd als 'MUELL. ARG.', voluit *Mueller Argoviensis*, een verwijzing naar *Argovia*, de gelatiniseerde naam van het kanton Aargau (Zwitserland), waar hij in 1828 geboren werd.

Nadien werd nimmer een diepgaande revisie van de zeer gecompliceerde familie *Resedaceae* ondernomen. MUELL. ARG. zelf publiceerde opnieuw een revisie in 1868, maar deze herhaalde toch grotendeels zijn werk van 1857, ofschoon toch ook nogal wat wijzigingen werden aangebracht. Een goed overzicht verscheen in 1936 door F. BOLLE. De thans gereed gekomen revisie berust op een veelvoud (17.000–20.000 exemplaren) van het materiaal, dat MUELL. ARG. ter beschikking had. Het aantal genera, waarin de familie thans verdeeld wordt, bleef 6 (MUELL. ARG.: 6), terwijl het aantal soorten (ca. 60) wat minder werd dan dat van MUELL. ARG. Niettemin bleken vele aanvullingen en wijzigingen noodzakelijk: naast het intrekken van enige soorten, werden ook enkele nieuwe gevonden, de omgrenzingen van enige genera en vele soorten werden verbeterd of verlegd, een aantal namen moest worden veranderd, nieuwe sleutels op de genera en soorten werden geschreven.

Door de vele inzamelingen en gepubliceerde gegevens kon thans een veel uitvoeriger en nauwkeuriger beeld van de soorten worden ontworpen dan een eeuw geleden mogelijk was. De soorten werden, elk voor zich, in detail afgebeeld, hetgeen een serie platen voor één familie opleverde, die misschien wel nergens in de botanische literatuur overtroffen wordt.

De literatuur, die op taxa der *Resedaceae* betrekking heeft, is enorm van omvang en chaotisch, soms zelfs onontwarbaar. Deze revisie heeft geschift en geordend, verworpen wat voos en aanvaard wat waardevol bleek te zijn. Een gering aantal publikaties bleef, ook na een jacht in vele landen van Europa, onbereikbaar.

De familie der *Resedaceae* wordt morphologisch, taxonomisch (in zeer brede zin), geografisch, biologisch en in economisch opzicht besproken, omschreven, en vervolgens in genera verdeeld (sleutel op de genera). In alphabetische volgorde worden de genera behandeld, literatuurbronnen (een keuze) toegevoegd, terwijl alle conclusies worden toegelicht en voor elk genus een sleutel op de soorten is gemaakt. De soorten worden omschreven, de literatuur opgesomd, de typificatie gegeven, de geografische verspreiding aangeduid, een aantal geselecteerde herbarium exemplaren opgesomd, de synoniemen genoemd (en een uiteenzetting gegeven waarom tot synonymie werd besloten) terwijl aantekeningen ('notes') bij elke soort betrekking hebben op de nomenclatuur, de geschiedenis van de soort, zijn levenscyclus of ecologische bijzonderheden en, indien bekend, zijn relaties tot de mens.

Omdat de periode benodigd om dit omvangrijke werk te drukken te lang bleek om de auteur binnen de gestelde tijdslimiet tot de promotie toe te laten, verschijnt het in twee delen.

# CONTENTS



This first instalment of *The Resedaceae* will be followed by a second containing the genera *Reseda* L. and *Sesamoides* Ort., and some other chapters. Date of publication of instalment I: 7 July, 1967. Future address of the author: Director, The Herbarium, Min. of Agriculture, Dokki, U.A.R. (Egypt).

# INTRODUCTION

The family *Resedaceae* was for the first time revised by JEAN MUELLER in 1857. This 'Monographie de la famille Résédacées' was awarded a gold medal and became an acknowledged classic.

J. MUELLER (9-V-1828–28-I-1896) was born at Teufenthal, Kulm distr., Aargau kanton, in Switzerland, and is usually referred to in botanical literature as 'MUELL. ARG.', meaning '*Mueller Argoviensis*', a reference to his birth in Aargau (*Argovia* in latin) and in contradistinction to other MUELLERS. At the time of publication of his 'Monographie', MUELL. ARG. was conservator of the A. DE CANDOLLE herbarium at Geneva. His book was incorporated in the next year in the Neue Denkschrifte der Schweizerische Gesellschaft zu Zürich.

This may be the place and time to state that MUELLER's work is of exceptional depth and quality which may have deterred later botanists to attempt studying the family as a whole, the more so, as its taxonomy is largely dependent on minute details and the literature very confused, scattered in literally hundreds of publications and frequently only traceable after considerable effort.

Only one general survey appeared after MUELL. ARG.'s revisions (a final one, to a large extent identical with the first of 1857, appeared in DE CANDOLLE's Prodromus in 1868), by F. BOLLE (in 1936; in the second edition of Natürl. Pflz. fam.).

A century of collecting increased the specimens available for a new revision to almost 20.000; the field data became very much more complete, the Code of Botanical Nomenclature was composed (and the type-method adopted as a governing principle). It is not without some comfort to see that MUELL. ARG. recognized 60(66) spp., arranged in 6 genera in the family, and to discover that in the present revision slightly less spp. are recognized, arranged in 6 genera. However, it may be noted that the rich sources now available, led to a clearer or revised delimitation of a number of species, a reshaping of some genera, and to the withdrawal of many and the proposal of few, infraspecific taxa. The large number reduced or rejected names (or taxa) in the present revision is a cleansing of resedaceous literature already long overdue.

The genus *Stefaninia* CHIOV., which was not accepted after its publication, is now adopted as a subgenus. There remain in *Resedaceae* very few species to be discovered, it would seem, and with a possible exception for the area S. Arabia-Somalia, it may well be that the natural taxa of *Resedaceae* are practically all represented in the total of the herbarium collections of the world. It ought not to be assumed, however, that further collections of *Resedaceae* would be without interest. On the contrary: of many species, the number of specimens available is clearly too low for a satisfactory assessment of variability. It might eventually appear that in some cases closely related taxa would better be united in one single species, although BENTHAM and HOOKER's firm belief that not more than 30 well-distinguished species existed (Gen. Pl. 1, 1862, p. 111) is not supported

by the present revision or by MUELL. ARG.; the outcome of the present study is more or less in between.

The *Resedaceae* are widespread in thickly populated or often explored regions and many species are weedy, changeable and closely allied. Local floristic publications on such groups often contain new names, proposed without adequate comparative study of specimens outside the area. Reversely, taxa which are, at least to the eye of general systematist, strikingly alike in habit, prove to possess constant differential characters, discoverable either after careful dissection or only if 'complete' specimens (fully developed fruits, fully mature seeds) are at hand.

Many species of *Resedaceae* need experimental taxonomical research, without which the delimination of infraspecific taxa is merely guess-work, or tentative. This state of affairs was demonstrated by large series of specimens of some common species and for that reason the number of infraspecific taxa admitted in the present revision is very much below that found in MUELL. ARG.'s revisions. The cytological data published (chromosome numbers) are of limited value because, mostly, no herbarium specimens exist to verify the identifications of the investigated material.

It is virtually impossible (and hardly useful) to discuss, or even cite, the thousands of places in literature where resedaceous taxa are treated or mentioned. In the present revision, only selected references are included, which were thought to have some interest, either taxonomically, economically, or historically.

In MUELL. ARG.'s monograph of 1857 dozens of references to names are found, often only to indicate an error in earlier literature, some msc.-name, or a misidentification. As far as these names were entered in Index Kewensis, they are discussed (in various places) in the present revision. The other names, found in MUELL. ARG.'s monograph, and numerous names published elsewhere, are mentioned here also, but especially as regards infraspecific names, one cannot hope to trace them all.

If it is wished to have the early literature listed as fully as possible, it will be necessary to consult MUELL. ARG.'s monograph; the references to the monograph found in the present revision point to that source.

MUELL. ARG.'s monograph presumably was published in the second half of 1857 although the preface is dated 'janvier 1857'. Its presentation to the jury at Geneva in June 1856 cannot be accepted as the date of publication (cf. MUELL. ARG., Mon. Rés., p. 4). It appears that MUELL. ARG. published the description of a new species (*'Reseda praetervisa'*) at the end of his Monograph. This was based on specimens cultivated in the Geneva Botanical Garden in 1857 (cf. pp. 232, 234). It follows that MUELL. ARG. can only have made the description in the second half of the year. The addition of the description to the monograph was only possible if the book appeared in the second half of 1857. It is a fortunate coincidence that, even if for nomenclatural purposes the earlier date (June 1856) would be accepted, no name changes are involved for priority reasons.

MUELL. ARG. appears not to have stated exactly what ranks were occupied by the infraspecific taxa adopted by him, and which he provided with various signs

while being named for the first time. After a comparison of his classifications within the species, it was thought best to accept MUELL. ARG.'s infraspecific taxa marked by a Greek letter (α, β, γ etc.) as varieties, when marked by a letter in italics as forma (*a*, *b*, *c*, etc.) and when marked by a doubled Greek letter as a subforma (αα, ββ, etc.).

In order to identify the obviously closely related and usually rather variable species of *Resedaceae*, it is often necessary to study complete specimens (flowers and mature fruits). It is, nevertheless, sometimes also possible to name specimens which lack either flowers or fruits, but an inexperienced user of the keys or descriptions is cautioned because considerable changes in the appearance of fruit or seeds may occur during development and ripening. Especially the seed – which often shows guiding characteristics in the testa – ought to be fully ripe in order to be judged.

It appears that the colour of the flower may change in the process of drying. Only when flowers without exception are found to be white in dried specimens, they can be accepted as 'white'. If dried specimens are not clearly white-flowered, the colour of the fresh flower may be yellow, ochraceous, cream or, also, white.

Boiling and carefully dissecting some flowers is usually necessary, although after numerous identifications the habit of many species becomes familiar and identification often possible at first sight. However, a critical identification requires dissection, accompanied by a considerable magnification of several organs, and a careful observation of numerous characters.

To keep the citation of examined specimens within reasonable limits it was decided:

*a.* to cite type material (indicating if not seen, 'n.v.').

*b.* to cite only illustrative specimens of common, widespread taxa, while selecting material of different parts of its area of distribution, and to cite of rarer taxa all examined specimens. The specimens are arranged alphabetically to the collector's names.

*c.* to add a list of specimens examined at the end of the revision. This index only lists the collector's names and numbers, the identity of their specimens, and the herbaria where they are preserved. By omitting specimens bearing no collector's number the index was reduced at least two thirds in length.

*d.* the specimens cited are arranged according to country (finding locality). The countries are arranged alphabetically. It was found advantageous to cite islands of some size separately, in the same way as a country.

Ecological notes and further data were mainly derived from the collector's labels; those data are not found in the collector's index. In this way it was avoided to add almost endless lists of examined specimens to a number of common species, while on the other hand, every species is accompanied by a sufficiency of cited specimens and factual data. Also a general outline of the distribution is

so obtained where it was not feasible to draw a map because the natural distribution was obscured by dispersal as a weed.

Cultivated specimens, either as an ornamental or in botanical gardens, are only cited if they are authentic or type material. Several hundreds of specimens were identified, and are labeled and preserved in various herbaria as a result of the present research, but not cited, because they were anonymously collected, of uncertain origin, or for other reasons.

In particular I wish to acknowledge gratefully the ready assistance and hospitality extended to me at the British Museum (Nat. Hist., Bot., and the Library at Bloomsbury), the Royal Botanic Gardens, Kew, and at the Linnean Society in London. Repeated requests for the loan of specimens were, for various reasons, not successful at Barcelona, Baghdad, and Montpellier. The kind help of various nature, and willingness to forward specimens on loan by the directors of the undermentioned institutes and herbaria, is deeply appreciated.

AAR : Herbarium Aaron Aaronsohn, P.O.B. 20, Zikhron Ya'aqov, Israel (Palestine).
AMD : Hugo de Vries-Laboratories, Hortus Botanicus, Amsterdam, Netherlands.
ANK : Ankara Üniversitesi Fen Fakültesi Botanik Enstitüsü, Ankara, Turkey.
B : Botanisches Museum, Königin Luise Strasse 6–8, Berlin-Dahlem, Germany.
BAK : Botanical Institute (Systematic Div.), Acad. Sci., Baku, Azerbaijan S.S.R., U.S.S.R.
BAS : Botanisches Institut der Univ. Basel, Basel, Switzerland.
BEGO : Beth Gordon, (A. D. Gordon Agric. Nat. Study Inst.), Deganya, Israel (Palestine).
BLAT : Blatter Herbarium, St. Xavier's College, Fort, Bombay I, India.
BM : British Museum (Nat. Hist.), Bot. Dept., Cromwell Rd, London SW 7, Gr. Britain.
BOL : Bolus Herbarium, Univ. Cape Town, Rondebosch, Cape Town, Rep. South-Africa.
BP : Museum of Nat. Hist., Dept. of Bot., Budapest, Hungary.
BR : Jardin Bot. de l'Etat, 236 rue Royale, Bruxelles 3, Belgium.
BRNM: Moravian Museum, Bot. Dept., Preslova 1, Brno, Czechoslovakia.
BRNU: Herbarium of J. E. Purkyně Univ., Bot. Inst., 2 Kotlářska, Brno, Czechoslovakia.
BUC : Inst. Botanic al Univ. C.I. Parhon, Sos. Cotrocení 32 (Grad. Bot.), Bucuresti, Roumania.
C : Bot. Mus. and Herbarium, Gothersgade 130, Copenhagen, Denmark.
CAI : Cairo Univ., Fac. Sci., Dept. Bot., Giza, Cairo, Egypt, U.A.R.
CAIM : Agric. Museum, Herbarium, Min. Agr., Dokki, Giza, Cairo, Egypt, U.A.R.
CN : Lab. Botanique, Fac. Sci., Univ. Caen, Calvados, France.
COI : Bot. Inst., Univ. Coimbra, Coimbra, Portugal.
CORD: Mus. Botanico, Fac. Cienc., Avda Vélez Sarsfield 249, Córdoba, Argentina.
DD : For. Res. Inst. Coll., Dehra Dun, U.P., India.
DR : Inst. Bot. Techn. Univ. Dresden, Zellescher Weg 40, Dresden A 20, Germany.
DS : Nat. Hist. Mus. Stanford Univ., Dudley Herb., Stanford, California, U.S.A.
E : Herbarium Royal Botanic Garden, Edinburgh, Scotland, Gr. Britain.
EA : The East African Herbarium P.O.B. 5166, Nairobi, Kenya.
F : Chicago Nat. Hist. Mus., Roosevelt Rd and Lake Shore Drive, Chicago 5, Illinois, U.S.A.
FI : Herb. Univ. Flor., Ist. Bot., Via Lamarmora 4, Firenze, Italy.
FR : Forschungsinst. u. Naturmuseum Senckenberg, Senckenberg-Anlage 25, Frankfurt a. M., Germany.
G : Cons. Jard. botan., 192 route de Lausanne, Genève, Switzerland.
GAT : Inst. Kulturpflanz.f., Gatersleben, Kr. Aschersleben, Germany.
GE : Ist. Ort. Bot. 'Hanbury' dell' Univ., Corso Dogali 1.C, Genova. Italy.
GH : Gray Herb., Harvard Univ., 22 Divinity Av., Cambridge 38, Mass., U.S.A.

GOET : Syst.-Geobot. Inst., Univ. Goettingen, Unt. Karsp. 2, Göttingen, Germany.
GRO : Dept. Syst. Bot., Bot. Laboratory, Gr. Rozenstraat 31, Univ. Groningen, Netherlands.
HAL : Bot. Inst. Martin Luther Univ. Halle-Wittenberg, Halle, (Saale), Germany.
HBG : Staatsinst. Allg. Bot., Jungiusstr. 6, Hamburg 36, Germany.
HUJ : Hebrew University, Dept. Botany, Jerusalem, Israel (Palestine).
ISTE : Farmakognozi Enstitüsü, Eczaci Okulu, Istanbul Univ., Istanbul, Turkey.
JE : Institut für Spezielle Botanik und Herb. Haussknecht, Jena, Germany.
K : Herbarium, Royal Bot. Gardens, Kew, Richmond, Surrey, Gr. Britain.
L : Rijksherbarium, Schelpenkade 6, Leiden, Netherlands.
LD : Bot. Museum, Lund, Sweden.
LE : Herb. of the Komarov Bot. Inst., Ac. Sci. U.S.S.R., Prof. Popovstr. 2, Leningrad P-22, U.S.S.R.
LINN : Herbarium Linn. Soc., Burlington House, Piccadilly, London, Gr. Britain.
MICH : Univ. Herb., Univ. of Michigan, Ann Arbor, Michigan, U.S.A.
MO : Missouri Bot. Garden, 2315 Tower Grove Ave, Saint Louis 10, Missouri, U.S.A.
NY : New York Bot. Garden, Bronx Park, New York 58, New York, U.S.A.
P : Mus. Nat. Hist. Nat., Phanérogamie, 16 rue Buffon, Paris V, France.
PAD : Ist. Orto Bot. dell' Univ., Via Orto Botanico 15, Padova, Italy.
PAV : Bot. Inst. of the Univ., P.O. Box 165, Pavia, Italy.
PH : Ac. Nat. Sci., Philadelphia 3, Pennsylvania, U.S.A.
POM : Herb. of Pomona Coll., Claremont, California, U.S.A.
PR : Bot. Dept. of the Nat. Mus., Praha, Czechoslovakia.
PRC : Univ. Carol. Fac. Biol. Sci. Cath., Nové Mêsto, Benátská 2, Praha 2, Czechoslovakia.
PRE : Bot. Res. Inst., Nat. Herb., 590 Vermeulen St., Pretoria, Rep. South-Africa.
RAB : Inst. Sci. Chérifien, Lab. Phanérogamie, Av. Biarnay, Rabat, Morocco.
RSA : Rancho Santa Ana Botanic. Garden, 1500 North Coll. Ave, Claremont, California, U.S.A.
S : Bot. Dept., Naturhist. Riksmus., Stockholm 50, Sweden.
SIM : Simon Hb, Benkenstr. 58, Basel, Switzerland.
STE : Dept. Plantkunde, Univ. Stellenbosch, Stellenbosch, Rep. South-Africa.
TEH : Nat. Hist. Mus. (Muzeyeh oloomeh Tabi-i), Univ. of Teheran, Khiyatan Sepah, Teheran, Iran.
TEX : Herb. Univ. of Texas, Austin 12, Texas, U.S.A.
U : Bot. Museum and Herb., Lange Nieuwstraat 106, Utrecht, Netherlands.
UC : Herb. Univ. California, Dept. Bot., Berkeley 4, California, U.S.A.
UPS : Inst. Syst. Bot., Univ. of Uppsala, P.O.Box 123, Uppsala 1, Sweden.
US : U.S. Nat. Mus., Dept. Bot., Smithsonian Inst., Washington D.C., U.S.A.
W : Naturhist. Mus., Burgring 7, Wien I, Austria.
WAG : Lab. Plant Taxon. -Geogr., Gen. Foulkesweg 37, Wageningen, Netherlands.
WRSL: Inst. Bot., Univ. Wroclawskiego, ul. Kanonia 618, Wroclaw, Poland.
WU : Bot. Inst., Univ. Wien, Rennweg 14, Wien III, Austria.
Z : Bot. Gart. Inst. Syst. Bot., Univ. Zürich, Pelikanstr. 40, Zürich, Switzerland.

# GENERAL PART

## THE FAMILY RESEDACEAE

> Vix datur ullum genus, determinando characteri, difficilius. Ludit enim numero et figura in diversis speciebus.
>
> Linnaeus, Gen. Pl. 1754, p. 207 (comment on the genus *Reseda*).

### HISTORY

The family name *Resedaceae* is to be dated 1821 (S. F. GRAY, Nat. Arr. Br. Pl. 2, 1821, p. 665; cf. BULLOCK *in* Taxon 7, 1958, p. 28, et l.c. 8, 1959, p. 196). It is based on the generic name *Reseda* L. LINNAEUS adopted the name *Reseda* for a number of species, among which one was said to be named *Reseda* by PLINY. Probably PLINY had another, non-resedaceous plant (in the Linnean concept) in mind. It ought to be noted that LINNAEUS's interpretation was not rash, or indifferent to PLINY's intention, but rather maintained what had become usage in older botanical literature. C. BAUHIN undoubtedly had a resedaceous taxon (in the modern sense) in mind (Pinax Theatr. Bot. 1623, p. 99) while referring in connection with '*Reseda*' to PLINY (Hist. nat., lib. 28, cap. 12), and so had LOBEL (Stirp. hist. 1581, p. 110), J. BAUHIN (Hist. pl. 1651, p. 465), TOURNEFORT (Elem. 1, 1694, p. 336), MORISON (Pl. hist. 3, 1699, p. 615), TOURNEFORT (Inst. 1719, p. 424), and many other early authors.

That PLINIUS's *Reseda* was some other plant is probable, e.g. because all later authors prove to be unable to discover the medical virtue of healing swellings and inflammations ascribed to 'Reseda'.

PARKINSON for example has several resedaceous taxa (Theat. Bot. 1640, p. 822–823), among which one believes to recognize *R. lutea*, *R. alba*, and *R. phyteuma* ('*R. affinis Phyteuma Monspeliensium dicta*, Loves plant of Mompelier'). By his comment it is made apparent that already in his day confusion regarding their specific identity prevailed. He noted: '*Reseda in Latine a sedandis doloribus collectiones et inflammationes discutere nomen traxit:* for it has no Greeke name that I know: yet is thought by most to be that *Reseda* of PLINY which he saith grew about Ariminum'. PARKINSON concludes: 'None of our later authours have mentioned any known properties, these plants are endued withall more than what may be gathered from the definition of the name which is to ease paines'. He also remarks on the taste of the plant, which might indicate, he suggests, some medical virtue.

DODOENS (Cruydtboeck, 4th ed., III, lib. XII, 1608, p. 690), discussed the identity of 'Groot Sesamoides', which had been also treated by DIOSCORIDES (*Sesamoeides mega*, lib. 4, cap. 152). He suggests that DIOSCORIDES never saw the plant and confused it with other species, and further states that recent authors believed that THEOPHRASTUS's 'Swert Niescruyt' is the same, because

it was named '*Sesamaceum*' or '*sesamoides*', which means a herb resembling *Sesamum*. THEOPHRASTUS had reported that those of Anticyra used the fruits of Niescruyt which resemble the fruits of *Sesamum*. Now DIOSCORIDES wrote that the inhabitants of Anticyra often referred to 'Niescruyt' or 'Groot Sesamoides' as '*Elleborus*'.

It were a futile effort to trace and identify which species most of the early pre-Linnean authors referred to: they themselves, surely, were hardly certain about their plants and their differences from allied taxa. It is, however, fascinating to observe in which manner the 'image' of our present-day *Resedaceae* gradually gains in shape and outline. The sound insight of C. BAUHIN placed *R.* in the vegetable system in a position, which proved to be tenable afterwards, in the light of a wealth of new data. THEOPHRASTUS, DIOSCORIDES, CLUSIUS, DODOENS, and others, not disposing of the methods and means for modern circumscription, were aware of the resemblance in the ovary of *Reseda, Veratrum* (Niescruyt), and *Helleborus*; all have star-like spreading carpel-tops and linear stigma's crowning the pluricarpellate ovary. A morphological pattern in the course of time is perceived and recognized by the early botanists who step by step established the morphological foundations governing Linnean and present-day taxonomy. Whether DIOSCORIDES had some clear knowledge of *Resedaceae* is, indeed, doubtful. His description, and the accompanying drawing of '*Sesamoeides mega*' may or may not represent *R. alba* or an allied taxon, and '*Sesamoeides leukon*' or '*S. mikron*' may perhaps represent *Sesamoides (Astrocarpus)* as it is now known; there is no telling (cf. DIOSC., Gr. Herbal, ed. GUNTHER 1934, p. 544–545).

In addition, DIOSCORIDES (cf. ed. GUNTHER, 1934) has some facts regarding '*Phuteuma*', but this author of the 1st century meant, possibly, to refer to some *Silene sp.* (l.c., p. 520), which was by 'some related to be good for a love medicine'. Although there is no reason to believe that by *Phuteuma* DIOSC. a resedaceous plant was indicated, the name became the epithet for the well-known *Reseda phyteuma* L., and the rumour of the love-potion is rarely forgotten by numerous early authors.

Nevertheless, resedaceous taxa are found in early literature, though often not identifiable as regards the species. A usual name is '*sesamoides*', combined with some epithet or phrase. It is to be noted that '*sesamoides*' and '*reseda*' are repeatedly mentioned around the beginning of the Christian era, but apparently escaped attention throughout the following centuries and the Middle-Ages.

ISIDORUS HISPALENSIS (6th cent.) or HILDEGARD VON BINGEN (11th century) appear to have no record of *Resedaceae*. In two '*Hortus Sanitatis*' compilations (15th cent.) more than 500 *spp.* are treated but there is, as it seems, no *Resedacea* among them (cf. FISCHER, Mittelalt. Pflzk. 1929, p. 82–94).

DODOENS (Cruydtboek, 4th ed., V, lib. XXIV, 1608, p. 1199) accepts '*Reseda*' as identical with '*Eruca*' (some Cruciferous plants) but to him it is exotic ('Vreemde Rakette, in Latijn *Eruca peregrina Italica vel Cantabrica*, oft oock *Reseda Plinii Neotericorum*'). It grows in Italy but also in Burgundy and even in the Netherlands where it is called 'Italian Raket'. A descriptive note makes it

reasonably certain that *R. alba* L. was referred to. He also discussed 'Wouwe' or '*Lutum*' (l.c. p. 118), which was sown in many places in the Netherlands, occurred also wild growing and further in Central Europe. Of earlier names he noted that PLINIUS (lib. 33, cap. 5) discussed this as *Lutea*, VITRUVIUS (lib. 7, cap. 14) as *Luteum*, and VIRGILIUS *Lutum* (Bucol. lib. 4). This name, DODOENS declared resulted that in Latin all objects having the same colour as produced by the plant *Lutum*, are said to be '*luteus*'.

DODOENS accepts '*lutum*' as the correct name, because VIRGILIUS has it, demonstrating the esteem for VIRGIL in the 17th century.

*Lutum* is 'nowadays', declared DODOENS, not used medicinally, but much in demand among dyers. They dye wool and cloth and linen, either yellow or green; the tissues to be dyed yellow must be very white and not tinged by any other colour. A beautiful green colour is obtained by treatment of blue tissues with *Lutum*. References are further made to 'Cleyn *Sesamoides* of CLUSIUS' and '*Ephemerum* of MATTHIOLUS'.

DODOENS (l.c. vol. III, cap. XII, p. 690–691) suggests that DIOSCORIDES never saw 'Groot *Sesamoides*', and that the early authors were confused about it. He is also unable to decide about its identity but arrives at the conclusion that it will occur in Greece. The name *Sesamoides* alludes to the seeds, which resemble those of *Sesamum*. The 'Groot *Sesamoides* van Salamanca' described by CLUSIUS, as reported by DODOENS, is most probably not resedaceous. It has opposite leaves, resembling *Olea*, and it is extremely bitter of taste, and slimy and this hardly characterizes *Reseda*. The 'Cleyn *Sesamoides*' (l.c., p. 691), *Sesamoides parvum*, is more like *Resedaceae*, it would seem, but again the seeds are said to be very bitter. *Sesamoides parvum Salamanticum* of CLUSIUS may well be *Sesamoides (Astrocarpus)* according to description. DODOENS copied CLUSIUS not very carefully. CLUSIUS's description (Rar. Pl. Hist. Lib. III, cap. iiii, 1601, p. 295–296) is well applicable to *Sesamoides* ORTEGA and is accompanied by a reasonably clear drawing.

C. BAUHIN undoubtedly referred to a resedaceous plant (Pinax Theat. Bot. 1623, p. 99) while quoting PLINY (lib. 28, cap. 12) but he is (like everybody after him) unable to establish by his own experience or observations the medical virtues of modern *Reseda*, ascribed to '*Reseda*' by the Ancients.

BAUHIN placed *Reseda* near '*Eruca*' (not identical!) on account of its taste and appearance; his view of an affinity to *Cruciferae* was supported by an abundance of more detailed evidence produced in later centuries.

J. RAY placed '*Reseda, Luteola* and *Phyteuma Monspeliensium*' together and *Viola* is in close affinity (Meth. Pl. 1682, p. 142). He referred '*Sesamoides parvum*' to *Compositae* (l.c., p. 73) and '*Sesamoides salamanticum*' is '*Lychnidis viscosae species*' (l.c., Index), altogether not an advance compared to what had been perceived before him, but interesting because of the approach to *Violaceae*.

LINNAEUS placed (Sp. Pl. 1753, p. 448–450) *Resedaceae* between *Euphorbia* and *Agrimonia*, a neighbourhood of *Euphorbia* being suggested again a century later for strange reasons (LINDLEY).

ADANSON (Fam. Pl. 2, 1763, p. 407) has the *Resedaceae* among the 'câpriers'

*(Capparidaceae)* and BATSCH (Tabl. aff. 1802, p. 57) allied to *Violaceae*. A. L. DE JUSSIEU among *Genera Capparidibus affinia* (Gen. Pl. 1789, p. 245).

REICHENBACH (Fl. Germ. Exc. 1833, p. 696) made no mention of a family *Resedaceae*, its taxa forming part of his *Tetradynamae* (a family including *Cruciferae*). As concerns the gynaecium, *Reseda* is comparable to *Argemone* and *Chelidonium* and as concerns the androecium: *Schizopetalum*. This classification reflects the current view of that time; partly it is in agreement with earlier authors, and partly it introduces the point of a possible affinity to *Papaveraceae*.

RAFINESQUE judged *Resedaceae* allied to *Papaveraceae* (Fl. Tel. 2, cent. IV, 1837 (1836), p. 92), to *Hypericum* and to *Portulaca*. He objected to relationship with *Capparidaceae*, as DE JUSSIEU had proposed (l.c. 3, cent. VII, 1837 (1836), p. 72).

MUELL. ARG. expressed the view (following 'l'illustre R. BROWN' (Obs. OUDNEY, DENH., CLAPP. 1826, p. 22)) that *Resedaceae* are most closely allied to *Capparidaceae*. He added that in particular he was decidedly opposed to consider *Euphorbiaceae* as allied. The resemblance of *Datisca* to *Resedaceae* is but superficial. MUELL. ARG. only finds a historical interest in AGARDH's opinion that relationship exists to *Delphinium* or *Ranunculaceae* (*in* Flora 1833, p. 113). Also, there is no natural affinity to *Tropaeolaceae* or *Onagraceae* (MARTIUS, Comp. reg. veg. 1835, p. 49). Supporting J. DE TRISTAN's discussion on the natural affinities of *Resedaceae* (*in* Ann. Mus. Hist. Nat. 18, 1811, p. 392–402) MUELL. ARG. reported that DE TRISTAN centred *Resedaceae* among *Capparidaceae*, *Passifloraceae*, and *Cistaceae*, while recognizing at the same time close affinity to *Violaceae* (l.c., p. 400); if the *Papaveraceae* and *Cruciferae* are added, we obtain the complete picture of families allied to *Resedaceae* (MUELL. ARG., Mon. Rés., 1857, p. 73, 92). It will be observed that this inserts the *Resedaceae* into the Order *Rhoeadales* in a very satisfactory way; it is the position *Resedaceae* are generally given till the present day.

BENTHAM and HOOKER (Gen. Pl. 1, 1862, p. 110–112) judged *Resedaceae* closely allied to *Capparidaceae; Cruciferae* and *Violaceae* they placed not far away, but they do not comment.

MUELL. ARG. maintained his evaluation of relationship in 1868 (*in* DC., Prodr. 16(2)), although he added that long ago its affinity was much in debate ('*olim valde vexata*', l.c., p. 549), a statement which is not subscribed to by the present author. On the contrary, it is most encouraging to observe how resedaceous affinity was divined by very early authors, and how their suggestions gained depth and strength, while occasionally it was tried to introduce other views (based on clever reasoning and observation) and how the subsequent differences in opinion confirmed, in our day, initial outlines.

Some notes on post-Muellerian publications may lead the history of the family in the vegetable system to the present; they add to and illustrate what has been discussed here.

BAILLON, while placing *Resedaceae* between *Cruciferae* and *Capparidaceae* gave a very readable and lucid review of morphology and other subjects (Hist. Pl. 3, 1872, p. 293–304).

EICHLER, referring to LINDLEY's view, who advocated affinity to *Euphorbiaceae* (cf. below, morphology of petals), mentioning T.S. RALPH's article (*in* Roy. Soc. Victoria 1865; Bot. Zeit. 1866, p. 173) judged it 'eine blosse Wunderlichkeit' (Blüthendiagr. 1878, p. 214). He further opposed a place between *Capparidaceae* and *Cruciferae* (l.c., p. 218); he even finds them not quite fitting in the 'Reihe *Rhoeadinae*', and they are, perhaps, he feels, better placed in *Cistiflorae*. However, the sum of available evidence may be seen as ultimately leading to the closest affinity to *Capparidaceae* and so he let *R.* remain aside that family and in *Rhoeadinae* (p. 218).

VAN TIEGHEM placed *Resedaceae* in close affinity to *Violaceae*, and also to *Capparidaceae* (Traité bot. 2nd ed. 2, 1891, p. 1623), the latter family being the link with *Cruciferae*.

HALLIER (*in* Arch. Néerl. ser. 2, 1, p. 156-157) suggested that *Capparidaceae* were ancestors to *Cruciferae* and *Resedaceae*, and declared *Papaveraceae* less allied. This conclusion (not the argument) of 1912, is fully supported by TAKHTAJAN in 1959 (Evol. Angiosp. p. 187, 205).

In 1935, *Resedaceae* are part of *Rhoeadales* in WETTSTEIN (Handb. Syst. Bot. 2, p. 727), aside *Cruciferae* and *Moringaceae*, but with clear relationship to *Capparidaceae*, in conformity with the opinion of HELLWIG (*in* ENGL. et PR., Nat. Pflz. fam. 1 ed., III(2), 1891, p. 239) and other cited authors.

BOLLE maintains this view in 1936 (l.c. 2nd ed., 17b, p. 679).

JOHANSEN made *Resedaceae* approach *Violaceae*, supporting and repeating SOUÈGES's view that the embryonal development of *R. luteola* is 'exactly the same' as that which prevails in the 'Onagrad Type' (Pl. Embry. 1950, p. 147). To the general taxonomist the taxa, alleged to have an onagraceous embryology appear to be a rather heterogeneous company (l.c., p. 109), and one may wonder whether the segregation of 'onagrad' development from cruciferous is sufficiently corroborated by other botanical disciplines.

ERDTMAN investigated the pollen of 8 species (4 genera) of *Resedaceae* and finds more or less resemblance to pollen grains of *Capparidaceae*, less in *Cruciferae* and *Violaceae* ('not so similar', Poll. morph. pl. tax. 1952, p. 375, 376).

LAWRENCE (Taxon. Vasc. Pl. 1951, p. 525), while documenting his conclusion, considered *R.* an 'undoubtedly phyletically advanced family within the order *(Rhoeadales)*, in agreement with ENGLER, RENDLE and BESSEY.' It is to be noted that RENDLE did not exactly make a statement of this nature (see below).

A. B. RENDLE placed *Resedaceae* 'somewhat apart from the other families' in *Rhoeadales* (Class. Fl. Pl. 2, repr. 1956, p. 189). Although the marked 'tetramery of *Capparidaceae*' is absent in *Resedaceae* (he said), the families are most nearly related, as shown by the 'parietal placentation, and the development of gynophore and an excentric disc, leading to median zygomorphy of the flower'.

METCALFE and CHALK summarized anatomical data of stem and leaves (Anat. Dic. 1, 1957, p. 95–97) and find that the stomata are ranunculaceous and not cruciferous, whereas the stem-anatomy suggests, first of all, affinity to *Cruciferae*. It may be observed that METCALFE and CHALK were only able to consider the stomata in ca. 5% of the cruciferous genera (and a still lower per-

centage of species) and so, perhaps, the difference in stomatal anatomy between ranunculaceous and cruciferous taxa might lessen after a much wider range of taxa in both families will have been studied.

HUTCHINSON raised the family *Resedaceae* to the rank of an Order *(Resedales)* which he placed aside *Cruciales*, an Order consisting of the family *Cruciferae* ('a large and completely climax family derived from the *Papaveraceae*'; cf. Fam. Fl. Pl. 2nd ed., 1, 1959, p. 117). While it may be felt that this elevation in rank would need some argument in support, HUTCHINSON makes no statement regarding relationship of *Violaceae* (another monotypic Order: *Violales*), or of *Capparidaceae*, which he attributed with a 'folded embryo', and which are, apparently, not related (Fam. Fl. Pl. 2nd ed., 1, 1959, p. 108).

DARNLEY GIBBS (in SWAIN, Chem. Pl. Taxonomy 1963, p. 67–68) pointed to HEGNAUER's earlier conclusions, and stated that various previous research-workers are agreed upon *Resedaceae* as a member of *Rhoeadales* as regards chemical evidence.

HEGNAUER (Chemotax. Pfl. 3, 1964, p. 606) finally confirmed that modern research supports the view that chemical data indicate that *Capparidaceae*, *Cruciferae*, *Resedaceae*, and *Moringaceae* are naturally allied (cf. TAKHTAJAN, Evol. Ang. 1959, p. 204, 205).

## HABIT

*Resedaceae* are herbs, often having a tendency to acquire a lignescent stem-base and upper part of the taproot, or shrubs. They vary between a few cm and more than 3 m in height, are upright or ascending (decumbent) and usually sparingly branched, the branches as a rule irregular and spreading. One taxon (in *Ochradenus*) may straggle or twine. The desert-genera *Ochradenus*, *Randonia* (and *Oligomeris*) are profusely (as a result of browsing?) branching shrubs and branches of *Ochradenus* may end like sharp thorns. The leaves of these taxa are often caducous and the green branches assume their assimilatory function.

Frequently, *R.* are annual or perennial herbs, producing a rosette from which the leafy stem rises; the radical rosette may be absent but the tendency for a rosulate arrangement be expressed in cauline leaf-arrangement (e.g. in *Ochradenus*). The flowers are arranged in terminal, spikelike inflorescences, white, yellow or greenish, a bright touch of colour often added by orange, or brick-red anthers.

In biennials, MUELL. ARG. observed (Mon. Rés., p. 15) that the stem of the first year dries in autumn on the root. During that season, or in the following spring, basal lateral branches develop. Sometimes, the stems of a biennial become decumbent, dry, and whither down to the root and in the third season new stems arise. MUELL. ARG. observed that among biennials some specimens may occur of a longer life-cycle. The present author judging from the appearance of numerous herbarium specimens wishes to stress MUELLER's suggestion that climatic and edaphic factors largely determine the length of the life-cycle of many *R.* although the duration of an individual plant is also a species charac-

teristic. The appearance of the herbarium specimens suggest that a general tendency to become perennial prevails.

Summarizing it may be said that most *R.* may become perennials. In the dry season stems and leaves whither and die but the subterraneous swollen (tap)-root may remain alive, often bearing some short stems (buds) or stolons which grow rapidly after the first rains. It is believed, and supported by some factual evidence, that in a species some (physiological) taxa may be annual and others are able to survive and become perennial (or biennial). Selections in *R. odorata* resulted in perennial ornamentals instead of the usually annually sown garden plants (cf. BOLLE, l.c., p. 675), it is alleged.

## ECOLOGY

*Resedaceae* are sun-loving plants of steppe, savanne, and desert. Their ecological potentialities are expressed by the most graphic data of a finding locality I ever came across: 'Death Valley, Furnace Creek Canyon, Funeral Mt.' (in California, cf. *Oligomeris linifolia*). Many *Resedaceae* can be seen as invaders of recently disturbed areas (occurring as weeds along roads, waste places, or in arable fields). The majority prefer medium altitudes, but are able to grow in the lowland and at considerable altitudes also. Some are confined to the high mountain zones (e.g. *R. glauca, R. complicata, R. virgata*), others are found on mountain plateau's (e.g. central Spain, Sinai, Turkey, Asia Minor, Ethiopia). Usually there is a preference for calcareous soils but rarely it would seem that a species can be classified as strictly calcicole. Some taxa may grow on saline soils.

*Reseda* is often seen e.g. in the vegetation of a pontic character in company with *Stipa,* or *Bromus erectus,* in the garigue of the Lower Pyrenées together with *Lavandula* and *Genista,* near the beach or on gravel banks of river beds, or in the *Argania*-association in western Morocco. *Oligomeris* forms part of the desert vegetation in some SW United States and Mexico, and of SW Africa. *Ochradenus* is a common desert shrub of Egypt, the Orient, and Arabia. *Randonia* characterizes a sub-association on gypsaceous, very arid habitats in the central northern Sahara.

## DISTRIBUTION

*Resedaceae* are a subtropical family of the northern hemisphere, which may penetrate into the tropics or the temperate zone. It is also indigenous in southwestern Africa, S and slightly N of the tropic of Capricorn. Centred round the Mediterranean, it extends through Asia Minor to the southern Caucasus and Caspian area, to the northwestern Deccan Peninsula, to Arabia and Socotra, to Egypt, Ethiopia, Somalia, Kenya, Uganda, West Tropical Africa, and the eastern Atlantic archipelago's. *Oligomeris* is a widespread genus in S Africa, Mediterranean and in the arid parts of Arizona, Nevada, California, Texas, and Mexico. In short, the distribution of the family largely corresponds with the pattern on Map 6, p. 22, in CROIZAT's Space, Time, and Form (1962) and the

analogous way in which two vicarious taxa in *Oleaceae* are distributed and two vicarious species of *Oligomeris*, is amazing. The spreading of some species of *Reseda* as weeds somewhat obscures the natural limits of the family. It is improbable that *R. lutea* is indigenous in Great Britain (as far north as Scotland), in the Netherlands and in northern Germany; *R. luteola*, an age-old dyer's plant also may or may not be indigenous in these latitudes. The specimens of *Reseda* found on the American continent or in S Africa are undoubtedly adventitious (see further notes to the genera).

## MORPHOLOGY

Root. The manner of development of the (diarch) root is similar to that in *Cruciferae*. There are 3 groups of initial cells. One is dermatogenous (epidermis and rootcap), a second produces the periblem, a third the plerom (cf. MORSTATT, Beitr. Kennt. Resed. *in* FÜNFSTÜCKS, Beitr. wiss. Bot. 5, 1903, p. 24–26, and BOLLE in ENGL. et PR. Nat. Pflz. fam. 2nd ed., 17b, 1936, p. 662).

There is a taproot, which may penetrate deeply, and frequently becomes woody. The root-system of *Reseda lutea* was pictured and described by KUTSCHERA (Wurzelatlas 1960, p. 316–318). VAN TIEGHEM and DOULIOT reported (*in* Bull. Soc. bot. France 35, 1888, p. 279) that a root-cap is present in some *Resedaceae*, but is absent in others, a peculiarity confirmed by ERIKSSON (*in* PRINGSHEIM, Jahrb. 11, 1878, p. 339, 431) and by MORSTATT (Beitr. Kenntn. Resed. 1903, p. 35).

Stem. The terete stem is, as a rule, longitudinally ribbed *(Reseda)*; the ribs seem to emerge gradually from the inner stem tissue (vascular?). They run over some distance on the stem surface, finally to continue in the decurrent leaf-base and decurrent leaf-midrib, suggesting concaulescence.

Especially in *Ochradenus*, a raised area on the main stem surrounds the insertion of a side-branch and this has its very base constricted in dried specimens which suggests that there may be juicy (glandular?) tissue girdling the beginning of a side-branch in fresh (growing) specimens.

In the centre the stem is pithy; the pith may disintegrate but in some species it is permanent and compact. For additional details on stem anatomy see MUELL. ARG. (Mon. Rés. 1857, p. 16–23) and METCALFE and CHALK (l.c.).

Stipuloid (basal) dents. Minute, conical dents, being placed laterally at the leaf-base, seem to be stipular. On the other hand, they may be interpreted as extremely reduced leaf-lobes, which view is supported by the presence of 2–4 stipuloid (on stem and leaf-edge) dents in various Spanish mountain species (cf. *R. glauca, R. complicata, R. gredensis*). An interpretation of the basal foliar dents as lobes (though reduced) would imply that *Reseda* has, morphologically, incised leaves only. A taxonomical description, for this morphological reason admitting incised leaves only, would become misleading because in many *Reseda*-species all, or part of, the leaves certainly seem entire. Only a careful in-

spection of the leaf-base reveals the presence of the minute dents, of which for descriptive convenience the cauline ones could be defined as 'stipules' (resembling and being situated in the manner of stipules). Because from a theroretical morphological point of view the stipule might ultimately be interpreted to be of foliar nature, 'stipule' as a descriptive term can be admitted.

As regards the concept that the stipuloid dents could be interpreted as reduced lobes, it is to be remarked that in the majority of species there is present one single pair. The pair of dents is remarkably constant in size though occurring in so many different taxa. It seems not probable that the reduction of one pair of lobes would be halted at exactly the same stage in numerous, otherwise clearly different, species and genera.

On the other hand, in a group of species, with entire (linear) leaves (e.g. *R. glauca, R. virgata*), there are more than one pair of dents and these vary irregularly in size. Here an interpretation of the serial teeth as reduced laminar lobes would seem natural. If a large number of well-developed leaf-lobes occurs there appears to be one single pair of dents, but now their size is extremely reduced (less than 1 mm).

In seedlings the cotyledons may or may not have the basal dents. It seems that all these facts do not warrant a conclusion whether the dents are stipular or laminal. Furthermore, there is a difference in durability: in many species the stipuloid dents persist till the death of the stem, in other species they drop much earlier. In addition, the dents are usually glandular and may produce a slimy liquid. MORSTATT finds a different structure in different species. They never contain vascular tissue.

MUELLER ARG. stated that the basal dents appear directly after the apex of the developing lamina and before any other lateral organ. He deduced that they are to be interpreted as the reduced uppermost (eldest) pair of lobes (MUELLER ARG., Mon. Rés., p. 24). BOLLE and TROLL prefer to accept the basal dents as stipules (in ENGL. et PR., Nat. Pflz. fam. 2nd ed., 17b, 1936, p. 661) but they suggest that the higher inserted teeth on the leaf-edge in species of the 'section' *Glaucoreseda* would represent reduced laminal lobes. TAKHTAJAN accepts the basal dents as (reduced) stipules (Evol. Angiosp. 1959, p. 61).

It seems not in place to decide here whether, morphologically, the dents in the majority of species are to be regarded as stipules or not; they are here described as 'basal dents'.

Leaf. According to MUELLER ARG. the phyllotaxis is 3/8 and 2/5 and the leaf-insertion not constant. The genetical spiral turns right to left (the observer being placed in the axis of the stem (Mon. Rés., p. 27).

The leaf blade is incised in various manners but compound leaves do not occur; the blade may be entire, crenate to ternately or pinnately (or rarely bipinnately) lobed. It is flat, sometimes crisped (on edge); the margin is never serrate. In principle the leaf is sessile, though sometimes a short petiole may be present because the decurrent blade narrows before reaching the leaf-base; one could use the descriptive term 'winged petiole' (and midrib) in many cases. The

lobes are asymmetrical (basiscopal) and decurrent; an assessment was made by TROLL (*in* Nov. Act. Leop. N.F. II, 3/4, 1935, p. 438).

The leaves are never quite succulent, although they are herbaceous and often juicy. They are green, greyish green to ashy or glaucous; in some species they may turn orange to light red or purple-grey. This discoloration seems to be correlated with drought.

It has been stated that the proximity of the veins in the lamina (webbing) is in relation to the growing-locality. *R. lutea* was found to be provided with 1160 mm length of veinlets in 1 sq. cm leaf, on dry sandy slopes. Plants in shadowed, moist places often had less than 200 mm per square cm (cf. BOLLE, l.c., p. 663, with reference to HABERLANDT, Phys. Pfl. 6th ed. 1924, p. 356).

Indumentum. Usually the epidermis is not smooth, because enlarged epidermal cells protrude, which results in 'blisters', or a 'scabrid' or 'muricate' surface. On emergences from the surface, often wide-lumened thick-walled, one-celled hairs are present (cf. METCALFE and CHALK, Anat. Dic. 1, 1957, p. 95). When dry, these hairs shrink, flatten and curl, but when moisture touches them, they regain their former shape, even in dead specimens. They were compared as to shape, to the finger of a glove, their tip being rounded (VOLKENS, l.c.). Enlarged mitriform epidermis cells may function as water-storage (BOLLE, l.c., p. 663).

Inflorescence. The flowers are subsessile or pedicelled, arranged in open or dense, terminal, simple or sparingly branched racemes, which usually are spicoid. A gradual or sudden change from leaf to bract may occur. Always each flower is subtended by a single-nerved, long-attenuate, acute bract. The bract is accompanied by basal dents (see above) in the manner of the stem-leaves. Often the bracts far exceed the flower-buds and the top of the young inflorescence is comose. MUELL. ARG. remarked that a change in phyllotaxis develops towards the top, the angle of divergence decreasing (Mon. Rés., p. 31). The pedicels have as many ribs as there are sepals, or twice as many.

Flower. The flowers are said to be homogamous or slightly protandrous; there is, however, a report that *R. glauca* has receptive stigma's before the anthers open. Many species need to be investigated on this point. Bisexual flowers are usual but monosexual flowers (or plants) occur, although the sexes are not strictly segregated (*Ochradenus, Oligomeris*).

The flowers most commonly are zygomorphic by a difference in size of the sepals, degree of development and shape (or position) of the petals, shape of the disc, and the position of the stamens. Isomerous flowers occur in *R. luteola*. The sequence of development of floral organs is centripetal.

Sepal. The oblong or triangular, herbaceous, persistent or deciduous sepals are free, or more rarely in the lower part connate (*Sesamoides*) or borne (being wide apart) by the fleshy disc (*Ochradenus*). They generally are white-margined. Sometimes 1–3 adaxial sepals are slightly larger than the other.

MUELL. ARG. observed that during floral ontogeny in *Reseda*, the 2 upper lateral sepals appear first, very soon followed by the superior sepal. After this, the lower lateral sepals develop, and finally the lowermost sepal. Only after the appearance of all sepals, the lateral and lower petals begin to develop.

MURBECK and HENNIG distinguish 2 whorls of 3 sepals. The development of 2 lateral sepals preceding the other, is 'usual' in flowers without bracteoles (EICHLER, HENNIG).

Petal. Rarely, the petals are completely absent or represented by one or more, ephemerous, minute squamulae *(Ochradenus)*. Sometimes they are flat, single-nerved and present in a varying number (1–5; *Oligomeris*). Most commonly there are 6, laciniate petals, either with an auricled claw or appendaged *(Reseda, Caylusea, Randonia, Sesamoides)*. *Randonia* has luxuriously developed petals (sometimes doubly appendaged). PAYER observed that the appendage begins its rapid growth only when the laciniae are already largely developed. It appears, he declared, to be only a kind of 'appendix' of the claw, similar to what is often seen on the claw of the petal in many *Caryophyllacées* (PAYER, Traité organ. comp.fl. 1857, p. 195).

The isomerous flower of *Reseda luteola* results from the abortion of the median adaxial sepal (of 5 sepals) and 4 petals (of 5) resulting from the fusion of a pair of adaxial petals (cf. BOLLE l.c., p. 666).

MUELLER ARG. (Mon. Rés., p. 39) pointed out that DE TRISTAN (Ann. Mus. Paris 18, 1811, p. 392) and GRENIER et GODRON (Flore France 1, 1848, p. 188) considered the appendage of the petal as the petal itself. This petal, then, would carry a number of laciniae, peltately and dorsally inserted. The presence, absence, and the course of the vessels clearly indicate, MUELLER concluded, that this concept of the petal is untenable.

Another reference made by MUELLER ARG. is to LINDLEY (Collect., 1822, p. 22) who interpreted the petals as neutre or sterile flowers; the dorsal laciniae then would represent staminodes, and these petaloid sterile flowers would surround an apetalous central flower, consisting of stamens and pistil. One of LINDLEY's arguments was that each supposedly sterile flower (petal) had, at base, an 'appendage'. The appendages, singly, would equal the fleshy disc surrounding the base of the fertile flower. The disc might represent, as a consequence, the calyx of the fertile flower and the appendages of the petals, accordingly, must be seen as (perianth) remnants of the sterile flowers (petals). R. BROWN (Obs. pl. OUDNEY, DENHAM, and CLAPPERTON 1826, p. 24) opposed LINDLEY's concept, no doubt for good reasons, however ingenious LINDLEY's view may have been. It deserves record that LINDLEY himself, later on, abandoned his previous theory (Veg. Kingd. 1846, p. 348, 356).

HENSLOW further proved the resedaceous flower to be simple, and not compound (*in* Transact. Cambridge Phil. Soc. 5 (1), 1833, tab. 5–9).

AUG. DE ST HILAIRE supposed the presence of two whorls of opposed petals; in both whorls the petals were obviously not connate (choripetalous) but the pairs of opposed petals, DE ST HILAIRE suggested, were fused, one being repre-

sented by the 'appendage' to the other (I Mém. Réséd. 1837, p. 5 seq., and cf. PAYER, Traité organ. végét. 1854, p. 194, 195, tab. 39, 40).

The research by BUCHENAU (*in* Bot. Zeit. 11, 1853, p. 363–370) and by PAYER (l.c.) however, preceded and agree to MUELLER ARG.'s concept: appendaged petals in a simple flower are characteristic of *Resedaceae* (Mon. Rés., p. 36–38); to be concluded: the appendage is a neogenous, acquired character of the petal. Sometimes the superior petals seem to possess a doubled limb, viz. a partly double row of laciniae.

It might be remarked here that the morphology of *Reseda* and allied genera is liable to lend support to the view that all lateral organs are homologous and phylloid. The shape of the foliage leaf, which is accompanied at or near its insertion by minute (ca. 0.5 mm long), conical dents (suggesting stipules) is reflected by the bracts.

In some species lower bracts gradually assume more and more the appearance of stem leaves (cf. *R. suffruticosa*), but always the bracts are, without exception, accompanied by minute dents, in a similar way, and of similar shape, as the foliage leaves.

It further may be observed that the shape of the petals is also easily comparable to that of the foliage leaf. The appendage (appendaged claw) of the petal seems of equal nature as the 'winged' basal part of the lamina or, eventually, the decurrent rims of the blade on petiole and stem. A question, not to be answered here, because a reply would necessitate a close morphological and anatomical study, comparatively and ontogenetically, is what is represented by the upper free transverse rim of the appendage (the limb nearly always being peltately attached to the appendaged claw). Is this rim neogenous, or could it be, perhaps, of stipular nature, comparable e.g. to the ligule in the grass-leaf (ARBER's concept) or, by another bold and not factually supported stretch of the imagination, be homologous to the stipuloid basal dents?

Disc. In the genus *Oligomeris* there is no evidence of a swollen receptacle, no 'disc'. In the genus *Reseda* a disc is present, rising above the insertion of sepals and petals, and surrounding the base of the whorl of filaments and the ovarial stipe; the base of the filaments (not the base of the ovarial stipe) are fused with it. This cylindric or infundibular disc widens somewhat towards the apex, where it becomes excentric, expanding at the posterior side to a fleshy, generally semilunate limb. This limb is often erose on edge and may produce nectar from an olive-coloured gland at the base of the staminal tube (in *Reseda*). MUELL. ARG. surveyed the several authors, who discussed the gland (cf. Mon. Rés., p. 44). He rejected the concept of AUG. DE ST HILAIRE (I Mém. Réséd., p. 9) that the disc can be seen as the sole free remnant of an hexamerous whorl of 'discs', which alternated with the petals. Five discs would have become obsolete. DE ST HILAIRE supported his view by the presence of 5 scales in '*R. canescens*' (= *Caylusea hexagyna*) which develop and merge to a 5-lobed 'limb' the lobes of which alternate with the petals.

In *Ochradenus* the torus appears to extend laterally, while being greatly

swollen, which results in that the sepals (and petals if present) are widely separated and placed on the outer wall of a fleshy, broadly expanded receptacle. This flower may (and was) described as perigynous. The flat disc may rise as a collar, surrounding the base of the whorl of filaments and then a 'doubled' disc is said to be present, one ('outer') dish-shaped, and the other inner disc approaching in shape the single disc in *Reseda*. In *Randonia* the doubled disc is present, the inner very much larger than the outer, becoming in the upper half membranous and deeply erose ('*corona parastaminalis*', MUELL. ARG.).

Stamens. The androecium consists of 3 to more than 40 stamens. In each taxon their number varies, but the variability remains between taxonomically significant limits.

In the early stages of development – immediately following the initial stage of the petals – the stamens often seem to be arranged in two alternating whorls. Sometimes, when there are 10 or less stamens, only one whorl appears to be represented, if very numerous, more than 2 whorls may be occupied; in *R. luteola* there are 3–4 whorls, all this according to PAYER's and to MUELLER ARG.'s observations. A subulate (sometimes locally) increased filament carries the anther; it is inserted dorsally and the anther is versatile.

The arrangement of the stamens in 1, 2 or 3 whorls often is uncertain. It seems that always the median back stamen is present and the oldest, at least in the genus *Reseda*.

These facts, dating from the first half of the 19th century and MUELL. ARG.'s work, were confirmed and added to by GOEBEL (1882) and by HENNIG (*in* Planta 9, 1930, p. 517–518) on *Reseda*. The first stamen to appear, the adaxial median one, only *seems* to be situated between the pair of superior petals; in reality it is inserted much above the level of insertion of the petals, on the raised axis (disc) and so are the subsequent stamens (HENNIG, l.c.). Being situated on, and inserted in, the disc, they do not retain any arrangement in whorls relating to the perianth. The arrangement of the stamens on the disc is related only to the space that happens to be available during development. Alternation if recognizably present, is accidental. To HENNIG, the floral diagrams by EICHLER and by MORSTATT are unacceptable; 'dedoublement', though often assumed to be present in *Resedaceae*, HENNIG assumes, is not found in that family. HENNIG calls attention to the fact that the vascular bundle for the stamen appears considerably later than the filament, which supports the concept of a derived station (arrangement).

The anther is at first quadrilocular (PETERMANN, Deutschl. Fl. 1849, tab. 12, fig. 89, g; MUELL. ARG., Mon. Rés. 1857, tab. IV, fig. 51) but soon the tissue of the sept between the pairs of loculi is changed into pollen (each cell producing one tetrade), and the anther becomes bilocular. The mature anthers open by a longitudinal fissure, appearing exactly where the sept previously was situated (when the anther was 4-locular). One could say that the anther splits laterally and not, when described as it may seem, introrsely. It is often seen that the fissure starts from an apical pore. The anther is ellipsoid to subglobular,

cordate at base, rounded at the apex and the filaments curve when the moment of splitting approaches; DE ST HILAIRE's description of the movement of the stamens (I Mém. Réséd. 1837, p. 15) was much improved upon by HENNIG (*in* Planta 9, 1930, p. 522–525).

After the development of the anther, the filament appears. It lengthens considerably when the flower opens. One-sided filamental growth causes all stamens to curve downwards (l.c., p. 522); some all-sided growth now results in additional length of the filament. While the anthers (thecae) split, the filaments straighten and may even curve reversely. The hindmost stamens straighten (and recurve) first and their anthers may be emptied when the foremost stamens start straightening. The curving phenomena of the filaments are influenced by the direction of gravitation (HENNIG, l.c., p. 522–525).

From the apex of the filaments grows the connective. The loculi (thecae) develop basally and lengthen downwards which results that the filaments become inserted at about the middle of the anther (HENNIG, l.c., p. 525). The young anther clasps the apex of the filaments by two posterior ridglets. When maturity approaches, the ridglets shrink and the filamental apex is released. The mature anther turns and becomes directed by 90° to the length-axis of the filament. Drying and shrinking of the filament-apex fixes this position (cf. HENNIG, l.c., p. 525, p. 526, fig. 24/I, 24/II, 25, 26).

When the stamens are free, they are nearly always early shed; when connate at base, they are persistent but a sharp demarcation between these conditions is not always feasible. If a disc is present in the flower, it might be argued that, with the exception of *Reseda luteola*, the filaments are never quite free, but for descriptive purposes it is preferable to say that the stamens are free, when not connate above the apex of the disc.

Pollen. The abundant pollen grains are pallid yellow, ellipsoid, and are produced in tetraeders. They show 3 symmetrical, rather deep grooves and a very delicately reticulate exine (cf. MUELL. ARG., and H. FISHER *ex* BOLLE l.c., p. 667). In general they are 20–25 (12–40 μ) long (MUELL. ARG.: ca. 1/50 mm) and slightly sticky. They seem to be similar throughout the family though differing in size and in the relation length-width. MUELL. ARG. declared that the pollen contents escape by a slit in one or more of the grooves; there are no pores. ERDTMAN cited a number of literature references (Pollen morph. pl. tax. 1952, p. 375–376) and investigated 8 species (4 genera), citing herbarium specimens. He finds pollen grains in *Capparidaceae* which resemble those in *Resedaceae* more or less, whereas the grains of *Cruciferae* and *Violaceae* are not so similar. The pollen is 3-colpate, axis 18–35 μ and the surface is finely reticulate.

Ovary. When the (second) whorl of stamens is nearly completed, a papilla from the centre of the receptacle has reached its full length. It can be described as an ovarial stipe which represents a gynophore. The very short staminal tube surrounds the gynophore but is not fused with it, except in cases when the disc narrows basally when an extremely short androgynophore may result. From

this apex the walls of the ovary (carpels) appear and develop. In the descriptions following below the ovary or fruit is only said to be stipitate when a free part of the stipe is visible above the disc.

The gynoecium consists of 2–7, usually 3–4 partly (one third to almost entirely) connate, or eventually free *(Sesamoides)* carpels. The placentas are on the suturas of the joined carpels, visible at the outside of the ovarial walls (ovary one-chambered) as 'ribs'. A distinct style is absent; the stigmatic tissue is on the inner surface, usually only the upper part, and on the top of the ovarial teeth. The apical edges of the carpels do not fuse and with very few exceptions the ovary is not fully closed above; the ripe fruit usually gapes widely.

MUELL. ARG. described the placenta as parietal; length-wise they occupy the inner corners of the angular, single-chambered ovary, and they alternate with the ovarial teeth. In the subgenus *Glaucoreseda* the apical part is forked and each branch penetrates into an ovarial 'tooth'.

DE TRISTAN (*in* Ann. Mus. 18, 1811, p. 392) believed the ovary of *Reseda* composed of 3(4) carpels on which the longitudinal median nerve (midrib) bears the placenta. The apex of the carpel is bilobed and one lobe of each of a pair of adjacent carpels join with the neighbouring lobe; together the pair of lobes (a left lobe of one carpel joining the right lobe of the adjacent carpel) form one ovarial tooth (cf. ST HILAIRE, II Mém. Réséd. 1837).

For ontogenetical reasons MUELL. ARG. strongly opposed that view. He declared that a leaf (carpel) which would prolong its lateral parts and of which the centre would stay behind is 'without example'. It might be observed, however, that afterwards this concept was not generally rejected, e.g. to explain the *Bauhinia*-leaf (although there is also a theory explaining the bilobed *Bauhinia*-leaf as a marginal fusion of two leaflets), and the leaf of *Liriodendron* (cf. also ARBER, Monocot. 1925, grass-ligule). In some species of *Reseda*, it may be added, the leaves show a bilobed (forked) top.

MUELLER ARG. finds it difficult to accept a median placentation while the placenta (in the species with furcate placenta) would become laminar in its upper part (branches of the apical fork). He concluded that if the placentation is accepted morphologically as marginal, the structure of the ovary and its placentation becomes readily understandable. A final point MUELL. ARG. observes in the frequent presence of papillae on the margins of the leaves (sepals, bracts), which are commonly found on the (outside) edges of the ovary, as a kind of counterpart following the rows of ovules on the placenta inside the ovary. This line of argument, it is felt by the present author, may perhaps serve to indicate a zone of carpellate fusion but is weakened by MUELLER's remark that the papillae 'resemble aborted ovules'. The suggestion that the papillae on the exterior ovarial wall somehow would be homologous to ovules is very difficult to accept. Papillae may be present on the disc, often on the testa, both on the lamina and on the stem, in brief, they are erratic epidermal outgrowths, which may tend to show some arrangement, e.g. along nerves, on edges of organs. MUELL. ARG., of course, was unaware of the concepts and the suggested origin of ovules in the 'new morphology' of our days.

Papillae can be present in any amount or in any position on the ovary. The occurrence of denticulate or papillate ovary-edges proves or disproves nothing as concerns the placentation on the carpels.

Some evidence, perhaps, is found in teratologous ovaries studied by HENSLOW (*in* Transact. Cambr. Phil. Soc. 5(1), 1835 (1833), tab. II, fig. 30), also reported by MUELL. ARG. In deformed ovaries of *Reseda odorata* appeared 3 free leaf-like carpels (accompanied by the basal dents!), which showed marginal placentation. ARBER (STUD. Fl. Struct. *in* Ann. Bot. N.S. 6, 1942, p. 46) declared 'the gynaeceum is one of the most familiar examples of a gynaeceum with several carpels joined edge to edge.' While she discussed the relation between paracarpous *(Reseda)* and syncarpous ovaries, and listed important literature on the subject, she demonstrated the parietal placentation of the resedaceous ovary as being marginal in character. Obviously, this leads to the conclusion that each ovarial tooth is the involute apex of one carpel, and not the fused apical parts of adjacent carpels, which follows from the view of DE TRISTAN.

MUELL. ARG. noted that the ovules are campylotropous, bitegmic. They are in 2 to 4(5) rows, rather constant in number in each taxon, and a considerable percentage fails to develop and produce a viable seed. VAN TIEGHEM remarked that in *Reseda*, rather exceptionally, the outer integument develops before the inner (Traité bot. 2nd ed., 2, 1891, p. 901).

Capsule. MUELL. ARG. observed that before fertilization the outside ovarial ribs are in between the placentas; after fertilization the reverse position comes into being. The upper edges of the gaping ovary (in *Reseda*) as a rule withdraw and the ripe capsule gapes widely ('coilocarpium' *sensu* REICHENBACH).

The capsular wall is chartaceous to crustaceous; in *Ochradenus* the wall may become succulent, fleshy, and the capsule seems a berry *(bacca)*, is 'baccoid'.

The resemblance of the wall-anatomy of the capsule to that of a leaf was noted by MUELL. ARG. (l.c., p. 51). In several spp. it appears that specimens with long or with short capsules occur; otherwise they are similar. Brachycarpous specimens are less common than macrocarpous (cf. *R. stricta*, *R. muricata* etc.).

In *Reseda* subg. *Stefaninia* the capsular wall is membranous like in *Ochradenus ochradeni*. The seeds escape after it is torn (wind?, drought?). The empty carpidia of *Caylusea* are open lengthwise; when mature the carpel spreads and flattens and exposes the seed(s) resting on the axial part. In *Sesamoides* the capsule splits transversely across the single, dorsally attached, seed.

Seed. The seeds are reniform (or hippocrepiform), not much varying in shape. The appearance and size of the fully mature seed is of much taxonomical significance.

The testa consists of an outermost (upper) tissue of thick-walled cells (basal walls thinnest). The second (inner) layer is bordered by an upper layer of very thick-walled, ligneous cells. The second layer determines the appearance of the

seed-surface in the ripe seed. It is usually black, often with a greenish or reddish hue, sometimes dark brown. The colourless outermost testa-epidermis is at full maturity only visible after considerable magnification and with difficulty, in some cases (e.g. section *Phyteuma* in *Reseda)* it is tardily detaching, scaling, and so easier visible.

NETOLITZKY discussed the testa and seed anatomy and gave some rather crude figures (in LINSBAUER, Handb. Pflz. anat. II (2), vol. 10, 1926, p. 144–145, fig., lit.!). He concluded that there exists a striking resemblance to *Papaveraceae*, and *P.* may be more primitive than *Resedaceae*. The anatomy of the seed in *Capparidaceae* and *Moringaceae* is easily derived from that in *Resedaceae*, he suggested; *Violaceae* are also in close reach.

NETOLITZKY proposed to distinguish testa's which have an epidermis of which the cell-lumen is centrifugally reduced (cell-walls increased at the top and upper corners but downwards, bottom-wall and lower side walls, remaining thin) as a 'Resedaceentypus'. This kind of cell-wall in the testa occurs mainly in *Choripetalae* (cf. l.c., p. 11).

Below the second layer of the testa, a most delicately striped, colourless pellicle (cells 'tracheal') may surround the embryo: this resembles endosperm, but actually is a remnant of the inner integument and so not to be confused with genuine endosperm. It can be described as 'a third layer' of the testa. MUELL. ARG. defined this layer as the final stage of the inner integument of the ovule, and denied the presence of true endosperm in the mature seed (cf. GAERTNER, Fruct. Sem. Pl. 1, 1785, p. 368, tab. 76; MUELL. ARG. Mon. Rés. 1857, p. 59–60 and HENNIG *in* Planta 9, 1930, p. 530–534). Anatomical studies by ORR (*in* Notes Roy. Bot. Garden, Edinburgh 1921, p. 249–257, 259–260, plate 168) demonstrated the striking similarity between the third (inner) layer of the testa (so described by BAILLON, Hist. Pl. 3, 1874, p. 296) of *Reseda* and the *Cleomeae* in *Capparidaceae*. This layer is termed 'perisperm' in the present revision.

HENNIG (*in* Planta, 1930, p. 530–538) described the origin and presence of 'Nährgewebe', on top of the funicular vascular tissue, leading to the endosperm-like layer surrounding the embryo, and capping the cotyledons. It is here pointed out that a small bulge on the outside of the seed, especially distinct in some species of *Ochradenus*, in many taxa indicates the presence of this storage tissue (Nährgewebe).

Seemingly ripe capsules still may not contain fully mature seeds which are indispensable to judge the seed-characters. The sinus of the reniform seed (area of the hilum) may be so narrow as to be non-existent, a groove (the testa covering the apex of the radicle and of the cotyledons). It also occurs that the sinus is a narrow open gap or slit, or somewhat wider and filled by a light-coloured large-celled amorphous tissue, like an elaiosome or caruncula. This tissue may protrude from the sinus and was here described as carunculoid tissue (see below: Biology). Rarely the sinus is not more than a little notch in the reniform seed where a slight depression indicates the place of the sinus generally.

Embryo. The embryo is curved, the cotyledons incumbent, thick, smooth,

plano-convex. One cotyledon is slightly larger than the other. The radicle is very large and the plumula in the seed not differentiated.

Embryonal development begins by a 3-lobed (heartshaped) tissue (cf. MORSTATT, l.c., p. 36): the initials of the cotyledons and the radicle. Further development follows the cruciferous pattern, according to MORSTATT and to HENNIG (*in* Planta 9, 1930, p. 530–534), but SOUÈGES is of a different opinion (see below: Anatomical notes, and above, p. 10).

Seedling. Viable seeds (there seem to be, as a rule, a large percentage of dead seeds) germinate under favourable circumstances, after 3–10 days. The testa bursts at or near the hilum and the hypocotyl appears, lengthening rapidly. The primary root develops at the lower end; on top the hypocotyl bears the tardily shed testa, from which the cotyledons protrude and escape, turning from pinkish to green in the meantime. The smaller cotyledon is freed first (for more detail see notes to genera).

In *Reseda alba* the cotyledons have basal dents; in *Caylusea abyssinica* and in *Ochradenus baccatus* the dents are absent in the cotyledons but accompany the first leaves (also in *Reseda)*. They very strongly suggest to have some glandular function; in *Caylusea* they are provided with an extremely thin, crinkly hair (fig. 2, o) on top.

The first pair of leaves is simple, opposite, decussate to the cotyledons. The root of *Reseda* is diarch (cf. BOLLE, l.c., p. 662, also for lit.); root hairs ± distichous.

## BIOLOGY

In *Reseda* generally, nectar is excreted on the lower surface of the disc extension. This assembles in a kind of cup-shaped container formed by the appendaged petal-claws, a fact already reported by LINNAEUS (Hort. Ups. 1748, p. 150).

Short-snouted bees are the usual visitors and pollinators. *Dipterae*, other *Hymenopterae*, *Coleopterae*, and *Lepidopterae* may be seen to visit the flowers but seem to contribute little to pollination. During flowering the stamens change their direction (see notes sub Stamens and sub *R. phyteuma*). The filaments which are curved downwards stretch and straighten, one after the other, the higher preceding the lower. The opened anthers, by their position and direction promote that insect visitors become sprinkled with pollen (see notes above, on Stamens).

It is to be noted that a tendency to change direction is also found in the pedicels of many species, during flowering or more often subtending the growing fruit and also in the capsular stipe.

While the anthers open, they turn 90°, and from introrse become transversely directed (HENNIG *in* Planta 9, 1929, p. 522). The ovoid to ellipsoid anthers change colour before splitting (see also notes below on phytochemistry).

Cross-fertilization seems the rule; selfing succeeds in *R. odorata* and is said to fail in *R. lutea* (cf. HENNIG, l.c. p. 528). Hermaphrodite flowers are normal; rarely monosexual flowers are observed. In *R. odorata* monoecious, dioecious, and polygamous plants were found (COMPTON *in* New Phytol. 12, 1913, p. 197).

Plants in *Ochradenus* and *Oligomeris* often are polygamous.

SERNANDER observed (*in* K. Svenska Vet.-Akad. Handl. 41, 1906 p. 295–296, tab. 8) that in numerous species of *Reseda* the pedicels change direction during anthesis and until the fruit is ripe. Finally the rachis of the inflorescence becomes rigid and on erect pedicels the open capsules release the seeds when a strong wind shakes the stems (anemochorous; examples *R. alba*, *R. glauca*, *R. lutea*, *R. luteola*). In other species the ripe fruits point downwards and the seeds fall down from the gaping capsules; these species are myrmecochorous. Ants are attracted to, and carry away, the caruncula (elaiosome), SERNANDER declared (cf. HEGI (MARKGRAF), Fl. v. Mitteleuropa IV/I, 1958, p. 519).

Externally a mass of cells produced near hilum and micropyle may be present. This carunculoid tissue ('elaiosome') is a loose, whitish, irregularly massed amount of large, thin-walled cells containing oil, slime and calcium oxalate crystals; the surface cells burst easily and the tissue becomes slimy. This 'elaiosome' changes gradually into the adjacent testa. When transported the seed is liable to become slimy or sticky and earth-particles may adhere (SERNANDER). If this happens to produce some sort of layer covering the elaiosome, the ants may overlook the seed.

On the other hand it appears that this myrmecochory is not strict and the plant also may disperse simply by the seeds dropping from the nodding capsule (autochory).

It may be added to SERNANDER's observations, however interesting as they are, that the seeds in the pendent capsules he refers to, certainly all possess carunculoid tissue (*R. phyteuma* and its allies). One species even has seeds marked by a bright red-brown zone bordering this presumably ant-attracting tissue (*R. inodora*). Apart from SERNANDER's remarks, I met with no records of observed myrmecochory and it certainly is to be noted that the caruncle is best developed on the shiny black seed of *R. lutea* and its allies, which have stiffly erect capsules; a coincidence caruncle/pendent capsule/myrmecochory is not taxonomically or biologically significant; it is also not demonstrated that myrmecochory is of importance in the dispersal of *Resedaceae*.

Seeds germinate within 14 days, often much sooner. BOLLE reported (l.c., p. 674) that they remain viable during 3–4 years. In a few cases when the author could try the viability of the seeds it appeared that they certainly keep not much longer. There is no evidence that the longevity found in some weed seeds occurs in *Resedaceae*. It is possible that the percentage of viable seed is closely linked to reaching full maturity.

MUELL. ARG. reported (l.c.) a nucellar mass, which becomes more or less green at both ends and supplies the means of growth for the embryo. In the ripe seed only traces remain. He finally declared that in particular in species of the Canary Islands these cells appeared to be more durable, and so 'endospermic cells' might surround the embryo, resembling a perisperm (see also notes on seed).

The full-grown embryo may have a greenish tinge and contains oil drops (see below, phytochemistry). Vascular tissue is absent.

VAN TIEGHEM noted that the hypocotyl ('tigelle') is separated by a fold of the integument ('repli du tégument'), whereas in *Cruciferae* the hypocotyl is directly in touch with the cotyledons (Traité bot. 2 ed., 2, 1891, p. 1628). His meaning is not quite clear to me, but it may be intended to say that the incumbent, hippocrepiform shape of the resedaceous seed is not found in *Cruciferae*.

## ANATOMICAL AND ONTOGENETICAL NOTES

A detailed description of the ontogeny of the ovule may be consulted in MUELL. ARG.'s monograph (p. 55–57; see also VAN TIEGHEM, Traité bot. 2 ed., 2, 1891, p. 581). MUELL. ARG. points out that his observations differ widely from those of earlier anatomists (l.c., p. 57). Here is to be observed that ontogenetical research without the documentation of conserved herbarium specimens is of highly restricted value (cf. remarks below on cytological results (chromosomes)).

The mature ovule is covered by an outer integument, which is very easily detachable from, and is not fused or connate with, the subjacent layer of tissue. The raphe is vascular tissue of the placenta which expands apically and forms the olive-green chalaza. After fertilization the raphe develops a loosely knit mass of cells laterally, in the area of the micropyle. In the seed this mass of cells, if present, appears as a kind of caruncle (see above, Seed).

A more recent, richly illustrated study of ontogeny is of L. HENNIG's (*in* Planta 9, 1930, p. 530–538). HENNIG confirmed GUIGNARD's observation (*in* Compt. rend. Ac. Sci. Paris, 1900) that the egg-nucleus of *Reseda* is exceptionally small.

MUELL. ARG. recorded numerous anatomical data, and in particular furnished a detailed description of the anatomy in the developing stem.

SOUÈGES (Compt. rend. acad. sci. Paris 201, 2, 1935, p. 910) advocated the view that in *R. luteola* the embryonal development more closely resembled that of *Oenotheraceae* than of *Cruciferae* (see also above, Seed).

The stomata are provided with small closing cells; auxiliary cells are absent. Many species have equal numbers of stomata in the upper and lower surface of the leaf (e.g. *R. lutea* $\pm$ 60 per sq. mm according to MUELL. ARG.). Myrosin cells occur sometimes in association with the stomata, which are of the ranunculaceous kind (METCALFE and CHALK, Anat. Dic. 1, 1957, p. XV).

It was suggested that perhaps myrosin cells could be homologous with papaveraceous lactiferous cells (l.c., p. 87). Slime cells are frequent (HENNIG *in* Planta 9, 1930, p. 507).

## CYTOLOGY

A survey of cytological data was given by BOLLE (l.c.), which may be referred to for more data than are found here (see also above, anatomical and ontogenetical notes).

The ovule is crassinucellar; the embryosack is of the usual composition (8

nuclei) and fertilization porogamous. Double fertilization was demonstrated in *R. lutea* (cf. BOLLE, l.c., p. 672). HENNIG, while giving a detailed description of embryosac development and fertilization (*in* Planta 9, 1930, p. 530–534) showed that the endosperm is nuclear at first but it becomes celled and finally it practically disappears.

The chromosomes are very certainly in need of study. Only a few species were investigated so far. It is indispensable that specimens subjected to chromosome counts or studies, will be properly conserved in an institutional herbarium. Without this precaution any research into chromosomes of *Reseda* is bound to be of restricted value, if of any value at all.

| | | n | 2n |
|---|---|---|---|
| Oligomeris | linifolia[1] | 24 | |
| Randonia | africana[2] | | 30 |
| Reseda | alba | 10 | 20 |
| Reseda | arabica | 12 | |
| Reseda | complicata | | 28, 30 |
| Reseda | crystallina | | 24 |
| Reseda | diffusa | 24 | |
| Reseda | glauca | 10, 12, 14 | |
| Reseda | inodora | | 12 |
| Reseda | lanceolata | | 24 |
| Reseda | lutea | 24 | 48 |
| Reseda | luteola | | 24, 26, 28 |
| Reseda | media | 6 | |
| Reseda | odorata | 6 | 12, 14 |
| Reseda | phyteuma | | 12 |
| Reseda | scoparia[3] | | 30 |
| Reseda | stricta | | 48 |
| Reseda | suffruticosa[4] | 10 | |
| Reseda | villosa | 16 | |
| Reseda | virgata | | 28 |
| Sesamoides | canescens | | 20 |

It is to be noted that in most cases it was not possible to verify the chromosome counts by means of preserved herbarium specimens. In the Chromosome Atlas by DARLINGTON and WYLIE (2nd ed., 1955, p. 50) a number of data is reported, and LÖVE, ASKELL and LÖVE, DORIS (Opera bot., Lund, 5, 1961, p. 190–191) added to these. As the records did not include all available data, and since a few more counts were made after the publication of the above-mentioned compilations (which include lit. ref.) a new list is given above. EIGSTI suggested on account of the presence of 'capsella type' prochromosomes in *Reseda*, which are also known to occur in *Cruciferae*, affinity and phylogenetic relationship (*in* Bot. Gaz. 98, 1936, p. 368). His important conclusions are further referred to in the Notes to *Reseda* (see there). For other data see MALIK ([1]) (*in* Sci. and Cult. 25, 1960, p. 437), REESE ([2]) (Polyploidiesp. nordsah. Wüste *in* Flora 144, 1957, p. 607, lit.!), LARSEN ([3]) (*in* Biol. Skrift. K. Dansk Vidensk. Selsk. 11 (3), 1960, p. 8, 9, 49, 52, fig. 27, 28), and ([4]) A. GARDÉ and N. MALH.-GARDÉ (*in* Genetica Iberica 5, 1953, p. 118, 120, fig. 13) who investigated a specimen of

*R. suffruticosa* cultivated in Madrid Bot. Garden, but state that they believe that *R. alba* is identical. Finally, a paper by GORI deserves mentioning (*in* Caryologia X, 1957, p. 391, 401) who confirmed some counts and added details on cytology and embryosac development.

## PHYTOCHEMISTRY

Long cells of the root and stem of *Reseda* contain myrosin which is also found in the stomata of stem and leaf (see above). MUELL. ARG. declared that the cellulose of *Resedaceae* seemed to him of an exceptional nature ('une nature exceptionelle dans le règne végétal'; Mon. Rés. 1857, p. 14).

Calcium oxalate crystals were observed in the larger pith-cells of *R. odorata* and, generally, in the seeds (monocline crystals of primary calcium oxalate in the inner epidermal cells of the testa).

In tissue of *Reseda* a substance colouring yellow is present. MUELL. ARG. observed that water, in which fragments of *Reseda* were left standing, was yellow tinged after one or two days (l.c., p. 65). CHEVREUL isolated the substance and named it 'luteoline'; it consists of minute, needle-shaped, yellow, silky, glossy crystals.

*R. luteola* contains luteolin ($C_{15}H_{10}O_6 + 2H_2O$), a yellow dye, formerly of economic importance and widely used. It is accompanied by a low percentage of apigenin and occurs also in other *R.*-species e.g. *R. lutea*, possibly also in *Euphorbia cyparissias*, some *Leguminosae*, and in *Petroselinum* DC. (cf. WEHMER, Die Pflz. st. 2nd ed. 1, 1929, p. 418).

Essential oils, producing the characteristic scent of *R. odorata* may be extracted from the roots and from the flowers. The yellow oil from the flowers is not fluorescent, has a density of 0.961 at 15 °C, solidifies when cooled, smells very unpleasantly but becomes attractive if solved in very small concentration. The scent might partly be ascribed to phenylaethyl mustardoil (cf. BOLLE, p. 664). REINHARDT stated that 1 kg Geraniol ('Geraniumoil') were distilled with 500 kg fresh *Reseda*-flowers and the obtained Resedageraniol was brought into commerce (Kult. gesch.Nutzpflz. IV (2) 1911, p. 510; cf. HEGI (MARKGRAF) Fl. v. Mitteleuropa IV/1, 1963, p. 519).

The seeds of *R. luteola* contain 30% 'Reseda-seedoil' or 'wauöl' (german), which is described as a greenish, unpleasantly smelling, bitter, readily drying, fatty oil. In the embryo of *Resedaceae* in general, oil drops may be observed.

The root of *R. luteola*, when crushed, smells like horse-radish (*Armoracia lapathifolia* GILIB.). Some species turn orange-red (e.g. *R. lutea*, *R. phyteuma*, *R. odorata*, the apical part of the capsule of *R. inodora*). This discolouration of leaves, stems or fruits occurs at the end of the life-cycle. Field-observations indicate that drought promotes early and bright colouring. The colour is brought about by the change of chloroplasts into chromoplasts (rhodoxanthin, carotin, xanthophyll). Anthocyane is never present (see BOLLE, l.c. p. 664, also for lit. ref.).

HENNIG (*in* Planta 9, 1930, p. 550) reported 6,3 as the acidity (Azidität) for juice pressed from living plants.

The ashes of *Resedaceae* resemble ashes of *Cruciferae* in their high percentage of $SO_3$. Other similarities are in the presence of mustardoil (mustardoil glucosids), myrosin, and in the high percentage of fatty oil in the seed.

M. KUTAČEK demonstrated the presence of glucobrassicine – a forerunner of ascorbigen and many indolderivates, in '*Brassicaceae*', *Sisymbrium*, *Crepis*, *Resedaceae* and *Capparidaceae*. Glucobrassicine occurs mainly in young organs and is absent in seeds and dormant buds. This presence of glucobrassicine accentuates relationship between *Resedaceae*, *Cruciferae*, and *Capparidaceae*. This research was done in the Institute for Experimental Botany of the Czech Academy of Science, and probably so far is not published (cf. Stencilled report 88, Lab. Tuinbouwpl.t., Landbouwhogeschool, Wageningen). This research confirms and continues BLAGOWESTSCHENSKI's findings of 1955 (cf. TAKHTAJAN, Evol. Angiosp. 1959, p. 204, 205).

The young anther is orange. Towards and at maturity it turns yellow. The orange colour is caused by minute drops of carotine (or carotinoid rhodoxanthin?; KJAER, Progr. chem. org. nat. prod. 18, 1960, p. 122–176), in the endothecium, which disappear during pollen formation (HENNIG, *in* Planta 9, 1930, p. 527). This is usual but in *Reseda odorata* it is present not only in an exceptionally large quantity, but also appears to be more permanent.

For a discussion of various mustardoilderivates see WANNENMACHER in HEGI (MARKGRAF), Fl. v. Mitteleuropa IV/1, 1963, p. 508–514.

## PHYTOPATHOLOGY

A survey of facts and literature concerning diseases and parasites was given by BOLLE (l.c. p. 676–677). Of some interest is the occurrence on *Resedaceae* of a number of parasites common on *Cruciferae* (e.g. caterpillar of *Pieris brassicae* and other spp., and of *Phyllotreta*). A specimen of *Oligomeris linifolia*, examined in the course of this study, proved to suffer from the attack of *Albugo (Cystopus) candida* (HOOK.) O.K., the world-wide parasite in *Capsella* and other *Cruciferae*. In the roots or base of the stem the larvae of the snouted beetle *Baris paciformis* often lives (HENNIG, *in* Planta 9, 1930, p. 549). Physopods *(Thysanoptera)* are present on every inflorescence; early stages especially in young ovaries and in the tips of the carpels (HENNIG l.c.).

An interesting remark was made by MUELL. ARG. (l.c., p. 64) who declared that he never met with any herbarium specimen of *Resedaceae*, among the numerous specimens he examined, which had been attacked by insects. This is partly confirmed by the present author. Among many thousands of specimens, partly preserved under conditions not at all suitable to repel insects, only a few dozens had suffered from insect attack. The (allied) *Cruciferae*, on the other hand, are known among taxonomists as one of the families, which are readily attacked in herbaria by insects.

A monstrosity was described by G. HENSLOW (*in* Journ. Linn. Soc. Bot. 19, 1882, p. 214). He named it *Reseda odorata* var. *prolifera alba*, a name without status under the Code, of course. It was pictured on Plate 32 (l.c.) and resem-

bled 'the ordinary kind, only the flowers were doubled, forming little balls of minutely fringed petals'. Large panicles developed, over one foot in length, branching profusely with elegantly depressed branches. 'Every branch arises out of the centre of an abortive flower and occupies the place of the pistil. Occasionally two branches arise out of the same flower. In some cases a whorl of open, but coherent carpels is seen, showing that the branch originates from the middle of that whorl'. This plant cannot set seed, but has been 'readily propagated by cuttings'. These inflorescences are fragrant. A basketful was exhibited at the Roy. Hort. Soc. (1881). The same monstrosity was collected in Spain.

Another monstrosity, of which the petals, stamens, carpels and ovules assumed a more or less leaf-like character was described by J. S. HENSLOW (*in* Transact. Cambr. Phil. Soc. 5(1), 1835 (1833), p. 95–100, tab. 12). SCHIMPER (*in* Bot. Zeit. 1, 1829, p. 428) described a monstrosity.

In the course of examining specimens for the present revision proliferous monstrosities were observed in *Caylusea* and in *Reseda*, a large *Celosia*-like fasciation, carrying numerous buds and some flowers and fruits in *Ochradenus baccatus* (LUNT 141, Hadhramaut, K), and exceedingly lengthened ovaries (possibly due to insect attack) in specimens of *Reseda* and *Ochradenus* (fig. 8, f).

PENZIG (Pfz. teratol., 2nd ed, 2, 1921, p. 126–127) summarized all teratological forms of *Resedaceae*. HENNIG gave a further survey and discussion (*in* Planta 9, 1930, p. 542–548) of 'heteromorphosis, and of invirescences or malformations' (l.c., p. 551–563). She certainly was right to correct PENZIG, who considered basal (subterranean) shoots in 'annuals' as teratologous (l.c., p. 126, *R. lutea*), by explaining that numerous species of *Resedaceae* survive the dry or cold season just by this natural means, becoming biennial or perennial.

## ECONOMIC IMPORTANCE

Most *Reseda*-species may occur as weed but are never aggressive or noxious.

*R. luteola* was used for dyeing since time immemorial (see above, history and phytochemistry) and grown in Europe till well into the 19th century. It is possible that some local cultivation still persists (see also notes sub *R. luteola*).

It is reported that *R. phyteuma* and *R. alba* would be eaten locally as a vegetable, tasting somewhat like cabbage (BOLLE, l.c., p. 677). Greece is mentioned in particular but it is to be noted that cattle in NW Europe refuse *R.*; however, it occurs there, probably, as an introduced weed.

MUELL. ARG. (l.c., p. 64) and LAMARCK (in POIR., Encycl. Méth. Bot. 6, 1804, p. 161, concerns *R. lutea*), also noticed a taste like cabbage in *Reseda*, and they judged the taste and smell of the root like that in *Cruciferae*. Prof. DE WIT found the same taste in root and leaf of *R. suffruticosa* near Aranjuez but could scarcely perceive it in specimens of *R. alba* and *R. lutea* grown at Wageningen (see also above, phytochemistry).

*Oligomeris* and *Ochradenus*, possibly also *Randonia*, are of considerable value as a food for animals (camels, donkey's, goats etc.) under desert conditions.

Medical virtue was often ascribed to *Resedaceae*, probably without sufficient

ground. PLINY (Hist. Nat. lib. XXVII, cap. 12) stated: *Circa Ariminum nota est herba, quam Resedam vocant. Discutit collectiones inflammationesque omnes. Qui curant ea, addunt haec verba, Reseda morbos, reseda, scisne scisne quis hic pullos egerit? radices nec caput nec pedes habeant; haec ter dicunt, totiesque despuunt* (cf. RAY, Hist. Pl., 1688, p. 1053). POIRET (Hist. pl., 1825–1829, p. 194) was one of the first to point out that *Reseda sensu* PLINY presumably was quite another plant. There is no *Reseda* known which cures in the way described by PLINY, with or without verbal admonitions. The name '*reseda*', however, is to convey the thought of 'sedere', to becalm, to calm down, to 'recede'.

So, during centuries some *Reseda*-species were regarded as sedative, diaphoretic, and diuretic. *R. lutea* was known in german speaking countries as 'Harnkraut', very possibly because of its yellow flowers (signature theory; Harn = urine). MUELL. ARG. reviewed an array of historical data.

BOERHAAVE (Hist. pl. 1727, p. 333) declared: '*Vires sunt aperientes, radix contusa manibus febricantium saepe applicatur et in omnibus convenit cum Rubia*'. It would be interesting to know whether BOERHAAVE applied *Reseda* in medical practice and if so, to hear about his findings.

Often *R. lutea* was used as a diuretic but at the end of the 18th century its fame had vanished (ZWINGER, Theatr. 1774, p. 530). Ancient pharmaceutical names are *Radix et herba Luteolae* and *Radix Resedae* (KOSTELETZKY, Allgem. mediz. pharm. Flora 35, 1836, p. 1589; cf. MUELL. ARG. l.c., p. 64–65).

*Phyteuma*, as alluded to by DIOSCORIDES (1st century) was, he said, used by the Ancients in love potions. It is, certainly, not a *Reseda*. LINNAEUS described *Reseda phyteuma*. Now KOSTELETZKY seems to believe that *Reseda* was used as an aphrodisiac (l.c., p. 1590), and *e.g.* PARKINSON published a crude picture and description of 'Loves Plant of Mompelier' (Theatr. bot. 1640, p. 822, 823) which possibly represents *Reseda phyteuma* L. This is another example of the careless confusion accompanying *Reseda* till the middle of the 19th century. A trace of its repute is found in its present popular name (as a garden plant): 'mignonette'. FÉE declared that the *Resedaceae* hold no interest as medicinal plants (Cours hist. nat. pharm. 1, 1828, p. 475). On the other hand, CHIOVENDA found in Somalia that the chewn root of '*Reseda migiurtinorum*' was applied against snake bite (Fl. Somala 1929, p. 88). See also notes to *Ochradenus somalensis*.

Many *Reseda*'s have some fragrance; the smell is judged differently by different observers; it also varies according to species.

*R. alba* and *R. lutea*, if brought from the cool autumn air into a warm room, emit a strong scent, although they seem scentless in the open, at low temperature (DE WIT). The strongest scent is produced by *R. odorata*, which is cultivated both as an ornamental and as an oil-producer for cosmetics (S France); see also above, notes on phytochemistry, and below, notes to *Reseda odorata*.

**Description of the Resedaceae**

S.F. Gray, Nat. Arr. Brit. Pl. 2, 1821, p. 665, *nom. fam. cons.* (Code 1966, p. 222). For various further references on the family see: Muell. Arg., Mon. Rés. 1857, p. 37, 88; *id.* in DC., Prodr. 16(2), 1868, p. 548; Hellwig in Engl. et Pr., Nat. Pflz. fam. III(2), 1891, p. 237; F. Bolle in l.c., 2nd ed., 17b, 1936, p. 659; Lawrence, Taxon. Vasc. Pl. 1951, p. 524; Hegi, Fl. v. Mitteleuropa, 2nd ed. (Markgraf), 1963, p. 518–524 (pollen p. 526–527); Engler (Melchior), Syllabus II, 1964, p. 178, 189–192.

Herbs or (small) shrubs, annual or perennial or biennial. Taproot lignescent or not, usually widely branching and deeply penetrating, never tuberous. Young root diarch (root-hairs distichous).

*Stems* usually branching (branches irregular, often widely spreading), sometimes branching very densely (desert shrubs), erect, rarely ascendent, very rarely winding, terete though usually distinctly ribbed (decurrent leaf-edges and midrib), at base often lignescent, pithy (very often pith disintegrating), in some desert taxa ending in a sharp thorn.

*Leaves* herbaceous, rarely subsucculent, spirally inserted, simple though usually lobed or incised, margin entire, sometimes crisped, blade decurrent on the petiole (leaves seemingly sessile), lobes usually asymmetrical (proximal half wider), a minute basal dent ('stipuloid') on each side at the insertion of the leaf, sometimes one or more, irregular, subulate, colourless teeth in the lower half of the leaf on edge, midrib always winged in incised leaves, venation pinnate, veinlets webbed.

*Indumentum* often present, consisting of white, round-topped, fluffy, crinkly hairs, or represented by protruding epidermal cells (leaf-surface scabrid or blistered), rarely quite absent, in *Caylusea* mixed with acute, claw-shaped hairs.

*Inflorescence* terminal, racemose (spicoid), simple or branched.

*Flowers* zygomorphic, sometimes almost actinomorphic, solitary in the axil of a bract, without bracteoles, pedicelled or subsessile, bisexual, rarely monosexual, dioecious or polygamous, very rarely apetalous, hypogynous or rarely perigynous, white, yellow or cream, sometimes with some fragrance.

*Calyx* herbaceous, usually asymmetrical. Sepals 6 (or up to 8, or less), valvate or almost so, the adaxial (median) usually smaller than the other, inserted below, or rarely on, the disc, persistent or not.

*Petals* alternating with the sepals, usually deciduous, 6 (or up to 8, rarely less or 0), almost always different in shape and size, appendaged or more rarely without appendage (in particular *Oligomeris*), above the appendage laciniate, the two superior (adaxial) largest, the lateral smaller and less divided, the anterior smallest and most reduced.

*Disc* infundibuliform or collar-shaped, asymmetrical, surrounding the base of the filaments and fused with them, and the ovarial stipe, apically with a one-sided semilunate horizontal extension. Extension usually velvety or papillose, or

lacerate; rarely disc absent *(Oligomeris)*, or widely spread, cup-shaped, and bearing on the outer wall sepals and petals, sometimes doubled.

*Stamens* usually 16–22 (varying between 3 and over 50), one (the eldest) between the two superior petals, the others seemingly in one or more, hardly distinguishable whorls, surrounding the ovary or, rarely, one-sided *(Oligomeris)*, consisting of filament and anther. Anthers versatile, more or less ellipsoid, finally biloculed; loculi splitting lengthwise, more or less laterally.

*Pollen* appearing in tetraeders, yellow, tricolpate, surface very delicately reticulate.

*Ovary* consisting of 3–4 carpels, sometimes 5 or 6, rarely 2, angled, provided with (2–) 3–4 (–6) apical teeth (style and stigma), each tooth or dent the conical apex of one carpel where its margins are in contact, but lower downwards are connate with the margin of the adjacent carpel (stigmatoid tissue on the inner surface of the dent, near its top), as a rule gaping, one-chambered or, more rarely, partly apocarpous. In apocarpous *Sesamoides* each carpel dorsally gibbous in the apical part and closed.

*Stipe* though usually minute and completely hidden by the surrounding disc, frequently partly emerging. Placenta on the ovarial wall, sometimes forked and penetrating into the dents (subgenus *Glaucoreseda*), multiovulate, rarely placentation central and basal, or a single ovule attached to a ventral placenta in each free carpel *(Sesamoides)*. Ovules campylotropous, bitegmic, usually imbricate and in 2 or more rows.

*Fruit* a dry, gaping, thin-walled capsule (mouth shortly and broadly teethed or nearly entire), (long) cylindrical to depressed globose, or rarely (desert shrub) baccoid, the wall becoming fleshy, or free carpidia starwise, arranged on a somewhat succulent carpophore. In the latter case *(Sesamoides)* the solitary seed escaping through a transverse split; in *Reseda* subgen. *Stefaninia* capsule closed.

*Seeds* reniform, numerous (solitary in carpidia of *Sesamoides*), papillose, rugulose or smooth, radicle close to hilum (sinus narrow, or closed, or filled by (protruding) carunculoid tissue), when attached to placenta radicle above, cotyledons below (except *Caylusea*). Upper layer of testa (epidermis) membranous, colourless, in rugose or papillose seeds sometimes evanescent (flaking), in smooth seeds adhaerent. Middle layer crustaceous, black or blackish or dull brownish, if black usually with a purplish, olive-greenish, or yellowish sheen. Endosperm absent; perisperm represented by an envelope (inner layer of testa) between embryo and outer testa, and often by nutritious tissue capping the cotyledons, or (also) between cotyledons and hypocotyl.

*Embryo* with incumbent, fleshy, almost equal cotyledons, together smaller or almost equally large as the radicle; plumula not developed.

Type genus: *Reseda* L.

Distribution: Tethyan, in addition S. Africa, SW United States and Mexico For details see above.

Notes. The name *Resedaceae* S. F. GRAY (1821) is a conserved family name (Code 1966, p. 222). Although De Candolle published the name 'Résédacées' for a natural family repeatedly and much earlier (Théorie élém. ed. 1, 1813, p. 214 ed. 2, 1819, p. 244), this was not accepted because the name was not in latin and not ending by *-aceae*, Mr. BULLOCK informed me (in litt.).

The family consists of 6 genera. From a morphological point of view its nearest allies are *Capparidaceae* and *Cruciferae*. From both families *Resedaceae* are almost always easily distinguished by the gaping apex of the one-chambered ovary and capsule, the zygomorphic, always bracteate flowers, and the basal dents (stipuloid glands) on either side of the leaf-insertion. Distinguishing characters from *Capparidaceae*, in addition, are in that *R.* only very rarely have less than 3 carpels (*Capp.*: 2), and never a morphologically marked style and stigma. From *Cruciferae*, in addition, *R.* can be distinguished in that never a dissepiment in the fruit occurs, and there is the difference in arrangement (and number) of the stamens. In the course of time, the floral arrangement was differently interpreted. Here a few diagrams are reproduced (p. 34).

As regards a concept of phylogeny within the family it is inevitable, primarily, to form an opinion whether modern *Resedaceae* are mono- or pluriphyletic in origin, and a theory concerning the phylogeny of the genera cannot be shaped without some evaluation of their remarkable geography. A large percentage of endemic taxa and an exceptionally wide disjunct distribution of one genus *(Oligomeris)* appear to exist.

NORRIS (*in* Amer. Journ. Bot. 28, 1941, p. 101–113) judged *Resedaceae* and *Capparidaceae* the most primitive families in *Rhoeadales* and suggested that an ancestral taxon, 'somewhat resembling the existing *Resedaceae* and *Capparidaceae*' would be the origin of *Cruciferae*, *Fumariaceae* and *Papaveraceae* by 'subsequent parallel evolution'. That the parietal placentation in the large majority of *Rhoeadales* is derived, probably, from axile placentation, can be deduced from views held by PURI (*in* Proc. Nat. Acad. Sci. India 15, 1945, p. 74–91, p. 86).

If so, this would suggest that the placentation in *Caylusea* is a primitive character, but HENNIG, on the contrary (*in* Planta 9, 1930, p. 542) explains caylusean placentation as the result of early inhibition of growth of the placenta, a derived character. PURI's opinion (l.c.) ought to be considered in relation to DE TRISTAN's concept of the resedaceous ovary (see above).

The view that *Papaveraceae* are not related to *Resedaceae* was accentuated by HALLIER and others (see above) but HUTCHINSON (Fam. Fl. Pl. ed 2, 1, 1959, p. 117) clearly is inclined to admit relationship. His opinion may be supported *e.g.* by the similarity of petal development in *R. lutea* and *Hypecoum* (NELSON, Gesetzm. Gest. wand. Blütenber. 1954, p. 139). TAKHTAJAN, however, united *Capparidaceae*, *Cruciferae* and *Resedaceae* to the Order *Capparidales* and joins this with *Cistiflorae* on account of pollen-characters. MELCHIOR (1964) retains Reihe *Papaverales*.

MORSTATT (Beitr. Kenntn. Resed. 1903) held the view that the hexamerous perianth in *Resedaceae* is derived; pentamerous perianths are more primitive.

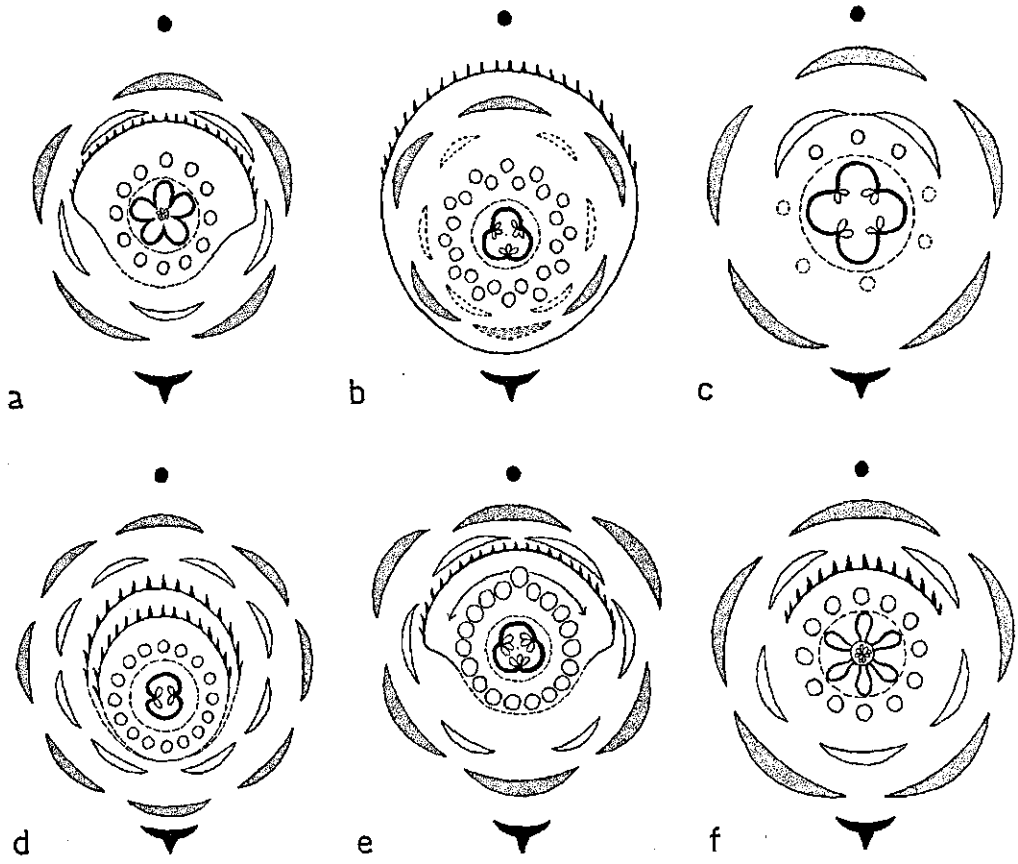


FIG. 1. Floral diagrams of the genera in *Resedaceae*. – a: *Caylusea*; b: *Ochradenus*; c: *Oligomeris*; d: *Randonia*; e: *Reseda (lutea)*; f: *Sesamoides*. – e: after Hennig; d and f: based on Eichler; a, b, c: original.

This finds support in NELSON's work (Gesetzm. Gest. wand. Blütenber. 1954, p. 199) but is opposed by MURBECK (*in* Kungl. Svenska Vet. Akad. Handl. 50, 1912, p. 1–168). HENNIG declared that the flower of *Reseda luteola* clearly is based on a pentamerous pattern. The fusion of the 2 superior petals, and the reduction of the superior sepal indicate a pentamerous ancestry to the present 4-merous flower (HENNIG *in* Planta 9, 1930, p. 519). To be noted: the stamens in *R. luteola* are, a very rare situation in *Resedaceae*, completely free.

The family was subdivided in various ways. SPACH (Hist. vég. Phan. 7, 1839, p. 93) proposed 2 'sections', *Resedinées* (mainly *Reseda* and *Ochradenus*), and *Astrocarpinées (Sesamoides* and *Caylusea)*. MUELL. ARG. arrived at recognizing 3 'tribes' (in DC., Prodr. 16(2), 1868, p. 550): *Cayluseae*, *Astrocarpeae*, and *Resedeae; Resedeae* were subdivided in subtrib. *Resedineae* and subtrib. *Randoniae*. Governing characters were free or connate carpidia. The free carpidia might contain axile, erect ovules *(Cayluseae)*, or a parietal, pendent ovule

*(Astrocarpeae)*, and connate ovaria might be surrounded by perigynous sepals, petals, and stamens *(Randoniae)* or hypogynous sepals, petals, and stamens *(Resedineae)*. Other arrangements are possible and have been attempted but there is no compelling reason, I suggest, to change MUELL. ARG.'s systematy of the *Resedaceae*.

Concluding this survey of various data on the family *Resedaceae*, it ought to be remarked, that many literature citations here referred to provide data leading to publications not reported on now. Also it should not be assumed that this survey makes reading MUELLER ARG.'s introductory chapters superfluous (Mon. Rés. 1857, p. 9–77); on the contrary they are to be read both for the information they contain and as an example of classical botanical writing. Their lucidity, balanced composition, logical persuasion, and quiet enthusiasm may well warrant their being adopted as very desirable reading when schooling taxonomists, an example of a standard one might endeavour to reach. Finally, one is somewhat surprised to find, when confronted with the wealth of data and opinions now available, that so many points of research have been touched and yielded so much information but, at the same time, how very much remains to be done. So many questions were only provisionally and partly answered and so many problems, old and new, were hardly tackled at all.

**Key to the genera of Resedaceae**

1. Placenta basal and central (axile, discoid) . . . . . **1. Caylusea**
1. Placenta(s) more than one, parietal.

2. Carpels free or only at base connate. A single ovule attached dorsally, near the middle in each carpel. Carpidia stellately spreading on top of an increased carpophore when ripe . . . . . **6. Sesamoides**
2. Carpels half or more connate or fused. Ovary single-chambered. Placenta with numerous ovules.

3. Disc absent. Petals 2 (very rarely more) or one, small, not appendaged or clawed . . . . . **3. Oligomeris**
3. Disc(s) present.

4. Disc infundibuliform. Sepals and petals hypogynous (torus not laterally extended and swollen) . . . . . **5. Reseda**
4. Disc cup-shaped, the swollen, laterally extended torus, doubled or single. Sepals (and petals) perigynous.

5. Petals luxuriously developed, persistent. Disc doubled (inner disc a lacerate 'parastaminal corona'). Carpels 2 or 3 . . . . . **4. Randonia**
5. Petals minute, if present at all ephemerous, on the outer wall of the fleshy torus; often disc more or less doubled. Carpels 3, rarely 4 . . . . . **2. Ochradenus**

# SPECIAL PART

## THE GENERA AND SPECIES OF THE RESEDACEAE

### 1. Caylusea A. DE ST HILAIRE

St Hil., II Mém. Réséd. (Montpel.) 1837, p. 29 *(nom. conserv.); id. in* Ann. Sc. Nat. ser. 2, 7, 1837, p. 375; Spach, Hist. Nat. Vég. Phanér. 7, 1839, p. 105; Walp., Rep. 2, 1843, p. 754; Webb, Fragm. Fl. Aeth.-Aeg. 1854, p. 27; Muell. Arg., Mon. Rés. 1857, p. 225 (et *in* Neue Denkschr. Schw. Ges. Zuer. 16, 1858); Boissier, Fl. Or. 1, 1867, p. 435; Muell. Arg. in DC., Prodr. 16(2), 1868, p. 550; Oliver, Fl. Trop. Afr. 1, 1868, p. 102; Post, Fl. Syr. Palest. Sin. 1896, p. 114; Durand et Schinz, Consp. Fl. Afr. 1(2), 1897, p. 179; Pirotta, Flor. Col. Erit., *in* Ann. R. Ist. Bot. Roma 8(5), 1902, p. 258; Muschler, Man. Fl. Egypt 1, 1912, p. 438; Blatter, Fl. Arab. *in* Bot. Surv. Ind. 8(1), 1919, p. 45; Ramis, Bestimm. Fl. Aeg. 1929, p. 97; Dinsmore in Post, Fl. Syr. Palest. Sin. 2nd ed., 1, 1932, p. 140; Bolle in Engl. et Pr., Nat. Pflz.fam. 2nd ed. 17b, 1936, p. 691; Andrews, Fl. Pl. Anglo-Egypt. Sudan 1, 1950, p. 66; Cufodontis *in* Bull. Jard. Bot. Brux. Suppl. 24, 1954, p. 158; Täckholm, Stud. Fl. Egypt 1956, p. 334; Elffers et Taylor in Hubbard and Milne-Redhead, Fl. Trop. E. Afr. 'Resedaceae', 1958, p. 1; Ozenda, Fl. Sah. Sept. Centr. 1958, p. 278; P. Taylor *in* Kew Bull. 1958, p. 283; Quézel et Santa, Nouv. Fl. Alger. 1, 1962, p. 438; Rechinger *f.*, Fl. Lowl. Iraq 1964, p. 328.

*Hexastylis* Rafinesque, Fl. Tellur. 3, 1837 (1836), p. 73, *non* Raf., Neogen. 3, 1825, no. 1113 (cf. Muell. Arg. in DC., Prodr. 16(2), 1868, p. 550 and Merrill, Index Raf. 1949, p. 115, 132; =*Asarum* L.).

*Stylexia* Rafinesque, Fl. Tellur. 4, 1838 (1836), p. 121; Merrill l.c.

Erect, ascending or prostrate, annual or short-lived bushy herbs, (5–) 25 to over 1 m tall; taproot more or less lignescent, slender.

*Stems* branching, leafy; pith solid.

*Leaves* simple, alternate, entire. Indumentum consisting of round-tipped (resedaceous) and of sharp-tipped (claw-shaped) hairs.

*Inflorescences* terminal, simple, spike-like racemes. Bracts (sub)persistent.

*Flowers* solitary, in the axil of a bract, bisexual.

*Calyx* inserted below the disc, 5-partite, persistent.

*Petals* free, as many as and alternating with the sepals, inserted at the base of the disc, deciduous, appendaged, the superior petal largest, the anterior petals gradually simpler, limb palmatipartite (of lowermost sometimes simple). Appendage dorsally with a minute rim, lengthwise and over the vascular bundle.

*Disc* (sub)cylindric, the apical part expanded opposite the superior petal, extension obliquely orbicular to semilunate, membranous or fleshy.

*Stamens* 10–15, more or less regularly surrounding the gynophore. Filaments deciduous. Anthers ellipsoid or ovoid, base cordate, opening by 2 slits.

*Ovary* on a short gynophore (exserted from the disc), consisting of (4–) 5–6

(–7) free, gaping carpels. Carpels boat-shaped, one-chambered, empty, at base fusing and surrounding a slightly rised, axile, discoid placenta. Apex of carpel finally hardening and solid, conical. Ovules campylotropous, erect, 10–18 crowded on the placenta; radicle directed towards the base of the carpel.

*Fruit* the stellately arranged erect or divergent carpidia.

*Seeds* often as many as the carpidia (or almost so, a number of ovules being abortive), reniform or hippocrepiform. Outermost layer of the testa persistent.

Type species: *Caylusea canescens* ST HIL. (= *C. hexagyna* (FORSK.) GREEN).

Distribution: S and E of Mediterranean, E Africa, N Africa (Cape Verde Isl., Rio de Oro, Morocco, Algeria, Lybia, Egypt), Creta, Palestine, Libanon, Jordan, Iraq, Arabia, E Africa (Sudan, Eritraea, Ethiopia, Uganda, Kenya, Tanzania (Zanzibar)). In Central Africa, S of the Sahara, in the Chad district.

Notes. AUG. DE ST HILAIRE described *Caylusea* as a new genus (II Mém. Rés. 1837, p. 29, and *in* Ann. Sci. Nat. ser. 2, 7, 1837, p. 375). It was monotypic, one single species being admitted: *C. canescens* ST HILAIRE (see *C. hexagyna*).

The name refers to ANNE-CLAUDE-PHILIPPE DE TUBIÈRES, DE GRIMOARD, comte de CAYLUS (1692–1765), French archeologist of great repute, author of many volumes on Egyptian and circummediterranean antiquities, arts, biography, and of novels (cf. GRÉGOIRE, Dict. Hist. Biogr., nouv. ed., 1876, p. 405).

As the priority of the name appeared debatable, RAFINESQUE having published names for the genus at about the same time, it was conserved. Most probably, conservation was not necessary but it is, obviously, a safeguard for stability. *Caylusea* is an easily distinguishable natural genus which may account for the absence of synonyms.

**Key to the species of Caylusea**

1. Seeds rugose. Superior petal 4–5-lobed . . . . . **1. abyssinica**
1. Seeds minutely and closely papillose.
2. Superior petals (3–5–)7–9-lobed. Leaf-edge usually ciliolate; leaf-blade linear-(ob)ovate . . . . . **2. hexagyna**
2. Superior petal 2–3-lobed. Leaf-edge glabrous; leaf-blade ovate-elliptic . . . **3. latifolia**

## 1. Caylusea abyssinica (FRESEN.) FISCH. et MEY. Fig. 2, 4a

Ind. Sem. Hort. Petrop. 7, 1840, p. 43, *in* Linnaea 1841, Beibl. p. 106; A. Braun *in* Flora 1841, p. 281; Walpers, Rep. 2, 1843, p. 754; A. Richard, Tent. Fl. Aeth.-Aeg. 1854, p. 29; Muell. Arg., Mon. Rés. 1857, p. 229, tab. 10, fig. 133 (et *in* Neue Denkschr. Schw. Ges. Zuer. 16, 1858); *id.* in DC., Prodr. 16(2), 1868, p. 551; Oliver, Fl. Trop. Afr. 1, 1868, p. 103; Durand et Schinz, Consp. Fl. Afr. 1(2), 1897, p. 179; Pirotta, Fl. Col. Eritr. *in* Ann. R. Ist. Bot. Roma 8, 1903, p. 258; Blatter, Fl. Arab. *in* Rec. Bot. Surv. Ind. 8(1), 1919, p. 45; Bolle in Engl. et Pr., Nat. Pflz.fam. 2nd ed., 17b, 1936, p. 691, fig. 428c; Andrews, Fl. Pl. Anglo-Egypt. Sudan 1, 1950, p. 66; Cufodontis *in* Bull. Jard.

Bot. Bruxelles Suppl. 24, 1954, p. 158; Elffers *in* Kew Bull. 1955 (1956), p. 630; Elff. et P. Taylor in Hubb. et Milne-Redhead, Fl. Trop. E. Afr., Resedaceae 1958, p. 3, fig. 1; P. Taylor *in* Kew Bull. 1958, p. 286, fig. 1 (5–9).

*Reseda abyssinica* Fresenius, Beitr. 3, Fl. Abyss. *in* Mus. Senckenb. 2, 1837, p. 106.

*R. pedunculata* R. Brown in Salt, Abyss. Exp. App. 4, 1814, p. 64 *(nomen)*.

*Astrocarpus abyssinicus* Hochst. *ex* Oliver, Fl. Trop. Afr. 1. 1868, p. 103 *(nomen in synon.)*.

Annual or occasionally biennial, generally glabrous, often scabrid, 25–100 (150) cm tall herb; taproot somewhat lignescent.

*Stems* erect (or ascending), simple or branching, glabrous (rarely sparsely pilose), often scabrid, terete, ribbed; pith solid.

*Leaves* entire, sometimes upper leaves whorled, 2–8 cm long, up to 2 cm wide, acutish to short acuminate, sessile, occasionally scabrid on nerves and margins, linear–(ob)ovate or linear-oblong, rarely narrowly elliptical, margins sometimes undulate.

*Flowers* white, in terminal spicoid racemes. Racemes slender, dense, comose, (5–)10–40 cm long, peduncle acutely ribbed, usually scabrid. Bracts persistent, minutely scabrid, linear, 2–3 mm long, $^1/_4$ mm wide, margins narrowly pallid, entire or (obscurely) scabrid. Pedicels sulcate, usually scabrid, 1–2 mm long in flower, slightly longer in fruit.

*Sepals* 5, persistent, subequal, oblong, $1^1/_2$–$2^1/_2$ mm long, ca. $^2/_3$ mm wide, (minutely) scabrid on edge and dorsally on nerve, acute, sometimes obtusish.

*Petals* 3–4 mm long. Limb of superior petal usually 4–5-palmatipartite (occasionally 3 or 6 laciniae), incisions up to ca. $^4/_5$ downwards; central lobe longest, linear, obtusish, lateral lobes oblong, attenuate towards top, gradually shortening laterally (sometimes outermost lobe much the shorter); appendage peltate (limb-base broadly attached), obovate, somewhat less than half as long as the limb, transverse rim partly adnate to limb-margin (± gibbose in front of the limb), margins almost entire. Lateral and anterior petals often slightly longer than the superior petal, limb usually simple, sometimes the lateral petal 2–3-partite, rarely the anterior petal 2-partite.

*Disc* cylindroid, 1 mm high and wide, extension suborbicular, at the posterior side $^1/_2$ mm wide, half as wide at anterior side, membranous, margin ciliate-papillose.

*Stamens* 10–13, usually exceeding the petals. Filaments deciduous, verruculose, 3–$3^1/_2$ mm long, usually slightly dilated about the middle. Anthers oblong-ovoid, 1 mm long, usually retuse, asperulous.

*Ovary* (sub)globose, $1^1/_2$–2 mm long, stipitate above the disc (exserted stipe ca. $^3/_4$ mm long), carpels 5–6(–7), widely dehiscent, boat-shaped, top closed and solid, scabridulous especially on midrib, margins ciliate, teeth conical, erect. Placenta central-basal, discoid. Ovules ca. 13, erect, crowded, radicle inferior.

*Capsule* stellately dehiscent, $3^1/_2$–4 mm long, 4–5 mm wide, when ripe wide

open, horizontally directed and usually each carpel subtending one seed, scabridulous on the back, margins colourless, ciliate.

*Seeds* brownish-black, reniform, ca. $1^1/_2$ mm long, just over 1 mm wide. Sinus narrow, filled with carunculate tissue. Testa rugose, covered by the minutely papillate-tesselate outer layer.

Type: Dr. R. RÜPPELL s.n., Aethiopia (see notes).

Distribution: Sudan, Ethiopia, Kenya, Uganda, Tanzania, Ruanda-Urundi, Malawi, ?Zanzibar.

Notes. FRESENIUS's description of *Reseda abyssinica* (l.c.) makes it certain that *Caylusea* was at hand (see also Index Kew. 2, 1895, p. 696). No collector's number was mentioned. The type may be represented by 'Reseda abyssinica cult. in h. bot.' (in FRESENIUS hb., FR). It is an old specimen and may have been grown from seeds brought from Ethiopia by RÜPPELL. On the other hand, there is no proof. ELFFERS (*in* Kew Bull. 1955, p. 630) rejected this FRESENIUS specimen and proposed to appoint SCHIMPER 103 as the neotype. Although the argument is not convincing, SCHIMPER 103 is a good specimen and widely distributed, and for the time being may be accepted as the neotype.

*Reseda pedunculata* (Index Kew. 2, 1895, p. 697) is a name without description published by R. BROWN (l.c.). SALT's specimen, seen and so named by R. BROWN is in BM; it is *Caylusea abyssinica* (cf. MUELL. ARG. in DC., Prodr. 16(2), 1868, p. 551).

*Astrocarpus abyssinicus* is a name which HOCHSTETTER added to SCHIMPER 1937 (referred to *in synon.* by OLIVER, l.c.). SCHIMPER 1937 is present in several herbaria and belongs here. It was also cited by MUELL. ARG. (Mon. Rés. 1857, p. 230, and l.c. 1868, p. 551).

Ecology. *C. abyssinica* is an East African highland plant. It behaves like a weed; though common in many areas it never is really aggressive or obnoxious. In the D'ALLEIZETTE hb. is a specimen originating, it is alleged, from Zanzibar.

Ethiopia. GILLETT found it (14475, K) at Aghere Mariam, 1750–2100 m alt., on a dissected plateau with a rainfall of possibly 900 mm, maximum in May, dry in Nov.–March. It was 'a weed of cultivation', with brick-red anthers and white petals. MOONEY confirms this (5709, K) at Shashemanne, at ca. 2300 m alt., rainfall 125 mm, where it flowered and fruited in February. EVANS and FLENLEY observed (277, K) *C. abyssinica* as a grassland species near Debra Markos.

Uganda. PURSEGLOW (P 3348, K) noted it as a bushy herb in grassland at 2100 m alt., near Kigezi, bearing fl. and fr. in March.

Kenya. GILLETT collected (14020, K) *C. abyssinica* on a stony ridge, cleared montane scrub, not far from houses, under 635 mm rainfall, at Mayale, with fl. and fr. in October. BALLY judged it (7993, K) not common in open grassland at Chyala North.

Many reports are extant stating it to be a weed. In Ethiopia it was a weed on Tef fields in Sigamo (SCHIMPER 271, S); DE WILDE's and DE WIT found it as a

road-side weed in various places in Ethiopia (Alemaya 9834, WAG; Jimma region 10207, WAG). As a weed it occurred in Kenya, Trans Mzoia, in maize land, above 2000 m (SYMES 762, K); at path sides in disturbed grassland at Thika Road House, Nairobi (VERDCOURT B 552, K). In Uganda 'a common weed' (THOMAS 54355, K); a weed in derelict maize garden, in Tanganyika, Iringa distr. (MILNE-REDHEAD et TAYLOR 11066, K); local, in abandoned cultivated areas at Lyamungo, Tanganyika (GREENWAY 3139, K); a common weed of cultivation (DAVIES D 349, K) in Rungwe distr., Tanganyika.

*C. abyssinica* may participate in a weed community e.g. in Tanganyika, Moshi distr., in the sun on an old marrow heap with *Amaranthus, Galinsoga, Chenopodium* etc. abundant (P. HUXLEY 71, K). GREENWAY found it (3139, K) common in places in 'very open *Clerodendron-Vernonia* bush formation'. At Serengeti it had fl. and fr. in May, at 1600 m alt., and was loc. common in 'inselberg vegetation', with *Vernonia – Erlangea cordifolia – Sanseviera robusta* fringes. GREENWAY noted there (10.639, K) also *Hoslundia, Hibiscus, Phyllanthus, Cordia, Grewia, Commiphora, Pavetta, Tarenna, Turraea, Cassine, Ficus.*

Some collectors expressly noted that the flowers are scentless; they are usually white, but may be 'pink-red' (Alemaya Agric. Coll., Ethiopia) or reddish (PALMER 23, K).

Adventitious as a weed near Rotterdam (Schiehaven) in the Netherlands, it was collected by KERN, v. OOSTSTROOM and REICHGELT (21047, L).

Sown at Wageningen, *C. abyssinica* develops luxuriously in the course of the summer and produces seed in abundance. These germinate readily after 4–5 days. The green cotyledons escape from the testa, one after the other, after the colourless hypocotyl has reached 1–4 cm in length. They differ very slightly in size (fig. 2, m–n). The first pair of leaves is opposite, decussate to the cotyledons. The cotyledons have no visible trace of basal dents, the first leaves, however, are accompanied by a set of relatively large dents, the top of which ends in a long, crinkled hair (fig. 2, o). This hair needs closer anatomical study; it seems to be always present but may turn out to be nothing but a shriveled remnant of a drop of glandular liquid.

The next 3 or 4 pairs of leaves gradually lose the opposite position and phyllotaxis becomes at the same time step by step normal (by stem torsion?).

It is to be noted that the colourless upright basal dents clearly have an excretory function and although they are in the first pair of leaves nearly cauline, shift in the following leaves to an appreciably higher position on the edge of the petiole. They move further from the stem and certainly are not cauline. In addition, the long decurrent edges of the petiole as ribs on the stem of the young seedling strongly suggest concaulescence of the leaves (cf. notes to the leaf, general part). However, the ultimate position of the basal dents is at the axil-edges of the adult leaf on the adult stem and this return to the initial situation, one cannot help supposing, may be the result of a prolonged concaulescence of the petiole of the adult leaf. The problem deserves comparative research through the *Resedaceae* and could have a bearing on the interpretation of the leaf-morphology (see general part, notes on Leaf) and perhaps of the phylogeny.

Economic notes: In Tanganyika, Mbeya distr., the 'leaves eaten as spinach by local natives (Mambwila, Wasatwa, Wsangu) and also by white settlers'. SCHIMPER stated that seeds which get among the Tef harvest make 'bread' bitter (cf. notes on History, CLUSIUS on *Sesamoides* seeds), and recorded that goats are said to be harmed by the plant.

Vern. names: Ethiopia. MOONEY summarized (Gloss. Ethiop. Pl. names, 1963) as follows: *yerenchi* (Amharinia), *merreret* (Tigrinia-Eritrea), *arranchi* (Gallinia), *jerenchi* (Gallinia-Harar). Tanganyika. Kimasai (purko): *engusori*, (sonja): *mwaka*.

Illustrative specimens: Ethiopia. Alemaya Agric. Coll. B-93, Alemaya; De Wilde, D.W.-Duyfjes et De Wit 9834, Alemaya, between Dire Dawa and Harrar; *id.* 10207, ca. 15 km NE Bonga, Jimma road; Dillon s.n. à 57, prov. Tigre, Adoua; Evans et Flenley 277, stream S of Debra Markos airfield; *id.* 375, nr Tchamaya gorge, Debra Markos-Addis rd; Gillett 14475, Aghere mariam (Alghe), 5°38′. N, 38°14′. E; Hall 78, Haik; Jimma Agric. Techn. School 3, Jimma; Massey 57, vicinity of Gondar; Mooney 5709, near Shashemanne Arussi; *id.* 5490, Santamma, 15 m. NW Jimma; Negro 569: Suva . . . dill Oletta, pr. campo Mettà; Pappi 214, Hamasen, Sala Dharo; *id.* 634, Scimenzana, Guna guna (Eritrea); *id.* 3504, Amasen tra Arbariba e la Porte del Diavolo (Eritrea); *id.* 4393, *ibid.*, diutorni di Asmara; Petit, Choa prov.; Pichi Sermolli 144, Island in Lake Tana; Schimper 103, Adowa; *id.* 1937 (= 103); *id.* 353, Gaha-meda; *id.* 271, Sigamo; Siegenthaler 1548, Jimma; Soccardo 57, ? Simwa; Stewart E8, Jimma; Taschdjian 290, Agaumeder, Bahr der Georglius.

Kenya. Bally 7993, Chyala north; Bogdan B97, Langata Forest, Nairobi; A. Bogden AB 1892, 20 m SE Eldoret Plains; Curtis 1049, 1135, s.l.; R.E. Fries et Th. C.E. Fries 1010, Coles Farm; *id.* 1571, pr. flum. Kongoni; Gesnell 722, Eldoret mts; Gillett 14020, N Prov., Moyale; Lind et Agnew 5039, Ngong hills, nr summit; Lindblom s.n., V 1920, Londiani; Mainwaring s.n., Aberdare range; Matzen s.n., XII 1962, Enderasha Ltd, Mweiga; Mearns 1198, vicinity Fort Hall; Mücke 145, Kiboko (Kiboscho); Soresby Routledge s.n., Aberdare range (Masai); Symes 762, Trans Nzoia, 8 m. from Kitale; Verdcourt 552, Nairobi, Thika Road House.

Malawi. Stolz 2055, Nyassa Highland, station Kyimbila; *id.* 24436, s.l.

Ruanda-Urundi. G. Michel 4906, Rubena ruderal.

Sudan. F.W. Andrews A 250, Gash Delta, Kassala Prov.; *id.* A 234, Tokar Delta, *ibid.*; G. Aylmer 158, Red Sea hills; R. B. Drummond and J. H. Hemsley 959, Port Sudan; J. K. Jackson 2748, Erkowit (Kassala), Red Sea hills.

Tanzania. Mrs Adamson 12.641, lower Mblangeti valley; B. D. Burtt 3615, Manyoni distr., Davies D 349, Rungwe distr.; Mrs J. Fosbrooke 4, rim of Ngorongoro crater, hills above Loliondo; Geilinger 1577, N prov., Kiboya; Greenway 3139, Lyamungo S slope; *id.* 10.639, S of Seronera Dam, Serengeti; A. E. Haarer s.n., Moshi distr.; P. Huxley 71, Moshi distr.; Milne-Redhead et P. Taylor 10076, Mbeya distr.; *id.* 11066, Iringa distr.; Napier 845, Nairobi plains beyond racecourse; Procter 1438, near Mbeya; Schlieben 1076, stromgebiet oberen Ruhudji, landsch. Lupembe; *id.* 4351, Kilimandscharo.

Uganda. J. R. Dale U 246, Moruongole; Harger s.n., Eldoret distr., Elgeyo escarpment; Mac Innes 62, Kenya mt; Purseglow P 3348, Kabale, Kigezi; Thomas 54355, Agoro.

?Zanzibar. Alleizette s.n., XII 1906, env. de Zanzibar.

**2. Caylusea hexagyna** (FORSK.) M. L. GREEN **Fig. 3, 4b-d**

Stand. Sp. Nom. Cons. 1926, pp. 26, 63; *id.* in Int. Bot. Congr. Cambr. 1930, Prop. Brit. Bot. 1929, p. 102, no 3122; Maire *in* Bull. Soc. Sc. Nat. Maroc 13, 1934 (1933), p. 264 ('(Forsk.) Maire'); Jahandiez et Maire, Cat. Pl. Maroc 3, 1934, p. 888; Bolle in Engl. et Pr., Nat. Pflz.fam. 2nd ed., 17b, 1936, p. 691, fig.

428g; Emberger et Maire, Cat. Pl. Maroc 4, 1941, p. 1015; Andrews, Fl. Pl. Anglo-Egypt. Sudan 1, 1950, p. 66, fig. 46 ('(Forsk.) Dandy'); Cufodontis *in* Bull. Jard. Bot. Bruxelles Suppl. 24, 1954, p. 159; Täckholm, Stud. Fl. Egypt 1956, p. 334, tab. 51; Ozenda, Fl. Sahara Sept. Centr. 1958, p. 278, fig. 58; P. Taylor *in* Kew Bull. 13 (2), 1958, p. 285, fig. 1 (10–15); Quézel et Santa, Nouv. Fl. Alger. 1, 1962, p. 438, tab. 38, fig. 1217; Rechinger *f.*, Fl. Lowl. Iraq 1964, p. 328.

*C. h.* var. *glabrescens* (Muell. Arg.) Maire *in* Bull. Soc. Sc. Nat. Maroc 13, 1934 (1933), p. 264; Emberger et Maire, Cat. Pl. Maroc 4, 1941, p. 1015.

*C. h.* var. *rigida* (Muell. Arg.) Maire l.c.; Emberger et Maire l.c.

*C. h.* var. *glabra* Maire in Bull. Soc. Hist. Nat. Afr. Nord 26, 1935, p. 188; Emberger et Maire l.c.

*C. h.* var. *papillosa* Maire l.c., p. 187.

*C. canescens* St Hilaire, II Mém. Réséd. 1837, p. 38; Walpers, Rep. 2, 1843, p. 754; Webb in Hooker, Niger Fl. 1849, p. 101; *id.* Fragm. Fl. Aeth.-Aeg. 1854, p. 27; Muell. Arg., Mon. Rés. 1857, p. 226, tab. 10, fig. 132 (et *in* Neue Denkschr. Schw. Ges. Zuer. 16, 1858); Boissier, Fl. Or. 1, 1867, p. 436; Muell. Arg. in DC., Prodr. 16 (2), 1868, p. 551; Oliver, Fl. Trop. Afr. 1868, p. 102; Post, Fl. Syr. Palest. Sin. 1896, p. 114; Durand et Schinz, Consp. Fl. Afr. 1(2), 1897, p. 179; Pirotta, Fl. Col. Eritr. *in* Ann. R. Ist. Bot. Roma 8(5), 1903, p. 258; Muschler, Man. Fl. Egypt 1, 1912, p. 438; Blatter, Fl. Arab. *in* Rec. Bot. Surv. Ind. 8(1), 1919, p. 46; Ramis, Bestimm. Fl. Aeg. 1929, p. 97; Jahandiez et Maire, Cat. Pl. Maroc 2, 1932, p. 314.

*C. c.* α *rigida* Muell. Arg., Mon. Rés. 1857, p. 228 (et *in* Neue Denkschr. Schw. Ges. Zuer. 16, 1858); Durand et Schinz l.c., p. 180; Muell. Arg. in DC. Prodr. 16 (2), 1868, p. 552.

*C. c.* var. *rigida* αα *prolifera* Muell. Arg. 11. cc.

*C. c.* β *foliosa* Muell. Arg., Mon. Rés. 1857, p. 229 (et *in* Neue Denkschr. Schw. Ges. Zuer. 1858); *id.* in DC., Prodr., l.c.; Dur. et Sch., Consp. Fl. Afr. 1(2), 1897, p. 180.

*C. c.* var. *foliosa* ββ *glabrescens* Muell. Arg. Mon. Rés. l.c.

*C. c.* c. *glabrescens* (Muell. Arg.) Muell. Arg. in DC., Prodr. 16(2), 1868, p. 552.

*C. c.* var. *prostrata* Post, Fl. Syr. Palest. Sin. 1896, p. 114; Blatter, Fl. Arab. *in* Rec. Bot. Surv. Ind. 8 (1), 1919, p. 46; Dinsmore in Post l.c. 2nd ed., l. 1932, p. 141.

? *Caylusea moquiniana* Webb, Fragm. Fl. Aeth.-Aeg. 1854, p. 28.

*Reseda canescens* L., Syst. Nat. ed. 12, 1767, p. 330 (*haud* L. 1753); Houttuyn, Nat. Hist. 2 (8), 1777, p. 725; Vahl, Symb. 2, 1791, p. 52; Willdenow, Sp. Pl. 2(2), 1800 (1799), p. 877; Hornemann, Hort. Hafn. 2, 1815, p. 501; Sprengel, Syst. Veg. 2, 1825, p. 413; Fresenius *in* Mus. Senckenb. 1, 1834, p. 172; Muell. Arg., Mon. Rés. 1857, p. 227, *cum lit.!*

*R. hexagyna* Forskål, Fl. Aeg.-Arab. 1775, cent. III, p. 92; Rafinesque, Fl. Tell. 3, 1837 (1836), p. 73 *(sphalmate: Reseda hexastylis)*; Merrill, Index Rafin. 1949, p. 132.

*R. podocarpos* Viviani, Pl. Aeg. Dec. IV, 1830, p. 7; Walpers, Rep. 2, 1843, p. 753.

*Hexastylis arabica* Rafinesque l.c. (non *Hexastylis* Rafin. 1825); Merrill l.c.

*H. canescens* Rafinesque l.c.; Merrill l.c.

*Stylexia arabica* et *S. canescens* Rafinesque (by inference) l.c. 4, 1838 (1836), p. 121; Merrill l.c.

Annual or perennial, usually canescent, variously pilose to glabrescent or rarely glabrous, (5–) 30–40 (–80) cm tall herb; taproot lignescent.

*Stems* several, rarely solitary, erect, ascending or decumbent, simple or branching, more or less pilose, terete, ribbed; pith solid.

*Leaves* entire, rarely the uppermost ± whorled or shortly connate at base (suggesting a 3-sect leaf), oblong to linear-(ob)ovate, 2–6 (–7) cm long, (3–) 5–8 (–16) mm wide, usually acute, sessile, rarely basal leaves petiolate, indumentum (if present) denser on midrib and margin, margins entire, sometimes undulate, usually ciliate or scabrid.

*Flowers* white, (rarely yellow), in terminal spicoid racemes. Racemes slender, (3–) 10–20 (–40) cm long, peduncle terete. Bracts persistent, glabrous, ovate-oblong, 1–2 (–3) mm long, $^1/_3$–$^1/_2$ (–$^3/_4$) mm wide, acute, margins narrowly pallid. Pedicels rather thick, ± scabrid, $^1/_2$–2 mm long in flower, slightly longer in fruit.

*Sepals* 5, persistent, subequal, scabridulous to glabrous, (narrow)-ovate, $1^1/_2$–2 mm long, $^1/_2$–$^2/_3$ mm wide, margin narrowly pallid, smooth.

*Petals* 3–$3^1/_2$ mm long. Limb of superior petals 5–7 (–11), palmatipartite incisions $^2/_3$ or more downwards, sometimes depth irregular, rarely lateral lobes ± reduced, central lobe longer than the lateral, longer to up to more than twice as long as the appendage; laciniae rounded to acutish; appendage peltate, (widely) attached above the middle, obovate, slightly over 1 mm long, transverse rim usually adnate to limb-margins; margins entire, papillose to ciliolate. Lateral and anterior petals almost as long as superior one, limb reduced, 3-partite, sometimes 2-partite in anterior petal.

*Disc* subcylindric, expanded posteriorly, 1 mm high, top $1^3/_4$ mm wide (incl. extension), extension ± excentric orbicular, usually fleshy, rarely membranous, often minutely papillose, sometimes sparsely pilose, margin curved downwards.

*Stamens* 11–15, exceeding the petals. Filaments deciduous, hispidulous (sometimes glabrous), filiform, 3–4 mm long, sometimes dilated above. Anthers oblong-ellipsoid, $1^1/_2$ mm long, $^3/_4$ mm wide, retuse.

*Ovary* ovoid to urceolate, ca. 2 mm long, $1^1/_2$ mm wide, long stipitate above the disc (exserted stipe ca. $1^1/_4$ mm long, often hispidulous); carpels 5–6 (very rarely 4 or 3), up to ca. $^4/_5$ free, boat-shaped, glabrous, margins densely long strigose, teeth conical, ca. $^1/_4$ mm long, divergent. Placenta central-basal, discoid. Ovules (12–) 14 (–18), erect, crowded on the placenta, radicle pointing downwards.

*Capsule* stellately dehiscent, 3–5 mm long, $2^1/_2$–4 mm wide, on a 3–4 (–5)

mm long carpophore, glabrous, (carpel 2-seeded), margins pallid-ciliate, cuspidate, ca. 1 mm long, divergent.

*Seeds* black (yellow-green tinged) or dark brown, dull, globular ovoid, 1 mm long, $^3/_4$ mm wide. Sinus closed, represented by a groove. Testa densely papillose, papillulae in regular close rows, following seed-contour.

Type: FORSKÅL s.n., à 1762, *inter rudera ad Caid bey, prope Kahiram* (C, HB VAHLII: lectotype; HB SCHUM: isolectotype).

Distribution: N and E Africa (including the Sahara), Sudan, Ethiopia; Egypt, Libanon, Palestine, Jordan, Syria, Arabia, Iraq, and Persia. Cape Verde Arch., and Crete. Doubtful record from Italy.

Notes. LINNAEUS published and described *Reseda canescens* (Sp. Pl. 1, 1753, p. 448). He published and described for the second time *Reseda canescens* in 1767 (Syst. Nat. ed. 12 (2), p. 330). *Reseda canescens* L. (1767) is very different from *Reseda canescens* L. (1753).

In LINN is a specimen labeled 'canescens' (629.3), which was not present in 1753 but may be accepted as the type for *Reseda canescens* L. (1767). This view was also expressed by SANDWITH (written note in LINN). It belongs in *Caylusea hexagyna.*

Index Kewensis (2, 1895, p. 696) listed *Reseda canescens* A. ST HIL. Actually, J. B. BAILLIÈRE (*in* Ann. Sc. Nat. sér. 2, 7, 1837, p. 375) in a review of ST HILAIRE's 'Deuxième Mémoire sur les Résédacées (1837)' used the name *Reseda canescens.* BAILLIÈRE stated that ST HILAIRE wished to recognize the corrected reprint of the second memoir only, and that ST HILAIRE rejected the original, first issue, of the 'Deuxième Mémoire' (same year) on account of many misprints.

Although there is no absolute proof by direct reference, the text makes it evident that ST HIL. only wanted to refer (in both papers of 1837) to *Reseda canescens* L. (1767), and not to *Reseda canescens* L. (1753), nor did he publish '*Reseda canescens* ST HIL.', as was e.g. correctly stated by WEBB (in HOOKER, Niger Fl. 1849, p. 101).

ST HILAIRE described in 1837 (l.c., p. 29) a new genus, *Caylusea. R. canescens* L. (1767) was the only species representing *Caylusea.* Now *R. canescens* L. (1767) is a homonym of *R. canescens* L. (1753) and so *Caylusea canescens* ST HIL. is to be treated as a new name (cf. Code 1966, Art. 72, Note). The name *Caylusea canescens* was widely used after 1837 for the species now discussed. In passing, it may be noted that GREEN (see below) declared that ST HILAIRE 'does not appear to have employed the name *Caylusea canescens*', but this is an error. ST HILAIRE did use it (l.c., p. 38).

In 1775 the name *Reseda hexagyna* FORSKÅL (also spelled FORSKÅHL) was published (Fl. Aegypt.-Arab. p. LXVII (nom. loc., and vern. name), p. 92 (descr.)).

In the Copenhagen Herbarium are 2 specimens collected by FORSKÅL in 1762, '*inter rudera ad Caid bey prope Kahiram*'; one sheet is marked on the reverse

'HB. VAHLII', and the other marked 'HB SCHUM'. The specimen marked 'HB VAHLII' is now designated as the lectotype specimen of *Reseda hexagyna* FORSK. A third specimen at Copenhagen originated from the FORSKÅL collections and is marked 'HB. HORN'. Its origin seems uncertain but it is conspecific with the other two FORSKÅL specimens.

It would appear from a specimen preserved in the DUDLEY Herbarium (COMMERSON hb., DS 144691) that seeds of a plant collected by FORSKÅL were grown at Paris. This latter hb. specimen carries a label: '*Reseda aegyptiaca floribus hexagynis divi* FORSKÅL, H.B. Paris. 1764, 7 *bri incipiente florum dein abortium*', and a slip written in old msc. '*Reseda hexagyna forskål*'. The specimen formed part of a 'herbier fait par COMMERSON avant son voyage, donné par M. WEDDELL, en juillet 1850', and was also named *Reseda canescens* L. The specimen is poor and carries some flower buds. It belongs in '*Caylusea canescens*' and may be accepted as FORSKÅL's *R. hexagyna*.

This amount of authentic specimens proves that *Reseda hexagyna* FORSK. is identical with *Caylusea canescens* ST HIL. (see also notes under *Reseda canescens* L. and the notes on the genera *Sesamoides* and *Caylusea*).

As *Caylusea canescens* ST HIL. dates from 1837 and *Reseda hexagyna* FORSK. from 1775, it is evident that the correct combination in *Caylusea* is *Caylusea hexagyna* (FORSK.) M. L. GREEN (cf. Prop. Brit. Bot. 1929, p. 102 (no 3122), Int. Bot. Congr. Cambr. 1930; Int. Rules Bot. Nom. 1935, p. 144).

GREEN's new combination was first published in 'Stand. Spec. Nom. Cons. 1926' (p. 29 and 63), a stencilled list distributed by Kew, to several botanical institutes and botanists, and referred to in Index Kewensis. The combination was repeated in regular printing in 1929, 1930 and 1935.

It seems debatable whether GREEN's combination ought to be dated 1926 or 1929. Index Kewensis, suppl. XIII, 1966, p. 25, has '1929', the year of 'printing'. The Wageningen copy of the stencilled list issued by Kew is dated 30th June 1926. Possibly it is not contrary to the Code to accept 1926 as the date of publication.

The combination *Caylusea hexagyna* (FORSK.) DANDY was published in F. W. ANDREWS, Fl. Pl. Anglo-Egypt. Sudan (1, 1950, p. 66). It is a superfluous name.

A number of infraspecific taxa has been described. It appears that no satisfactory segregation can be made; all intermediates are commonly found.

A variety *rigida* MUELL. ARG. (l.c.) is rather robust, with rigid branches, and with sparse, short, crisped leaves. It was based on a number of specimens of Egypt and Sinai. One of these (KRALIK) is pictured (fig. 4, d). Var. *foliosa* MUELL. ARG. (l.c.) is smaller, slightly glaucous, less rigid and has somewhat larger and more numerous leaves (fig. 4, b). In the variety *foliosa*, MUELL. ARG. described ββ *glabrescens*, which was different from var. *foliosa* in its being nearly entirely glabrous, and also by more spreading leaves and smaller seeds. MUELL. ARG. based this on a specimen cultivated in 1812 in the botanical garden of Montpellier (l.c., p. 229). In 1868 he appears to raise this 'ββ' to the rank of a variety ('c', l.c., p. 552), although he refers to it as a 'forma'. In 1857 he observed that

*Reseda mediterranea* L., as present in LINN, was judged to be identical with 'glabrescens'. Index Kewensis (2, 1893, p. 698) listed '*Reseda mediterranea* L. *ex* MUELL. ARG.' (Mon. Rés., 1857, p. 227). For a discussion of *R. mediterranea* L. see notes sub *R. lutea* L.

*Caylusea canescens* ST HIL. var. *prostrata* was segregated by POST, who desired to name decumbent plants by this varietal name. There is no way satisfactorily to delimit the prostrate plants from the remainder of the species (fig. 4, c).

The type specimen of *Caylusea moquiniana* WEBB was not seen but a careful comparison of all characters mentioned leads to the conclusion that it is synonymous with *C. hexagyna*, apparently a form which is somewhat more pubescent than usual and it was said to bear some ternate leaves.

*Reseda podocarpos* VIVIANI (cf. Index Kew. 2, 1895, p. 697) was described as having a pedicellate ovary and fruit, and a central placenta. Although I have not seen the type, there is no doubt as to its being synonymous.

MERRILL and others have demonstrated the confused nomenclature employed by RAFINESQUE (see above sub *Hexastylis* and *Stylexia*).

Ecological notes: Arabian Pen. In Hodeida, 50 km from San'a, POPOV found *C. hexagyna* growing along the edges of fields, in an escarpment area of terraced cultivation (POPOV PB 3, BM). At 100 miles W of Kuwait Town, it grew in an area with much rain in winter and spring 1948–49, and it bore reddish flowers (TOMLINSON 636, BM). On stony places and sandy stretches N of Jedda, PROTT collected it (1387, 1466, BM).

Chad. In Equatorial Africa (Rep. Chad, Zouar-Badai), GUICHARD noted at ca. 1500 m alt. that it grew on pumice soil (KG/Tib./43, BM).

Ethiopia (Eritrea). SCHWEINFURTH and RIVA collected flowering plants at Goura, at 2100 m alt. in March (925, K), and in the Keren region, MOONEY secured flowers in March and August (8057, K), there was 350 mm rainfall. BALLY, on the coastal Halibai plains in N Eritrea collected flowering specimens on sandy soil among *Heliotropium* (B6937, K), and N of Keren, in the Anseba Valley, on cultivated silt, 'sometimes prostrate, sometimes erect' plants.

Ifni. CABALLERO judged *C. hexagyna* 'muy comun' in plains and river beds.

Jordan. TOWNSEND collected *C. hexagyna* in sandy and stony desert, scarce, fl. in May at Wadi Aseikhim, Azraq area 1923 (65/44, 65/353, K).

Libya. GUICHARD (KG/Lib./437, BM) gathered it at Fezzan, fl. in April, in depressions near the foot of dunes. It dominates on 'dry, previously flooded silt'.

Morocco. J. J. F. E. DE WILDE c.s. observed it 'flatly prostrate' in desert sands, behind dikes of *Eucalyptus*-plantations at Taganout (Goulimine), fl. in April (1923, WAG).

Palestine (Israel). AARONSOHN collected *C. hexagyna* 'Jericho à la Mer Morte (3447, AAR). TUVIA KUSHNIR gathered flowers in June 1941 at Nahal Arnon, Moav, Delta, and D'ANGELIS in May, 1951, W of Dead Sea, at Ein Gedi (HUJ) fruits. In the Judean desert NAFTOLSKY collected fruits in April (HUJ).

EIG's specimen from the Judean desert is densely white pilose (2.4.1932, HUJ). GABRIELITH observed it growing on lime in the Dead Sea area (Massada), in March (26.3.1929, HUJ). *C. hexagyna* occurs in the Negev, where ORSHANSKY and ZOHARY collected it 69 km from Eilat, in the Arava valley, Hammada (13.3.1951, HUJ). LORCH secured *C. hexagyna* at Wadi Khiani, Negev, on loess (HUJ), and D'ANGELIS found in November fl. and fr. in the western Negev, near Gevulot. EIG, ZOHARY and FEINBRUN collected it in a Nubian sandstone region, on compact sand at ca. 1000 m alt., in Edom, El Hesma (24 km of El-Queira), in an assoc. of *Zilla spinosa – Noea mucronata,* prostrate specimens, fl. 30.III.1936 (HUJ); the same collectors secured specimens of over 80 cm tall in the Negev, ca. 14 km N of Ras-el-Naqb (Naqb-el-'Aqaba), in a depression, on sandy gravelly soil in an assoc. of *Zygophyllum dumosum – Zilla spinosa* (HUJ).

United Arab Republic (Egypt). ZOHARY and FEINBRUN collected *C. hexagyna* in western Sinai, Wadi Sheikh, ca. 50 km N of Convent St Catherina, on compact sandy soil in bed of wadi, 'Artemisietum judaici', fl. and fr. in May. The same collectors observed it in the same country at Wadi Mukattab, on the banks of the wadi, in 'Haloxylonetum schweinfurthii'. Near the sea, at El Arish, NAFTOLSKY found specimens with exceptionally large leaves (7 cm long, $1^1/_2$ cm wide, HUJ).

FORSKÅL collected 'Reseda hexagyna' in fallow fields near Caid Bey, in the neighbourhood of Cairo. DELILE also met with *C. hexagyna* 'in deserts near Cairo'. SCHIMPER found it at Abu Zabel in the shadow of 'Mimosa's', in sandy places, edge of desert (41, L).

Summarizing it can be said that *Caylusea hexagyna* is a desert plant, which under certain conditions (silt) can become abundant, otherwise it is a scattered species, which may behave as a moderate weed, never being aggressive or noxious, whereas *C. abyssinica* appears to occur very frequently as a weed, though in small numbers. The data assembled on its occurrence in plant associations suggest that *C. hexagyna* moves rather freely and in varying company.

*C. hexagyna* often sprouts from subterranean parts; the young stems lengthen quickly after the dry season; this way of surviving is e.g. also found in *Reseda lutea* and in *Sesamoides.*

Vernacular names: Egypt, Cairo: d(h)enâbâ; Sinai desert: deinaba.

Illustrative specimens. Algeria. Désiré 59, Sahara occ., Hamada du Dra, O. Oum el Assel; Gram 502, centr. Sahara, Mouydir Mts; Lhoti 104, reg. Hoggar, Tamamasset.

Arab. Pen. Bates 2087, 2164, Jeddah; Botta s.n. à 1838, Taifa; Hildebrandt 145, Geddah; Kerchir 54, Buraiman nr Jeddah; Kadry et Khodeir s.n., spring 1962, Wadi Hanifa, Kharig Rd; Khattab s.n., 28.IV.1944, Hedjaz, Wadi Abha; *id.*, El Sharaiy; *id.* 516, El Ttaief, Wadi Moharam; Kruijt 63, 99, E Djeddah.

Cape Verde Isl. Chevalier 44255, 44282, Ile de Sal, Algodeira; J. D. Hooker (Webb) in 1867, Ins. Jap.; Santo 3226, Santiago, Trinidad; Schmidt s.n., II, 1851, Ins. Boa Vista.

Creta. Sieber (Lucosa dedit) s.n., s.d., Candia, Iraklion.

Ethiopia (Eritrea). Bally 6636, Anseba Valley, 15 m. N of Keren; *id.* 6937, Halibai Plains, coastal; Mooney 8057, near Keren, 38°27': E, 14°47'. N; Pappi 3506, Tra Arbariba e le porte del Diavolo; Schweinfurth et Riva 925, Goura.

Ethiopia. Hildebrandt 531, 532, Habab, auf trocknen Ebenen.

Iran. Sintenis s.n., IV.1901, Transcaspica, Krasaowodsk.

Iraq. Field et Lazar 83, Montafah; *id.* 126, Rutba; Gillett et Rawi 6275, S desert, Shabicha; Rechinger *f.* 12656, desert occ., inter Ramadi et Rutba.

?Italy. Schumann 444, prope Aquilegiam.

Jordan. Dinsmore 9980, 10427, Arabia petraea, N Gurf-Ud Dàràwàh; *id.* 14427, 40 km W Azraq; Kasapligil 2158, R Tafile, Wadi-UmFanajeen; *id.* 2601, Amman distr., Azraq, Wadi Ratam, between Chachran and Duraz village; *id.* 2635 Burqu, 27 km NW H4 IPC pipe station; Rechinger *f.* 12885, desertum Syriacum, inter Amman et Rutba, inter H5 et H4, 205 km ab Amman; *id.* 12923, prope H5, 163 km ab Amman orientem versus; Samuelsson 2884, Wadi Nimrin.

Libanon. Kotschy 525, s.l.

Libya. Guichard KG/Lib/437, Fezzan in Aramas, Edeyen.

Morocco. Balls B 2623, B 2624, Quarzazat; Brettes c.s., s.n., 20.I.1947, Kheneg el Adam, près d'El Ayoun; Emberger s.n., 2.IV.1927, Haha, près Tamanar; *id.*, 2.V.30, Grand Atlas, Quarzazat; *id.*, V.1932, Dj. Bani, à Tatta; Gattefossé s.n., 2.V.1930, Tiznit; Humbert et Maire s.n., IV.1927, Kasr es Souk; Jahandiez 197, Sous, Agadir; Maire et Wilczek 102, Ait Atta, Taomart; *id.*, s.n., 4.IV.1935, ad rupas fluminis Noun; Paulsen s.n., 6.IV.1936; Samuelsson 6536, Sous, Oued Massa près Imaissa; Stomps s.n., 6.IV.1936, between Agadir et Tiznit; Uggla s.n., 6.IV.1936, prope Oued Massa; J. J. F. E. De Wilde c.s. 1841, c. 23 km NNE Tamri, Mogador-Agadir rd; *id.* 1923, Tagaout, rd. Goulimine, Bou Izakarn.

Palestine (Israel). D'Angelis et Chazaelith 524, Negev, Revivim; Boissier s.n., IV.1846, Gaza; Bornmüller 125, Jericho ad Ain-i-Sultan et Wadi Kilt; Davis 3702, Jerusalem-Jericho; Dinsmore 427, Maris mortui, Jericho; *id.* 2980, Wad el Kelt; *id.* 1627, Maris mortui, S Maza; *id.* B2980, N Ghawr-us Sâfujah; Jouannet-Maire 628, Dead Sea; Samuelsson 621, Judaea inter Kahn Hatur et Jericho.

Rio de Oro. Caballero 1.VIII.1934, rio Ifni y del Serha, et llano de Tagraga; Moralès-Agacino et Rungs 361, 29.V.1942, Sahara espagnol, between El Hama et Oued Sekorum.

Sokotra. Theodore Bent, June 1897.

Sudan. Bent in 1896, Nubia 21° L, 3000–4000 ft, sea coast; Drar 432, Erkowit, Red Sea hills; *id.* 516, Gebel Nahaile; Lemono 17, Red Sea, Suakin to Hor Jawanib.

U.A.R. (Egypt). Abdallah s.n., 17.IV.1962, S Sinai, Wadi Isla; *id.* 50, *ibid.*, Wadi El Hommor; Ascherson 47, Cairo Wüste; *id.* 142, Tenida (Oase Dechela); Ball s.n., 13.IV.77, near Rhameses; Boissier s.n., I.III.1846, Egypto media et Arabia petrea; Bornmüller 10370, Cairo, pr. Abbasiye; Bové 150, desert de Sinai (monstrosity); Boulos s.n., 3.X.1952, Wadi Digla; *id.*, 23.IV.1959, N Sinai, Wadi el Maghara; Cramer s.n., 8.I.1880, Abassieh, env. de Cairo; Drar 51, E desert, Wadi Lehami; *id.* 148, 163, Wadi Selilo; *id.* 225, Wadi Ararat; *id.* 389, Wadi el Lega, Convent Sinai; *id.* 476, *ibid.* Gebel Katherina; *id.* 625, NW Sinai, Mitla Pass, opp. Suez; *id.* 823, Sinai, Ras el Nagb (Nageb), Aqaba Gulf; Ehrenberg s.n., I.1821, Beni Suef; Girgis et Sami s.n., 13.XI.1959. Wadi Rishrash; Ibrahim s.n., 22.III.1956, Burg el Arab; Kaiser 20 (à 1891 et 1892), Sinai, Wadi Bedr; Kotschy 56, Torrah nr Cairo; Kralik s.n., 22.III.47, Birket el Hadji, nr Cairo; *id.* 10.III.1848, Beni Hasan; Kramer s.n., 2.V.1904, Sinai, Wadi ab Orta; Letourneux 21, Ramses; Lutton 409, behind Bab el Nasr et Bab el Azhar; Saäd s.n., 13.III. 1957, Wadi Liblab; Schimper 41, nr Abu Zabel; Schweinfurth 34, Wadi Om Dhamarana; id. 150, Abuska, Fayum; *id.* 2337, between Kossèr and Ras Benass, Wadi Gadireh; Shabetai 900, Hamada, E Beni Mazar; *id.* 915, El Awamer, Abnüb; *id.* 2724, Gebel Elba, Wadi Ideib; *id.* 3536, S Galala, Wadi Askhar; *id.* 4159, S Sinai, Wadi Tmara nr Wadi Feiran; Sickenberger s.n., 2.III.1879, Gebel Ahmar, nr Cairo; G. Täckholm s.n., 3.XII. 1926, Wadi Dowaica, E Cairo; V. Täckholm 138, Sinai, Wadi el Araba; *id.* 202, Sinai, Er Raha Plain; *id.* 150, Red Sea Coast, mouth of Wadi Ghadir; *id.* 24.IV.1961, Abu Zeitun, Wadi Feiran; *id.* 562, Gebel Elba distr., Bir Shallal; *id.*, 1905, slope of El Kassira Mt.

**3. Caylusea latifolia** P. TAYLOR **Fig. 5**

*in* Kew Bull. 13, 1958, p. 285, fig. 1 (1–4); Elffers et P. Taylor in Hubbard et Milne-Redhead, Fl. Trop. Afr., 'Resedaceae', 1958, p. 3.

Perennial herb or fruticose, pale green, pubescent stems half a metre tall; taproot ligneous.

*Stems* few, more or less erect, once or twice branching, densely papillose-pubescent above, lignescent and glabrescent at base, terete, ribbed; pith solid.

*Leaves* entire, crowded, (sub)sessile, glabrous or sparsely papillose-puberulous on midrib, narrowly ovate to elliptic, up to 6 cm long and to 2 cm wide, acute or acuminate, flat, smooth.

*Flowers* white, pedicellate, in spicoid racemes. Racemes terminal, dense, slender, ca. 20 cm long; peduncle terete, papillose-pubescent. Bracts persistent, glabrous, ovate-subulate, up to 3 mm long, long acuminate, margins narrowly pallid. Pedicels stout, puberulous, crowded, 2–$3^1/_2$ mm long in flower.

*Sepals* 5, persistent, subequal, glabrous, oblong (-ovate), ca. 2 mm long, $^3/_4$ mm wide, obtuse to acutish, margins narrowly pallid.

*Petals* ca. 4–$4^1/_2$ mm long, exceeding the sepals. Limb of superior petals nearly to base 2–3-partite, central lobe longer than adjacent lobe(s), $1^1/_2$–2 as long as appendage; central lobe linear-(ob)ovate, obtuse to acute, lateral lobes $^1/_2$–$^2/_3$ as long as central lobe, narrow-linear to subulate, acute, appendage peltate, (widely) attached, obovate, ca. 2 mm long, $1^1/_2$ mm wide, transverse rim free, ca. $^1/_5$ mm wide, a minute sharp-edged rim running dorsally lengthwise over the vein; margins minutely papillose. Lateral petals slightly smaller than superior, anterior petal usually the longest; limbs entire, linear-obovate, ca. 3 times as long as appendage.

*Disc* subcylindric, expanded posteriorly, just over 1 mm high, $1^1/_2$ mm wide (incl. extension), below up to $^2/_3$ mm wide, (sub)membraneous, sparsely ciliolate, margin slightly curved upwards, entire.

*Stamens* 15, longer than the petals. Filaments deciduous, filiform, 2–3 mm long, hispidulous. Anthers oblong-ellipsoid, ca. 1 mm long, apex rounded, asperulous.

*Ovary* ovoid, ca. $2^1/_2$ mm long, stipitate, exserted stipe just over 1 mm long, stipe usually hispidulous; carpels 5–6, boat-shaped, with discoid central placenta, glabrous but margin of carpel long white-ciliate, teeth conical, slightly divergent. Ovules ca. 15, erect, radicle pointing downwards.

*Capsules* erect, globular, carpidia stellately spreading, ca. 3 mm long, 4–5 mm wide, on a 3–4 mm long carpophore, glabrous, each carpidium usually 2-seeded.

*Seeds* ultimately greenish-black, dull, globular-ovoid, $1^1/_3$ mm long. Sinus wanting, represented by a shallow groove. Testa papillulose, papillae in regular rows, following the contour of the seed.

Type: Mrs ADAMS no. 628, Kenya, Northern Frontier Province, Huri Hills, 1500 m, July 1957 (K, holotype).

Distribution: Known only from the type locality.

Ecology: The type specimen was flowering and fruiting in July, and growing as a 'small herb on top of volcanic hills, white flowers, alt. 1500 m', probably in semi-desert scrub.

Specimens examined: Only type specimen known.

**2. Ochradenus** DELILE

Fl. Egypte 1813, p. 92 (15); Muell. Arg., Mon. Rés. 1857, p. 92 (Neue Denkschr. Schw. Ges. Zuerich 16, 1858); Boissier, Fl. Or. 1, 1867, p. 421; Muell. Arg. in DC., Prodr. 16(2), 1868, p. 578; Oliver, Fl. Trop. Afr. 1, 1868, p. 104; Post, Fl. Syr. Pal. Sin. 1896, p. 111; Durand et Schinz, Consp. Fl. Afr. 1(2), 1897, p. 188; Pirotta, Fl. Col. Erit. *in* Ann. R. Ist. Roma 8(5), 1903, p. 257; Muschler, Man. Fl. Egypt. 1, 1912, p. 443; Thonner, Fl. Pl. Afr. 1915, p. 229; Blatter, Fl. Aden *in* Rec. Bot. Surv. Ind. 7, 1914–1916, p. 112; Blatter, Fl. Arab. l.c. 8(1), 1919, p. 49; Ramis, Bestimm. Fl. Aeg. 1929, p. 97; Dinsmore in Post, Fl. Syr. Pal. Sin. 2nd ed., 1, 1923, p. 136; Bolle in Engl. et Pr., Nat. Pflz. fam. 2nd ed., 17b, 1936, p. 682, 685; Andrews, Fl. Pl. Anglo-Egypt. Sudan 1, 1950, p. 67; Cufodontis *in* Bull. Jard. Bot. Bruxelles Suppl. 24, 1954, p. 161; Täckholm, Stud. Fl. Egypt. 1956, p. 331; Ozenda, Fl. Sahara Sept. Centr. 1958, p. 278.

*Homalodiscus* Bunge *ex* Boissier, Fl. Or. 1, 1867, p. 422, et Suppl. 1888, p. 69; Blatter, Fl. Arab. l.c., p. 50.

Shrubs, very rarely straggling or climbing, often standing leafless, usually glabrous, 40–100 cm, sometimes up to 3 m tall; taproot ligneous.

*Stems* repeatedly branching or branching in all directions, branchlets thorn-topped (after drying of apex), rugosely ribbed; bark of young branches green, when old turning brown or ashy; pith solid or disintegrating.

*Leaves* entire, sessile, ± fleshy, remote or crowded (rosulate), when dry often foveolate, linear to oblong, $^1/_2$–5 cm long, 1–4 mm wide, obtuse to acute, margins entire. Basal dents present, pallid-ochraceous, often several together.

*Inflorescence* a terminal, densely flowered, spike-like raceme.

*Flowers* solitary, subtended by a bract, bisexual, rarely polygamous, yellow-green or white.

*Sepals* perigynous, 6–5, on the outside wall of the fleshy, cup-shaped torus or disc, widely apart, oblong to (ob)ovate.

*Corolla* perigynous, often seemingly absent, if present, petals minute, usually few, ephemeral and caducous, limb entire or forked, lobe(s) linear, appendage peltately attached to superior petal or reduced (in other petals).

*Disc* the fleshy torus, extending laterally, widely cup-shaped or disc-shaped, often raised centrally to a collar-like rim (a 'second' disc) surrounding and encompassing the fused basal part of the filaments and the ovarial stipe.

*Stamens* hypogynous, 10–30 (–50), rarely arrested; filaments at base adnate to disc and surrounding gynophore, filiform, deciduous, or persistent; anthers (ob)ovate to ellipsoid, sometimes minutely asperulous, cordate at base.

*Ovary* single-chambered, open, before and sometimes also after fertilization, 3 (rarely 4)- carpellate, often minutely punctate-glandular, teeth turgid, margins inflexed and top stigmatoid. Placenta parietal, alternate with the dents, not forked. Ovules campylotropous, in 2–4 rows, numerous.

*Fruits* baccoid or a leathery or membranous capsule, apex seemingly closed or gaping, obovoid to globular(-oblong), sometimes punctate-glandular, with numerous seeds.

*Seeds* reniform to ovoid, $1^1/_2$–2 mm long, $1$–$1^1/_2$ mm wide, black (with a reddish tinge), glistening or dull, sinus narrow or wanting. Perisperm well developed.

Type: *Ochradenus baccatus* DELILE.

Distribution: SE Mediterranean Region (Libya, Egypt, Arabia, Palestine), from Iran to W Pakistan, southward to Ethiopia and Somaliland and Socotra.

Notes. When publishing the new genus *Ochradenus*, DELILE based this on a single new species, *Ochradenus baccatus*. The name was explained: 'Folia basi utrinque glandula luteola stipata. Inde nomen genericum ὠχρὸς pallidus, ἀδὲν glandula'. The genus is now known to consist of 6 species; further research possibly may lead to the establishment of some additional species.

*Homalodiscus* was published by BOISSIER (Fl. Or. 1, 1867, p. 422), referring to 'Bunge in litt.'. MUELL. ARG. (in DC., Prodr. 1868, p. 588) refused to accept *Homalodiscus* BUNGE *ex* BOISSIER as a genus ('dignitate generica caret'). The only difference with *Ochradenus*, and present in *O. baccatus* solely, was in the fleshiness of the capsule and this, MUELL. ARG. rightly stressed, is not a generic character, being variable and quantative. In addition, the disc being fleshy to a varying degree is also an instable difference, and so is its being excentric or not. MUELL. ARG. maintained *Homalodiscus* as a section in *Ochradenus*; additional collections and some new discovered species demonstrate that there is sufficient reason to maintain *Homalodiscus* as a section.

The section *Ochradenus* consists of a single species: *O. baccatus* DELILE; it is characterized by baccoid capsules, with closed mouth and containing papillulose, dull seeds. There is a single disc. The section *Homalodiscus* (BUNGE) MUELL. ARG. (in DC., Prodr. 16(2), 1868, p. 588) has leathery (subsucculent), chartaceous or membranous capsules, with gaping or closed apex and which contain smooth, brightly glossy seeds. There are one or two discs and every intermediate form between one and two discs.

As name-bringing author for the section *Homalodiscus*, BUNGE was cited here, and not BOISSIER, in view of MUELL. ARG's citation (l.c.).

*Ochradenus* is a genus of desert shrubs, bearing leaves after rains but usually the terete, wrinkled, straight branches stand bare. The bark is green and has an assimilatory function. In many herbarium specimens the bark appears to have slipped from the wood, suggesting the presence of an intermediate slimy layer of tissue.

Various desert animals browse on the shrubs, and the result is a dense, crowded mass of rigid branches which usually end in a sharp thorn (after the apex of the branch has dried up and is shed). In flower the terminal racemes are bright yellow by massed stamens. NORRIS (*in* Am. J. Bot. 28, 1941, p. 101) studied the pattern of vascular bundles in the torus of *Resedaceae*. He judged *Reseda* at 'one extreme' and *Ochradenus* 'at the other', *Reseda* being most advanced in the family (l.c. p. 102). In more than one species (perhaps in all) flowers may be ♀ (a whorl of arrested stamens surrounding the ovary), ♂ (the ovary being abortive) or ☿; they may occur together on one single plant. *Ochradenus baccatus* is peculiar by its white, berry-like capsules, resembling the fruit of mistletoe; the capsules of the other species vary between leathery, herbaceous and membranous.

The pallid yellowish gland, referred to by the generic name *Ochradenus*, is the area of insertion of leaves or branches. Usually there is an ochre or orange tissue, bearing a number of denticules, which appear to be glandular. Nothing can be suggested of any function or biological importance. Besides, the appearance of the branch-insertion suggests some anatomical interest. Often, a branch seems to emerge from under the cortex and lifting it to some extent – the raised elliptic area surrounding the branch-base being yellowish or light brown – and its beginning may well consist, one is inclined to think, of numerous extremely short, crowded internodes, which are followed by greatly lengthened internodes and which carry, in season, rosulate groups of leaves (again shortened internodes?). It is to be noted that this possible morphology is more clearly suggested by some specimens, than by others. If it is to be evaluated as a species character, it must be investigated on numerous specimens, and in anatomical detail.

The herbarium specimens suggest that leaves and flowers appear more or less simultaneously but after the fruits ripen the leaves are shed. It is somewhat surprising and disappointing that on this group of desert shrubs – which certainly are not only of biological and morphological interest but also of economic importance and possibilities –, no detailed study on any part or aspect of its life-cycle seems to exist.

The oil contents of the resedaceous embryo, is paralleled by the oil, present in the capsular wall of (all?) *Ochradenus* species. Oil drops escaping from dry fruits of *O. baccatus* make spots in paper bags containing them.

The perisperm is well developed. The enveloping layer round the embryo is comparatively thick; the nutritious tissue capping the cotyledons is often indicated by a bulge in the testa (see also notes on seed and seedling sub O. *baccatus*).

**Key to the species of Ochradenus**

1. Testa papillulose or rugulose, not glossy.
   2. Capsule baccoid, fleshy, closed. Seeds papillulose, brown to black. Disc single . . . . . **2. baccatus**
   2. Capsule leathery, gaping. Seeds rugose and papillulose, ashy brown. Disc doubled . . . . . **6. spartioides**
1. Testa smooth, glossy like varnished.
   3. Stamens 40 or more. Seeds carunculate. Disc doubled . . . . . **3. dewittii**

3. Stamens up to 30. Disc single or doubled.
   4. Capsule seemingly closed. Stamens 12–25.
      5. Capsule thinly membranous, inflated . . . . . **4. ochradeni**
      5. Capsule leathery, subsucculent . . . . . **5. randonioides**
   4. Capsule gaping. Stamens 25–30. Petals present, appendage large . . . **1. aucheri**

**1. Ochradenus aucheri** BOISSIER **Fig. 6**

Diag. Pl. Nov. Or. ser. 2, 3(1), 1854 (1853), p. 50; Muell. Arg., Mon. Rés. 1857, p. 96, tab. 6, fig. 85 (Neue Denkschr. Schw. Ges. Zuer. 16, 1858); *id.* in DC., Prodr. 16(2), 1868, p. 588; Bolle in Engl. et Pr., Nat. Pflz. fam. 2nd ed., 17b, 1936, p. 686.

*Homalodiscus aucheri* (Boissier) Boissier, Fl. Or. 1, 1867, p. 422; Blatter, Fl. Arab. *in* Rec. Bot. Surv. Ind. 8(1), 1919, p. 50.

Shrub (base woody) green to glaucescent, glabrous, 40–70 cm tall; taproot ligneous.

*Stems* much branching, branches often divaricate, rising from orange-ochraceous insertions, leafy in season, top of branchlets ± thornlike, rugulose, green, cortex of old branches turning brown; pith very narrow, solid.

*Leaves* entire, sessile, linear-spathulate, wrinkled when dry, 2–5 cm long, 1–3 mm wide, obtuse to acutish, margin entire.

*Flowers* yellow, on slender pedicels, in terminal 10–20 (–30) cm long racemes, peduncle ribbed. Bracts deciduous, oblong, 1–2 mm long, acute. Pedicels expanding into the torus, terete, 1–3 mm long, up to twice as long in fruit.

*Sepals* 6, deciduous, oblong-obovate, 2 mm long, top rounded, obtuse, margin entire.

*Petals* minute, creamy white, early deciduous, shorter than the sepals, $1^1/_2$ mm long; limb (of all petals) entire, $1^1/_2$ × as long as the appendage, linear-spathulate, 1 mm long, top rounded; appendage peltately attached to limb-base, ovate, $^3/_4$ mm long, margin minutely, irregularly denticulate. Lateral and anterior petals reduced.

*Disc* excentric-orbicular, cup-shaped, $3^1/_2$ mm wide (incl. extension), fleshy, uneven, inner rim raised (especially at posterior side) encircling the fused bases of the filaments, glabrous, margin wavy.

*Stamens* 25–30, varying in length; filaments deciduous, fused at base, glabrous, $1^1/_2$–$2^1/_2$ mm long. Anthers ovoid to ellipsoid, $1^1/_4$ mm long, minutely scabridulous.

*Ovary* cylindric, seemingly sessile, obscurely glandular-punctate, 3-toothed, teeth conical, tip and margins lacerate-papillate, mouth not contracted, seemingly closed by approach of inter-dental lobes. Placenta not forked. Ovules 13–16 per placenta, in 3–4 rows.

*Capsules* erect, (ob)ovoid-cylindrical, 1 cm long, $^1/_2$ cm wide, walls chartaceous, minutely glandular-punctate, teeth up to 1 mm long, notched, mouth narrowly gaping.

*Seeds* brown-black with a reddish tinge, glossy, reniform, $1^1/_2$ mm long, ca.

1 mm wide, ecarunculate, sinus closed, indicated by grooves. Testa smooth or obscurely rugululose, outer layer persistent.

Type: AUCHER-ELOY 4178, 'in regno Mascatensi' (K).

Distribution: Muscat; S and E Iran to W Pakistan.

Notes: BOISSIER based on AUCHER-ELOY 4178 a new species: *Ochradenus aucheri* BOISSIER (l.c.). Afterwards he transferred *O. aucheri* to *Homalodiscus*, a genus in the present revision adopted as a section. BOISSIER stressed as differences with *Ochradenus baccatus*, the larger flowers and non-baccoid, open capsule. Other differential characters are in the more numerous stamens, the larger fruits and the smooth (not papillulose) seeds.

Ecological notes: K. H. et F. RECHINGER collected *O. aucheri* in Iran (Prov. Sistan) near the Afghan border at 1000 m alt., fruiting at the end of May (RECHINGER 4097, s). They also met with it in Baluchistan (W Pakistan), Makran, bearing leaves, flowers and young fruits on April 17th (25°31′ N, 62°82′ E). At 200 m alt., 25°09′ N and 62°21′ E, it had fruits in the same month (RECHINGER 27983, 27799, w). In the Karvandar Mts (Baluchistan), at 1500–1600 m alt., fruits were present in May (RECHINGER 3968, w). POPOV (57, BM) collected it in 'a minor sandy water course, in dry sandstone hills' near Pasni (Baluchistan), with flowers and young fruits in May. Young branches emerge from a coloured, raised area in the bark of the parent branch.

Vernacular name: THESIGER noted in Oman 'qurlia', a name resembling that in use for *O. baccatus* (see there).

Specimens examined: Arabian Pen. Aucher-Eloy 4178 (Muscat); Lee-Oldfield FNLO 38, Wadi Ghor; Thesiger, April 25, 1948, Oman.

Iran. K. H. et F. Rechinger 3379, prov. Lar, inter Hadjiabad prope Tarum et Bandar Abbas, ad jugum Guhra; *id.* 3968, prov. Balučistan, inter Khash (Vasht, Kwash) et Iranshahr (Bampur), Mts Karvandar; *id.* 4097, prov. Sistan, Mt Malik Sian ad confines Afghaniae.

W Pakistan. Popov 57, Baluchistan, near Pasni; K. H. Rechinger 27799, 27811, *ibid.*, Makvan, 10–30 km SW Turbat, versus Gwadar; *id.* 27983, *ibid.*, Makran, Suntsar, versus Kikki.

**2. Ochradenus baccatus** DELILE **Fig. 7, 8**

Fl. Egypt. 1813, p. 92, H.N. Botanique tab. 31, f. 1; Fl. Aeg. Illustr. 1813, p. 63; Spreng., Syst. Veg. 2, 1925, p. 464; Fresen. *in* Mus. Senckenb. 1, 1834, p. 173; Muell. Arg., Mon. Rés. 1857, p. 94, tab. 6, fig. 84 (Neue Denkschr. Schw. Ges. Zuer. 16, 1858); Boissier, Fl. Or. 1, 1867, p. 422; Muell. Arg. in DC., Prodr. 16(2), 1868, p. 589; Oliver, Fl. Trop. Afr. 1, 1868, p. 104; Baker *in* Kew Bull. 1894, p. 319; Post, Fl. Syr. Pal. Sin. 1896, p. 111; Durand et Schinz, Consp. Fl. Afr. 1(2), 1897, p. 188; Pirotta, Fl. Col. Eritr. *in* Ann. R. Ist. Roma 8(5), 1903, p. 257; Muschler, Man. Fl. Egypt 1, 1912, p. 433; Blatter, Fl. Aden *in* Rec. Bot. Surv. Ind. 7, 1914–1916, p. 113; *id.* Fl. Arab. l.c., 8(1), 1919, p. 49; Ramis, Bestimm. Fl. Aeg. 1929, p. 97; Dinsmore in Post, l.c., 2nd ed., 1932,

p. 136; Bolle in Engl. et Pr., Nat. Pflz.fam., 2nd ed., 17b, 1936, p. 686, fig. 430; Burtt et Lewis *in* Kew Bull. 1949, p. 301; Andrews, Fl. Pl. Anglo-Egypt. Sudan 1, 1950, p. 67, fig. 47; Täckholm, Stud. Fl. Egypt. 1956, p. 331, tab. 51; Cufodontis *in* Bull. Jard. Bot. Bruxelles Suppl. 24, 1954, p. 161; Ozenda, Fl. Sahara Sept. Centr. 1958, p. 278, tab. 85.

*Ochr. b.* β *scandens* Hochst. et Steud. *ex* Muell. Arg., Mon. Rés. 1857, p. 95 (Neue Denkschr. Schw. Ges. Zuer. 16, 1858); Boissier, Fl. Or. l.c.; Muell. Arg. in DC., Prodr. l.c.; Pirotta l.c.; Blatt. Fl. Arab. l.c.; Cufod. l.c.; Täckh. l.c.

*Ochr. b.* ββ *monstruosa* Muell. Arg., Mon. Rés. l.c. (Neue Denkschr. Schw. Ges. Zuer.); *id.* in DC., Prodr. 16(2), 1868, p. 589; Blatter, Fl. Arab. l.c.

Shrub, sometimes straggling or twining, usually quite glabrous, $^1/_2$–2 m tall, rarely taller; taproot ligneous.

*Stems* numerous, divaricately branching, often bare, leafy in season, branches straight, usually rigid and ending like a thorn, if climbing slender and whip-like, rugose, green, the cortex often seeming to become detached easily, perhaps by a slimy layer; pith narrow, solid.

*Leaves* entire, sessile, fleshy, wrinkled when dry, linear; 2–5 cm long, $1^1/_2$(–4) mm wide, top rounded, tip acute, margin entire.

*Flowers* yellow on stiff pedicels, sometimes polygamous. Racemes (3–) 5–15 (–30) cm long, densely (lax in the scandent form) flowered, peduncles ribbed, apex often acute, thornlike. Bracts usually deciduous, fleshy, oblong, 2–3 mm long, acute. Pedicels terete, 1–2 mm long, sometimes slightly longer in fruit.

*Sepals* 5 (or 6), far apart on the outer (under) wall of the discoid receptacle, oblong-ovate, 1–$1^1/_2$ mm long, blunt.

*Petals* absent or a few, ephemeral, subulate, very minute, usually exappendiculate petals present.

*Disc* unevenly orbicular, finally fleshy and reflexed, surrounding excentrically the fused and adnate whorl of filament bases, and the seemingly sessile ovary, glabrous, margin undulate.

*Stamens* 12–18, (in ♀ flowers arrested and hypogynous) otherwise of varying length. Filaments deciduous, glabrous, filiform, $1^1/_2$–$2^1/_2$ mm long. Anthers ovoid to ellipsoid, 1 mm long, smooth.

*Ovary* cylindric, glabrous, smooth, 3-dentate; dents stumped, the stigmatic tissue on apex, mouth gaping. Placenta not forked. Ovules 4–7 per placenta, in 2(–3) rows.

*Capsules* bacciform, globose, sessile on the disc, 4–6 mm in diam., glabrous, succulent, apex strongly contracted, seemingly closed; seeds few.

*Seeds* brown to reddish-black, reniform, ca. $1^3/_4$ mm long, 1 mm wide, sinus very narrow. Testa minutely papillose (outer layer persistent), papillae not touching, in regular rows following the seed-contour.

Type: DELILE s.n., 'In valle fontis "el-Touâreq", prope Soueys; et in Aeg. sup.'.

Distribution: Deserts of the SE Mediterranean area, Libya to Egypt, Arabia, southwards to Ethiopia, Somaliland and Socotra, through the Orient to W Pakistan (Sind).

Notes: DELILE's type to *Ochradenus baccatus* (possibly at P) was not seen but there is no doubt as to its identity. It was collected 'in valle fontis el-Touâreq, prope Soueys (?Suez); et in Aeg. sup.'. BURTT et LEWIS (*in* Kew Bull. 1949, p. 301) stated as type-locality 'Egypt, Medynet-abou, Qournah et Denderah, sur les limites du désert'. *O. baccatus* is the widest spread species in the genus; it represents a section (see notes to the genus).

MUELL. ARG. validated the name 'β *scandens*' HOCHST. et STEUD. which had been distributed on printed labels accompanying 'W. SCHIMPER 915; In collibus granitosis prope Dscheddam. Arabiae felicis inter Acacias'. There is no evidence warranting the straggling specimens to be segregated; all possible intermediates between the spiny, compact desert-shrub, and the twining straggler, with slenderer, whip-like branchlets occur. A note to this effect, probably written by HOOKER, is attached to the syntype of 'var. scandens' (STOCKS 409, K). No correlation was found to exist between the straggling habit and the presence of monosexual flowers, although the (very limited amount of) available specimens might suggest a more common occurrence of flowers with arrested stamens on climbing plants.

DELILE, when publishing *Ochradenus* as a new monotypic genus, represented by *O. baccatus* DELILE, added a full description to the detailed plate. (Descr. Egypte, Hist. Nat. II, 1813, p. 92–93, tab. 13). The main characteristic is, DELILE declared, the transparent berry, which is ovoid, whitish, and ca. 1 cm long. He described *O. baccatus* as a $1^1/_2$ m tall, rounded shrub with straight, slender branchlets. The bark of the stem is yellowish, of the branches light green. The linear sessile leaves are inserted below a yellow, glandular, shiny tubercle, which is scarcely visible in dried specimens. Very few fruits are produced, the large majority of the flowers being shed early. All parts of the plant have a strong smell, like *Cochlearia*. Camels, goats and sheep graze the branches, which causes the plant to become very dense. It flowers in December.

Seeds received from the botanical garden at Karachi made it possible to observe seedlings in the greenhouse at Wageningen. They germinate (under favourable conditions) after 5–6 days. The hypocotyl lengthens rapidly to 2–3 cm. The pallid green, equally sized cotyledons escape readily from the testa, which opens before the apex of the radicle. It seems that there a small circular part of the testa may become detached, a kind of operculum, after which a dorsal median length split and two lateral splits make escape for the hypocotyl and cotyledons easy (fig. 8, g-$g^1$). The structure of the testa in *O. spartioides* also suggests the presence of terminal operculoid tissue, and the same phenomenon can be seen in *Caylusea*. Lack of living material prevented further observations but the point certainly deserves to be further studied throughout *Resedaceae* when an opportunity arises.

A part of the perisperm becomes visible (colourless) in the opening of the

gaping testa. This pellicle remains entire while the (outer) testa splits apart over it and the cotyledons glide out, like from the finger of a glove.

There is no visible evidence of basal dents on the cotyledons, though a single (green) tooth-like excrescence, median, at each side of the joined base of the cotyledons can be observed (fig. 8, k). The first pair of (decussate) leaves which are comparatively much wider than the adult leaves, have (small) basal dents.

Germination appears to be irregular, in the same way as is prevalent in *Resedaceae* generally. Among a number of seeds from a single capsule some germinated days later after the majority appeared (simultaneously) above the surface. A comparatively large number do not germinate at all. Seedlings of *O. baccatus*, after rapid initial growth, show no further lengthening but need over a week to form the first pair of leaves.

NORRIS (*in* Am. J. Bot. 28, 1941, p. 102–103) found that in the genus *Reseda* nectariferous tissue was present and outside that genus nowhere in the family except in *O. baccatus*, where there was some 'histological evidence' of nectariferous tissue. Apparently, NORRIS did not investigate the nature of the yellow tissue at the base of the leaves and branches (see also notes to the genus).

Ecological notes: Arabia. In March 1952, TOTHILL (53, BM) noted that ♂ and ♀ plants were growing alongside in granite rocks. It was a somewhat woody herb, up to 4 ft high, at 2130 m alt., 17 km N of Dhahram. The same collector (105, BM) found *O. baccatus* in flower in July, in SW Arabia, Bisha Road, 31 km SE of Taif, at the edge of *Acacia tortilis* plains, again on granite rocks. He declared 'sallam' has disappeared and 'rainfall about 3 inches'. In the same region D. VESEY-FITZGERALD (21°20′ N, 40°20′ E, BM) observed it in flower in May as a 'ropey lian'. Sandy soil with gypsum were noted by M. L. GRANT at Abqaiq, 12 km SE of Dhalman, in semi-desert (16841, BM). There were fruits in November.

Mrs. T. CARPENTER, at Muharraq stated 'on some bushes the seeds make a show in March looking like pearls on the stem' (107, BM). G. L. BATES (2042, 2099, BM) collected flowering specimens in February, on stony, sandy hillsides near Jeddah, on granite hills, where SCHIMPER (915) had secured it a century earlier (in 1835). Both collectors noted *Acacia*'s growing among *O. baccatus*. The time of flowering was put in the same month by SCOTT and BRITTON (522, BM), in the San'a district, Ghaiman, at ca. 3000 m alt. and by THESIGER, at Ghurlaia (Yirsha), W El Haira, SW Rub'-el-Khali (BM).

COLLS, POPOV, ILLIN and GILLILAND (4172, BM) found it 'binding a small dune in *Acacia* scrub' at Wadi Irma (Shabwa area). SCHWAN, collecting near Taif (46, BM) observed that it was 'quite common throughout Saudi Arabia', favouring the edges of wadis where soil moisture is little better than average. Though 'it is not a preferred plant' it is closely grazed for want of better. Another collector, working 10 km N of 'Jidda' judged it 'a good range plant, but it is so rare that it is not of much account' and 'usually quickly eliminated by camels or goats.' In the same region POPOV collected scandent specimens, 13.12.

1948, with up to 30 cm long inflorescences and arrested stamens (GP/ 125, BM).

At Taif, SIMONDS found it at ca. 1800 m alt. (24, BM), on flat sandy stretches, seeking protection of thorn bushes, and PROTT saw it in flower from August to October on the shore near Jeddah (17 bis, BM).

Bahrein Isl. R. GOOD collected *O. baccatus* in sandy dunes (16, BM).

Chad. At Wadi Basso, Ennedi Mts, P. C. HUTCHISON secured flowers and young fruits on Oct. 28, from a shrub, up to 10 ft in height (115, BM).

Ethiopia. There are flowering specimens collected in August by HILDEBRANDT (659, BM) at Az-Terles, but additional data concerning the occurrence in Ethiopia are wanted.

Iran. KOELZ, observing a flowering plant at Bandar Abbas (14164, W) in December, described the flowers as 'lemon color'. In Kerman prov., *O. baccatus* grew on a sandy silty plain among *Calotropis procera*, *Lycium* cf. *barbarum* (?MIDDLETON 3585, K). KØIE collected it 16 March in flower at Dalechi (1479, C). Possibly it is common on Gunnam Isl. in the Persian Gulf (R. HAY, 1949–50).

Jordan. North of Aqaba, at Wadi-el-Yutum, it was 'common in desert galleries, grazed by all kinds of livestock', and it flowered in December (KASAPLIGIL 1816, K).

Kuweit. DICKSON said it was 'rare' in Kuweit, a large bush, 4 ft high, eaten by camels, and growing in sandy torrent beds, in the Zor hills.

Oman & Muscat. In Oman *O. baccatus* flowered in April (LEE-OLDFIELD FNLO 203, BM).

Pakistan (Sind). At 900 m alt., on calcareous mother-rock, RECHINGER (29467, W) found it flowering in May, locality 30°05′ N, 68°00′ E. SABNIS (B 1052, BLAT) collected *O. baccatus* on sandy plains near Nasarpur. It seems that the twining form often occurs here e.g. at 600 m alt. in the Surjawa hills (SABNIS 30881, BLAT). The specimen collected by STOCKS (409, K), one of the type specimens of 'var. scandens', comes from Sind and agrees exactly with SCHIMPER 915 from Arabia (see above).

Palestine (Israel). At sealevel in Wadi Shaïb (Transjordan), N. P. CLARKE (14, BM) noted 'brilliant golden flowers' on *O. baccatus*. In April, E. WALL (4/4/33, BM) found it flowering at Wadi Nimrin (Transjordan). At the same time LUPTON collected it in flower on a sandy bank, in a subtropical wadi (Wadi Kelt), Jerusalem (BM). At Ain Farah, however, in rocky places the 1–2 m tall shrubs flowered in July (MEYERS et DINSMORE B 4170, CAI). It is common in the Negev, where e.g. EIG, ZOHARY, and FEINBRUN (HUJ) found it 2–3 km of Ras-el-Naqb (Naqb-el-'Aqaba) in furrows on granite hills, at ca. 750 m alt., in '*Gymnocarpetum fruticosae*'. The specimen had young fruits on 2 April, 1936, and arrested stamens; it was not climbing. In the Lower Jordan Valley, ZOHARY collected 3 km E of Ein Fara, in canyon rocks, on Dec. 20, 1941, a very leafy specimen bearing ripe fruits (HUJ).

Socotra. In 1881, SCHWEINFURTH collected *O. baccatus* 'am Fusze des Kalkgebirges' (372, BM). GWYNNE noted at Acoily, at 300 m alt., 'arid scrubland' (215, BM) and at 650 m, at Hagend (226, BM), it flowered in June.

Somalia. Flowers were yellow, and ripe fruits white on a large bush, up to 7 ft high, on open ground in *Juniper*-zone (1600–2000 m alt.) on the southern slope of Wagger Mts (BALLY 27-10-54, K). HILDEBRANDT found flowers in April, in 'Meid Vorbirge', and the plant was reputed to be good camel fodder (1516, CORD).

BOALER (A 1, K) saw the 'broom-like shrub' on red soil over nodules secondary limestone, at 1500 m alt., along the Hargeisa Rd, 20 m W of Burao, in the Gairin Arori Plain, where it occurred 'front and body of *Andropogon*-vegetation areas'. HEMMING (1606, BM) collected it about the same altitude, bearing flowers in September, on a plateau above Galgallo of 'almost bare limestone'. He noted 'nothing higher in this area'. The same collector got *O. baccatus* on 'heaps of fallen broken cliffs near the sea', 15–30 m alt., at Bereda (1800, BM). Elsewhere it was 'straggly erect' in watercourses in 'stony basement pediments' (HEMMING 1130, BM).

Sudan. At Port Sudan, it flowered in January, 'a climber on *Acacia*' (MAC DOUGAL, T. LYKER 34, BM).

U.A.R. (Egypt). SHABETAI (F 1786, CAIM) noted at Gebel Elba, Wadi Rabdeit, 'climbing on *Euphorbia cuneata*', all over the place. At Wadi Feiran, at 800 m alt., it was a bush, 60–70 cm high, with sulphur yellow flowers (MEINERTZHAGEN s.n., BM). SHABETAI (F 4212, CAIM) collected it near the Red Sea shore, at Wadi Um El Zanatir, S Galala, on sandy calcareous soil, fruiting in December. SIMPSON (1227, CAIM) judged the berries to 'glisten like those of *Viscum album*', in May at Wadi Hof. TÄCKHOLM noted in July, at Wadi Rishrash, S of Helwan 'snow-white when ripe' (CAI), where the plants are 'common between limestone' (fl. and fr. in March, DRAR s.n., CAIM). The same collector observed at Wadi Bileh, N Hurghada, that plants, fl. in January, were 'largely eaten by cattle, gazelle' (DRAR s.n., 29.1.1932, CAIM).

WHEELER HAINES found Febr. 1951, 100 km Police Check Post, Suez Rd, 'young branches much browsed' (CAI); it was 'abundant near Seyal trees, seen at first growing intertwined with the trees before the lower branches are lost'.

Vernacular names: In 'Arabia petraea', SCHIMPER noted *gurrdi* or *gursi*. In the SE Egyptian desert, DRAR noted *gordy* and *qordy*; near the Red Sea Coast (S Galala) it was *gurdy* (SHABETAI); KAISER heard this latter name at Wadi Hof and in Sinai; it is used generally; BOULOS met with 'wad-hai' at Gebel Elba.

On Socotra they have *girdhi* or *gurdhi* (SCHWEINFURTH), in Kuweit *gurthi* and *gârthi* (DICKSON).

In Somalia, HILDEBRANDT recorded *mürhau*, confirmed by BALLY, who wrote *myro*, and GLOVER & GILLILAND, who have *murhau*. In S Arabia (Jol Naza), INGRAMS recorded *gurdiyah*, and on the northern Jol, near Zamuk, it was *gurdhiya* (COLLS, POPOV, ILLIN, GILLILAND).

Illustrative specimens: Aden. Hildebrandt 788, dune b. Aden.
Arabian Pen. Botta s.n., à 1838,, Taifa; Deflers 231, Wadi Dhabab; Ehrenberg 212,

Ins. Fusan (Farasan); Fischer 49, Gedda; Grant 16841, Al Hasa, Abgaiq, 12 km SE Dhahran; Kadry et Khodeir s.n., spring 1962, Wadi Hanifa; Khattab, 20.V.1944, El 'Ethrebān Village, Abha; *id.* 167, Gabal 'Arafat; *id.* z4636, N El Taief; Khodeir 39, Kharj Road; Kruijt 213, E Djeddah; Lee-Oldfield FNLO 203, Oman; Popov GP/125, Buraiman nr Jeddah; Schimper 915, prope Dsched-dam; Thesiger s.n., Buraimi, foot of Oman Mts.; Stephenson PRS 353, nr Jeddah.

Arabia petr. Schimper 305, Wadi Gurra; *id.* 307, valle Hebran.

Ethiopia. Ehrenberg s.n., à 1822, Arkiko-Dougola; Hildebrandt 659, Az-Tevlet?

Iran. Behboudi 288, prov. Lar, Badagha, inter Lar et Lenge; *id.* 494 E, Biaban, Kardar et Sirigue; Bornmüller 39, Ins. Rischni; *id.* 2046, 2047, inter Kaserun et Buschir (Kotel Mallu, Kotel Kumaredsch); *id.* 38, Laristan, Bender-Abbas; Gauba et Sabeti 290, prov. Baluchistan, Tiss prope Chahrbahar; *id.* 287, prov. Khusistan, Borasdjun prope Ahwaz; *id.* 289 a, prov. Lar, Dalun inter Lar et Bender Abbas; Grant 16983, Fars, 60 km SE Bastak; Køie 1479, Dalechi; Kotschy 159, distr. Abuschir, prope p. Dalechi; Scharf 490 E, prov. Baloučestan, Iranshahar, Damén; *id.* 493 E, *ibid.*, Cahbahar; *id.* 496 E, *ibid.*, Tangué Darhé; Stapf 117, by Khane Radar.

Jordan. Kasapligil 1808, Maan, Wadi Musa, Petra; *id.* 1816, Wadi El-Yutum, N Aqaba; Khattab, s.n., 11.I.1944, Aqaba; Samuelsson 2878, Wadi Nimrin; Wall s.n., 26.III.33, 4.IV.33, *ibid.*

Libya. Ascherson 146, Gebel Abu Toda.

Palestine (Israel). Aaronsohn 3466, Engeddi; Monzo 101, desertum judaicum, Wadi Kelt; Bojko s.n., 8.II.1936, Wadi Fahr, E Juda; Dinsmore 2170, Jerusalem, Wadi Kelt; Linder s.n., 5.III.1912, 'Ain-Fārah, 12 km NE Jerusalem; Meyers 170, Jerusalem, Wadi el-Kelt; Meyers et Dinsmore 2170, *ibid.*; *id.* B 170, Maris Mortui, St. George's Convent; *id.* B 4170, Ain Farah; Roest 3, 70 km N Eilat; Samuelsson 2497, Desert. judaicum (Judaea), inter Jerusalem et Jericho, Wadi Kelt; Yehudai 632, Arava Valley, outlet of Wadi Figra.

Socotra Isl. Paulay s.n., 28.I.1899, bei Râs Kattánen; *id.*, 2.II.1899, Wadi Fâleut; Simony s.n., 12.I.1899, Râs Shoab.

Somalia. Bally B 9647, upper ?Sheik; Drake-Brockman 293, 297, Golis Range; Gillett 4393, Duwi; Hildebrandt 1516, Meid. Vorberge; Merla, Azzaroli et Fois s.n., 19.III.1956, Migiurtina, Valle del Darror Scusciuban (only leafless branches).

Sudan. Drar 306, Sinkat, Red Sea Hills; Kassas 826, Khor Arbaat; Lynes 400, Darfour, Jebel Meidob.

U.A.R. Boissier s.n., I/II. 1846, s.l.; Boulos s.n., 27.X.1956, Gebel Elba, Wadi Haikwal; *id.*, 22.IV.1959, N Sinai Wadi El-Maghara; Bové 4, env. du Suez; Cramer s.n., 6.V.1880, env. du Caire, Ouadi Doukla; Drar s.n., 14.IX.28, El Gedeirat; *id.*, 29.I.32, Wadi Bileh, N Hurghada; *id.* 60, Wadi Lehami, E Desert; *id.* 150, 158, Wadi Selilo; *id.* 101, SE Desert, Wadi Rabdit; *id.* 176, Gebel Elba, Wadi Kansisrob; *id.* 93, NE Sinai, Wadi Tayiba; *id.* 139, *ibid.*, Wadi el Hommour; *id.* 727, C. Sinai, El Themed, Isthmic Desert; *id.* 844, Ras el Naqb, Aqaba Gulf; Ehrenberg s.n., X.1821, Farschūt; *id.*, XI.1823, montibus Sinaticis; Kassas s.n., near Ain Sokna; Kaiser 210, 272, 684, Sinai; *id.* 45 (1841, 1891), Sinai, Wadi Badr; *id.* 45 (1893), *ibid.*, Wadi Letitih?; Kotschy 938, Sinai; Kralik s.n., 24.II.1848, près de Thèbes; *id.* 7.III.1848, près de Manfalout; Letourneux 25.II.1877, 19 (26.II.1877), Djebel Attakah, prope Suez; Muschler s.n., III.1906, Sinai, Djebel Nakus; Sa'ad et Khattab, Cairo-Suez Desert Road; Schilden et Doorenbos 4, road to Bir Abu Darag, W Suez; Schweinfurth 325, bei Abāde, Manfalout; *id.* s.n., 10–12.IV. 1887, N Galala, Wadi Ashar; *id.* 17.V.1887, N. Theile, Wadi Tarfeh; *id.* X.96, Wadi Gerrani bei Heluan; *id.* 23.V.1904, 6.III.1909, Thèbes, Medinet Habu; Shabetai z 2726, Gebel Elba, Wadi Radbeit; *id.* z 4161, Sinai, Wadi el Humur at el Ramla; *id.* 5833, Wadi um Yasr, Râs Ghārib; Sickenberger '4291', 13.V.1880, Wadi Gendeles; Sieber s.n., s.d. Benisuef; *id.* Theba; Simpson 703, Wadi Rishrash; G. Täckholm s.n., 15.IV.1927, Wadi Hof; *id.* 21.I.1929, Mersa Halaib; V. Täckholm c.s. 21.III.1960, Wadi el Hay, Saff desert; Volkens s.n., 4.II.1884, Wadi Hof, Heluan.

W Pakistan. Gleadow s.n., II. et III. 1902, Sind; Lace 3618 A, Baluchistan, Wam Dangi; K. H. Rechinger 29467, Quetta, Torkhan supra Harnai; Sabnis B 1052, Nasarpur, Sind; Thickhurst 30881, Surjana Hill, Sind.

### 3. Ochradenus dewittii ABDALLAH, *sp. nov.* Fig. 9

*Ochradenus dewittii* species nova staminibus numerosis (40–60), discis duobus, capsulis chartaceis hiantibus satis distincta.

Almost leafless, entirely glabrous shrub.

*Stems* slender, whiplike, pallid green, finely ribbed, 3–5 mm thick; pith solid.

*Leaves* few, sparse, rarely with young, axillary inovations, fleshy, longitudinally rugulose, linear-oblong, usually slightly widening in the upper part, 2–3$^1/_2$ cm long, 1–2 mm wide, acute or obtusish; margin entire. Basal dents deciduous, glandular, conical, ca. 1 mm long.

*Flowers* in terminal spicoid racemes. Inflorescence laxly flowered, up to ca. 25 cm long and 1 cm wide; peduncle finely ribbed. Bracts persistent (basal dents comparatively large), fleshy, linear to ovate, up to ca. 5 mm long, acute, margin entire. Pedicels terete, smooth, rather thick, gradually widening above, up to 2 mm long.

*Sepals* 5–7, tardily decidous, widely apart on the outer surface and near the periphery of the overhanging fleshy extension of the torus, oblong to -ovate, 2 mm long, 1 mm wide, obtuse to acutish, margin entire.

*Petals* white, minute, as many as the sepals, deciduous, slightly longer than the sepals; limb narrow-linear, dilated and more fleshy towards top, ca. 1$^3/_4$ mm long, about 3 times as long as appendage, in superior petal peltately attached to the lower half of the appendage, usually near the apex of the appendage in the other petals, appendage cordate, ca. $^3/_4$ mm long, $^1/_3$ mm wide, transverse rim hastate, short papillose especially dorsally, margins sparsely dentate-papillose, of other petals diminishing gradually.

*Discs* 2, the outer dish-shaped, just over 1 mm high, 1$^3/_4$ mm wide, overtopping the sepals, inner disc rising from a constricted base above the outer disc, cup-shaped, over 1 mm high, 1$^1/_2$ mm wide, obliquely surrounding the base of the filaments, glabrous, broadly dentate.

*Stamens* crowded in more than one whorl (irregular), much exceeding the ovary. Filaments ca. 40–60, tardily deciduous, glabrous, filiform, ca. 2$^1/_2$ mm long. Anthers oblong-ovoid to ellipsoid, 1 mm long, deeply sagittate.

*Ovary* sessile, 3-toothed, mouth seemingly closed, walls minutely and densely punctate-glandular (oil glandlets). Placenta not forked. Ovules 10–12 per placenta, in 3–4 rows.

*Capsule* ovoid to ellipsoid (urn-shaped), erect to patent (pedicel variously curved), over 1 cm long, ca. $^1/_2$ cm wide, gaping (mouth slightly contracted), wall chartaceous (not visibly glandular), teeth triangular, short and broad, often brighter (orange-brown) coloured.

*Seed* hippocrepiform or reniform, 1$^1/_2$ mm long, ca. 1 mm wide, smooth (surface minutely rugululose), glistening like varnished, blackish brown, when young ecarunculate but fully mature with light-coloured carunculoid tissue; sinus closed, indicated by a deep groove, perisperm-cap indicated by a small bulge.

Type: G. POPOV, GP/57/77 (BM, holotype).

Distribution: Southern Arabia, Oman (Muscat).

Notes. POPOV collected the type on May 2nd, 1957, with young and fully developed flowers and fruits among which some had reached maturity. The epithet refers to H. C. D. DE WIT, professor of botany at the University for Agriculture at Wageningen, who guided my work on *Resedaceae*.

Phytopathology. A teratologous flower (in POPOV GP/57/77, BM) showed an anomaly not recorded previously in *Resedaceae*. The inner disc was split, a corresponding splitting was present in the outer disc from where a sepal rose carrying two anthers on the upper (inner) surface near the apex.

Specimens examined: S Arabia. 'Comm. Mr. Guy Pilgrim 1906', 'Semail'. Oman (Muscat). G. Popov GP/57/77.

**4. Ochradenus ochradeni** (BOISSIER) ABDALLAH *comb. nov.* **Fig. 10**

*Reseda ochradeni* Boissier, Diagn. Pl. Nov. Or. ser. 2, 3(1), 1854 (1853), p. 49; Muell. Arg., Mon. Rés. 1857, p. 143, tab. 7, fig. 101 (Neue Denkschr. Schw. Ges. Zuer. 16, 1858), *id.* in DC., Prodr. 16(2), 1868, p. 588.

*Homalodiscus ochradeni* (Boissier) Boissier, Fl. Or. 1, 1867, p. 422; Muell. Arg. in DC., l.c.

*H. minor* Bunge *apud* Boissier, Fl. Or. 1, 1867, p. 423 (= var. *minor*).

*Ochradenus minor* (Bunge *apud* Boiss.) Muell. Arg. in DC., Prodr. 16(2), 1868, p. 588 (= var. *minor*).

*O. boissieri* Muell. Arg. in DC., Prodr. 16(2), 1868, p. 588; Bolle in Engl. et Pr., Nat. Pflz.fam. 2nd ed., 17b, 1936, p. 686.

**Key to the varieties in O. ochradeni**

Branchlets divaricate. Stamens ca. 20. Bracts equaling pedicels . . . . . var. **ochradeni**

Branchlets strict. Stamens 15–17. Bracts up to half as long as pedicels . . . . .var. **minor**

**a. var. ochradeni**

A pale green, glabrous, 40–80 cm tall perennial; taproot lignescent.

*Stems* usually solitary, divaricately branching, laxly leafy, finally aphyllous, branches delicately ribbed; pith solid.

*Leaves* entire, sessile, fleshy, linear-obovate to -spathulate, $^3/_4$–$1^1/_2$(–$2^1/_2$) cm long, up to 3 mm wide, obtuse to acute; margin entire.

*Flowers* apetalous, on patent pedicels. Racemes 15–25 (or more) cm long, laxly flowered. Bracts tardily deciduous, fleshy, linear to obovate, ca. 3 mm long, acute. Pedicels stout, obscurely ribbed, 1–3 mm long, up to 4 mm in fruit.

*Sepals* 6, tardily deciduous, reflexed, ovate, often narrowly oblong, obtuse.

*Petals* wanting.

*Disc* orbicular, almost symmetrical, without collar round the insertion of the

stamens, cup-shaped, spreading, margins becoming reflexed, smooth or wavy.

*Stamens* 18–25, equal, deciduous. Filaments smooth, filiform, 2–3 mm long. Anthers ellipsoid to oblong, 1 mm long, $^3/_4$ mm wide.

*Ovary* ovoid-cylindric, sessile, minutely glandular-punctate, 3-dentate, dents subcylindric, 1 mm long, divergent, inner surface and interdental lobes densely papillulose, mouth gaping (seemingly closed), constricted beneath the teeth. Placenta not forked. Ovules 12–15 per placenta, in 3(–4) rows.

*Capsules* erect, obovate, sessile above the disc, 9–12 mm long, minutely glandular-punctate, thinly membranous, teeth cuspidate, mouth contracted beneath the teeth, seemingly closed.

*Seed* hippocrepiform, ca. 2 mm long, with some scarcely perceptible rugulations (lengthwise), glossy, brown, carunculate; sinus closed, a wide groove.

Type: AUCHER 4179, 'in regno Mascate vel in Persia australi' (see notes).

Distribution: Iran.

**b. var. minor** (BOISS.) ABDALLAH *nov. comb. stat.*

Basionym: *Homalodiscus minor* Bunge *apud* Boissier, Fl. Or. 1, 1867, p. 423.

Up to 30 or 40 cm tall. Branches strict. Inflorescence densely flowered. Stamens ca. 15. Bracts shorter than in var. *ochradeni.*

Type: BUNGE, in Persia inter Ispahan et Teheran, ad Gäs.

Distribution: Known only from the type locality.

Notes. The earliest description and name for *O. ochradeni* was published by BOISSIER (Diagn. Ser. 2(1), 1854 (1853), p. 49) who then used the name *Reseda ochradeni.* This was based on one single specimen, AUCHER-ELOY 4179, collected, it was stated, either in Mascat or in southern Persia.

In 1867, BOISSIER moved *Reseda ochradeni* BOISSIER into *Homalodiscus,* coining *Homalodiscus ochradeni* (BOISSIER) BOISSIER (Fl. Or. 1867, p. 422). He now located AUCHER-ELOY 4179 in southern Persia, and added a specimen collected by BUNGE between Kerman and Yezd.

Among the isotypes of AUCHER-ELOY 4179 (BM, K, L, P) is one, originating from P which has in unidentified handwriting on its label 'regno Mascat' and also, by the same hand, *Reseda physocarpa* DCNE, an unpublished name added to this and a number of isotypes. However, the msc. addition 'regno Mascat' is on the usual label which has also in printing 'Asie occidentale 1837'. Now, AUCHER-ELOY visited Mascat – as far as the available information goes – only in 1838. AUCHER-ELOY 4178, the type of *O. aucheri,* nevertheless, was never doubted as regards its origin from Mascat, and, obviously, 4178 precedes 4179.

It is further to be noted, that the ripe, membranous, inflated capsules on AUCHER-ELOY 4179 were never collected again. BORNMÜLLER 2045 (from Persia)

has young fruits which suggest to become similar, in the end, to the physocarpous fruits of AUCHER-ELOY 4179. There is no certainty. It seemed best to follow BOISSIER's (and MUELL. ARG.'s) conclusion and refer AUCHER-ELOY 4179 to 'Persia australis', pending the arrival of more complete specimens from Persia (or Muscat).

*Homalodiscus minor* BOISS. (l.c.) was accepted as a species by MUELL. ARG. but referred to *Ochradenus: O. minor* (BOISS.) MUELL. ARG. (l.c.); MUELL. ARG. confessed that he found it difficult to segregate these flowering, more rigid branches, of which the flowers had slightly less numerous stamens than in '*O. boissieri*', as a species. The bracts are shorter than in '*O. boissieri*', but then the length of the bracts is variable in *Ochradenus*. No significant difference being available it was decided to reduce *O. minor* to a variety in *O. ochradeni*. In the type-locality (near Gäs, between Isfahan and Teheran) additional collections ought to be made in order to assess the true status of 'O. minor'.

Ecology: BORNMÜLLER collected *O. ochradeni* var. *ochradeni* in the deserts at Kuschkuh, in full flower and just fruiting in April. BUNGE's specimens (between Kerman and Yezd) were fruiting in April. It was stated that var. *minor* flowered one month later.

Specimens examined: Var. *ochradeni* – Iran. Aucher-Eloy 4179; Bornmüller 2045, prov. Kerman, ad Kuschkuh, inter Kerman et Yesd; Bunge s.n., IV.1859, inter Kerman et Yesd.

Var. *minor* – Persia. Bunge s.n., V.1859, inter Ispahan et Teheran, nr Gäs.

**5. Ochradenus randonioides** ABDALLAH *nom. nov.* **Fig. 11**

*Randonia somalensis* Schinz in Bull. Herb. Boiss. 3, 1895, p. 398; Dur. et Schinz, Consp. Fl. Afr. 1(2), 1897, p. 179; Bolle in Engl. et Prantl, Nat. Pflz.fam. 2nd ed. 17b, 1936, p. 691; Cufodontis *in* Bull. Jard. Bot. Brux. Suppl. 24, 1954, p. 159.

*Ochradenus somalensis* Baker *f. in* Journ. Bot. 34, 1896, p. 52; Chiov. Fl. Som. 2, 1952, p. 12; Bolle in Engl. et Prantl, Nat. Pflz.fam. 2nd ed., 17b, 1936, p. 686; Cufodontis *in* Bull. Jard. Bot. Brux. Suppl. 24, 1954, p. 161.

**a. var. randonioides**

Low, glaucous-green, white bristly pilose or scabrid shrubs, 60–100(–150) cm tall, often dense, cushion-shaped; taproot ligneous.

*Stems* diffusely branching, branches rigid, crowded, with spiny tips; cortex of young branches and branchlets pale, of older branches turning ashy brown, scaly and flaking (flakes membranous); pith solid.

*Leaves* entire, sessile, glaucous-green, fleshy, rosulate to solitary, hispidulous to glabrous, wrinkled when dry, linear- to linear-obovate, $^1/_2$–$1^1/_2$ cm long, 2–3 mm wide, gradually attenuate to the base, obtuse; margin entire.

*Flowers* bright yellow to greenish, polygamous, in terminal racemes. Racemes short, up to 5 cm long; peduncles delicately ribbed, scabrous to hirtellous. Bracts (sub)persistent, linear to oblong, 2–4 mm long, obtuse to acute. Pedicels

rather stout, scabridulous or hispidulous, 1–2 mm long, slightly longer in fruit.

*Sepals* 6, deciduous, oblong to (ob)ovate, 1–2 mm long, obtuse or acute.

*Petals* 5 or 6, minute, about as long as the sepals. Limb entire, narrow, linear, obtuse, ca. 3 times as long as the erose-margined appendage and peltately attached close to its base. Lateral and anterior petal similar to superior ones (limb of lateral petals sometimes 2-sect), appendages gradually diminishing or wanting.

*Discs* 2, obliquely developed, margin entire; inner disc funnel-shaped, basal part adnate to staminal tube, outer disc as high as the sepal is long, shorter towards the anterior side, inner disc half as long.

*Stamens* 12–14, tardily deciduous. Filaments slender, smooth, up to $2^1/_2$ mm long. Anthers ovoid, just over 1 mm long, apiculate or rounded.

*Ovary* ovoid-cylindroid, shortly stipitate, minutely glandular-punctate, seemingly closed or slightly gaping, 3-toothed, teeth conical, connivent, teeth and interdental (inflexed) lobes not papillulose, smooth. Placenta not forked. Ovules 5–7 per placenta in 2 rows.

*Capsule* ovoid to ellipsoid, subsessile above the discs, 6–10 mm long, 3–6 mm wide, walls semi-succulent or leathery, minutely glandular-punctate, teeth 1 mm long, divergent, apex seemingly closed.

*Seed* reddish dark brown to black, glossy, smooth, hippocrepiform, $1^1/_2$ mm long and almost as wide; sinus closed, ± ecarunculate, indicated by a groove.

Holotype: RUSPOLI-KELLER Exp. à 1891 (ABDALLAH, prof. KELLER, FI).

Distribution: Somalia and Ethiopia (Harar Prov.).

Notes: A specimen collected in Somalia, Aug. 1894, at the Shebeli river by DONALDSON SMITH is the sole basis for *Ochradenus somalensis* BAKER *f.* (l.c.), published in 1896. A year before, SCHINZ had published *Randonia somalensis* (l.c.). The new combination in *Ochradenus*, based on *Randonia somalensis* SCHINZ necessitated a new name, *O. randonioides* ABDALLAH *nom. nov.*, because *Ochradenus somalensis* was occupied.

SCHINZ also had a single specimen (ABDALLAH, prof. KELLER, in 1891) at his disposal. He noted several differences with the monotypic genus *Randonia*, but the doubled disc moved him, nevertheless, to place his new species into *Randonia*, because, he reasoned, the generic segregation of *Randonia* in *Resedaceae* precisely rests on the presence of a doubled disc.

A considerable wider range of specimens from Somalia has become available, although by no means sufficient for an adequate comparative study of the changeable morphology of this and of the other species in *Ochradenus*. It appears that the disc may be dish-shaped, flat, concave or convex and there may or may not be a raised collar surrounding the base of the filaments ('disc doubled'); every intermediate stage appears to occur. This is somewhat surprising, because if the extremes are compared considerable differences can be easily

noticed (cf. fig. 11). In addition to the varying development and shape of the disc(s) there is the indumentum. Densely whitish hispidulous specimens occur, and there are quite glabrous specimens. No character was found to be correlated with the presence or absence of the indumentum, but some sort of segregation can be effected on the sole character of being glabrous or not. The type-variety is hispidulous; the glabrous specimens are a variety (var. *glaber* ABD. *var. nov*).

On a herbarium label (GILLETT 3981, K) was noted the name '*Homalodiscus somalensis* Hutch. & Bruce', which could not be found in literature, and is not intended to be published here. As it was also not used in GILLETT's Plant form. W British Somaliland and Harar Prov. (*in* Kew Bull. 1941, p. 87), where the specimen was cited (9 years later) *Homalodiscus somalensis* is assumed to be a herbarium name only.

Ecological notes: Ethiopia. In January, this shrub, 1 m in height, bore fruit in *Acacia* lowlands in Harar province. It may not be common in S Ethiopia, being only once collected (Iecama BH-6, K).

Somalia. At Burao, SIMMONS (77, K) described *O. randonioides* var. *randonioides* as a 'country shrub, 2 ft high'. There, BALLY judged this to be 'rare', in 'approximately open country, with tufted grass in wooded ravine, at 700 m alt'. The shrub bore fruits 23.10.1954 (10176, K).

GILLETT collected it in 'Hargesia' (3953, K), on open level (46, 110, 139, K).

COLLENETTO collected *O. randonioides* var. *glaber* at ca. 1000 m alt., in exposed situations on rocky ground, 10°13′ N, ground at 1500 m alt.; its flowers were yellow-green (22.9.32), at 9°33′ × 44°1′. He noted that camels eat it, and the vern. name was 'gosa mudoweyi', which GILLETT explains as: gōsa is molar teeth, and mudo: black, 'because it blackens the teeth of grazing animals'. One wonders if this is the whole story. The young fruits, seen in profile, strikingly resemble molar teeth. There may be an allusion to their shape in the vernacular. One day after this collection, GILLETT secured another specimen (3981, K), a 'shrublet, in open places', with yellow flowers and 'good feed for all stock'. He remarks on the possibility that 3981 could be the male of 3953, stating 'the Somalis distinguish the 2.'. It would seem from the appearance of the dried flowers, that 3953 bears mainly ♂ flowers and 3981 has ♀ flowers (mainly), and also numerous 4-dentate ovaries instead of the usual 3-dentate.

Captain PECK also got *O. randonioides* var. *randonioides* (299, K) at Hargeisa, flowering 28th August 1941. In the same region ANDY collected a plant having ♀ flowers (Y96, K).

Here, BALLY described it as a spreading shrublet, to $1^1/_2$ ft high, on rocky slopes, with stiff branchlets, alt. 1600 m; it flowered on October the 1st, 1954 (9912, K). On the other hand, HEMMING met with it as 'a bushy tree, up to 9 ft, much branched' (1396, K).

A leafy specimen was collected on June the 7th, 1953, by M. WHITE (99, K).

GLOVER and GILLILAND described it as a 'branching cushion-shrub', or as 'intricately branched shrub or bush of 2 ft'. In the Tug bank area they found both

flowers and fruits in October 48°47′ E. The flowers on this 'not common' shrub were cream. He noted 'aura-diyeh (Warsamgeleh)' which means, he declared 'male camel doctoring'. The root is burnt and powdered, 'ashes are put on any (?) wound of a camel' (140, K).

Vernacular names: Somalia. *Gulor* (HEMMING); *mirrow* (SIMMONS; Burao); *gōsa mudoweyi* (GILLETT; Hargeisa).

Specimens examined: Ethiopia. Iecama (Imp. Eth. Coll. Agr. Mech. Arts) BH-6, prov. Harar, Aware.

Somalia. Abdallah (prof. Keller) à 1891, exp. Ruspoli-Keller, s.l.; Andy Y 96, Hargeisa, in valley; Bally 9912, Hargeisa; *id.* 10176, W of Baran; Gillett 3953, Hargeisa, 9°33′ × 44°1′; *id.* 3981, Hargeisa; Glover and Gilliland (Shansar) 46, 110, Tug bank at Burao; *id.* (Chimbuksis) 139, Bihen – Las Anod roadside; Hemming 1396, 91 m S of Garoe (?); *id.* 1622, Mijertein, 15 m E of Cain (?); Capt. Peck 299, Hargeisa; Scortecci, estate 1953, Reg. d. Haud, zona di Burtinle; Simmons 77, Burao; M. White 99, in sand on Tug bank.

**b. var. glaber** ABDALLAH *var. nov.*

Varietas nova *Ochradeni randonioides* glabritie per totam plantam scabridulam vel laevem distincta.

Equaling in all respects *O. randonioides* var. *randonioides* but different by its being completely glabrous.

Holotype: HEMMING 1622, Somalia-Mijertein (K).

Distribution: Somalia (Buran, Bender Beila, Sciuciuban).

Ecology. At Mijertein, 500 m alt., 15 m E of ?Causs-Gardo road, HEMMING described the type specimen as a 'bush to 3 ft high, 4 ft wide', with very small yellow flowers (1622, K).

Vernacular name: Somalia. *Aura-diyeh* (COLLENETTO).

Specimens examined: Somalia. Collenetto 140, Buran (10°13′ N, 48°47′ E); Hemming 1622, Somalia-Mijertein, 15 m east of ? Causs-Gardo road; Merla, Azzaroli et Fois 26.1.1954, Miguirtinia, piana sabbiosa presso la costa ad E. della collina Sagaleh (Bender Beila); Popov GP/57/39, near Sciusciuban.

**6. Ochradenus spartioides** (O. SCHWARTZ) ABDALLAH *comb. nov.* **Fig. 12**

Basionym: *Randonia spartioides* O. Schwartz *in* Mitt. Instit. Bot. Hamb. 10, 1939, p. 76.

Perennial straggling or spreading shrubs, green and glabrous except for the inflorescence, 1–1½ m high; taproot ligneous.

*Stems* virgately branching, rigid and straight, sparsely leafy, glabrous, delicately rugulose, ribbed; pith disintegrating, internodes finally narrow-tubular.

*Leaves* few, remote, subsucculent, glabrous, linear-obovate, $1^1/_2$–3 ($3^1/_2$–5 cm descr. orig.) cm long, ca. 2 (0,25–0,65 cm descr. orig.) mm wide, acute, margin entire.

*Flowers* cream to yellow, in terminal racemes. Racemes stiff, narrowly conical, 5–$12^1/_2$ (1,8–2,5 cm descr. orig.) cm long, dense flowered. Bracts persistent, linear(-obovate), 4 mm long, acutish, margin entire. Pedicels finely ribbed, glandular-pubescent, in flower 4–5 mm long, slightly longer in fruit.

*Sepals* 6, deciduous, regularly arranged, remote (interval wide), subequal, glabrous, oblong, 2–$2^1/_2$ mm long, obtuse, margins entire, obscurely pallid.

*Petals* 1–2 mm long, almost as long as the sepals. Limb of superior petal entire, ca. 3 times as long as the appendage, lobe very narrow-linear, 1–$1^1/_2$ mm long, obtuse, appendage peltately attached well above the middle, obovate, ca. $^1/_2$ mm long, $^1/_3$ mm wide, transverse rim free, emarginate, margins minutely papillose. Lateral and anterior petals similar to superior petal, limb of lateral petal sometimes 2-partite, of anterior petal entire; appendage gradually reduced.

*Discs* 2, cup-shaped, outer disc bearing sepals and petals, fleshy, shorter than inner disc, obliquely developed, 1 mm high adaxially, margin entire; inner disc funnelform, submembranous, basal part adnate to the staminal tube, ca. 1 mm long, upper part obliquely surrounding the filaments at base, margin crenate.

*Stamens* 25, longer than the petals, deciduous, glabrous. Anthers oblong, 1 mm long, $^1/_3$ mm wide, broadly obtuse, slightly asperulous.

*Ovary* ovoid, 2 mm long, $1^1/_4$ mm wide, stipitate, minutely glandular-punctate, mouth slightly contracted beneath the teeth, 3-toothed, teeth erect. Placenta not forked. Ovules ca. 12 in 3 (2–4) rows.

*Capsules* erect to patent, ovoid-oblong, 8 mm long, 5 mm wide, glandular (glands very slightly raised), mouth slightly contracted beneath teeth, teeth shortly cuspidate, ca. $^1/_2$ mm long.

*Seeds* (immature) greenish-yellow, dull, reniform, $1^1/_3$ mm long, 1–$1^1/_5$ mm wide. Sinus narrow. Testa rugose, outer layer probably persistent.

Type: O. SCHWARTZ 1474, in Arabien im Küstengebiet von Hadramaut: am Gebirgsabfall hinter Makalla, Wadi Himam (w; n.v.).

Distribution: Aden (Hadhramaut); known from the type region only.

Specimens examined: Aden. Guichard KG/HAD/376, rocks near Mukalla; O. Kerfoot 3033, Hadhramaut, East Aden Protectorate, Wadi Himam, above Mukalla, Apr. 1961.

Notes. O. SCHWARTZ, in his original description (l.c.) gave measurements for the leaves and the inflorescence (as indicated) differing considerably with the measurements found in the specimens, which came to my knowledge. SCHWARTZ's type could not be traced, in spite of many attempts. His description indicates that he had only a young flowering specimen at his disposal, which may account for the differences in the measurements.

Ecological notes: KERFOOT judged *O. spartioides* 'not common' at Wadi Himam, above Mukalla, where he collected it in April 1961, with flowers and fruits, a solitary straggling shrub, ca. 4 ft high, dark green stems, and greenish-cream to yellow flowers (3033, BM). GUICHARD found it in the same state, height, and season, 11 years earlier, stating 'mostly stem with few narrow leaves'.

### 3. Oligomeris CAMBESSÈDES

in Jacquem. Voy. Inde 'Bot'. 4, 1835 ((? 1834), 1838 vel 1839, '1844'), p. 23, tab. 25 *(nom. conserv.)*; Walpers, Rep. 2, 1843, p. 754; Webb, Frag. Fl. Aeth.-Aeg. 1854, p. 26; Muell. Arg., Mon. Rés. 1857, p. 213 (Neue Denkschr. Schw. Ges. Zuer. 16, 1858); Harvey in Harvey et Sond., Fl. Cap. 1, 1860 (1859–1860), p. 64; Boissier, Fl. Or. 1, 1867, p. 435; Muell. Arg. in DC., Prodr. 16(2), 1868, p. 584; Oliver, Fl. Trop. Afr. 1, 1868, p. 103; Battandier in Batt. et Trab., Fl. Alg. 1888–90, p. 87; Post, Fl. Syr. Palest. Sin. 1896, p. 113; Dur. et Schinz, Consp. Fl. Afr. 1(2), 1897, p. 186; Muschler, Man. Fl. Egypt 1, 1912, p. 442; Thonner, Flow. Pl. Afr. 1915, p. 229; Blatter, Fl. Arab. *in* Rec. Bot. Surv. Ind. 8(1), 1919, p. 48; Ramis, Bestimm. Fl. Aeg., 1929, p. 97; Dinsmore in Post, l.c. 2nd ed., 1, 1932, p. 140; Bolle in Engl. et Prantl, Nat. Pflz.fam. 2nd ed., 17b, 1936, p. 684; Andrews, Fl. Pl. Anglo-Egypt. Sud. 1, 1950, p. 67; Cufodontis *in* Bull. Jard. Bot. Brux. Suppl. 24, 1954, p. 161; Täckholm, Stud. Fl. Eg. 1956, p. 442; Ozenda, Fl. Sah. Sept. Centr. 1958, p. 278; Quézel et Santa, Nouv. Fl. Alg. 1, 1962, p. 438; Rech. *f.*, Fl. Lowl. Iraq 1964, p. 324; Wildenauer et Roessl in Merxmüller, Prodr. Fl. Südwestafr. 'Resedaceae' no. 49, 196.

*Resedella* Webb et Berth., Phyt. Canar. 1, Mar. 1836, tab. XI; *id.* l.c., 1, 1837 (1836–40), p. 106 (sphalmate tab. IX); Reichenbach, Handb. 1837, p. 261; Spach, Hist. Nat. Vég. Phan. 7, 1839, p. 96.

*Dipetalia* Rafin., Fl. Tellur. 3, 1837 (1836), p. 73 *(nom. rej.)*; Merr., Ind. Rafin. 1949, p. 132.

*Ellimia* Nutt. in Torr. et Gray, Fl. N. Amer. 1, 1838, p. 125 *(nom. rej.)*.

*Holopetalum* Turcz. *in* Bull. Soc. Nat. Moscou 16, 1843, p. 51; Muell. Arg., Mon. Rés. 1857, p. 208 (Neue Denkschr. Schw. Ges. Zuer. 16, 1858).

Erect to ascending, rarely decumbent herbs, occasionally shrublets (8–) 15–40(–60) cm tall, glabrous or scabrid, usually branching at base.

*Stem* leafy, usually branching, terete, ribbed or more or less angled (by the decurrent leaf-bases); pith disintegrating or solid.

*Leaves* simple, alternate, with basal (stipuloid) dents, entire, sessile, delicately decurrent, blades narrow, linear to -(ob)ovate or spathulate, chartaceous to sometimes almost succulent, often with 1–2 subulate, hyaline dents on edge near the base.

*Inflorescence* terminal, simple, spikelike, elongating, densely flowered, occasionally rather lax.

*Flowers* unibracteate, (sub)sessile, hermaphrodite or monosexual and then polygamous, white, not fragrant.

*Sepals* 2–5, persistent, entire, herbaceous, often white-margined.

*Petals* 2 (very rarely up to 5), free or up to more than half connate, alternating with posterior sepals, usually tardily shed, exappendiculate, usually entire, occasionally shallowly incised, oblong-obovate, obtuse to acute.

*Disc* wanting.

*Stamens* 3–4 (inserted posteriorly) or (5–)7–10(–12) (and ± surrounding the ovary); filaments (sub)persistent, glabrous, filiform-subulate, usually slightly monadelphous posteriorly; anthers subglobose-oblong, usually minutely asperulous, apex notched, cordate at base, introrsely splitting.

*Ovary* pluricarpellate, (4–5 carpels), unilocular, gaping, subglobose to ovoid, obtusely angled, glabrous, rarely scabridulous, sessile, 4(–5) dentate; dents turgid, margins inflexed, top papillosely stigmatoid. Placenta undivided. Ovules 5–15 per placenta, in 2–5 rows, funicle long (comparatively).

*Capsules* gaping, mouth sometimes contracted beneath the teeth, subglobose to (ob)ovoid, $3^1/_2$–6 mm long, 3–4 mm wide, glabrous or rarely scabridulous, membranous, sessile, rarely on pedicels up to $^1/_2$ mm long.

*Seeds* subglobose to ovoid, $^1/_2$–1 mm long, black or dark-brown, exalbuminous; radicle near hilum; sinus wanting, represented by a shallow groove; testa very glossy, smooth (obscurely rugulose or reticulate under high magnification), outer layer persistent. Embryo curved, radicle subcylindric, almost equaling the cotyledons; cotyledons incumbent; plumule wanting.

Type: *Oligomeris glaucescens* CAMBESS. (= *O. linifolia* (VAHL) MACBRIDE).

Distribution: Canary Islands, N Africa, SW Asia up to W India, S Africa and U.S.A., i.e. Arizona, California, Nevada and Texas, and in Mexico.

Taxonomical notes: The name *Oligomeris* is derived from ὀλίγος = few, and μερίς: part, which alludes to the few stamens and petals. As regards the date of publication of *Oligomeris* CAMBESSÈDES (in JACQUEMONT, Voy. Ind. 4, '1844', p. 23) the following is to be noted.

It is certain that the text of JACQUEMONT's Voyage was published separately from the Atlas.

According to WIEGMANN's Archiv f. Nat. gesch., 6 'livraisons' of the text were published in 1835 (l.c. 2(2), 1836, p. 8); 40 livraisons had been published in 1842 (l.c. 8(2), 1842, p. 443); 9 further livraisons in 1843 (l.c. 9(2), 1843, p. 406). In 1845 WIEGMANN reported that the whole work is now completed; a final part also contains the 180 plates of the Atlas, he declared (l.c. 11(2), 1845, p. 376; cf. also Fl. Malesiana Bull. 15, 1960, p. 733).

As *Oligomeris* appeared on p. 25, it may be accepted for certain that the date of publication of the text is not later than 1835. It is even possible that *Oligomeris* dates from 1834, a date repeatedly cited by MUELL. ARG. (Mon. Rés. 1857, p. 213, 216, and in DC., Prodr. 16(2), 1868, p. 586, 587).

In the list of conserved names in the Code (1966) *Oligomeris* is dated '1838 vel 1839 ('1844')', which is certainly incorrect, and seems to have been taken from PFEIFFER (Nomencl. Bot. 2, 1874, p. 489).

It is superfluous to conserve the name *Oligomeris* (1835 or 1834) against *Dipetalia* RAFIN. (1837, '1836') or *Ellimia* NUTT. *ex* TORREY et GRAY (1838).

As regards the genus *Resedella* WEBB et BERTH. of 1836, this certainly also was later published than *Oligomeris* CAMB. WEBB himself drew attention to the fact that the plate of *Oligomeris* was published before *Resedella* was (Fragm. Fl. Aeth.-Aeg. 1854, p. 26), a statement endorsed by MUELL. ARG. (Mon. Rés. 1857, p. 216).

As regards the Atlas belonging to JACQUEMONT's Voyage, the data are contradictory. From WIEGMANN's report of 1845 (l.c.) it might be deduced that the plates appeared together between 1843 and 1845. However, ZAIN-EL-ABIDIN drew attention to the fact that in ENDLICHER's Genera Plantarum since 1839, and in WALPERS's Repertorium since 1842, repeated references are found to plates (cf. Biologia 4, 1958, p. 212, 214). Not mentioned by ZAIN-EL-ABIDIN is WEBB and BERTHELOT's reference to a plate of *Oligomeris*, that had been made known by CAMBESSÈDES, and which they had seen (Phyt. Can. 1837, p. 107). This is more support for the records by ENDLICHER and WALPERS of a separate, earlier publication of plates than stated by WIEGMANN, but it remains a curious fact that WEBB and BERTHELOT declared in 1837 that no description had been published relating to the plate of *Oligomeris*. However this may be, there is no reasonable doubt as to the priority of *Oligomeris* CAMB. over *Resedella* WEBB et BERTH., and the name *Oligomeris* may be removed from the list of conserved names; it has a comfortable priority over *Dipetalia*, *Ellimia*, and *Resedella*.

It finally is to be noted that BURTT and LEWIS (*in* Kew Bull. 1949, p. 303), having discussed some of the points mentioned here, arrive at the contrary conclusion that the name *Oligomeris* deserves to be entered in the list of conserved names. It needs, however, as demonstrated here, no conservation. In accordance with, and in consequence of his published statements, WEBB himself rejected *Resedella* in favour of *Oligomeris*, because of priority.

Tab. XI of WEBB et BERTH., Phyt. Can., was published in March 1836. It had as legend 'Resedella subulata Nob.'. It contained many floral details and a habit drawing of the plant. This has to be accepted as the earliest and valid publication of the genus *Resedella* (and the species *Resedella subulata*). *Resedella* WEBB et BERTH. is a monotypic genus, dating from 1836 (cf. STEARN *in* Journ. Soc. Bibl. Nat. Hist. 1(2), 1937, p. 55, 58–59, and Art. 32, 42, 44, Code, 1966).

It follows that the type species of *Resedella* WEBB et BERTHELOT, is *Resedella subulata*. The specimen from 'Webb's own Canary Island collectings' (cf. BURTT and LEWIS *in* Kew Bull. 1949, p. 302) on which the data pictured in tab. XI rest, can be regarded as type specimen.

In 1837, WEBB et BERTH. published the text belonging to tab. XI (by error citing it as tab. IX). They added a second species, *Resedella dipetala*. It now appears that in 1836 they adopted the epithet 'subulata', from DELILE who used it for 'Reseda subulata Delile', a *nomen nudum* (Ill. Fl. Aegypt. 1813, (p. 15), 63). They cited, however, the DELILE specimen, and added as a second specimen examined: SCHIMPER 241. It cannot be doubted that *Resedella subulata* WEBB et BERTHELOT as a species is identical with 'Reseda subulata Delile', but they

did not intend to accept the name *Reseda subulata* DELILE; they took up the epithet only. As to nomenclature the author's citation may be without further reference and *Resedella subulata* WEBB et BERTH. be accepted as a new name (see further sub *O. linifolia*), the protologue of the first publication being without reference to DELILE.

WEBB and BERTHELOT declared that *Resedella* is allied to the genus *Luteola* by the structure of the flower which is in fours, but differs from it by the structure of the capsule. *Resedella* is well isolated among all other *Resedaceae* by the abortion of the 'adventitious whorls' and by the complete absence of the stamen-bearing disc.

They stated that the petals of the species at the Cape of Good Hope are separated. *Resedella dipetala* WEBB et BERTH. as to name appears to be based on *Reseda dipetala* AIT. (1789); they declare in a note to *Resedella subulata* that AITON'S species is different (l.c. p. 107).

In 1837, *Resedella* WEBB et BERTH. is ascribed to the Canary Islands (Fuerteventura and Lancerota), Egypt, and 'Arabia petrea' (SCHIMPER 241), it being based, as to taxon, on *Reseda subulata* DEL. (Ill. Fl. Egypt. 1813, p. 15). About the second species mentioned, *Resedella dipetala* (AIT.) WEBB et BERTH., it is to be noted that WEBB declared that of the *Resedella* species one occurred in North Africa and the other in South Africa. For *Resedella subulata* he delimited an area of distribution including N Africa, but he stated nothing special regarding the distribution of *R. dipetala.*

It must be inferred that *Resedella dipetala* occurs in S Africa (see further sub *O. dipetala* and *O. dregeana*).

*Dipetalia* RAFINESQUE was published in Fl. Telluriana 3, 1837, p. 37. In the protologue is stated: 'Type D. capensis Raf. Reseda do Burm. R. dipetala Ait.' which automatically reduces *Dipetalia* to *Oligomeris* (cf. MERRILL, Index Raf. 1949, p. 132).

*Ellimia* NUTTALL in TORREY et GRAY (Fl. N. Am. 1, 1838, p. 125), was published by including NUTTALL'S msc. in the printed text of Flora of N. America (l.c.). The type is from 'St. Barbara, California'; it was not seen. Specimens from the type-locality fully matching the description of *Ellimia* prove it to be a later synonym of *Oligomeris.*

TURCZANINOW based the generic description of *Holopetalum* (*in* Bull. Soc. Nat. Moscou 16(1), 1843, p. 51) on a specimen 'Reseda n. 7533 in Drège coll. pl. Capensium'.

DRÈGE originally named 7533 'Reseda' but TURCZANINOW named it 'Holopetalum pumilum' while establishing the genus *Holopetalum.* He apparently derived this generic name from the entire petals of the flower. TURCZANINOW added that he considered *Holopetalum* very different from *Oligomeris* but his argument is insufficiently supported. DRÈGE 7533 undoubtedly belongs in *Oligomeris* (cf. *O. dipetala*) where two free petals and one single petal in a flower may occur on the same plant.

For South Africa, E. P. PHILLIPS records in *Resedaceae* a single genus, *Oligomeris* CAMBESS. (Gen. S. Afr. Pl. 2nd ed., 1951, p. 357). In *Oligomeris* ('10

spp.') 6 species are 'extending from the Transvaal to the eastern parts of the Karoo, the north-western districts of the Cape Province, and from Natal to the Albany district. In the present study only 3 species are admitted in *Oligomeris*, two S African, represented by several varieties.

**Key to the taxa in Oligomeris**

1. All or at least some (young) leaves with 1–2 pairs of very small, subulate dents on leaf-edge near the base. Plants often annual. Stamens 3–4. Capsules globular. Seeds ca. $^1/_3$ mm long . . . . . **2. linifolia**

1. Dents on leaf-edge absent. Plants usually perennial. Stamens up to 12. Seeds up to 1 mm long.

   2. Stamens 3(–4), adaxial. Flowers bisexual . . . . . **1. dregeana**
      Bracts shorter than the flowers, petals blunt and usually notched. Capsule globular.
         Sepals usually 3–4 . . . . . **dregeana** var. **sphaerocarpa**
      Bracts usually exceeding flowers. Petals narrow, entire. Capsule ovoid.
         Sepals 5 . . . . . **dregeana** var. **dregeana**

   2. Stamens (5–)8–10(–12), surrounding ovary. Flowers sometimes monosexual or polygamous . . . . . **3. dipetala**
      Leaves (oblong-)spathulate, 3–4 mm wide . . . . . **dipetala** var. **spathulata**
      Leaves narrow, varying, 1–2 mm wide
         Capsule (sub)globular. Stem usually woody, sometimes over 1 cm in diam. **dipetala** var. **dipetala**
         Capsule (ob)ovoid. Petal often spathulate. Stems if woody not exceeding $^1/_2$ cm in diam. . . . . **dipetala** var. **burchellii**

## 1. Oligomeris dregeana (MUELL. ARG.) MUELL. ARG. Fig. 13, 16

*Reseda dregeana* Presl *in* Abh. Kön. Böh. Ges. Wiss. ser. 5, 3, 1845, p. 438 (in Bot. Bem. 1846 (1844), p. 8), *nomen nudum.*

*Resedella dregeana* Muell. Arg. *in* Bot. Zeit. 14, 1856, p. 39; *basionym.*

*Oligomeris dregeana* (Muell. Arg.) Muell. Arg., Mon. Rés. 1857, p. 216, tab. 10, fig. 219 (Neue Denkschr. Schweiz. Ges. Zuer. 16, 1858); Harvey in Harvey et Sonder, Fl. Cap. 1, 1860 (1859–60), p. 64; Muell. Arg. in DC., Prodr. 16(2), 1868, p. 586; Durand et Schinz, Consp. Fl. Afr. 1(2), 1897, p. 187; Bolle in Engl. et Pr., Nat. Pflz.fam. 2nd ed., 17b, 1936, p. 685.

*O. dipetala* (Aiton) Turcz. *quoad specimen.*

### a. var. dregeana

Perennial, (glaucous) green, glabrous, rarely scabridulous, 10–30(–40) cm tall suffruticose herb; taproot ligneous, usually thick.

*Stems* numerous, often decumbent-ascending at base, branching, densely leafy, terete, ribbed; pith disintegrating, internodes tubular.

*Leaves* entire, sessile, usually with axillary, crowded, small leaves, almost fleshy, glaucous-green, linear to -spathulate, 1–$1^1/_2$(–2) cm long, ca. 1 mm wide, acute, margin pallid and minutely scabridulous.

*Flowers* white, sessile, hermaphrodite, in terminal spicoid racemes. Racemes 4–10 cm long, usually rather dense, peduncles strongly ribbed, occasionally

obscurely scabridulous. Bracts persistent, lower ones leaf-like and exceeding the flower, upper gradually shorter, occasionally scabridulous, oblong-ovate to subulate, 15–3 mm long, $^2/_3$–$^1/_2$ mm wide, acute, edge pallid, minutely scabridulous. Pedicels very short, almost absent, up to $^1/_2$ mm long, in fruit.

*Sepals* (3–)5, persistent, almost equal, incurved, evenly distributed, obscurely scabrid, linear, $2^1/_2$(–3) mm long, nearly 1 mm wide, edge hyaline, slightly denticulate.

*Petals* 2, slightly shorter than the sepals, hyaline, early shed, alternating with the superior sepals, exappendiculate, ovate to linear or narrowly obovate, ca. 2 mm long, $^1/_2$ mm wide, top rarely shallowly notched, as a rule gradually tapering to an acute apex.

*Stamens* 3(–4), almost equaling and alternating with the petals. Filaments persistent, at base fused, glabrous, filiform-subulate, $1^1/_2$ mm long. Anthers globular-oblong, $^1/_3$ mm long, minutely scabridulous.

*Ovary* ovoid, sessile, 3 mm long, glabrous, sometimes slightly scabridulous, gradually narrowing towards the teeth, (3–)4(–5)-toothed, teeth conical, 1 mm long, tip densely lacerate. Ovules 7–9 per placenta, in 2(–3) rows.

*Capsules* erect, sessile, ovoid-oblong, 4–6 mm long, 3–4 mm wide, glabrous or very slightly scabrescent, bladdery, teeth triangular, 1 mm long, usually divergent, mouth gaping, slightly contracted beneath the teeth.

*Seeds* black, very glossy, ovoid-globular, 1 mm long, nearly as wide, obscurely rugululose. Sinus wanting, represented by a shallow groove; outer layer persistent.

Type: DRÈGE, Zwartkey, auf der Fläche, 4000 Fuss Höhe, Dec. (s).

Distribution: S Africa (Cape prov., Lesotho, Natal, Orange Free State, Transvaal).

**b. var. sphaerocarpa** ABDALLAH, *nov. var.*

Varietas nova *O. dregeanae* capsulis globosis bracteis brevioribus quam flores satis distincta.

Leaves linear, top slightly wider. Sepals usually 3–4. Petals ovate, usually shallowly incised, obtuse. Capsules globular, cuspidate. Seeds ca. $^1/_2$ mm long.

Type: LAM et MEEUSE 4053 (L, holotype).

Distribution: SW Africa.

Notes. *Resedella dipetala* WEBB et BERTH. (Phyt. Canar. 1, 1837, p. 107) was based on *Reseda dipetala* AITON. This may be deduced from the introductory note to *Resedella dipetala*, in which reference is made to '*Reseda dipetala* Hort. Kew.'. Specimens collected by THUNBERG and ECKLON (no 113), preserved in

the DELESSERT hb. are cited. The combination *Resedella dipetala* rests on *Reseda dipetala* AITON. As regards nomenclature the position is clear.

WEBB (and BERTHELOT) added a description to their new combination *Resedella dipetala* (AIT.) WEBB et BERTH. Obviously, this description ought to fit *Reseda dipetala* AITON but this is not so. *Reseda dipetala* AITON was reported to have 10 stamens and from the present revision it appears that the number of stamens generally varies between 8 and 10; rarely specimens bear flowers having up to 12 or less than 8 (5!) stamens. *Resedella* is described as having 3 stamens. The specimen of *Resedella dipetala* studied and described by WEBB was stated to be without stamens and WEBB suggested for that reason that *Resedella dipetala* might be dioecious. In his description, however, WEBB reported that the position of the filaments is adaxial and one-sided (l.c. p. 107); this is in agreement with the circumscription of *Resedella* but does not agree with *Reseda dipetala* AITON. One is inclined to believe that WEBB had a flower before him without anthers, not without stamens, which would explain his contradictory statements.

In the WEBB hb. (FI) is one single sheet carrying the name *Resedella dipetala* and this name accompanies a specimen of *Oligomeris linifolia*. This may well explain the problem.

WEBB probably described this specimen which may have formed part of his Canary Islands collection. He believed that it represented *Reseda dipetala* AITON (and published the new combination *Resedella dipetala* while describing it). Actually he described *O. linifolia*, a common species in the Canary Islands. Now it becomes clear why he described the capsule of *Resedella dipetala* as 'depressed-globose' which is a character of *O. linifolia* and also why he judged the petals twice as long as the sepals, which is evident in *O. linifolia* (though this may also be found, frequently, in flowers of *O. dipetala*). The number (not quite clearly stated) of the stamens and their arrangement is in accordance with the characters of *O. linifolia*, not of *Reseda dipetala*. As regards the described taxon, *Resedella dipetala* (AITON) WEBB et BERTH. represents *O. linifolia*.

WALPERS (Rep. 2, suppl. 1, 1843, p. 754) reduced *Resedella dipetala* to a synonym of *Oligomeris glaucescens* CAMB. (= *O. linifolia*). Because he cited *Reseda subulata* DELILE as another synonym to *O. glaucescens*, and also *Resedella subulata* WEBB et BERTH. while citing 't. 9!' referring no doubt to 'TAB. IX' (Phyt. Can., p. 108), which is a misprint for 'TAB. XI', it must be concluded that WALPERS judged *Resedella dipetala* and *Resedella subulata* as conspecific, which is, as regards the taxon, correct (see also Notes to *Oligomeris*, in reference to *Resedella*).

TURCZANINOW published and described *Oligomeris dipetala* (*in* Bull. Soc. Nat. Moscou 27, 1854, p. 330). He opposed WALPERS's view and stated that *O. dipetala* TURCZ. was different from *O. glaucescens*. He based his opinion on a specimen collected by DRÈGE, and added that a specimen collected by ECKLON was unknown to him, but was different according to PREST (sic!, obviously a reference to PRESL).

PRESL had stated (Bot. Bem. 1846 (1844), p. 8): '*Reseda dipetala* Drège pl. cap. exs. – non est planta Aitoniana a clar. Ecklon e promontorio bonae spei relata,

sed alia verosimiliter nova species, *R. dregeana* Presl.' *Reseda dregeana*, by the way, is a *nomen nudum*.

TURCZANINOW thus had noted that PRESL judged DRÈGE'S '*Reseda dipetala*' a specimen named in hb., to be different from *Reseda dipetala* AITON which, PRESL stated, had also been collected by ECKLON. PRESL judged correctly.

NOW TURCZANINOW published *Oligomeris dipetala* and founded his description on DRÈGE's specimen. He used the epithet '*dipetala*' which accompanied it. He also declared not to be acquainted with a specimen collected by ECKLON and so left PRESL'S opinion for PRESL'S own responsibility.

The written name *Reseda dipetala* added to DRÈGE'S specimen is a reference to *Reseda dipetala* AITON, it may reasonably be assumed (it elicited PRESL'S protest). TURCZANINOW thus adopted the name *Reseda dipetala* AITON as basionym for *Oligomeris dipetala* (AITON) TURCZ.

It can also be argued that TURCZANINOW opposed the synonymy proposed by WALPERS and so wished to re-establish *Resedella dipetala* WEBB et BERTH. as a distinct species while referring it to *Oligomeris*. This implies that *Resedella dipetala* is the basionym for *Oligomeris dipetala* TURCZ. but it was demonstrated above that ultimately this leads to the same source: *Reseda dipetala* AITON. As to the name *Oligomeris dipetala* (AIT.) TURCZ. is explained. The taxon described by TURCZANINOW is *O. dregeana*. See further Notes to *O. dipetala*.

By validating *Reseda dregeana* as *Resedella dregeana*, and subsequently by publishing the combination *Oligomeris dregeana* MUELL. ARG. (11. cc.) coined the nomenclaturally correct name.

Ecological notes: On open grassy plains at foothills at Eland's Hoek (nr Aliwal North) it flowered in June at an alt. of ca. 1500 m (BOLUS 98, BOL). SUTTON, at Zwartruggens (1400 m alt.) found fl. in July, and it was a rare herb, growing in brown sandy loam of a ridge (1102, PRE); MEDLEY WOOD'S Natal specimen fl. at van Reenen in November, in grasslands (ca. 1800 m alt., 6553, G). PONT, near Kroonstad, secured it on 'sandy soils in Acacia's near Vals Rivier', fl. in December (284, PRE). SCHLECHTER noted *O. dregeana* at Botha's Hill among rocks ('in saxos'), fr. in December (3958, BOL).

A marginal variety of *O. dregeana*, distinguished by its globular fruits (var. *sphaerocarpa*) occurs in SW Africa. LAM, MEEUSE (4053, L), and LANJOUW (21, U) found it at 200 m alt. in the Namib desert, a small shrub, greenish fl. in August, in grassy fields on quartsite sands.

WILDENAUER and ROESSLER quoted DINTER 8469 as *O. linifolia* (in MERXMÜLLER, Prodr. Fl. SW Afr. 49, 1966, p. 2); the specimen originates from SW Africa and belongs in *O. dregeana* var. *sphaerocarpa*.

Specimens examined: Var. *dregeana*. Cape prov. Acock 8277, banks of Groot Vet Road, nr. Brandfort-Winburg road; Acocks 9242, distr. Stutterheim, S Commonage-quarry; Bolus 98, Elands Hoek, nr. Aliwal North; Burtt-Davy 10973, distr. Vryburg, Doornbult; Cooper 559, Beaufort; Comins 709, distr. Middelburg, 4 m from Middelburg on Rietpoort road; Drège s.n. 'XII. 1838', Zwartkey, auf der Fläche; *id.* '1840', '1843', '1878', Port Natal; Flangan 1539, nr. Burghers Dorp; Galpin 7804, distr. Queenstown, banks Klass Smits River at

Bradford Drift; Kuntze s.n., 12.II.94, Cradock; *id.* s.n., 26.II.94, Cathcart; McOwan 1988, 1998 ad ped. Boschberg; *id.* 1998, M. Klijn Vischrivier; *id.* 1998, prope Somerset East; Pegler 1703, distr. Cala, Cala commonage nr. Bushman Cave; *id.* 1748, between Cala and Ngamakwe; Turner s.n., I. 1931, distr. Vryburg, farm Panplaats, 22 m N. Vryburg; Verdoorn 1512, distr. Middelburg, Grootfontein; Zeyher 116.8, Cradock auf Bergen und Hügeln, Tarkarivier.

Lesotho (Basutoland). Dieterlen 286, distr. Leribe.

Natal. Medley Wood 6553, van Reenen.

Orange Free State. Burtt-Davy 10838, distr. Boshoff, Smitskraal; Flanagan 1491, Orange Riv. nr. Bethulië; Pont 284, reg. Kroonstad, nr. Vals Riv.; *id.* 1429, Fauresmith; Rehmann 3856, Bloemfontein; Smith 5279, distr. Fauresmith, Brandewijnkuil, nr. Heenenweerskop; Story 1032, distr. Bloemhoff, 11 m N Bloemhoff, level Themeda veld; Thode 4608, Witzieshoek; Welti s.n. '9', distr. Bloemfontein, Bestersput.

Transvaal. Burtt-Davy 7013, Barkfontein, G.R.C.; *id.* 9164, distr. Heidelberg, Uitgevallen 197; Kinges 1888, distr. Lichtenburg, farm Vaalbank; Rogers 22699, distr. Potchefstroom, Welverdiend; Schlechter 3958, pr. Lijdenburg; *id.* 6086, reg. orientalis, Bothashill; Sutton 1102, distr. Rustenberg, Zwartruggens.

Var. *sphaerocarpa*. SW Africa. Dinter 8469, bei Cap Cross, auf bracksandigem Boden; Lam et Meeuse 4053, Namib; Lanjouw 21, *ibid.*

## 2. Oligomeris linifolia (VAHL) MACBRIDE **Fig. 14, 16**

*in* Contr. Gray. Herb. n.s. 53, 1918, p. 13; Bolle in Engl. et Pr., Nat. Pflz.fam. 2nd ed., 17b, 1936, p. 685, f. 427 G et 429; Burtt & Lewis *in* Kew Bull. 1949, p. 301; Andrews, Fl. Pl. Anglo-Egypt. Sud. 1, 1950, p. 67, fig. 48; Cufodontis *in* Bull. Jard. Bot. Bruxelles Suppl. 24, 1954, p. 161; Täckholm, Stud. Fl. Egypt 1956, p. 334; Ozenda, Fl. Sah. Sept. Centr. 1958, p. 278, fig. 85; Munz and Keck, Calif. Fl. 1959, p. 205; Quézel et Santa, Nouv. Fl. Alg. 1, 1962, p. 438, tab. 38, fig. 1218; Rech. *f.*, Fl. Lowl. Iraq 1964, p. 324; Wildenauer et Roessler in Merxmüller, Prodr. Fl. SW. Afr. 1966, Resedaceae 49, p. 2; Raizada *in* Indian For. 92, 1966, p. 318.

*O. glaucescens* Cambess. in Jacquemont, Voy. Inde 4, 1835,'? 1834' (1844), p. 24, tab. 25; Boissier, Voy. Bot. Esp. 2, 1839–45, p. 78; Walpers, Rep. 2, 1843, p. 754; Webb, Frag. Fl. Aeth.-Aeg. 1845, p. 26; Oliv. Fl. Trop. Afr. 1, 1868, p. 104; Thonner, Flow. Pl. Afr. 1915, tab. 55.

*O. ellimia* (Nutt.) Webb, Frag. Fl. Aeth.-Aeg. 1854, p. 27 *(nom.illeg.)*.

*O. resedella* (Webb et Berth.) Webb, l.c., p. 26 *(nom.illeg.)*.

*O. subulata* (Del. *ex*) Webb, l.c.; Boissier, Fl. Or. 1, 1867, p. 435; Muell. Arg. in DC., Prodr. 16(2), 1868, p. 587; Battandier in Batt. et Trab., Fl. Alg. 1888–90, p. 87; Post, Fl. Syr. Palest. Sin. 1896, p. 113; Durand et Schinz, Consp. Fl. Afr. 1(2), 1897, p. 187; Muschler, Man. Fl. Egypt 1, 1912, p. 443; Blatter, Fl. Arab. *in* Rec. Bot. Surv. Ind. 8(1), 1919, p. 48; Ramis, Bestimm. Fl. Aeg. 1929, p. 97; Jahandiez et Maire, Cat. Pl. Mar. 2, 1932, p. 318; Dinsmore in Post, l.c. 2nd ed. 1, 1932, p. 140.

*O. s. abortiva* (Muell. Arg.) Muell. Arg. in DC., Prodr. l.c.

*O. dispersa* Muell. Arg., Mon. Rés. 1857, p. 214, t. 10, fig. 128 (Neue Denkschr. Schw. Ges. Zuer. 16, 1858).

*O. d.* α *delileana* J. Gay ex Muell. Arg. l.c.

*O. d.* α *d.* αα *abortiva* Muell. Arg. l.c., p. 215; Dur. et Schinz, l.c.

*O. d.* α *d.* β *webbiana* Muell. Arg. l.c.

*O. d.* α *d.* γ *muricata* Muell. Arg. l.c., p. 216.

*O. ruderalis* (Nutt.) Nelson et Kennedy *in* Muhlenbergia 3, 1908 (1907), p. 138.

*Reseda linifolia* Vahl *in* Hornem., Hort. Hafn. 2, 1815, p. 501; Sprengel, Syst. Veg. 2, 1825, p. 463; Walpers, Rep. 2, 1843, p. 751.

*R. tridens* Viviani, Pl. Aeg. Decad. IV, 1830, p. 6; Walpers, l.c., p. 753.

*R. oligandra* Edgeworth *in* Journ. As. Soc. Beng. 7, 1838, p. 764; Walpers, Rep., l.c.

*Resedella subulata* Webb et Berth., Phyt. Canar. 1, 1836, tab. XI; id. l.c., 1837 (1836–40), p. 107 ('tab. IX').

*R. dipetala* (Aiton) Webb et Berth., l.c., *quoad specim. descr.*

*Ellimia ruderalis* Nutt. in Torr. et Gray, Fl. N. Amer. 1, 1838, p. 125.

Annual, or perennial, glaucous-green, glabrous, rarely obscurely scabridulous, (5–)10–30(–50) cm tall herbs, sometimes base and taproot ligneous.

*Stem* numerous, rarely solitary, erect or spreading and ascending, often branching, densely leafy, glabrous, terete, ribbed; pith disintegrating (internodes narrowly tubular).

*Leaves* entire, sessile, with axillary innovations of smaller leaves, glaucous-green, glabrous, linear to ± spathulate, 1–4 cm long, 1–2 mm wide, obtuse to acute, margins entire, with 1 or 2 pallid, subulate (ca. 1 mm long) dents on the edge near the base, in addition to the stipuloid basal dents, sometimes only a few leaves provided with subulate dents.

*Flowers* white, (sub)sessile, bisexual, in terminal spike-like racemes. Racemes elongating, (2–) 5–25 cm long, up to $^3/_4$ cm wide in fruiting, dense or sometimes rather lax; peduncles ribbed, glabrous, rarely scabridulous. Bracts persistent, almost as long as the flower, triangular to linear-subulate, 1–2 mm long, up to 1 mm wide, acute; white margin broad.

*Sepals* 2–4(–5), persistent, subequal, 1–$1^1/_2$(–2) mm long, $^1/_2$–$^2/_3$ mm wide, triangular to ± linear, sinus between superior sepals much wider than the other.

*Petals* 2 (very rarely 3), sometimes seemingly one, exceeding (ca. $1^1/_2$ × as long) the sepals, hyaline, persisting, if sepals few than petals between the 2 superior sepals free or up to half connate, not appendaged, (oblong-) obovate to ovate, $1^1/_2$–2 mm long, $^3/_4$–1($1^1/_4$) mm wide, entire or sometimes ± incised, acute or obtuse, uninerved.

*Stamens* 3–4, about equaling the petals, inserted posteriorly and alternating with the petals. Filaments persistent, very shortly monadelphous, glabrous, filiform-subulate, $1^1/_2$–2 mm long. Anthers globular-ovoid, $^1/_3$ mm long, $^1/_4$ mm wide, sometimes obscurely scabrid.

*Ovary* ovoid-globose, sessile, ca. $1^1/_2$ mm long and wide, glabrous, sometimes minutely scabrid, obtusely 4-angled, sulcate, (3–)4(–5)-toothed (teeth conical, $^1/_3$–$^1/_2$ mm long, tip lacerate), mouth contracted or not.

*Ovules* ca. 12 per placenta, in 3–5 rows.

*Capsules* erect, (sub)sessile, (sub)globular, $2^1/_2$–$3^1/_2$ mm long and as wide,

glabrous or rarely minutely scabrid, walls rounded, bladdery, deeply sulcate, teeth triangular or cuspidate, $^1/_2$–1 mm long, mouth widely gaping.

*Seeds* greenish black, very glossy, ovoid to -globular, ca. $^1/_2$ mm long. Sinus represented by a groove. Testa smooth (obscurely rugulose under high magnification), outer layer persistent.

Type: 'Reseda linifolia, HN 1813, HB SCHUM' (C: lectotype).

Distribution: Canary Islands, N Africa, (?Ethiopia, cf. Cufodontis l.c.), SW Asia up to NW India, S and SW of U.S.A. (Arizona, California, Nevada, Texas), Mexico (Sonora).

Taxonomical notes. MACBRIDE published the new combination, 'Oligomeris linifolia' (l.c.) basing it on *Reseda linifolia* VAHL (in HORNEM., Hort. Hafn. 2, 1815, p. 501). He cited *O. subulata* WEBB (1854) and *Reseda subulata* DELILE (1813) as synonyms.

In his comment on the new combination he pointed out that *R. subulata* DELILE is a '*nomen nudum*' and the first name accompanied with a description is *Reseda linifolia* VAHL.

MACBRIDE declared that NELSON and KENNEDY (1905) made the new combination *Oligomeris ruderalis* basing it on '*Ellimia ruderalis* NUTT.' (1838), a specimen from Nevada with capsules, 'distinctly bilobed as to each of the main lobes'. He added that he did not see this specimen and concluded that the materials from both America and Canary Islands are identical.

'R. linifolia Hornem.', is listed in Ind. Kew (2, 1895, p. 697). In the Copenhagen Herbarium 2 specimens are preserved attributed to HORNEMANN. On the first sheet is written in verso 'Reseda linifolia', and crossed out is 'Reseda purpurascens 4'. The sheet was further marked 'MUSEUM BOTANICUM HAUNIENSE' and 'HB VAHLII'. It carries a very poor specimen of *Sesamoides*. On the second sheet is written in verso 'Reseda linifolia', a written initial, possibly signifying HORNEMANN, viz. HN 1813. It is also possible, though, that HN 1813 refers to Histoire Naturelle of DELILE's Descript. Egypte of 1813, where *Reseda subulata* appeared. However, the sheet is further marked 'MUSEUM BOTANICUM HAUNIENSE' and 'HB SCHUM'. It carries a very poor specimen of *Oligomeris*.

VAHL's protologue (in HORNEMANN, l.c.) runs:

> 4. R. linifolia V.M.: foliis subulato-linearibus canaliculatis, floribus 3–5-gynis. Hab. in Europ. austr. ♂.⊙. F. intr. 1808.

It follows: the name *Reseda linifolia* must be ascribed to VAHL (MARTIN) and the correct citation is '*R. linifolia* VAHL in HORNEMANN'. The first sheet, viz. the sheet carrying *Sesamoides* in the VAHL Hb., is to be rejected for typification.

This latter sheet carries the number '4'. Whether this '4' was crossed out together with 'Reseda purpurascens' is doubtful, the ink used and the way of writing suggest that '4' was added when *Reseda linifolia* was written on the sheet. The flowers have 4 distinct carpels. *Sesamoides* is indigenous in S Europe.

The specimen on the second sheet, however, has typically subulate-linear and caniculate leaves; VAHL's description as regards the leaves cannot refer to the first sheet because the leaves of the specimen of *Sesamoides* on this first sheet are flat, narrow, and more or less spathulate.

It follows that if a choice would be made, the majority of general data may be applied to the first sheet *(Sesamoides)* but it is also evident that the major part of the description proper is based on the other sheet.

*R. linifolia* VAHL in HORNEM. is based on discordant elements, and, perhaps, can be rejected (Code 1966, Art. 70).

If this view is not adopted, a lectotype can be selected, and this ought to be the second sheet, to promote stability of names and because it agrees best with the descriptive data of VAHL's.

As a result *Oligomeris linifolia* (VAHL) MACBRIDE *in* Contrib. Gray Herb. N.S. 53, 1918, p. 13) is to be accepted as the correct name for *Reseda linifolia* VAHL, typified by the second sheet in the VAHL Herbarium (C).

As regards the typification of *Oligomeris glaucescens* CAMB. it remains uncertain whether a specimen collected by JACQUEMONT is to be designated or whether the plate (tab. 25) should be accepted as the holotype (see also notes sub *Oligomeris*).

*Oligomeris ellimia* WEBB (l.c.) was published while *Ellimia ruderalis* NUTT. was cited as a synonym, and so the name is illegitimate.

*Oligomeris resedella* WEBB (l.c.) was published while *Resedella subulata* WEBB was cited as a synonym, and so the name is illegitimate.

*Oligomeris subulata* DELILE *ex* WEBB was published in 1854 (Fragm. Fl. Aeth.-Aeg., p. 26); it was based on *Reseda subulata* DELILE (Fl. Aeg. Ill. 1813, p. 15(63)), a *nomen nudum*. BURTT and LEWIS stated that the type 'of *Oligomeris subulata* WEBB is clearly among the Egyptian and Nubian specimens which he quotes from the Florence herbarium' (cf. Kew Bull. 1949, p. 302). It has been pointed out above (see notes sub *Oligomeris* for *Resedella subulata*) that *Reseda subulata* WEBB et BERTHELOT rests on a detailed plate (tab. XI, 1836). The plate, obviously, was drawn from a Canary Island specimen. As was also pointed out by BURTT and LEWIS, the specimen or eventually the plate is the type. The later typification of 'O. subulata Webb' by BURTT and LEWIS is against the Code. BOISSIER also published *Oligomeris subulata* (Fl. Or. 1, 1867, p. 435) overlooking the earlier publication of the same combination by WEBB and basing it again on DELILE's *nomen nudum* ('Reseda subulata').

*Oligomeris dispersa* MUELL. ARG. (Mon. Rés. 1857, p. 214) was fully described but in synonymy were cited *Reseda linifolia* VAHL and *R. subulata* DELILE. Evidently, MUELL. ARG. ought to have adopted 'linifolia' as the epithet, according the present Code. Synonymy with *Oligomeris subulata* follows from his citation of DELILE's name while he stated to have examined DELILE's specimen (in hb. BOISSIER). Afterwards MUELL. ARG. exchanged *Oligomeris dispersa* for *O. subulata* (in DC., Prodr. 16(2), 1868, p. 587).

NELSON and P. B. KENNEDY in their study 'New Plants from the Great Basin'

published the new combination *Oligomeris ruderalis* (NUTT.) NELSON et KENNEDY (l.c.).

They stated that *Ellimia ruderalis* had been published as a new species based on msc. by NUTTALL (*ex* TORR. et GRAY, Fl. N. Am. 1, 1838, p. 125). They added that MUELL. ARG. referred this to *O. subulata* (*O. glaucescens* CAMB.; DC., Prodr. 16(2), 1868, p. 551).

They judged, however, NUTTALL's species to be distinct and therefore published their new combination, basing it on NUTTALL's specimen which has a 4-lobed capsule, each lobe of them is bilobed in turn. The seeds are distinctly larger than in *O. glaucescens* CAMB. They referred to P. B. KENNEDY's specimen no. 1129 collected 12/5/1905 at Moapa, Lincoln County, Nevada, stating that the plant is frequent on dry gravelly 'mesas.'

KENNEDY 1129 specimen was not seen by me but I was able to examine KENNEDY 1799 from Clark County, Moapa, Nevada (DS, F, G, NY, PH) and found it to agree with all known descriptive data, In addition, MACBRIDE already pointed out the NUTTALL's taxon belonged in *Oligomeris linifolia* (see above), a view which is fully endorsed here.

*Reseda tridens* was first described by VIVIANI (l.c.). The type, if still extant, is from Lower Egypt. The detailed description leaves no doubt that *O. linifolia* was at hand, which was already recognized by MUELL. ARG. (sub 'O. dispersa') and by BOISSIER (sub 'O. subulata').

*Reseda oligandra* EDGEW. was described in 1838 (l.c.) but reduced by MUELL. ARG. to *Oligomeris 'dispersa' (recte: linifolia)*.

EDGEWORTH's description clearly indicates a species of *Oligomeris* and because only one species of *O.* occurs in the Sikh States it follows that *Reseda oligandra* is synonymous to *Oligomeris linifolia* (cf. Bot. Agric. acc. prot. Sikh States, p. 764, and Appendix II). This conclusion was confined by authentic material at Kew ('126 *Reseda oligandra* Edg., NW. India, M. P. Edgeworth 1844').

WEBB and BERTHELOT based *Resedella subulata* as a new combination on *Reseda subulata* DEL. (see notes to *Oligomeris*).

They recorded the species for Egypt and Arabia Petraea (SCHIMPER 241), and in the Canary Islands (Fuerteventura around 'Portem Caprarum'; Lancerotte near the town Arecife; see also *R. schimperi*, sub '*species rejiciendae*'). In addition to other considerations (mentioned above), and also because DELILE's specimen belongs in *O. linifolia, Resedella subulata* is reduced to synonymy.

Ecology. *O. linifolia* is a shrubby low herb, occurring from India, by way of N Africa to the SW United States and in Mexico. It grows in desert environments on a wide variety of soils, from below sealevel to above 1000 m, but is restricted to the tropics and subtropics and remains S of the Mediterranean. In Egyptian deserts it is a pretty plant, by its dense, brightly straw coloured rows of ripe capsules contrasting to the green flowering tops of the spikes. In the deserts of California, Texas and Mexico it may grow, locally, very abundantly (in Chaparral or the Lower Sonoran Life Zone). MUNZ and KECK report it: 'com-

mon in open, often subsaline places, below 3000 ft. (Creosote Bush Scrub, Alkali Sink) in California. A survey of selected ecological data follows.

Algeria. R. MAIRE (2217, G) found it in Central Sahara (Hoggar) on volcanic slopes, between slopes at In-Angel, at 1050–1100 m. Along the Tihalouin river (Ahaggar) in granitic soils at 2150 m, fl. and fr. in March, he (207, G) collected *O. linifolia*, and in the same region at Oued Aouari attacked by *Cystopus candidus* (1526, BRNU). The same botanist secured *O. linifolia* at 700–750 m alt., in sands near Tassili-n-Ajjer, in April, fl. and fr.

Arabia. KHATTAB (409, CAIM) collected it N of Medina on sandy soils in March 1954.

Canary Isl. It flowers and fr. on Fuerteventura in dry seaside sands in Febr. (PITARD 43, L) to May. On Lancerotta, BOURGEAU obtained it among rocks (327, WRSI).

India. In the Punjab it was secured by HOOKER *f.* et THOMSON, at 1000 ft alt. (C, K). DRUMMOND found it (3207, G) there in fr. in January, on a field nr Sirsa.

Iran. It was fl. in March 1893, on sandy soils at Buschir (BORNMUELLER 22, G; KOELZ 14852, W). Near Dalechi, KOTSCHY (119, WAG) collected it on rather fat soil nr warm sources in March.

Iraq. K. H. RECHINGER found it (14576, W) in the Basra district, in the southern desert at Zubair, very small plants, fl. and fr. at the end of March.

Oman. One specimen, anonymous, was found on pebble plains in mountains at Wadi Sigi (HUJ).

Pakistan. In W Pakistan, at Gumbaz (Quetba) K. H. RECHINGER collected it in fl. and fr., medio May (29642, W). At Makran (Beludschistan) RECHINGER obtained specimens at 800–850 m alt., 60 km S of Panjgur (28105, W). POPOV (162, BM) noted its occurrence in the same area on 'decomposing marl and silt hills, slightly saline'.

Palestine (Israel). At 200 m below sealevel, MEYERS and DINSMORE (4893, G) observed *O. linifolia* flowering in Febr., on dry places (Wadi Zuweirah). EIG, ZOHARY and FEINBRUN collected it in the Negeb, ca. 30 km NW of El-Kuntill at ca. 500 m alt. (2. IV. 1936, HUJ). The same botanists secured *O. linifolia* ca. 12 km N. of Ras-el-Naqb, on April 2, 1936, at 760 m alt., in an assoc. of *Zilla spinosa-Gymnocarpus fruticosus*, on soil covered with gravel, fruiting (HUJ). EIG observed it near the Dead Sea (7.4.1925, HUJ) and GABRIELITH at Wadi Mouhavit on lime, March 25, 1929 (HUJ). AARONSOHN collected flowering specimens between 'convent at Ain ed-Dück (Jericho), 29.3.1906' (AAR).

Tunisia. In fr. in desert sands in March (PITARD 2644, G).

U.A.R. (Egypt). In NW Sinai, DRAR (93a, 1939, CAIM) collected on calcareous soil *O. linifolia* in fl. in May. Near the monastery, it flowered in April, and was repeatedly collected. At El Meadi (nr Cairo) it was very common, very lush in cultivated loams, fr. in April (SIMPSON 1168, CAIM). Near Fayum, on salty sands it flowered in November (SHABETAI 4508, CAIM). Round neglected fields there, it was plentiful on a ditch bank in Febr. 1951 (HAINES s.n., CAI). As a roadside weed in Alexandria (PETRY 6.4.10, PR), and on the Red Sea Coast it was col-

lected in February (V. TÄCKHOLM c.s. 432, CAI). G. MAIRE (s.n.) secured it on calcareous fields at Dekellah (Alexandria).

U.S.A. Arizona. GILLESPIE (5584, DS) found it in Maricopa County at 1300 ft, fruiting in April, near Tempe (Canal). On adobe flats, SW Tucson, FOSBERG (7474, F) judged it 'succulent' in Febr. PRINGLE observed it on Pacific slopes in Arizona, fruiting in June (261878, F).

California. M. E. JONES (s.n., NY), collected it in Panamint Valley, east side, at 1400 ft., fr., in May. In the Mojave Desert it occurs in the Mesquite Valley (west side) at 2783 ft (L. R. ABRAMS 14268, DS). In Orange County it grew 5 miles S of Laguna Beach, common on bluffs above sea (H. L. MASON 2905, UC), fr. at the end of April. In the Colorado Desert (Coachella Valley, 3 m NE of Indio), it was an abundant annual in the Lower Sonoran, *Franseria dumosa* et *Atriplex linearis* life zone (C.B. WOLF 8436, RSA), fr. April 6. WIGGINS (9581, NY) found it on the beach along eastern margin of Salton Sea, $3^1/_2$ m S of Mortmar, Riverside County, on open saline sandy soil. Associated plants: *Allenrolfea occidentalis*, *Atriplex canescens* and *Sesuvium verrucosum*, fl. & fr. March 24. CARL B. WOLF (10858, RSA) secured it in the Mojave desert (2000 ft, Sheep hole Mts, San Bernardino) in sunny, dry places, open slopes on granite, North exp., abundant, in May; at 2300 ft, 3 m NE Barstow, on dry sunny lime rocks and clay, scattered on open flats (10301, DS), in a sandy wash at Hanks Well, San Bernardino (3219, DS), and on sandy alkali loam, in sun (3072, RSA), abundantly, fr. in April. Repeatedly WOLF assigns it to the Lower Sonoran Life Zone, associated with *Larrea* and *Franseria dumosa*, also with *Cassia armata*. On dry limestone rocks & silt in open flats, at 2783 ft. alt. WOLF (10629, TEX) found in the sun 'thousands of plants on open mosaics' on May 15, fruiting, in the NW End of Mesquite Valley (Inyo Co).

In saline desert near la Quinta, fl. and fr. in March (LEWIS S. ROSE 62012, RSA), in a desert wash at Cathedral City, at 250 ft. alt. (LEWIS S. ROSE 37145, MICH). In Death Valley, Furnace Creek Ranch it flowered 14.3.1928 (SKJØT-PEDERSEN 658, C); in the Colorado Desert, PH. A. MUNZ (9970, UC) found it fruiting in January 1926.

Nevada. P. B. KENNEDY collected *O. linifolia* near Moapa (1799, PH), fruiting in May.

Texas. ROBERT RUNYON noted (2566, F) in a large ravine, 8 m S. of Rio Grande, Starr County, that it was frequent in its preferred soil (day loam) at an alt. of 50 m., as slopes at base of hills, fl. March-May, and with bright green succulent leaves. WARNOCK (21746, DS) found it frequent between Persimmon Gulf and Boquillas, fr. in August. Very abundant, weedy on stony flats, creosote-shrub ass., 3 m S. of Persimmon Gap, Brewster Co (29°37' N, 103°09' W; ROGERS MC VAUGH 7825, MICH) fruiting in April. At 3000 ft in Joshua Tree National Monument, Riverside Co., fruiting in May (COLE 962, DS).

Mexico. GENTRY (7425, UC) collected it in a 'desert of dispersed succulent trees and suffrutescent shrubs'; soil rocky, 400–800 ft alt., fr. in March in the Sierra Viscaino. The same collection (4077, MO) secured in 'sandy alluvium in arroyo', where it was 'common in scattered colonies near Comonda (Baja Cali-

fonia). North of Cuarenta (San Ignacio-La Purisima), it grew on edges of and on raised areas in dry saline lake bed, fl. in October (J. H. THOMAS 8333, UC).

In Sonora, *O. linifolia* grows on the upper edge of Macdougal Crater, Pinacate Mts (MASON c.s., 1833). On Guadelupe Isl., along rocky washes and gentle slopes of mesa, just northeast of the weather station at the south end of the island (I. L. WIGGINS and W. R. ERNST 142, fr. April).

Illustrative specimens: Algeria. R. Maire 2217, Sahara centr., Hoggar, à in-Angel; *id.* 205, Ahaggar, Tamanghasset; *id.* 207, *ibid.*, Tihaliouin; *id.* 208, Tassili-n-Ajjer, Amqid; Murbeck 4, Hammam Salahin *prope* Biskra; Murbeck et Métivet 541, *ibid.*

Arabia. Aucher-Eloy 4176, reg. Mascate; Khattab 409, Hedjaz, Al Madinah, E. Al 'Awaly; *id.* 4633, *ibid.*, El-Taief; Schimper 241, Arabiae petraea, reg. Hauara (cf. notes *R. schimperi* and *Resedella subulata*).

Canary Islands. Børgesen 694, Gran Canaria, Isleta; Bourgeau 327, Lancerotta, port d'Arrecife; *id.* 1252, Canaria, Isleta; Burchard 336, Fuerteventura, prope Promontor; Gelert s.n., 10.IV.97, Gran Canaria, Las Palmas; *id.*, 16.IV.97, *ibid.*, Isleta, Faro; Hillebrand s.n., *ibid.*, montana de Galdar; Murray s.n., *ibid.*, Isleta; Pitard 43, Fuerteventura, Puerto de Lajas; Rikli s.n., 30.III.1908, Gran Canary Isleta bei Las Palmas.

India. Drummond 3207, Punjab, Castellum Sirsa, ditione Hissar, *id.* 4843, *ibid.*, *prope opp.* Ludhiana; Kabir 15280, *ibid. opp.* Hausi, ditione Hissar.

Iran. Bornmüller 32, Sinus Persicus austr., Insulae Hormus 'Hormos'; *id.* 36, *ibid.*, Insulae Kischm 'Qeshm'; *id.* 22, Farsistan, Buschir; Bunge s.n., IV.1859, inter Chabbis et Kerman; Gauba et Sabeti 300, prov. Khuzistan, Abadan; Koelz 14852, Bushire, Fars; Kotschy 119, ad fontes calides, prov. Dalechi; Scharif s.n., 22.II.99, prov. Baloučestan Iranchahr (Feld); Stapf 116, bei Buschir.

Iraq. Graham 412, Zubair; Lazar 536, near Bagdad; Rechinger 8596, distr. Basra, Jabab Sanam; *id.* 8666, 14576, *ibid.*, SSE Zubair, Haswa; *id.* 14313, *ibid.*, prope stationem Makhaila, SW Basra, Haswa; *id.* 15415, *ibid.*, Zubair, the New Athel.

Libya. Ascherson 36, bei Samma.

Mexico. Johnson and Barkley 16221 M, Coahuila, SW of Monterey; Moran 6808, Coronado Isl., Middle Isl., Palmer 22, State of Coahuila, at Salthillo; *id.* 235, vicinity of Aldama; Purpus 4534, Coahuila, Cerro de Cypriano; Wiggins 6258, Sonora, Llano, 9 m N Torres; *id.* 7688, Bahia de los Angeles.

Morocco. ?Ahmed s.n., V.31, Tatta, Dj. Bani; Emberger s.n., à 1935, Oued Noun; Miré et Reymond s.n., VI. 1950, Zig, en aval de Rissani.

Pakistan. Hooker s.n., 5–9.II.1857, prov. Punjab, Kohat to Kalabagh, west side of Indus River; *id.*, 10–14.II.1857, *ibid.*, Kalabagh, left side of Indus River; *id.* 17.II–5.III.1857, ibid., Musakél, via Várcha and Choia to Gujart; *id.*, 18–22.III.1857, *ibid.*, from the Bári Duáb, 60 m NE of Lahór; Koelz 1593, Punjab, Sirsa; Monro 247, Makhdumpar-Multan; Nasir 'Stewart hb 16306', Punjab, distr. Attock, Jhalar, 'Jhalawar' (Brijnagar); Nath 15468, 15833 Peshawar; Popov 162, Baluchistan, near Panjgur; Ranger 59, Punjab, distr. Multan; Rechinger 27716, Baluchistan, Makran, 8–25 km W. Awaran versus Turbat; *id.* 27835, *ibid.*, 80 km. S. Turbat versus Pasni; *id.* 27859, *ibid.*, inter Pasni et Kappar; *id.* 27964, *ibid.*, inter Gawadar et Suntsar; *id.* 27981, *ibid.*, Suntsar versus Kikki; *id.* 28105, *ibid.*, 60 km S. Pangur; *id.* 29642, Quetta, Gumbaz; *id.* 30041, Bannu, N. of Bannu; Stewart 1386, Punjab, Sangla Hill; Stewart et Nasir 27903, distr. Attock, Dhok Pathan.

Palestine (Israel). Dinsmore 893, prope mare; Meyers et Dinsmore (1834) 4893, Wadi Guweiran.

U.A.R. Abdallah s.n. 15.IV.1962, S. Sinai, Wadi Thal and Wadi Isla; Abdallah c.s., s.n. 14.IV.1962, *ibid.*, Wadi El-Hommor; *id.*, 21.IV.1962, Wadi El-Sheikh; Ascherson 144, bei Esneh; Bornmüller 10373, Cairo prope Turra; Boulos s.n., 24.IV.1959, M. Sinai, Wadi El-Mizeirie, near Gebel El-Maghara; Cramer s.n., 28–30.IV.1891, environs du Couvent du Sinai; Drar 397, Bir Abraq; *id.* s.n., 4.IV.39, Sinai, Wadi Heredin, S. El-Arish; *id.*, 5.IV.39, Wadi El-Arish, *id.*, 7.IV.1939, Wadi El-Hosami, near El Qosseima; *id.* 36, Sinai, Wadi Abar, Gebel

Ataqa; *id.*, 714, *ibid.*, Isthmic desert, Nekhl; Kralik s.n., Berket El-Hadji, près du Caire; *id.*, 20.II.1848, Esneh; Letourneux s.n., III. 1877, Mariut; *id.*, 23.III.1877, Ramlé, *id.*, IV. 1877, Mex; G. Maire s.n., 15.III.1909, Iles du Nil à Minieh; Petry s.n. 6.IV.10, Alexandria; Sáad 163, El-Alamein; Schweinfurth 151, Abuksa, Fayum; Shabetai z 4/63, Sinai, Wady Feiran; *id.* z 3689, Cairo, near the Citadel; *id.* 27004, Victoria, near Alexandria, *id.* 5626, Wadi Um Jusr, Ras Gharib; Sieber s.n. 1818, ad Schiut; Simpson 686, Wadi Rishrash, SE El-Saff; *id.* 1168, El Meadi; G. Täckholm, s.n., 20.III.1928, El Arish; Wiest 524, prope Cahiram.

U.S.A. Arizona. Gillespie 5584, Maricopa County, N of Tempe; A. et R. A. Nelson 1681, Gila Valley, Indian ruins; Parish 33, Tucson; Pringle s.n., 4.IV.1882, mesas near Camp Lowell; Wiggins 6597, 3 m NE Wellton, Yuma County.

California. Abrams 3135, Los Angeles County, San Pedro hills; *id.* 3493, San Diego County, Tia Juana hills; F. E. et E. S. Clements 7, Howard Canyon, Chapparral, La Jolla; Cheville et Funston 583, Death Valley, Furnace Creek Canyon, Funeral Mt.; Ferris 13469, *ibid.*, Bradbury well, National Monument; Munz et Hitchcock 12150, Imperial Co, 2 m N Cargo Muchacho Mts; Spencer 234, Colorado Desert, Cayote wells, San Diego Co.; Tharp s.n., 15.VI.31, Marathon, Chisos Mts; Wolf 10629, Inyo Co., 2 m N San Bernardino Co. line.

Nevada. Kennedy 1799, Clark County, Moapa.

Texas. Jones 3777, El Paso; Mc Vaugh 7825, 3 m S Persimmon Gap, Brewster Co., *id.* 7950, Presidio Co., 10 m NW Presidio; Warnock 46129, Pecos Co., E Fort Stockton.

### 3. **Oligomeris dipetala** (AITON) TURCZANINOW **Fig. 15, 16**

*in* Bull. Soc. Nat. Moscou 27, 1854, p. 330 *(nomen tantum)*.

Basionym: *Reseda dipetala* Aiton.

*Oligomeris capensis* Harvey in Harvey et Sonder, Fl. Cap. 1, 1860, p. 64; Perkins *in* Engl. bot. Jahrb. 43, 1909, p. 418; Bolle in Engl. et Pr., Nat. Pflz.fam. 2nd ed., 17b, 1936, p. 685, fig. 427 F; Wildenauer et Roessler in Merxmüller, Prodr. Fl. SW Afrika 1966, Resedaceae 49, p. 1.

*O. c.* var. *pumila* (Turcz.) Harvey, l.c., p. 65; Perkins, l.c. p. 419.

*O. c.* var. *virgata* Harvey, l.c. p. 65; Perkins, l.c. p. 419.

*O. c.* var. *capensis* Perkins, l.c. p. 418, *('eucapensis')*.

*O. dipetala* (Aiton) Muell. Arg. in DC., Prodr. 16(2), 1868, p. 585 (*taxon tantum, nom. non* Turcz.); Dur. et Schinz, l.c.

*O. d.* α *capensis* (Thunberg) Muell. Arg., l.c.; Dur. et Schinz, l.c.

*O. d.* β *virgata* (Harvey) Muell. Arg., l.c.; Dur. et Schinz, l.c. p. 187.

*O. d.* γ *pumila* (Harvey) Muell. Arg., l.c.; Dur. et Schinz, l.c. p. 186.

*O. burchelli* (Muell. Arg.) Harvey in Harvey et Sonder l.c. p. 65; Dur. et Schinz, Consp. Fl. Afr. 1(2), 1897, p. 186; Bolle, l.c., p. 685.

*O. spathulata* (E. Meyer *ex* Turcz.) Harvey in Harvey et Sonder, l.c.; Muell. Arg. in DC., Prodr. 16(2), 1868, p. 586; Dur. et Schinz, l.c. p. 187; Bolle in Engl. et Pr., l.c. p. 685; Wildenauer et Roessler, l.c. Resed. 49, p. 2.

*O. (Holopetalum) lycopodioides* Schinz et Dinter *in* Bull. Herb. Boissier, ser. 2, 3, 1903, p. 812; Bolle in Engl. et Pr., l.c. p. 685.

*O. frutescens* Dinter *in* Fedde Rep. 19, 1924, p. 319.

*O. upingtoniae* Dinter, l.c.

*Reseda capensis* Burm. *f.*, Fl. Capensis Prodr. 1768, p. 13 (see notes).

*R. dipetala* Aiton, Hort. Kew. 2, 1789, p. 132; Vahl, Symb. 2, 1791, p. 52; Willdenow, Sp. Pl. 2(2), 1800 (1799), p. 878; Sprengel, Syst. Veg. 2, 1825, p. 463; Walpers, Rep. 2, 1843, p. 751.

*R. capensis* Thunberg, Fl. Cap. ed. Schultes 2, 1823, p. 402.

*Dipetalia capensis* (Burm. *f.*) Rafinesque, Fl. Tell. 3, 1837 (1836), p. 73; Merrill, Ind. Rafin. 1949, p. 132.

*Resedella dipetala* Webb et Berth., Phyt. Can. 1, 1837, p. 107 *(nomen tantum)*.

*Holopetalum pumilum* Turczaninow *in* Bull. Soc. Nat. Moscou 16, 1843, p. 51; Muell. Arg., Mon. Rés. 1857, p. 209, tab. 9, fig. 125 (Neue Denkschr. Schweiz. Ges. Zuer. 16, 1858); *id.* in DC., Prodr. 16(2), 1868, p. 585.

*H. p.* β *majus* Muell. Arg., l.c., p. 210.

*H. spathulatum* E. Mey. *ex* Turczaninow, l.c. 27, 1854, p. 336; Muell. Arg. *in* Bot. Zeit. 14, 1856, p. 39; *id.*, Mon. Rés. 1857, p. 211, tab. 9, fig. 126 (Neue Denkschr. Schweiz. Ges. Zuer. 16, 1858); *id.* in DC., Prodr. 16(2), 1868, p. 586.

*H. burchelli* Muell. Arg. *in* Bot. Zeit. l.c.; id., Mon. Rés. 1857, p. 212, tab. 9, fig. 212 (Neue Denkschr. Schweiz. Ges. Zuer. 16, 1858); *id.* in DC., Prodr. 16(2), 1868, p. 586.

Perennial, rarely ?annual, sometimes greyish-green, glabrous, smooth to ± scabrid, (8–)15–40(–60) cm tall plants, sometimes suffruticose often woody at base; taproot ligneous, sometimes 2(—more) cm thick.

*Stems* many or few, rigid, erect or ascending and flexuous, usually densely leafy, terete, ± ribbed, glabrous, sometimes scabridulous; pith usually solid, sometimes internodes narrowly tubular.

*Leaves* entire, sessile, often with axillary innovations of smaller leaves, (sub) fleshy, sometimes glaucous, glabrous, sometimes scabrid, linear to -obovate or spathulate, adult leaves (3-) 5–15(–25) mm long, $^2/_3$–2 (–4) mm wide, (broad) obtuse to acute or short acuminate, margins obscurely pallid, entire, smooth or scabrid.

*Flowers* white, rarely pinkish, sessile, sometimes monosexual (female), in terminal spicate racemes. Racemes elongating, (3–)5–15(–25) cm long, $^2/_3$–$1^1/_2$ cm wide when fruiting, usually very dense, peduncles finely ribbed. Bracts persistent, triangular to linear-subulate, up to $1^1/_2$ mm long, $^1/_2$–$1^1/_2$ mm wide, acute; margins broadly white, entire. Pedicels wanting or nearly so.

*Sepals* 5, persistent, glabrous, smooth or scabridulous, linear to (ob)ovate, $^3/_4$–2 mm long, $^1/_2$–1 mm wide, obtuse to acutish; margins broadly white, entire.

*Petals* 2 (very rarely up to 5), exceeding to sepals, hyaline, usually tardily deciduous, alternating with (superior) sepals, exappendiculate, oblong to more or less spathulate or clavate, ($1^1/_2$–)2–3(–$3^1/_2$) mm long, $^3/_4$–$1^1/_2$ mm wide, broad obtuse to acute, uninerved.

*Stamens* (5–)8–10(–12), sometimes rudimentary or wanting, usually surrounding the ovary. Filaments persistent, glabrous, up to $3^1/_2$ mm long. Anthers subglobose-oblong, $^2/_3$–1 mm long, $^1/_2$ mm wide, sometimes minutely scabridulous.

*Ovary* ovoid to ± globular, (sub)sessile, up to $3^1/_2$ mm long, 1–2 mm wide, glabrous, inflated, obtusely angled, shallowly sulcate, 4(–5) toothed; teeth conical, $^1/_2$–1 mm long, tip lacerate, connivent or divergent. Ovules 5–15 per

placenta, in (2–) 3–4(–5) rows.

*Capsules* erect, (sub)sessile (rarely pedicels up to 1 mm long), globular to (ob)ovoid or broad-cylindric, $3^1/_2$–6 mm long, 3–4 mm wide, glabrous, bladdery, shallowly grooved; teeth triangular to cuspidate, $^1/_2$–$1^1/_4$ mm long, sometimes mouth contracted beneath the teeth.

*Seeds* (brownish-)black, very glossy, globular-ovoid, $^1/_2$–1 mm long, $^1/_3$–$^4/_5$ mm wide. Sinus wanting, represented by a deep groove. Testa smooth (obscurely rugulose under high magnification), outer layer persistent.

Type: AITON s.n., culta Hort. Kew. (from seeds, MASSON; ?K).

Distribution: S Africa (Cape prov., Orange Free State, SW Africa).

**a. var. dipetala**

Glaucous-green, occasionally scabrid, erect and stiff or ascending and flexuous, suffruticose; base woody.

*Leaves* ± succulent, occasionally scabrid, linear to obovate (or often less than 10 mm long when spathulate), 3–15(–20) mm long, ca. 1–2 mm wide, obtuse to acute.

*Flowers* sometimes unisexual (female).

*Sepals* elliptic-oblong or (ob)ovate, 1 mm long; obtuse to acute.

*Petals* narrow, $1^1/_2$–3 mm long, ca. 1 mm wide, obtuse.

*Ovary* subglobose to (ob)ovoid, 1–$2^1/_2$ mm long. Ovules 6 per placenta, in (2–)3 rows.

*Capsules* sessile, (sub)globose or (ob)ovoid, very rarely broad-cylindric, $3^1/_2$–5 mm long, 3–4 mm wide, teeth conical to cuspidate, ca. 1 mm long, mouth usually contracted beneath teeth.

*Seeds* brown-black, up to 1 mm long, slightly less wide.

Distribution: Area of the species.

**b. var. burchellii** (MUELL. ARG.) ABDALLAH *comb. et stat. nov.*

Basionym: *Holopetalum burchelli* Muell. Arg. *in* Bot. Zeit. 14(3), 1856, p. 39.

Glaucous-green, sometimes scabrid, erect and rather stiff, taproot often lignescent.

*Leaves* sometimes scabrid, linear to -obovate, 8–12(–20) mm long, ca. 1–2 mm wide, acute to acuminate; margins occasionally coarsely scabrid.

*Flowers* sometimes monosexual (female).

*Sepals* narrow-oblong to linear-(ob)ovate, 1–2 mm long, less than 1 mm wide, obtuse or acute.

*Petals* narrow-oblong to -spathulate or -clavate, $2^1/_2$–$3^1/_2$ mm long, ca. 1 mm wide, round-obtuse to acutish.

*Ovary* oblong-ovoid, 2–3$^1/_2$ mm long.
*Capsules* sessile (rarely pedicels up to $^1/_4$ mm long), oblong-(ob)ovoid, 4$^1/_2$ × 3 mm, teeth conical to cuspidate, $^1/_2$–1$^1/_4$ mm long, ± divergent.
*Seeds* black, almost 1 mm long and wide.

Type: BURCHELL, Cat. geogr. pl. Afric. austral. extratrop. 2549 (lectotype L 908.183–824; G).

Distribution: Area of the species.

**Key to subvarieties in var. burchellii**

| | |
|---|---|
| Leaf-margins ± smooth, leaves rather lax. Petals obtuse . . . . . | **subvar. burchellii** |
| Leaf-margins coarsely scabrid, leaves dense. Petals acutish . . . . | **subvar. lycopodioides** |

**subvar. burchellii**
*Leaves* glabrous, occasionally scabridulous, margins ± smooth, usually lax. Petals rounded-obtuse.

Distribution: Area of the variety.

**subvar. lycopodioides** (SCHINZ et DINTER) ABDALLAH, *comb. et stat. nov.*

Basionym: *Oligomeris (Holopetalum) lycopodioides* Schinz et Dinter *in* Bull. Herb. Boiss. ser. 2, 3, 1903, p. 812.

Leaves dense, especially the margins coarsely scabrid. Petals acutish.

Type: DINTER 330, Deutsch-Südwest-Afrika; Gross Namaland, Windhoek, auf Kalk, Febr. 1899; fl. et fr. (Z, holotype).

Distribution: Type locality only.

**c. var. spathulata** (E. MEY. *ex* TURCZ.) ABDALLAH *comb. et stat. nov.*

Basionym: *Holopetalum spathulatum* E. Mey. *ex* Turczaninow *in* Bull. Soc. Nat. Moscou 27(2), 1854, p. 330.

Greyish-green, often scabrid, erect; taproot lignescent.
*Leaves* fleshy, usually scabrid, oblong-spathulate, (5–)10–15(–25) mm long, (2–)3–4 mm wide, obtuse, sometimes ± mucronate.
*Flowers* hermaphrodite.
*Sepals* oblong-ovate, 1$^1/_2$–$^3/_4$ mm long, round-obtuse.
*Petals* ovate (rarely obovate), ± rhomboid, 2–3 mm long, obtuse to acutish.
*Ovary* ovoid, 3 mm long. Ovules ca. 15 per placenta in 4–5 rows.
*Capsules* subsessile (pedicels sometimes up to 1 mm long), (sub)globose,

4–5 mm long, teeth cuspidate, 1 mm long, mouth contracted beneath teeth.
*Seeds* dark brown, $^4/_5$–1 mm long, $^2/_3$–$^4/_5$ mm wide.

Type: DRÈGE, Pl. exs., in Cap. Boni Spei, ad Garip in planitie et in collibus ad ostium rivuli infra 600 ped. s.m., sub 'Reseda spathulata E. Meyer' (G (DC., BOISS.) et Reg. Berol.).

Distribution: Area of the species.

Nomenclatural notes: For the first time *Reseda capensis* was published in 1768 by BURMAN *f.* (Prodr. Fl. Cap., p. 13). The protologue is only:

'Reseda (capensis) caule fruticoso, foliis linearibus ternis, apice mucronatis.'

Of *Resedaceae* only one genus occurs at the Cape: *Oligomeris*. The linear leaves, with mucronate tip, and the suffruticose habit mentioned by BURMAN *f.* agree with *Oligomeris*. The type might be conserved in the Burman herbarium at Geneva.

Actually there is one sheet at Geneva carrying a good specimen of *Oligomeris*. It has no identification by BURMAN. A second sheet in C carries what may be a duplicate of the Geneva specimen. On the back of the sheet is written 'ded. Dr Burman'. It seems reasonable to accept these two sheets as type material, noting that some confusion accompanied the identification of type specimens of *Reseda capensis* Burm. *f.* (part of the specimens believed to be types are *Sesamoides;* cf. MUELL. ARG., Mon. Rés. 1857, p. 222, 'Astrocarpus'). *Sesamoides* does not occur in S Africa and so must be rejected as a possible choice.

In 1823, *Reseda capensis* THUNBERG was published (Fl. Cap. ed. SCHULTES, p. 402). There is no reference to BURMAN *f.* 's earlier name and so *Reseda capensis* THUNB. is a homonym of *Reseda capensis* BURM. *f.*

The name *Reseda capensis* THUNBERG was subsequently used by HARVEY for the combination *Oligomeris capensis* (THUNB.) HARVEY (in HARVEY et SONDER, Fl. Cap. 1, 1859–60, p. 64). The name *Oligomeris capensis* HARVEY is to be regarded as a new name (Code 1966, art. 72).

The citation *Oligomeris capensis* (BURM. *f.*) HARVEY, used by BOLLE (in ENGL. et PR., Nat. Pflz.fam. 2nd ed., 17b, 1936, p. 685) and by WILDENAUER and ROESSLER (in MERXMÜLLER, Fl. SW Afr., Resed., 49, 1966, p. 1) also is not correct.

As *Oligomeris capensis* is the binomial by which BURMAN and THUNBERG's species (they had the same taxon in mind) has become currently known, it was considered whether it could be maintained.

The most promising procedure seemed to adopt *Oligomeris capensis* HARVEY, the nomenclaturally 'new name'. One could advocate the view that, admittedly, HARVEY ought to have adopted BURMAN *f.*'s epithet for his new combination in *Oligomeris*, whereas he took THUNBERG's. This, clearly, is inadmissible but, on the other hand, had he, as was necessary, taken BURMAN *f.*'s 'capensis' instead,

the resulting binomial would have become the same. Although it is very tempting to interpret the Code in such a way as to escape the conclusion that *Oligomeris capensis* HARVEY must be rejected, it was nevertheless inescapable. Perhaps, the Code fails explicity to rule that the type of the new name *Oligomeris capensis* HARVEY must be the type of THUNBERG's *Reseda capensis*. Clearly, the type of *O. capensis* HARVEY is not BURMAN's specimen. The type method, it is concluded here, is one obstacle for maintaining O. *capensis* HARVEY.

The combination *O. capensis* based on *Reseda capensis* BURM. *f.* is not available.

*Holopetalum pumilum* TURCZ. was based on a specimen collected by DRÈGE ('Reseda n. 7533' in DRÈGE coll. pl. Capensium). The genus *Holopetalum* was based on one single species *Holopetalum pumilum* (*in* Bull. Soc. Nat. Moscou, 16, 1843, p. 51). There is reason to assume that DRÈGE 7533 a, collected at 'Winterveld', between 'Nieuwjaarsfontein' and 'Ezelsfontein', between 3000–4000 ft., December-January (cf. Flora, Beigabe zu Band II, 1843, p. 57, 215) is the same taxon (or specimen). It is a small-leaved dwarf specimen, as often seen growing under unfavourable conditions.

As the type of *Reseda capensis* THUNBERG is designated here 'UPS 11387, THUNBERG, Carro cis Langkloof, in praeclivis collium, prope Goudsrivier'.

*Reseda dipetala* AITON rests on specimens grown from seeds introduced in 1774 from the Cape of Good Hope (Mr. FR. MASSON). It was explained in the Notes to *O. dregeana* that *O. dipetala* (AITON) TURCZ. is the nomenclaturally correct name for the species.

The genus *Dipetalia* RAFINESQUE is a rejected name (Code 1966, p. 291).

*Holopetalum spathulatum* (E. MEYER *ex* TURCZ.) TURCZ. (*in* Bull. Soc. Nat. Moscou 27, 1854, p. 330) was published by TURCZANINOW who declared that *H. spathulatum* is the second species which he referred to the genus *Holopetalum*. While pointing out why *Holopetalum* is distinct from the genus *Oligomeris* (his argument was not accepted in the present revision, see notes to *Oligomeris*), he noted that the specimen described was 'Reseda spathulata E. Meyer', collected by DRÈGE at the Cape of Good Hope. HARVEY used the name as the basionym of *Oligomeris spathulata* (l.c.), but after examining the type, the taxon appears best reduced to a not always clearly demarcated variety in *Oligomeris pumila*.

*Holopetalum burchelli* MUELL. ARG. was based on BURCHELL 1850 et 2549 (in hb DC). It is interesting to note that MUELL. ARG. himself suspected identity with *Reseda capensis* THUNB. and with *Reseda capensis* BURMAN *f.* (Mon. Rés. 1857, p. 212).

*Oligomeris capensis* var. *virgata* HARVEY was referred to *O. dipetala* (AIT.) MUELL. ARG. *(nomen illeg.)*: *O. dipetala* β *virgata* (BURKE, ZEYHER 33), while MUELL. ARG. noted that the variety was part of 'Holopetalum pumilum Muell. Arg.' (in DC., Prodr. 16(2), 1868, p. 585). Although MUELL. ARG.'s nomenclature needed change, his taxonomy is in accordance with the present revision, but

var. *virgata* is best reduced to synonymy (of *O. dipetala* (AIT.) TURCZ.; cf. also MUELL. ARG. l.c., sub 'α *capensis*').

*Oligomeris lycopodioides* SCHINZ et DINTER (*in* Bull. Herb. Boiss. Ser. 2, 3, 1903, p. 812) was based on 'Dinter 330' a specimen from 'Gross-Namaland', near Windhoek. It was found growing on calcareous soil, and bore fruit and flower in February.

The authors suggested that the species might belong in *Holopetalum*. Actually, the type consists of vigorous, rather scabrid specimens of *O. dipetala* var. *burchellii*.

*Oligomeris frutescens* DINTER rests on DINTER 2069, 'Seskamelboom', and DINTER 2942, near Harebis (syntypes); they belong in *O. dipetala* var. *dipetala*.

*Oligomeris upingtoniae* DINTER rests on DINTER 714, Grootfontein, and DINTER, Aub near Rehobot (syntypes); they belong in *O. dipetala* var. *dipetala*.

*O. dipetala* is a very variable species. The shape of the capsule, the petals, the leaves and also the habit of the plants are not constant nor is any of these or other characters correlated with each other. This is illustrated e.g. by LEISTNER 1735 (PRE) which has suffruticose stems, leaves up to 8 mm long, the petals oblong-spathulate and broad obtuse, and capsules (immature) ovoid. WILMAN 16424 (BOL) differs in having cylindric or subglobose capsules, the petals oblong-elliptic and the stems very thick and woody (ca. 1 cm). RANGE 1442 (BOL) matches LEISTNER 1735 but has (sub)globose capsules. ACOCKS 8170 (BOL), is an exact match of RANGE 1442. ESTERHUYSEN 769 (BOL) differs from WILMAN's 16424 by the capsules which range from subglobose to ovoid; on the other hand SIDEY 330 (S) matches that of WILMAN but has ovoid capsules. SCHINZ 905 (Z) represents another aspect. It has oblong-ovoid capsules, stamens rudimentary, (ca. 8), and the leaves spathulate. DINTER 8030 (BOL, G, PRE, S, Z) is another example of variability. Its capsules are globular, the stamens range from 5 to 6 on the same plant (cf. S), when 5 the stamens are not equally set; there is a wide lateral gap in the staminal whorl, the leaves are ca. $^1/_2$ cm and spathulate, the plant is decumbent with a perennial root. DINTER 7407 (BOL, G, S, Z) is another example, the stems being ± herbaceous.

It follows that from these and numerous other specimens that *O. dipetala* is a widely varying taxon comprising many other later published species and other taxa. The varieties maintained in the present revision are not always quite clearly distinguishable; intermediate specimens are not rare.

Ecological notes: ACOCKS found *O. dipetala* 'common in damp hollows', at 1300 m alt., in the Hutchinson div. at the Cape (9590, PRE). In Orange Free State, HENRICI observed at Fauresmith in October this 'prostrate shrub' frequent, with reddish-white flowers, on brakveld (nr. Kalebasdrift, 2857, PRE). SCHWEIKERDT confirmed this (1140, PRE) at Gipsbank Farm, Jacobsdal, where he observed 'pale brown stamens'. At Paljasfontein (Fauresmith) it was a 'woody perennial', at 1500 m alt., with salmon-coloured anthers (C. A. SMITH, 5445, PRE).

SCHLIEBEN described it as a 'woody, 20–40 cm tall shrublet', bearing white fl.; 83 m W of Kenhardt (8891, PRE). HUTCHINSON at Postmasburg (3032, BOL) saw 'pale pink' flowers. MERXMÜLLER and GIESS also noted this colour in Jan. at Gobabis, in 'an inundated calcareous pan' (1175, PRE). At Barkly West, ACOCKS collected (2252, PRE) fl. and fr. in December, where *O. pumila* was frequent in a limestone vlei (nr. Smith's Mine). The same collector (18170, BOL) judged it 'locally fairly frequent' on a brak sandy river bed, 'erect, 30–60 cm tall bushes' at Warmbad (SW Africa). LEISTNER found it 'loc. common' in the marginal zone of Klein Sebobogas Pan (Kalahari Gemsbok National Park), at 1000 m alt., fl. and fr. in December (990, PRE). PEARSON, in Little Namaqualand found the 'woody bases' common on sandy slopes at Kamabies, at 1000 m alt. (3950, BOL).

It appears that the geographical areas of distribution of *O. dipetala* and *O. dregeana* overlap largely, but in the northern part they diverge, *O. dipetala* being more western.

Var. *burchellii*. In Cape Prov., 28m. N of Prieska, BRYANT collected *O. dipetala* var. *burchellii*, fl. and fr. in November; it was 'abundant in sandy vlei, growing in tufts or clumps' (1176, PRE). STORY, in SW Africa, noted: 'seepy area at edge of Gautscha Pan, gray lax herb, loc. frequent', fl. in August (5233, PRE). SCHOENFELDER (S 468, PRE) found it common on heavier soil, fl. grey-white, with disagreeable smell. The subvar. *lycopodioides* grew on 'calcareous layers' of sources, 1600 m alt., at Windhoek (DINTER 337, Z).

Var. *spathulata*. At Lüderitz, var. *spathulata* grew on 'boulders', slope of hill, fr. in October (KINGES 271, PRE). PILLANS collected it in Little Namaqualand, dry sandy course of Oorlap River (PILLANS 5048, BOL), fr. Sept.-Oct.

DRÈGE's finding localities are either vague or unreliable.

Uses: At Fauresmith, on brakveld, it was 'eagerly eaten' (HENRICI); it was 'good sheep food' (Gipsbank Farm, Jacobsdal distr., O.F.S.; SCHWEICKERDT). At Vrijburg, TURNER noted (29614 PRE), that 'the fresh roots were chewed by natives as for stomach ache', at Farm Panplaats (Jan. 1931).

Vernacular name: *Aarbossie* (Fauresmith, O.F.S.).

Illustrative specimens: Var. *dipetala*. Rep. S Africa. Cape Prov. Acocks 2252,distr. Barkly, nr. Smith's mine; *id.* 9590, distr. Hutchinson, Hutchinson; *id.* 14556, distr. Montagu, Warmwatersberg (Hot Springs); Bolus 289, prope Graaff Reinet; *id.* 1104, Ratelfontein, ditione Fraserburg; *id.* s.n. X.1867, Graaff Reinet; Burman s.n., s.d., Cap. bon. Spei (type of *R. capensis* Burm. *f.*; G); Drège 7533 a, Port Natal et Afr. mér., Winterveld, zwischen Nieuwjaarsfontein und Ezelsfontein; *id.* 7533 a, Garip, bei Verleptpram; Ecklon et Zeyher 113, Karro, inter Mts Zwartberge, in Graafreynet et Langekloof (Georg.), tum in Winterfeld (Beaufort); Esterhuysen 769, Kalahari reg., div. Barkly West, Hongerdoorn; *id.* 770, *ibid.*, Silverstreams; *id.* 2357, *ibid.*, div. Hay, Floradale; *id.* 6606, div. Uniondale, Uniondale Hot Springs; Goatcher s.n., X. 1905, reg. Karrooicae, Krom River; Henrici 3944, reg. de Aar, Burgerville; Hafstrom 991, distr. Kimberley, Benauwdheidsfontein; *id.* 1010, *ibid.*, Mostertshoek, Paarde-

klagroad; Hutchinson 3032, Postmasburg; *id.* 3052, reg. Griqualand West, Wattwater; Leistner 963, distr. Kuruman, 11 m NW. Blikfontein; *id.* 990, Kalahari, distr. Gordonia, Gemsbok National Park, Klein Sebobogas Pan; *id.* 1735, *ibid.*, distr. Hay, Rooinekke, 32 m W. Griquatown; Marloth 856, Kimberley, Griqualand West; Schlieben 8891, distr. Kenhardt, 83 m W Kenhardt; Sim 2864 = 5965, Hanover; Thunberg s.n., s.d., ex Cap. b. Spei (type of *Reseda capensis* Thunberg; UPS); Wilman 16424, Kalahari region, Herbert div., nr Kimberley (Honey nest kloof); Zeyher 33, Beaufort, prope desertum Karroo, ad Renosterkop.

Orange Free State. Henrici 2857, distr. Fauresmith, Kalabas drift, Rehmann 3545, Kanonfontein; *id.* 3617, ibid., Draaifontein; Schweickerdt 1140, reg. Jacobsdal, farm Grijsbank; Sidey 330, Douglas.

Southwest Africa. Acocks 18170, distr. Warmbad, 4½ m S of Charly's Puts; Bradfield 82, Okahandja; Dinter 724, Hereroland, Grootfontein; *id.* 5217, Dreihoek; Marloth 1486, distr. Okahandja; Quiapütz, Merxmüller et Giess 1175, distr. Gababis, farm Nico; Pearson 3950, reg. Little Namaqualand, Kamabies; *id.* 4328, reg. Gt Namaqualand, Gabis; Range 1442, near Gibeon; Vuuren et Giess 1102, distr. Gibeon, farm Lekkerwater, 32 m E Aranos; de Winter 3570, distr. Keetmanshoop, 12 m from Ariamsvlei on rd to Warmbad.

Var. *burchellii*. Cape Prov. Bryant 1176, distr. Prieska, 28 m N Prieska; Burchell 2549, Afr. austr. extratrop.; Rogers 30026, distr. Colesberg, Naauwpoort.

Southwest Africa. Bradfield 82, Waterberg, Quickborn; Dinter 330, Gross-Namaland, Windhoek (holotype of *O. lycopodioides*; Z); *id.* 337, *ibid.*; *id.* 7407, Grootfontein-Abenab; Örtendahl 654, Great Namaqualand, Ariamsvlei, farm Walserbrunn; Schinz 905, Amboland; Schoenfelder 468 et 481, Grootfontein; Story 5233, distr. Gautscha Pan; Watt 2397, distr. Kalahari; Gautscha Pan, Zebraveld.

Var. *spathulata*. Cape Prov. Drège s.n., à 1838, Port Natal et Afr. mérid.; *id.* à 1840, Cap.; *id.* à 1843, Afr. austr.

Southwest Africa. Dinter 3726, 'Kuckans – Pockenbank'; *id.* 4087, ?Halenberg, sandige Rinnsale; *id.* 8030, Bastardland, Urusis; *id.* s.n., X.1923, Gross Namaland; Kinges 2717, distr. Lüderitz, Kovies Mts; Merxmüller et Giess 3008, distr. Lüderitz-Süd, Tsirubberge; Pillans 5048, W region, Little Namaqualand, Oorlap river; Range 208, s.l.; Schinz 906, Gross-Namaland.

## 4. **Randonia** COSSON

*in* Bull. Soc. Bot. Fr. 6, 1859, p. 391; Muell. Arg. in DC., Prodr., 16(2), 1868, p. 554; Battandier in Batt. et Trabut, Fl. Alg. 1888–1890, p. 82; Durand et Schinz, Consp. Fl. Afr. 1(2), 1897, p. 179; Thonner, Flow. Pl. Afr. 1915, p. 229; Bolle in Engl. et Pr., Nat. Pflz.fam. 2nd ed. 17b, 1936, p. 691; Cufodontis *in* Bull. Jard. Bot. Brux. Suppl. 24, 1954, p. 159; Täckholm, Stud. Fl. Egypt 1956, p. 331; Ozenda, Fl. Sah. Sept. Cent. 1958, p. 276; Quézel et Santa, Nouv. Fl. Alg. 1, 1962, p. 437; Quézel, Végét. Sahara 1965, p. 94.

Erect, bushy herbs, 40–100 cm tall, glabrous; taproot ligneous.

*Stems* aphyllous or leafy, glabrous, variously branching, often crowded, rigid and often ending like a sharp spine; pith solid, narrow.

*Leaves* simple, alternate, entire, linear to -obovate, attenuate towards base. Basal dents present.

*Inflorescences* terminal, simple, spike-like racemes. Bracts herbaceous, subtending a solitary flower.

*Flowers* white, bisexual, hermaphrodite.

*Sepals* (7–)8, perigynous on the outer, cup-shaped disc, at base fused and connate with the disc, persistent, entire, herbaceous.

*Petals* alternating with and as many as the sepals, persistent, inserted on the outer wall of the inner disc, very large (aestivation imbricate), unequal, superior petal largest and usually longest, limb lamellately appendiculate at base, lamella inflexed, ± lacerate, claw dilated laterally. Limb of superior petal irregularly incised (central lobe oblong or linear), lateral lobes cristate or palmatisect) or all lobes of limb almost similar. Limb of lateral and anterior petal usually reduced, sometimes entire, usually variously lobed; appendage reduced, edge entire, denticulate or erose.

*Discs* 2, cup-shaped, outer one much shorter than the inner disc, fleshy, excentrically developed (posterior side much larger), margin entire, sometimes wavy, inner disc in the upper part membranous, erose, oblique, surrounding the base of the filaments.

*Stamens* 16–18, almost equaling the petals, filaments persistent, at base fused with the inner disc, free above, glabrous, filiform-subulate.

*Anthers* ellipsoid, minutely asperulous, apex rounded, emarginate.

*Ovary* unilocular and gaping, 2–3 carpellate, subglobose, obtusely angled, papillose, punctately glandular or glabrous, (sub)stipitate, 2–3 toothed, dents turgid, cuspidate, margins inflexed, strongly papillosely stigmatoid. Placenta parietal, alternate with the dents, entire. Ovules large, campylotropous, (sub) sessile, in 3 rows.

*Fruit* a gaping capsule, urceolate to globose, sometimes asperulous on the ribs, subcoriaceous, many seeded.

*Seeds* rotundate-reniform, brown. Sinus very narrow. Outer layer of the testa hyaline, papillose, tardily dehiscent.

Type: *Randonia africana* COSSON.

Distribution: Western and Central Sahara (Algeria, Mauretania, Morocco) reaching to ?Senegal and Egypt.

**1. Randonia africana** COSSON **Fig. 17**

*in* Bull. Soc. Bot. Fr. 6, 1859, p. 392; Muell. Arg. in DC., Prodr. 16(2) 1868, p. 555; Battandier in Batt. et Trab., Fl. Alg. 1883–90, p. 83; Dur. et Schinz, Consp. Fl. Afr. 1(2), 1897, p. 179; Jahandiez et Maire, Cat. Pl. Mar. 2, 1932, p. 315; Bolle in Engl. et Pr., Nat. Pflz.fam., 2nd ed., 17b, 1936, p. 691, fig. 427a; Emberger et Maire, Cat. Pl. Mar. 4, 1941, p. 1015; Täckholm, Stud. Fl. Egypt 1956, p. 331; Ozenda, Fl. Sah. Sept. Centr. 1958, p. 278, f. 85; Quézel et Santa, Nouv. Fl. Alg. 1, 1962, p. 437, tab. 38, fig. 1215; Quézel, Végét. Sahara 1965, p. 94.

Perennial, glaucous-green, glabrous, 50–100 cm tall, sometimes with rigid, and spine-tipped branches, of the habit of *Ochradenus baccatus;* taproot ligneous.

*Stems* numerous, divaricately branching, yellowish-green, turning reddish-brown gradually, terete, rugulose, rigid, becoming aphyllous except the young twigs, tips spinescent, glabrous; pith solid.

*Leaves* deciduous, directed lengthwise in close proximity of the twig, glaucous-green, fleshy, glabrous, obovate to oblong or spathulate, $^1/_2$–$1^1/_2$ cm long, 1–$1^1/_2$ mm wide, top rounded to acutish; margin narrowly pallid, entire.

*Flowers* white, short pedicellate, in terminal spicoid racemes, petals and sepals perigynous. Racemes rigid, elongating 10–25(–30) cm long, rather open; peduncles terete, glabrous. Bracts deciduous, fleshy, oblong-ovate, 1–2 mm long, $^1/_3$–$^1/_2$ mm wide, acutish, margin obscurely pallid, entire. Pedicels stout, glabrous, 1–$1^1/_2$ mm long in flower, 2–$2^1/_2$(–3) mm long in fruit.

*Sepals* (7–)8, persistent, posterior sinus wider than the others, almost equal, glabrous, oblong-obovate, 1–$1^1/_2$ mm long, top round obtuse, rarely acutish; margin narrowly pallid, entire.

*Petals* 2–3 mm long, persistent, exceeding the sepals, when flowering claws imbricate. Limb of superior petals variously incised, 3-partite or flabellate, or cristate or all lobes ± equal in shape and linear, (occasionally lateral lobes reduced and the limb appearing simple), $^1/_2$–$^3/_4$ as long as the appendage, central lobe if distinct almost linear, obtuse; appendage peltately and widely attached above the middle, broadly obovate, 2–$2^1/_2$ mm long, ca. 2 mm wide, upper transverse rim free, $^1/_2$–$^3/_4$ mm wide, undulate or lacerate, margins glabrous. Lateral petals sometimes longest, anterior shortest; limbs ± reduced, cristate or 1–3(–more)-partite, lobes almost linear, ± equal. Appendages gradually smaller, always with free, transverse rims.

*Discs* 2, cup-shaped, inner 1–2 mm high, upper part membranous, lacerate-erose, outer much shorter than inner disc, both very much longer developed opposite the superior petal than abaxially, fleshy.

*Stamens* 16–18, about equaling the petals. Filaments persistent, glabrous, filiform, $1^1/_2$–$2^1/_2$ mm long. Anthers ellipsoid, 1 mm long, $^1/_2$ mm wide, obscurely scabridulous, top emarginate.

*Ovary* subglobose, ca. 3 mm long, (sub)-sessile, papillose-scabrid (at least partly), walls bulging, mouth gaping, slightly contracted beneath teeth, 3 or 2-toothed, teeth cylindric above, ca. 1 mm long, divergent. Placenta not forked. Ovules 5–7 per placenta, in 3 rows.

*Capsules* erect, urceolate to globular, 3–4 mm long, bladdery, substipitate (in the disc), walls (wholly or partly) ± papillose, mouth slightly contracted beneath the teeth; teeth cuspidate, up to 1 mm long, curving outwards, interdental lobes papillose.

*Seeds* finally brown, half-glossy, globular-reniform, $1^1/_2$ mm long. Sinus narrow. Surface of testa hyaline-papillose, outer layer tardily dehiscent.

Type: L. KRALIK 19, 'Plantae Algerienses exsiccatae, 1858', in argilloso-arenosis ad Bir Arefdji in planitie depressa Chachia d'Ouargla dicta, 29 Aprili (C, UPS, W).

Distribution: Sahara (S Morocco, Mauretania, Algeria, Libya, to NW of U.A.R., and to ?Senegal).

Notes: COSSON published in 1859 (l.c.) a detailed description of a new genus, *Randonia* Coss., and referred one species to it, *Randonia africana* Coss., a new species published simultaneously. It is uncertain if this was at the earliest data of publication because KRALIK's set 'Plantae Algerienses exsiccatae' is dated on the label 1858. The label of KRALIK 19, in indelible autograph, carries descriptive data concerning *Randonia* and *R. africana* by COSSON. It is possible that the set was distributed previous to the publication in 1859 (l.c.). As no nomenclatorial consequences are involved, the point may be recorded but remain undecided, the publication in the Bull. Soc. Bot., 1859, being accepted as the first.

The name *Randonia*, refers to Count RANDON, a Marshal of France, who conquered and pacified the whole of Algeria and by whose benevolent interest in COSSON's explorations the author was greatly assisted.

Ecological notes: *Randonia africana* resembles in habit in some respects its counterpart, *Ochradenus baccatus*, in the desert vegetation of Egypt and eastwards (see sub *O. baccatus*). *Randonia* branches as densely, assumes the same habit after browsing, produces spinescent twig-tops, has also green, terete assimilatory branches, and stands aphyllous in the dry season. On the other hand, it usually remains a much smaller plant. There is a similar variability in habit: whip-like branches may develop instead of the usual rigid, short ones, suggesting the scandent form on *Ochradenus baccatus*, but *Randonia africana* never becomes a straggler to the same degree.

QUÉZEL (Végét. Sahara 1965, p. 94) distinguished a 'pseudo-steppe' characterized by *Randonia africana* and *Cornulaca monacantha*. This vegetation has been described by GUINET (Trav. Inst. sci. chérif., sér. gén. 2, 1954, p. 75–167). It occupies a strip of over 200 km in length directly bordering the 'Grand Erg occidental', especially in more or less sandy 'regs mous'. Beside sand-inhabiting species, there are some which come to the fore, declared QUÉZEL, and which are appreciably gypsophilous. Among these latter, *Randonia africana* is, perhaps, the most important.

*R. africana* also appears in a sub-association named after it (QUÉZEL l.c. p. 69, et lit.!). This 'sous-association à *Randonia africana*' belongs in the association of *Zygophyllum album* ssp. *geslini* and *Traganum nudatum*, which is very widely found in the northern Sahara, from southern Tunisia to the W Sahara. It occurs on gypsaceous soils containing a limited amount of soluble salts and often covered by a moving surface-layer of wind-blown sand. On the southern slopes of the Grand Erg Occidental the floristic range becomes poorer and two species appear, which are characteristic of gypsaceous soils containing a varying amount of soluble salts in the very arid parts of the northern Sahara. These spp. are *Randonia africana* and *Oudneya africana*. For this revision no data could be traced on trials with *Randonia* (or *Ochradenus*) to re-establish destroyed vegetation under desert-conditions, but these and other data suggest possibilities as

both *Randonia* and *Ochradenus* appear to belong among the hardiest desert-plants and are eligible for grazing while withstanding browsing rather well.

Algeria. COSSON found *R. africana* in the Sahara of southern Algeria in dried pools, on sandy clays or gypsum soils. It was abundant in the Ngoussa oasis and rarer on the gypsum hills at the El Hadjira oasis. It flowered in April to May.

L. CHEVALLIER (158, WU) declared it rather frequent in the palm oasis Ghardaia, fruiting in April at El Golea, on sands and roads in March-April 1902, (AMD, BRNU). CHIPP described *R. africana* as 'a hard springy herb, generally grazed' in the El Golea district (141, K), ANDREÁNSKY (28.III.1928, BP) collected it at Owargla, in the 'gour' region, on stony clays.

FAURE observed it at 1000 m, on desert sands, in southern Oran, Beni-Ounif, fl. April (25.4.1938, BAS), and in the end of May (31.5.1934, SIM) at Colomb-Béchar at 780 m alt.

ANDREÁNSZKY collected *R. africana* in *Anthyllis*-vegetation at 40 km distance from Ouargla, in dense soils (25 Mart. 1928, BP).

In Oran province, close to Figuig, SAMUELSSON collected it in stony deserts at ca. 900 m alt. (6845, GH), flowering in April. HOCHREUTINER observed yellowish flowers on May 24, 1901, at 15 km from Ain Sefra, a tufted herb on sandy plains (419, GH).

MAIRE collected *Randonia* in stony calcareous desert round Beni-Abbès (88, K).

Egypt. SHABETAI collected it (3457, CAIM) on April 15, 1934, on calcareous and sandy grounds at Seferzen near Sellum, in flower.

Libya. *Randonia africana* was rarely collected, but the specimens connect the main area of distribution (W Sahara) with the only collection in Egypt. OGDEN secured a specimen near Taglet (14.8.1959, K) and near Fezzan (12.XI.1960, K). The latter specimen (140 km S of Hun) was growing in a sandy depression in 'seriz' at 300 m alt. There was 'no other vegetation', two shrubs of *R.* were present. KEITH (807, K) found the flowers 'cream-coloured'.

Cirenaica. PAMPANINI collected a specimen at Tra Bir Acheim (3270, K). GUICHARD gathered fl. and young fr. on 8 March, 1952, at Wadi Touzist on a $1^1/_2$ m high shrub (KG (Lib) 203, K).

Mauretania. SAUVAGE collected small, brush-like specimens in the Mauretanian desert, at about 40 km E of Ain bin Tchi (1302, RAB).

Morocco. MAIRE et WILCZEK collected *R. africana* at Tafilatet, in steppe (236, PR). MAIRE also secured it at 1300 m alt., in the Great Atlas, in desert grazing spots, in the valley of Todgha near Tinghir, flowering in May (14158, RAB).

Once collected in 'Senegal', ROGER in 1824 (GH), locality doubtful, but as *Randonia* occurs in Mauretania, it might grow across the Senegal border also.

Specimens examined: Algeria. Alleizette s.n. V. 1922, Beni Ounif, S Oran; Andreánszky s.n., 28, III. 1928, Sahara Alg., Gur ad sept. ab opp. Ouargla; *id.*, 29. III. 1928, *ibid.*, ad sept. ab opp. Ouargla, ca. 40 km.; *id.*, *ibid.* Columb Béchar; Battandier s.n., IV. 1906, Beni Ounif, S Oran; Bousquet 151 (? 191), Ain Sefra; Chevallier 158, Sahara Alg., Ghardaia; *id.* s.n., 13. III. 1899, *ibid.*, El Goléa; *id.*, 29. V. 1899, *ibid.*, Ain Sefra; *id.* 158bis, *ibid.*, El Goléa, Tadmaït; *id.* s.n., 31.III.02, *ibid.*, El Goléa ad Ben Bachir; *id.*, III et IV. 1902, *ibid.*, El Goléa; *id.*, IV. 1902, *ibid.*; *id.*, 17.IV.1902, *ibid.*, El Goléa; *id.* 19.IV.1902, *ibid.*, Ghardaia, Oum el Klab;

Cosson s.n., IV. 1858, Alger; *id.* 28.IV.1858, prov. Constantine, entre Areq el Dom et El Hadjira (?paratype); *id.* 29.IV.1858, prov. Cirtensis, ad Arefdji, depresso Chechia d'Ouargla (= ? Kralik 19, type); *id.*, 7.V.1858, sud de la prov. d'Alger, Oued Mzab, Hassi el Djual (paratype); Desiré 13 et 23, Sahara Alg. occ., Hamada du Dra, O Oum et Assel; Emberger s.n., 26.IV.1927, Beni Ounif; Faure, s.n. 31.V.1934, sud Oranais, Colomb-Béchar; *id.*, 23 et 25.IV.1938, *ibid.*; Gram 42, Sahara Alg., Hamada, ca. 6 km W Ouargla; Hochreutiner 419, prov. d'Oran, ca. 15 km N Ain Sefra, Faidjet el Betoum; Kralik 19, Bir Arefdji, depresso Chachia d'Ouargla dicta (type); R. Maire s.n., 18.IV.1934 et 1935, Sahara occ. prope Oasim Tendouf; Murat 1440, Sahara occ. Zemmour à Imalghen; Orre s.n., $^1/_2$. III.1922, Oued Tilia, västra Tadmaït; Paulsen s.n., 19.IV.1936, Sahara Alg., près Beni Ounif; Reese s.n., 22.V.1932, sud Oranais, inter Beni-Ourcif el Col de Jenaga; Samuelsson 6845, dept. Oran, Djebel Zenega, pr. Figuig; Schibler s.n., 3.IV.1910, S Oran, Beni Ounif de Figuig; Stomps s.n., 18.IV.1936, Hamada bij Figuig; Vischer hb. s.n., 8.IV.1928, Figuig; Wall '3', 19.IV.36, Oknen S om Beni Ounif.

Mauretania. Sauvage '353', 24.I.1941, Sahara Mauritania sept, à l'Est de Aïn ben Teli.

Morocco. ?Delecluse 86, Ksar es Souk; R. Maire s.n., 24.IV.1933, Gheris prope Djorf; R. Maire et Wilczek 236, Tafilalet; *id.* 541, Hamada de Tindouf; Samuelsson 6861, Mt. Djebel el Maiz; Uggla s.n., 18.IV.1936, ad radices montes Djebel et Maiz; Vindt 6324, Rherin, Tizougarine, au S de Goulmina.

?Senegal. Roger (dedit) s.n., XI. 1824, Senegal.

U.A.R. Shabetai z 3457, Seferzen near Sellum, Mariut.

# FIGURES

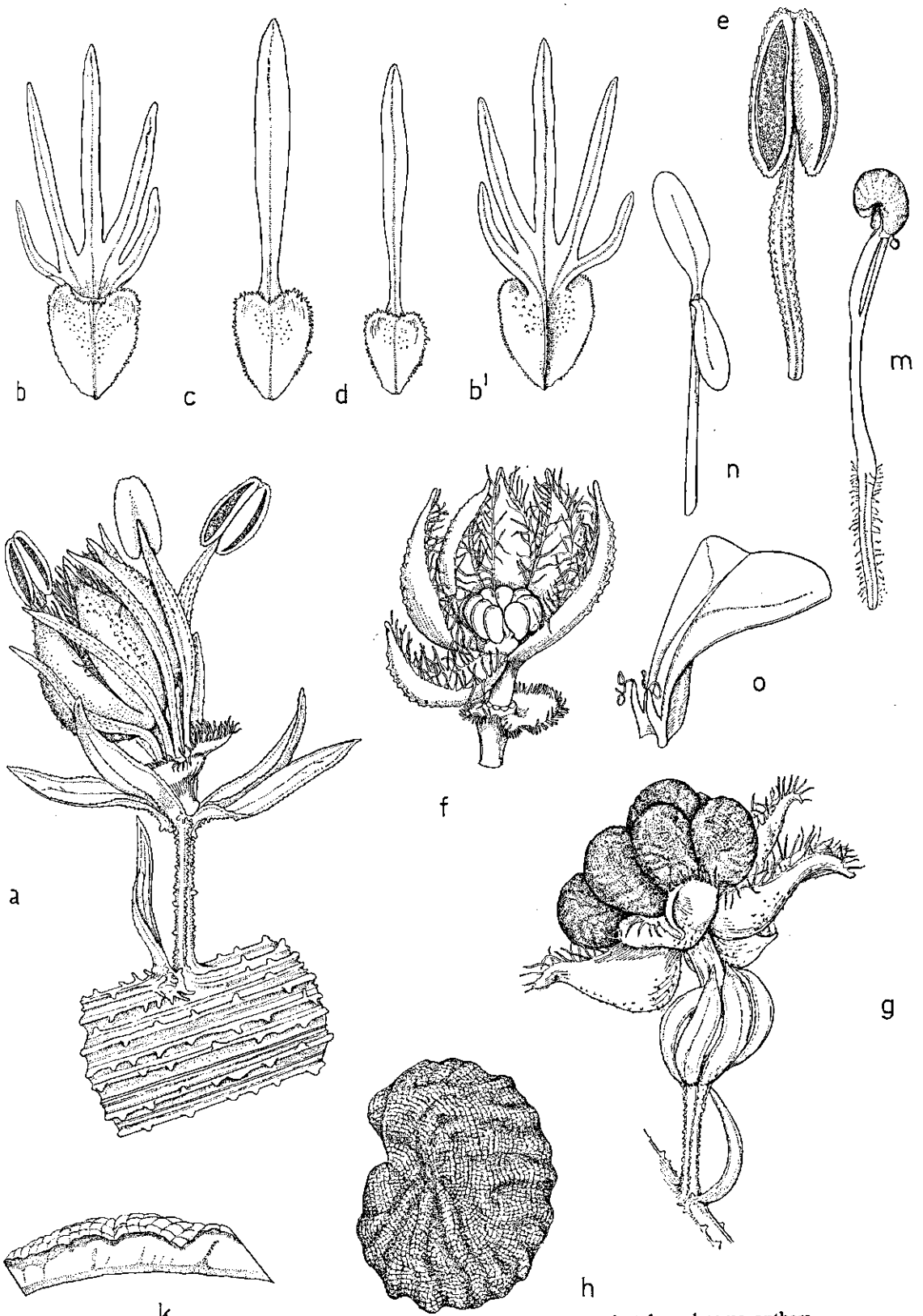


FIG. 2. *Caylusea abyssinica* (Fresen.) Fisch. et Mey. – a: flower (petals and some anthers removed); b, b¹: sup. pet. (front and back); c: lat. pet.; d: ant. pet.; e: stamen; f: ovary and disc; g: fr.; h: seed; k: section testa; m: germination; n: cotyl.; o: base 1st leaf, basal dents. – a-d, f: 15×; e: 20×; g: 10×; h: 30×; k: 70×; m: 7×; n: 5×; o: 25×. – a-f: Schimper 103 (G); g, m, n, o: De Wit, Bonga (Ethiopia), culta WAG; h, k: Gillett 14020 (W).

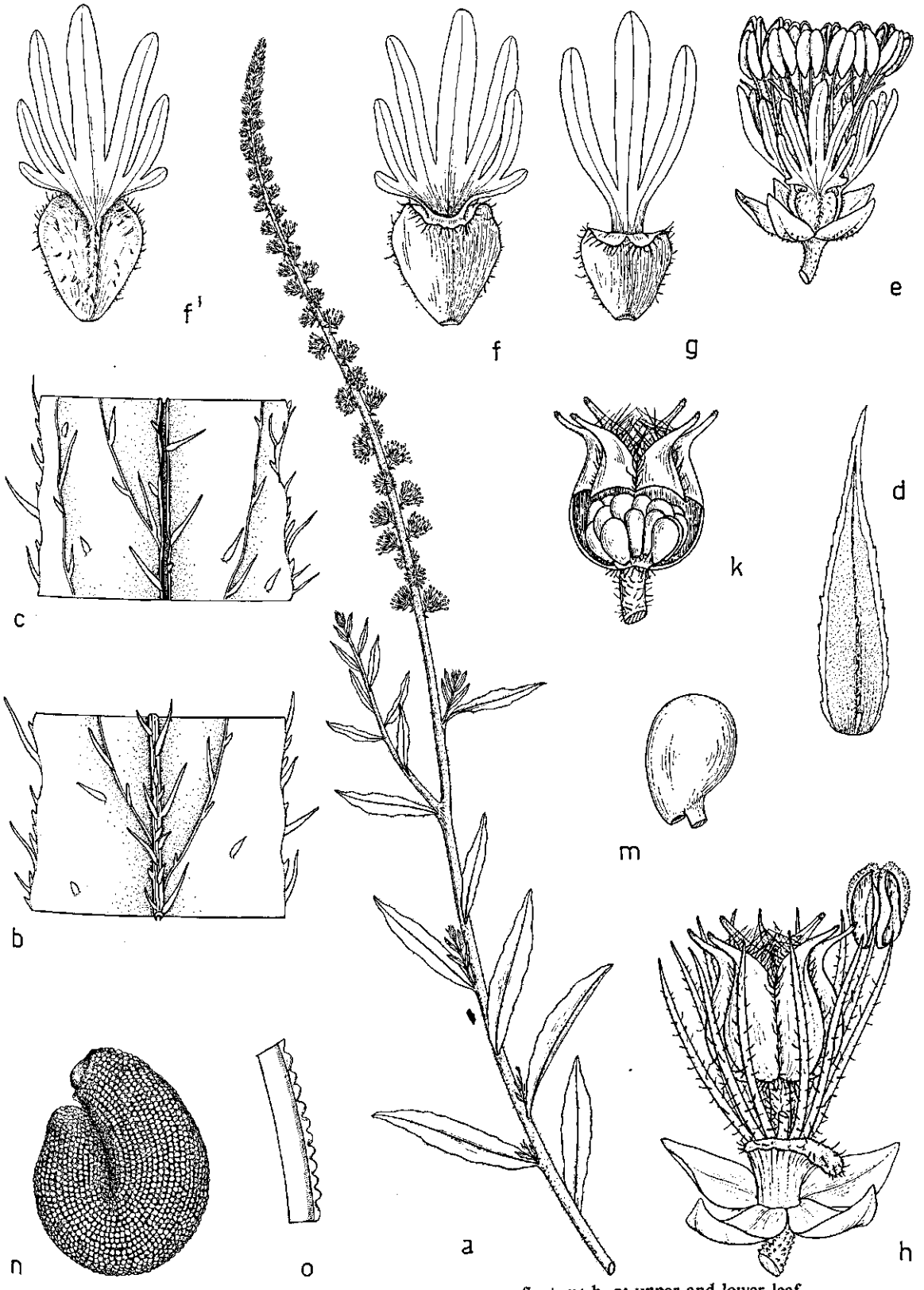


FIG. 3. *Caylusea hexagyna* (Forsk.) M. L. Green – a: fl. stem; b, c: upper and lower leaf-surface; d: bract; e: fl.; f, f¹: sup. pet. (front and back); g: lat. pet.; h: fl. (pet. and most anth. removed); k: ovary (partly opened); m: ovule; n: seed; o: section testa. – a: $^{5}/_{6}\times$; b, c: 8×; d: 35×; e: 8×; f-k: ca. 12×; m: 40×; n: 35×; o: 80×. – a-o: Herb. Forskål (C, lectotype).


FIG. 4. *Caylusea abyssinica* (Fresen.) Fisch. et Mey. – a: habit (Gillett 14020, S). – *C. hexagyna* (Forsk.) M.L. Green – b: 'var. foliosa' (E. Sickenberger 2.III.1879, Z); c: 'var. prostrata' (Abdallah s.n., 20. IV. 1962, CAIM); d: 'var. rigida' (Kralik, 10.III.1848, W). – a-d: $^1/_4\times$.

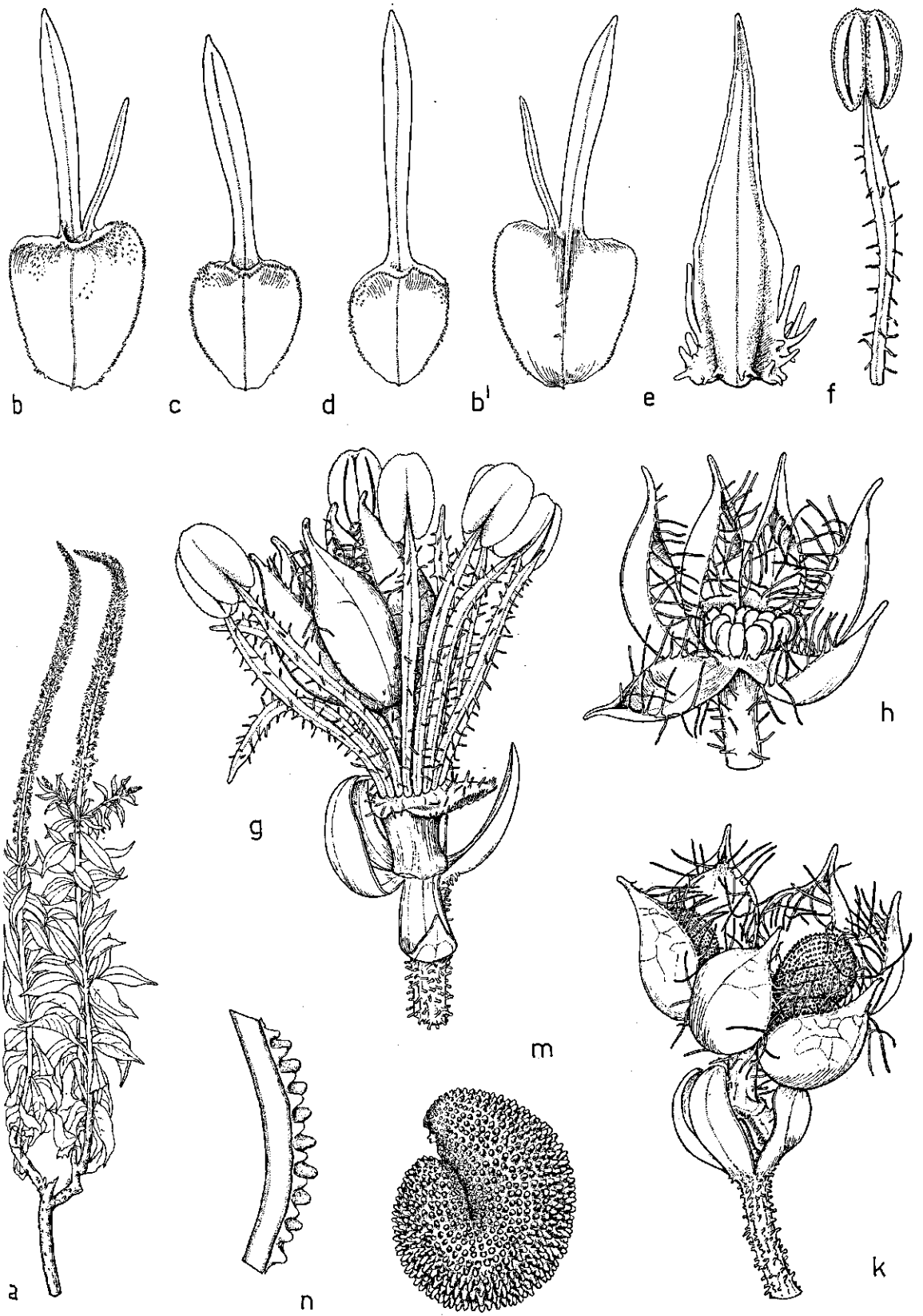


FIG. 5. *Caylusea latifolia* P. Taylor – a: habit; b, b¹: sup. pet. (front and back); c: lat. pet.; d: ant. pet.; e: bract; f: stamen; g: fl. (pet. removed); h: ovary; k: fr.; m: seed; n: section testa. – a: 1/8×; b-d: 15×; e: 30×; f: 15×; g: 13×; h: 15×; k: 10×; m: 30×; n: 70× – a-n: Mrs Adamson 628 (K, holotype).

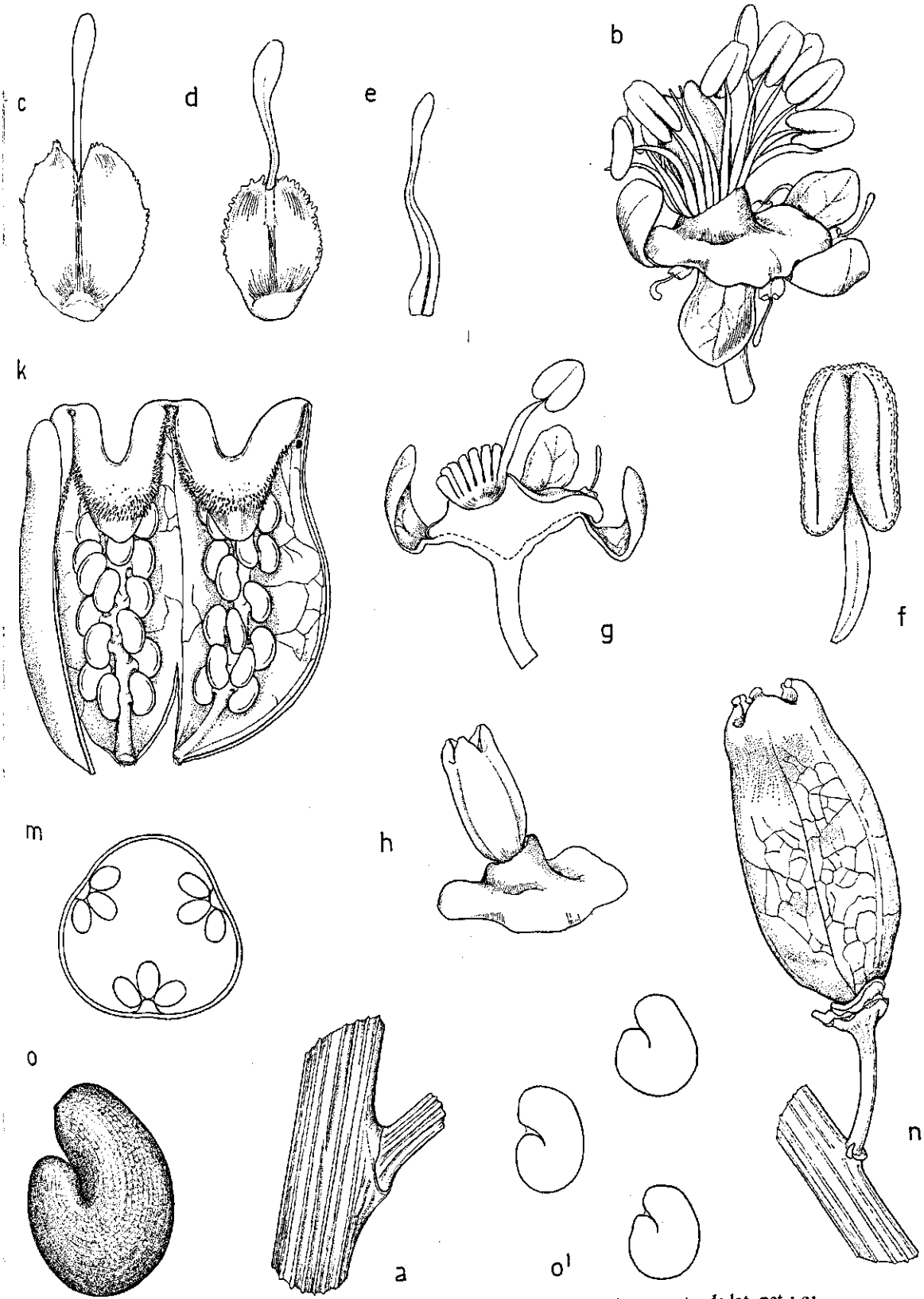


FIG. 6. *Ochradenus aucheri* Boiss. – a: insertion of branch; b: fl; c: sup. pet.; d: lat. pet.; e: ant. pet.; f: stamen (short); g: section fl.; h: ovary and disc; k: ovary (opened); m: section ovary; n: fr.; o, o¹: seeds. – a: 2½×; b, g, h, o¹: 10×; c, d, e: 30×; f, k, m, o: ca. 20×; o¹: 12×; n: nat. size. – a-m: K. H. et F. Rechinger 3379 (US); n, o, o¹: K. H. Rechinger 27799 (W 1379).

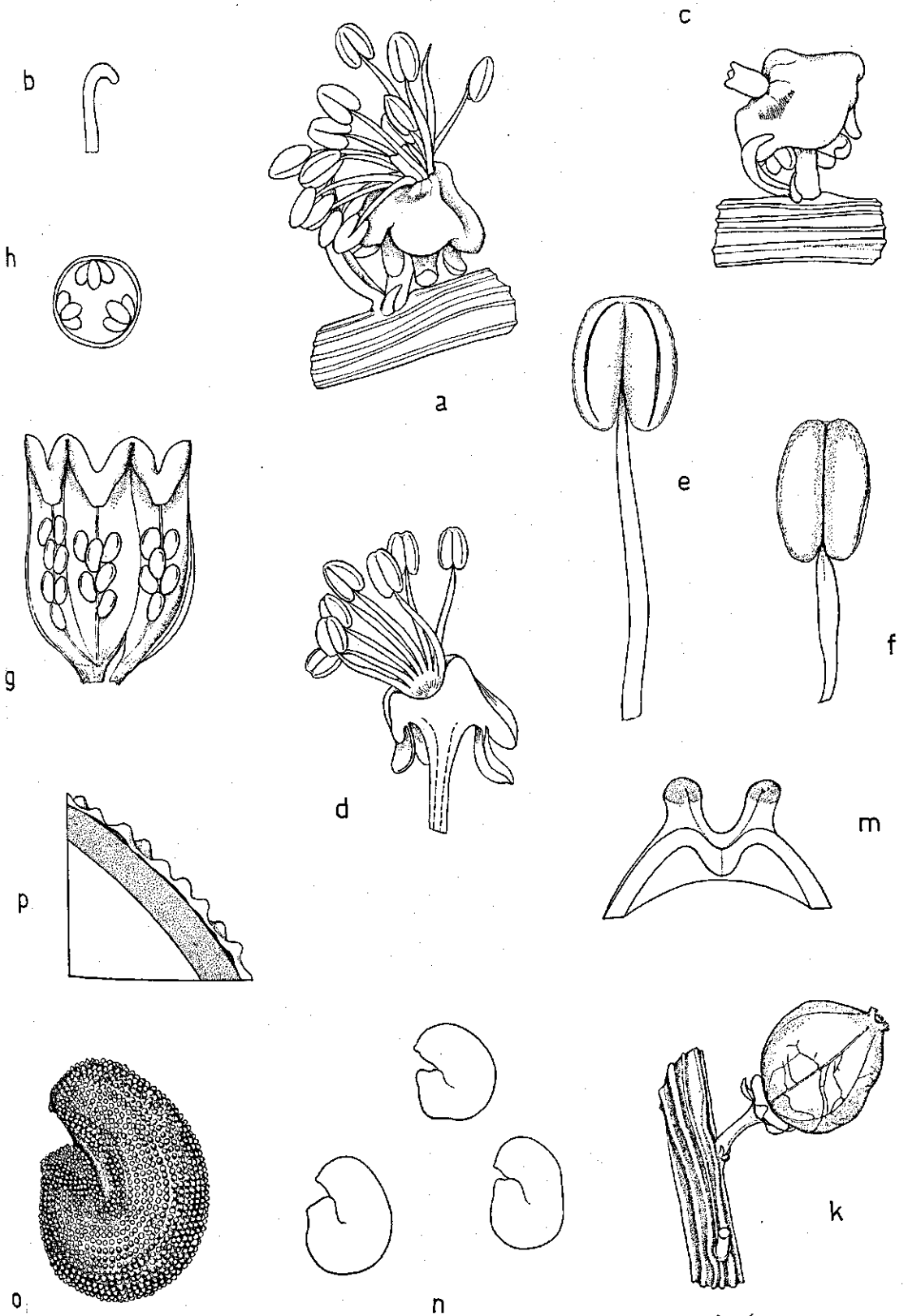


FIG. 7. *Ochradenus baccatus* Delile – a: fl.; b: petal; c: ovary and disc; d: section (stamen arrangement); e, f: stamen; g: ovary (opened); h: arrangement of ovules; k: young fr.; m: fr. wall, apical section; n, o: seeds; p: section testa. – a, c, d: 10×; b, e, f: 25×; g, h: 30×; k: 5×; m: 25×; n: 10×; o: 25×; p: 65×. – a, b, c, e, g, h: Wall 4.4.33 (S); d: Samuelsson 2878 (S); f: Alonzo 24.3.1934 (S); k-p: Shabetai z6480 (CAIM).


FIG. 8. *Ochradenus baccatus* Delile – a: habit; b: 'var. scandens', habit; c: ♀ fl.; d: ♂ fl.; e: fr.; f: diseased ovaries; g-g¹: germination; h: 1st leaf, basal dents; k: base of cot., lateral. f: diseased ovaries; g-g¹: germination; h: 1st leaf, basal dents; k: base of cot., lateral. – a, b: 1/3 ×; c, d: 15 ×; e, f: 2 1/2 ×; g, g¹: slightly enl.; h, k: 25 ×. – a, e, f: Shabetai – a, b: 1/3 ×; c, d: 15 ×; e, f: 2 1/2 ×; g, g¹: slightly enl.; h, k: 25 ×. – a, e, f: Shabetai z6480 (CAIM); b, c: Schimper 915 (L, HAL, syntype of 'var. scandens'); d: Stocks 409 (K, syntype of 'var. scandens'); g, g¹, h, k: seeds Bot. Gard. Karachi, culta WAG.

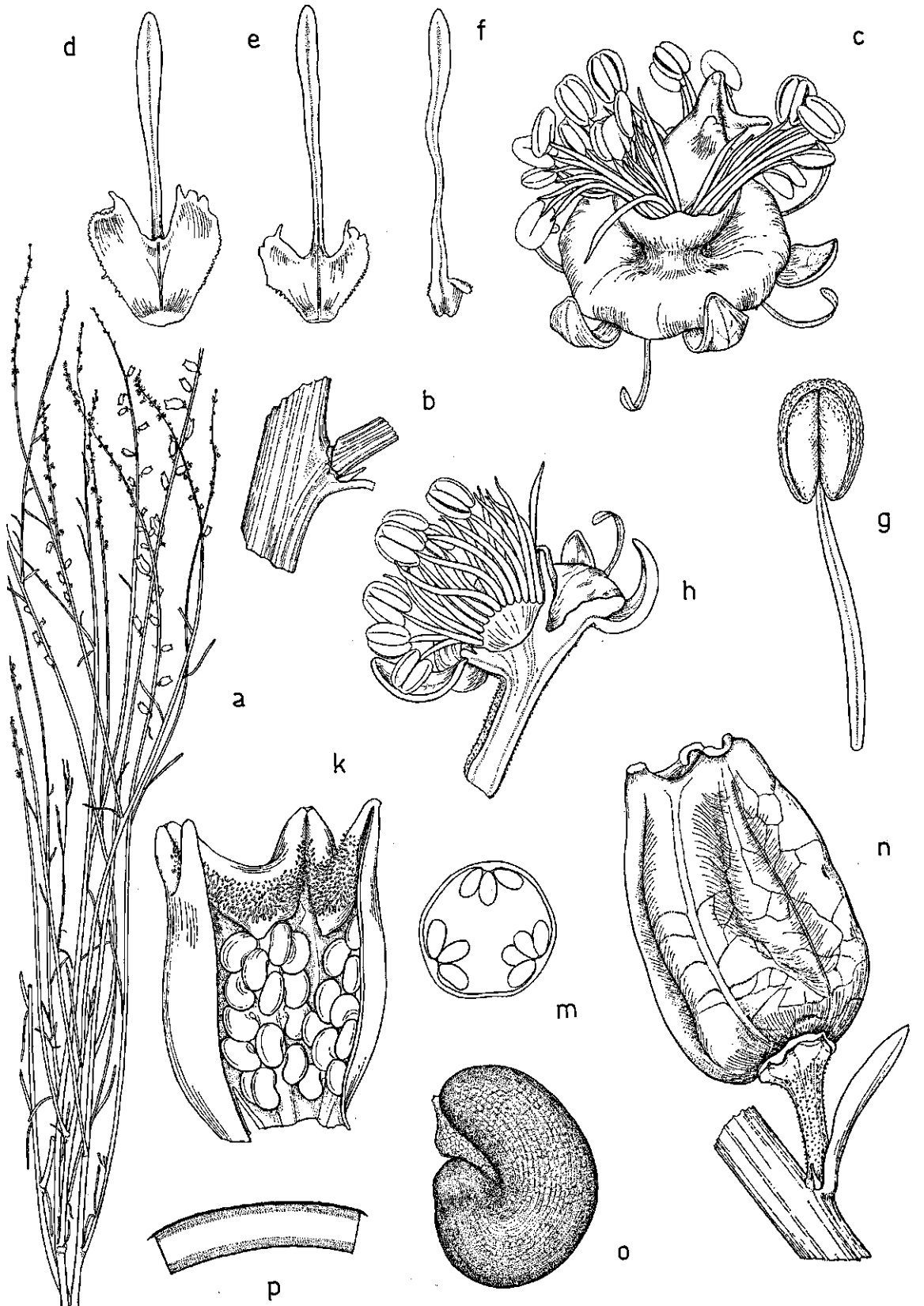


FIG. 9. *Ochradenus dewittii* Abdallah *sp. nov.* – a: habit; b: insertion of branch; c: fl.; d: sup. pet.; e: lat. pet.; f: ant. pet.; g: stamen; h: section fl.; k: ovary; m: section ovary; n: fr.; o: seed; p: section testa. – a: 1/6×; b, n: 5×; c, h, k: 10×; d, e, f, o: 25×; g, k, m: 20×; p: 65×. – a-p: Popov GP/57/77 (BM, holotype).

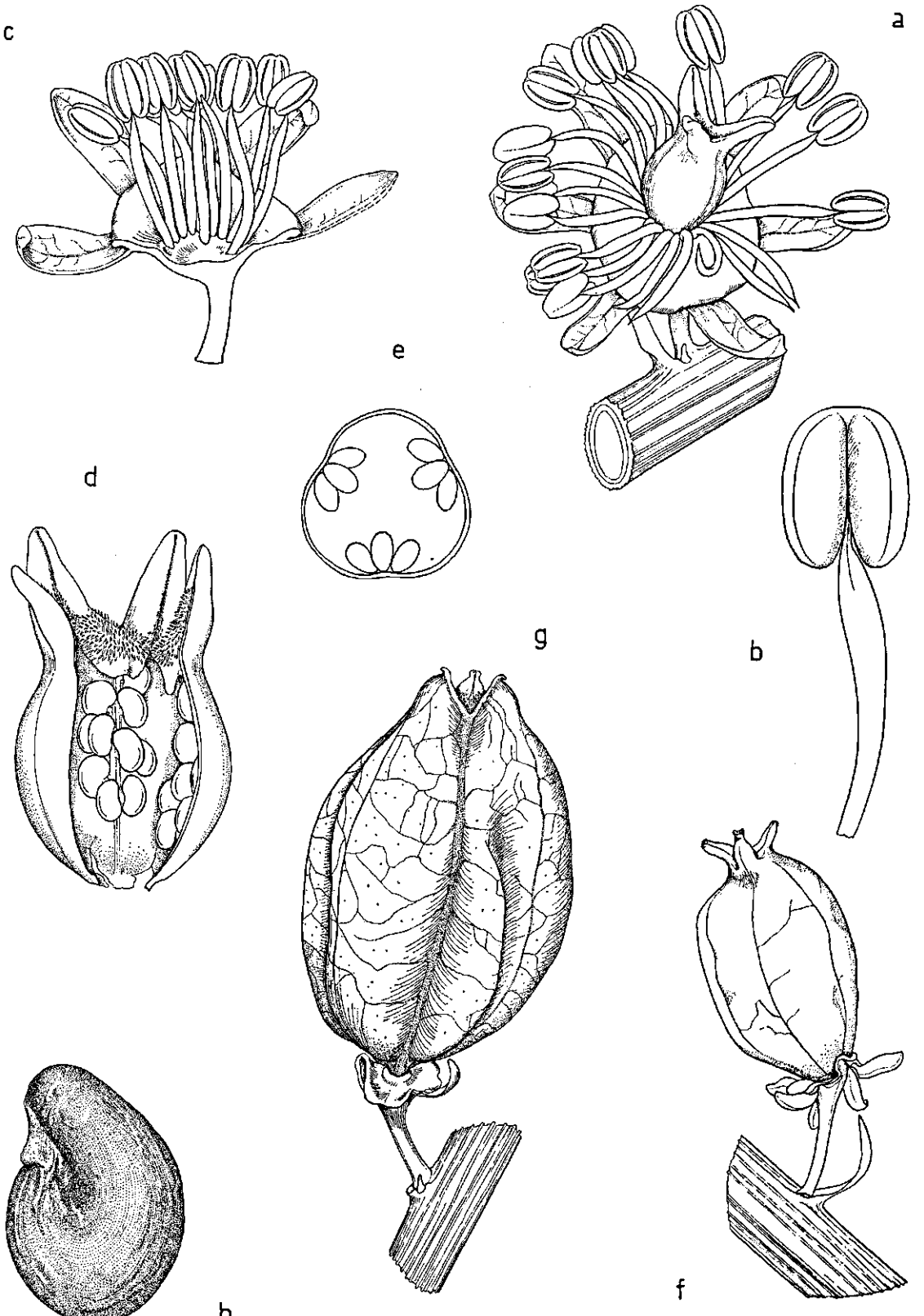


FIG. 10. *Ochradenus ochradeni* (Boiss.) Abd. *comb. nov.* – a: fl.; b: stamen; c: section fl.; d: ovary; e: section ovary; f: young fr.; g: ripe fr.; h: seed. – a, c: 10×; b, d, e: 25×; f, g: 5×; h: 20×. – a-e: Bornmueller 2045 (W); f: Bunge, Apr. 1859 (C); g, h: Aucher-Eloy 4179 (BM, type).

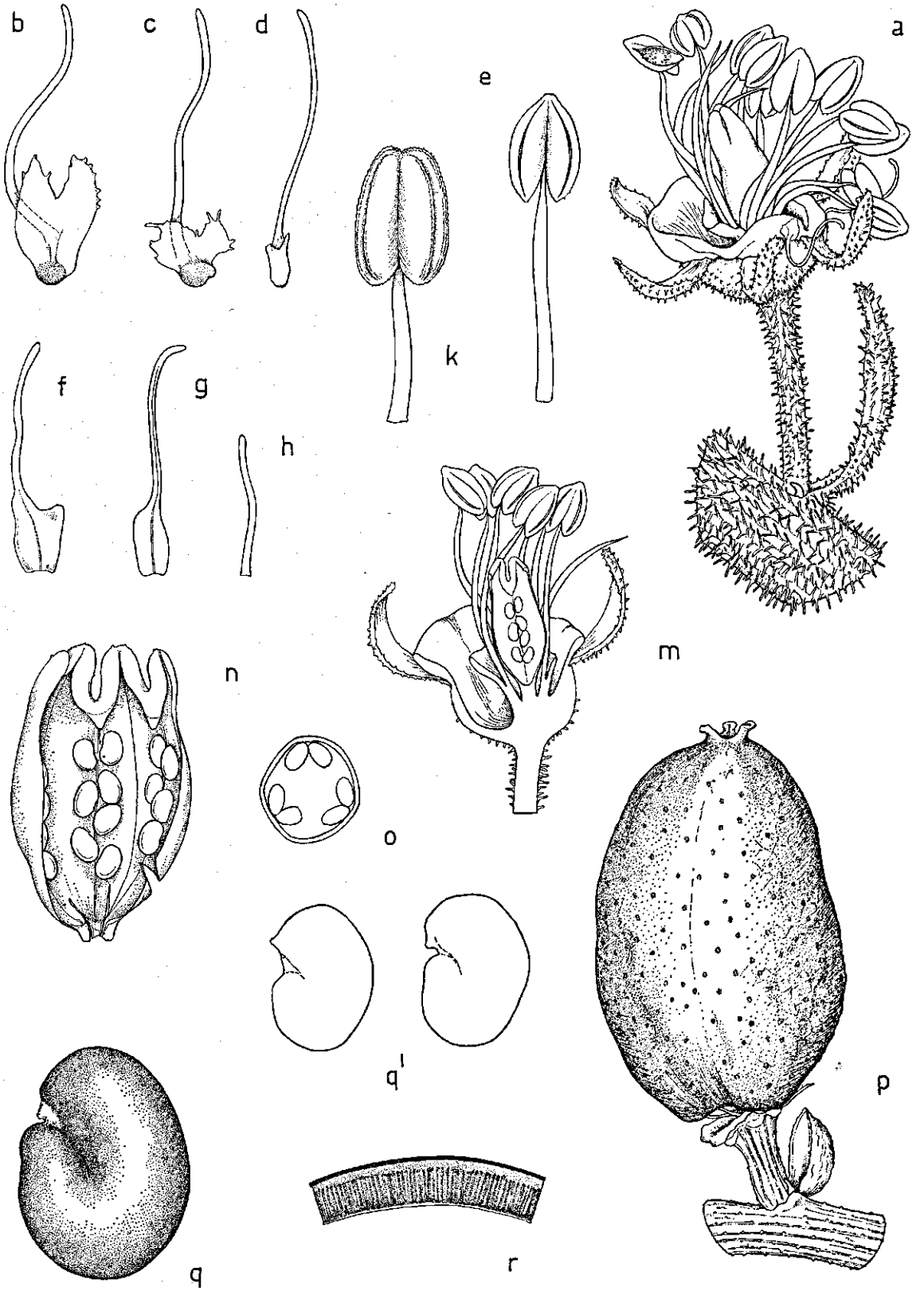


FIG. 11. *Ochradenus randonioides* Abd. – a: fl.; b: sup. pet.; c: lat. pet.; d: ant. pet.; e: stamen; f, g, h: petals; k: stamen; m: section fl.; n: ovary opened; o: section ovary; p: fr.; q,q¹: seed; r: section testa. – a, m: 12×; b, c, d, n, o: 30×; e: 20×; f, g, h: 40×; k: 22×; p: 10×; q: 25×; r: 70×. – a-e, m, n, o: Keller in 1891 (type *Randonia somalensis*, Z); f-k: Hemming EAH 1622 (S); p, q, r: Merle, Azzar. *et* Fois 26.1.1954 (FI).

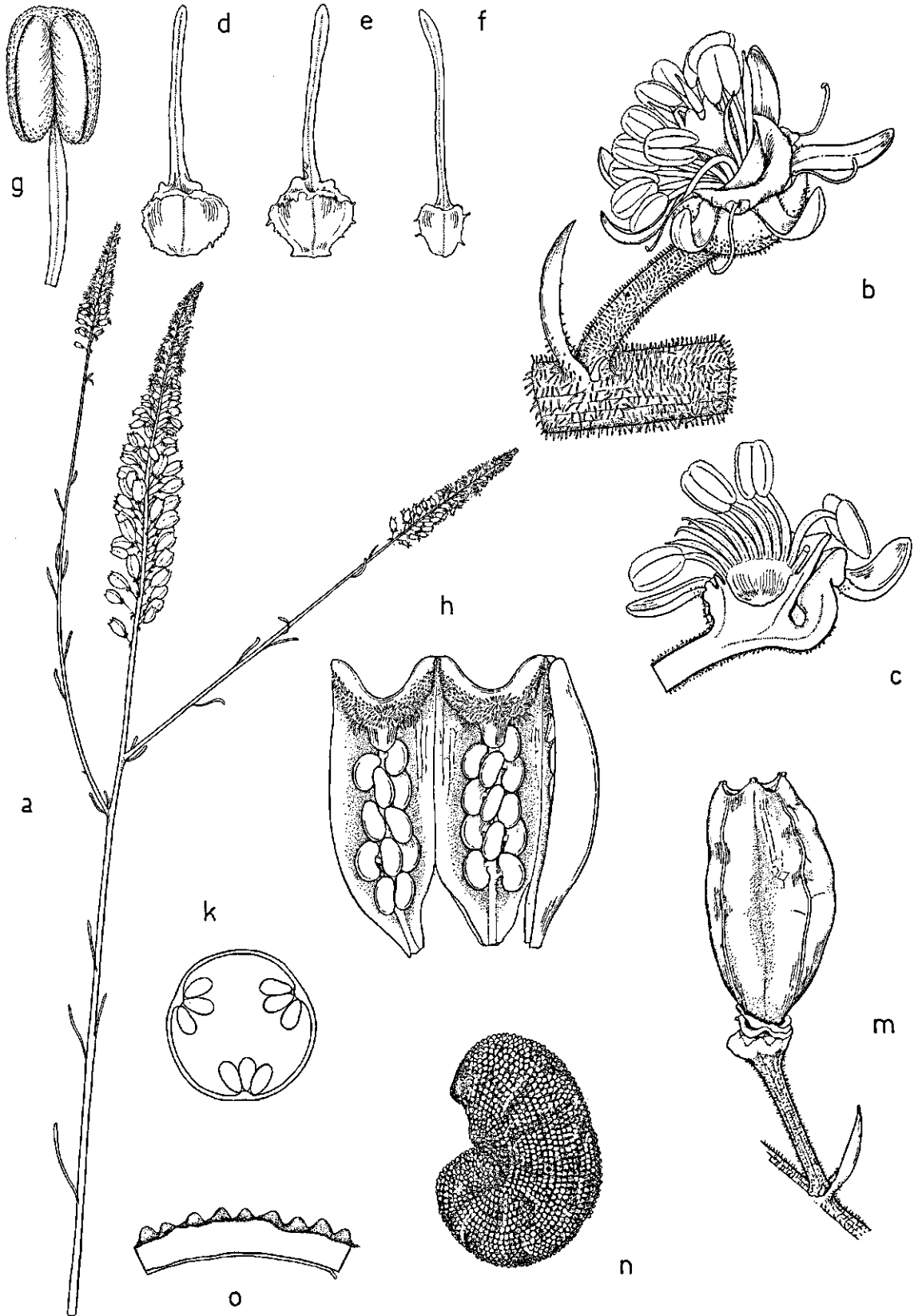


FIG. 12. *Ochradenus spartioides* (O. Schw.) Abd. – a: habit; b: fl.; c: section fl.; d: sup. pet.; e: lat. pet.; f: ant. pet.; g: stamen; h: ovary; k: section ovary; m: fr.; n: seed; o: section testa. – a: $^1/_2\times$; b, c: $10\times$; d-g: $20\times$; h-k, n: $25\times$; m: $5\times$; o: $65\times$. – a-m: Kerfoot 3033 (K); n, o: Guichard KG/HAD/376 (BM).

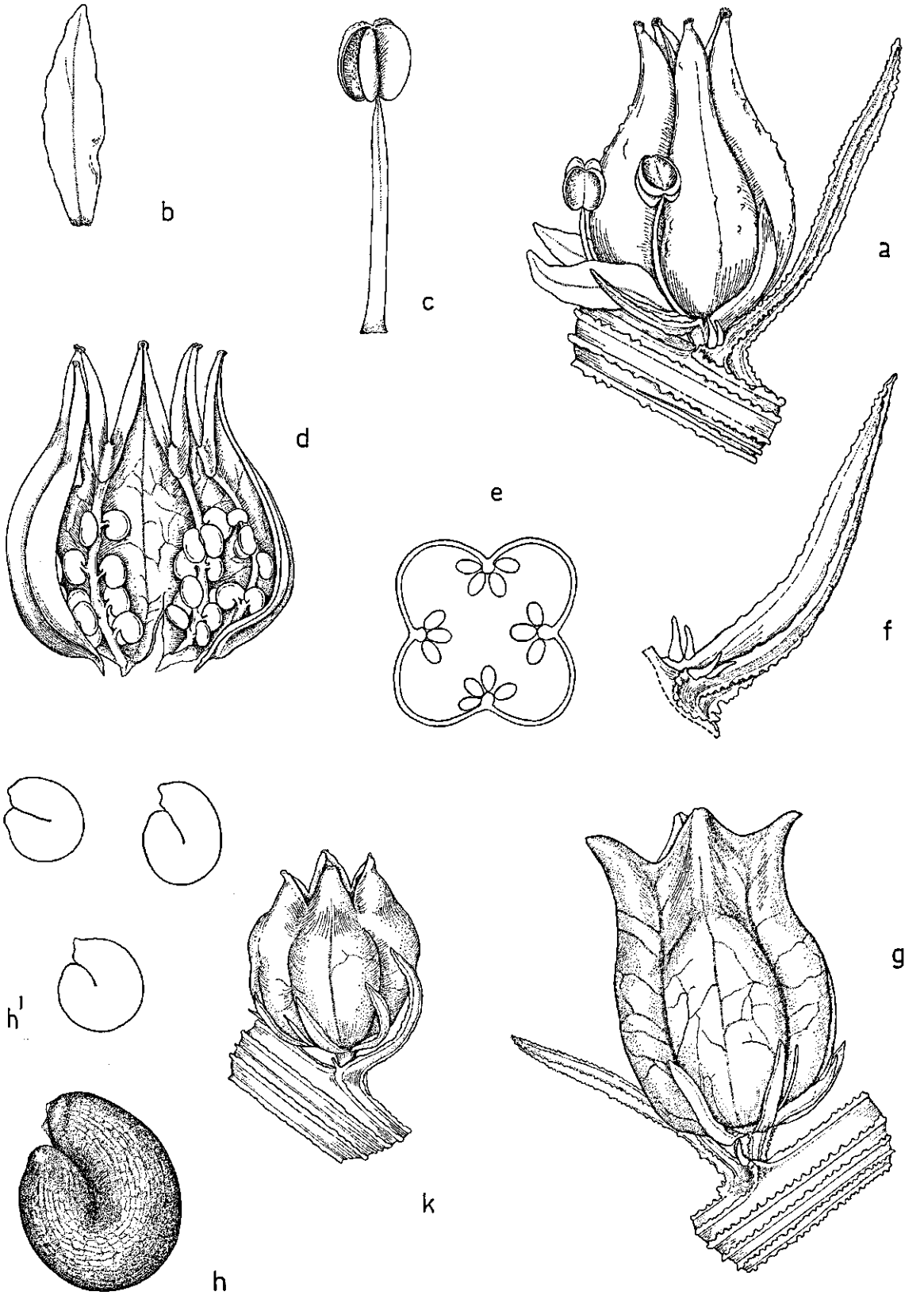


FIG. 13. *Oligomeris dregeana* (Muell. Arg.) Muell.Arg. – a: fl.; b: pet.; c: stamen; d: ovary; e: section ovary; f: bract; g: fr.; h, h¹: seeds; k: fr. – a, b, h¹: 15×; c: 25×; d, e: 17×; f: 20×; g, k: 10×; h: 30×. – a, c: R. Schlechter 6086 (Z); b, d, e, f: R. Schlechter 6086 (G); g, h, h¹: Alice Pegler 1748 (BOL); k: Lam and Meeuse 4053 (L, holotype, var. *sphaerocarpa*).

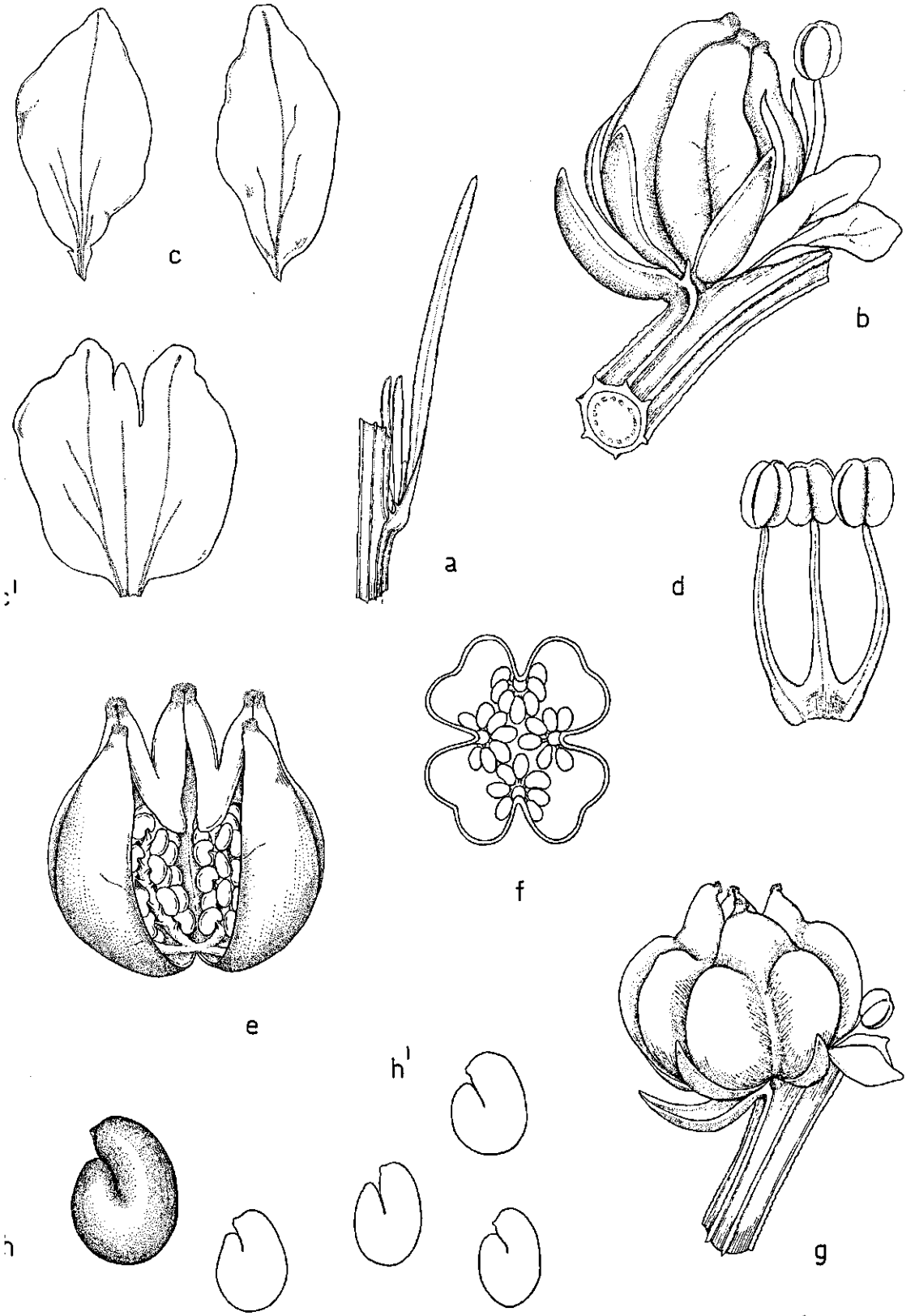


FIG. 14. *Oligomeris linifolia* (Vahl) Macbride – a: leaf and basal dents; b: fl.; c, c¹: pet.; d: stamens; e: ovary; f: section ovary; g: fr.; h, h¹: seeds. – a: 2½×; b, d, e, f: 20×; c, c¹: 25×; g: 10×; h: 30× .– a, h: Ruth A. Nelson 5042 (DS); b-f: Roxana S. Ferris 13469 (DS); g: R. McVaugh 7950 (DS).

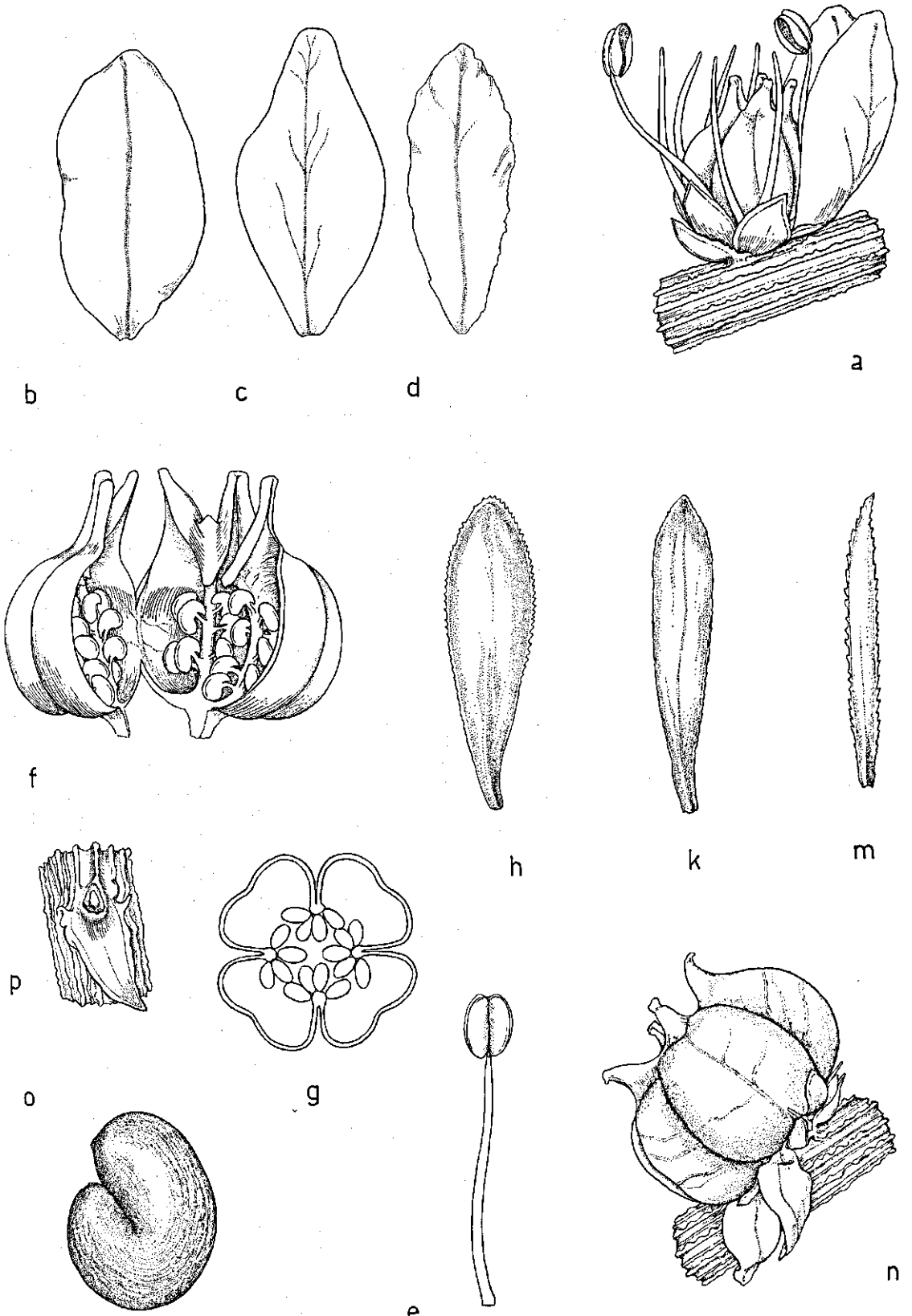


FIG. 15. *Oligomeris dipetala* (Ait.) Turcz. – a: fl.; b. c, d: pet.; e: stamen; f: ovary opened; g: section ovary; h, k, m: leaves; n: fr.; o: seed; p: bract (fl. detached). – a-e: 15×; g: section ovary; h, k, m: leaves; n: fr.; o: seed; p: bract (fl. detached). – a-e: 15×; f, g: 22×; h-n: 10×; o: 30×. – a, b, e, f, g, k: Burman hb '*R. capensis*' (G, S); c, h: Merxmüller et Giess 3008 (PRE, var. *spathulata*); d: Burchell 2549 (L 2446, subvar. *burchellii*); m: Dinter 330 (subvar. *lycopodioides*); n, o, p: hb Thunberg (UPS).


FIG. 16. *Oligomeris linifolia* (Vahl) Macbride – a: habit. – *O. dregeana* (Muell. Arg.) Muell. Arg. – b: habit. – *O. dipetala* (Ait.) Turcz. – c: habit var. *spathulata*; $c^1$: habit subvar. *burchellii*; $c^2$: habit subvar. *lycopodioides*. – *Randonia africana* Cosson – d, $d^1$: habit. – All $^1/_3\times$. – a: R. McVaugh 7950 (DS); b: Alice Pegler 1748 (BOL); c. Merxmüller et Giess 3008 (PRE); $c^1$: Burchell 2549 (L 2446); $c^2$: Dinter 337 (Z); d: hb J. Lange Apr. 1858 (C); $d^1$: K. Gram 42 (C).

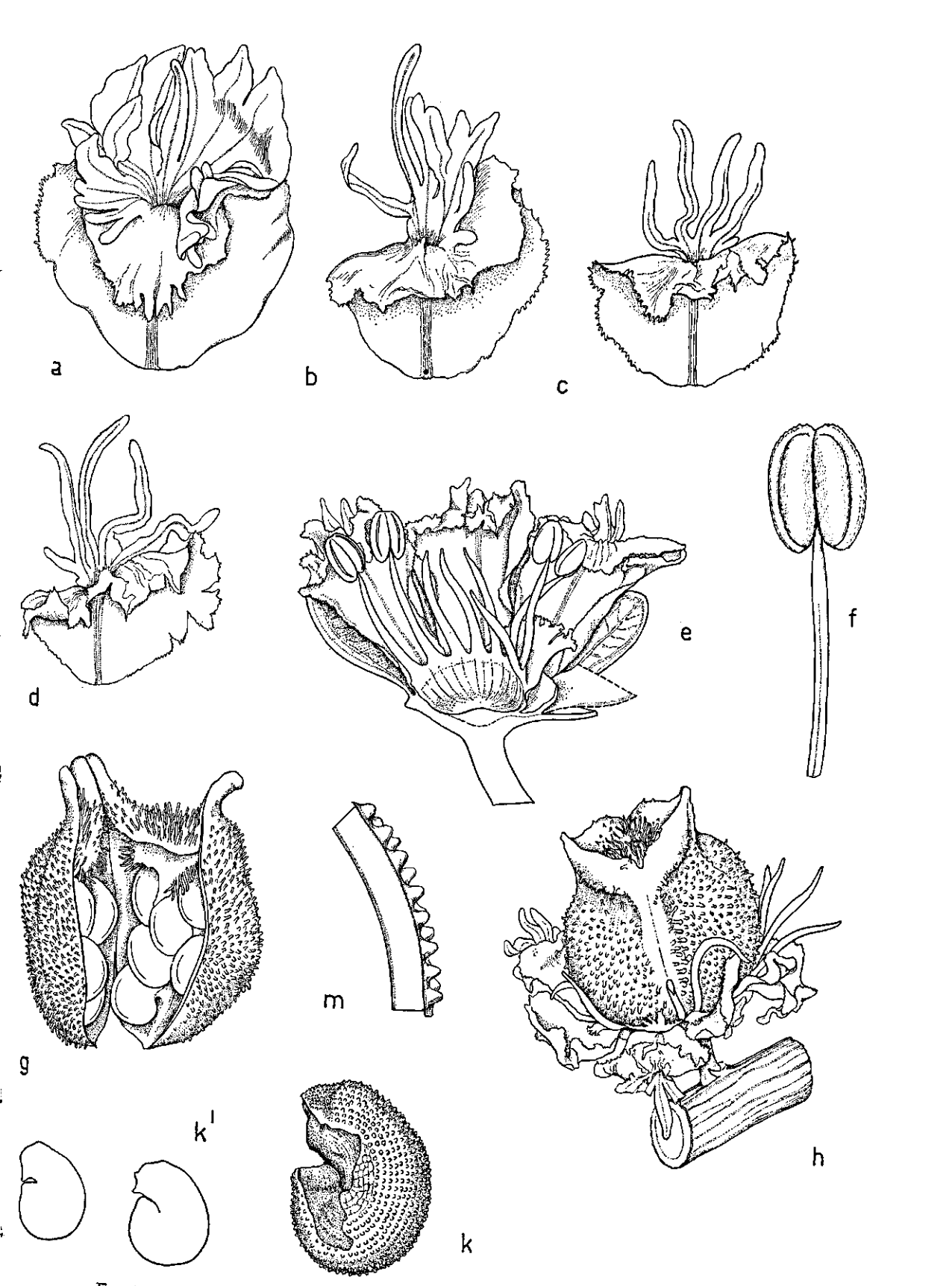


FIG. 17. *Randonia africana* Cosson – a: sup. pet.; b, c: lat. pet.; d: ant. pet.; e: section fl.; f: stamen; g: ovary; h: fr.; k, k¹: seed; m: section testa. – a-d, f: 20×; e, k: 15×; g: 20×; h: 10×. – a-g: Kralik 19 (type, UPS); h-m: L. Chevallier 158 (WU).