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Biologiske Skrifter, bind 8, nr. 1

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M. KØIE AND K. H. RECHINGER

SYMBOLAE AFGHANICAE

Enumeration and Descriptions of the Plants Collected by
L. EDELBERG and M. KØIE on "The 3rd Danish Expedition to Central Asia"
and by W. KOELZ, H. F. NEUBAUER, O. H. VOLK,
and others in Afghanistan.

I.

K. H. RECHINGER: LABIATAE

København 1954
i kommission hos Ejnar Munksgaard

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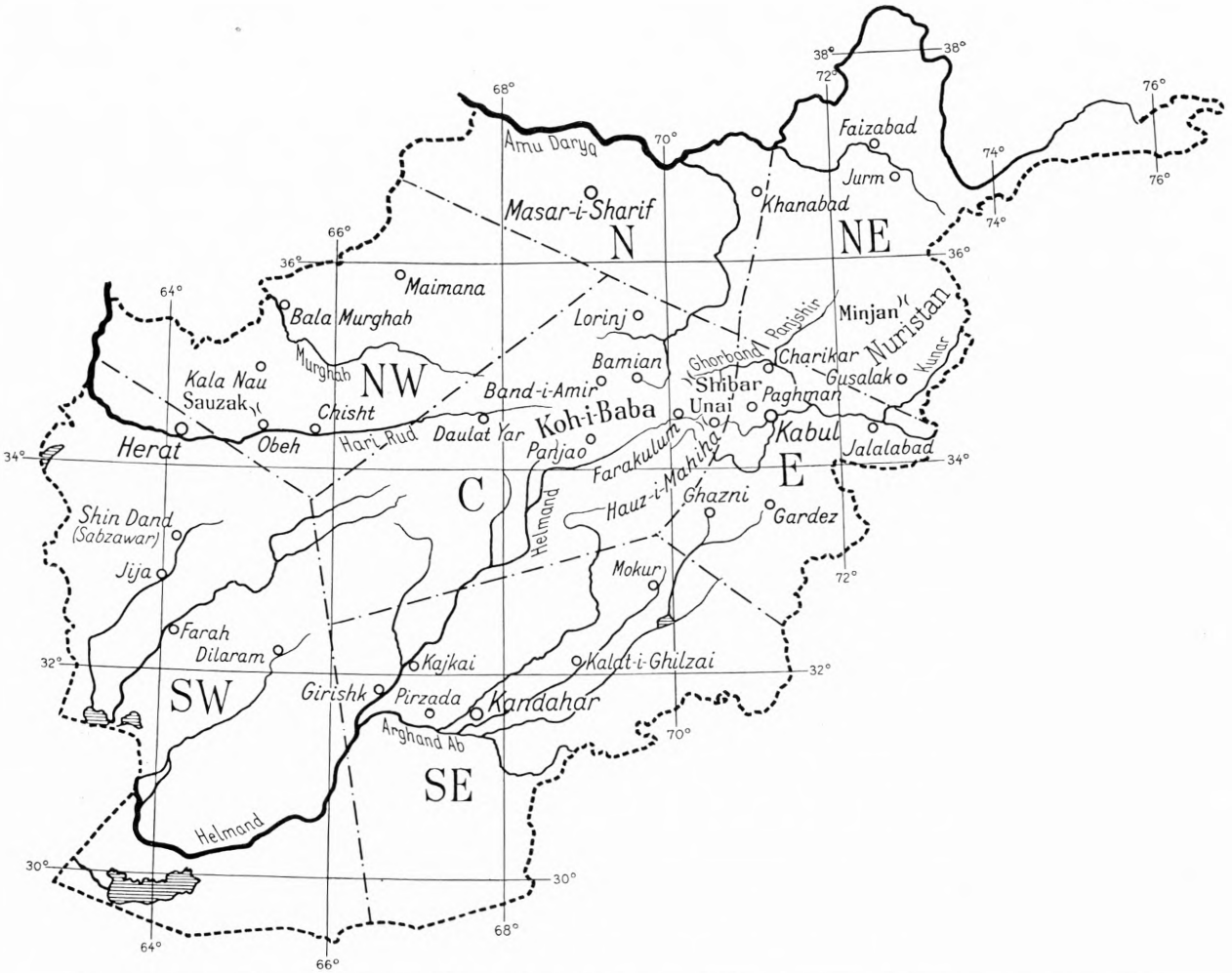
Introduction.

As members of the Third Danish Expedition to Central Asia L. EDELBERG and M. KØIE collected plants in Afghanistan in 1948—49. The collections comprised about 5,000 numbers. Dr. K. H. RECHINGER of the Naturhistorisches Museum, Vienna, undertook the systematic treatment of a large part of the material. At the same time, Dr. RECHINGER received a large material (2,600 numbers) collected in Afghanistan by W. KOELZ in 1937 and 1939. It was therefore decided that the whole of this material should be made the subject of a common taxonomic treatment and publication. To this material was also added a large number of plants collected by H. F. NEUBAUER and smaller collections by G. CHAWORTH-MUSTERS, CODRINGTON and K. LINDBERG. Furthermore, plants which had been lying untreated or only provisionally named in various museums were included in this general survey, for instance plants collected in May and June 1833 by M. HONIGBERGER and some of GRIFFITH's and AITCHISON's materials. Some plant groups collected in recent years by A. GILLI are also included in the survey. Finally, a plant collection of about 2,800 numbers by O. H. VOLK has recently been added to the material.

These additions have brought the total up to more than 11,000 numbers. It will be seen from the survey of plant-collecting in Afghanistan (p. 7 et seq.) that this material represents by far the greater part of all specimens collected since GRIFFITH and AITCHISON introduced the Afghanistan flora to the scientific world in the last century. A substantial part of the material originates from regions which previously were terra incognita from a botanical point of view.

Many of the localities referred to in this work are not shown on any map. Others will be difficult to identify because of considerable discrepancies in orthography. In the absence of established orthographic rules, we have given the localities in the spelling used by the collector, because this is the spelling that will be found on the labels. A complete list of more exact geographical locations cannot be prepared until the treatment has been completed because new material has been coming in all the time. For preliminary orientation we have divided Afghanistan into seven parts: N, NE, E, SE, SW, NW and C as indicated in the map. These geographical abbreviations are placed in front of the localities given. Nuristan has been segregated from the north-east part of the country, mainly because it is a well-defined area from which a particularly large number of plants has been collected, but also because the monsoon



Map of Afghanistan with the divisions used in the text and the localities most commonly mentioned.

rain renders the vegetation of Nuristan different from that of most of the other parts of Afghanistan. Otherwise, no attempt has been made to divide the country by plant geography.

All numbers are kept at the herbaria for which the plants were collected; thus, plants collected by EDELBERG and KØIE are kept in Copenhagen; those collected by KOELZ are in Beltsville, and NEUBAUER's are in Vienna. In most cases, however, there are duplicates of the numbers collected by EDELBERG, KØIE and KOELZ. Of such numbers there is also a specimen in the museums with which the respective taxonomists are associated. For new species that specimen will generally be the type. The museums where the new species are kept is given in the text; the first museum indicated contains the herbarium where the type specimen is to be found.

Data on habitats, etc. have been cited in the language used by the collector on the label.

The following abbreviations have been used for herbaria: C is the Botanical Museum, Copenhagen; BM: British Museum; BPI: Beltsville, Plant Industry Station, Maryland, U.S.A.; W: Naturhistorisches Museum, Vienna.

The names of the collectors are abbreviated as follows: E is L. EDELBERG; K: M. KØIE; Kz: W. KOELZ; N: H. F. NEUBAUER; V: O. H. VOLK.

The habit figures have been drawn by Dr. FRIDA RECHINGER, in by far the most cases after the type specimens. From the Rask-Ørsted Foundation we have received a grant for this purpose, for which we wish to express our sincere gratitude. The flower dissections have been drawn by ALOIS PATZAK.

The plant families will be published in the sequence in which the treatment is completed, and in the language (German or English) used by the author. It is intended to conclude the work with a survey of Afghanistan's vegetation.

Survey of Plant-Collecting in Afghanistan.

By Mogens Køie.

In the following survey a brief review will be given of the explorers who have collected plants in Afghanistan, their itineraries and the times when they visited the various regions.

We owe our first knowledge of the Afghan flora to W. Griffith. Before he went to Afghanistan he had travelled in India as an explorer for several years. In the middle of April 1839 he crossed the present frontier of Baluchistan at Chaman on the road from Quetta to Kandahar. From the end of June he followed the caravan road through Khilat-i-Gilzee (Qualat-i-Ghilzai, 5th July) and Ghuznee (Ghazni, 21st July) to Kabul where he arrived on the 10th August, 1839.—On the 24th August he left Kabul and travelled via Sir-i-Chusme (Sar-i-Chasma, the sources of the Kabul River) through Koh-i-Baba to Bamian. After a couple of days' stay at Bamian he went back to Kabul by almost the same route, arriving at Kabul on the 17th September.—A few collections were made during the subsequent journey from Kabul to Lalpore (Lalpura, on the frontier of Pakistan) in October, 1839.

Of the 1,273 numbers enumerated by Griffith (1848, p. 205—323) as collected in Afghanistan the first 526 are from regions which are now part of Pakistan.

In January—May, 1840 Griffith travelled along Kooner (Kunar River) to Chugur Serai (Chiga Serai) in south-east Nuristan (then Kafiristan) and thence to Kabul where he arrived on the 5th June. The 206 numbers collected during this journey are listed in the above-mentioned book, p. 324—367.

Griffith's last collections in Afghanistan were made during a journey which lasted from the end of June to the end of September, 1840. He followed his previous route to Bamian and went on to Koh-i-Baba where he collected 200 (mostly alpine) species which, however, are not included in his lists of plants.

In April—August, 1879 Surgeon-Major J. E. T. Aitchison made large collections in the region of the Kuram Valley, but only a comparatively small part of them came from Afghanistan, being from the areas around the Karaia River and the Hazar-Darakht River, which he called the Hariab District.—The following year Aitchison returned to the Kuram Valley, but he probably did not reach the north side of the Safed Koh Range which now forms the frontier between Afghanistan and Pakistan.

Aitchison's next journey in 1884—85, when he travelled in the southern and western parts of Afghanistan, made a greater contribution to our knowledge of Af-

ghanistan's flora and vegetation. He gave a detailed itinerary of this journey (1888, p. 27):

On the 22nd September, 1884 he left Quetta, travelling westward along the Registan Desert, north of the Chagai Hills on the frontier of Baluchistan, and met the Helmand River near its southmost bend. From there he followed the Helmand to where it flows into the Hamun Marshes. He went on to Jowain (Djuwain) and along Harud (i. e. Adraskand River) and turned north to Hari Rud, following the course of this river from about 38 kilometres (24 miles) west of Herat to Khusan (Kuhsan) on the Persian frontier (where he arrived on the 18th November) and went on to Badghis, the land north of the Paropamissus Range which drains into the Murghab River and its tributary Kushk Rud. After a couple of months' stay in Kala-Bala-Murghab he traversed the south-east corner of Turcmenistan and proceeded along Kushk Rud back to Kuhsan where he arrived on the 26th April, 1885. Until early June he then collected plants in the western part of the Paropamissus Range.

After a trip in Khorasan he made another journey in Afghanistan: At the end of July he set out on his home journey travelling south and east of Kuhsan, with a stop at Kilki near Mt. Do-Shakh (Doshah) before he crossed the Persian frontier about the 18th August, 1885.

The collections amounted to about 800 species, a large part of which came from Khorasan where AITCHISON spent most of June and July, 1885.

N. I. VAVILOV and D. D. BUKINICH made long journeys in Afghanistan in 1924 and in 1926—27. Their main purpose was to collect cultivated plants. Some of the grasses collected during these journeys have been described by ROSHEVITZ (1928).

During 1923—29 C. MANGER collected plants in Afghanistan, especially in the vicinity of Kabul. Some of his material was lost. The remainder, mostly weeds from cultivated land, was listed and described by BORNMÜLLER (1933).

G. KERSTAN, a member of the German Hindukusch Expedition, collected plants in Nuristan in June—August, 1935. A few plants were also taken near Kandahar and Girishk in early May. Some of the plant groups are named and published (HAECKEL und TROLL, 1938).

A considerable part of the material to be dealt with in this work was collected by WALTER KOELZ who went to Afghanistan in 1937 and 1939 in the course of his travels to collect plants for the Plant Industry Station, Beltsville, Maryland, U.S.A. KOELZ' itineraries had to be reconstructed on the basis of his labels; this was done by CHARLES VOURI, New York, and ANDREW ARCHER of the Herbarium of U.S. National Arboretum, Washington, D.C. The following survey is based on their deductions:

KOELZ arrived at Jalalabad on the 9th May, 1937, reached Kabul on the 13th May and until the 27th June he worked within a triangle approximately delimited by Jalalabad—Gardez—Charikar (Nos. 11,377—12,154).

On the 30th June, 1937, KOELZ crossed the Shibar Pass into the north-east

part of the country, and made collections on various routes between Khanabad, Faizabad and the Minjan Pass in July and August. In September he collected plants in the northern part of Afghanistan, striking west as far as Balkh (Nos. 12,156—13,194).

During October—November, 1939 KOELZ went from Kabul by way of Kandahar—Girishk—Farah—Herat—Zermast Pass to Andkhui in the northern lowland, collecting 70 numbers.

KOELZ' second journey in Afghanistan extended from the middle of August to the end of October, 1939. He began collecting plants near Kabul, crossed the Shibar Pass going northwest and west through the northern mountainous area to the Maimana region, turned back to Balkh where he ceased collecting (Nos. 13,474—14,151).

A large part of L. EDELBERG's collections were brought together in Nuristan. He set out in late February 1948 at Gusalak on the Pech River (tributary of Kunar River). Up to the middle of June he collected a large number of specimens in the regions around this river, striking north as far as Shtive (north of Pashki) and along the Vaigel River east of Shtive. On the 18th—23rd June he made an excursion to the area around Kamdesh on the Bashgal River. On the 29th June he crossed the Weran Pass (i. e. Minjan Pass) and during the following three weeks collections went on in Minjan along a route which followed the Weran River via Jurm to Faizabad and back by way of Zebak and Sanglich (where KOELZ collected plants in 1937, about six weeks later in the year).—From the 22nd July to the 4th August EDELBERG supplemented his previous collections from the Pech River area.

He returned to Nuristan in early July 1949; this time he went to the Kunar Valley. The following month he gathered material in the tracts of the Pech and Vaigel Rivers.

Before his last trip to Nuristan EDELBERG made an excursion to Deh Kundi in the upper reaches of the Helmand River.

M. KØIE, together with Mrs. A. KØIE, started west of Kandahar just before the middle of May 1948. In the first half of June they went via Farah to Herat and on to the Sauzak Pass north of Herat. They returned to Kabul by way of Kandahar, arriving in Kabul in late June.

On the 9th July they set out on a one-month journey through the central plateau, crossing the Unai Pass to Panjao, proceeded west to Daulat Yar on the upper Hari Rud, (with a northward detour to Koh-i-Baba). In the last half of August they collected along a route farther north: Kabul—Shibar Pass—Bamian—Band-i-Amir—Doab. In the beginning of October KØIE went to the Panjshir Valley. In November he made short excursions to Jalalabad and to the cedar woods near Gardez.

On the 19th February, 1948 M. KØIE—this time together with L. EDELBERG—travelled back via Kandahar to Herat, arriving there on the 12th March. In the latter half of March they worked in the tracts north and north-east of Herat between that town and Kushk, Bala Murghab and Maimana. They returned to that area for about one week in late April.

In the period 5th—14th April they worked between Herat and Farah, and 15th—23rd April between Herat and Chisht on the Hari Rud west of Obeh. In the beginning of May they set out on the journey back to Kabul where they arrived on the 12th May.

In the area Kandahar—Farah—Herat plants have been collected during the whole vegetation season; it is thus the area most intensively investigated by KØIE.

H. F. NEUBAUER, during 1949—51, made comprehensive journeys in Afghanistan, notably in the eastern and northern parts of the country, and collected considerable amounts of material. In addition to making several excursions in a wide circle centered on Kabul (Unai Pass, Tschak Wardak, Paghman, Ghorband Valley, Panjshir Valley, etc.), NEUBAUER travelled from Kabul to the following regions in 1949: 6th—12th May to Katawas east of Ghazni—Mokur; 30th May—5th June to Kandahar; 18th—21st June to Katawas; 5th—8th July to Ghazni—Mokur and thence north to Djaghori; 10th—19th August to Khost and Katawas; 25th September—14th October to North Afghanistan along the following route: Shibar Pass—Pul-i-Khomri—Khanabad—Faizabad—Kunduz—Hasrate Iman (on Oxus River)—Kunduz—Pul-i-Khomri—Tash Kurgan—Masar-i-Sharif—Shibarghan—Sar-i-Pul—Andkhui and back via Tash Kurgan and Pul-i-Khomri.—In 1951: 4th—17th August he travelled to Nuristan from Asmar (on the Kunar River) to the Vaigel and Pech Rivers; 24th—31st August to Bamian and Band-i-Amir.

O. H. VOLK (Würzburg) collected during 1950—1953 in many places, mainly in the western part of the province Badakhshan and east of a line between Kabul and Gardez.

All the above-mentioned botanists collected plants in the vicinity of Kabul where also I. M. HONIGBERGER, G. CHAWORTH-MUSTERS, CODRINGTON and K. LINDBERG worked. In addition, CODRINGTON collected a few specimens from Bamian and Band-i-Amir and LINDBERG from Northwest Afghanistan.

The largest continuous area from which there are no collections at all is delimited approximately by the Hari Rud and Helmand River and the towns Girishk, Farah and Herat. Many localities within that area reach altitudes of 4,000 metres (13,000 ft.); nearly all the specimens collected along its southern and western perimeter have been taken at altitudes below 1,500 metres (5,000 ft.). The flora of this south-western mountainous area is likely to be rather different from the flora found in the more rainy mountains north of Hari Rud, but from the latter area, too, our knowledge of flora and vegetation is relatively scarce. Only KOELZ has collected here, and his material proved to be comparatively rich in species new to science.

A survey of Afghanistan's vegetation was published by LINCHEVSKY and PROZOROVSKY (English translation 1949), based on the very scant literature and on inferences from the knowledge of the vegetation of surrounding countries.

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LABIATAE

Von K. H. Rechinger, Wien.

Ajuga bracteosa Benth. — **NE:** Nilkhan, 8000 ft. (Kz. 11696). — **Nuristan:** Gusalak, 1000 m (E. 1552), 1200 m (E. 1497), Vama 1300 m (E. 454), Dshanda 1650 m (E. 894).

Unter obigem Namen fasse ich hier die durch folgende Merkmale gekennzeichneten Exemplare zusammen: Rhizom verholzend, Blätter dicklich, Indument weiß, relativ kurz, Blattnervatur undeutlich, Tragblätter breit, oft gelappt, Blüten blaß, Stamina knapp exsert.

A. parviflora Benth. ap. Hooker, Fl. Brit. Ind. 4:703 (1885). — **Nuristan:** Gusalak, 1000 m (E. 35, 36, 153, 259, 304).

Unter diesem Namen fasse ich die Exemplare zusammen, die durch folgende Eigentümlichkeiten gekennzeichnet sind: Wurzel nicht verholzend, Blätter dünn mit deutlicher Nervatur, Indument relativ lang und rauh, Blüten noch in getrocknetem Zustand leuchtend blau, Stamina eingeschlossen.

Meine Identifikation der vorliegenden Pflanzen mit *A. parviflora* stützt sich vor allem auf die blauen Blüten mit eingeschlossenen Stamina. Die vorliegenden Exemplare haben jedoch im Gegensatz zu den vom Autor zitierten Exemplaren Wawra no. 1463 glatte, kahle Grundblätter.

Teucrium Edelbergii Rech. fil., n. sp. — Fig. 1 und 2.

Sect. nov. ***Pseudoscorodonia*** Rech. fil. — Flores in ramis axillaribus multifloris abbreviatis subcorymbose dispositi, bracteis subulatis herbaceis suffulti. Calycis labium superius tridentatum, dente intermedio longissimo latissimo ovatoacuminato, lateralibus brevissime triangularibus, labium inferius profunde bifidum dentibus lanceolatis divergentibus. Corolla flava. Habitu *T. Scorodoniae* L. similis sed inflorescentia, calyce, corolla diversissima. — Species unica:

Rhizoma tenue stolones subterraneos radicantes caules floriferos proferentes emittens. Caules 20—30 cm longi stricte erecti, internodiis mediis 4—5 cm longis, herbacei, tenues, obtuse quadranguli, pilis brevibus recurvis eglandulosis laxe obsiti, subsimplices, ex axillis plurimis ramulos tenues abbreviatos minute paucifoliatos proferentes, regulariter foliati. Folia omnia in sicco tenuiter membranacea, supra intense subtus pallidius viridia, pilis brevibus eglandulosis supra laxissime subtus laxe obsita, laxiuscule tenuiter pennato- et reticulato-nervosa, petiolo tenui ± 1 cm longo suffulta, patentia; inferiora e basi ± oblique truncata ovata, ± crenata, 2—3 cm

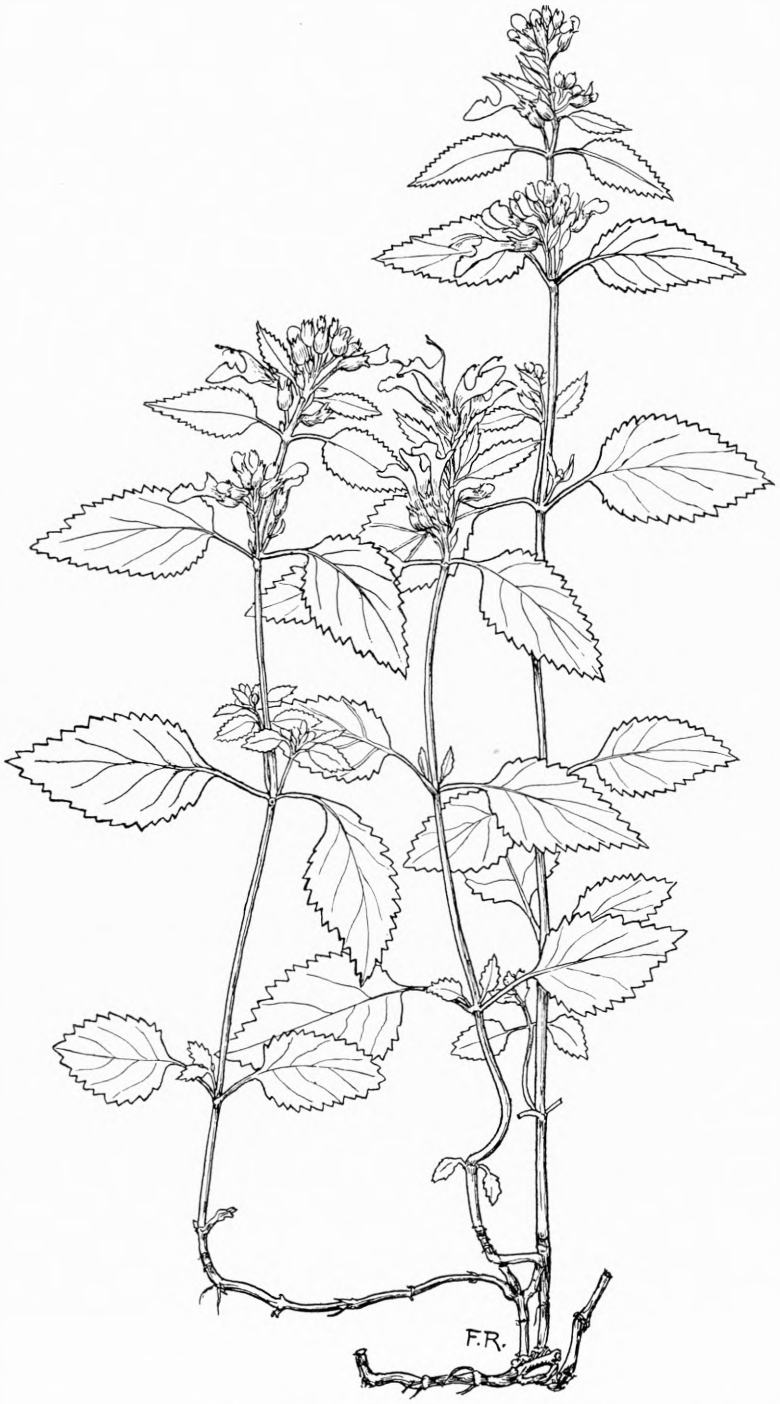

Fig. 1. *Teucrium Edelbergii* (E. 887). $^3/_4$.

Fig. 2. *Teucrium Edelbergii* (E. 887). ca. 5×.

longa, ± 1 cm lata; folia superiora paulo increscentia, 4 cm longa, 2—2.5 cm lata, basi ± cordata, apicem versus sensim longe attenuata, irregulariter interdum subduplicato- vel sublobato-dentata vel crenato-serrata; folia summa lanceolata, argute inciso-serrata. Axillae foliorum superiorum cymas pedunculatas (usque 1 cm) multifloras proferentes. Bracteae inferiores lanceolatae, argute serratae, pedunculatae, superiores subulatae, integrae, omnes herbaceae; inflorescentia pilis brevibus partim eglandulosis partim glanduliferis breviter hirsuta. Calyx ± 5 mm longus, oblique oblongo-campanulatus, herbaceo-membranaceus, tenuiter 10-nervius, hirsuto-glandulosus, bilabiatus, labio superiore tridentato dente intermedio longissimo latissimo ovato-acuminato, lateralibus brevissime triangularibus, labio inferiore profunde bifido dentibus lanceolatis acutis divergentibus. Corolla ± 11 mm longa, in vivo ut videtur pallide flava, breviter glanduloso-pilosa; labii lobus medianus rotundato-dilatatus ± deflexus, laterales lanceolati acuti. Stamina et stylus longe exserti.

Nuristan: Vaigel, 1500 m, along stream, 31.V.1948 (Edelberg 887, Typus, hb. W., C.). Darimtal ab Ort Darim aufwärts, 1900—2400 m (N. 51/1024). Aschpi-Pass (N. 51/1046).

T. Polium L. — **SW:** Jija, 900 m (K. 3373). — **SE:** Girishk, 1000 m, rocks along stream, frequent (K. 2149).

T. serratum Benth. — **NW:** Obeh, 1600 m (K. 4069). — **Nuristan:** Nishei, 1300 m (E. 815). — **E:** Mamakhel, 4000 ft., along stream, fl. pale rose (Kz. 11585). Ghorband, 1700 m, river edge (K. 2777). Bagrami, Nedjerau-Tal, an einer feuchten Mauer (N. 51/270). Kabul (N. 51/359). — **SE:** Girishk, 900 m (K. 2144).

T. Stocksianum Boiss. (e descr.). — **Nuristan:** Vaigel, ca. 1500 m (E. 888). Barikot (E. 1795). — **E:** Kabul (Honigberger, hb. W.). — **Baluchistan:** Quetta (K. 3374).

Scutellaria Edelbergii Rech. fil., n. sp. — Fig. 3.

Sect. *Lupulinaria* Hamilt. — Suffrutex ramosissimus, ramis inferne tortuosis ramosis longiuscule lignescentibus decumbentibus, superne herbaceis arcuato-ascendentibus, ad 20 cm longis, pilis patulis vel retrorsis brevibus diametro caulis multo brevioribus eglandulosis canescentibus; internodia media ad 3 cm longa. Folia omnia discoloria, supra laete viridia laxe breviter eglanduloso-pubescentia, subtus canescentia breviter tomentello-puberula, nervis lateralibus utrinque ± 4 supra tenuiter immersis subtus tenuiter prominentibus; lamina ad quartam vel quintam partem crenata, in foliis superioribus crenato-dentata, crenis utrinque ± 5. Folia inferiora petiolo laminam ± aequante suffulta; lamina ad 15 mm longa et lata, late subrhombico-triangularis, basi plerumque perlate sinuato-cuneata, rarius subhorizontaliter truncata; folia superiora brevius petiolata decrescentia, latitudine circiter sesquilongiora, basi magis cuneata apice acuta, margine angustius et acutius crenato-dentata. Inflorescentia densiuscula interdum inferne laxiuscula, 3—5 cm longa; axis inflorescentiae pilis numerosis axis diametrum ad summum aequantibus hispida, pilis brevioribus glanduliferis paucis immixtis. Bracteae herbaceae flavido-virides, integrae, calycem floriferum superantes, oblanceolato-subrhombicae, acutae

Fig. 3. *Scutellaria Edelbergii* (E. 1140). $^{5}/_{6}$.

hispidulae et patule longiuscule glanduloso-pilosae. Calyx florifer vix 3 mm longus herbaceus hispidus eglanduloso-pilosus, fructifer ignotus. Corolla ± 20 mm longa, tubus rectus, labium inferius in vivo violascens, in sicco expallescens concolor, pilis brevibus pluribus glanduliferis imprimis in labio superiore obsita. Nuculae ignotae. — Inter species *S. orientali* L. affines combinatione characterum sequentium insignis: habitu decumbenti-ascendente, foliis inferioribus latitudini aequilongis superioribus ad summum sesquilongioribus non profunde crenatis, indumento brevi e pilis eglandulosis consistente subtus densiore discoloribus, nervis subtus distincte prominentibus.

Nuristan: Chetras, 2800 m, 30.V.1948 (Edelberg 846, Typus, hb.W.,C.). Pashki, 2600 m (E. 739). Kamdesch (E. 1140). — **E:** Above Kudikhel, 8000 ft. (Kz. 11558).

Das letztgenannte Exemplar ist von zwerghaftem Wuchs mit niedergestreckten Aesten, knapp 1 cm langen etwas schmäleren, z. T. reichlicher und kleiner gekerbten Blättern, relativ größeren breiten purpur-violett überlaufenen Brakteen und stellt wahrscheinlich eine besondere Rasse dar.

S. Heydei Hook. — Kurrum valley, from Habibkalla to Pewarkotal and Alikhel (Aitchison 201, hb. Boiss.).

Das Exemplar ist ursprünglich unter der Bezeichnung *S. glutinosa* Benth. var. veröffentlicht worden.

Scutellaria Koelzii Rech. fil., n. sp. — Fig. 4.

Sect. *Lupulinaria* Hamilt. — Suffrutex basi longe et crasse lignosus caespitosus 15—20 cm altus. Caules rami foliaque minute pruinoso-papillosi regione inflorescentiae excepta eglandulosi. Rami floriferi tenues arcuato-erecti simplices vel subsimplices, internodiis mediis 2—3 cm longis laxe foliati. Folia caulina inferiora petiolo laminae latitudine breviore usque eam aequante suffulta, lamina ± 1 cm longa, ± 5 mm lata, ambitu ovato- vel late lanceolata, prope basin latissima, basi late cuneata vel subrotundata, apicem acutam versus sensim attenuata, margine leviter ± remote irregulariter crenato-dentata vel rarius ± integra, nervatura pennata supra immersa subtus prominente, concolor in sicco laete flavescenti-viridis, consistentia crassiuscule membranacea. Folia superiora paulo decrescentia breviter petiolata vel sessilia proportione angustiora subargutius dentata vel subserrata. Inflorescentia stricta, ab initio valde laxa, internodiis infimis 2—3 cm longis, axis pilis longis numerosis glanduliferis et setis axis diametro longioribus eglandulosis hispidula. Bracteae ± anguste ovato-lanceolatae vel lanceolatae, acutae, integerrimae, calycem floriferum ± aequantes. Pedicelli rigidi axi principali paralleli vel ei appressi, fructiferi incrassati ad 5 mm longi. Calyx herbaceo-membranaceus, florifer ca. 15 mm longus, fructifer auctus, scutello late rotundato incluso ad 5 mm longus et latus, antice coerulescens. Corolla 20—22 mm longa, flava, tubo tenui superne parum ampliato recto axi parallelo, labiis in vivo purpureis, in sicco atro-violascentibus. — Inter species gregis *S. multicaulis* Boiss. notis sequentibus memorabilis: colore totius plantae laete flavescenti-viridi, indumento caulis foliorumque brevissimo papilloso-pruinoso, foliis concoloribus ovato-lanceolatis remote interdum indistincte paucidentatis, axi in-

Fig. 4. *Scutellaria Koelzii* (Kz. 11947). $^{5}/_{6}$.

florescentiae patule glanduloso-hispida, bracteis ovato-lanceolatis sat parvis, corollae tubo tenui superne parum ampliato.

E: Sirotai, 10,000 ft., dry slopes, clumps, flowers yellow and purple, 18.VI.1937 (KOELZ 11947, Typus, hb. W., BPI.). Paghman, 8000—9000 ft., 2. and 10.VI.1939 (CHAWORTH-MUSTERS s. n., hb. BM.). Paghmantal (N. 50/703). Kabul, 2100 m (K. 2316, hb. C., floribus desideratis).

Die Exemplare von CHAWORTH-MUSTERS haben etwas reichlicher und deutlicher gezähnte Blätter und nicht so sehr gestreckte Infloreszenz wie der Typus, stimmen aber im übrigen, so im schlanken Korolltubus und im charakteristischen, kaum sichtbaren, kleinpapillösen Indument vollkommen mit dem Typus überein.

S. leptosiphon Newski, det. K. FITZ. — **C:** Kala Sarkari, 7000 ft., dry earth, cliff face, fl. pale rose, center deeper (Kz. 13921). Binimang, 8000 ft., (Kz. 13882). — **E:** In der Schlucht zwischen Botkhak und Kord-e-Kabul, Polster bildend aus Felswandritzen, trocken, doch Schattenseite (N. 51/371).

S. Litwinowii Bornm. & Sint. (Syn. *S. multicaulis* Aitch., Journ. Linn. Soc. 19: 184 [1882] non Boiss.). — Badghis (AITCH. 474, hb. Boiss.).

Stimmt mit dem Typus, SINTENIS no. 1726 aus Kisil-Arwat, Karakala, Kutenak, genau überein. Auffällig durch die sehr stumpf gekerbten bis ganzrandigen, kurzgestielten Blätter und große, breite, abstehend behaarte Blüten.

Scutellaria lorinjensis Rech. fil. & Fitz, n. sp. — Fig. 5.

Sect. *Lupulinaria* Hamilt. — Suffrutex ca. 30 cm altus multicaulis, ramis e basi arcuata erectis subsimplicibus vel prope basin virgato-ramosis, internodiis mediis ad 3 cm longis. Tota planta inflorescentiae regione excepta pilis brevibus eglandulosis copiosis canescens. Folia inferiora petiolo lamina breviore suffulta; lamina ambitu late lanceolata infra medium latissima, basi cuneata usque abrupte attenuata, apice acuta, margine remote breviter paucilobato-dentata, consistentia crassiuscula, nervis paucis supra immersis subtus crasse prominentibus, pilis brevibus eglandulosis glandulis sessilibus pallidis immixtis utrinque aequaliter canescens. Folia superiora paulo decrescentia, brevius petiolata usque sessilia, basi subtruncata brevius et minus distincte dentata. Inflorescentia stricta, ad 15 cm longa, ab initio laxissima, internodiis infimis ad 4 cm longis; axis crassa valida, pilis eglandulosis axis diametro paulo brevioribus vel eum aequantibus patentibus et pilis glanduliferis brevioribus crassioribus numerosissimis hispidulo-villosa. Bracteae herbaceo-membranaceae flavescenti-virides, late obovato-rhombicae, breviter acuminatae, elevate nervosae, calycem floriferum involucrantes, indumento ut in axi inflorescentiae. Pedicelli axi appressi, ± 4 mm longi. Calyx florifer scutello incluso ± 4 mm longus longe laxe hispidulus et brevius glanduloso-pilosus, fructifer paulo ampliatus bracteas paulo superans, tenuiter membranaceus pallide viridis, superne atro-violascens. Corolla 16—18 mm longa, tubo sursum valde ampliato, in sicco flava, labio inferiore atrato (in vivo vide indicationes collectoris infra relatas). Semina immatura ellipsoidea, 1.5 mm longa, grisea, sublaevia. — In affinitatem *S. multicaulis* Boiss. pertinet, combinatione characterum sequentium insignis: indumento cinerascente brevi eglanduloso

Fig. 5. *Scutellaria lorinjensis* (Kz. 13741). $^{2}/_{3}$.

Fig. 6. *Scutellaria macrochlamys* (K. 2640). $^{1}/_{1}$.

foliorum et caulium, foliis angustis paucidentatis vel dentato-sublobatis, bracteis calycem floriferum involucrantibus latis breviter acuminatis elevate nervosis, axi inflorescentiae hispido-villosa et glanduloso-pilosa, corolla bicolore sursum valde ampliata.

C: Lorinj pass, 10000 ft., dry slope, standard deep purple, center reddish, lip yellowish, 27.VIII.1939 (KOELZ 13741, Typus, hb. W., BPI.). Same locality (Kz. 13742, hb. W., BPI). — **E:** Gulbahar, Blüte gelb, Unterlippe blau (N. 50/714).

Außer durch *S. lorinjensis* und durch *S. Koelzii* ist der Formenkreis der *S. multicaulis* Boiss. in Afghanistan noch durch mindestens zwei weitere Sippen vertreten, über deren Abgrenzung und systematische Bewertung ich bisher keine hinreichende Klarheit erlangen konnte.

Die erste Form liegt mir von folgenden Fundorten vor: Zentral-Afghanistan (KÖIE 3392). — Deh Kundi, oberes Hilmend-Tal, Hezarajat (EDELBERG 1909). — "Burchao Pass, 9000 ft., dry slope, semidecumbent, fl. purple and yellow" (KOELZ 14113). — "Pulalam, 7000 ft., desert, in clumps, plant 12 inches high, fl. yellow and purple" (KOELZ 11851). Von *S. Koelzii* unter anderm auffällig verschieden durch reichlich mit kurzgestielten Drüsen bekleidete Blätter und teilweise auch Stengel.

Von der zweiten Form sah ich nur ein Fragment im Hb. BOISSIER von folgendem Fundort: "Kurrum valley, Hariab Dist., 7500—8000 ft." (AITCHISON 537). Wuchs zart und niedrig, mit abstehenden dünnen Aesten, Blüten im trockenen Zustand dunkel; in dem aus kleinen Papillen bestehenden Indument stimmt die Pflanze mit *S. Koelzii* überein.

Scutellaria macrochlamys Rech. fil. & Fitz, n. sp. — Fig. 6.

Sect. *Lupulinaria* Hamilt. — Dense caespitosa humilis, tenuiter lignescens, ramis brevibus inferne ramosissimis diffusis dense foliatis sterilibus decumbentibus floriferis ascendentibus. Tota planta indumento hirsuto-tomentello canescens. Rami filiformes flexuosi, in parte superiore herbacei, pilis albis rectangulariter patentibus caulis diametrum aequantibus eglandulosis hirsuto-villosi. Folia petiolo tenui lamina usque duplo longiore suffulti; lamina minutissima 3—5 mm longa, longitudine saepe latior, palmato quinque- usque septemsecta vel pinnato-lobata, lobis saepius rotundatis, ambitu late flabellato-cordata usque late ovato-elliptica, margine revoluta, nervis supra valde impressis subtus prominentibus rugosa, ut petioli pilis albis patentibus eglandulosis dense villoso-pubescens cinerascens. Inflorescentia 4—7 cm longa, in statu compresso 2 cm lata, internodiis valde abbreviatis, bracteis permagnis imbricatis. Bracteae 10—14 mm longae, 6—11 mm latae, obtusiusculae vel acutae, inferiores irregulariter leviter late paucicrenatae usque sublobatae, superiores ± integrae, basi late cuneatae, tenuiter herbaceo-membranaceae, pallide virides, nervis violascentibus palmato-pennatis percursae, longe nitenter candide villosae, flores fere omnino occultantes. Pedicelli 3—4 mm longi, axi appressi. Calyx florifer minutus, fructifer valde auctus, scutello incluso ± 5 mm longus, tenuiter membranaceus, virescenti-flavescens, dense longe hispido-villosus. Corolla 10 mm longa, tenuis, erecta, in sicco basi flavescens superne purpurascenti-violascens, pubescens. Nuculae vix 2 mm longae, ellipsoideae nigrae appresse albo-lepidotae. — Species habitu dense caespitoso, foliis minutissimis pluribus palmatilobis, inflorescentiis densissimis bracteis permagnis pallide viridibus violaceo-venosis imbricatis, corollis proportione minutis valde insignis, vix cum specie alia comparanda.

C: Koh-i-Baba, 2400 m, along stream (Köie 2640, Typus, hb. W., C.). — **E:** Oberes Paghmantal (N. 50/702).

Scutellaria Neubaueri Rech. f., n. sp. — Fig. 7.

Sect. *Vulgares* Benth. Subsect. *Peregrinae* Boiss. — Verosimiliter suffrutescens multicaulis. Caules arcuato-erecti, 10—15 cm longi, inferne obtuse, superne acutius quadranguli, paucinodi, internodiis mediis 3—4 cm longis, simplices, toto longitudine superne densius hispido-villosi, pilis longioribus eglandulosis diametrum caulis fere aequantibus pluri-articulatis acutis copiosis, brevibus crassioribus glanduliferis crebre immixtis; caulis spicastro denso plerumque simplici 2—3 cm longo terminatus. Folia omnia in sicco membranacea, nervatura tenuiter pennato-reticulata vix prominente, lamina utrinque subtus densius hispido-villosa, pilis eglandulosis longioribus et glanduliferis brevioribus immixtis, ut in caule; folia caulina inferiora delapsa; media ad 3 cm longa et lata, basi profunde cordata, apice acuta vel obtusiuscula, margine late breviter crenata, crenis utrinque 4; petiolus 1.5—2 cm longus; foliorum par summum plerumque tantum diminutum sed forma et proportionibus a foliis mediis vix diversum; folia caulina in bracteas non transientia. Axis inflorescentiae bractearum et calycis indumentum longe hispide et brevius glanduloso-villosum. Bracteae latius vel angustius lanceolatae, breviter petiolatae, acutae, in sicco bruneo-purpurascentes, calycem aequantes. Calyx 2.5 mm longus. Corolla ca. 16 mm longa, colore in vivo?, in sicco pallide bruneo-purpurascente, tubo tenui e basi eximie curvato erecto, indumento mixto. Nuculae ignotae. — Inter affines caulibus humilibus, indumento denso hispido villoso-glanduloso, foliis superioribus vix diminutis, corollae tubo tenui valde curvato insignis.

Fig. 7. *Scutellaria Neubaueri* (N. 1951/737). $^2/_3$.

Nuristan: Zwischen Ort Waigel und Nischai. 12.VIII.1951 (Neubauer 51/737, hb. W.).

Scutellaria nuristanica Rech. f., n. sp. — Fig. 8.

Sect. *Vulgares* Benth. Subsect. *Peregrinae* Boiss. — Basis caulis deest sed certe perennis. Caulis 60 cm altus, stricte erectus, obtuse quadrangulus, internodiis omnibus elongatis, mediis ± 6 cm longis, simplex, folia in sicco brunescentia, laxissime minutissime papilloso-puberula, subtus pallidiora secus nervos breviter antrorse pubescenti-scabrida; folia inferiora et media ad 5 cm longa, ad 4.5 cm lata, basi profunde cordata, apice ± acuta, margine late breviter subirregulariter crenato-dentata, dentibus utrinque 10—12; petiolus brevis, emarginatura laminae plerumque non vel vix longior, crassiusculus, 5—8 (—10) mm longus; folia superiora decrescentia

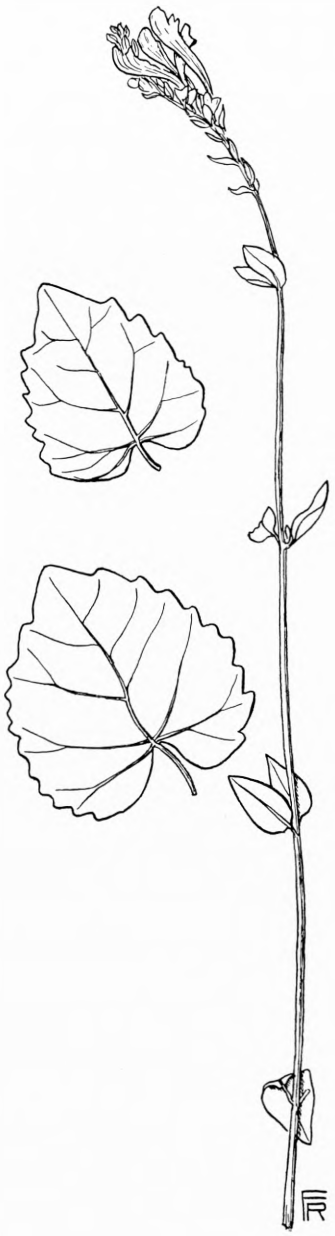

Fig. 8. *Scutellaria nuristanica* (N. 1951/971). $^{2}/_{3}$.

Fig. 9. *Scutellaria poliochlora* (E. 1792). $^{1}/_{2}$.

brevius petiolata proportione longiora, acutiora, subintegra usque integerrima. Axis inflorescentiae cum bracteis et calycibus pilis albis brevibus pubescens, pilis glanduliferis brevissime crasse stipitatis immixtis. Bracteae ovato-lanceolatae acutae brevissime petiolatae integrae, calyce plerumque breviores vel eum ad summum aequantes, flavescenti-virides. Calyx florifer ad 4 mm longus, fructifer ignotus. Corolla ad 2 cm longa, in vivo pulchre cyanea (e collectore), in sicco purpurascens, e basi curvata tubo erecto axi inflorescentiae subparallelo, pilis longiusculis crispulis pro maiore parte non glanduliferis immixtis. Nuculae ignotae. — Inter affines caule elato stricto subglabro, internodiis elongatis, foliis profunde cordatis subglabris, inflorescentia valde abbreviata insignis.

Nuristan: Zwischen Ningalam (1300 m) und Darim Ort (ca. 1900 m). Blüte schön blau. 5.VIII.1951 (NEUBAUER 51/971, hb. W.).

Scutellaria poliochlora Rech. f. et Edelberg, n. sp. — Fig. 9.

Sect. *Vulgares* Benth. Subsect. *Peregrinae* Boiss. — (Basis deest). Caules verosimiliter plures, ad 80 cm alti tenues, erecti, obtuse quadranguli, internodiis omnibus valde elongatis, mediis 6 cm longis, in tertia vel quarta parte tenuiter ramosi; rami oppositi, tenues, divaricati, aphylli, in spicastra abeuntes; indumentum caulis e pilis numerosis brevissimis eglandulosis et e glandulis perminutis brevius quoque stipitatis consistens, subpruinoso-canescens. Folia omnia in sicco membranacea, nervatura subpalmato-pennato-reticulata subtus aliquantum prominente, bicoloria, supra viridia laxe breviter pubescentia et minutissime glandulosa, subtus cinerea, densius et sublongius pubescenti-tomentosa et breviter glanduloso-pilosa; lamina foliorum mediorum 4—6 cm longa et lata, basi profunde cordata, apice obtusiuscula vel subacuta, margine late cuneata, crenis utrinque ± 10 saepe ± irregularibus, interdum minute obtuse cartilagineo-apiculatis; petiolus 15—25 mm longus; folia superiora sensim decrescentia, proportione longiora, brevius petiolata, apice acutiora, margine minus distincte crenata. Inflorescentia primaria et rameales florendi tempore quoque inferne laxiusculae; axis cum bracteis et calycibus pilis longioribus eglandulosis patentibus hispidula, pilis brevioribus glanduliferis sat crebre immixtis. Bracteae ovato-lanceolatae saepe longiuscule acuminatae, herbaceae, calycem ad summum aequantes. Calyx florifer 4—5 mm, fructifer membranaceus paulo auctus ad 7 mm longus. Corolla ± 2 cm longa, in vivo cyanea fuisse videtur, in sicco bruneo-purpurascens, tubo basi paulum curvato, patula, pilis longioribus eglandulosis et brevibus glanduliferis laxe obsito. Nuculae ignotae. — Affinis *S. nuristanicae* Rech. f. habitu elato, foliorum forma, corollae longitudine, sed differt ab ea: caule ramoso, indumento cinerascente densiore, foliis bicoloribus, corolla patula nec erecta.

Nuristan: Kamdesh-Barikot, VIII.1949 (EDELBERG 1792, hb. W., C.).

Scutellaria polyadenia Rech. fil., n. sp. — Fig. 10.

Sect. *Lupulinaria* Hamilt. — Suffrutex ramosissimus, ramis in parte inferiore decumbentibus lignosis, superne herbaceis arcuato-ascendentibus, 10—20 cm longis, pilis longis eglandulosis rami diametrum ± aequantibus hispidis, pilis bre-

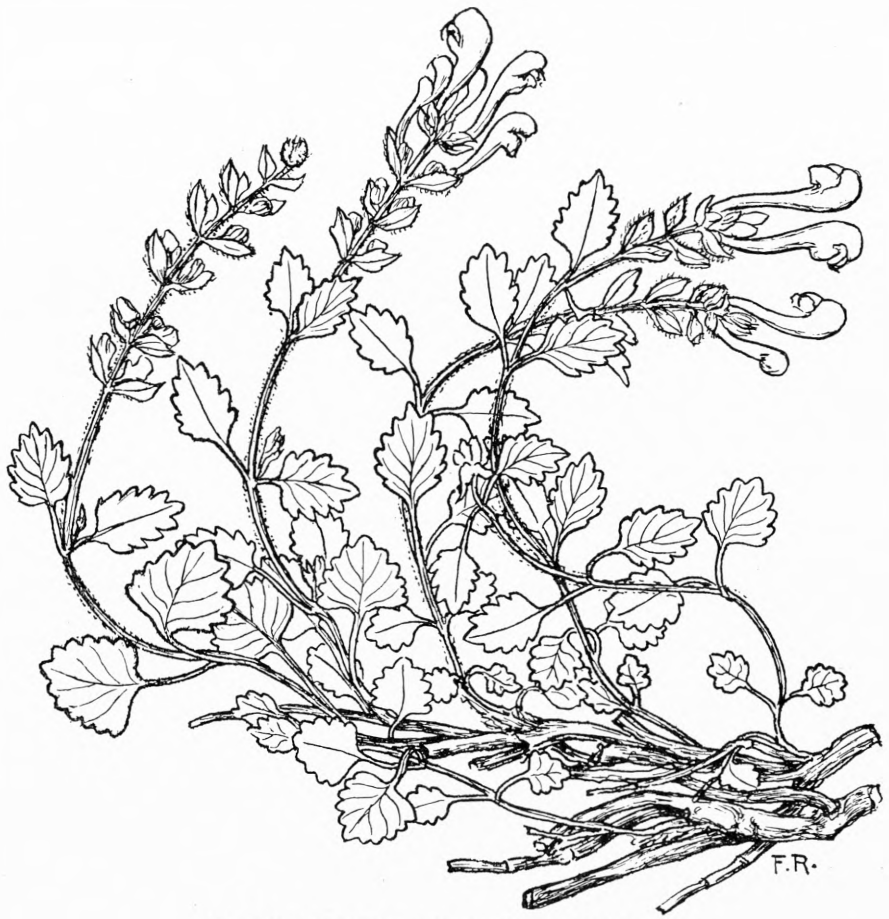

Fig. 10. *Scutellaria polyadenia* (Kz. 11641). $^1/_1$.

vioribus glanduliferis copiose immixtis; internodia media ± 2 cm longa. Folia omnia utrinque laete viridia subconcoloria; nervatura supra tenuiter distincte immersa, subtus tenuiter prominens, nervis lateralibus utrinque ± 4, infimis valde approximatis; lamina ad tertiam circiter partem inciso-crenata, crenis utrinque ± 5, utrinque pilis longis patentibus eglandulosis hispidula pilis brevioribus glanduliferis copiosissime immixtis. Folia inferiora longe tenuiter petiolata, petiolo laminam aequante vel paulo superante; lamina 10—14 mm longa et lata, late triangularis vel ovato-triangularis, basi horizontaliter truncata usque late sinuato-attenuata. Folia superiora sensim paulo brevius petiolata, proportione paulo longiora angustiora, basi distinctius cuneata crenis apiceque subacutioribus. Inflorescentia 4—8 cm longa laxiuscula; axis inflorescentiae pilis axi diametro longioribus rectangulariter patentibus eglandulosis hispidissima, pilis brevioribus glanduliferis copiose immixtis. Bracteae herbaceae, inferiores quoque calycem fructiferum superantes, ovato- vel rhombico-

ovatae vel lanceolatae, acutae, irregulariter dentatae rarius subintegrae, omnes dense hispidae et glanduloso-pilosae; bracteae superiores sensim decrescentes ± integrae. Pedicelli axi appressi rigiduli, ad 5 mm longi. Calyx florifer ca. 3 mm, fructifer ca. 6 mm longus, herbaceo-membranaceus, superne interdum violaceo-suffusus. Corolla 20—22 mm longa, tubo subrecto, in vivo flava labio inferiore purpurascente breviter glanduloso-pilosa. Nuculae maturae ignotae. — In affinitatem remotiorem *S. orientalis* L. pertinet; basi longe et crasse lignescente, foliis brevibus saturate viridibus concoloribus, indumento longo denso hispido et longe patule glanduloso insignis.

NE: Daulatshah, 7000 ft., in stream bed, plant 6 inches high, flowers yellow and purple, 21.V.1937 (Koelz 11641, hb. W., BPI.).

Thuspeinantha brahuica (Boiss.) Briq. — **NW:** N. of Herat, 900—1100 mm (K. 4059). — **SW:** Jija, 1200 m (K. 3574).

Marrubium alternidens Rech. fil., Oesterr. Bot. Zeitschr. 99:38 (1952). — **SW:** Herat, 1400 m (K. 2271). — **C:** Hauz-i-Mahiha, 2500 m (K. 2359). — **E:** Paghman, 8—9000 ft. (Chaworth-Musters). Tagau, 6000 ft. (Kz. 11788). — **NE:** Khash Distr., 8000 ft., (Kz. 12931). — Jurm, 1600 m (E. 1418). — **SE:** Kalat — Mokur, 1800 m (K. 3843). — Kamard, 6000 ft., in field (Kz. 13567).

Differt a *M. vulgari* L. dentibus calycinis alternatim longioribus et brevioribus, apice nunquam hamato-incurvis, longioribus tubum plus quam dimidio superantibus, plerumque etiam calycibus longioribus et nuculis magis atratis.

M. procerum Bge., e descr. — **C:** Upper Hari Rud, 2500 m (K. 3394). Lorinj Pass, 10000 ft., dry slope (Kz. 13748).

M. vulgare L. — **E:** Mamakhel, 4000 ft., along stream (Kz. 11578). Jagdalek, 5000 ft., open dry soil (Kz. 8245).

Entspricht durch die zehn gleichartig ausgebildeten, an der Spitze stark eingebogenen Kelchzähen dem *M. vulgare*, doch sind die Kelche durchschnittlich etwas kleiner als bei der europäischen Pflanze. In der dichten, weißwolligen Behaarung besonders des unteren Stengelteiles erinnern die afghanischen Belege an die mediterrane var. *lanatum* Benth.

Sideritis montana L. — **C:** Lorinj, 8000 ft. weed in field, 2 ft. high fl. yellow, tipped brown (Kz. 13697). — **E:** Kabul, Aliabad, am Bewässerungsgraben in den Versuchsfeldern (N. 50/193). — **E:** Paghman (N. 50/718).

Nepeta brachyantha Rech. fil. et Edelberg, n. sp. — Fig. 11.

Sect. *Cataria* Benth. — Basi lignescens laxe caespitosa. Caules floriferi ascendentes, tenues, 10—15 cm longi, ramulosi vel ± simplices, foliati, a medio circiter ex axillis floriferi, inferne longe hirsuto-villosi indumento caulis diametro longiore, superne breviter ± appresse lanato-villosi, internodiis in regione florifera elongatis 2—4 cm longis. Folia inferiora et media aequalia, minuta, petiolo longo tenui (8—14 mm) hirsuto-lanato suffulta, lamina 7—9 mm longa, longitudini aequilata vel latior e basi sinuato-truncata vel leviter cordata breviter reniformi- vel cordato-triangularis, apice rotundata, margine dense profunde usque laxe leviter crenata rarius subsinuata, nervatura pennato-reticulata, supra tenuiter impressa subtus vix prominens ± rugulosa, indumentum supra laxius subtus subdensius lanato-tomen-

Fig. 11. *Nepeta brachyantha* (E. 619). $^{5}/_{6}$.

tellum subcanescens. Cymae pauciflorae (3—5), in pedunculis filiformibus arcuato-ascendentes axillaribus inferioribus usque 2 cm longis. Bracteae lanceolato-subulatae, laxiuscule lanato-villosae, ad 2 mm longae. Pedicelli subnulli usque 1 mm longi, flores inde ± glomerato-approximati. Calyx 5—6 mm longus, tubuloso-campanulatus,

tenuiter herbaceo-membranaceus, nervis violascentibus tenuiter prominentibus, ore obliquo, dentibus jam in statu juvenili patentibus e basi late triangulari lanceolatis, tenuiter acuminatis ± 1.5 mm longis. Corollae tubus in calyce inclusus, limbus breviter exsertus bilabiatus, labio superiore brevi emarginato, inferiore longiore deflexo trilobo, in sicco sordide albida intense coeruleo-maculata et marginata. Nuculae ignotae. — Differt a *N. graciliflora* Benth. habitu suffrutescenti-caespitoso, indumento totius plantae densiore inferne longiore, foliis brevibus longitudini aequilatis vel latioribus, petiolo longo quam lamina saepe longiore, calycis crassioris dentibus latioribus ab initio patentibus, floribus brevissime pedicellatis, cymis inde densioribus.

Nuristan: Pashki, 2300 m, 17.V.1948 (Edelberg 619, Typus, hb. W., C.). Gusalak, 1000 m (E. 1569). Jshauda Pass, 31.VII.1949 (E. 2046). Im Tal und um den Ort Kurder, Seitental des Petsch, 1600—1700 m, (N. 51/758. — **E:** Bagrami, Nedjerau-Tal, an einer feuchten Mauer (N. 51/271).

N. bracteata Benth. — **NW:** Chisht, 1700 m (K. 3676, 3677). — **SW:** Jija, 900 m (K. 4060). — **E:** Kabul (N. 50/720, 50/725, 51/46). Kabul, Scher Darwasa, südexponierte Berglehne (N. 51/64). Basarak, Pandschirtal (N. 50/726). Tscharikar (N. 50/727). Gulbahar (N. 50/728). Jagdalek, 7000 ft., on dry slope (Kz. 11483). — **Baluchistan:** Quetta, 1900 m (K. 3383).

Köie no. 3676 ist durch ziemlich dichtes, kurzes, weiches Indument der Blattunterseite auffällig.

N. cabulica Rech. fil., Ann. Nat. Mus. 51:421 (1941) Wien. — Fig. 12. — **Nuristan:** Vama, 3000 m (E. 963). — **E:** Above Khudikhel, 8000 ft., along stream (Kz. 11561). Gulbahar (N. 50/711). Gulbahar (N. 50/712). Paghman-Tal (N. 50/715). Kabul (Honigberger, hb. W.).

Inter species sect. *Psilonepetae* calycibus brevibus, dentibus calycinis brevibus, foliis ovatis subcoriaceis grosse obtusiuscule serrato-dentatis insignis.

N. cabulica ist, wie die neueren Aufsammlungen zeigen, eine ziemlich variable Art. Schon die beiden oben angeführten Nummern von Koelz 11561 und Edelberg 963 weichen vom Typus in einigen Punkten ab. In höherem Maß gilt dies von den beiden folgenden Aufsammlungen: Panjshir (K. 3991) und "Giri, 7000 ft., dry slope, 18 in. high, fl. blue-purple" (Koelz 11496). Sie zeigen zarten, niedrigen Wuchs, sitzende Zymen, kleinere Kelche, im Verhältnis zum Tubus kürzere Kelchzähne, die an der Oberlippe nur ein Sechstel nicht ein Viertel der Tubuslänge, an der Unterlippe ein Drittel, nicht zwei Fünftel der Tubuslänge erreichen. Möglicherweise ist *N. cabulica* auf zwei Arten zu verteilen oder sie setzt sich aus mehreren Lokalrassen zusammen. Weiteres Material ist abzuwarten.

N. cataria L. — **NW:** Zehnadir, 8000 ft., along stream (Kz. 14017).

N. ciliaris Benth. — 'Afghanistan' (Griffith 4006 in hb. W. sub nom. aff. *N. salviaefoliae*).

Nepeta cinereo-violacea Rech. fil. & Köie, n. sp. — Fig. 13 und 14 a.

Sect. *Macrostegiae* Boiss. — Suffrutescenti-caespitosa multicaulis. Caules floriferi 15—25 cm alti, tenues simplices erecti, internodiis mediis ca. 4 cm longis, omnino tenuiter appresse velutino-tomentelli cinerascentes. Folia inferiora petiolo ad 5 mm longo suffulta, lamina ad 7 mm longa, 4 mm lata, basi subcordata

Fig. 12. *Nepeta cabulica* (HONIGBERGER s. n., Habitus Kz. 11496). $^3/_5$.

Fig. 13. *Nepeta cinereo-violacea* (K. 2438). $^2/_3$.

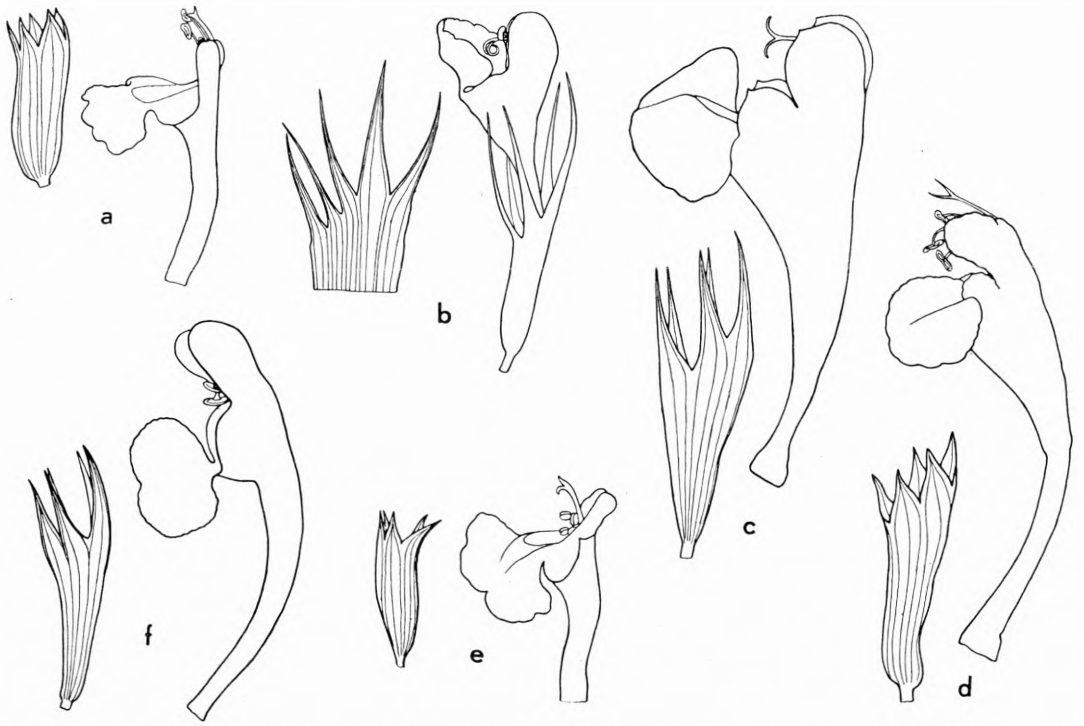

Fig. 14. a. *Nepeta cinereo-violacea* (K. 2438). b. *N. eriosphaera* (K. 3599). c. *N. leucocyanea* (E. 1273). d. *N. Mussinii* Henk. v. Donn. (zum Vergleich). e. *N. lavandulacea* (K. 3393). f. *N. oblanceolata* (E. 1739).

apice rotundata, margine crenata, florendi tempore plurima emarcida. Folia caulina media breviter (1—3 mm) petiolata usque subsessilia, e basi rotundata vel late cuneata oblongo-ovata usque oblongo-lanceolata, apice anguste rotundata vel acutiuscula, margine minutissime regulariter crenata, plerumque prope basin latissima, nervatura dense reticulata supra argute immersa, subtus paulum vel vix prominens, supra laxius subtus dense appresse velutino-tomentosa, indumento crassiuscula; folia superiora omnia sessilia, sensim decrescentia acutiora proportione angustiora. Folia floralia lanceolata valde diminuta. Inflorescentia laxiuscule appresse cinereo-tomentella; verticillastra ± 6, plurima ± remota. Cymae ± 3-florae, infimae interdum brevissime pedunculatae vel omnes ± sessiles. Bracteae ovato-lanceolatae acutae membranaceae tomentellae, quartam circiter partem calycis aequantes. Calyx ± 5 mm longus tubulosus, basi rotundatus, ore rectus, imprimis superne laete violaceo-suffusus, ad quartam circiter partem in dentes triangulares aequales acutos porrectos fissus. Corolla ± 9 mm longa, extus albo-puberula, tubo vix exserto, labio superiore brevi recto profunde inciso, labio inferiore deflexo ± 3 mm longo valde dilatato late rotundato, lateraliter constricto. Stamina posteriora labium superiorem superantia, anteriora eum aequantia. — Valde affinis *N. lavandulaceae* Rech. fil. & Köie, ab ea caulibus floriferis tenuioribus humilioribus, foliis minoribus,

verticillastris omnibus ± remotis ± sessilibus, calyce et corolla paulo longiore, staminibus posterioribus exsertis diversa.

C: Hauz-i-Mahiha, 2600 m, stream bed, (Köie 2438, Typus, hb. W., C.). — **E:** Sirotai, 9000 ft., field border, clumps, fl. lavender, spotted darker (Kz. 11940).

N. Clarkei Hook. fil. e. descr. — **Nuristan:** Zwischen Kotal-e-Agok und Waigel (N. 51/929). Pashki, 2500 m (E. 708, 1008).

N. daënensis Boiss. — **C:** Deh Kundi, 2700—3000 m, oberes Helmand-Tal (E. 1837, 1866). — **E:** Sirotai, 9000 ft., dry slope, fl. rose-lavender (Kz. 11962).

N. distans Royle, e. descr. — **NE:** Kash Distr., 8000 ft., along stream, large clumps, fl. blue-purple, mint scented (Kz. 12916). **Nuristan:** Pashki, 2600 m (E. 1316). Netshin, 2600 m (E. 1097), 3300 m (E. 1987). Zwischen Kotal-e-Agok und Waigel (N. 51/904).

Die vorliegenden Pflanzen stimmen mit der Originalbeschreibung und der Beschreibung in Hooker, Fl. Brit. Ind., in den wesentlichen Punkten überein. Vergleichsmaterial ist mir nicht zugänglich.

N. erecta (Royle) Benth. — **Nuristan:** Nishei, 2000 m (E. 790). Jshauda Pass (E. 2045).

Royle's Typus habe ich nicht gesehen. Die vorliegenden Exemplare variieren bezüglich der mehr oder minder stark schiefen Kelchmündung, Breite der Kelchzähne und Blütengröße, stimmen aber in den meisten Punkten mit indischen Exemplaren von Hooker gut überein.

Nepeta eriosphaera Rech. fil. & Köie, n. sp. — Fig. 15 und 14 b.

Sect. *Micranthae* Boiss. — Annua, 5—9 cm alta, simplex vel saepius prope basin ramis rectangulariter abeuntibus divaricatis arcuatis provisa, omnino dense longe molliter lanato-villosa. Caulis erectus paucinodus, internodiis 1.5—3 cm longis; rami basales saepe elongati, ad 5 cm longi, ut caulis primarius inflorescentiis sphaerico-capitatis densi- et multifloris 1.5—3 cm diametro terminati. Folia basalia minuta integra glabrescentia, longiuscule petiolata, orbiculato-spathulata, florendi tempore plerumque jam emarcida. Folia caulina increscentia, inferiora petiolo tenui 1—1.5 cm longo suffulta, lamina ad 1.5 cm longa et lata, basi truncata vel subcordata, infra medium latissima, apice rotundata, margine subintegra vel obsolete grosse crenata, utrinque villosa glabrescens, nervatura indistincta; folia caulina superiora inflorescentiam fulcrantia breviter petiolata vel sessilia, ad 2 cm longa et lata, orbiculata, supra ± glabrescentia, subtus dense villosa, indumento secus nervos densiore nitente. Bracteae subulatae herbaceae villoso-lanatae, calyces plerumque superantes. Calyx 9—10 mm longus, tubulosus, herbaceus, tenuiter nervosus, villosus et glanduloso-punctatus, ore paulum obliquus, dentibus anguste lanceolato-subulatis, longioribus calycis longitudinem subaequantibus; dentes calycini et bracteae purpureo-violaceo-suffusae. Corolla in sicco intense coerulea, calyce vix tertia parte longior, tubo in calyce incluso in limbum sensim ampliato, extus villosula et glanduloso-punctata. — Inter affines indumento longissimo mollissimo, inflorescentiis magnis capitatis dense longe villosis, calycis dentibus longis, corolla brevi insignis.

SW: Jija, 900 m, 7.IV.1949 (Köie 3599, Typus, hb. W., C.). — **SE:** Pirzada, 900 m (K. 3381).

Es scheint mir, daß manche annuelle *Nepeta*-Arten zu ausdauernden nähere verwandtschaftliche Beziehungen haben als untereinander, so etwa *N. eremophila* Bornm. zu den *Capituliferae*, *N. Straussii* Bornm. und *N. Pravitziana* Rech. fil. zu *Oxynepeta* etc. Verzweigung, Anlage der Infloreszens, Gestalt der Brakteen u. s. w. liefern entsprechende Hinweise. Bei einer Neugruppierung der *Nepeta*-Arten wären entweder innerhalb dieser Sektionen Parallelreihen ausdauernder und annueller Arten zu unterscheiden oder die annuellen Arten wären zu besonderen, den einzelnen aus ausdauernden Arten bestehenden Sektionen entsprechenden Sektionen zu vereinigen.

Fig. 15. *Nepeta eriosphaera* (K. 3599). $^2/_3$.

N. floccosa Benth. s. l. — **C:** Panjao, ca. 3000 m (K. 2705). — **NE:** Sanglech, 11500 ft., dry slope (Kz. 12605).

N. glutinosa Benth. — **NE:** Kash Distr., 10000 ft., in clumps, fl. blue-purple (Kz. 13015). Minjan, 3700 m (E. 1435).

Nepeta heterotricha Rech. fil., n. sp. — Fig. 16.

Sect. *Macrostegiae* Boiss. — Suffrutex caespitosus multicaulis. Caules floriferi 30—45 cm alti, ascendentes vel erecti, tenues fragiles flexuosi, obtuse quadranguli, in parte inferiore paucifoliati, omnino appressissime albido-tomentosi, prope basin ramulos numerosos steriles breves tenues minute foliatos emittentes. Ramuli steriles cum foliis longe patule fere gossypino-villoso-lanati. Folia petiolis tenuibus 3—9 mm longis suffulta, minutissima, 3—7 mm longa, 2.5—4 mm lata, e basi truncata vel late cuneata ovata usque oblonga, apice rotundata, margine subinciso-crenulata, nervis pennato-reticulatis supra tenuiter impressis subtus prominentibus. Folia ramorum floriferorum similia sed brevius petiolata et indumento appresse tomentoso praedita. Verticillastra 5—10, plerumque omnia ± remota, multiflora, inferiora sine floribus ad 15 mm diametro, cymis in verticillastris inferioribus quidem breviter pedunculatis. Bracteae ad 2.5 mm longae, ovato-lanceolatae, apice sensim breviter acuminatae, albido-membranaceae, nervo unico subcarinato percursae, tomentosae, glabrescentes. Calyx 4—5 mm longus, tubulosus, ore leviter obliquo, membranaceus, nervis approximatis tenuiter sed distincte prominentibus, lanato-tomentosus; dentes calycini 1.5—2 mm longi, porrecti, anguste lanceolati, valde acuti, longe subplumoso-villosi. Corolla ignota. Nux 1.2 mm longa, 0.6 mm lata, pallide brunea, sublaevis. — Differt a *N. juncea* Benth.: indumento in ramulis sterilibus longe patulo-villoso-lanato, in caulibus floriferis appressissime tomentoso, foliis omnibus minutissimis, bracteis brevibus saepe vix dimidium calycem aequantibus.

C: Polat, 9000 ft., on dry slope in clumps, 18 inches high, flowers lavender, 10.IX.1939 (Koelz 13945, hb. W., BPI.).

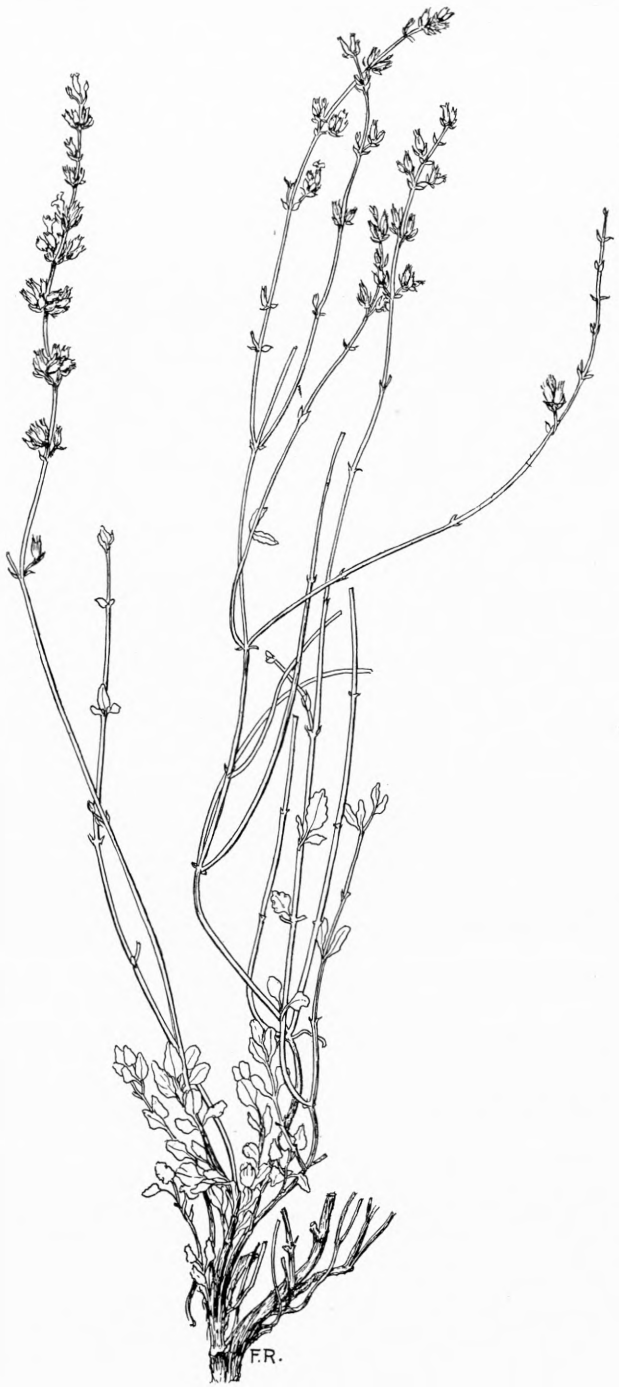

Fig. 16. *Nepeta heterotricha* (Kz. 13945). $^{3}/_{5}$.

Fig. 17. *Nepeta Honigbergeri* (Chaworth-Musters s. n., Habitus Honigberger s. n.). $^{1}/_{2}$.

N. Honigbergeri Rech. fil., Ann. Nat. Mus. Wien 51: 420 (1941). — Fig. 17. — **E:** Kabul (HONIGBERGER, Typus, hb. W.). Paghman, 2100 m (K. 2303). Paghman, 8000—9000 ft. (CHAWORTH-MUSTERS, hb. BM.). — **C:** Hauz-i-Mahiha, 2600 m (K. 3391). — **NE:** Gulbahar (N. 50/706).

Affinis *N. oxyodontae* Boiss. quae a *N. Honigbergeri* indumento brevi griseo foliorum multo minorum, cymis remotis paucifloris, calycibus ad summum 7 mm longis, dentibus calycinis 2—2.5 mm tantum longis differt.

N. juncea Benth. — **E:** Kabul, 1700 m (K. 4014). Pandscheschan bei Kabul (N. 50/705). Chandau, 8000 ft., dry ground, clumps, fl. lavender, spotted darker, 3 ft. high (Kz. 11762).

Nepeta Koelzii Rech. fil., n. sp. — Fig. 18.

Sect. *Spicatae* Boiss. — Perennis, basi ut videtur lignescens. Caulis 60—80 cm altus, erectus vel ascendens, validus, obtuse quadrangulus, internodiis mediis 3—5 cm longis, subsimplex vel in parte superiore breviter stricte ramosus, atropurpureo-suffusus, papillis minutissimis scabridus. Folia inferiora jam emarcida; media 4—5 cm longa, 4—8 mm lata, anguste lanceolata, basi in petiolum ad 5 mm longum sensim cuneato-attenuata, apicem acutam versus subaequaliter attenuata, margine remote argute serrata, nervis partim subparallelis subtus crasse prominentibus supra immersis, in sicco crasse membranacea subcanescenti-viridia, imprimis subtus papillosa et glanduloso-punctata, ex axillis ramulos abbreviatos paucifoliatos proferentia. Folia superiora decrescentia, angustiora, minus distincte serrata usque subintegra. Verticillastra 7—11, multiflora, infima remota, media et superiora in spicastrum densum conferta. Bracteae 5—6 mm longae, anguste subulatae, tenuiter membranaceae, pilis longis eglandulosis et brevibus glanduliferis obsitae. Calyx ore subrecto, tubus membranaceus tenuiter elevate nervosus, ± 5 mm longus, breviter glanduloso-papillosus, pilis longis articulatis eglandulosis crispis imprimis in parte superiore immixtis; dentes calycini subaequales, ± 4 mm longi, e basi dilatata abrupte in aristam subulatam attenuati, breviter glanduloso-papillosi et longe eglandulosociliati. Corolla in vivo coerulea-purpurea (e collectore), in sicco valde expallens, tubo angusto curvato e calyce exserto. Nuculae bruneae nitidae. — *N. Moricandiae* Bge. mihi e descriptione tantum notae affinis videtur, sed ab ea caule foliisque papilloso-scabridis, foliis angustioribus, bracteis brevibus calycem nunquam aequantibus, corollae tubo exserto diversa.

NE: Daraim, 8500 ft., clumps, 3 ft. high, flowers blue-purple, 9.VIII.1937 (KOELZ 13039, Typus, hb. W., BPI.). Pahin Shahr, 8000 ft., flowers lavender, spotted darker, 15.VII.1937 (Kz. 12419, hb. W., BPI.).

N. laevigata (Don) Hand.-Mzt. (Syn. *N. spicata* Benth.). — **NE:** Ruka, 1800 m (K. 2949). — **Nuristan:** Papruk, 2350 m (E. 1059). Aschpi-Pass (N. 51/1040).

Die Art ist von Südwest-China über die Südabdachung des Himalaya und große Teile Indiens bis Afghanistan verbreitet und variiert in mehreren Punkten. Das mir augenblicklich zugängliche Material ist nicht ausreichend zur Entscheidung, ob eine geographische Differenzierung vorhanden ist. Die Behaarung der Kelche und Brakteen ist im allgemeinen bei den

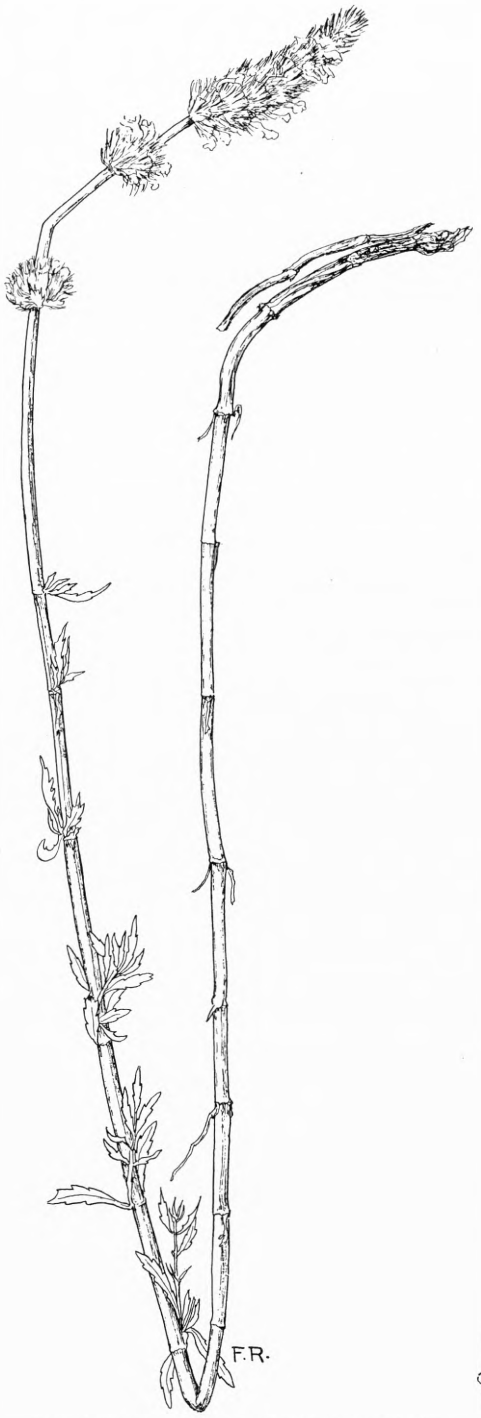

Fig. 18. *Nepeta Koelzii* (Kz. 13039). $^1/_2$.

Fig. 19. *Nepeta lavandulacea* (K. 3393). $^2/_3$.

afghanischen Exemplaren etwas dichter und mehr seidenartig, in einzelnen Fällen sind auch die Kelchzähne etwas stärker borstenartig verlängert, auch ist die Serratur der Blätter im allgemeinen schärfer und die Oberlippe der Korolle etwas schmäler als an chinesischen Exemplaren. Aber auch die indischen Exemplare variieren stark in der Länge und Breite der Brakteen, Länge der Kelchzähne und Schärfe der Blattserratur.

Nepeta lavandulacea Rech. fil. & Köie, n. sp. — Fig. 19 und 14 e.

Sect. *Macrostegiae* Boiss. — Suffrutescens pluricaulis. Caules floriferi 30—40 cm alti erecti vel ascendentes, internodiis mediis 4—5 cm longis, simplices vel inferne breviter tenuiter pauciramosi, omnino tenuiter appresse velutino-tomentelli cinerascentes. Folia inferiora petiolo 10—14 mm longo tenui suffulta, lamina ad 15 mm longa, 10 mm lata, e basi truncata ovata vel oblongo-ovata, apice rotundata, florendi tempore plerumque ± marcescentia. Folia caulina media breviter (3—6 mm) petiolata, e basi truncata vel subcordata vel subsinuato-rotundata oblonga, apice rotundata, margine regulariter minute crenata, plerumque prope basin latissima, nervatura dense reticulata supra argute tenuiter immersa, subtus paulum vel indistincte prominens, utrinque dense appresse velutino-tomentosa, indumento crassiuscula; folia superiora sensim decrescentia, brevius petiolata usque subsessilia, proportione angustiora, acutiora. Folia floralia valde diminuta lanceolata acuta subintegra. Inflorescentia omnino breviter appresse velutino-tomentella cinerascens; Verticillastra ± 10, inferiora 2—4 remota, media et superiora ± approximata. Cymae multiflorae, inferiores breviter (2—3 mm) pedunculatae, superiores brevius pedunculatae usque subsessiles. Bracteae minutissimae lanceolatae tomentellae acutae membranaceae, nervo mediano tenuissimo interdum violascente percursae, quartam vel ad summum tertiam partem calycis aequantes. Calyx ± 4.5 mm longus, tubulosus basi breviter attenuatus, ore rectus, vix ad quartam partem in dentes lanceolato-triangulares acutos subaequales fissus. Corolla ca. 7 mm longa extus albo-puberula, tubo breviter exserto, labio superiore recto leviter inciso ± 1.5 mm longo, labio inferiore ca. 2.5 mm longo deflexo valde dilatato late rotundato antice inciso, prope faucem albido-barbulato, in sicco intense coeruleo-maculato et -punctato. Stamina omnia quam labium superius breviora. — Bracteis membranaceis latiusculis ad interim inter *Macrostegias* inseranda, sed affinitas propter bracteas brevissimas adhuc dubiosa, forsan cum valde affini *N. cinereo-violacea* Rech. fil. & Köie sectionem propriam efficiens.

C: Farakulum, 2800 m, 21.VII.1948 (Köie 3393, Typus, hb. W., C.). Shibar, 2500 m, 15.VIII.1948 (K. 2797, hb. W., C.). Shibar Pass, 10000 ft., dry slope, clumps, flowers lavender, scented, 30.VI.1937 (Kz. 12159, hb. W., BPI.).

Nepeta leucocyanea Rech. fil. & Köie, n. sp. — Fig. 20 und 14 c.

Sect. *Stenostegiae* Boiss. — Caespitoso-suffruticosa, pumila, appresse floccoso-lanata. Caules floriferi 5—10 cm longi, deflexi vel ascendentes, inferne ramulosi, internodiis mediis 1—2(—3) cm longis. Foliorum paria infima in squamas lanceolatas membranaceas bruneo-purpurascentes mutata. Folia caulina brevissime petiolata basi sinuato-truncata usque late cuneata, ambitu late ovato-triangularia vel ovata,

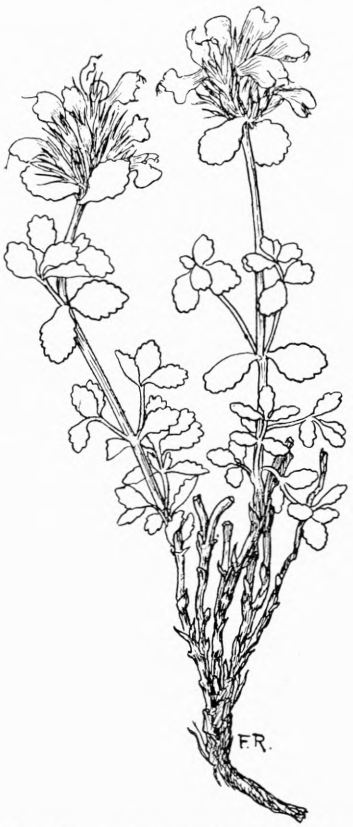

Fig. 20. *Nepeta leucocyanea* (K. 2622). $^3/_4$.

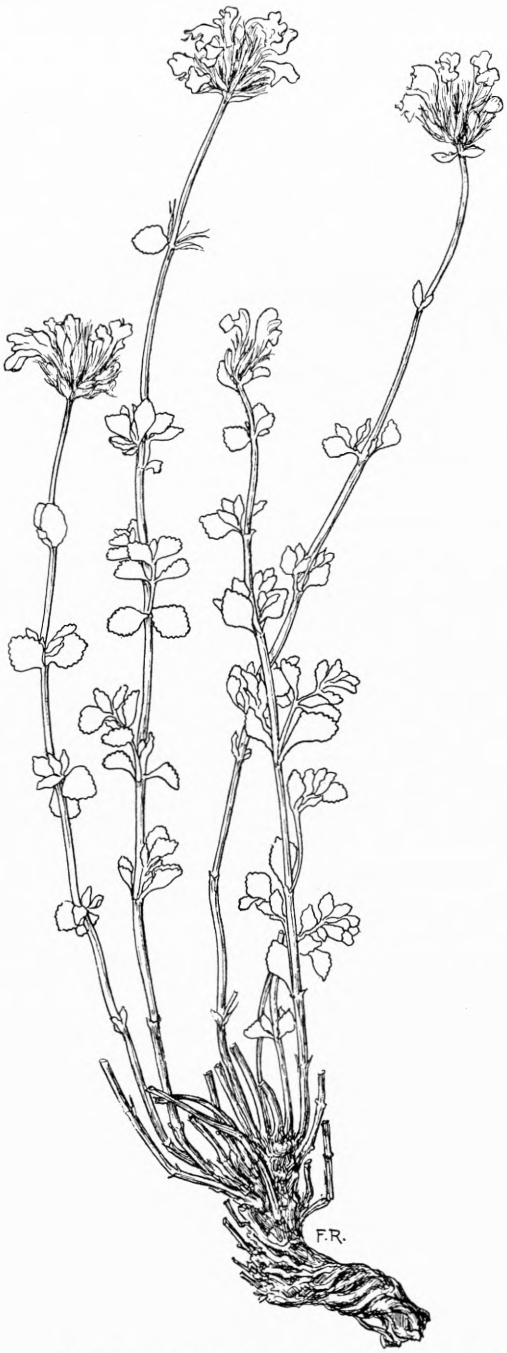

Fig. 21. *Nepeta minjanensis* (Kz. 12664). $^3/_5$.

vel orbiculata vel subflabellata, anguste regulariter crenata, apice rotundata, indumento appresse floccoso-lanato albida crassiuscula, nervatura tenui reticulato-rugulosa. Folia summa ab inferioribus vix diversa inflorescentiam fulcrantia. Inflorescentia multiflora capitata. Bracteae numerosae anguste lineari-subulatae, herbaceae, quam calyces subbreviores usque sublongiores, lanato-villosae, Calyx ± 9 mm longus, ore obliquo, tenuiter albido-membranaceus, nervis tenuibus viridibus, laxe villosus, ad tertiam circiter partem in dentes anguste lanceolato-subulatos fissus. Corolla in sicco intense coeruleo-violacea, 16—18 mm longa, subglabra, tubo angusto curvato superne subito valde ampliato. Nuculae ignotae. — Differt a *N. Mussinii* Henk. habitu pumilo, foliis latitudine non vel vix longioribus appresse albo-floccoso-lanatis anguste crenatis, bracteis lineari-subulatis, calyce ad tertiam partem in dentes anguste lanceolato-subulatos fisso, corollae labio superiore quam inferius breviore, staminibus inclusis.

C: Koh-i-Baba, 3900 m, snow bed, 24.VII.1948 (Köie 2622, Typus, hb. W., C.). — **NE:** Parun — Minjan-Pass, 23.VII.1948 (E. 1273, hb. W., C.).

N. longibracteata Benth. — **NE:** Sanglech, 13000 ft., alpine meadow among rocks, fl. purple-blue, plant scented (Kz. 12637).

Nepeta minjanensis Rech. fil., n. sp. — Fig. 21.

Sect. *Capituliferae* Boiss. — Suffruticoso-caespitosa, basi crasse lignescens. Caules floriferi numerosi 20—25 cm longi, subsimplices quadranguli, internodiis mediis 3—4 cm longis, omnino appresse albo-tomentelli, imprimis inferne paulum glabrescentes. Folia breviter (1—4 mm) petiolata, e basi late vel anguste cuneata ovata vel rhombico-ovata, crenulata obtusiuscula, indumento brevi tomentello utrinque canescentia crassiuscula, minuta, 6—11 mm longa, 5—8 mm lata, superiora subsessilia, longitudine aequilata vel sublatiora, rhombico-flabellata, nervatura saepe indistincte reticulato-rugosa, omnia quam internodia semper multoties breviora, inferiora ex axillis ramulos tenues abbreviatos parvifoliatos proferentia. Flores in capitula densa multiflora depresso-globosa terminalia congesta. Bracteae subulatae herbaceae numerosae villoso-tomentellae, quam calyces plerumque paulo breviores. Calyx 8—10 mm longus, ore obliquus, tenuiter albido-membranaceus, nervis tenuibus viridibus, laxe villosus, ad tertiam partem vel paulo ultra bilabiatus, dentibus e basi paulo dilatata longissime tenuissime subulatis. Corolla in vivo coeruleo-purpurea (e collectore), in sicco expallens, extus villosula glabrescens, calyce circiter duplo longior, tubo tenui curvato, antheris exsertis. — A ceteris speciebus sectionis indumento brevi, foliis minutis, calycis forma ac indumento diversa.

NE: Minjan Pass, 12000 ft., clumps, flowers blue-purple, 26.VII.1937 (Koelz 12664, hb. W., PBI.).

Nepeta oblanceolata Rech. fil. & Edelberg, n. sp. — Fig. 22 und 14 f.

Sect. *Spicatae* Benth. — Suffruticoso-caespitosa. Caules floriferi ca. 25 cm longi, e basi decumbente valde arcuato-ascendentes simplices, internodiis numerosis brevibus inferioribus vix 1 cm, mediis ± 1.5 cm longis, superioribus sensim paulo longioribus, pilis brevibus patulis vel ± retrorsis papilloso-puberuli et glandulis

Fig. 22. *Nepeta oblanceolata* (E. 1739). $^3/_4$.

breviter stipitatis obsiti. Folia omnia in sicco crassiuscule membranacea laete viridia, nervis secundariis valde antrorsis non numerosis parum ramulosis supra paulum impressis subtus leviter prominentibus percursa, imprimis margine et subtus secus costam medianam pilis brevibus papilloso-scabrida et subtus inter nervos copiose glanduloso-punctata, margine apicem versus remote breviter serrato-crenata, omnia ex axillis fasciculos foliorum linearium vel anguste lanceolatorum proferentia, omnia basi sensim in petiolum longiusculum (± 5 mm) attenuata; basalia apice rotundata, 5—7 mm lata, superiora sensim paulo angustiora, apice acuta, summa linearia valde acuta, ad 1.5 mm lata. Verticillastra numerosa contigua, in spicastrum 4—5 cm longum, floribus exclusis ad 12 mm latum congesta. Bracteae subulatae ± $^2/_3$ calycis longitudinis aequantes. Flores plurimi brevissime tenuiter pedicellati. Calyx ± 7 mm longus, anguste tubulosus, basi valde attenuatus, superne sensim paulo ampliatus, ore paulo obliquo, ad $^2/_5$ vel fere ad medium in dentes lineari-subulatos breviter irregulariter plurimum glanduloso-ciliatos divisus, tenuiter herbaceo-membranaceus, omnino breviter glanduloso-papillosus. Corolla ad 12 mm longa, in sicco albida brunescens, tubo tenui valde curvato e calyce longe exserto; labium superius ca. 4 mm longum leviter curvatum, antice profunde incisum; labium inferius ad 3 mm longum ± deflexum. Stamina inclusa, thecae atrocyaneae. Nux ignota. — Differt a *N. lineari* Benth. habitu humili caespitoso-suffruticoso, caulibus floriferis valde arcuatis, internodiis valde abbreviatis numerosis, foliis oblanceolatis antice crenato-serratis, omnibus in petiolum longum sensim attenuatis, indumento regionis inflorescentiae sparso breviter glandulifero, dentibus calycinis breviter glanduloso-ciliatis nec longe plumosis.

Nuristan: Derin, 11.VII.1949 (Edelberg 1739, hb. W., C.).

N. persica Boiss. — **SW:** Herat, 1400 m. (K 2272).

N. podostachys Benth. — **C:** Farakulum, 2800 m (K. 2562). Sabz Pass, 10000 ft., spring meadow (Kz. 13820). Unaipass (N. 51/534 & 542). — **NE:** Minjan, 2600 m (E. 1603). — **E:** Paghman, 8000—9000 ft. (Chaworth-Musters). Paghman, 2200 m (K. 2312). Mittleres Paghmantal (N. 50/695). Sirotai, 9000 ft., in fields (Kz. 11925).

Die unter diesem Namen im weiteren Sinn zusammengefassten Pflanzen variieren in mehreren Hinsichten beträchtlich, ohne daß ein Parallelgehen bestimmter Merkmale erkennbar wäre. So hat z. B. Edelberg no. 1603 stark verholzende Basis, niedrigen Wuchs, kleinere, besonders scharf gesägte Blätter, relativ langen Kelchtubus und relativ breit lanzettliche, bis drei Millimeter Breite erreichende Brakteen. Köie no. 2562 hat weniger stark verholzende Basis und kürzeren Kelchtubus, ist sonst der vorigen ähnlich. Koelz no. 11925 ist kaum verholzend, hochwüchsig und hat schmal pfriemliche, meist 1 mm, selten bis 2 mm breite Brakteen. Koelz no. 13820 hat schlaffen Wuchs, stumpf, fast gekerbt-gesägte Blätter und schmal pfriemliche Brakteen.

N. Prainii Duthie. — **E:** Kurram valley, slopes of Safed Kuh-range (Hare s. n., Isotypus in hb. Delessert).

N. pubescens Benth. (e descr.). — **C:** Hauz-i-Mahiha, 2500 m, damp ground (K. 2354).

N. raphanorhiza Benth. — **NE:** Daulatash, 7000 ft., on damp slope, 6 in. high,

fl. blue-purple, bulbous root (Kz. 11652). Forajghan Pass, 10000 ft., damp ground (Kz. 11727). — **Nuristan:** Nishei, 2500 m (E. 777). Chetras, 2800 m (E. 837). Pashki, 2300—3000 m (E. 571, 755, 937). Vama, 1400 m (E. 362, 416, 461).

Auch diese Art variiert erheblich in der Höhe des Wuchses, Form und Umriß der Blätter und im Indument. Koelz no. 11727 hat an Stengel und Blättern winzige bald verschwindende Papillen. Edelberg no. 937 und Koelz no. 11652 haben längeres, abstehendes Indument. Auch die Korollengröße variiert einigermaßen.

N. satureioides Boiss. — **NW:** Nördl. von Herat, 1100 m (K. 4057). — **E:** Kord-Kabul, Gul-Tara (N. 51/360).

N. Sewertzovii Regel. — **NW:** Murghab—Kala Nau, 700 m (K. 3526). Kishlik, 700 m (K. s. n.). — **SW:** Jija, 900 m (K. 4058). — **NE:** Kail, 8000 ft., dry slope, fl. blue-purple (Kz. 11682). — **NE:** Gulbahar (N. 50/709). — **E:** Kabul, Aliabad (N. 51/94). Tscharikar (N. 50/710).

Regel in Acta Hort. Petrop. 6: 360 (1880) erwähnt in seiner Beschreibung der *N. Sewertzowii* nicht, ob die Kelchmündung gerade oder schief ist. Eine bessere Beschreibung und gute Abbildung der Art findet sich bei Aitchison & Hemsley in Trans. Linn. Soc. 2. ser. 3: 96 (1888). Tatsächlich ist die Kelchmündung bei dieser Art gerade, nur selten ganz schwach schräg. Dadurch unterscheidet sie sich von der habituell ähnlichen *N. micrantha* Bge., die immer eine deutlich schräge Kelchmündung hat. — Sintenis no. 811 aus Aschabad in Turkmenien ist ebenfalls *N. Sewertzowii*.

Nepeta xylorhiza Rech. fil., n. sp. Fig. 23.

Sect. *Macrostegiae* Boiss. — Suffrutex crasse lignosus caespites magnos densos efficiens. Rami steriles numerosi filiformes ± abbreviati densiuscule foliati. Caules floriferi 8—15 cm longi, erecti vel ascendentes, tenues simplices, internodiis ad 4 cm longis, subaphylli vel minute paucifoliati, subacute quadranguli, appresse canescenti-tomentosi. Folia ramorum sterilium petiolo tenui ± 1 cm longo suffulta; lamina parva, 8—12 mm longa, 7—9 mm lata, ambitu ovato- usque oblongo-tringularis, basi sinuato-truncata vel subcordata, apice rotundata, margine minutissime regulariter crenulata, nervatura indistincte pennata et densissime reticulato-rugulosa, utrinque dense appresse canescenti-tomentosa crassiuscula. Verticillastra 5—8, multiflora, infima ± remota, media et superiora ± approximata, floribus exclusis 7—9 mm diametro. Bracteae membranaceae ovato-lanceolatae acutae numerosae, maiores 4(—5) mm longae, tomentellae, ± distincte purpurascenti-plurinervulosae. Calyx ± 5 mm longus, tubulosus, purpurascens, lanato-tomentellus, ore leviter obliquo; dentes subinaequales, longiores e basi dilatata subito subulato-attenuati lanato-villosi vix 1 mm longi. Corolla calyce circiter duplo longior, roseo-lavandulacea atrius maculata (e collectore), tubo curvato, extus lanatula et glanduloso-punctata, labiis brevibus subaequilongis, superiore profunde inciso, inferiore trilobo. Nuculae (submaturae) bruneae, laeves, ± 1.1 mm longae. — Inter affines basi crasse lignosa, habitu dense caespitoso, foliis minutis inferioribus quidem longe petiolatis, caulibus floriferis tenuibus, glomerulis bracteis calycibus floribus minutis, dentibus calycinis brevissimis insignis.

Fig. 23. *Nepeta xylorhiza* (Kz. 14125). $^3/_4$.

NW: Burchao Pass, 9000 ft., dry slope, shrub one feet high, flowers rose-lavender, dotted darker, plant scented, 12.X.1939 (KOELZ 14125, Typus, hb. W., BPI.). — **E:** Kabul, 7000 ft., 11.VIII.1939 (Kz. 13486, hb. W., BPI.).

Die Nummer 13486 weicht vom Typus durch etwas höhere blühende Sprosse mit zahlreicheren Stengelblättern ab; der Wuchs ist ebenso zart und die Blätter sind ebenso klein wie beim Typus.

Dracocephalum Aitchisonii Rech. fil., n. sp. — Fig. 24.

Sect. *Buguldea* Benth. — Basi lignescens ramis longe repentibus. Rami floriferi ± 10 mm longi ascendentes simplices, internodiis mediis 1.5—2 cm longis, quadranguli, brunescentes, breviter retrorso-puberuli. Folia ad 20 mm longa, ad 14 mm lata, inferiora breviter petiolata, superiora ± increscentia, sessilia, omnia ad medium fere inciso-lobata, lobis utrinque 4—5, apice rotundatis sinibus angustis acutis separatis, in sicco membranacea viridia imprimis subtus subglaucescentia, subglabra vel subtus secus nervos ± pubescenti-scabra; folia summa inflorescentiam capitatam densam fulcrantia. Bracteae quam calyces breviores, e basi anguste cuneata obovatae vel obovato-spathulatae, utrinque inciso-serratae, dentibus angustis antrorsis et apice in aristas ± 5 mm longas attenuatis. Calyx ± 15 mm longus, rigidule herbaceo-membranaceus, leviter curvatus. Tubus anguste tubulosus ± 6 mm longus; labium superius integrum, ± 7 mm longum, anguste ovatum, subito in aristam tenuem fere 2 mm longam attenuatum; labii inferioris dentes (4—)5 mm longi lanceolati, sensim in aristam ca. 1.5 mm longam excurrentes. Corolla in vivo coerulea fuisse videtur, in sicco brunescens, extus hirsuto-puberula, labio superiore recto ± 4 mm longo, antice truncato et ± emarginato, labio inferiore 5—6 mm longo deflexo pronfunde trilobo. Nuculae ignotae. — Differt a *D. noduloso* Rupr. caulibus floriferis brevibus, foliis profundius lobatis subglaucescentibus, in-

Fig. 24. *Dracocephalum Aitchisonii* (Aitchison 573). $^1/_2$.

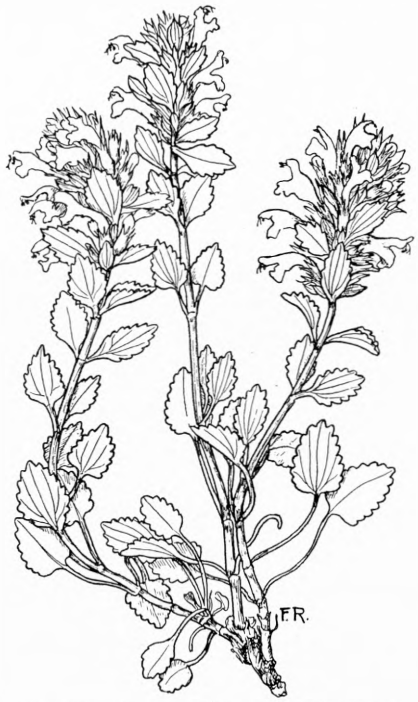

Fig. 25. *Dracocephalum nuristanicum* (E. 1672). $^2/_3$.

florescentia capitato-congesta, bracteis et dentibus calycinis longius aristatis, calycis labio superiore apice minus late rotundato.

E: Kurrum Valley, Biankhel, Sikaram and Seritagh, 9000—12000 ft., VI.—VII. (Aitchison 573, Typus, hb. Boiss. sub nom. affine *D. origanoidi*).

Dracocephalum nuristanicum Rech. fil. & Edelberg, n. sp. — Fig. 25.

Sect. *Idiodracontes* Briq. — Basi leviter induratum, caespites parvos formans. Caules floriferi (7—)12—14 cm longi, crassiusculi, ascendenti-erecti, interdum leviter flexuosi, simplices, internodiis ± 1.5 cm longis, tota longitudine regulariter foliati, herbacei quadranguli, brevissime retrorse puberuli. Folia omnia in sicco tenuiter membranacea, supra atroviridia subtus pallidiora, nervis tenuibus subflabellato-parallelis parum ramulosis, apice rotundata, margine anguste basin versus profundius crenata; inferiora petiolo longo (ad 2 cm) tenui suffulta, ovato-triangularia basi cordata, ad 12 mm longa, ad 8 mm lata, subtus secus nervos papillosa ceterum glabra; superiora sensim brevius petiolata et decrescentia, basi sinuato-truncata vel ± late cuneata, imprimis ad petiolum et subtus secus nervos puberula ceterum ± glabrescentia; summa verticillastra infima fulcrantia quam flores evidenter breviora, e basi cuneata ovato-lanceolata acuta serrata. Verticillastra 7—10, in spicastrum ± abbreviatum saepe subcapitatum congesta. Bracteae ovatae usque ovato-lanceolatae, $^1/_2$ usque $^2/_3$ calycis longitudinis aequantes, basi subrotundatae vel

late usque anguste cuneatae, apice acutae mucronulatae, margine serrulatae usque subintegrae, herbaceae, antice ± violaceo-suffusae, omnino tenuissime pennato-reticulato-nervosae. Calyx ± 8 mm longus, tenuissime tubulosus, herbaceus, laxiuscule villoso-hirsutus, labio superiore ± 3.5 mm longo, 2—2.5 mm lato, mucronulato, inferiore in dentes 4 anguste subulatos ± 3.5 mm longos fisso. Corolla 12—14 mm longa valde curvata, in vivo ut videtur coeruleo-violacea, extus puberula. Stigma profunde bilobum exsertum. Stamina exserta thecis atroviolaceis. — Differt a *D. nutante* L. habitu humili, inflorescentia subcapitato-congesta, calycibus minoribus herbaceis, floribus minoribus, foliis minutis mediis et superioribus basi truncatis vel cuneatis.

Nuristan: Elasoon, 7.VIII.1949 (Edelberg 1672, Typus, hb. W., C.). Ibidem (E. 1713, hb. C.). Chetras, 30.V.1948 (E. 835, hb. C.). Parun — Kamdesh, 19.VI. 1948 (E. 1091, hb. C.). Urura Pass, 3000 m, in der Umgebung der Alm ober Kuschtes (N. 51/607).

Lallemantia Royleana (Wall.) Benth. — **NW:** Kishlik, 700 m (K. 3982). N. of Herat, 900—1100 m (K. 4056). — **SW:** Jija, 900 m (K. 3567, 3568, 4055). — **NW:** Minjan (E. 1498). Pandschirtal, Basarak (N. 50/713). — **Nuristan**, Gusalek, 1100—1200 m (E. 1501, 1562). — **E:** Begram, near Chariker, 5000 ft. (Codrington, hb. BM.). Tscharikar, (N. 50/716). Kabul, südexponierte Berglehne zwischen der Altstadt und Guzar Gah (N. 51/60). Kabul, Fels bei Aliabad (N. 51/108). Kabul (N. 50/719). Chandau, 8000 ft., dry ground (Kz. 11763). Pulalam, 7000 ft., in desert (Kz. 11861).

Hymenocrater argutidens Rech. fil., Fedde Rep. 48: 160, Taf. 104, Fig. 1 (1940). — **NW:** Chisht, 1600 m (K. 3618). — **E:** Bagrami, Nedjerau-Tal, am Bach (N. 51/325).

H. elegans Bge. (ad interim). — **E:** Nozi, 9000 ft., dry slope, clumps, fl. purple (Kz. 12030).

Die Bestimmung sämtlicher *Hymenocrater*-Arten ist als provisorisch zu betrachten. Die Gattung ist dringend einer Revision bedürftig, welche aber nur bei Vergleich der Bunge'schen Typen möglich ist. — Die vorliegenden Exemplare unterscheiden sich von den persischen als *H. elegans* bestimmten u. a. durch spitzere Kelchzähne, die nur am Rand rotviolett überlaufen sind.

H. sessilifolius Benth. — **NW:** Safedsang, 10000 ft., dry slope (Kz. 13995). — **C:** Deh Kundi, 2700 m (E. 1910). Bamian valleys (Codrington, hb. BM.). Hauz-i-Mahiha, 2500 m (K. 2375, 3389). Panjao, 2700 m (K. 2694).

Prunella vulgaris L. — **Nuristan:** Aschpi Pass (N. 51/1047). Shtive, 2600 m (E. 1308). — **E:** Begram near Charikar, 5000 ft. (Codrington 60 a, hb. BM.). Tagau, 6000 ft., damp ground (Kz. 11797). Unteres Paghmantal (N. 50/699).

Eremostachys acaulis Beck ex Rech. fil., Fedde Rep. 48: 161, Taf. 103, Fig. 1 (1940). — **C:** Koh-i-Baba, 3100 m (K. 2654). — **E:** Kabul (Honigberger s. n., Typus, hb. W.). Paghman, 8000—9000 ft. (Chaworth-Musters, hb. BM.). Sirotai, 9000 ft., dry slope (Kz. 11964).

E. laciniatae Bge. affinis videtur sed caule omnino deficiente vel brevissimo insignis. Folia divisione valde variabilia.

Eremostachys bamianica Rech. fil., n. sp. — Fig. 26 und 27 a.

Grex *Laciniatae* Pop. — Partes subterraneae ignotae, collum gossypino-lanatum. Caulis 20—40 cm altus, simplex, internodiis paucis elongatis, inflorescentia quartam partem usque dimidium caulis occupante, lanato-villosus demum valde glabrescens, brunescens vel purpurascens. Folia basalia non numerosa parva erecta; petiolus ± 5 cm longus, lanato-villosus; lamina 5—7 cm longa, ± 2 cm lata, ambitu lanceolata, infra medium latissima, apice acuta, in sicco crasse membranacea, supra glabrescens, subtus villoso-lanata, nervatura laxe reticulata supra immersa subtus prominente, irregulariter inciso-lobata, lobis angustis ± acutis antrorsis, inferioribus ultra 1 cm longis, superioribus sensim brevioribus dentiformibus. Foliorum caulinorum par unicum plerumque evolutum; lamina breviter petiolata anguste lanceolata acuta internodia aequans, irregulariter sinuato-serrato-lobata. Folia verticillastra fulcrantia inferiora caulinis similia verticillastra superantia, sensim breviora, superiora basi dilatata minus distincte serrato-lobata usque subintegra, densius lanato-villosa. Verticillastra 3—6 multiflora sessilia, inferiora valde remota, superiora ± approximata usque contigua. Bracteae numerosae lineari-subulatae rigidae subpungentes, $^1/_3(-^2/_3)$ calycis longitudinis aequantes, dense longe lanato-villosae. Calyx 20—25 mm longus, rigide coriaceo-membranaceus, 10-nervius, nervis indumento denso villoso-lanato et breviter glandulifero ± occultis saepe indistinctis. Dentes calycini 5, in mucrones inaequales subpungentes ± 2 mm longos excurrentes, late subcontinue alati, alis paulum usque vix incisis. Corolla calyce plerumque plus quam duplo longior, in sicco brunescens; labium superius ± 16 mm longum, depresso-galeatum, extus laxe villosum et breviter glandulosum, intus longe strigoso-barbatum; labium inferius vix brevius, ad 2 cm latum, late trilobum, lobo mediano laterales tegente, omnibus antice late rotundatis vel fere truncatis. — Differt ab *E. cabulica* Beck ex Rech. fil. imprimis bracteis lineari-subulatis calyce tertia parte usque dimidio brevioribus (nec late elliptico-lanceolatis calycem subaequantibus), calycibus floribusque maioribus, indumento densiore longiore magis persistente, foliis verticillastra infima fulcrantibus

Fig. 26. *Eremostachys bamianica* (Codrington s. n.). $^2/_5$.

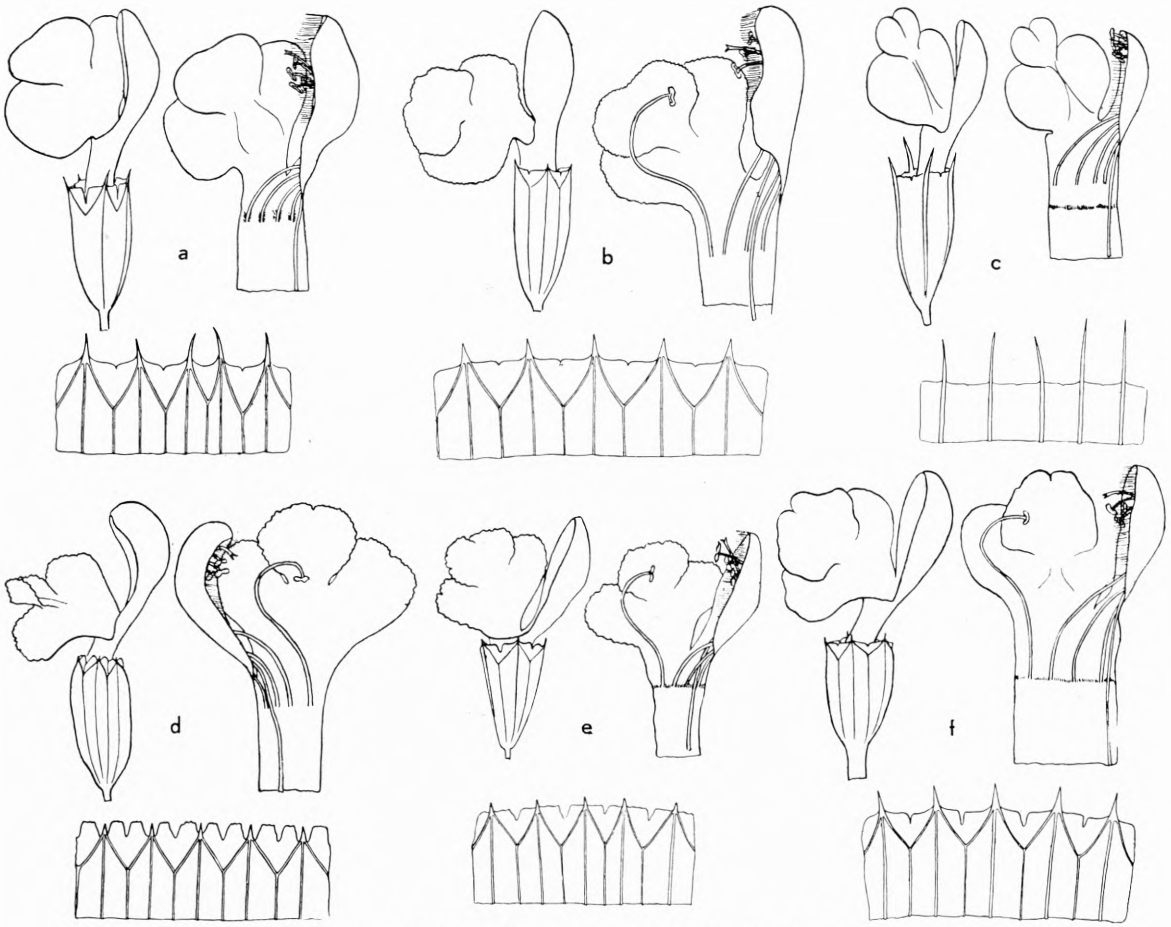

Fig. 27. a. *Eremostacys bamianica* (CODRINGTON s. n.). b. *E. Edelbergii* (E. 947). c. *E. gymnoclada* (K. 3861). d. *E. sanglechensis* (Kz. 12640). e-f. *E. vacillans* (e Kz. 11698, f CHAWORTH-MUSTERS s. n.).

multo angustioribus et longioribus. — *E. cabulica* et *E. bamianica* ambae foliis pro sectione parum divisis excellunt.

C: Bamian valley, 8000 ft., 2.VII.1940 (CODRINGTON s. n., Typus, hb. BM.).

E. cabulica Beck ex Rech. fil. Fedde Rep. 48: 161, Taf. 103, Fig. 2 (1940). **E:** Kabul (HONIGBERGER s. n., hb. W.). Kabul, 6000 ft., dry slope, 3 ft. high, fl. gold (Kz. 11415).

Affinitas adhuc subdubia, dentibus calycinis ovatis subrecurvis non alatis nec transversaliter truncatis insignis.

Eremostachys Edelbergii Rech. fil., n. sp. — Fig. 28 und 27 b.

Grex *Speciosae* Pop. — Rhizoma lignescens fibroso-corticosum. Caulis ca. 60 cm altus simplex valde obtuse quadrangulus purpurascens, omnino pilis crispulis densiuscule hirsuto-villosus non glabrescens, internodiis perpaucis elongatis. Folia

Fig. 28. *Eremostachys Edelbergii* (E. 947). $^1/_2$.

basalia rosulata petiolata, petiolus ± 10 cm longus laminam aequans hisuto-vlliosus; lamina 10—15 cm longa, 5—7 mm lata, ambitu oblongo-ovata, plerumque infra medium latissima, utrinque pilis magna pro parte ± fasciculatis vel substellatis hirsuta, in sicco crassiuscula fragilis canescenti-viridis, nervis subtus pallidis pro-

minentibus, bi- vel incomplete tripinnatifida, segmentis utrinque ± 5 liberis, supremis tantum ± confluentibus, infimis 4—5 cm longis petiolulatis, superioribus sessilibus vel axi oblique adnatis, lobis ultimi ordinis omnibus rotundatis crenato-lobatis. Folia caulina paribus 1—2 evoluta valde decrescentia, breviter petiolata, ceterum basalibus similia. Folia verticillastra inferiora fulcrantia sessilia, verticillastra superantia, anguste pinnata usque bipinnata, segmentis utrinque ± 7, superiora sensim breviora minus divisa densius villosa. Verticillastra 4—5, infima remota, superiora ± contingua, omnia multiflora. Bracteae herbaceae lanceolatae mucronulatae, ± dimidios calyces aequantes, dense longe villosae, 2—3 mm latae. Calyx 18—22 mm longus, sessilis, basi breviter attenuatus superne paulo ampliatus, dense longe nitide albo-villosus eglandulosus, rigide herbaceo-membranaceus, nervis tenuiter tantum prominentibus; dentes calycini recti brevissimi, in mucronulum ± 1.5 mm longum stramineum rigidulum excurrentes, perlate alati horizontaliter truncati, incisuris minimis aequalibus saepe vix 1 mm profundis separati. Corolla calyce circiter duplo longior, labium superius 12—15 mm longum, 5—8 mm altum, in sicco sordide pallide roseum, extus ± breviter sericeo-villosum depresso-galeatum, intus antice longe strigoso-villosum; labium inferius deflexum, 15—18 mm longum, in sicco ochraceum, longitudine plerumque latius latissime trilobum, lobis sese tegentibus, mediano antice late leviter emarginato; tubus intus exannulatus. Filamenta subaequilonga ad basin leviter papillosa, thecis valde divaricatis.

Nuristan: Pashki, 2600 m, 10.VI.1948 (Edelberg 947, hb. C.).

Eremostachys gymnoclada Rech. fil. & Köie, n. sp. — Fig. 27 c.

Grex *Integrifoliae* Pop. (?). — Partes subterraneae ignotae. Planta valde elata valida, certe ultra 1 m alta; caulis erectus, internodiis mediis ca. 20 cm longis, a medio longe pauciramosus rarius simplex, obtuse quadrangulus glaberrimus laevis pallide bruneus. Folia omnia glaberrima, in sicco crassiuscule membranacea, laete usque obscure viridia concoloria, nervatura laxe pennato-reticulata subtus brunescente prominente. Folia basalia petiolo laminam subaequante suffulta. Lamina ad 13 cm longa, ad 7 cm lata, irregulariter grosse lyrato-pinnatifida, segmentis inferioribus utrinque 1—2 liberis ad 6 cm longis, 3 cm latis, basi rhachidi late oblique adnatis, apice rotundatis irregulariter grosse crenato-serratis usque-lobatis, segmentis superioribus ± confluentibus valde irregulariter grosse crenato-lobatis vel incisis. Folia caulina basi attenuata sessilia, ad 17 cm longa, ad 5 cm lata, in tertia parte superiore latissima, basin versus subintegra, in parte superiore grosse irregulariter sinuato-lobata usque subruncinato-serrata. Folia floralia inferiora calyces ± duplo superantia, oblonga, apice paucidentata, basi late cuneata vel subrotundata vel sessilia, nervis ± parallelis; folia floralia superiora sensim breviora, proportione angustiora, acutiora, integra. Verticillastra 6—10, pauci- (2—4-)flora, inferiora subremota, superiora approximata spicastrum formantia. Bracteae herbaceae, ad 6 mm longae, calycibus appressae, anguste lineari-subulatae, non pungentes. Calyx ± 20 mm longus, tubuloso-campanulatus, herbaceo-membranaceus, flavescenti-viridis, subenervius vel in parte superiore valde indistincte quinquenervius, basi paulum

attenuatus, antice vix ampliatus, ore transverse truncatus, dentium alis omnino contiguis vel interdum incisionibus minimis separatis, dentibus duobus inferioribus in mucrones flavidos erecto-patulos ad 3 mm longos, dentibus tribus superioribus in mucrones paulo breviores abrupte excurrentibus. Corolla in vivo aurea, in sicco immutata vel brunescens, calyce duplo circiter longior; labium superius ± 17 mm altum, leviter convexe galeatum, extus glabrum, intus longe strigose albo-barbatum; labium inferius multo longius, ad 21 mm longum, glabrum, trilobum, lobis lateralibus late rotundatis, intermedio multo minore antice inciso. Stamina 4, subaequalia. Nux ignota. — Affinitas adhuc subdubia; glabritie *E. glabrae* Boiss. similis a qua autem foliis magis divisis, corollae et calycis structura valde diversa.

NW: Kishlik, 700 m, 5.V.1949 (Köie 3861, hb. W., C.).

E. labiosa Bge. — **NW:** Qala Nau, 800 m, frequent on the hills (K. 3964). Obeh, 1700 m (K. 3667). — **SW:** Jija, 900—1200 m (K. 3898, 4063).

E. regeliana Aitch. & Hemsl. — **NW:** Qala Nau—Sauzak, 1400 m (K. 3926). Chisht, 1600 m (K. 3708). — **SW:** Herat, 1100 m (K. 3932). Jija, 1200 m (K. 4062).

Eremostachys sanglechensis Rech. fil., n. sp. — Fig. 29 und 27 d.

Grex *Speciosae* Pop. — Partes subterraneae desunt; planta collo squamis latis membranaceis longe villosis obsita et longe gossypino-lanata. Caulis humilis 13—16 cm altus, simplex, longe albide lanato-villosus, inflorescentia $^1/_3$—$^2/_3$ caulis longitudinis occupante. Folia basalia numerosa rosulata caulem subaequantia; petiolus laminae subaequilongus, longe villoso-lanatus; lamina 6—9 cm longa, 2—3 cm lata, in medio vel paulo infra latissima, in sicco crassiuscule membranacea rugulosa canescenti-viridis, nervatura subtus brunescente prominente crebe reticulato-anastomosante, pinnatifida, segmentis utrinque usque 8 oblongo-obovatis crebre minute inciso-crenatis usque crenato-dentatis, saepe basi ± oblique attenuatis sessilibus, segmentis summis saepe ± confluentibus. Folia caulina non evoluta. Folia verticillastra infima fulcrantia longiscule petiolata basalibus similia, verticillastra superantia, superiora multo minora minus divisa, summa valde reducta. Verticillastra usque 3, ± approximata vel subcontigua, densissima multiflora sessilia. Bracteae numerosae herbaceae non rigidae, ad $^1/_2$ usque $^2/_3$ calycis longitudinis aequantes, anguste lineari-lanceolatae vel fere lineares valde acutae, densissime longe lanato-villosae eglandulosae. Calyx ad 23 mm longus, a basi sensim paulo ampliatus vel interdum e basi attenuata fere cylindricus, rigide coriaceo-membranaceus, decemnervius, omnino dense candide lanato-villosus eglandulosus; calycis limbus dentibus 5 breviter rigidule mucronulatis utrinque truncato-bialatis; limbus incisuris omnibus subaequalibus quasi 15-dentatus. Corolla calyce circiter sesquilongior; labium superius ca. 13 mm longum valde convexe galeatum, dense breviter tomentellum, latere interno longe strigoso-barbatum, in sicco violascenti-purpurascens, saepe valde incurvum; labium inferius superiore plerumque paulo tantum brevius, valde dilatatum, perlate profunde trilobum, lobis antice rotundato-truncatis non vel indistincte emarginatis, in sicco flavescenti-ochraceum. Filamenta subaequalia thecis divaricatis. Nuculae ignotae. — Inter affines caule pumilo, indumento longo denso, foliis

Fig. 29. *Eremostachys sanglechensis* (Kz. 12640). $^2/_3$.

crebre reticulato-rugosis, imprimis autem calycis dentibus omnibus regulariter bialatis, limbo inde quasi 15-dentato insignis.

NE: Sanglech, 13000 ft., flowers gold, 25.VII.1937 (Koelz 12640, hb. W., BPI.).

Eremostachys vacillans Rech. fil. & Edelberg, n. sp. — Fig. 30 und 27 e—f.

Grex *Laciniatae* Pop. — Rhizoma crassum lignescens, collo gossypino-lanato. Caulis valde elatus, fragmentarie tantum obvius, certe ultra 1 m altus, internodiis paucis elongatis saepe ultra 20 cm longis, superne pauciramosus, pallide bruneus, obtuse quadrangulus, glaber. Folia rosularia numerosa petiolata; petiolus 6—9 cm longus, dimidiam circiter laminam aequans, longe crispe villosus; lamina 15—30 cm longa, 7—14 cm lata, ambitu oblongo-ovata, saepius infra medium latissima, herbaceo-membranacea, laete viridis, secus rhachidem et subtus secus nervos pilis longiusculis crispis simplicibus sparse hirsuto-villosa, nervatura pennato-reticulata subtus tenuiter prominente, irregulariter pinnata vel pinnato-lobata, segmentis in-

fimis utrinque 1—4 liberis, ± distincte petiolulatis grosse irregulariter lobato-dentatis, mediis rhachidi oblique adnatis, superioribus in segmentum terminale irregulariter laciniato-lobatum confluentibus. Folia caulina valde decrescentia glabrescentia, segmentis angustioribus acutioribus basi plerumque omnibus conjunctis, breviter petiolata usque subsessilia. Folia verticillastra inferiora fulcrantia ea superantia oblonga vel lanceolata, irregulariter inciso-lobata, valde glabrescentia. Verticillastra 5—12, ± 6-flora, inferiora valde (usque 20 cm) remota, summa approximata vel fere contigua. Bracteae lineari-subulatae, herbaceae, vix pungentes, dimidios calyces ad summum aequantes, crispule pilosae glabrescentes. Calyx 13—16 mm longus, sessilis, basi attenuatus superne paulo ampliatus, ± sparse crispule villosus glabrescens et glandulis sessilibus obsitus, rigide herbaceo-membranaceus, nervis tenuiter prominentibus; dentes calycini brevissimi, primum subrecti deinde ± extus curvati, in mucronulos rigidulos stramineos saepe ± inaequales, in dentibus inferioribus ad 3 mm, in superioribus ad 1.5 mm longos excurrentes, perlate alati horizontaliter truncati, incisuris minutis separati. Corolla calyce circiter duplo longior, in vivo aurea (?), in sicco brunescens vel ochracea; labium superius 12—14 mm longum, 3—5 mm altum, depresso-galeatum, extus laxiuscule pubescens, intus longe strigoso-villosum; labium inferius subaequilongum deflexum, trilobum, lobis late rotundatis; tubus intus ad basin filamentorum tenuiter piloso-annulatus. Filamenta subaequalia, thecis valde divaricatis. — Species nova notis sequentibus insignis:

Fig. 30. *Eremostachys vacillans* (E. 521). $^2/_5$.

statura valde elata, planta saepe valde glabrescens, calyces pro sectione parvi, bracteae dimidios calyces ad summum aequantes.

Nuristan: Vama, 1400 m, 4.V.1948 (EDELBERG 521, Typus, hb. W., C.). — **NE:** Nilkhan, 8000 ft., dry slope, flowers gold, 4.VI.1937, (Kz. 11698, hb. W., BPI.). — **E:** Paghman, 8000—9000 ft., 2.VI.1939 (CHAWORTH-MUSTERS s. n., hb. BM.). Begram near Charikar, 5000 ft., 4.VI.1940 (CODRINGTON 55, hb. BM.).

Die neue Art variiert in mehreren Merkmalen ziemlich stark. Der Typus ist großblättrig, die Blatteilung ist an den größten Blättern tief und stark, die Behaarung relativ reichlich, die Kelchzähne sind relativ kurz und untereinander gleich lang. Die Pflanze von CHAWORTH-MUSTERS ist relativ zart, unverzweigt, die Blätter sind relativ klein, deren Behaarung ziemlich stark, der obere Stengelteil und die Infloreszenz sind fast völlig verkahlt, die Kelchzähne wie beim Typus. CODRINGTON no. 55 ist ein Fragment einer hochwüchsigen, fast völlig verkahlten Pflanze, die Brakteen sind etwas breiter als beim Typus. Aehnlich ist KOELZ no. 11698, aber blühend.

Eremostachys vulnerans Rech. fil. & Köie, n. sp. — Fig. 31.

Grex nova *Vulnerantes* Rech. fil. & Köie. — Dentes calycini valde inaequales rigidissimi vulnerantes. Bracteae lineari-subulatae rigidissimae pungentes, quam calyces longiores. Folia cordata crenata. Caulis elatus validus. — Species unica:

Partes subterraneae deficientes. Collum residuis petiolorum comosum et longe gossypino-lanatum. Caulis 60—120 cm altus, simplex, validissimus, obtusissime quadrangulus usque subteres, omnino villosus, in parte superiore quidem substrigoso-lanatus, eburneus usque pallide bruneus, internodiis paucis valde elongatis, inflorescentia dimidium usque tertiam partem superiorem caulis occupante. Folia basalia rosulata non numerosa, petiolo villoso-lanato laminam subaequante suffulta. Lamina 12—16 cm longa, ad 5 cm lata, in medio vel paulo infra latissima, basi truncata vel leviter cordata, apice ± rotundata, margine grosse interdum sublobato-crenata, supra brevius sublaxius tomentella flavescenti-viridis, subtus densius longius tomentosa albescens, nervatura supra tenuiter immersa, subtus prominenter pennata et crebre reticulato-anastomosante. Foliorum caulinorum paria 1(—2) plerumque tantum evoluta, breviter petiolata, basi attenuata, elliptico-lanceolata, latitudine 3—4—plo longiora, ceterum basalibus similia. Folia verticillastra infima fulcrantia basi late rotundata vel subcordata sessilia, ambitu ovata, apice acuta, margine crenato-subserrata, quam verticillastra paulo usque subduplo longiora; folia fulcrantia superiora sensim breviora, minus distincte crenata usque subintegra. Verticillastra 6—11, omnia plerumque valde remota, sessilia multiflora compacta. Bracteae numerosae rigidissimae calyces superantes, lineari-subulatae, in mucronem validum vulnerantem glabrescentem excurrentes, pilis patulis elgandulosis villosae, pilis brevioribus glanduliferis copiose immixtis. Calycis tubus fructifer ± 16 mm longus, basi ± attenuatus sursum paulo ampliatus, rigidissime coriaceus decemnervius, indumento e pilis longis villosis et brevioribus glanduliferis consistente, dentibus valde inaequalibus, brevioribus tribus in mucronem rigidum erectum vulnerantem 3—4 mm longum, longioribus duobus in mucronem validissimum patentem valde vulnerantem

Fig. 31. *Eremostachys vulnerans* (Habitus K. 2307, Blüten Kz. 12078). Habitus $^1/_2$.

usque 12 mm longum excurrentibus, omnibus late alatis, ala antice transverse truncata vel subsinuata incisionibus angustis ± 3 mm profundis separatis. Corolla in vivo roseo-purpurea (e collectore), in sicco brunescens, calyce circiter sesquilongior; labium superius applanato-galeatum, extus villosum et breviter glandulosum, intus strigoso-barbatum; labium inferius paulo brevius rotundato-trilobum, lobo mediano lateralibus longiore et latiore. Nuculae (submaturae) nigrae, ± 4 mm longae, quadrangulae, apice barba candida 1.5—2 mm longa provisae.

E: Paghman, 2200 m, 8.VII.1948 (Köie 2307, Typus, hb. W., C.). Paghman, 7500 ft., flowers rose-purple, 26.VI.1937 (Kz. 12078, hb. W., BPI.). Paghmantal (N. 50/717).

Phlomis bracteosa Royle — **Nuristan:** Shtive, 2600 m (E. 1290). Ashpei, 2300 m (E. 1658).

Die afghanischen Exemplare sind von der Mehrzahl der im Hb. Mus. Wien vorhandenen himalayischen und chinesischen durch folgende Merkmale verschieden: 1. dichte abstehende, fast borstige Behaarung, besonders der Infloreszenzregion; 2. verhältnismäßig lange Blätter, die z. T. zwei- bis dreimal so lang wie breit sind; 3. lang zugespitzte Kelchzähne; 4. schmal pfriemliche Brakteen. Die von Afghanistan durch den Himalaya bis Südwest-China verbreitete Art ist nach dem mir augenblicklich vorliegenden, nicht sehr reichlichen Material sehr variabel und wird sich möglicherweise an Hand von reichlicheren Belegen in mehrere geographische Rassen gliedern lassen.

Ph. cancellata Bge. — **NW:** Ardewand, 1500 m (K. 2249).

Ph. cashmeriana Royle — **Nuristan:** Ashpei, 2300 m (E. 1665). — **E:** Kurram valley (Harsukh 14694, hb. W.).

Phlomis dichroa Rech. fil., n. sp. — Fig. 32.

Sect. *Oxyphlomides* Benth. — Partes subterraneae deficientes. Caulis 50—70 cm altus, arcuatus vel subrectus ± flexuosus, prope basin ± 5 mm crassus, internodiis mediis ca. 10 cm longis, inferne longe aphyllus, superne remote foliatus, infra medium pauciramosus, ramis ca. 15 cm longis erecto-patentibus foliatis et floriferis, obtuse quadrangulus, dense breviter stellato-tomentosus inferne teres valde glabrescens. Inflorescentia tertiam vel quartam partem caulis occupans. Folia caulina media ad 11 cm longa, prope basin ad 5.5 cm lata, petiolo latiusculo ± 1 cm longo vel longiore suffulta, basi late sinuato-cordata et in petiolum attenuata, apicem acutam versus sensim attenuata, integerrima, in sicco crasse membranacea, discoloria, supra laxe scabride stellato-tomentosa sordide atro-viridia, subtus dense intertexte stellato-tomentosa albida, nervatura crebre pennato-reticulata supra immersa subtus crasse prominens. Folia caulina superiora sensim minora proportione angustiora, basi late rotundata vel acuminata in folia floralia transientia. Verticillastra (2—)4, 3—4 cm diametro, omnia remota dense multiflora. Bracteae numerosissimae subulatae, quam calyces paulo longiores, stellato-tomentosae, in mucronem tenuem glabratum non vulnerantem excurrentes, calycibus appressae. Calyx 10—14 mm longus, basi dense breviter stellato-tomentosus, nervis vix prominentibus, dentibus latissime

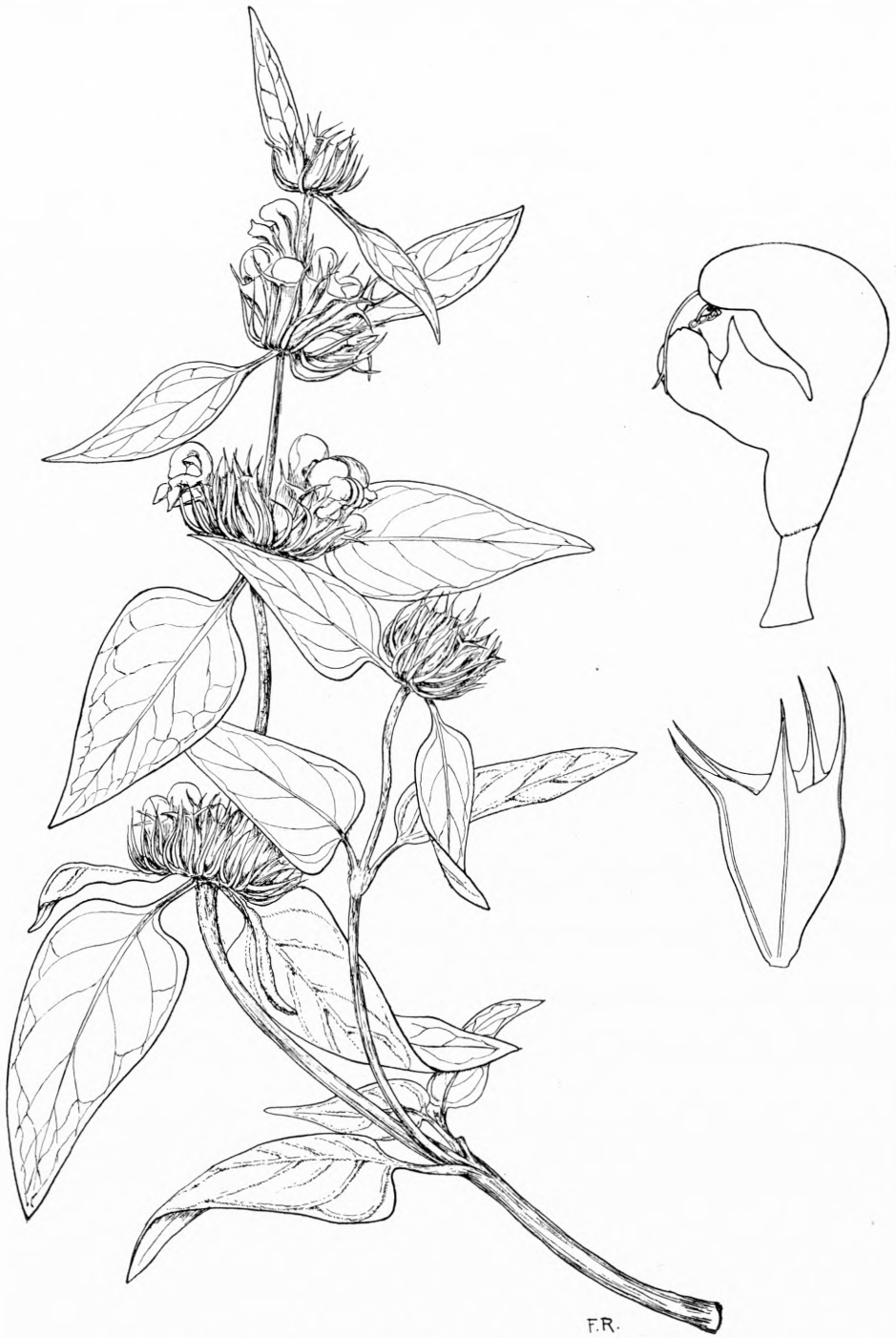

Fig. 32. *Phlomis dichroa* (Kz. 12918). Habitus $^{3}/_{5}$.

rotundatis brevissimis incisione minuta separatis, ore quasi horizontaliter truncatus, dentibus in mucrones rigidos pungentes glabrescentes patentes abrupte contractis. Corolla in vivo roseo-purpurea (e collectore), in sicco valde expallens, dense stellato-tomentosa, calyce vix duplo longior; tubus in calyce inclusus intus annulo piloso praeditus; labio superiore 12—15 mm longo ca. 6 mm alto valde convexo-galeato; labio inferiore subaequilongo trilobo, lobo mediano rotundato subemarginato, lateralibus valde acutis. Nux ignota. — Differt ab affinibus, imprimis a *Ph. thapsoide* Bge. foliis magnis discoloribus, calyce maiore ore quasi transverse truncato, dentibus calycinis in mucrones longiores patentes excurrentibus.

NE: Khash District, 8000 ft., dry ground, fl. rose-purple, 8.VIII.1937 (Koelz 12918, Typus, hb. W., BPI.). Khash District, 10000 ft., in clumps, 9.VIII.1937 (Kz. 13000, hb. W., BPI.). — **E:** Bagrami, Nedjerau-Tal, 3000 m, haufig in der oberen Waldzone, (N. 51/221, hb. W.).

Ph. thapsoides Bge. — **NE:** Rustak, 4000 ft., dry ground, bushy, fl. yellow (Kz.13124).

Phlomis trineura Rech. fil., n. sp. — Fig. 33.

Sect. *Oxyphlomides* Benth. — Partes subterraneae deficientes. Caulis 45 cm altus erectus subflexuosus simplex, internodiis mediis ca. 3 cm longis, a basi fere regulariter foliatus et florifer, teres dense breviter stellato-tomentosus, prope basin tantum glabrescens. Folia inferiora petiolo brevi a lamina vix distincto incluso ad 10 cm longa, ad 0.8 cm lata fere linearia, basi apiceque subaequaliter attenuata, apice rigide mucronulata integerrima, in sicco rigida subcoriacea, nervis tribus parallelis tota longitudine percursa, lateralibus margini approximatis, irregulariter tenuiter anastomosantibus omnibus supra profunde immersis subtus crasse prominentibus, indumentum ubique aequaliter breviter stellato-tomentosum canescenti-flavescenti-virens. Folia media et superiora vix decrescentia omnia verticillastra fulcrantia, summa quidem verticillastro duplo usque subtriplo longiora, 0.5 cm lata. Verticillastra 5—8-flora, numerosissima, sessilia conferta, spicastrum subcontiguum formantia. Bracteae ternae basi connatae calyces aequantes vel superantes, rigidissime mucronatae squarroso-patentes pungentes stellato-tomentosae imprimis in parte superiore glabrescentes. Calyx 13—15 mm longus tubuloso-campanulatus basi attenuatus, superne paulo ampliatus, elevate plicato-quinquenervius, omnino dense breviter stellato-tomentosus, dentibus subaequalibus 2—3 mm longis late rotundatis incisionibus angustissimis acutis separatis omnibus rigide mucronatis, superioribus 3 in mucrones ± 1.5 mm, inferioribus 2 in mucrones ± 3 mm longos excurrentibus. Corolla calyce vix duplo longior, dense breviter stellato-tomentosa, in vivo ut videtur sordide roseo-purpurascens ("magenta" e collectore), labio superiore ± 1 cm longo, ± 4 mm alto, regulariter curvato-galeato inferiore sublongiore trilobo. Nuculae fere 5 mm longae crasse ovato-ellipsoideae atrobruneae, minute rugulosae, glabrae apice breviter acuminatae. — *Ph. persicae* Boiss. habitu aliquantum similis sed foliis omnibus aequalibus linearibus trinerviis, caule a basi fere florifero, corollis maioribus, bracteis longis pungentibus squarroso-patentibus diversissima.

Fig. 33. *Phlomis trineura* (Kz. 13965). Habitus $^1/_2$.

N: Akupruk, 8000 ft., dry slope, pl. 2 ft. high, flowers magenta, 11.IX.1939 (KOELZ 13965, hb. W., BPI.).

Eriophyton afghanicum Rech. fil., n. sp. — Fig. 34 und 37 a. Zum Vergleich *E. Wallichianum* Benth., Fig. 37 b.

Partes subterraneae et bases caulium desunt sed planta verosimiliter perennis pluricaulis. Caules floriferi ut videtur 15—30 cm longi, ad 6 mm crassi, simplices, internodiis inferioribus et mediis ad summum 8 cm longis, in tertia circiter parte superiore floriferi, internodiis superioribus abbreviatis, omnino molliter lanati. Folia inferiora petiolo lato ad 1 cm longo suffulta; lamina transversaliter dilatata, late reniformi-flabellata, ca. 2 cm longa, 3 cm lata, antice late obtuse crenata; folia superiora sensim increscentia, brevius petiolata usque sessilia, floralia maxima ad 6 cm longa, 7 cm lata, basi sinuato-subcordata vel truncata vel late cuneata, late obtuse crenata, nervis palmatis profunde furcatis superne ± parallelis et crebre reticulato-anastomosantibus, subtus tenuiter distincte prominentibus, consistentia in sicco crasse molliter herbacea, indumento denso albo lanato-villoso nitente. Folia superiora ex axillis flores singulos, (rarius 2—3-nos) proferentia. Calyx ± 15 mm longus, tenuiter herbaceo-membranaceus, ore rectus ad $^2/_5$ circiter in dentes aequales e basi triangulari subito tenuiter subulato-mucronatos non pungentes fissus, dense molliter lanato-villosus. Corolla magnitudine variabilis 3—4 cm longa, consistentia tenuissima, in vivo roseo-purpurea (e collectore), tubo superne sensim ampliato; labium superius applanatum leviter curvatum antice truncatum extus laxe villosum; labium inferius quam superius plus quam duplo longius, lateraliter constrictum, lobo mediano late obcordato, antice profunde inciso. — Differt ab *E. Wallichiano* Benth. corollae labio superiore brevi applanato, antice truncato, labio inferiore quam superiore duplo longiore, ejusque lobo mediano late obcordato, calycis dentibus brevioribus, indumento calycino breviore ± 2 mm (nec 4—5 mm) longo, foliis magis rotundatis obtusius crenatis, distinctius reticulato-rugosis.

NE: Magnaul, 11000 ft., clumps, fl. rose-purple, 29.VII.1939 (KOELZ 12782, hb. W., BPI.).

Lamium album L. — **Nuristan:** Nishei, 2900 m (E. 775). Chetras, 2900 m (E. 842). Aschpi Pass (N. 51/1051). Zwischen Nischai und Ningalam (N. 51/791).

L. amplexicaule L. — **NW:** Murghab, 500 m, in fields (K. 3510). — **C:** Farakulum, 2800 m (K. 3385). — **Nuristan:** Gusalak, 1000 m (E. 108, 118, 233, 299). — **E:** Paghman, 7500 ft., fields (Kz. 12077).

Leonurus cardiaca L. s. l. — **C:** Hauz-i-Mahiha, 2500 m (K. 2425). — **Nuristan:** Nishei (E. 778). Pashki, 2500 m (E. 1317). Shtive, 3000 m (E. 1281). Netchingel, 3300 m (E. 1988). Zwischen Kotal-e-Agok und Waigel (N. 51/880). — **E:** Unteres Paghmantal (N. 50/692).

Lagochilus cabulicus Benth. — **E:** Kabul (HONIGBERGER, hb. W.).

Lagochilus nuristanicus Rech. fil. & Edelberg, n. sp. — Fig. 35 und 37 c.

Partes inferiores desunt sed planta certe suffruticosa pluricaulis. Caules floriferi ultra 30 cm longi, erecti, simplices vel superne pauci-ramosi, eburnei glabri laeves

Fig. 34. *Eriophyton afghanicum* (Kz. 12782). $^4/_5$.

quadranguli ± sulcati. Folia petiolo 1—1.5 cm longo latiusculo albo anguste herbaceo-marginato suffulta, lamina ambitu cordato-triangularis, 2—3 cm longa et lata, laete viridis herbacea utrinque crebre glanduloso-punctata, margine scabridula ceterum glabra, bi- usque tripinnatifida, lacinulis 1—2 mm latis saepe supra medium latioribus, inferioribus rotundatis superioribus ± acutis. Folia verticillastra fulcrantia inferioribus similia, superiora sensim paulo minus dissecta. Spinae subhorizontaliter patentes vulnerantes 10—15 mm longae. Verticillastra ± 4, plerumque 6-flora. Calyx 24—28 mm longus, tenuiter rigidule membranaceus pallide flavescenti-viridis, ad medium circiter in dentes late oblongo-lineares subaequales apice rotundatos et minutissime mucronulatos fissus, glaber laevis glanduloso-puncatus, dentibus margine scabridulis, nervis 5 principalibus in dentium mucrones excurrentibus et 5 commissuralibus tenuissimis interdum evanescentibus; laciniis tenuiter crebre reticulato-nervosis. Corolla ad 4 cm longa, in sicco albida, nervis carneo-brunescentibus; labium superius subrectum ca. 2 cm longum, extus pubescens antice truncatum crenulatum longe barbatum; labii inferioris lobi lateral recti antice emarginato-truncati, medianu deflexu flavescens incisus. Filamenta inclusa. — Differt ab affini *L. Paulsenii* Briq. imprimis dentibus calycinis tubum aequantibus nec eo 2—3-plo longioribus.

NE: Minjan, Iskan, 2700 m, 15.VII.1948 (Edelberg 2199, hb. W., C.).

Stachys arvensis L. — **SE:** Pirzada, 1000 m (K. 3384).

Das Vorkommen bei Kandahar liegt völlig außerhalb des Areals dieser Art, das nach Boissier, Fl. or. Europa nördlich bis Schottland, östlich bis Mittelrußland, das Mittelmeergebiet von Portugal bis Dalmatien, Makaronesien und Nordafrika umfaßt. In Amerika wurde die Art adventiv beobachtet.

St. hissarica Regel (? e descr.) — **NE:** Najil, 4500 ft., on dry slope, 3 ft. high, fl. rose-purple (Kz. 11628).

Stachys maleolens Rech. fil., n. sp. — Fig. 36 und 37 d.

Partes subterraneae et bases caulium floriferorum desunt, sed planta verosimiliter perennis pluricaulis; in vivo foetida (e collectore). Caules floriferi quadranguli arcuato-ascendentes, internodiis superioribus ± 5 cm longis, breviter pauciramosi foliati, pilis brevibus patulis vel ± retrorsis simplicibus eglandulosis hirsuto-puberuli praeterea minutissime glanduloso-papillosi. Folia ramealia breviter (± 3 mm) petiolata, ovato-lanceolata, basi anguste rotundata vel cuneata, apice acuta, margine grosse irregulariter serrata usque subintegra, laxe pennato- et reticulato-nervosa, utrinque breviter hirsuto-pubescentia et copiose minutissime glanduloso-papillosa, consistentia in sicco molliter membranacea. Folia florum glomerulos fulcrantia sessilia latiora subintegra. Florum glomeruli ± 3, omnes remoti multiflori, ad 3 cm diametro. Bracteae lineari-subulatae, quam calyces paulo usque tertia parte breviores. Calyx ± 11 mm longus, infundibuliformis, rigidule herbaceo-membranaceus, 10-nervius, hirsuto-villosus et minutissime glanduloso-papillosus, ultra tertiam partem in dentes patulos rigidulos e basi lata sensim valde subulato-acuminatos fissus. Corolla calyce circiter duplo longior, sordide rosea (e collectore),

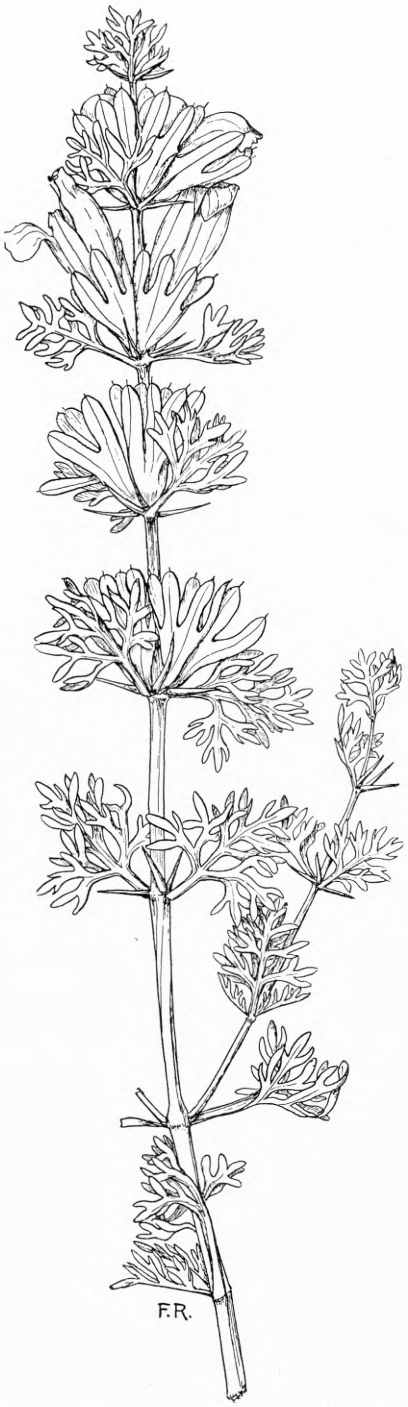

Fig. 35. *Lagochilus nuristanicus* (E. 2199). $^{3}/_{5}$.

Fig. 36. *Stachys maleolens* (Kz. 13014). $^{2}/_{3}$.

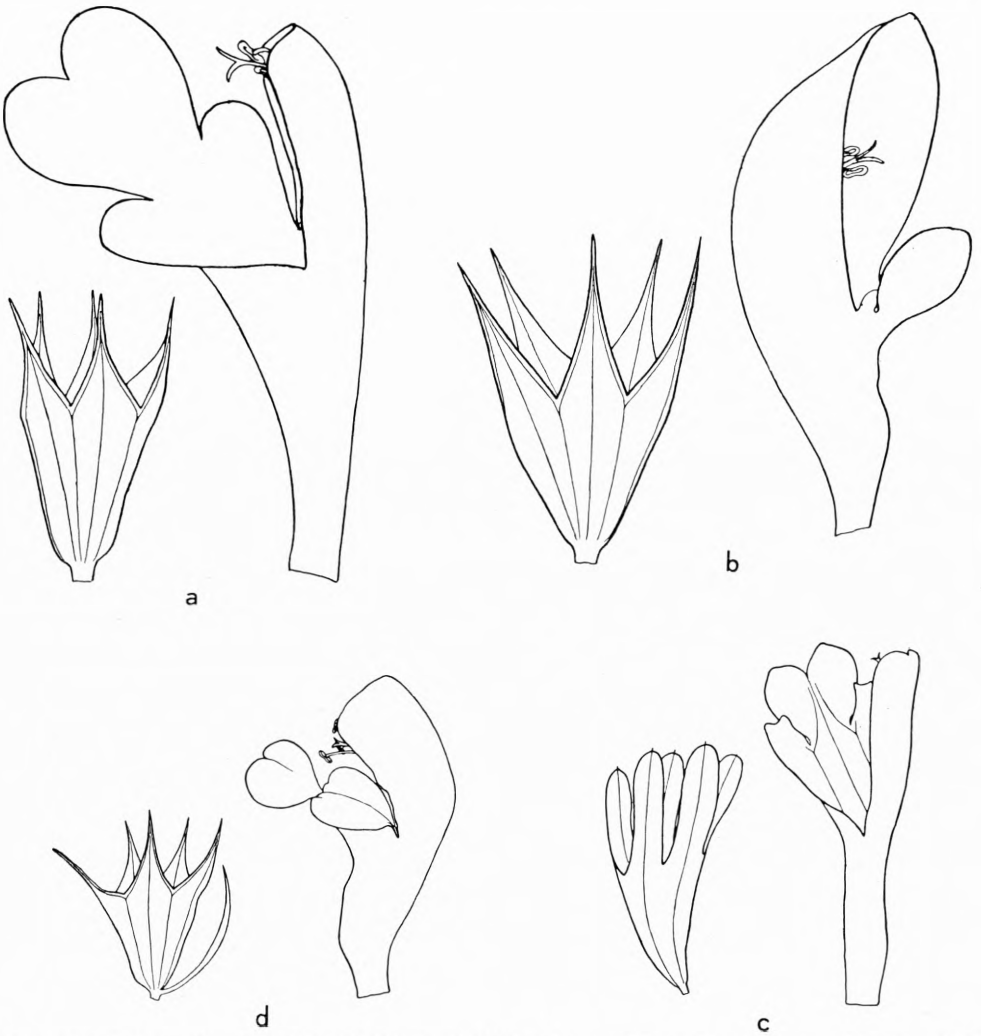

Fig. 37. a. *Eriophyton afghanicum* (Kz. 12728). b. *E. Wallichianum* Bth. c. *Lagochilus nuristanicus* (E. 2199). d. *Stachys maleolens* (Kz. 13014).

tubo crasso in calyce incluso superne sensim ampliato, labio superiore subgaleato, antice truncato et inciso, extus valde villoso, labio inferiore sublongiore lateraliter panduriformi-inciso, antice rotundato-emarginato. Stigma bifidum lobis subaequalibus. Stamina subexserta. Nuculae ignotae. — Affinitas speciei adhuc inperfecte notae dubia; corollae labio superiore subgaleato *Phlomidem* in mentem revocans, sed ab hoc genere calycis forma foliorumque non rugosorum indumento abhorrens.

NE: Khash District, 10000 ft., in clumps, flowers old rose, malodorous plant, 9.VIII.1937 (Koelz 13014, hb. W., BPI.).

St. parviflora Benth. — 'Afghanistan' (Griffith 4032, hb. W.). — **NW:** Obeh, 1700 m (K. 4065). Sauzak, 2000 m (K. 2192). — **C:** Deh Kundi, 3000 m (E. 1845). Aoi Khurak, 9000 ft., dry slope (Kz. 13784). — **NE:** Gulbahar (N. 50/608). Jagdalek, 5000 ft. (Kz. 8249). — **E:** Kabul (Honigberger, hb. W.). Kabul, 6000 ft., dry slope, (Kz. 11406). Kabul (Lindberg). Kabul, 1700 m (K. 4066). Paghman, 17 miles west of Kabul, 8000—9000 ft. (Chaworth-Musters, hb. BM.). Begram near Charikar, 5000 ft. (Codrington 8, hb. BM.). Sirotai, 9000 ft., dry ground, clumps, fl. lavender (Kz. 11929). — **SE:** Girishk, Kajkai, 1000 m, in fields (K. 2152).

St. trinervis Aitch. & Hemsl. — **NW:** N. of Sauzak, 1600 m (K. 3909). Nördlich Herat, 1200 m (K. 4068). — **SW:** Jija, 1300 m, frequent on the plains in the Southwest (K. 2288, 3592).

Salvia compressa Vahl — **SW:** Jija, 1000 m (K. 3826).

Salvia Edelbergii Rech. fil., n. sp. — Fig. 38 und 43 a.

Sct. *Aethiopis* Benth. subsect. *Gongrosphace* (Bge.) Boiss. — Perennis. Caulis ca. 40 cm altus, internodiis mediis ca. 6 cm longis, herbaceus, quadrangulus, usque ad medium foliatus, a medio florifer, in medio breviter pauciramosus, omnino dense breviter glanduloso-pilosus, inferne insuper ± lanato-villosus. Folia infima petiolo 1—2 cm longo glanduloso-piloso et lanato-villoso suffulta, e basi cordata ovato-triangularia, ad 9 cm longa, 5.5 cm lata, apice acuta, margine crenata usque ± obtuse subsinuato-dentata, nervis arcuato-pennatis et crebre minute reticulatis, juniora discoloria supra villosa valde glabrescentia viridia, subtus primum dense appresse albo-tomentosa deinde valde glabrescentia. Folia superiora basi late cordata sessilia, latitudine non vel vix latiora. Folia verticillastra fulcrantia late rotundato-cordata, 6—8 mm longa et fere aequilata, apice subito acuminato-mucronulata, horizontaliter patentia, tenuiter subpellucide albo-membranacea, inferiora pro maiore parte herbacea, omnes imprimis marginem versus laxiuscule villosa ± glabrescentia et sparse glanduloso-punctata, margine pilis longioribus crispulis eglandulosis et pilis brevioribus glanduliferis ciliata. Pedicelli 1(—2) mm longi erecti usque arcuato-deflexi. Verticillastra 3—4-flora, inferiora internodiis ± 3 cm longis separata, superiora ± approximata. Calyx ± 8 mm longus, campanulatus, tenuiter herbaceo-membranaceus, inferne albescens, superne viridis nervis coerulescentibus tenuibus vix prominentibus, imprimis secus nervos et ad dentes calycinos laxe breviter setulosus, praeterea dense minute glanduloso-papillosus et glandulis sessilibus maiusculis obsitus, leviter bilabiatus labiis divergentibus; labium inferius in dentes 2 triangulari-lanceolatos sensim in mucrones ± 1 mm longos attenuatum; labium superius ± coerulescens brevissime tridentatum. Corolla calyce fere triplo longior, in sicco albida leviter brunescens; tubus e calyce breviter vel vix exsertus, intus squamula ciliata provisus, contractus et distincte inflato-ampliatus; labium superius ± 15 mm longum, ca. 5 mm altum, falcato-curvatum, inferiore plus quam duplo usque triplo longius; labium inferius ± 5 mm longum deflexum lobis lateralibus anguste lanceolatis, mediano transverse dilatato late rotundato concavo. Stamina inferne

Fig. 38. *Salvia Edelbergii* (E. 1300). $^1/_2$.

Fig. 39. *Salvia Honigbergeri* (HONIGBERGER s. n. fruchtend, CHAWORTH-MUSTERS s. n. blühend). $^1/_2$.

cohaerentia, connectivo perlongo curvato, crure inferiore valde abbreviato omnino sterili, abrupte unilateraliter dilatato.

NE: Minjan; Ptili, 2700 m, 20.VII.1948 (EDELBERG 1300, hb. W., C.).

S. glutinosa L. — **NE:** Ruka, 1800—2100 m (K. 2957). — **Nuristan:** Pashki, 2300 m (E. 1321). — **E:** Kurrum valley (AITCH. 594, hb. W.).

Das letztgenannte Exemplar ist durch länger zugespitzte Blätter mit spitzeren, stärker abstehenden Basalzipfeln und durch feinere Randkerbung der Blätter auffällig.

S. Honigbergeri Rech. fil., Ann. Nat. Mus. Wien 51: 48 (1941). — Fig. 39. — **C:** Hauz-i-Mahiha, 2500 m (K. 2336). — **E:** Jagdalek, 5000 ft., open dry slopes, 14 in. high, fl. rose-purple, bracts and calyx of similar tone, clumps (Kz. 11480). Arbarp, 11 miles west of Kabul, 7000 ft. (Chaworth-Musters, hb. BM.). Kabul (Honigberger, Typus, hb. W.). Begram (Codrington 54, hb. BM.). In den Felsen am Hang zum Munar Schakrie (N. 51/389).

Differt a *S. Hydrangea* DC. calycibus maioribus lobis late rotundatis obtusis, bracteis late cordatis vel rhombicis membranaceis intense purpureo-suffusis apice herbaceis, verticillastrorum superiorum foliolis terminalibus late ellipticis obtusis. Differt a *S. Sheilei* Boiss. cui bracteis praeter apicem membranaceis similis, calycibus floribusque et foliorum forma.

S. leriaefolia Benth. — Fig. 40. — **NW:** Herat, Ardewand, 1200 m (K. 3387). — **SW:** Herat, 1000 m (K. 3556). — **E:** Begram near Charikar (Codrington 46, hb. BM.). Tscharikar (N. 50/698). Kabul, 1700 m (K. 4017). Giri, 7000 ft., on dry plain, 1 ft. high, fl. white tipped rose (Kz. 11499).

S. macilenta Boiss. — **SW:** Farah, 700 m (K. 4067).

S. Moorcroftiana Wall. — **E:** Mamakhel, 4000 ft., on dry plain, 10 in. high, fl. pale blue-purple (Kz. 11575).

Salvia polychroma Rech. fil. & Edelberg, n. sp. — Fig. 41 und 43 b—d.

Sect. *Aethiopis* Benth. subsect. *Gongrosphace* (Bge.) Boiss. — Partes subterraneae et pars inferior caulis desunt. Caulis ca. 120 cm altus, stricte erectus, ad $^2/_3$ circiter regulariter foliatus, internodiis mediis ad 10 cm longis, in tertia parte superiore paniculato-ramosus et florifer, herbaceus quadrangulus, breviter glanduloso-pilosus, pilis longioribus eglandulosis in parte inferiore raro, in regione inflorescentiae ± crebrius immixtis. Folia caulina inferiora longe (8—10 cm) petiolata; lamina ad 20 cm longa, ad 5 cm lata, basi cordata, apice acuta, margine subsinuato- usque sublobato-crenata, a basi ad medium fere aequilata, a medio apicem versus sensim attenuata; folia caulina media basi profunde cordata semiamplexicaulia, ad 15 cm longa, prope basin 6 cm lata, apice producta valde acuta, margine acuta et ± minute duplicate sinuato-dentata; folia omnia concoloria, supra atroviridia glabrescentia subpapilloso-rugosa, subtus vix pallidiora valde glabrescentia, secus nervos tenuissime tomentosa et glandulis sessilibus obsita, nervatura dense pennato-reticulata subtus tenuiter prominente. Folia summa et ramealia similia sed minora. Bracteae late rotundato-cordatae integerrimae breviter molliter mucronatae tenuiter albido-membranaceae, tenuiter subparallele viridi-nervosae, inferiores ± herbaceae, superiores violaceo- vel purpureo-suffusae, calyces adultos subaequantes usque eis quarta parte breviores, lamina subglabrae margine minute ciliatae. Verticillastra omnia remota. Calyx 12—14 mm longus, late campanulatus, breviter bilabiatus, labiis valde divergentibus, membranaceo-herbaceus, superne et nervis pallide viridis, margine setulosus praeterea glanduloso-punctatus; labio superiore saepe coeruleo-suffuso, breviter tridentato dentibus lateralibus breviter mucronulatis intermedio multo

Fig. 40. *Salvia leriaefolia* Bth. (Kz. 11499 blühend, CODRINGTON 46 fruchtend). $^2/_3$.

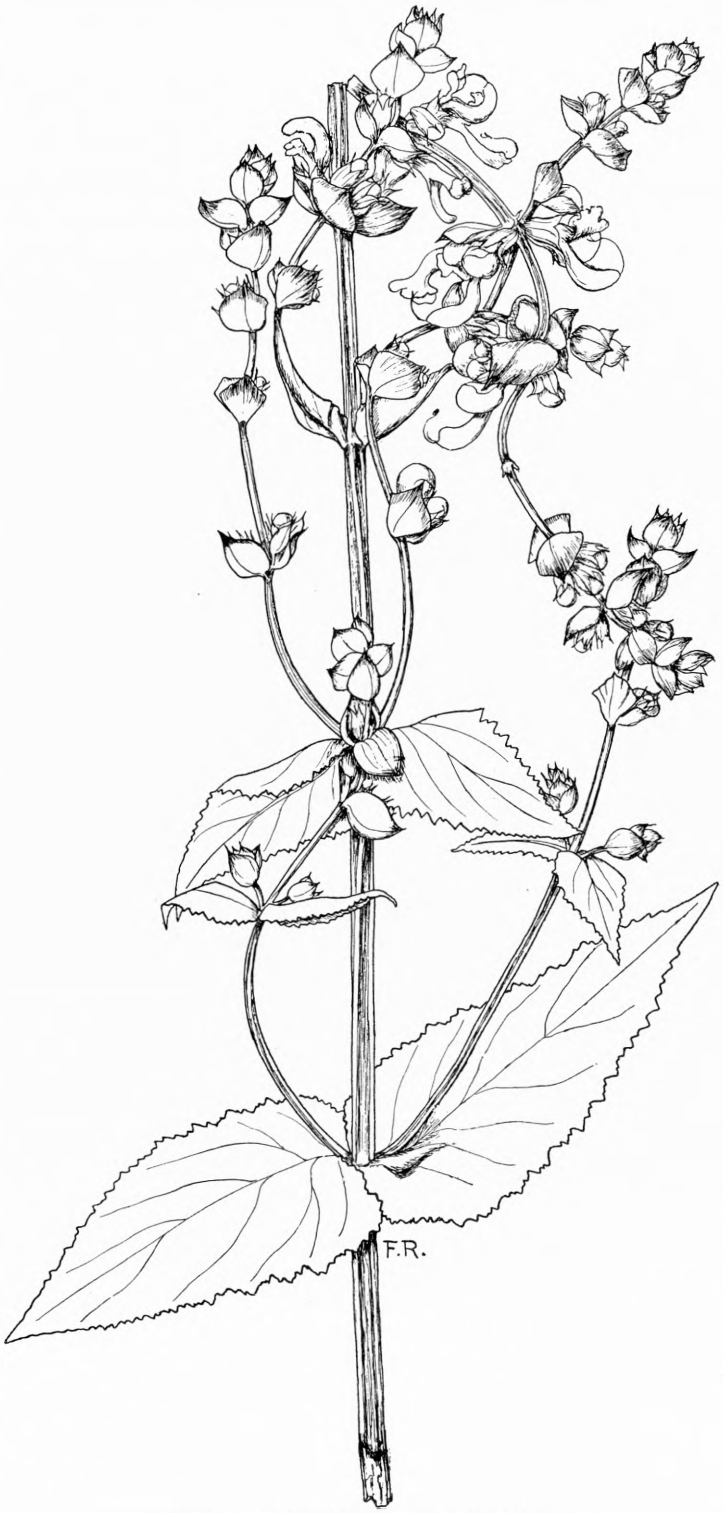

Fig. 41. *Salvia polychroma* (E. 1437). $^{3}/_{5}$.

breviore submutico; labio inferiore in dentes 2 lanceolatos sensim in mucrones ad 2 mm longos excurrentes fissum. Corolla calyce circiter triplo longior, in vivo coerulescenti-purpurea (e collectore), in sicco expallescenti-brunescens; tubus in calyce inclusus superne antice incisus et inflate dilatatus, labium superius 12—15 mm longum, falcatum, ca. 5 mm altum; labium inferius basi attenuatum deflexum trilobum in sicco brunescens atrius maculatum. Stamina inferne coherentia, connectivo perlongo curvato, crure inferiore abbreviato sterili, asymmetrice ± dilatato.

NE: Minjan, Nau, 2700 m, field border, 30.VI.1948 (EDELBERG 1437, Typus, hb. W., C.). Daulatshah, 7000 ft., in stream bed, plant strongly scented, 31.V.1937 (Kz. 11633, hb. W., BPI.). — **E:** above Gardez, 8000 ft., field borders, in clumps. $2^1/_2$ ft. high, blue-purple hood, lip white, edged broadly yellow, 20.VI.1937 (Kz, 11971, hb. W., BPI.). Tera Kotal, 8000 ft., in clumps, plant 4 ft. high, 15.VI.1937 (Kz. 11888, hb. W., BPI.).

Bei der letztgenannten Pflanze ist die Behaarung sehr kurz und spärlich und die Brakteen sind ungewöhnlich groß.

Salvia polyclada Rech. fil., n. sp. — Fig. 42 und 43 e.

Sect. *Aethiopis* Benth. subsect. *Gongrosphace* (Bge.) Boiss. — Partes subterraneae desunt. Caulis ca. 90 cm altus (e collectore), ut videtur a basi fere iteratim copiose paniculato-ramosus, internodiis mediis 6—10 cm longis, tota longitudine foliatus, herbaceus quadrangulus, omnino dense breviter appresse tomentosus, imprimis in regione florifera pilis glanduliferis brevibus copiose, longioribus eglandulosis sparse immixtis. Folia caulina inferiora breviter (1.5—3 cm) petiolata, superiora sessilia ad 15 cm longa, ad 8 cm lata, prope basin vel in tertia parte inferiore latissima, oblongo-ovata usque late ovato-triangularia, apice obtusiuscula vel ± acuta, margine ± acute sinuato-lobata et insuper ± indistincte crenato-dentata, concoloria utrinque indumento brevi aequali canescenti-flavescenti viridia, glandulis sessilibus ± sparse immixtis, nervatura pennata et copiose tenuiter reticulata subtus tenuiter prominens, supra tenuiter rugoso-immersa. Folia superiora et ramealia similia sensim decrescentia. Bracteae albido-membranaceae rotundato-cordatae integerrimae, breviter molliter mucronato-acuminatae, dimidios calyces circiter aequantes, ± virescenti- vel purpurascenti-suffusae et -nervosae. Verticillastra inferiora ± remota, media et superiora ± approximata. Pedicelli 1(—2) mm longi, erecti usque patuli vel ± nutantes. Calyx 8—10 mm longus, late campanulatus, breviter bilabiatus, labiis valde divergentibus, rigidule herbaceo-membranaceus, superne ± purpurascenti-suffusus, nervis tenuiter sed distincte prominentibus, pilis longioribus eglandulosis et brevioribus glanduliferis et glandulis sessilibus obsitus; labium inferius in dentes 2 ovato-lanceolatos ± abrupte breviter acuminatos fissum; labium superius in dentes 3 brevissime acuminatos conniventes intermedio valde reducto fissum. Corolla calyce circiter duplo longior, breviter hispidula et glanduloso-punctata; tubus in

Fig. 42. *Salvia polyclada* (Kz. 12160 und Kz. 13507a, Typus) $^{3}/_{5}$.

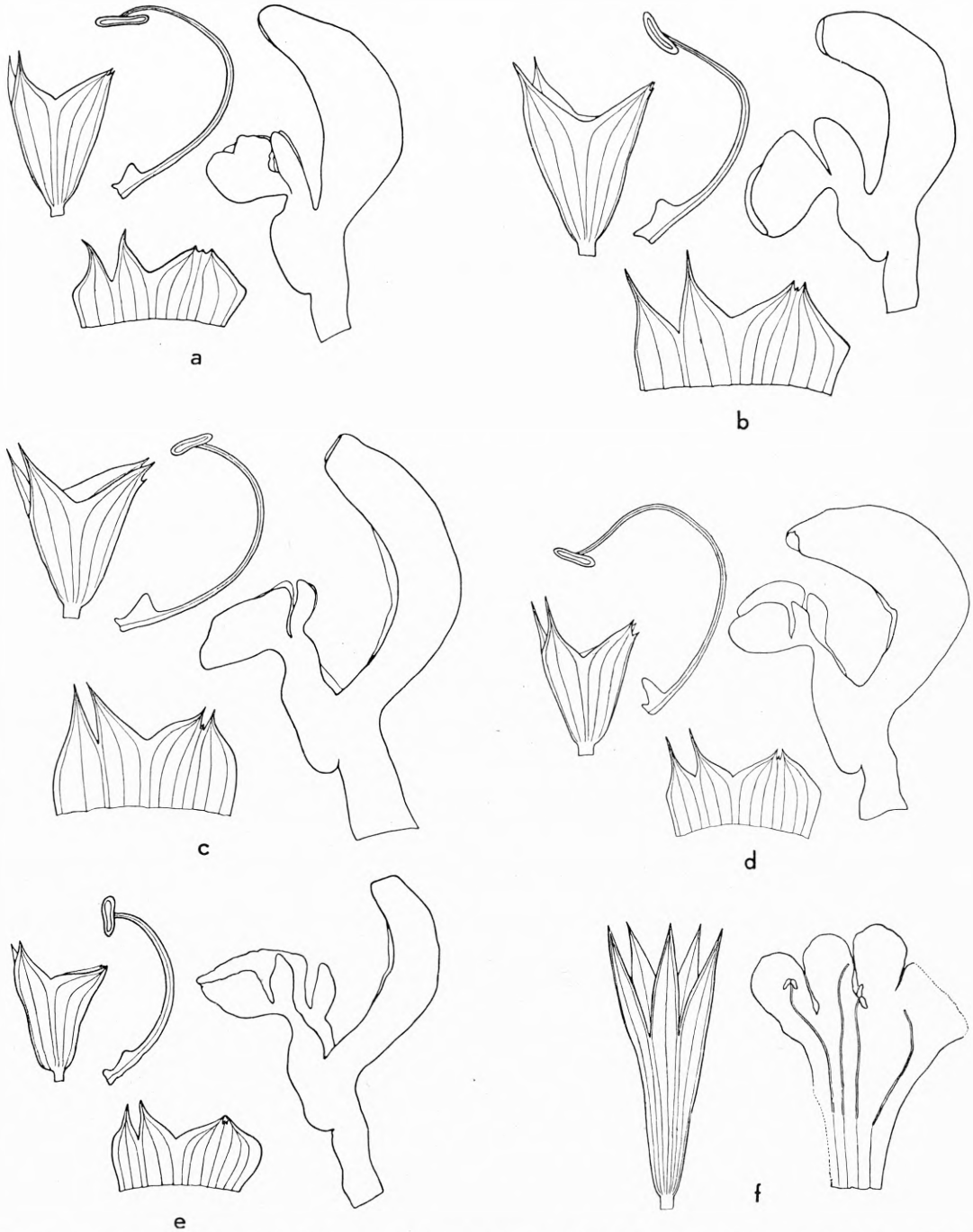

Fig. 43. a. *Salvia Edelbergii* (E. 1300). b—d. *S. polychroma* (b E. 1437, Typus, c Kz. 11888, d Kz. 11971). e *S. polyclada* (Kz. 13507 a). f. *Micromeria subulifolia* (Kz. 13857).

calyce fere complete inclusus, superne abrupte inflato-dilatatus; labium superius in vivo coerulescenti-purpureum (e collectore), in sicco expallens brunescens, falcatum, 7—8 mm longum, 2—2.5 mm altum; labium inferius in vivo flavum, basi intensius maculatum (e collectore), basi attenuata concavum, lobis lateralibus lanceolatis incisionibus angustis profundis a mediano separatis, mediano rotundato-dilatato. Stamina inferne coherentia, connectivo perlongo curvato, crure inferiore valde abbreviato, omnino sterili paulum unilaterialiter subsinuato-dilatato.

C: Shibar Pass, 8000 ft., plant 3 ft. high, hood blue-purple, lip yellow, dotted darker in the throat, 22.VIII.1939 (KOELZ 13507 a, Typus, hb. W., BPI.). Same place, 10000 ft., dry slope, clumps. 3 fr. high, 30.VI.1937 (Kz. 12160, hb. W., BPI.). Lorinj, dry slope, 8000 ft., plant 3 ft. high, 26.V.1939 (Kz. 13651, hb. W., BPI.). Unaipass (N. 51/502).

S. rhytidea Benth. — **C:** Farakulum, 2800 m, common (K. 3390). — **E:** Paghman (N. 50/697).

Zu dieser Art gehört auch GRIFFITH 3989 in hb. W., die weder von BENTHAM noch von BOISSIER zitiert wird. Die Art gehört nach dem Blütenbau unbedingt zur Sektion *Gongrosphace* und ist wohl zunächst mit *S. sahendica* Boiss. & Buhse verwandt, wie bereits BENTHAM vermutet.

S. santolinaefolia Boiss. — **SE:** Pirzada, 900 m (K. 2033). — **Baluchistan:** Quetta, 1600 m (K. 3377).

S. Sclarea L. — **NE:** Khash Distr., 8000 ft., field border (Kz. 12917). Faizabad, 1100—1200 m (E. 1608). — **E:** Kabul (HONIGBERGER, hb. W.). Paghman, 2100 m (K. 2305). Paghman (N. 50/696).

S. spinosa L. — **NW:** Herat-Sauzak, 1200 m (K. 3912).

Perowskia abrotanoides Karel. — **N:** Rabatak, Passhöhe zwischen Taschkurgan und Pol-e-Khomri (N. 50/229). — **C:** Binimang, 8000 ft., dry plain (Kz. 13883). — **Baluchistan:** Quetta, 1800 m (K. 3375).

P. atriplicifolia Benth. — **E:** Kabul, 1800 m (K. 2328). Paghman, 7500 ft., on dry slope (Kz. 12084). Paghman (N. 50/693). Paghman (N. 50/694). Jagdalek, 8000 ft., dry ground, bushy, 3 ft. high, fl. purple, plant scented (Kz. 13198).

Die Pflanze unter KOELZ' 13198 hat schmälere, weniger gelappte Blätter.

Ziziphora afghanica Rech. fil., Phyton 3:169 (1951). — Fig. 44. — **C:** Hauz-i-Mahiha, 2500 m (K. 2342). — **NE:** Faizabad, ca. 1900 m (E. 1362). Urura Pass, ca. 3000 m in der Umgebung der Alm ober Kuschtos (N. 51/625). — **Nuristan:** Jshauda Kotal, (E. 2024). — **E:** Paghman, 2100 m (K. 2320). Paghman (CHAWORTH-MUSTERS, hb. BM). Paghmantal (N. 50/704). Sirotai (Kz. 11955). Mamakhel (Kz. 11527, Typus).

Basi crasse lignescens. Rami floriferi crassi validi humiles ascendentes, fasciculati vel ramosi, infra inflorescentiam saepe dense breviter villosi. Folia ellipticousque late lanceolata, latitudine 3—4-plo longiora, infra medium latissima, consistentia crasse membranacea, folia superiora increscentia, basi ciliata, plerumque omnino glabra, omnia nervis subtus valde prominentibus provisa. Capitula foliis

Fig. 44. *Ziziphora afghanica* (Kz. 11527). $^5/_6$.

summis involucrata. Flores longe pedicellati. Calyx 6 mm longus. Indumentum calycis longiuscule sed laxe hispidulum papillis immixtis.

Die Art ist ziemlich variabel; das charikteristische Stengelindument ist nicht an allen Exemplaren gleich deutlich ausgeprägt. EDELBERG 1310 hat ungewöhnlich schmale Blätter, die bis fünfmal so lang wie breit sind; auch EDELBERG 1362 ist nicht typisch.

Z. pseudodasyantha Rech. fil., Phyton l. c. 167. — **C:** Farakulum, 3100 m (K. 3386). Hauz-i-Mahiha, 2500 m (K. 2344). Lorinj Pass (Kz. 13738). Band-e-Amir, unterster See (N. 51/467). Band-e-Amir, obere und mittlere See (N. 51/452). Band-e-Amir, an trockenen, sandigen Stellen am Bach (N. 51/483). — **E:** Kabul (HONIGBERGER, hb. W.)

Differt a *Z. dasyantha* M. B. s. str. (Kaukasus) basi valde lignosa habitu non repente ramis floriferis in parte superiore non patule pilosis, calycibus brevioribus ad summum 5 mm longis brevius pilosis, foliis consistentia crassioribus.

Z. tenuior L. — **NW:** Kishlik, 700 m (K. 4054). — **SW:** Jija, 1200 m (K. 3571). — **NE:** Kail, 8000 ft., dry slope (Kz. 11675). — **Nuristan:** Kantivo, 2300 m (E. 733). Gusalak, 1000 m (E. 1499, 1500). — **E:** Kabul (N. 50/722, 723, 724). Kabul (N. 51/40). Kabul (LINDBERG). Tscharikar (N. 50/721). Begram near Charikar, 5000 ft.

(Codrington 3). Paghman, 17 miles west of Kabul, 7000—9000 ft. (Chaworth-Musters). Gulbahar, 5000 ft., dry slope (Kz. 11439). — 'Afghanistan' (Griffith 3998, hb. W.). — **Baluchistan:** Quetta, 1600 m (K. 3382).

Calamintha repens (Don.) Benth. — **E:** Paghmantal (N. 50/701).

C. umbrosa (M. B.) Benth. — 'Afghanistan' (Griffith 3980, hb. W.).

C. vulgaris (L.) Druce — **Nuristan:** Nishei, 1600 m (E. 786).

Fig. 45. *Micromeria subulifolia* (Kz. 13857). $^1/_1$.

Micromeria subulifolia Rech. fil., n. sp. — Fig. 45 und 43 f.

Suffrutex pumilus caespitosus, caudicibus abbreviatis foliis anni praecedentis persistentibus imbricatis obsitus, surculis sterilibus hornotinis abbreviatis. Caules floriferi 3—7 cm alti, stricti, tenues, internodiis numerosis infimis valde abbreviatis superioribus sensim paulo elongatis ad 4—10 mm longis, simplices, a medio vel a tertia vel quarta parte superiore in spicastrum abeuntes. Folia omnia anguste lanceolato-subulata crassa rigida saepius ± complicata, dorso nervis crasse prominentibus 3(—5) percursa, infima imbricata, rigide erecto-patentia, flavescentiviridia, ut caules minutissime papillosa, interdum ± glabrescentia; infima ca. 2 mm, superiora increscentia 3—4(—5) mm longa, in folia flores fulcrantia abbreviata proportione latiora abruptius acuminata sensim transientia. Cymae omnes ad ramulos unifloros reductae; ramuli floriferi inferiores 3—7 mm longi, superiores valde abbreviati. Flores singuli, bracteolis minutis singulis foliis similibus suffulti. Calyx post florendum ± 7 mm longus, anguste tubulosus, tenuiter elevate 15-nervius, membranaceus, ore rectus, ad tertiam circiter partem in dentes lanceolatos subulatos aequales porrectos vel leviter patentes fissus, minute glanduloso-puberulus. Corolla ("probabiliter coeruleo-purpurea" e collectore) fragmentarie tantum obvia (vide iconem). Filamenta omnia inclusa, dua posteriora longiora, thecis valde divaricatis. — Species valde peculiaris, cum nulla alia comparanda; foliis rigidis anguste lanceolato-subulatis, caulibus floriferis pumilis strictis, cymis unifloris, calycibus 15-nerviis longissime tubulosis probabiliter sectionem propriam nisi genus proprium sistit.

C: Baligali Pass, 9000 ft., dry cliff-face, clumps, flowers prob. blue-purple, 30.VIII.1939 (Koelz 13857, hb. BPI., W. fragm.).

Fig. 46. *Origanum glaucum* (E. 1198). $^1/_2$.

Origanum glaucum Rech. fil. & Edelberg, n. sp. — Fig. 46 und 47.

Sect. *Eu-Origanum* Benth. — Suffrutescens multicaule. Caules 20—30 cm alti, internodiis mediis ± 3 cm longis, tenues, purpureo-violascentes, pilis brevissimis curvatis sparse puberuli glabrescentes, praeter inflorescentiam non ramosi. Folia caulina inferiora longiuscule (ad 5 mm) tenuiter petiolata; lamina ovata, ad. 18 mm longa, ad 12 mm lata, basi late cuneata usque fere rotundata, in tertia parte inferiore latissima, apice obtusiuscula vel subacuta, omnino integerrima, minutissime scabridula praeterea glabra, utrinque glauca subtus pallidiora ibique sparse impresse glanduloso-punctata, consistentia in sicco tenuiter membranacea; nervi tenues arcuato-

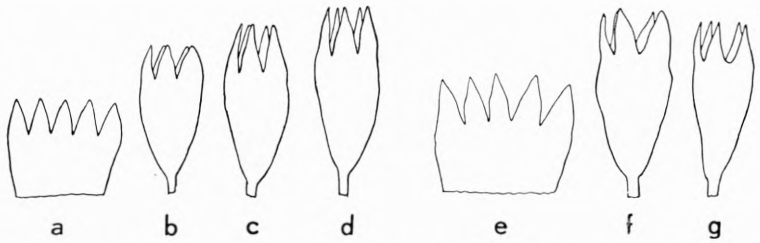

Fig. 47. a—d. *Origanum glaucum* (a—b E. 1198, c Kz. 12926, d E. 1393). e—g. *O. vulgare* (e—f Hallstadt, Stapf, g "Finnland 333").

pennati vix anastomosantes. Folia superiora similia, sensim minora, brevius petiolata. Inflorescentia e spicastris brevibus tenuibus paucifloris densiuscule subcorymboso-dispositis composita. Bracteae 3(—4) mm longae obovato-lanceolatae breviter acuminatae pallide virides, glandulis flavis sessilibus obsitae, glabrae, obsolete nervosae. Calyx ± 2.2 mm longus, anguste infundibuliformis, fere ad quartam partem in dentes 5 acutos triangulares aequales divisus, tenuiter nervatus, extus glaber sparse glanduloso-punctatus pallide viridis, intus ore albo-villosus. Corolla calyce vix duplo longior, in vivo certe alba, in sicco flavescenti-brunescens. — Species nova in affinitatem remotiorem *O. vulgari* L. spectans, ab eo caulibus gracilibus, foliis minutis glaucis glabris, bracteis et calycibus pallidis glabris minutis, dentibus calycinis proportione paulo brevioribus, floribus minutis diversa.

Nuristan: Chetras, 2000 m, 29.VII.1948 (Edelberg 1198, Typus, hb. W., C.). Darimtal ab Ort Darim aufwärts, ca. 1900—2400 m (N. 51/988). — **NE:** Faizabad (N. 51/1961).

Origanum glaucum Rech. fil. & Edelberg var. nova ***laxius*** Rech. fil. & Edelberg.

Differt a type caule jam infra medium ramoso et florifero, inflorescentia ampla laxa, spicastris non corymbose dispositis. — **NE:** near Faizabad, ca. 1900 m (Edelberg 1393, Typus, hb. W., C.). Khash District, 8000 ft., dry ground, flowers rose, mint-scented (Kz. 12926, hb. W., BPI.).

O. laxiflorum Royle (e descr.) — **Nuristan:** Zwischen Ningalam, 1300 m bis Darim Ort, ca. 1900 m (N. 51/948).

Fig. 48. *Thymus afghanicus* (Kz. 12981). $^1/_1$.

Fig. 49. *Thymus coriifolius* var. *Edelbergii* (E. 1026). $^1/_1$.

Thymus[1] ***afghanicus*** Ronniger, n. sp. — Fig. 48.

Basi valde lignescens, ramosus. Rami floriferi 6—7 cm longi, quadranguli, circumcirca pilis brevibus (0.1 mm) rigide patentibus obsiti. Surculi steriles procumbentes evoluti. Folia glabra, basi non ciliata, petiolata, obovata, antice rotundata, sursum increscentia, media 10—13 mm longa, 3—5 mm lata, infima minuta anguste elliptica (7 × 2 mm) a superioribus valde diversa, nervi laterales etiam supra medium folii abeuntes, omnes valde prominentes. Inflorescentia capitata. Pedicelli pilis brevibus rigide patentibus obsiti. Calyx 5 mm longus, ventro pilosus, dentes superiores subglabri, minute triangulares, 0.4 mm longi. Corolla calyce 3 mm longior, roseo-purpurea, extus glabra. Folia utrinque, calyx et corolla omnino

[1] Gattung *Thymus* bestimmt von † K. Ronniger, Wien.

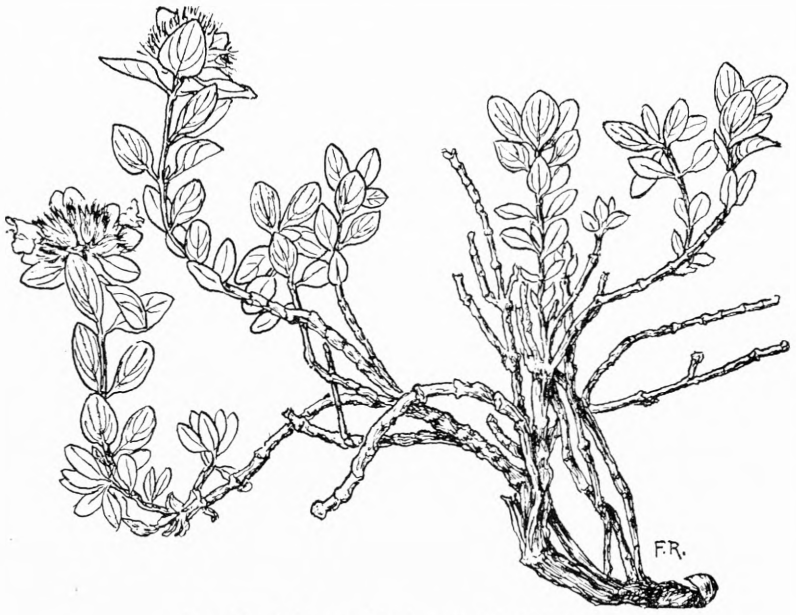

Fig. 50. *Thymus Koeieanus* (K. 2205). $^1/_1$.

glandulis minutis nitentibus dense punctata. — *Th. afghanicus Th. collino* M. B. affinis videtur, ab eo surculis sterilibus procumentibus evolutis, foliis increscentibus ciliis basalibus deficientibus, calycibus magnis diversus.

NE: Khash District, 10000 ft., 9.VIII.1937 (KOELZ 12981, hb. W., BPI.).

Thymus coriifolius Ronniger, Fedde Rep. 31:147 (1932). — Fig. 49. — **Nuristan:** Parun-Minjan Pass, ca. 3500 m (E. 1280). Pashki, 2300 m (E. 912 a). Nishei, 2500 m (E. 773). Elasoon, 3000 m (E. 1673). Weran, ca. 3800 m (E. 1251). — **E:** Sirotai, 3000 m (Kz. 11945, planta partim anomala, inflorescentia elongata, foliorum fasciculis terminata).

Th. coriifolius Ronniger var. nov. ***Edelbergii*** Ronn.

Ciliae dentium calycinorum superiorum eas inferiorum aequantes, 0.56 mm longae, tubus calycis circumcirca pilis similibus obsitus (in planta typica dentes calycini superiores papillis brevissimis 0.09 mm longis obsiti).

Nuristan: Shtive, 2550 m, 15.VI.1948 (EDELBERG 1026, hb. W., C.).

Thymus Koeieanus Ronniger, n. sp. — Fig. 50.

Basi valde lignescens copiose ramosus, surculis sterilibus procumbentibus nullis. Rami floriferi ca. 7 cm longi, subglabri, pilis brevissimis retrorsis sparsissime obsiti. Folia sursum valde increscentia, partim surculos axillares breves emittentia; folia omnia glabra, petiolata, ciliis basalibus nullis, infima minuta (5 × 2 mm), in parte inferiore caulis approximata, mediana 10—12 mm longa, plerumque 5 mm lata, oblongo-ovata, in tertia parte inferiore latissima, nervis lateralibus infra medium abeuntibus paulum prominentibus. Inflorescentia capitata. Calyx magnus, 7 mm

longus; dentes superiores triangulares ciliati, inferiores quam superiores longiores; tubus ventro pilosus. Corolla rubra calyce 5 mm longior, extus puberula. Folia utrinque, calyx et corolla omnino copiose minute glanduloso-punctata. — *Th. Koeieanus Th. Kotschyano* Boiss. et Hoh. affinis, ab eo caulibus subglabris, foliis increscentibus, basi non ciliatis, corollis rubris diversus.

NW: Sauzak, NW. of Herat, 2500 m, 10.VI.1948 (Köie 2205, hb. W., C.).

Thymus pseudalbanus Ronniger, n. sp.

Humilis, longe repens (innovatione *Eurepentium* Velen). Rami floriferi seriatim dispositi, 2—2.5 cm alti, internodium summum holotrichum, cetera goniotricha, pilis retrorsis obsita. Folia sursum valde increscentia, omnia glabra, in tertia vel quarta parte inferiore ciliata, elliptica usque anguste elliptica, basi cuneata, petiolo non distincto, in tertia parte superiore latissima, non glanduloso-puntata; nervi laterales utrinque tres, omnes subtus valde prominentes. Folia infima 4 mm longa, 4 mm lata, in tertia parte inferiore latissima. Folia surculorum sterilium 10 mm longa, 4 mm lata, late elliptico-cuneata, fasciculos foliorum angustiorum axillares proferentia, glandulis stipitatis nullis. Calyx 4 mm longus, ventro pilosus, dorso glaber; dentes calycini superiores breviter triangulares, 0.65 mm longi, ciliis nullis. Corolla lilacina (e collectore), gynodynamica, 5 mm longa, glabra.

Nuristan: Ururapass, in der Umgebung der Alm oberhalb Kuschtos, ca. 3000 m, 6.VIII.51 (Neubauer 642, hb. W.).

Thymus pseudoalbanus var. ***angustifrons*** Ronniger, var. nov.

Folia tantum 1—2 mm lata.

Nuristan: Ururapass, beiderseits oberhalb der Waldgrenze, ca. 3900 m, 9.VIII.51 (Neubauer 590, hb. W.).

T. pseudalbanus ist habituell dem *T. albanus* H. Braun in Luerssen, Bibliotheca Botanica, Heft 26: 86 (1892) sehr ähnlich; die unterscheidenden Merkmale sind folgende:

	T. albanus	*T. pseudalbanus*
Blühende Aeste:	durchaus goniotrich,	oberstes Internodium holotrich, sonst goniotrich;
Blätter:	wenig inkreszierend, bis $^1/_2$ oder $^2/_3$ bewimpert,	stark inkreszierend; bis $^1/_3$ bewimpert;
Seitennerven:	jederseits 2,	jederseits 3;
obere Kelchzähne:	lang und schmal, gewimpert,	kurz, dreieckig, ungewimpert;

Zataria multiflora Boiss. — **Baluchistan:** Quetta, ca. 1700 m (K. 3387).

Lycopus europaeus L. — **N:** Khanabad, 2000 ft., along stream (Kz. 12207). — **C:** Doab, 1400 m (K. 2879). Kamard, 6000 ft., along stream, 2 ft. high (Kz. 13615). — **NE:** Takia, 4500 ft., damp ground, 3 ft. high, fl. white (Kz. 13095). — **E:** Kabul, an einem Bewässerungsgraben (N. 50/46).

Mentha[1] *longifolia* (L.) Huds. s.l. — **NE:** Hazratsaid, 8000 ft., stream edge (Kz. 12863). Minjan, 2300 m (E. 1442). — **Nuristan:** Im Tal und um den Ort Kurder (N.

[1] Gattung *Mentha* bestimmt von F. Petrak, Wien.

51/773). Gusalak (N. 51/828). — **E:** Kabul, Guzar Gah, an Bewässerungsgräben (N. 50/45). Jalalabad (N. 51/850). — **SE:** Kandahar, Pirzada, 900 m (K. 2079).

M. longifolia (L.) Huds. var. *Royleana* Benth. — **C:** Kala Sarkari, 5000 ft., stream bank (Kz. 13900). Hauz-i-Mahiha (K. 3378).

M. longifolia (L.) Huds. var. *stenostachya* Boiss. — **NW:** Safedsang, 10000 ft., along stream (Kz. 13991). — **NE:** Ruka, 1800 m (K. 3379). — **C:** Doao, 5000 ft., along stream (Kz. 13513). — **E:** Paghman, 7500 ft., meadow (Kz. 12062). — **SE:** Pirzada, 900 m (K. 3380).

Mentha viridis L. — **E:** Kabul, kultiviert (N. 50/44).

Plectranthus rugosus Wall. — **Nuristan:** Vama, 1400 m (E. 1219). Derin (E. 1777). Kamdesh (E. 1154). Zwischen Ningalam (1300 m) bis Darim Ort (ca. 1900 m) (N. 51/970). Aschpi pass (N. 51/1045). Im Tal und um das Ort Kurder, 1600—1700 m (N. 51/771). — **E:** Chandau, 8000 ft., dry slope, fl. lavender (Kz. 11770).

Ocymum basilicum L. — **NE:** Jurm, 7000 ft. (Kz. 12912).

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Dan. Biol. Skr. 8, no. 2 (1955)

M. KØIE AND K. H. RECHINGER

SYMBOLAE AFGHANICAE

Enumeration and Descriptions of the Plants Collected by
L. EDELBERG and M. KØIE on "The 3rd Danish Expedition to Central Asia"
and by G. KERSTAN, W. KOELZ, H. F. NEUBAUER, O. H. VOLK,
and others in Afghanistan.

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København 1955
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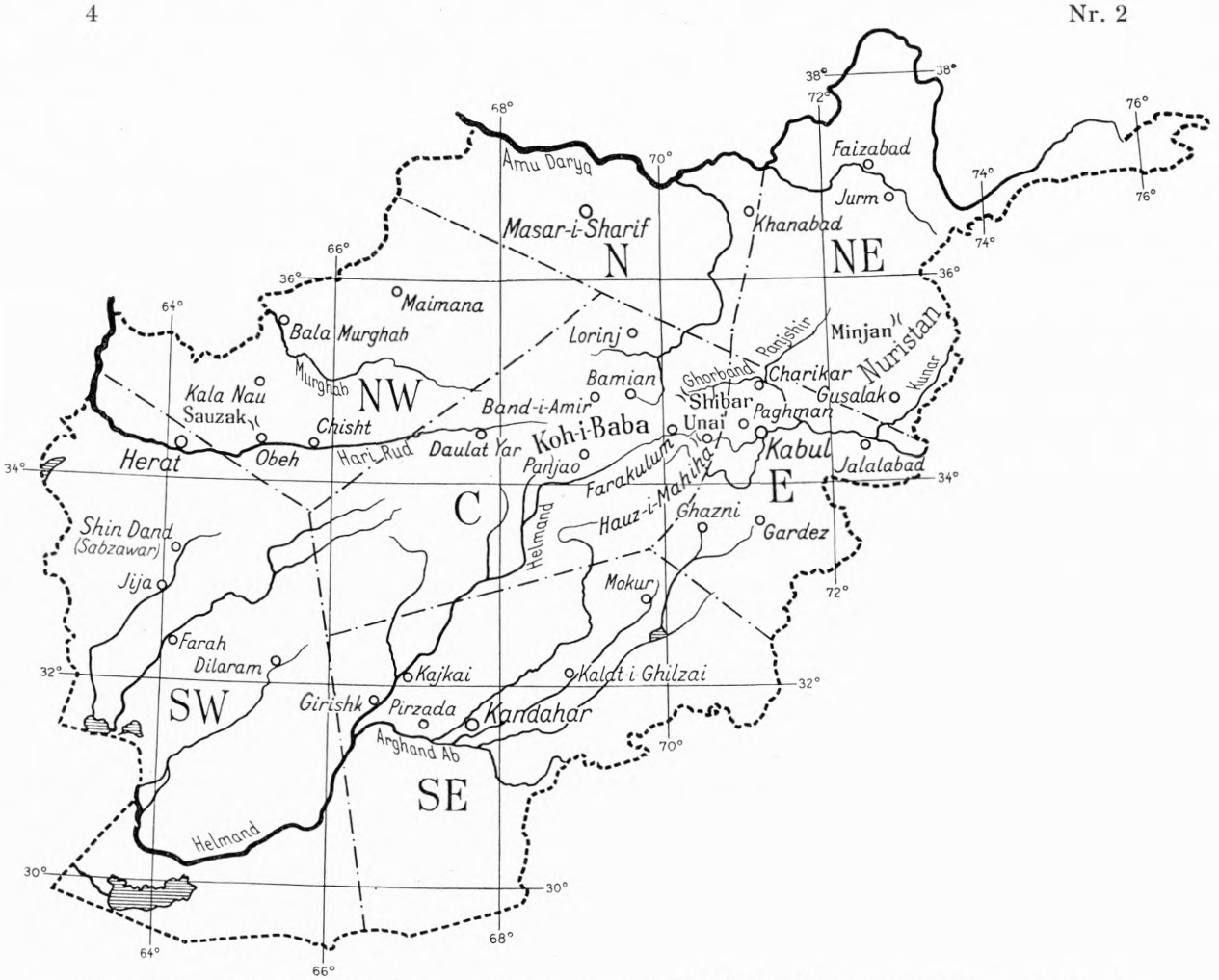
Introduction.

'Symbolae Afghanicae' contain an enumeration and descriptions of plants collected by L. EDELBERG and M. KØIE on 'The 3rd Danish Expedition to Central Asia' and by W. KOELZ, H. F. NEUBAUER, O. H. VOLK, and others in Afghanistan. The total number is about 11,000. The first part of Symbolae Afghanicae (Dan. Biol. Skr. 8, no. 1, 1954) contains a survey of plant-collecting in Afghanistan, compiled by M. KØIE, and the Labiatae by K. H. RECHINGER.

Many of the localities referred to in this work are not shown on any map. Others will be difficult to identify because of considerable discrepancies in orthography. In the absence of established orthographic rules, we have given the localities in the spelling used by the collector, because this is the spelling that will be found on the labels. A complete list of more exact geographical locations cannot be prepared until the treatment has been completed because new material has been coming in all the time. For preliminary orientation we have divided Afghanistan into seven parts: N, NE, E, SE, SW, NW and C as indicated in the map. These geographical abbreviations are placed in front of the localities given. Nuristan has been segregated from the north-east part of the country, mainly because it is a well-defined area from which a particularly large number of plants has been collected, but also because the monsoon rain renders the vegetation of Nuristan different from that of most of the other parts of Afghanistan. Otherwise, no attempt has been made to divide the country by plant geography.

All numbers are kept at the herbaria for which the plants were collected; thus, plants collected by EDELBERG and KØIE are kept at Copenhagen; those collected by KOELZ are in Beltsville, and NEUBAUER's are in Vienna. In most cases, however, there are duplicates of the numbers collected by EDELBERG, KØIE and KOELZ. Of such numbers there is also a specimen in the museums with which the respective taxonomists are associated. For new species that specimen will generally be the Type. The museums where the new species are kept is given in the text; the first museum indicated contains the herbarium where the type specimen is to be found.

Data on habitats, etc. have been cited in the language used by the collector on the label.



Map of Afghanistan with the divisions used in the text and the localities most commonly mentioned.

The following abbreviations have been used for herbaria: C is the Botanical Museum, Copenhagen; BM: British Museum; BPI: Beltsville, Plant Industry Station, Maryland, U.S.A.; W: Naturhistorisches Museum, Vienna.

The names of the collectors are abbreviated as follows: E is L. EDELBERG; K: M. KØIE; Kz: W. KOELZ; N: H. F. NEUBAUER; V: O. H. VOLK.

The habit figures have been drawn by Dr. FRIDA RECHINGER, the flower dissections by Dr. A. PATZAK, in most cases after the type specimen. From the Rask-Ørsted Foundation we have received a grant for this purpose, for which we wish to express our sincere gratitude.

The plant families will be published in the sequence in which the treatment is completed. It is intended to conclude the work with a survey of Afghanistan's vegetation.

COMPOSITAE

Von K. H. Rechinger, Wien.

Solidago virga aurea L. — **Nuristan:** Vaigel (E. 2053). Pashki, 2300 m (E. 1311). Zwischen Kotal-e-Agok und Alm bis Waigel (N. 51/931). Aschpi pass (N. 51/1033).

Aster altaicus Willd. — **NW:** Zehnadis, 10000 ft., dry slope (Kz. 14034). Ardewan, 1500 m (K. 2250). — **C:** Band-e-Amir, am oberen See (N. 51/473). Bamian (N. 51/398). Kala Sarkari, 7000 ft., dry fields (Kz. 13930). Polat, 9000 ft. (Kz. 13948). Shibar Pass, 10000 ft., dry slopes (Kz. 12162). Shanbashak Pass, 9300 ft., dry plain (Kz. 13866). Hauz-i-Mahiha, 2500 m, fields (K. 3265). Lorinj, 8000 ft., in field (Kz. 13677, 13678). Doao, 5000 ft., dry plain (Kz. 13527). — **NE:** Magnaul, 11000 ft. (Kz. 12783). Rustak, 2000 ft., dry ground (Kz. 13141). Kachari, 2300 m (E. 1455, 1597). — **Nuristan:** Zwischen Kotal-e-Agok und Alm bis Waigel (N. 51/937). Gusalak (N. 51/819). Darimtal, ab Ort Darim aufwärts, 1900—2400 m (N. 51/1008). Kushtos, 1800 m (E. 1113). Kamdesh (E. 1127). Asmar, 900 m (E. 1626). — **E:** Giri, 7000 ft., dry slope (Kz. 11504). Paghman, 2100 m (K. 2317). — **SE:** Kandahar, field edge (Kz. 13228).

Die nuristanischen Exemplare sind durch starke rutenförmige Verzweigung, schmale Blätter und sehr kleine Köpfchen auffällig und bilden vielleicht eine eigene Rasse.

A. flaccidus Bge. — **NE:** Sanglech, 13000 ft., flowers rays blue-purple (Kz. 12632). — **Nuristan:** Netshingel, 4000 m (E. 2007). Vaigel (E. 2030). Urura Pass, in der Umgebung der Alm ober Kuschtos, 3000 m (N. 51/606). Urura, 3900 m, Passhöhe (N. 51/578).

A. lacunarum Aitch. & Hemsl. — **NW:** Burchao Pass, 9000 ft., along stream, fl. rose-lavender, 6 inches high (Kz. 14131). — **C:** Qala Sakawa, 2500 m, meadow (K. 3279). Panjao, 2700 m (K. 2693). Kamard, 6000 ft., along stream, rays rose-purple (Kz. 13590). Bamian, im Geröll und Sand eines Bachbettes (N. 51/413). Band-e-Amir, am Bach (N. 51/480). — **E:** Kabul, trockener Hang (N. 51/367).

Erigeron, Sect. *Euerigeron* DC. sensu Asch. et Graebn. et Sect. *Trimorphaea* Cass.

E. canadensis L. — **Nuristan:** Chetras, 2000 m (E. 1213). Gusalak, 1000 m (E. 1507).

Erigeron discernendus Rech. fil., n. sp. — Fig. 1 und 8 a.

Sect. *Euerigeron* DC. — Basi lignescens multicaulis, caules ad 40 cm alti, stricte erecti, in summa parte breviter corymbose pauciramosi, internodiis mediis ± 2 cm longis, tota longitudine dense foliati, elevate striati, laxe crispule pubescentes eglandulosi. Folia basalia petiolo incluso ad 8 cm longa, ad 7 mm lata, in petiolum alatum insensibiliter attenuata, anguste oblongo-lanceolata, acuta, integra. Folia caulina numerosissima, omnia anguste oblongo- usque lineari-lanceolata, inferiora basi perlonge sensim attenuata subpetiolata, superiora valde abbreviata sessilia. Folia consistentia in sicco crasse herbaceo-membranacea, colore flavescenti-viridi, nervis praeter costam medianam crassiusculam vix prominentibus, indumentum foliorum e pilis eglandulosis brevibus et longioribus valde laxe dispositis consistens eglandulosum. Capitula ad extremos ramos singula, in statu compresso 12—15 mm diametro; involucrum polyphyllum ± 6 mm longum, phylla omnia subaequalia angustissime lineari-lanceolata, dorso late atroviridia, margine late hyalina, apice longe sensim attenuata, dorso pilis longis crispulis villosa, pilis brevioribus glanduliferis immixtis. Ligulae albidae vel pallide roseae (e collectore), in sicco expallescentes, tenuiter filiformes, involucro vix dimidio longiores. Achaenia juvenilia vix 1.5 mm longa, appresse sericea; pappus achaeniis plus quam duplo longior, scabridulus, brunescenti-rufescens. — Affinis videtur *E. Wightii* DC., a quo differt indumento caulis et foliorum valde laxo multo breviore imprimis in foliis basalibus evanescente, glandulis sessilibus in caule non obviis, involucri phyllis pilis crispulis longioribus flexuosis densius villosis, pappo longiore 5—6 mm longo.

NE: Sanglech, 11500 ft., stream bed, flower rays white to pale rose-purple, 24.VII.1937 (Koelz 12607, Typus, hb. W., BPI.). Minjan, Zebak, 2600 m (E. 1519, hb. C.).

E. himalayensis Vierh. — **Nuristan:** Kushtos, 1800 m (E. 1111). Chetras, 2000 m (E. 1199). Pashki, 2300 m (E. 1338). Gusalak (N. 51/825).

Erigeron myriocephalus Rech. f. et Edelberg, n. sp. — Fig. 2.

Sect. *Euerigeron* DC. — Annuus. Caulis 25 cm altus, ascendenti-erectus, prope basin ad 4 mm crassus, teres, striato-sulcatus laxe longiuscule hirsutus, dense foliatus, a quarta circiter parte inferiore ramosus et florifer, rami erecto-patentes tenues, iteratim ramosi conferte capituliferi, inflorescentiam dense scopiformem efficientes. Folia omnia in sicco tenuiter membranacea, laete viridia, praeter marginem et costam medianam ciliatam glabra; basalia et caulina inferiora in petiolum laminam circiter aequantem anguste cuneato-attenuata; lamina 3—5 cm longa, 5—9 mm lata, lanceolata, valde acuta, apicem versus grosse pauciserrata; folia superiora et inflorescentiae ramos fulcrantia sensim angustiora, brevius petiolata, minus anguste serrata usque integra. Involucrum ± 2.5 mm longum, hemisphaericum; phylla triseriata, anguste linearia, tenuiter membranacea, scarioso-marginata, apice longe sensim attenuata, glaberrima, margine interdum sparse indistincte lacerato-ciliata. Flores omnes ligulati, ligulae pallide purpureae filiformes convolutae, involucrum

Fig. 1. *Erigeron discernendus* (Kz. 12607). $^1/_2$.

Fig. 2. *Erigeron myriocephalus* (E. 204). $^2/_3$.

paulo tantum superantes. Achaenia (juniora) sericeo-hirsuta. Pappus uniserialis albus, quam achaenia juniora plus quam triplo longior. — Differt ab *E. Stocksiano* Boiss. (sec. diagnosim) indumento hirsuto nec glanduloso-scabro, involucri glaberrimi nec scabridi phyllis anguste linearibus sensim attenuatis; differt ab *E. Bungei* Boiss. (sec. diagnosim) indumento laxe hirsuto nec hirsutolanato, foliis inferioribus lanceolatis acutis glabris nec ovato-spathulatis obtusis glandulosis, involucro glabro triseriato nec scabrido biseriato.

Fig. 3. *Erigeron petroiketes* (Kz. 12752). $^1/_1$.

Nuristan: Gusalak, in alveo fluvii, 16.III.1948 (Edelberg 204, unicum hb. C.), ibidem 26.II.48 (E. 29a, C.), ibidem (E. 31, C.), ibidem (E. 126, C., W.).

Erigeron petroiketes Rech. fil., n. sp. — Fig. 3 und 8 a.

Sect. *Euerigeron* DC. — *Rhizoma paulum induratum*, caules floriferos plerumque plures emittens. Caules 3—10 cm alti, monocephali, inferne densius superne laxius foliati, internodiis mediis in speciminibus bene evolutis saepe ultra 1 cm longis, indumentum breviter sublaxe superne dense hirsutum papillis glanduliferis brevissimis sat sparse immixtis. Folia basalia et rosularia petiolo 1—3 cm longo suffulta, lamina (1—)3 cm longa, 1.5—3 mm lata, anguste oblongo-linearis, plerumque acuta, indumentum breve hirsutum, subtus densius supra laxum, pilis glanduliferis brevibus sat raris. Folia caulina superiora similia, ± sessilia, valde decrescentia. Caulis infra capitulum sensim paulo incrassatus; involucrum in statu compresso 7—8 mm longum, 12—15 mm diametro, phyllis latiuscule lanceolatis acutis aterrimis dorso pilis longis crispulis in sicco flavescentibus dense villosum, phyllis apice tantum denudatis. Ligulae albidae usque roseae (e collectore), tenuiter filiformes, involucro vix duplo longiores. Achaenia juvenilia ca. 2 mm longa, superne breviter hirsuta, inferne glabrescentia; pappus sordide albus flavescens laevis, ad 3 mm longus. — Species nova ex affinitate *E. uniflori* L. foliis angustissime linearibus, involucri phyllis latiusculis aterrimis dorso densissime longe crispule flavescenti-villosis diversus.

NE: Minjan Pass, 13500 ft., wet gravel, rays white to rose-purple, 27.VII.1937

(Koelz 12752, Typus, hb. W., BPI.). Minjan Pass, 12000 ft., fl. rays purple, 26.VII. 1937 (Kz. 12665, hb. W., BPI.). Minjan, Weran, 3700 m (E. 1596, hb. C.). Parun — Minjan Pass, 4000 m (E. 1271, hb. C.).

E. uniflorus L. s. l. ad int. — **Nuristan** (E. 1754).

E. orientalis Boiss. — **C:** Hauz-i-Mahiha, 2500 m (K. 2385). — **NE:** Minjan, 2550 m (E. 1453). — **Nuristan:** Gusalak (N. 51/818). Zwischen Kotal-e-Agok und Alm bis Ort Waigel (N. 51/918). — **E:** Paghman (N. 50/876, 50/898). Paghman, 7500 ft., meadow, fl. rays rose-purplish (Kz. 12063). Paghman, 2100 m (K. 2310).

Neubauer 918 abweichend durch sehr zarten Wuchs, lang gestielte Köpfchen, sehr kleine, relativ armblütige Hüllen und kurze, lockere Behaarung aller vegetativen Teile.

E. multicaulis Wall. — **NW:** Safedsang, 10000 ft., along stream, rays purplish (Kz. 14008). — **C:** Abi Khurak, 9000 ft., fl. rose-lavender (Kz. 13803). Farakulum, 2700 m, along stream (K. 3277). Hauz-i-Mahiha, 2600 m, along stream (K. 2409). — **NE:** Minjan, 2550 m (E. 1602). — **Nuristan:** Zwischen Kotal-e-Agok und Alm (N. 51/885). Pashki, 2300 m (E. 1337). Netshingel, 3500—4000 m (E. 1700).

E. orientalis und *E. multicaulis* lassen sich im Allgemeinen durch folgende Merkmale unterscheiden:

E. orientalis Boiss.	*E. multicaulis* Wall.
Wuchs kräftig, aufrecht oder aufsteigend.	Wuchs zarter, aufrecht.
Blütenstand stark verzweigt, vielköpfig, Köpfchen zusammengedrängt.	Blütenstand schwach korymbös verzweigt, wenigköpfig. Köpfchen nicht zusammengedrängt.
Stengel kraus wollig behaart.	Stengel kahl, bisweilen mit ganz feinen, kleinen Papillen besetzt.
Blätter lineal-spatelig, stumpf oder zugespitzt, zumindestens am Rand rauh behaart, Fläche kurz-rauhhaarig bis verkahlend.	Blätter lineal-lanzettlich, spitz, fast kahl, höchstens mit ganz feinen, kleinen Papillen besetzt, am Blattrand zerstreut mit einzelnen längeren Haaren vermischt.
Blätter im Durchschnitt bis 10 cm lang, 10—14 mm breit.	Blätter im Durchschnitt 3—4 cm lang, 7—8 mm breit.
Hüllblätter schmal lineal-lanzettlich, dicht kurzkraus behaart.	Hüllblätter schmal lineal-lanzettlich, mit feinen Papillen besetzt oder verkahlend.

Einzelne Pflanzen, wie z. B. Edelberg 1700, sind jedoch intermediär. Beide Arten sind sehr variabel.

Erigeron, Sect. *Conyzastrum* Boiss. (Species annuae):

Erigeron gusalakensis Rech. f. et Edelberg, n. sp. — Fig. 4.

Sect. *Conyzastrum* Boiss. — Annuus. Caulis ca. 20 cm altus, prope basin 6 mm crassus, breviter glandulosus et longe hirsutus, striato-sulcatus, purpurascens, densissime foliatus, ex axillis rosulas foliorum emittens, in tertia parte superiore sub-

Fig. 4. *Erigeron gusalakensis* (E. 151). $^{2}/_{3}$.

corymbose pluriramosus et florifer. Folia omnia consistentia in sicco tenuiter membranacea subsordide viridia, pilis glanduliferis breviter copiose obsita et pilis eglandulosis longioribus hirsuta. Folia rosularia numerosa, petiolo laminam aequante lato (prope basin 3 mm) suffulta; lamina lanceolata ad 3 cm longa, 5—7 mm lata, in petiolum longissime attenuata, apice acuta, grosse inciso-pauciserrata. Folia caulina linearia, integerrima, lamina a petiolo vix distincta ad 3.5 cm longa, 2—3 mm lata, integerrima, sub apice interdum paulo latior, acuta; folia inflorescentiae ramos fulcrantia angustisima linearia, ramealia diminuta filiformia. Involucrum depresso-hemisphaericum, ± 6 mm longum, in statu compresso 12 mm diametro atropurpureum, subuniseriatum; phylla latiuscule linearia, acuta, prope basin 1—1.2 mm lata, glanduloso-papillosa et pilis longioribus eglandulosis hirsuta. Flores et pappus involucrum aequantes; flores marginales feminei tenuissime filiformes, ligulae nullae, interiores tenuiter tubulosi pallide filiformes limbo acute brevidentato. Achaenia (juniora) subappresse pilosa; pappus albus scabridulus (15—) 20-radiatus achaenio juvenili subtriplo longior. — Differt ab *E. linifolio* Willd. caule crasso densissime foliato, inflorescentia subcorymbosa, pappo albo nec rufescente, involucri oligophylli subuniseriati purpurei phyllis latioribus eorumque indumento.

Nuristan: Gusalak, 1000 m, 9.III.1948 (Edelberg 151, hb. W., C.).

E. khorassanicus Boiss. — **NW:** Safedsang, 10000 ft., along stream (Kz. 14007). Burchao Pass, 10000 ft., dry slope, yellow, turning rose-purple (Kz. 14138). — **C:** Hauz-i-Mahiha, 2600 m, along stream (K. 2410). Farakulum, 2700 m (K. 3276). Aoi Khurak, 9000 ft., field (Kz. 13802). Sabz Pass, 10000 ft., spring meadow (Kz. 13821). Lorinj Pass, 10000 ft., dry slope, yellowish (Kz. 13751). — Wahrscheinlich abgeweidete Herbstform. — **NE:** Rubat, 8000 ft., field, rays white to purplish (Kz. 12825). — **E:** Oberes Paghmantal (N. 50/894).

E. linifolius Willd. — **E:** Laghman, 4000 ft., in field, fl. cream, 3 ft. high (Kz. 11615).

E. umbrosus (K. & K.) Boiss. — **Nuristan:** Gusalak, 1000 m (E. 30). — **E:** Paghman (N. 50/877).

Erigeron, Sect. *Conyzastrum* Boiss. (Species perennes):
Confer Rechinger fil., Phyton 2, pag. 124—133 (1950).
Clavis analytica sectionis emendata.

1a) Indumentum breve densum glanduloso-viscosum. Foliorum nervatura in pagina inferiore valde prominens. Capitula maiuscula, involucri phyllis 8 (—10) mm longis, anguste lineari-lanceolatis ..... *E. polyadenus* Rech. f. et Köie
1b) Indumentum varium nunquam glanduloso-viscosum. Foliorum nervatura non evidenter prominens 2
2a) Indumentum dense candide tomentosum valde appressum omnino eglandulosum. Involucrum brevissimum, ± 5 mm longum, saepe 3-seriatum. Planta habitu pumilo, caulibus gracilibus monocephalis ad 5 cm altis. *E. candidissimus* Rech. f. et Edelberg

2b) Indumentum lanato-floccosum vel densum, e pilis crispulis eglandulosis pilis brevioribus glanduliferis immixtis vel e papillis glanduliferis sparsis tantum (sc. *E. kermanensis*) consistens. Involucrum longius, flores disci dimidio superans, ± 2-seriatum *3*

3a) Indumentum densum lanato-floccosum pilis glanduliferis brevibus paucis vel subnullis. Rhizoma semper crasse lignosum *4*

3b) Indumentum densum vel laxum sed nunquam lanato-floccosum *7*

4a) Involucrum ± 10 mm longum, phyllis ± 1.5 mm latis supra medium latissimis. Achaenia ± 3.5 mm (*E. shahvaricus*) vel 5.5—6 mm (*E. mollissimus*) longa *5*

4b) Involucrum 7—8 mm longum, phyllis anguste lineari-lanceolatis, ± 1 mm latis, in medio circiter latissimis. Achaenia 4.5—5.5 mm longa *6*

5a) Capitula statu compresso 14—16 mm diametro, involucri phylla ± 30. Achaenia ± 3.5 mm longa. Planta habitu caespitoso, caulibus 3—6 cm altis, monocephalis *E. shahvaricus* Rech. f.

5b) Capitula statu compresso 18—20 mm diametro, involucri phylla ± 35. Achaenia 5.5—6 mm longa. Planta habitu elatiore, caulibus 15—20 cm altis, monocephalis vel furcatis ..... *E. mollissimus* Rech. f. et Köie

6a) Foliorum basalium lamina obovato-lanceolata 2 : 1. Folia caulina pauca linearilanceolata. Achaenia 5—5.5 mm longa. Pappi setae plerumque plus quam 30.... *E. Stapfianus* Rech. f.

6b) Foliorum basalium lamina oblongo-lanceolata 3:1. Folia caulina nulla vel perpauca. Achaenia ± 4.5 mm longa. Pappi setae ± 25. ..... *E. amorphoglossus* Boiss.

7a) Plantae plus quam 10 cm altae saepius pleiocephalae, foliis caulinis numerosis.. *8*

7b) Plantae nanae 2—7 (—8) cm altae semper monocephalae, foliis caulinis paucis vel subnullis..... *11*

8a) Involucrum ± 10 mm longum phyllis lanceolatis angustis. Caulis simplex. Indumentum laxum sed interdum subfloccosum superne etiam glandulosum *E. bizgensis* Rech. f.

8b) Involucrum 6—9 mm longum (si exceptione longius, phylla perlata: confer *E. latisquamus*). Caules saepius ramosi *9*

9a) Planta non vel vix lignescens. Folia basalia 3:1, lanceolata. Involucrum ± 6 mm longum phyllis angustis ± scariosis longe attenuatis. Achaenia ± 3.5 mm longa, pappi setae 25—30 ..... *E. persicus* Boiss.

9b) Plantae lignescentes caespitosae. Folia basalia late obovata 1:1—1:2. Involucri phylla exteriora omnino herbacea, perlata, 2.5—3 mm. *10*

10a) Folia basalia orbiculata usque obovata 1 (—2):1, grosse crenato-serrata; folia caulina 2:1. Involucrum ± 7 mm longum. Achaenia ± 4.5 mm longa, pappi setae ± 20 ..... *E. obovatus* (Benth.) Boiss.

10b) Folia basalia elliptico- usque oblongo-obovata, 1:1.5, saepius integra vel subintegra. Involucrum (7—) 8—9 (—10.5) mm longum. Achaenia ± 5 mm longa, pappi setae ± 30 ..... *E. latisquamus* Boiss.

11a) Folia basalia spathulata 1—2:1, bellidiformia. Involucrum ± 5 mm longum. Involucri phylla pilis crispulis eglandulosis longioribus et pilis glanduliferis brevibus obsita ..... *E. chionophilus* Boiss.

11b) Folia basalia lanceolata usque lineari-lanceolata 4—6:1. Involucrum 6—7 mm longum, phyllis pilis glanduliferis tantum obsitis *12*

12a) Caespites minutos vix lignescentes formans. Folia basalia lineari-lanceolata 6:1. Involucri phylla apice breviter angustata. Flores pallide rosei. Pappi setae ± 20 *E. Aellenii* Rech. f.

12b) Dense caespitosus lignescens. Folia basalia lanceolata (3—) 4:1. Involucri phylla longius attenuata. Flores intense rosei. Pappi setae plerumque plus quam 30.... *E. kermanensis* Rech. f.

E. amorphoglossus Boiss. — **C:** Lorinj Pass, 12000 ft., rock face, dry (Kz. 13796). — **E:** Nozi, 10000 ft., in limestone rock, fl. rose-purple (Kz. 11999).

No. 11999 hat ein dichtes, fast filziges, hauptsächlich aus langen drüsenlosen Haaren bestehendes Indument der Hüllen. Homologe Verschiedenheiten finden sich auch unter persischem Material der Art. Vorläufig ist aber kein Anhaltspunkt für eine Aufteilung gegeben.

No. 13796 weicht vom Typus nur unwesentlich ab durch kürzere, mehr spatelige Grundblätter. Das Indument der Hüllen besteht hauptsächlich aus kurzen Drüsenhaaren, untermischt mit sehr wenigen langen Deckhaaren.

Fig. 5. *Erigeron candidissimus* (E. 1925). $^1/_1$.

Erigeron candidissimus Rech. f. et Edelberg, n. sp. — Fig. 5 und 8 c.

Sect. *Conyzastrum* Boiss. — Rhizoma lignosum pluriceps, caespites parvos efficiens. Caules floriferi arcuato-ascendentes, pumili, ad 5 cm alti, tenues, prope basin vel ad tertiam partem tantum paucifoliati. Folia basalia et rosularia petiolo 5—10 mm longo suffulta; lamina 6—10 mm longa, 4—5 mm lata, basi attenuata, apice acuta, integerrima vel rarius indistincte dentata. Indumentum foliorum et caulium dense candide tomentosum valde appressum omnino eglandulosum. Folia caulina 1—3; folia superiora valde reducta anguste linearia vix visibilia. Involucrum ± 5 mm longum, e phyllis ± triseriatis consistens; phylla linearia, laxiuscule membranaceo-marginata, dorso dense appresse albido-tomentella, omnino eglandulosa, exteriora obtusiuscula, inferiora herbacea acutiora. Flores involucro dimidio fere longiores. Achaenia submatura 2—2.5 mm longa, appresse hirsuta; pappus sordide albus pauciradiatus, 3—3.5 mm longus. — Valde differt a ceteris speciebus sectionis habitu humillimo, caulibus gracilibus monocephalis, involucro brevissimo sed ± triseriato, indumento denso candide tomentoso valde appresso omnino eglanduloso.

C: Deh Kundi, 2900 m, 11.VI.1949 (Edelberg 1925, Typus, hb. W., C.). — **Nuristan:** Kurdertal (N. 51/808). Gusalak, an trockener, sonniger Felswand (N. 51/824). — **E:** Bagrami, Nedjerau-Tal, am Hang (N. 51/310).

Erigeron mollissimus Rech. f. et Köie, n. sp. — Fig. 6 und 8 d.

Sect. *Conyzastrum* Boiss. — Rhizoma crasse lignosum multiceps, caespites parvos efficiens. Caules floriferi usque 15 (—20) cm longi, simplices vel rarius furcati, ultra medium remote foliati, floccoso-tomentosi, imprimis superne glabrescentes. Folia basalia petiolo 1—3 cm longo suffulta, lamina 2—4 cm longa, 1—1.5 cm lata, ovata usque late lanceolata, in petiolum sensim attenuata, apice rotundata vel rarius acutiuscula, margine integra vel rarius obsolete dentata, con-

Fig. 6. *Erigeron mollissimus* (K. 2528). $^{1}/_{1}$.

sistentia in sicco crassiuscule membranacea, utrinque indumento floccoso intertexto albido densissimo usque laxiusculo obsita, nervis pennato-reticulatis subtus paulo prominentibus. Folia caulina pauca remota, valde decrescentia, anguste oblanceolata, basin versus longe sensim attenuata, apice breviter acuminata plerumque acuta. Involucrum 8—10 mm longum, e phyllis ± 35 (32—39) indistincte biseriatis lanceolatis saepe in parte superiore latissimis consistens; phylla dorso crasse mem-

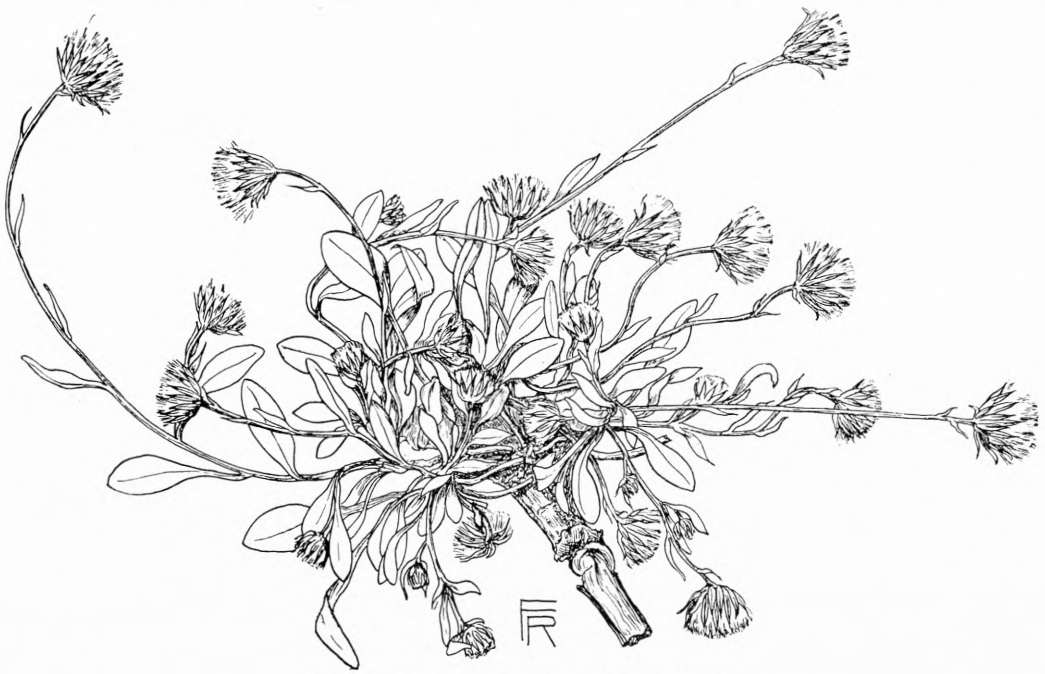


Fig. 7. *Erigeron polyadenus* (K. 2643). $^{2}/_{3}$.

branacea brunescentia subcarinata, margine anguste scariosa, imprimis interiora apice valde acuta, omnino dense albo-floccosa eglandulosa. Ligulae involucro tertia parte longiores, in sicco quidem purpurascentes. Achaenia ± 5.5—6 mm longa, longe hirsuta pilis erecto-patentibus. Pappus 5—5.5 mm longus, sordide albus 30—45-radiatus. — Differt ab *E. shahvarico* Rech. f.: habitu saepe elatiore, foliis basalibus latioribus obovato-oblongis obtusis subintegris plerumque longius petiolatis, involucris longioribus, indumento plerumque densiore floccoso-tomentoso, acheniis multo longioribus, pappo longiore.

C: Farakulum, 2700 m, 19.VII.1948 (Köie 2528, hb. W., C.).

Erigeron polyadenus Rech. f. et Köie, n. sp. — Fig. 7 und 8 e.

Sect. *Conyzastrum* Boiss. — Rhizoma crasse lignosum, caudices numerosos abbreviatos emittens, caespites densiusculos efficiens. Caules floriferi numerosi, 5—12 cm longi, diffusi vel ascendentes, tenues flexuosi herbacei, foliis angustis remote obsiti. Tota planta pilis glanduliferis brevibus flavescentibus

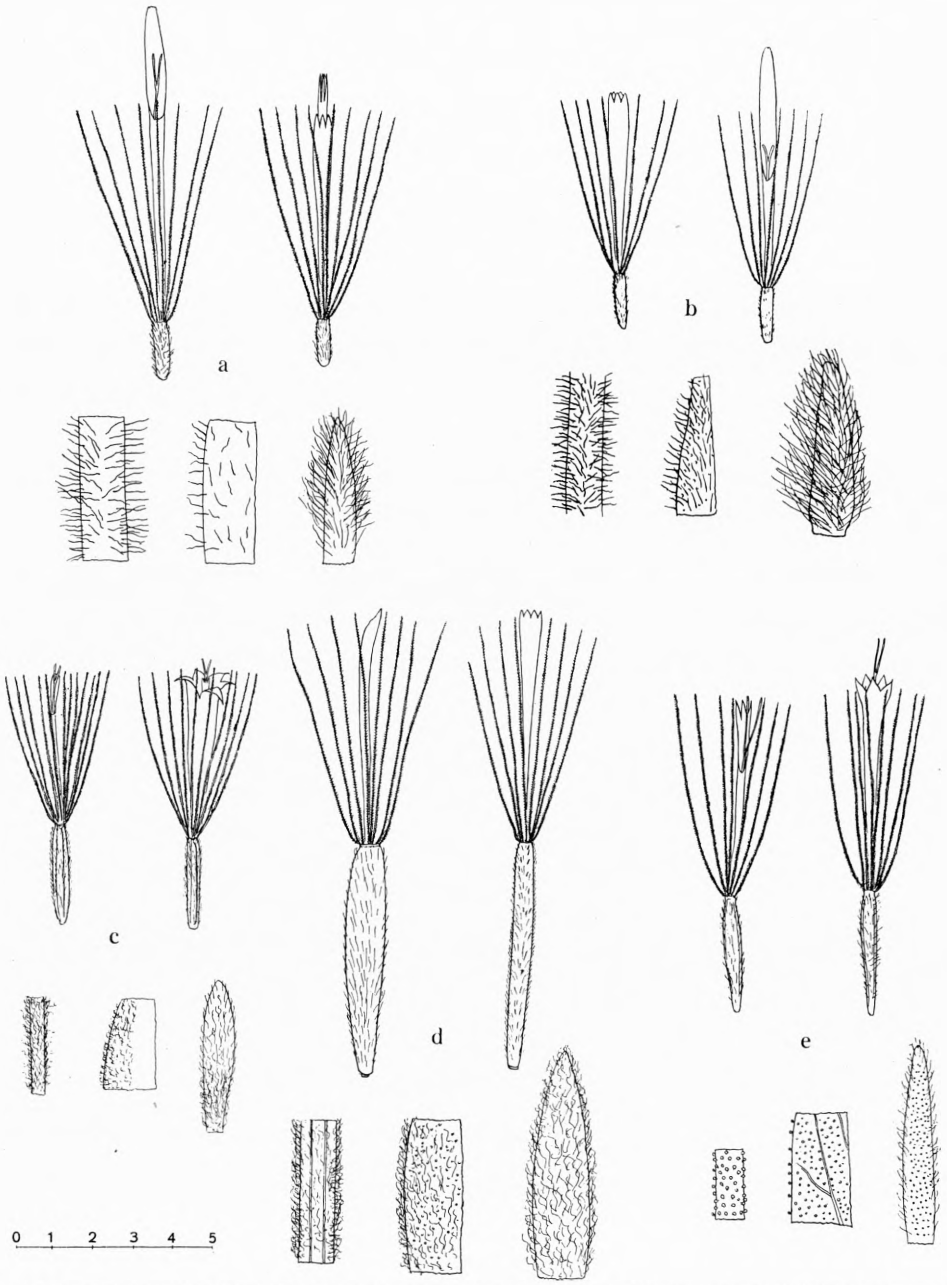


Fig. 8. Strahlenblüte, Scheibenblüte und Behaarung von Stengel, Blatt und Hüllblatt von: a. *Erigeron discernendus*, b. *E. petroiketes*, c. *E. candidissimus*, d. *E. mollissimus*, e. *E. polyadenus*.

obsita, pili longiores eglandulosi nulli. Folia basalia petiolo ± 1 cm longo suffulta, lamina obovata usque elliptico-lanceolata, 1.5—2 cm longa, 1—1.5 cm lata, basi attenuata, apice acuta vel rotundata; nervatura pennato-reticulata subtus valde prominens. Folia caulina lanceolata usque anguste linearia, latitudine saepe pluries longiora valde decrescentia; folia omnia integerrima. Involucrum 8 (—10) mm longum, e phyllis anguste lineari-lanceolatis apice sensim attenuatis compositum; phylla herbacea, anguste scarioso-marginata dense breviter glanduloso-pilosa. Achaenia submatura ± 5 mm longa, breviter hirsuta, Pappus achaenia aequans. — Differt ab *E. bizgensi* Rech. f. rhizomate crassius lignescente, indumento e pilis brevibus glanduliferis tantum consistente, foliis crassioribus, nervis subtus valde prominentibus, basalibus obovatis vel ellipticis, caulinis valde decrescentibus anguste lanceolatis.

C: Koh-i-Baba, Kotal-i-Reg, 3400 m, 24.VII.1948 (Köie 2643, Typus, hb. W., C.). — **NE:** Gulbahar (N. 50/917). — **E:** Bagrami, Nedjerau-Tal, am Bach (N. 51/308).

Erigeron, Sect. *Euerigeron* DC. sensu Asch. et Graebn., Subsect. nova ***Pseudoconyzastrum*** Rech. fil.[1] — Typus subsectionis: *E. andryaloides* Benth.

Plantae (saepe valde) lignescentes, habitu exacte species Sect. *Conyzastrum* referentes, sed floribus marginalibus ligulatis ad Sect. *Euerigeron* pertinentes.

1a) Involucrum brevissimum 5 mm longum. Planta pumila valde lignescens compacte caespitosa ..... *E. minjanensis* Rech. f.
1b) Involucrum longius *2*
2a) Folia utrinque anguste paucidentata vel fere lobata-dentata. Involucrum 6—7 mm longum ..... *E. stenodon* Rech. f. & Edelberg, *E. paghmanicus* Rech. f.
2b) Folia integra vel rarius minute pluridentata *3*
3a) Involucrum 8—10 mm longum. Foliorum lamina remote denticulata. *E. Koelzianus* Rech. f.
3b) Involucrum ± 7 mm longum. Folia integerrima *4*
4a) Planta plerumque ultra 10 cm alta, indumento nunquam dense albo floccoso-tomentello *5*
4b) Planta humilis, 8 cm alta, pilis crispulis intertextis dense subfloccoso-tomentella albida ..... *E. sanglichensis* Rech. f. & Edelberg
5a) Caules floriferi ad 20 cm alti, validi, erecti, plerumque furcati. Indumentum breviter patule hirsuto-pubescens laxiusculum. Planta virens. Folia integerrima..... *E. Edelbergii* Rech. f. & Köie
5b) Caules floriferi humiliores arcuati tenuiores, saepe simplices. Indumentum laxe appresse lanatum albescens, ± evanescens. Folia integerrima.. *E. andryaloides* Benth.

E. andryaloides Benth. — **E:** Kabul (Honigberger s. n., hb. W.). Paghman, 9000 ft., damp slope, rays white to rose-purple, 27.VI.1937 (Kz. 11117, hb. W., BPI). — **NE:** Weran, 3000 m (E. 1469, hb. W., C.).

Mit Vorbehalt stelle ich die genannten afghanischen Exemplare zu *E. andryaloides* Benth. Bei der Identifizierung kann ich mich außer auf die Diagnose nur auf ganz unzureichendes Material aus dem Himalaya stützen. Möglicherweise müßten aber auch diese afghanischen Exemplare, die übrigens auch untereinander nicht vollkommen übereinstimmen, von *E. andryaloides* abgetrennt werden. Immerhin stimmen sie in den Achänen, im Pappus und in der Behaarung so ziemlich mit himalayischen Exemplaren überein, doch sind die Köpfchen der afghanischen Pflanze durchschnittlich etwas größer (Involukrum 7 mm lang), die Stengel höher und dicker, das Indument weniger dicht.

[1] Hierher gehört auch *E. Wendelboi* Rech. f. apud Wendelbo, Nytt Magas. for Botanikk, 3:230—233 (Oslo 1954) aus Chitral (Wendelbo in hb. Oslo).

Erigeron Edelbergii Rech. fil. & Köie, n. sp. — Fig. 9 und 15 a.

Rhizoma induratum pluriceps vix lignescens, caespites parvos efficiens. Caulis florifer ad 20 cm altus, validus, in tertia parte superiore plerumque furcatus, internodiis elongatis mediis 4—5 cm longis, indumento brevi patulo hirsuto-pubescente laxiusculo; caulis ad $^2/_3$ regulariter remote foliatus, supra bifurcationem imprimis infra capitulum praeter pilos eglandulosos papillis brevibus glanduliferis obsitus. Folia basalia et rosularia petiolis ad 2 cm longis suffulta, lamina 2—3 cm longa, ± 1 cm lata, oblongo-lanceolata saepius acuta; folia consistentia in sicco tenuiter herbacea, canescenti-virescentia, indumento laxiusculo patulo hirsuto-pubescente pilis glanduliferis immixtis, nervi tenues non prominentes. Folia omnino integerrima, caulina sensim decrescentia, brevius petiolata acutiora, proportione angustiora; folia summa saepe tantum 1—3 cm infra capitulum sita, ad 15 mm longa, ad 1.5 mm lata, angustissime linearia valde acuta. Capitula in statu compresso 14—15 mm diametro, involucrum ± 7 mm longum, phyllis omnibus subaequalibus indistincte biseriatis lineari-lanceolatis dorso late herbaceis atro-viridi- vel purpureo-suffusis, prope basin ± scarioso-induratis, margine anguste hyalinis apice valde acutis pilis brevibus glanduliferis numerosioribus pilis longioribus crispis eglandulosis paucis obsitis. Ligulae 9—10 mm longae, 1—1.4 mm latae, in sicco quidem flavae anguste obovatae leviter emarginatae, involucro tertia parte longiores. Flores disci in sicco flavescentes. Achaenia juniora 3 mm longa, pilis erecto-patentibus hirsuta; pappus sordide albus pauciradiatus scabridulus. — Differt ab *E. andryaloide* (DC.) Benth. habitu valido, caulibus furcatis, indumento brevi subhirsuto nunquam floccoso, foliis integerrimis, ligulis flavis.

C: Deh Kundi, Sar-i-Nil, 3000 m. 7.VI.1949 (Edelberg 1941, Typus, hb. W., C.).

Es liegt ein zweites, wahrscheinlich zu dieser Art gehöriges unvollständiges Exemplar vor, das sich durch starkes Verholzen vom Typus unterscheidet:

C: Lorinj Pass, 10000 ft. (Koelz 13736, hb. W., BPI.).

Erigeron Koelzianus Rech. fil., n. sp. — Fig. 10 und 15 b.

Basi breviter lignescens, caespites parvos efficiens. Caules floriferi ad 20 cm alti, validi, arcuati vel erecti, simplices, monocephali, tota fere longitudine foliosi, indumento brevi crispulo pubescentes. Folia basalia plurima jam emarcida, petiolo ad 3 cm longo suffulta, lamina 3 cm longa, 1 cm lata, lanceolata acuta, valde remote denticulata. Folia consistentia in sicco herbacea, canescenti-viridia, indumento brevi crispule hirsuta pilis glanduliferis brevissimis sat copiose immixtis; nervi tenues vix prominentes. Folia caulina 4—5 remota, anguste oblongo-lanceolata, inferiora petiolata, superiora sessilia, quam basalia angustiora saepe remote sinuato-dentata; folia summa ± 1 mm lata anguste linearia, 1—2 cm infra capitulum sita. Capitula in statu compresso usque 2 cm diametro; involucrum 8—10 mm longum, phyllis numerosis subaequilongis lineari-lanceolatis demum basi cartilagineo-incrassatis dorso latiuscule herbaceis margine anguste hyalinis apicem acutam versus sensim attenuatis, dorso pilis crispulis albidis dense pubescentibus pilis glanduliferis copiose

Fig. 9. *Erigeron Edelbergii* (E. 1941). $^{3}/_{4}$.

Fig. 10. *Erigeron Koelzianus* (Kz. 12983). $^{1}/_{1}$.

immixtis demum ± glabrescentibus. Ligulae flavae lanceolatae, plerumque acutae vel apice emarginatae, involucro usque dimidio longiores. Flores disci in sicco bruneo-flavescentes. Achaenia juvenilia 3—3.5 mm longa, sparse appresse hirsuta; pappus sordide albus pauciradiatus ± 5 mm longus scabridulus. — Differt ab *E. Edelbergii* Rech. fil. capitulis maioribus multifloris, foliorum lamina remote denticulata nec integra, indumento breviore.

NE: Khash Distr., 10000 ft., 9.VIII.1937 (Koelz 12983, hb. W., BPI.).

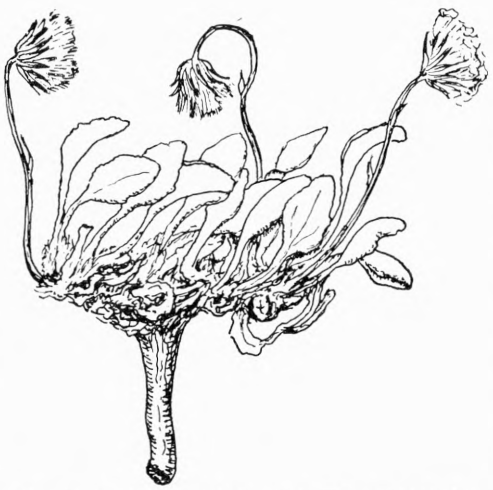


Fig. 11. *Erigeron minjanensis* (Kz. 12693). $^1/_1$.

Erigeron minjanensis Rech. fil., n. sp. — Fig. 11 und 15 c.

Planta pumila valde lignescens, caespites parvos convexos compactos efficiens. Caules floriferi tenues, 3—4 cm longi, diffusi flaccidi vel arcuati. Folia basalia conferta, petiolo ad 1 cm longo suffulta, lamina 8—12 mm longa, 3—5 mm lata, lanceolata, apice brevius attenuata acutiuscula, basi in petiolum sensim angustata, margine integra, indumento e pilis longis crispulis eglandulosis et brevioribus glanduliferis consistente canescentia, nervatura praeter costam medianam validam non visibili. Folia caulina pauca, inferiora anguste oblanceolata vel fere linearia, in quarta parte inferiore caulis sita, superiora perpauca subfiliformia. Involucrum 5 mm longum, phyllis exterioribus paulo brevioribus biseriatum; phylla dorso late herbacea latiuscule hyaline marginata, apicem versus longe sensim attenuata, pilis eglandulosis crispulis laxiusculis subfloccosa, pilis brevioribus glanduliferis subnullis vel nullis. Ligulae flavae, anguste lanceolatae, apice leviter emarginatae, involucro quarta parte circiter longiores. Flores disci flavidi demum rufescentes. Achaenia submatura ± 2 mm longa, pallide brunea, laxe subappresse hirsuta. Pappus sordide albus scabridulus, ca. 3 mm longus. — Differt ab *E. andryaloide* (DC.) Benth. habitu pumilo dense compacte caespitoso, caulibus ad 5 cm tantum altis, foliis parvis confertis, involucro et achaeniis brevioribus.

NE: Minjan Pass, 12000 ft., fl. yellow, 26.VII.1937 (Koelz 12693, hb. W., BPI.).

Erigeron sanglichensis Rech. f. et Edelberg, n. sp. — Fig. 12 und 15 d.

Suffrutescens, caespitosus. Caules floriferi 4—8 cm longi, tenues ascendentes, paucifoliati superne longiuscule nudi vel foliis valde diminutis subnudi. Folia basalia petiolo ad 1 cm longo suffulta, lamina 1—1.5 cm longa, 5 mm lata, oblongo-lanceolata in petiolum attenuata in medio vel paulo supra latissima, apice rotundata vel acuta, omnino pilis longis crispulis intertextis subfloccosa tomentella

Fig. 12. *Erigeron sanglichensis* (E. 1491). $^1/_1$.

albida glandulis sessilibus intermixtis. Indumentum caulis laxe floccosum albidum omnino eglandulosum. Folia caulina valde diminuta anguste lanceolata plurima in tertia parte inferiore caulis sita, ad 8 mm longa, vix 2 mm lata, acuta, indistincte petiolata. Involucrum ± 7 mm longum phyllis omnibus subaequilongis 0.8—1 mm latis indistincte biseriatum; phylla anguste lanceolata fascia viridi percursa, apice longe attenuata valde acuta, latiuscule hyaline marginata, apicem versus minute indistincte denticulata-lacerata; indumentum phyllorum albidum lanato-floccosum. Ligulae flavae, rotundatae vel truncatae, saepe indistincte paucicrenatae, involucro vix tertia parte longiores. Flores disci in sicco superne rufescentes. Achaenia (submatura) ± 3 mm longa, pallide brunea, compressa, appresse hirsuta. Pappus sordide albus scabridulus, quam achaenia paulo longior. — Inter affines indumento densiusculo albo floccoso-tomentoso, ligulis flavis, achaeniis brevibus compressis insignis.

NE: Sanglich, 3000—3600 m, 16.VII.1948 (Edelberg 1491, hb. C.).

Erigeron paghmanicus Rech. f., n. sp. — Fig. 13.

Suffrutescens caespitosus. Caules floriferi ad 10 cm longi, tenues, ascendentes vel suberecti, in dimidio vel tertia parte inferiore paucifoliati, superne longissime nudi. Folia basalia petiolo ad 2 cm longo suffulta; lamina (2—) 3—5 cm longa, (6—) 8—12 mm lata, lanceolata, in petiolum longissime attenuata, in medio circiter latissima, apice plerumque valde acuta, nervis tribus parallelis sat distinctis

Fig. 13. *Erigeron paghmanicus* (N. 884). $^{1}/_{1}$.

percursa, utrinque pilis longiusculis crispulis subfloccoso-intertextis laxiuscule obsita glandulis parce immixtis, utrinque sordide atroviridias, lamina margine imprimis in parte superiore dentibus angustis acutissimis brevibus patentibus vel ± antrorsis provisa. Indumentum caulis valde laxum eglandulosum crispulum subappressum demum verosimiliter evanidum. Folia caulina breviter petiolata vel ± sessilia, proportione angustiora. Involucrum 7 mm longum, phylla plurima subaequilonga, ± 1 mm lata indistincte biseriata, herbacea, anguste purpureo- et latiuscule hyaline marginata, apice acuta, margine saepius indistincte serrulata, primum parce puberula, deinde valde glabrescentia. Ligulae in sicco pallide flavae, angustae, rotundatae, involucro vix quarta parte longiores. Achaenia submatura 4 mm longa, pallide brunea, longitudinaliter elevate striata, laxe appresse hirsuta. Pappus sordide albus

albus scabridulus, quam achaenia brevior. — *E. stenodonti* Rech. f. et Edelbg. foliorum dentibus angustis acutis etsi multo minoribus affinis, sed foliorum forma, indumento, involucro diversus; *E. sanglichensi* Rech. f. et Edelbg. quoque affinis videtur sed notis in clavi analytica indicatis ab eo differt.

E: Paghman, 16. VII. 1950 (NEUBAUER 883, Typus, und 884, hb. W.).

Erigeron stenodon Rech. fil. & Edelberg, n. sp. — Fig. 14 und 15 e.

Suffrutex pumilus caespitosus. Caules floriferi ad 6 cm longi, tenues, arcuati vel diffusi, foliis anguste linearibus remote obsiti. Tota planta pilis longis

Fig. 14. *Erigeron stenodon* (E. 852). $^{1}/_{1}$.

albis crispulis intertextis dense floccoso-tomentosa. Folia basalia petiolo ± 1 cm longo suffulta, lamina ambitu rhomboideo- vel deltoideo-spathulata, ad summum 17 mm longa, dentibus inclusis aequilata, plerumque prope basin et prope medium dentibus singulis vel binis 2—5 mm longis prope basin 1—2 mm latis rectangulariter divergentibus vel subrecurvis obsita, interdum sublobata, apice acuta, margine plana vel subcrispata, nervatura subflabellata tenui indumento denso ± occulta. Folia caulina pauca remota valde decrescentia anguste lanceolato-linearia integra. Involucrum 6 (—7) mm longum oligophyllum subuniseriatum, phyllis oblanceolatis semper in tertia parte superiore latissimis albo-tomentellis saepe valde glabrescentibus, 1—1.3 mm latis, atro-purpureo-violaceis anguste hyaline marginatis

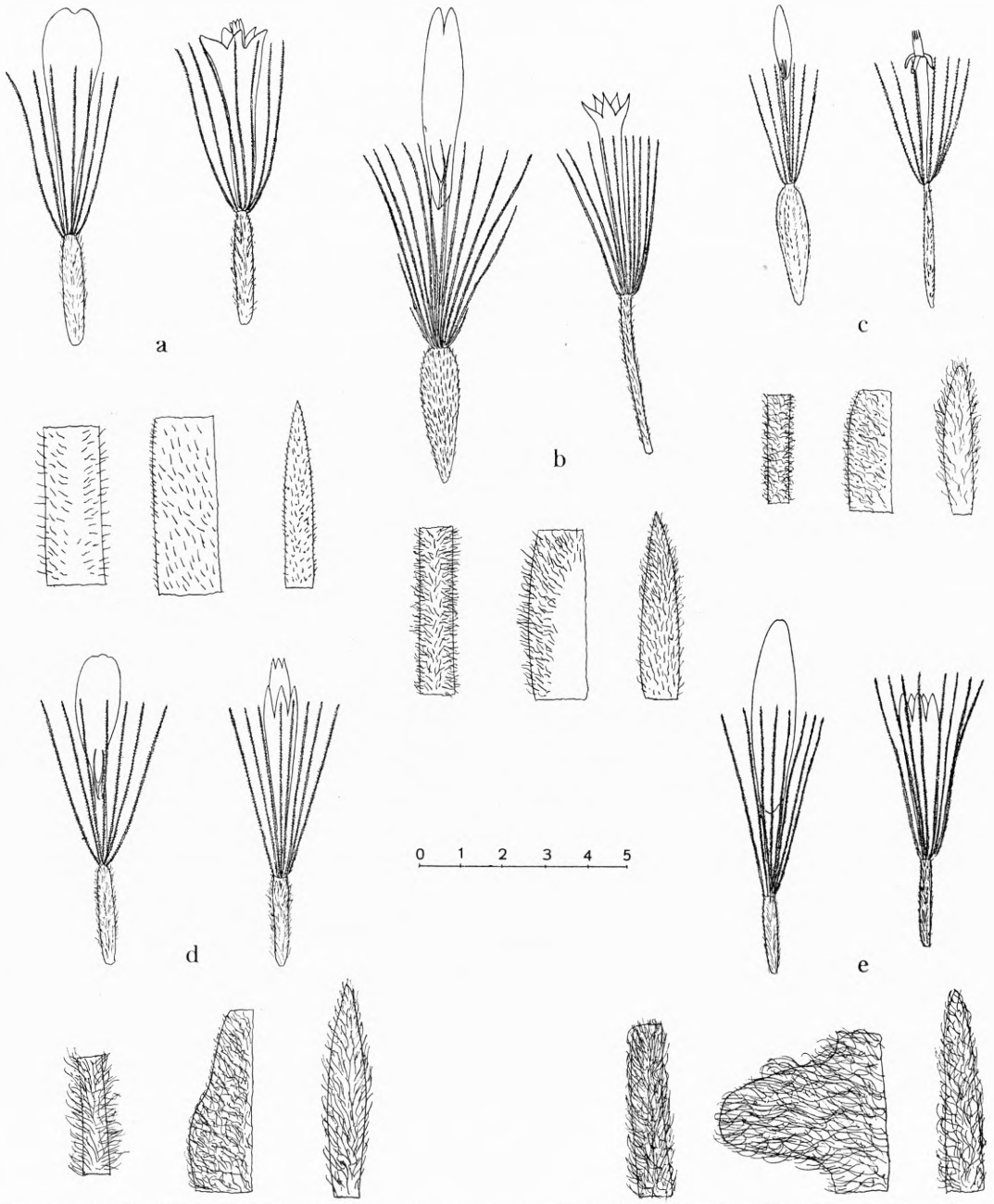


Fig. 15. Strahlenblüte, Scheibenblüte mit Behaarung von Stengel, Blatt und Hüllblatt von: a. *Erigeron Edelbergii*, b. *E. Koelzianus*, c. *E. minjanensis*, d. *E. sanglichensis* e. *E. stenodon*.

acuminatis, in parte superiore minute lacerato-denticulatis. Ligulae albae (e collectore) anguste lanceolatae, involucro dimidio fere longiores, apice minute crenulatae vel emarginatae. Flores disci in sicco sordide albidi. Achaenia juniora 2—3 mm longa, dense appresse sericeo-hirsuta. Pappus sordide albus scabridulus 3 mm longus. — Species indumento denso albido, imprimis autem foliis anguste lobato-paucidentatis, involucri oligophylli phyllis oblanceolatis purpurascentibus glabrescentibus, ligulis angustis albis valde insignis.

Nuristan: Chetras, 3000 m, 30.V.1948 (EDELBERG 852, Typus, hb. W., C.). Urura Passhöhe, beiderseits oberhalb der Waldgrenze, ca. 3900 m (N. 51/593).

Conyza Edelbergii Rech. fil., n. sp. — Fig. 16 und 17.

Verosimiliter perennis, ima basi indurata. Caules floriferi 25—30 cm longi, singuli vel plures, subsimplices vel inferne parce ramosi, erecti vel leviter arcuati, teretes, leviter striato-sulcati, breviter laxiuscule hirsuto-puberuli, tota longitudine foliati, in dimidio superiore e foliorum axillis ramos valde abbreviatos capitula pauca usque singula ferentes emittentes, capitula inde subracemose disposita. Folia surculorum sterilium petiolo tenui 2—2.5 cm longo suffulta, lamina ovata, basi breviter attenuata, apice late rotundato-acuminata, margine leviter late sinuato-dentata; folia caulina inferiora jam emarcida; superiora breviter petiolata, ovato- vel late elliptico-lanceolata, basi breviter attenuata, apice obtusiuscula vel acuta, margine leviter remote serrata; folia summa sensim decrescentia; omnia consistentia in sicco tenuiter papyracea, glandulis subsessilibus numerosis obsita, pilis

Fig. 16. *Conyza Edelbergii* (E. 2056). $^2/_3$.

brevibus eglandulosis hirsuto-puberula, sordide viridia subtus paulo pallidiora, nervatura tenui pennato-reticulata. Capitula breviter crassiuscule pedunculata, in statu compresso usque 15 mm lata. Involucrum 5—6 mm longum; phylla subaequalia pluriseriata, sat late (ad 1 mm) oblongo-linearia, sub apice latissima, breviter acuminata, omnino fere herbacea angustissime tantum hyaline marginata, indumento pubescente canescentia. Flores heterogami. Antherae non caudatae. Achaenia submatura 2 mm longa, compressa, brunescentia, appresse sericea. Pappus albus laevis multiradiatus fragilis, quam achaenia duplo longior. — Differt a *C. japonica* Less. capitulis maioribus, breviter pedunculatis subracemose dispositis, involucri phyllis latis herbaceis breviter attenuatis angustissime hyaline marginatis; differt a *C. aegyptiaca* Ait. involucri phyllis (ut supra), foliis latioribus minus argute serratis.

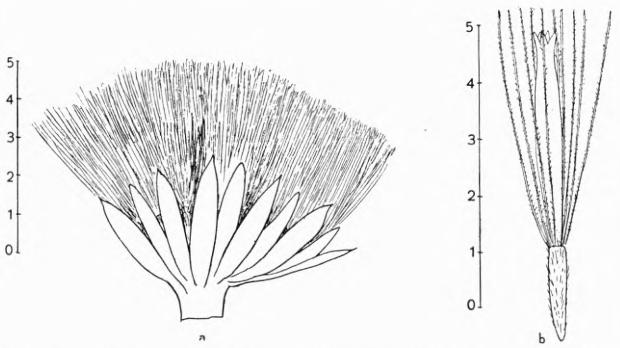


Fig. 17. *Conyza Edelbergii*. a. Köpfchen, b. Einzelblüte.

Nuristan: Netchingel (Edelberg 2056, hb. W., C.).

Conyza japonica Less. — **Nuristan:** Gusalak, 1000 m (E. 1590).

Blumea cabulica Rech. fil., Oesterr. Bot. Zeitschr. 97 : 222 (1950). — **E:** Kabul (Honigberger s. n., Typus, hb. W.).

Species nova pedunculis longis rigidulis arcuato- vel subrectangulariter divaricatis involucro indumentoque insignis et a *B. aurita* (L.) DC. diversa.

B. Honigbergeri Rech. fil., Oesterr. Bot. Zeitschr. l. c. 221. — **E:** Kabul (Honigberger s. n., Typus hb. W.).

Species nova foliis late obovatis acute irregulariter inferne sinuato-dentatis, capitulis minutis racemoso-dispositis congestis a formis *Blumeae arenariae* DC. diversa.

Pluchea caspica (Pall.) Hoffm. — **N:** Tashkurgan, 12000 ft. (Kz. 13187). Aqtscha, Pfl. 1 m hoch (N. 50/119).

Micropus longifolius Boiss. & Reut. — **NW:** Kishlik, 700 m (K. 4051). — **SW:** Jija, 900 m (K. 4053).

Filago Bornmülleri Hausskn. — **Baluchistan:** Quetta, 1400 m (K. 3268).

F. arvensis L. — **C:** Hauz-i-Mahiha, 2600 m (K. 2442). — **NE:** Basarak, Pandschirtal (N. 50/928). Ferajghan Pass, 10000 ft., dry ground (Kz. 11722). — **Nuristan:** Pashki, 2300 m (E. 1333). Shtive, 2600 m (E. 1291). — **E:** Unteres Paghmantal (N. 50/899). Kabul, Aliabad (N. 50/929).

F. spathulata Presl. — **NW:** Kishlik, 700 m (K. 4052). — **NE:** Basarak, Pandschirtal (N. 50/921). Kail, 8000 ft., dry slope, fl. whitish (Kz. 11680). — **Nuristan:** Gusalak, 1000—1200 m (E. 1496, 1588, 1505). — **E:** Kabul, Gartenunkraut (N. 50/920). Mamakhel, 5000 ft., dry slope, 4 inches high (Kz. 11566). — **SE:** Pirzada, 900 m (K. 2002, 2004).

Gymnarrhena micrantha Desf. — **SW:** Jija, 1200 m (K. 3577).

Leontopodinum campestre (Led.) Hand.-Mzt. — **NE:** Weran, 3000 m (E. 1477).

Die sehr zarten, dunklen, etwas verkahlenden Stengel haben eine etwas stärker abstehende, mehr lockere Behaarung. Die Grundblätter sind oberseits verkahlend.

L. leontopodium (DC.) Hand.-Mzt. — **NE:** Minjan Pass, 13500 ft., meadow (Kz. 12745). Weran, 3700 m (E. 1448). — **Nuristan:** Vaigel (E. 2029). Elasoon (E. 1737 b). Zwischen Aschpi Pass und Kuschtos (N. 51/660. N. 51/701). Urura Pass, 3900 m (N. 51/573).

Anaphalis Aurora Rech. fil. & Edelberg, n. sp. — Fig. 18.

Suffrutex multicaulis. Caules floriferi 15—20 cm longi, arcuato-ascendentes, internodiis brevissimis 5—10 mm longis tota longitudine dense foliati, ex axillis plurimis ramulos valde abbreviatos proferentes, appresse lanati. Folia omnia supra laxius subtus dense appresse lanato-tomentosa, inferiora lanceolata acuta, ad 17 mm longa, ad 5 mm lata, plana; media et superiora linearia, ad 20 mm longa, omnia arcte revoluta ± horizontaliter patentia, superiora paulo tantum decrescentia. Inflorescentia polycephala sublaxe capitato-corymbosa. Capitula subcampanulato-globosa, 4—5 mm diametro; phylla ± 4-seriata, laxe imbricata, omnia tenuiter membranacea opaca albida ± intense roseo-suffusa acuta, exteriora late triangularia, prope basin tomentella, media oblonga usque elliptica, interiora late lanceolata. Flores involucro breviores flavovirentes superne purpurascentes. Achaenia juvenilia sublaevia; pappi radii numerosi albi fragiles sublaeves. — Differt ab *A. virgata* Thoms. ex Clarke corymbis magis contractis, involucri phyllis latioribus obtusioribus roseis nec albis vel flavis.

Nuristan: Jshauda Pass (Edelberg 2039, Typus, hb. W., C.; 2060, hb. C.).

A. nubigena DC. — **Nuristan:** Zwischen Aschpi Pass und Kuschtos (N. 51/698. N. 51/206). Urura Pass bei Kuschtos, ca. 3000 m (N. 51/609). Elasoon, 3200 m (E. 1737 a).

A. seravschanica (C. Winkl.) Fedtsch. — **Nuristan:** Elasoon (E. 1799).

Lasiopogon muscoides (Desf.) DC. — **SW:** Jija, 1200 m (K. 3575).

Gnaphalium afghanicum Rech. f. et Köie, n. sp. — Fig. 19.

Sect. *Omalotheca* Cass. — Perenne caespitosum. Caules floriferi 3—10 cm longi numerosi tenues erecti vel arcuati, a medio circiter vel interdum iam infra

Fig. 18. *Anaphalis Aurora* (E. 2039 — Habitus $^{2}/_{3}$. a. Köpfchen, b. Fruchtknoten mit Pappus).

in spicastrum laxum abeuntes, albo-lanati, lana floccoso-gossypina, simplex, plurifoliatus. Folia rosularia linearia numerosa, ad 2 cm longa, ± 2 mm lata, in petiolum sensim attenuata, apice breviter acuminata, sub apice plerumque sublatiora, nervo mediano tenuissimo saepe fere vix visibili, utrinque sublaxe appresse pilosa canescenti-virentia. Folia caulina cauli fere appressa vel erecto-patentia, quam basalia angustiora, indumento magis lanato, in folia capitula inferiora fulcrantia breviora sensim transientia. Capitula 4—6, in spicastrum laxum inferne foliatum disposita, inferiora pedunculo tenui erecto vel axi fere appresso ad 5 mm longo suffulta. Involucrum ± 5 mm longum, basi rotundato-attenuatum, oligophyllum, phylla indistincte bi- usque subtriseriata, tenuiter membranacea, flavescenti-viridula, imprimis superne pallide brunescentia, exteriora floccoso-lanata, lateraliter et apice latiuscule hyalina, plurima acutiuscula usque acuta, interna autem obtusiuscula inciso-lacerata, extima quam intima triplo usque quadruplo breviora. Achaenia 1.2—1.4 mm longa, angustissime linearia, minutissime laxe papillosa. Pappus albus, setulis minimis appressis antrorsis scabridus, achaenio usque subtriplo longior. — Differt a *G. supino* L. capitulis numerosioribus in spicastrum laxum dispositis, involucri structura, phyllis minus numerosis post florendum erectis nec stellato-patentibus, phyllorum exteriorum pubescentia et cum interiorum proportione, achaeniis multo longioribus minute papillosis nec appresse sericeis basi apiceque minus attenuatis.

C: Koh-i-Baba, Kotal-i-Reg, 3400 m, along stream, 24.VII.1948 (Köie 2653, hb. W., C.).

Fig. 19. *Gnaphalium afghanicum* (K. 2653 — Habitus $^1/_1$. a. Köpfchen).

G. luteo-album L. — **SW:** S. of Herat, 1600 m (K. 3271). — **NE:** Gulbahar (N. 50/927). — **Nuristan:** Kama, 1400 m (E. 1221). Gusalak, 1000 m (E. 301). — **E:** Laghman, 4000 ft., along stream (Kz. 11600). Ghorband, 1200 m (K. 3270). — **SE:** Kajkai, 1000 m (K. 2146).

Helichrysum plicatum DC. s. l. ad int. — **NE:** Faizabad, 1100—1900 m (E. 1350). Pass Rabatak (N. 50/251).

Stengel 40 cm hoch, dicklich, straff, dicht beblättert. Stengel und Blätter dicht anliegend weiss wollig-filzig. Blätter relativ breit verkehrt lanzettlich. Hüllschuppen spitz, nicht streng anliegend.

C: Farakulum, 3000 m (K. 2543).

Etwas zarter als Edelbergs 1350. Blätter schmäler. Unter dieser No. liegen zweierlei verschiedene Formen: Ein Exemplar mit reich schuppiger Hülle, die Schuppen stumpflich, streng anliegend. Die Pflanze erinnert dadurch an *H. armenium* DC. Die übrigen Exemplare stimmen in der Hülle mit Edelbergs Exemplar überein.

NE: Daraim, 8500 ft., fl. yellow (Kz. 13022).

Stimmt im Wesentlichen mit der Mehrzahl der Exemplare von Köie 2543 überein. Solange nicht eine Gliederung des äusserst polymorphen Formenkreises vom *H. plicatum* DC. gelungen ist, lassen sich die wenigen bisher aus Afghanistan vorliegenden Exemplare, die untereinander auch nicht einheitlich sind, weder klar von *H. plicatum* abgrenzen, noch mit einer der bisher noch unbenannten zahlreichen Formen dieser Art identifizieren.

Fig. 20. *Helichrysum subsimile* (Kz. 13898). $^1/_1$.

Helichrysum subsimile Rech. fil., n. sp. — Fig. 20.

Sect. *Oligophylla* Boiss. — Perenne. Tota planta dense longe floccoso-tomentosa alba. Caulis 7—12 cm longus, arcuato-erectus. Folia basalia petiolo indistincto incluso 2—3 cm longa, 5 mm lata, obovato-lanceolata usque subspathulata; folia caulina oblongo-lanceolata acutiuscula utrinque attenuata sessilia decurrentia, cauli ± appressa, omnia utrinque dense albo-floccoso-tomentosa. Capitula 8—12 corymboso-congesta brevissime pedunculata, ad 5 mm diametro; phylla 30 vel plura, in seriebus 4—5 laxe imbricate disposita, ± squarroso-patula, exteriora basi floccoso-tomentosa, omnia nitentia ovata acutiuscula citrina. Flores flavi, ± 3.5 mm longi. Achaenia juvenilia brunea glabra; pappus subscabridulus flavus ca. 2 mm longus. — Differt ab *H. lavandulaefolio* Willd. cui habitu capitulis congestis involucri phyllorum numero affine: indumento densiore, foliis basalibus latius obovato-spatulatis, superioribus angustioribus acutioribus decurrentibus, pappo flavo.

C: Terak, 8000 ft., dry plain, 5.IX.1939 (Koelz 13898, Typus, hb. BPI., fragm. in hb. W.). Lorinj Pass, 10000 ft., dry slope, 27.VIII.1939 (Kz. 13731, hb. BPI.). — **Nuristan:** Gusalak, 1000 m, 30.IV.1948 (E. 1593, hb. C.).

Codonocephalum grande (Schrenk) Fedtsch., e descr. — **NW:** Koshbai, 8000 ft., field edge, 6 ft. (Kz. 14144). — **NE:** Daraim, 7000 ft., fl. yellow, 4 ft. high (Kz. 13071). Faizabad, 1100—1900 m (E. 1403).

Mit der Originalbeschreibung übereinstimmend, doch sind die Blätter undeutlich gezähnt bis ganzrandig, nicht "dentato-serrata".

Inula afghanica Rech. fil. & Köie, n. sp. — Fig. 21.

Sect. *Pentanema* Cass. — Suffrutex humilis multicaulis. Caules floriferi ± 15 cm longi, erecti vel paulum arcuati, in quinta circiter parte superiore tenuiter breviter divaricate ramosi, tenues, internodiis mediis saepe vix 1 cm longis tota longitudine dense foliati, copiose breviter glandulosi et sparse hirsuti, brunei, gemmis basalibus breviter sericeo-villosis. Folia caulina inferiora minuta, media increscentia 1—2 cm longa, 5—10 mm lata, elliptica vel late elliptico-lanceolata, basi attenuata sessilia, apice acuta vel subrotundata, margine integra, superiora denuo decrescentia, omnia in sicco rigide herbaceo-membranacea, laete flavescenti-viridia, copiose breviter flavescenti-glandulosa et breviter hirto-scabrida, nervis pennatis pauciramulosis tenuibus utrinque ± 3 subtus paulum prominentibus; folia superiora et ramealia acutiora. Involucrum 6 (—7) mm longum basi rotundatum, in statu compresso superne fere aequilatum, phyllis plerumque 4-seriatis membranaceis flavescentibus breviter dense ciliolatis arcte imbricatis ± late lanceolatis acutis, exterioribus et mediis apice breviter herbaceis squarroso-patentibus vel subrecurvis, interioribus porrectis omnino membranaceis. Flores non radiantes involucrum aequantes. Achaenia juvenilia hirsuta; pappi radii numerosi, sordide albi, minutissime scabriduli sublaeves. — Differt ab *I. pulicariaeformi* DC. habitu magis frutescente, foliis late flavescenti-viridibus copiose glandulosis praeterea magis scabridis, involucri phyllis minus numerosis regularius imbricatis scariosis flavescentibus, exterioribus et mediis apice distincte herbaceis, achaeniis et pappo jam in statu juvenili longioribus.

C: Hauz-i-Mahiha, 2500 m, 10.VII.1948 (Köie 2346, Typus, hb. W., C.).

Mit Vorbehalt stelle ich zu dieser Art die folgenden zwei Belege:

C: Lorinj Pass, 10000 ft., dry rock face, rays rose-purple (Kz. 13757, hb. W., C.). Baligali Pass, 9000 ft., dry cliff face, flrs. yellow, changing to purplish (Kz. 13856, hb. W., BPI.).

Sie unterscheiden sich vom Typus der *I. afghanica* durch folgende Merkmale. Niedriger, bis 4—6 cm, unverzweigt, gestauchte Internodien, Blätter kleiner, 7—12 mm lang, 3—5 mm breit, ausser der kurz-drüsigen, lange, seidig-wollige Behaarung, Hülle 4.5—6 mm lang, 3—4 reihig, Pappusstrahlen 7—9. Bei No. 13856 ist die drüsenlose Behaarung sehr dicht und lang.

I. divaricata (Cass.) Boiss. — **SW:** Farah, 700 m (K. 3259).

I. obtusifolia Kern. (Syn. *I. Thomsonii* Clarke) — Fig. 22. — **NE:** Minjan, Zebak, 2300 m (E. 1521). — Descr. amplificata:

Sect. *Bubonium* DC. subsect. *Lasiocarpae* Boiss. — Ima basi suffrutescens, pluricaulis, gemmis basalibus longe candide sericeo-villosis. Caules 15—20 cm longi monocephali validiusculi, internodiis mediis 1—1.5 cm longis, tota longitudine dense aequaliter foliati, pilis caulis diametrum ± aequantibus villosi. Folia caulina inferiora et media basi profunde cordata sessilia, oblongo-elliptica, 4—5 cm longa, 2—2.5 cm lata, margine integra, apice rotundata vel subacuta, in medio plerumque latissima, consistentia in sicco crasse herbaceo-membranacea, nervatura dense

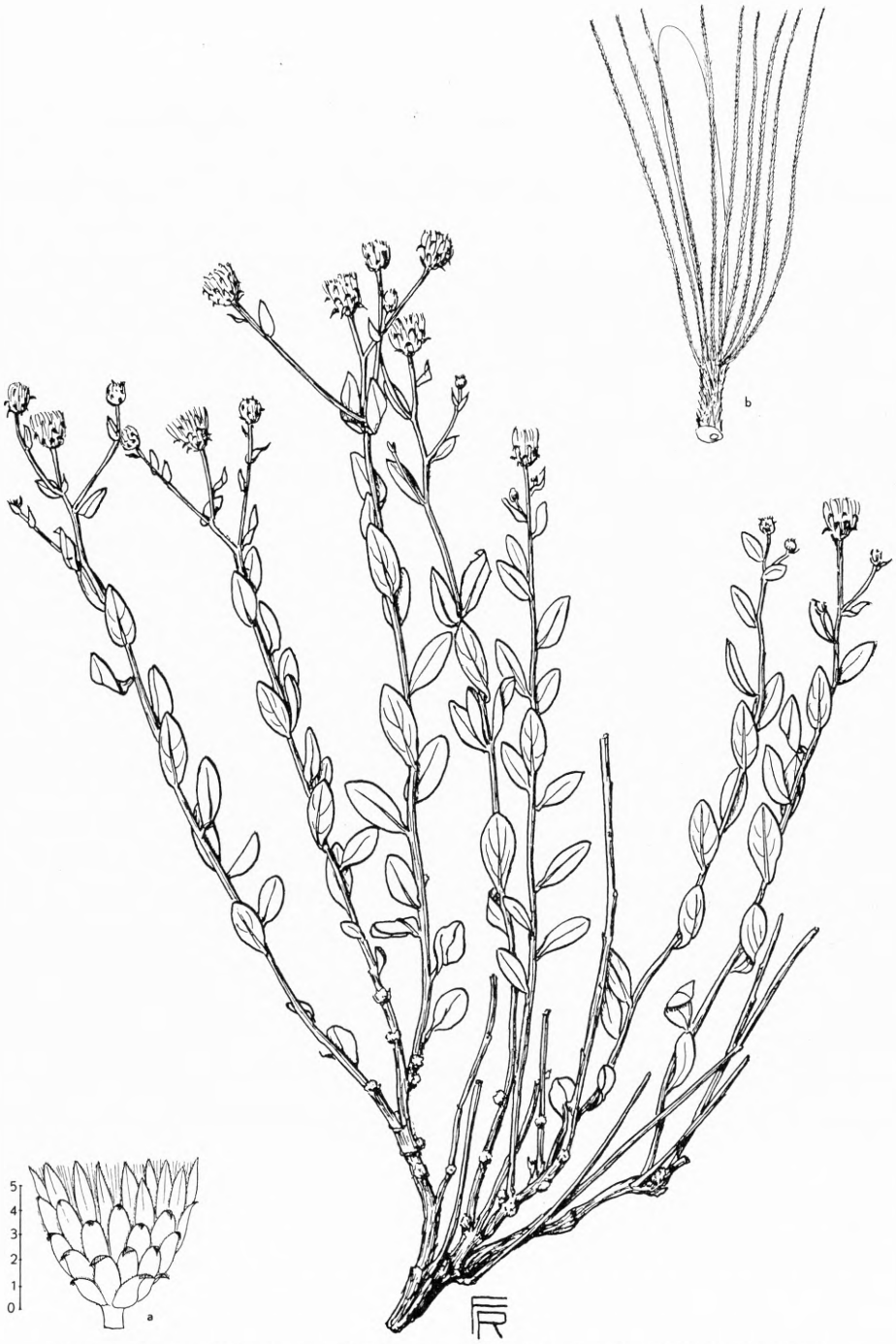


Fig. 21. *Inula afghanica* (K. 2346 — a. Köpfchen, b. Einzelblüte). Habitus $^3/_4$.

Fig. 22. *Inula obtusifolia* (E. 1521 — oben Einzelblüte). Habitus $^{2}/_{3}$.

Fig. 23. *Phagnalon glabrifolium* (Kz. 11983). $^{1}/_{1}$.

reticulata supra impressa subtus valde prominens, supra laxius subtus densius imprimis secus costam medianam dense longe villosa; folia superiora paulum decrescentia angustiora. Capitulum singulum terminale in statu compresso floribus inclusis 2 cm longum, 4 cm latum; involucrum laxe imbricatum phyllis plerumque 4-seriatis exterioribus saepe partim herbaceis, externis interdum dilatatis in folia capitulum fulcrantia quasi transientibus, mediis anguste lanceolatis acutis ± purpurascentibus villosis, internie pallidioribus ± glabrescentibus. Flores aurei, exteriores valde radiantes, radiis fere 1.5 mm latis breviter ± 3-dentatis. Achaenia juniora densiuscule appresse sericeo-villosa. Pappus sordidus sublaevis, sub lente minutissime scabridulus, ca. 7 mm longus. — Differt ab *I. Oculo-Christi* L. gemmis basalibus longe sericeo-villosis, indumento totius plantae longiore densiore, foliis proportione brevioribus, mediis latitudine duplo (in *I. Oculo-Christi* 3—4-plo) longioribus, nervatura dense reticulata subtus valde prominente, involucri latioris phyllis latioribus.

I. rhizocephala Schrenk — **C:** Bamian, an feuchten quelligen Stellen (N. 51/397). Band-e-Amir, obere und mittlere Seen (N. 51/456). — **E:** Ben Hissar, an feuchten Stellen (N. 51/350).

Clarke in Hooker, Icon. Plant. Ser. 3, Vol. 8; Pl. 173, unterscheidet seine *I. rhizocephaloides* durch purpurne Hüllschuppen, kurze Randblüten und kahle Achänen von der habituell gleichen *I. rhizocephala*. An dem vorliegenden reichen Material bestätigt sich das Parallelgehen der purpurnen Blütenfarbe mit der Kahlheit der Achänen. Die Länge der Randblüten dagegen ist bei beiden Arten wechselnd.

I. rhizocephaloides Clarke. — **C:** Unai Pass, an feuchten Stellen (N. 51/558). Hauz-i-Mahiha, 2500 m (K. 2447). Sabz Pass, 10000 ft., spring meadow (Kz. 13810), — **NE:** Ptili, 2600—2700 m (E. 1248, 1522). Minjan Pass, 12500 ft., damp meadow, fl. yellowish (Kz. 12774). — **Nuristan:** Netchingel, 3500 m (E. 1982). — **E:** Logarta (N. 51/377).

I. vestita Wall. (e descr.). — **E:** Mamakhel, 1350 m, dry slope (Kz. 11573).

Phagnalon glabrifolium Rech. fil., n. sp. — Fig. 23 und 24.

Sect. *Pentanema* Cass. — Suffrutex multicaulis 15—20 cm altus. Caules tenues erecti simplices vel prope basin ramosi tota longitudine regulariter foliati, internodiis mediis ad 15 mm longis. Tota planta glaberrima laevis. Folia inferiora florendi tempore marcescentia, media et superiora increscentia, oblongo-lanceolata, 2—3 cm longa, 4—7 mm lata, supra medium latissima, basin versus sensim longe attenuata subpetiolata, apice acuta, margine anguste revoluta, integerrima, costa mediana tenui subtus prominente supra immersa percursa, nervis lateralibus tenuissimis saepe vix visibilibus. Involucrum depresso-hemisphaericum e phyllis numerosissimis angustissime linearibus subfiliformibus omnino glaberrimis compositum; phylla indistincte 3—4-seriata, exteriora valde abbreviata ut media omnino herbacea, interiora flores paulo superantia apice subcaudata hyalina. Flo-

res filiformes, in vivo flavi (e collectore), in sicco superne bruneo-rufescentes. Achaenia submatura 1.5 mm longa, breviter hirsuta. Pappus achaeniis subtriplo longior pauciradiatus. — Differt a *Ph. Kotschyi* Schultz Bip. (Syria), cui habitu et glabritis simillimum, imprimis involucro paulo longiore, involucri phyllis numerosioribus tenuioribus, exterioribus quoque acutioribus.

E: Nozi, 10000 ft., lime rocks, in clumps, fl. yellow, 21.VI.1937 (Koelz 11983, Typus, hb. W., BPI.). Paghman, 7500 ft., dry rock face, 26.VI. 1937 (Kz. 12083, hb. W., BPI.). — **NE:** Faizabad (E. 1399, hb. W., C.). — **Nuristan:** (E. 1055, hb. W., C.). — **SW:** Südlich von Herat, 1400 m (K. s. n., hb. C. — specimina incompleta).

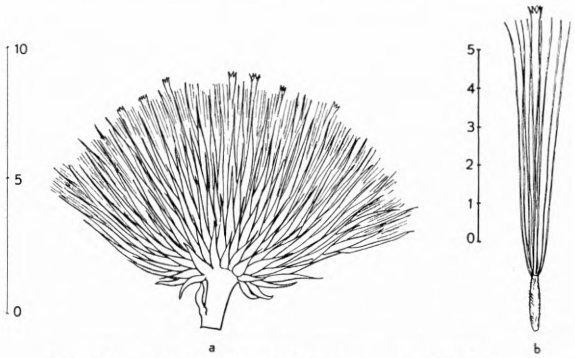


Fig. 24. *Phagnalon glabrifolium.* a. Köpfchen, b. Einzelblüte.

P. nitidum Fres. — **Nustan:** Vama, 1500 m (E. 959). — **SE:** Kajkai, 1000 m (K. 3304). Pirzada, 1100 m (2112).

P. niveum Edgew. — **Nuristan:** Kamdesh (E. 1147).

Varthemia asperella Rech. fil. & Köie, n. sp. — Fig. 25 und 26.

Suffrutex multicaulis, caulibus floriferis numerosissimis, ca. 30 cm longis, copiose tenuiter iteratim arcuato-ramosis, internodiis mediis 1—1.5 cm longis. Indumentum caulis foliorumque asperellum, e papillis crassiusculis brevibus acutis laxiuscule dispositis consistens. Folia inferiora ad 1.5 cm longa, 6—9 mm lata, basi anguste rotundata vel attenuata sessilia, acuta, remote breviter acute serrato-dentata; nervatura subtus tenuiter sed distincte prominens, praeter costam medianam e nervis paucis pennatis irregulariter laxe anastomosantibus consistens, nervorum par infimum e basi laminae ortum; consistentia in sicco coriaceomembranacea rigida; color sordide viridis. Folia superiora sensim decrescentia, proportione angustiora, ramealia superiora valde diminuta lineari-lanceolata. Capitula in ramis tenuibus ± arcuato-divergentibus terminalia, pappo incluso ca. 1.5 cm longa, in statu parum compresso ca. 5 mm lata. Involucrum anguste campanulato-cylindricum, ± 8 mm longum, basi breviter attenuatum vel subrotundatum, superne

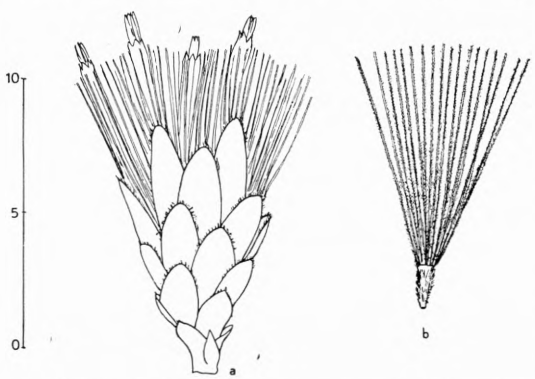


Fig. 25. *Varthemia asperella.* a. Köpfchen, b. Fruchtknoten mit Pappus.

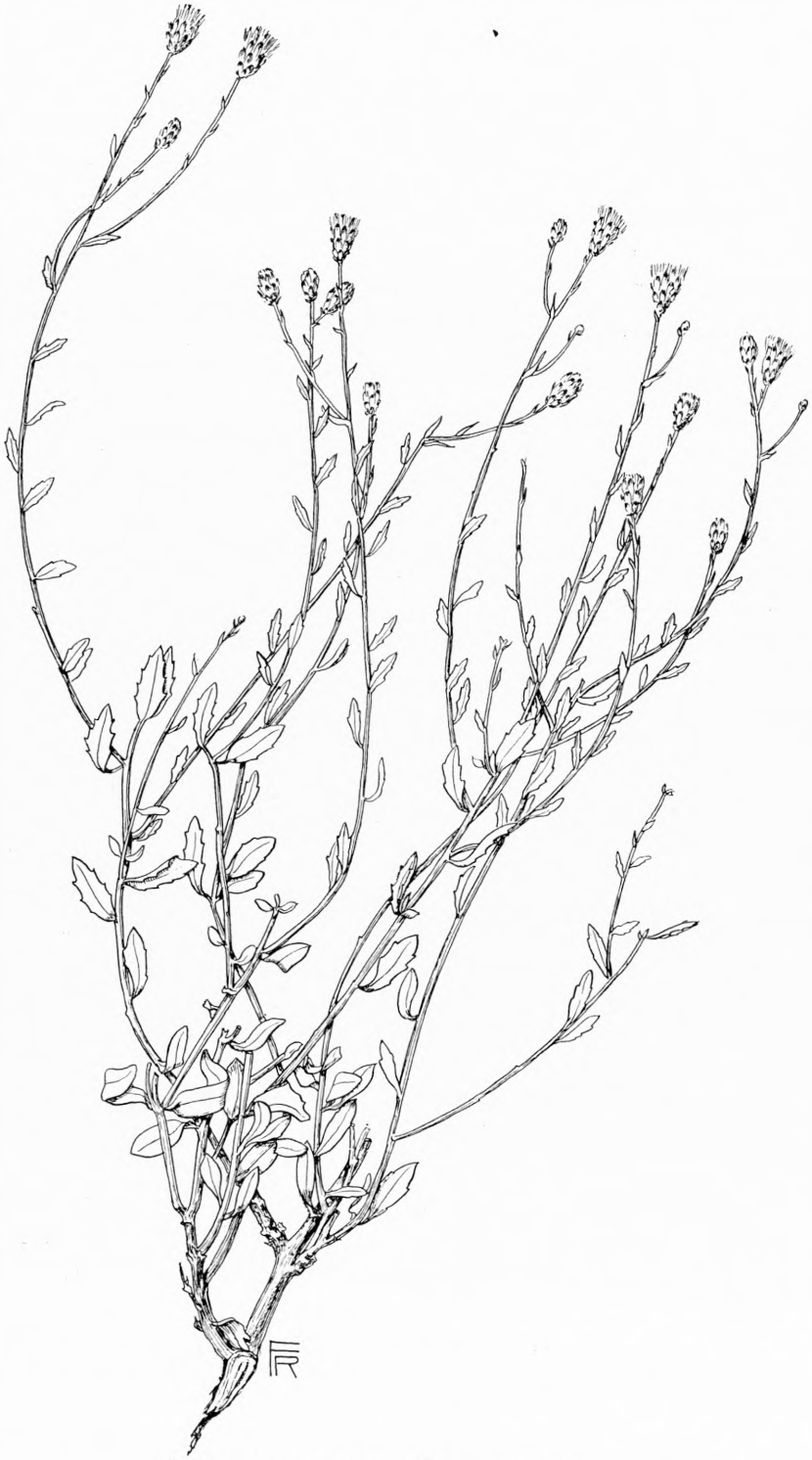


Fig. 26. *Varthemia asperella* (K. 2935). $^{3}/_{5}$.

paulo dilatatum, phylla plerumque 4-seriata regulariter imbricata, 12—16 mm lata, exteriora apice rotundata, media et interiora partim quidem acutiuscula, pallide membranacea, apice breviter herbacea, facie glabrescentia, anguste partim indistincte scarioso-marginata, ciliolata. Corolla 8—10 mm longa, in sicco flavescens. Achaenia (valde juvenilia) pilis longiusculis erecto-patentibus subsericeis obsita; pappus ± 7 mm longus, sordide albus multiradiatus sublaevis minutissime scabridus. — Differt a *V. platylepide* Rech. fil. & Köie caulibus copiose ramosis, indumento multo magis scabrido, foliis latis serratis, nervatura evoluta subtus prominente, involucri brevioris phyllis obtusioribus, pappo breviore.

NE: Ruka, 2000 m, 10.X.1948 (Köie 2935, Typus, hb. W., C.). Ghorband, 1700 m (K. 2878, hb. C.).

V. persica DC. — **NW:** Burchao Pass, 9000 ft., dry slope (Kz. 14128). — **N:** Akupruk, dry cliff (Kz. 13956). — **C:** Hauz-i-Mahiha, 2600 m, river bed (K. 2427). Doab, 1400 m (K. 3302). — **NE:** Ruka, 2000 m (K. 2936). — **E:** Ghorband, 1700 m (K. 2788).

Varthemia platylepis Rech. fil. & Köie, n. sp. — Fig. 27 und 28.

Suffrutex basi crasse lignosus cortice fibroso-dissoluto, caulibus floriferis numerosissimis ± 30 cm longis, tenuibus erectis herbaceis, tota longitudine dense foliatis, superne breviter corymboso-ramosis. Indumentum caulis foliorumque laxe minute puberulum subscabridum, glandulis minutis sessilibus immixtis. Folia omnia anguste lineari-lanceolata, inferiora ca. 2 cm longa, 1.5—3 mm lata, basi attenuata sessilia, integra, acute vel indistincte scarioso-mucronulata, costa mediana tenui percursa ceterum enervia, cauli fere appressa vel erecto-patentia, quam internodia semper multo longiora, superiora sensim decrescentia, ramealia ad 5 mm longa, vix 1 mm lata. Capitula in ramulis brevibus tenuibus erecto-patentibus singula terminalia, pappo incluso ca.

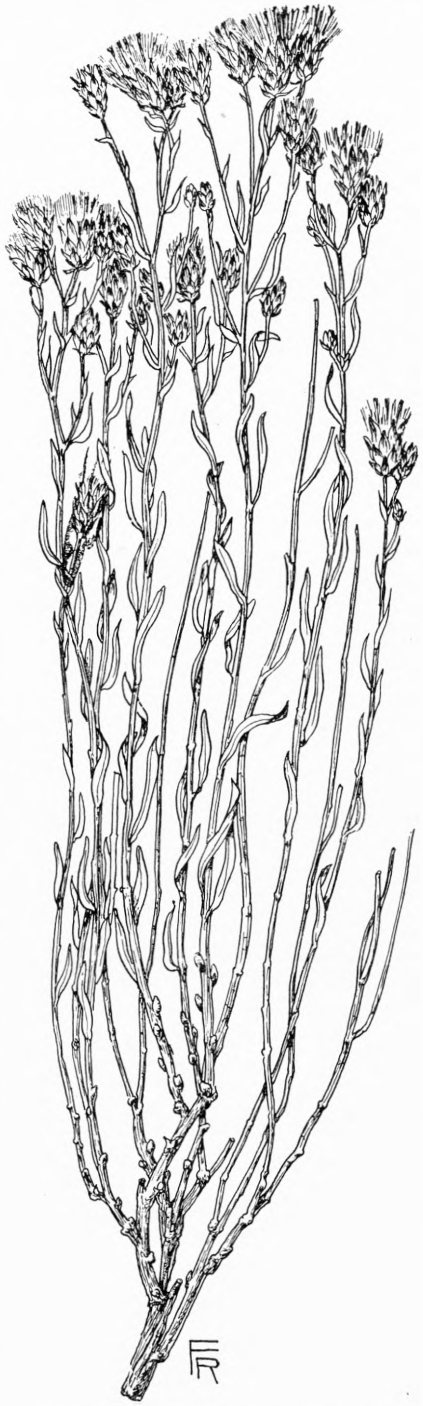


Fig. 27. *Varthemia platylepis* (K. 2384). $^{2}/_{3}$.

1.5 cm longa, in statu parum compresso ca. 5 mm lata. Involucrum anguste campanulato-cylindricum ± 11 mm longum, basi attenuatum, superne paulo dilatatum, phylla 4-seriata laxe regulariter imbricata, 1.5—2 mm lata acuta vel obtusiuscula vel subacuminata, inferne et sub apice pallide viridia ceterum membranacea brunescentia ± pellucida et anguste hyaline marginata. Corolla 8—10 mm longa, in sicco brunescens. Achaenia immatura 4—4.5 mm longa, breviter appresse pilosa; pappus sublaevis sordide albidus, ca. 1 cm longus. — Species nova involucri phyllis latis, foliis anguste linearibus integris uninerviis insignis.

C: Hauz-i-Mahiha, 2500 m, 11.VII.1948 (Köie 2384, Typus, hb. W., C.). Farakulum, 3000—3100 m (K. 2547, 3303, hb. W., C.). Upper Hari Rud, 2500 m (K.

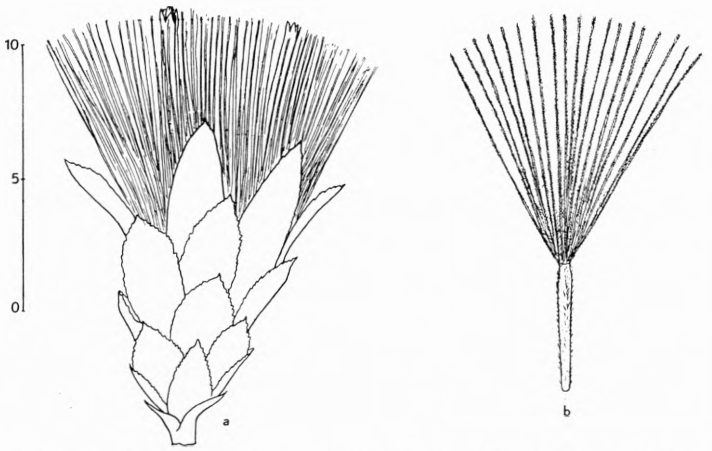


Fig. 28. *Varthemia platylepis*. a. Köpfchen, b. Fruchtknoten mit Pappus.

2755). Shibar Pass, 10000 ft., yellow (Kz. 13505, hb. W., BPI.). Lorinj Pass, 10000 ft., dry slope (Kz. 13728, hb. W., BPI.).

Pulicaria arabica (L.) Cass. — **SW:** S. of Herat, 1100 m (K. 3278). — **SE:** Kajkai, 1000 m (K. 2154).

P. crispa (Forsk.) Cass. — **E:** Mamakhel, 4000 ft., dry slope (Kz. 11602).

P. divaricata (Cass.) Boiss. — **SW:** Farah, 700 m (K. 3259).

P. dysenterica L. — **C:** Doab, 1400 m, river edge (K. 2878). Doao, 5000 ft., along stream (Kz. 13507). — **N:** Kundus, Versuchsfarm (N. 50/115.). — **NE:** Khash Distr., 8000 ft., spring edge (Kz. 12946).

P. dysenterica L. var. *microcephala* Boiss. — **NW:** Khwajaebichagli, 7000 ft., along stream (Kz. 14147).

P. dysenterica L. var. *stenophylla* Boiss. — **N:** Khanabad, 1200 ft., field border (Kz. 12212). Pulekhomri (N. 50/250). — **NE:** Jurm, 7000 ft., field (Kz. 12880).

Pulicaria olivascens Rech. fil. & Köie, n. sp. — Fig. 29 und 30.

Sect. *Francoeuria* Cass. — Caulis 40 cm altus, internodiis mediis 1—2 cm longis, imprimis in dimidio inferiore copiose ramosus; rami ad 15 cm longi, angulo recto patentes, simplices dense foliati, superne capitula pauca proferentes. Indumentum caulis ramorum inflorescentiae regionis e pilis glanduliferis crispulis longioribus et brevioribus consistens, olivascens. Folia caulina inferiora florendi tempore jam marcescentia, ad 25 mm longa, ad 14 mm lata obovata, obtusa vel acutiuscula, margine ± crispata basin versus attenuata et auriculato-cordata; nervatura in pagina inferiore leviter prominens sed indumento longo candido gossypino-floccoso saepe fere omnino occulta. Folia superiora et ramealia valde decrescentia. Capitula in corymbo terminali oligocephalo disposita, praeterea ad extremos ramos singula vel pauca, pedunculis tenuibus 9—10 mm longis suffulta. Involucrum depresso-semiglobosum subuniseriatum, phyllis linearibus ca. 1 mm latis acutis dense breviter olivaceo-glandulosis. Flores filiformes ut videtur flavidi. Achaenia submatura 0.8—0.9 mm longa, basin versus paulo attenuata subtruncata, densiuscule pilosa. Pappus ± 3 mm longus sordide albus. — Differt a *P. gnaphalode* (Vent.) Boiss. indumento in caule in ramis et in regione inflorescentiae omnino e pilis glanduliferis consistente olivascente, achaeniis subbrevioribus

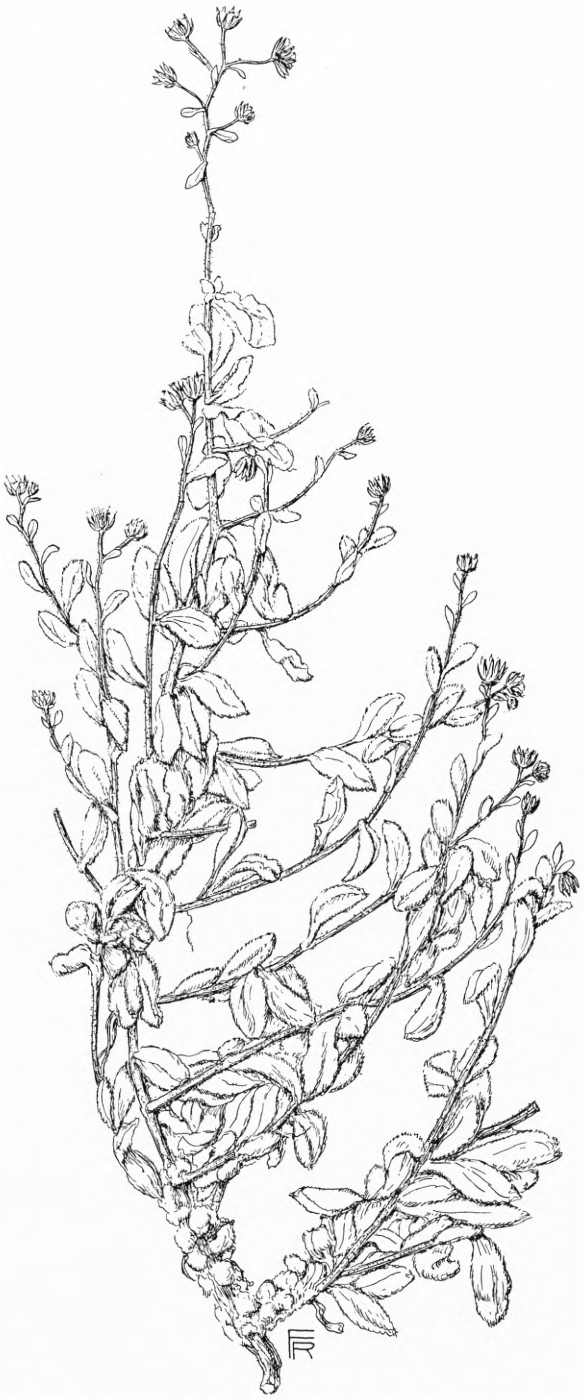


Fig. 29. *Pulicaria olivascens* (K. 2862). $^1/_2$.

basin versus minus attenuatis subtruncatis densius pilosis, foliis latioribus obovato-oblongis ± crispatis.

C: Doab, 1800 m, 22.VIII.1948 (Köie 2862, hb. W., C.). — **NE:** Rustak, 2000 ft. (Kz. 13130). — **SE:** Girishk, desert (Kz. 13229). Kajkai, 1000 m (K. 2150).

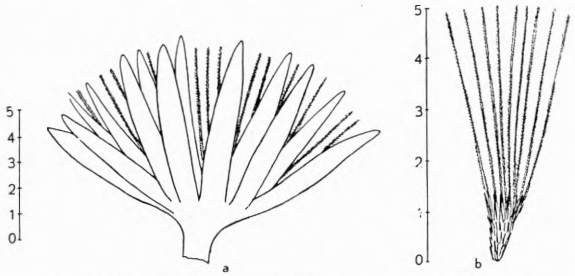


Fig. 30. *Pulicaria olivascens.* a. Köpfchen, b. Fruchtknoten mit Pappus.

Pulicaria sublepidota Rech. fil., n. sp. — Fig. 31 und 32.

Sect. *Eu-Pulicaria* Hoffm. — Suffrutescens multicaulis. Caules erecti, 30—40 cm alti, internodiis mediis 2—3 cm longis, a basi ramosi; rami omnes tenues angulo recto abeuntes, inferiores ad 15 cm longi, paulum sursum curvati, superne breviter pauciramosi, in ramulos monocephalos abeuntes vel subsimplices, paucifoliati. Indumentum in caulis internodiis infimis valde abbreviatis floccoso-congestum. Folia caulina inferiora longe (1—2 cm) petiolata; lamina ovato-lanceolata, basi breviter attenuata, 1.5—2.5 cm longa, 8—12 mm lata, acuta, margine minute erose crispato-crenulata; nervatura dense tenuiter pennato-reticulata, subtus valde prominens; indumentum breviter appresse floccoso-tomentosum albidum fere sublepidoto-sericeum; folia superiora decrescentia brevius petiolata angustiora acutiora, summa valde diminuta anguste lineari-lanceolata. Capitula in ramis strictis tenuibus solitaria; involucrum 6—7 mm longum, basi late conicum vix rotundatum, superne in statu compresso 7—9 mm latum, phyllis anguste linearibus apice sensim valde attenuatis flores aequantibus vel paulo superantibus, appresse canescenter floccoso-tomentosis, interioribus non numerosis subaequilongis hyaline membranaceis, nervo mediano viridi tenui percursis. Flores flavi. Achaenia (juniora) dense breviter hirsuta; pappi radii exteriores breves nitiduli, interiores non numerosi sordide albi ± 5 mm longi, minute scabriduli, corollam superantes. — Differt a *P. salviaefolia* Bge. ramis angulo recto abeuntibus valde divaricato-arcuatis, indumento foliorum appressissime subsericeo-tomentoso sublepidoto, foliis acutioribus, capitulis minoribus, floribus minus numerosis, involucri phyllis angustius linearibus, pappi radiis minus numerosis, achaeniis ut videtur minoribus densius breviter hirsutis.

NE: Tuki, 4500 ft., dry ground, flowers yellow, 15.VIII.1937 (Koelz 13119, hb. W., BPI.).

Lachnophyllum gossypinum Bge. — **N:** An der Strasse von Kundus nach West (N.50/116). — Kala Sarkari, 7000 ft., dry slope (Kz. 13931).

Fig. 31. *Pulicaria sublepidota* (Kz. 13119). $^{2}/_{5}$.

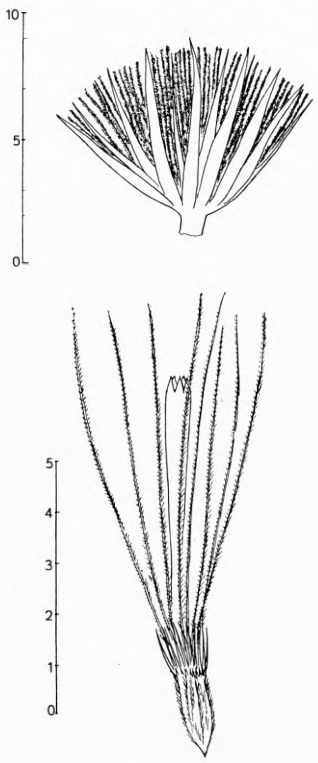


Fig. 32. *Pulicaria sublepidota*. Einzelblüte und Köpfchen.

Carpesium pubescens Wall. — **Nuristan:** Kamdesh — Barikot (E. 1791).

Xanthium strumarium L. Ohne Früchte, daher zweifelhaft. — **E:** Kabul, Guzar Gah (N. 50/72).

Bidens tripartita L. — **N:** Khanabad, 2000 ft., along stream (Kz. 12210). — **C:** Dashtisufed, 6000 ft., along stream (Kz. 13561). Kamard, 6000 ft., (Kz. 13619). — **NE:** Jurm, 7000 ft., field border, said to be used as tea (Kz. 12889). — **E:** Kabul, Guzar Gah (N. 50/104).

Anthemis austro-iranica Rech. fil., Aell., Esf., Oesterr. Bot. Zeitschr. 97:227 (1950). — **SE:** Pirzada, 900 m (K. 2025).

"Differt ab *A. Gayana* Boiss. cui achaeniis ecoronatis affinis caule plerumque elatiore semper folioso, foliis nunquam rosulato-congestis, longe rigide petiolatis foliorum segmentis paucis linearibus antice paulum dilatatis saepe simplicibus, pedunculis incrassatis, involucri phyllis angustius marginatis, paleis plerumque latioribus et latius hyaline marginatis rigidioribus; differt ab *A. brachystephana* Bornm. & Gauba, cui habitu similis, foliis longe rigide petiolatis, segmentis minus numerosis plerumque angustioribus et minus divisis, indumento totius plantae minus denso, pedunculis incrassatis, involucro saepe densius piloso plerumque angustius hyaline marginato, paleis latioribus rigidioribus in statu maturo atropurpureis, achaeniis ecoronatis vel raro coronula valde rudimentaria provisis".

A. caulescens Aitch. & Hemsl. — **NW:** Sauzak — Qala Nau, 1200 m (K. 3921). Chisht, 1700 m (K. 3704). — **SW:** Herat — Jija, 1400 m (K. 3945).

Man vergleiche über die systematische Stellung dieser Art Rech. f., Ann. Nat. Mus. Wien, 54: 3—4 (1944).

A. Cota L. — **N:** Baghlan, 3000 ft., fields (Kz. 12179).

A. Gayana Boiss. — **E:** Kulali, rays whitish, disc rose-purple (Kz. 11384). — **SW:** Jija, 900 m (K. 4030).

Achillea filipendulina Lam. — **NE:** Hazratsaid, 8000 ft., field edge (Kz. 12848). Jurm, 1600 m (E. 1417).

A. micrantha M.B. — **NW:** Ardewan, 1500 m (K. 2251). Laorlash, 9000 ft., along stream (Kz. 14101). — **C:** Lorinj, 8000 ft., in dry ground (Kz. 13670). — **NE:** Jurm, 1600 m (E. 1419). Faizabad, 4500 ft., field border (Kz. 12374). Daraim. 8500 ft., in field (Kz. 13063). Gulbahar, 5000 ft., along fields (Kz. 11429). Khash Distr., 8000 ft., mats along stream (Kz. 12957). — **E:** Nozi, 9000 ft., field border (Kz. 11986). Unteres und mittleres Paghmantal (N. 50/892). Charikar, 6000 ft., dry ground (Kz. 11817).

A. millefolium L. s. l. — **NE:** Khash Distr., 8000 ft., field and field edge (Kz. 12927, 12941).

A. Santolina L. — **SW:** Herat, 1600 m, frequent (K. 4029). — **C:** Deh Kundi, 2700 m (E. 1904). Bamian, 8000 ft. (Codrington). — **E:** Begram near Charikar, 5000 ft. (Codrington). Charikar, 6000 ft., dry ground (Kz. 11813). Kabul (N. 50/919).

A. vermicularis Trin. — **C:** Panjao, 2700 m (K. 3293). — **E:** Tera Kotal, dry ground, fl. gold, 1 ft. high (Kz. 11890).

Matricaria chamomilla L. — **E:** Kabul, Gartenunkraut (N. 50/911).

M. disciformis (C. A. Mey.) DC. — **NW:** Herat — Sauzak, 2000 m (K. 2216). Safedsang, 10000 ft., along stream, gold, 1 ft. high (Kz. 13999). — **C:** An den Seen von Band-e-Amir (N. 51/444). Bamian, river valley (Codrington). Lorinj, 8000 ft., field and field edge, gold (Kz. 13675, 13711). — **NE:** Gulbahar, 5000 ft., field border, fl. orange-yellow (Kz. 11445). Jurm, 7000 ft., weed, fl. gold (Kz. 12970). Iskan (E. 1600). — **E:** Kabul, Unkraut in Gärten und Getreidefeldern (N. 50/913). Tagau, 6000 ft., damp ground, fl. mustard yellow (Kz. 11803). Sirotai, 9000 ft., fields, fl. orange (Kz. 11924).

M. lamellata Bge. — **NW:** Qala Nau (K. 4032). — **SW:** Jija, 900—1400 m (K. 3579, 3597, 4031). — **E:** Kabul (N. 50/922, 50/923, 51/75). Kabul (Lindberg). Pandscheschah, trockene, sandige Berglehne (N. 51/54). Pulalam, 7000 ft. (Kz. 11867).

M. lasiocarpa Boiss. — **Baluchistan:** Quetta, 1400 m (K. 3264).

Chrysanthemum (*Tanacetum*) ***crassicollum*** Rech. fil., n. sp. — Fig. 33 und 34.

Basi induratum, verosimiliter caespitosum; caudices collo incrassati squamis ± 5 mm latis brevibus membranaceis bruneis imbricatis elevate plurinervosis provisi. Caules floriferi crassi, validi, ± erecti, ad 15 cm alti, internodiis mediis 2—3 cm longis, tota longitudine foliati, tenuiter elevate striati, superne densius inferne laxius tomentoso-lanati glabrescentes. Folia basalia numerosa, petiolata; petiolus 2—3 cm longus latiusculus; lamina

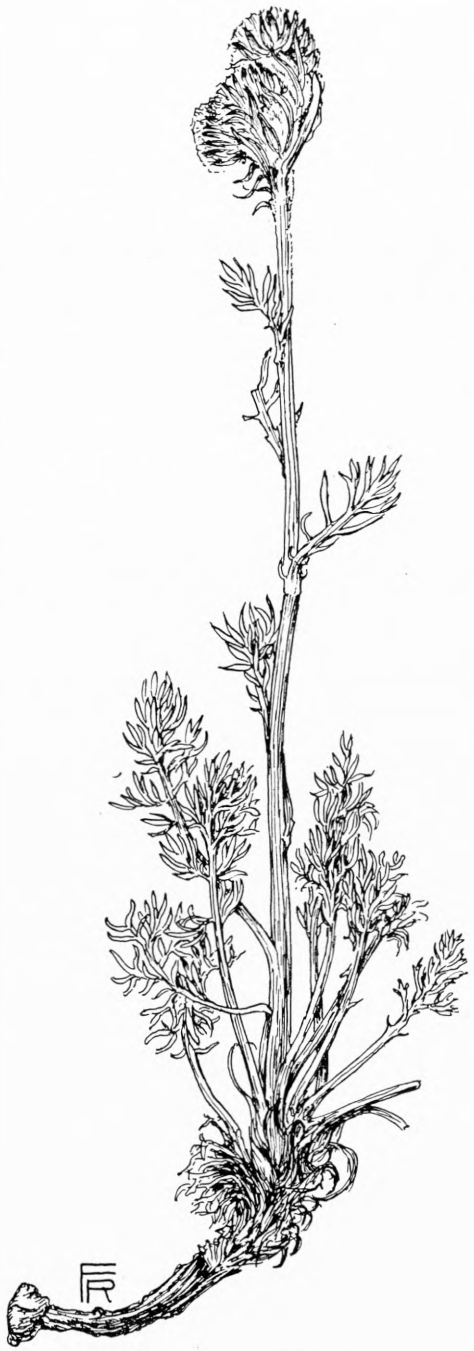


Fig. 33. *Chrysanthemum crassicollum* (Kz. 13771). $^4/_5$.

2—3 cm longa, 1—2 cm lata, ambitu late ovata vel elliptico-oblonga, in sicco flavescenti-viridis, laxe breviter lanata glabrescens, bi- usque tripinnatisecta, segmentis primi ordinis utrinque ± 3, lacinulis ultimi ordinis linearibus vel anguste lineari-lanceolatis ± divaricatis, ad summum 5 mm longis, 1 mm latis, acutis et brevissime cartilagineo-mucronulatis, in segmentis terminalibus palmato-congestis; rhachis latiuscule striato-nervosa integra. Folia caulina brevius petiolata sensim decrescentia, inferiora bi-, superiora simpliciter pinnatisecta, pectinata, segmentis ad 7 mm longis, 1 mm latis. Capitula numerosa corymboso-congesta, breviter crasse pedunculata vel subsessilia; involucrum 5—7 mm longum depresso-hemisphaericum; involucri phylla subaequalia, ad 1.5 mm lata, dense appressa, linearia usque lineari-lanceolata, medio herbacea, lanata glabrescentia, margine late atrofusca et minute eroso-subfimbriata usque subintegra, apice rotundata vel acutiuscula. Flores aurei non radiantes, tubo glanduloso-papilloso, limbo in lacinias 5 latiuscule lanceolatas 1.6 mm longas diviso. Achaenia (valde juvenilia) 1.5 mm longa, brunescentia glabra. — Differt a *Ch. Senecione* (Gay ap. DC. sub *Tanaceto*) collo incrassato squamis latis dense obsito, caulibus crassis, foliis flavescenti-viridibus magis glabrescentibus, foliorum laciniis magis elongatis acutioribus, in foliis caulinis superioribus longioribus, inflorescentia e capitulis numerosis congesta, involucri phyllis angustioribus.

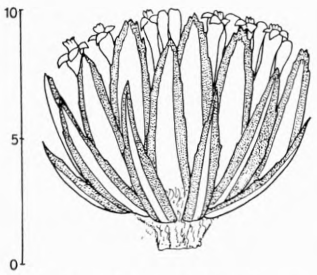


Fig. 34. *Chrysanthemum crassicollum.* Köpfchen.

C: Lorinj Pass, 10000 ft., dry slope, plant scented, flowers orange, 27.VIII.1939 (Koelz 13771, Typus, hb. W., BPI.). — **NW:** Safed Sang, 10000 ft., dry slope, plant scented, 6 inches high, flowers gold, 21.IX.1939 (Kz. 13988, hb. W., BPI.).

Chrysanthemum (*Tanacetum*) ***eriobasis*** Rech. fil., n. sp. — Fig. 35 und 38.

Dense caespitosum, basi crasse lignosum, collo residuis petiolorum membranaceo-dilatatis comoso, lana gossypina floccosa inter ea copiose erumpente. Caulis 45—75 cm altus, tenuis teres herbaceus tenuiter sulcato-striatus glaber, in quinta vel sexta parte superiore tenuiter breviter corymbose ramosus florifer, internodiis 5—10 cm longis remote foliatus, superne longe nudus. Folia basalia petiolo tenui striato-sulcato ca. 3 cm longo suffulta; lamina ambitu oblongo-obovata, laxe longiuscule lanata ± glabrescens, regulariter tenuiter tri- usque quadri-pinnatisecta, segmentis primi ordinis utrinque ± 5, lacinulis ultimi ordinis linearibus vel linearilanceolatis acutis divaricatis 2—3 mm longis, vix 1 mm latis; rhachis angusta integra; folia caulina inferiora omnino similia sed brevius petiolata, superiora valde decrescentia sessilia, omnia autem ad minimum tripinnatisecta. Capitula numerosa, in ramis 2—5 cm longis tenuibus divaricatis in pedunculos tenuissimos 1—2 cm longos divisis laxe corymbosa. Involucrum 3 mm longum, in statu compresso ad 6 mm diametro, valde depresse hemisphaericum; phylla arcte appressa subaequilonga angustissime linearia acutiuscula vel obtusiuscula, pallide flavescenti-viridia, glabra

vel subglabra, angustissime hyaline marginata. Flores aurei non radiantes, limbus in lacinias 5 breves acutas divisus. Achaenia (juvenilia) glabra, coronula brevissima lacerata provisa. — Lana gossypina basali, foliis tenuiter divaricate tri- usque quadri-pinnatisectis, caule elato glabro superne longe nudo, inflorescentia tenuiter ramosa laxiuscule corymbosa, capitulis parvis, involucro subglabro valde depresso phyllis angustissime hyaline marginatis insigne.

E: Nozi, 9000 ft., lime-rocks, in clumps, plant 3 ft. high, flowers gold, 22.VI.1937 (Koelz 11988, Typus, hb. W., BPI.). — **Nuristan:** Papruk, 2350 m (E. 1594, hb. C.). — **C:** Farakulum, 2900 m (K. 2513, hb. W., C.).

Edelberg 1594 weicht vom Typus durch niedrigeren Stengel, armköpfige Infloreszenz und noch reicher und feiner geteilte Blätter ab. Köie 2513 hat etwas größere Köpfchen von 7 mm Durchmesser und etwas breitere, kürzere und kürzer zugespitzte Blattzipfel.

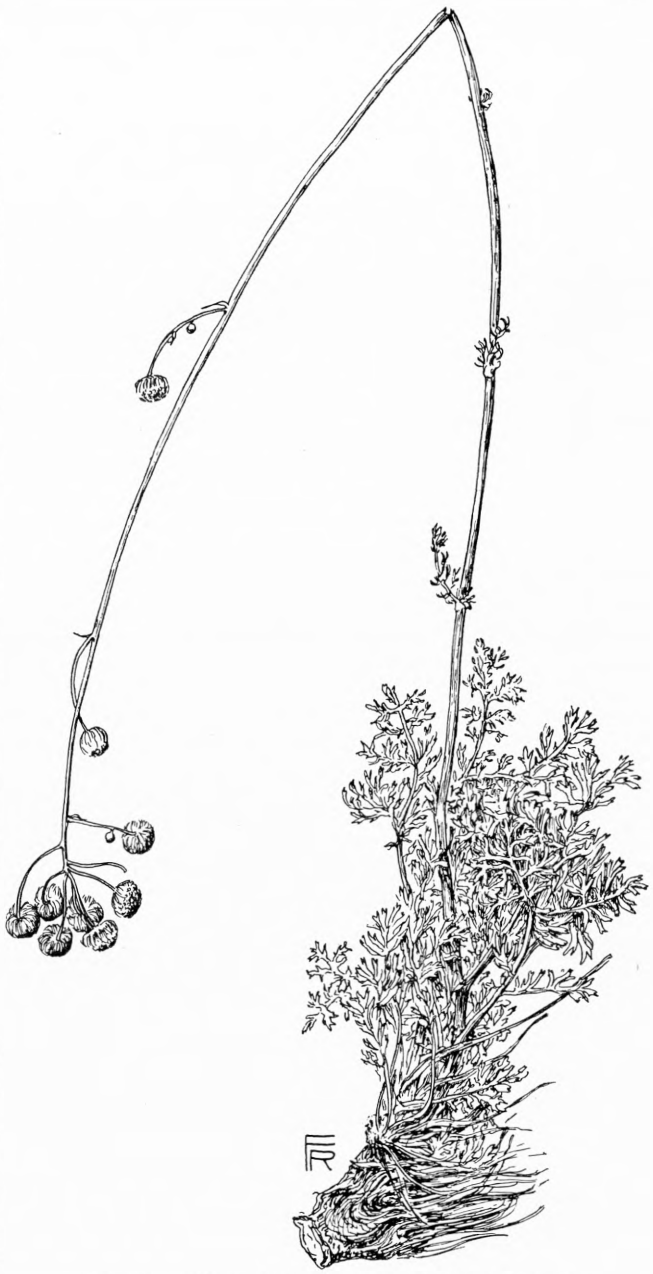


Fig. 35. *Chrysanthemum eriobasis* (E. 1594). $^{2}/_{3}$.

Ch. (*Tanacetum*) ***Fisherae*** (Aitch. & Hemsl.) Rech. fil., nomen novum. Syn. *T. Fisherae* Aitch. & Hemsl., Journ. Linn. Soc. 19:170 (1882). — **C:** Hauz-i-Mahiha, 2900 m (K. 2460). Unaipass (N. 51/508, 51/519). — **NE:** Minjan Pass, 12000 ft., fl. yellow (Kz. 12698). — **Nuristan:** Weran, 3000 m (E. 1460). — **E:** 35 km S. of Kabul (K. 2326). Below Sirotai, 8000 ft., dry ground (Kz. 11966). Oberes Paghmantal (N. 50/895, 50/910). — **SE:** Kajkai, 1000 m (K. 2150).

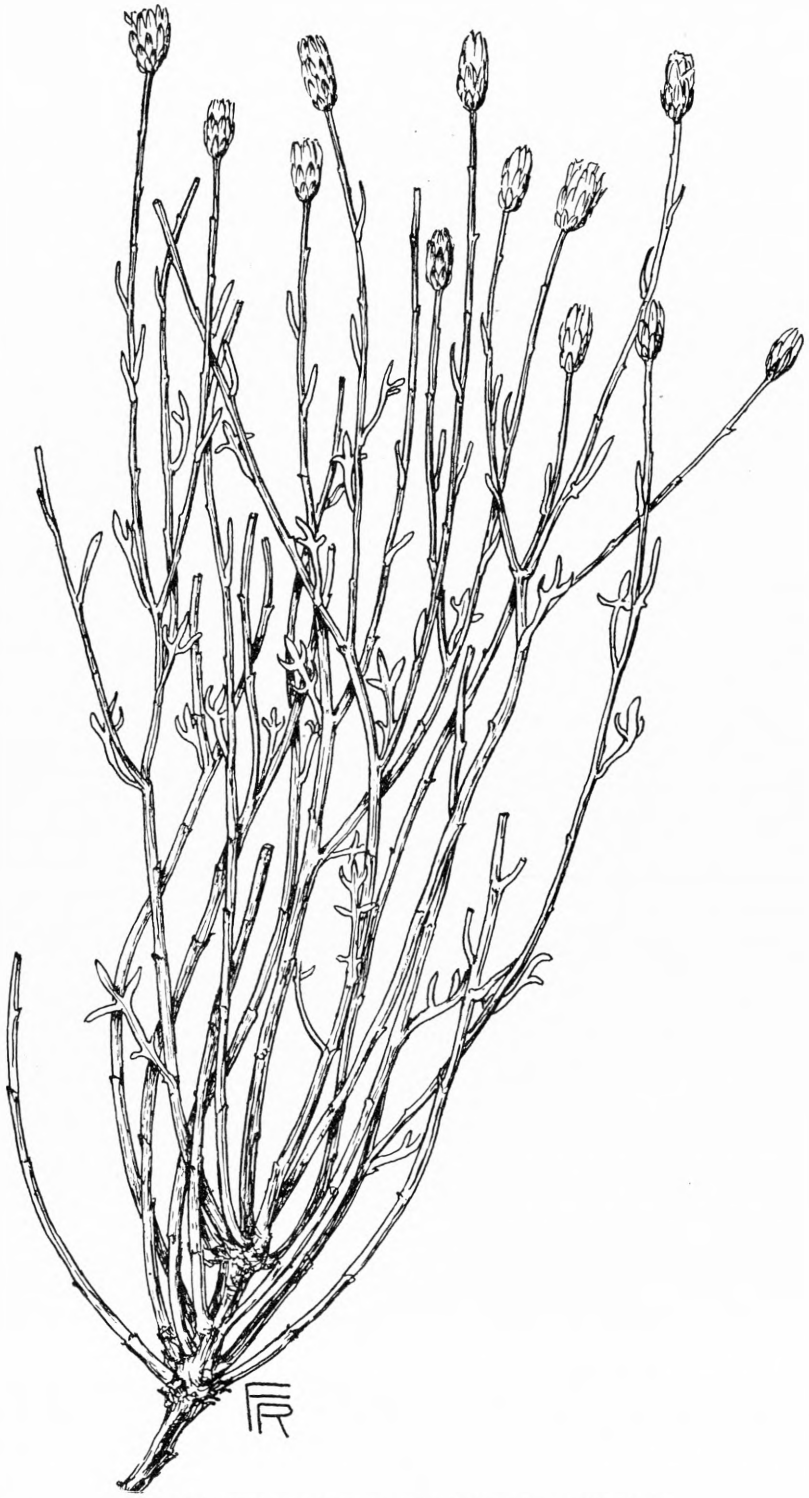


Fig. 36. *Chrysanthemum polycladum* (Kz. 13745). $^{1}/_{1}$.

NEUBAUER 508 ist durch polsterförmigen Wuchs, kurze starre, etwas strahlende Blätter, zarte Stengel und blass berandete Hüllschuppen auffallig.

Ch. gracile (Hook. & Thoms.) B. Fedtsch. — **Nuristan:** Chetras, 2000 m (E. 1207). Waigel (E. 2061).

Ch. pamiricum O. Hoffm. — **C:** Band-e-Amir, 2800 m (K. 3258).

Ch. parthenium (L.) Bernh. — **NE:** Daraim, 8500 ft., stream bank, rays white (Kz. 13064). Gulbahar, 6000 ft., damp ground, rays white, disk yellow (Kz. 11810). Gulbahar (N. 50/914). — **E:** Unteres Paghmantal (N. 50/900).

Chrysanthemum (*Tanacetum*) ***polycladum*** Rech. fil., n. sp. — Fig. 36 und 38.

Suffrutex inferne fasciculato-ramosissimus, 15—20 cm altus; rami ultimi ordinis ad 5 cm longi, tenues, stricte erecti, monocephali, laxe minute puberuli, cinerascenti-virides, tenuiter subangulato-striati. Folia omnia valde decidua, inferiora interdum ultra 2 cm longa, ad 1 cm lata, in segmenta perpauca remota divaricata angustissima vix 1 mm lata divisa; rhachis et petiolus aequaliter angustissimi. Folia superiora decrescentia minus divisa, summa utrinque lobulo vel denticulo unico provisa vel subintegra. Involucrum ad 8 mm longum, ad 3 mm diametro, anguste cylindricum, basi attenuatum, phyllis plerumque ± 4-seriatis arcte regulariter imbricatis appressissimis pallide bruneis scariosis, costa mediana tenui virescente percursis, apice acutis ibique atratis, ceterum subtomentellis valde glabrescentibus. Flores omnes aequales quinquedentati flavescenti-aurantiaci (e collectore). Achaenia pallide brunea glanduloso-punctata (juvenilia tantum visa). — Species habitu, foliis, involucris insignis, in affinitatem remotiorem *Ch. Fisherae* (Aitch. et Hemsl.) Rech. f. et *Ch. rupestris* (Pop. sub *Tanaceto*) nec Koidz. pertinere videtur.

C: Lorinj Pass, 10000 ft., dry slope, fl. yellow-orange, 27.VIII.1939 (KOELZ 13745, hb. W., BPI.).

Chrysanthemum porphyrostephanum Rech. fil., n. sp. — Fig. 37 und 38.

Sect. *Pyrethrum* (Gärtn.) Hoffm. Subsect. *Leucoglossa* (DC). — Suffrutex basi crasse lignosus caespitosus, ramis floriferis deflexo-ascendentibus tenuibus herbaceis ad 10 cm longis. Indumentum caulium et foliorum pubescenti-villosum ± evanescens. Folia inferiora et media longiuscule usque breviter petiolata, ambitu ovato- vel oblongo-lanceolata, pinnatisecta; segmenta principalia utrinque saepius 4, ad 5 mm longa, 0.5—1 mm lata, antice trifida vel vario modo saepe irregulariter paucilaciniata vel paucidentata vel integra, longiuscule cartilagineo-mucronulata, margine subtus incrassata vel ± revoluta, rhachis quam laciniae paulo vel vix latior integra ut segmenta nervo subtus tenuiter prominente percursa. Capitula ad ramos superne longiuscule (± 3 cm) nudos singula terminalia. Involucrum florendi tempore hemisphaerico-campanulatum, fructificatione completa expansum ad 12 mm diametro; phylla (2—) 3-seriata imbricata pallide membranacea tomentella, anguste fusco-marginata et minutissime lacerata; exteriora triangulari-lanceolata acuta, dimidiam circiter longitudinem interiorum attingentia; media et interiora subaequilonga linearia,

ca. 1 mm lata, apice rotundata vel obtusiuscula. Flores marginales purpurei longe radiantes. Achaenia ± 2 mm longa, tenuissima, curvata, brunea, angulata, angulis quinque pallidius costatis, basin versus attenuata apice coronula auriculiformi integra

Fig. 37. *Chrysanthemum porphyrostephanum* (Kz. 14123). $^1/_1$.

1 mm longa pallide membranacea praedita. — Differt a *Ch. armeno* (DC.) Hand.-Mzt. (= *Ch. fruticulosum* Fenzl) ligulis purpureis, involucri phyllis angustioribus (2—) 3-seriatis tomentellis angustissime fusco-marginatis, indumento caulis foliorumque magis patulo, achaeniis corona auriculiformi integra longiore praeditis.

NW: Burchao Pass, 9000 ft., dry slope, rays magenta, plant pleasently scented, 6 inches high, 12.X.1939 (Koelz 14123, Typus, hb. W., BPI.). — **C:** Bamian (Codrington s. n., hb. B.M.).

Ch. Richteria Benth. — **Nuristan:** Netshingel (E. 1981). Zwischen Kotal-e-Agok und Alm bis Ort Waigel (N. 51/908, W.). — **E:** Paghman, 9000 ft., damp slope (Kz. 12122). Oberes Paghmantal (N. 50/897). Bagrami, Nedjerau-Tal, am Hang (N. 51/312).

Ch. Stolitzkai Clarke — **NE:** Sanglech, 11500 ft., stream bed, rays white, clumps (Kz. 12626). — **Nuristan:** Ashpei Pass (E. 1750). Pashki, 2400 m (E. 945, 1020). Shtive, 2800 m (E. 1049).

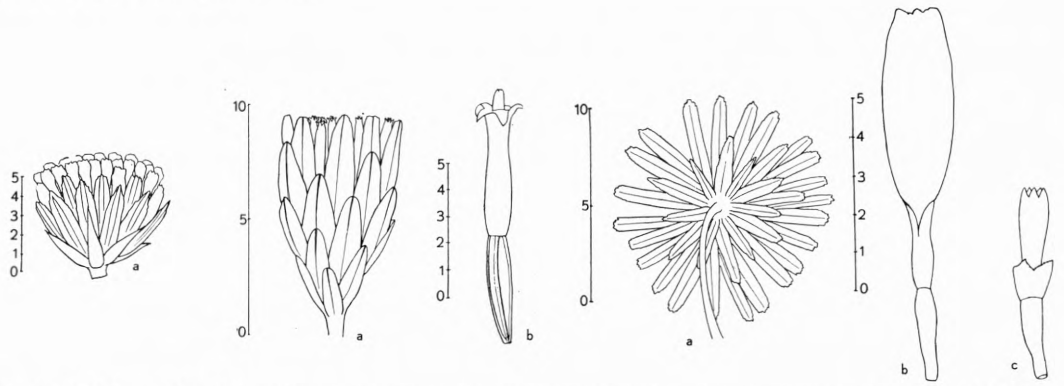


Fig. 38. Links nach rechts: *Chrysanthemum eriobasis*, *Ch. polycladum*, *Ch. porphyrostephanum*. a. Köpfchen b. und c. Einzelblüten.

Chrysanthemum (*Tanacetum*) ***subsimile*** Rech. fil., n. sp. — Fig. 39.

Basi induratum verosimiliter multicaule, collo residuis petiolorum lanceolato-dilatatis fibroso-marcescentibus comoso. Caules floriferi 40—50 cm alti, teretes validi subfistulosi, tenuiter sulcato-striati, remote paucifoliati, foliis superioribus remotissimis valde diminutis in dimidio superiore subnudi, lanato-pubescentes valde glabrescentes. Folia basalia florendi tempore jam marcescentia, longe tenuiter petiolata (6—10 cm); lamina ambitu 5—8 cm longa, 2—3 cm lata, laxe lanata ± glabrescens, tri- usque pluri-pinnatisecta, segmentis lineari-filiformibus divaricatis acutis mucronulatis. Folia superiora ± sessilia, valde diminuta, segmentis sublatioribus, ceterum inferioribus similia. Folium summum 4—6 cm infra inflorescentiam insertum valde diminutum, 15 mm longum, 5 mm latum, irregulariter conferte pinnatisectum. Inflorescentia e capitulis numerosis subumbellato-corymbosis congesta, ramis inferioribus 15—20 mm longis subhorizontaliter patentibus crassiusculis lanatis saepe capitula plura breviter pedunculata ferentibus. Involucrum valde depresse hemisphaericum, ca. 4 mm longum, in statu compresso 8 mm latum; phylla arcte appressa, triseriata, subaequilonga, medio herbacea, angustissime interdum indistincte atrofusco-marginata, imprimis intima apice late nitenter hyaline marginata, exteriora acutiuscula, interiora ± rotundata. Flores aurei non radiantes, tubo minute glanduloso-papilloso, limbo in lacinias 5 breves acutas diviso. Achaenia (valde juvenilia) brunescentia glabra, coronula brevi membranacea provisa. —

Fig. 39. *Chrysanthemum subsimile*. (Kz. 13008 — a. Köpfchen). Habitus $^{2}/_{3}$.

Differt a *Ch. longifolio* (Wall. sub *Tanaceto*) capitulis dimidio circiter minoribus, involucri phyllis tri- nunquam quadriseriatis, phyllis extimis lanceolatis nunquam setaceis, omnibus multo latius hyaline marginatis.

NE: Khash Distr., in mats, 10000 ft., flowers yellow, 9.VIII.1937 (KOELZ 13008, hb. W., BPI.).

Ch. umbelliferum (Boiss.) Burkill, Kew Bull. 1935:317 (1935). — **NW:** Qala Nau, 800 m (K. 3799).

Artemisia Absinthium L. — **C:** Bamian, 2500 m (K. 2922). Bamian (N. 51/402). — Afghanistan (GRIFFITH 3196/1, hb. W.).

Artemisia afghanica Rech. fil. & Köie, n. sp. — Fig. 40 und 43.

Suffrutex ± 30 cm altus, basi valde lignescens, caules floriferos numerosos et surculos steriles nonnullos emittens; rami floriferi erecti vel ascendentes, pallide brunei, floccoso-pubescentes glabrescentes striato-sulcati, inferne simplices, a medio vel a tertia parte superiore ramos plerumque stricte erectos ± breves floriferos emittentes; caules internodiis brevibus tota longitudine crebre foliati. Folia omnia in sicco consistentia crasse membranacea, in vivo ut videtur subcarnosa, colore sordide (vel flavescenti-) viridia, primum floccoso-pubescentia, deinde glabrescentia; folia inferiora et surculorum petiolata, petiolo erecto-patente laminam ad summum aequante, cetera brevius petiolata usque fere sessilia. Lamina ambitu late ovata, latitudine saepe non vel paulo tantum longior, ad 15 mm longa, bipinnatisecta, segmentis utrinque ± 4 ± approximatis, lobulis ultimi ordinis saepe brevibus latiusculis subrotundatis vel breviter acutatis; folia superiora sensim decrescentia, minus composita, lacinulis latioribus. Folia summa capitula fulcrantia valde diminuta sessilia, palmato-paucilobata usque subsimplicia. Inflorescentia ramis saepe pluribus abbreviatis omnibus stricte erectis vel axi subap-

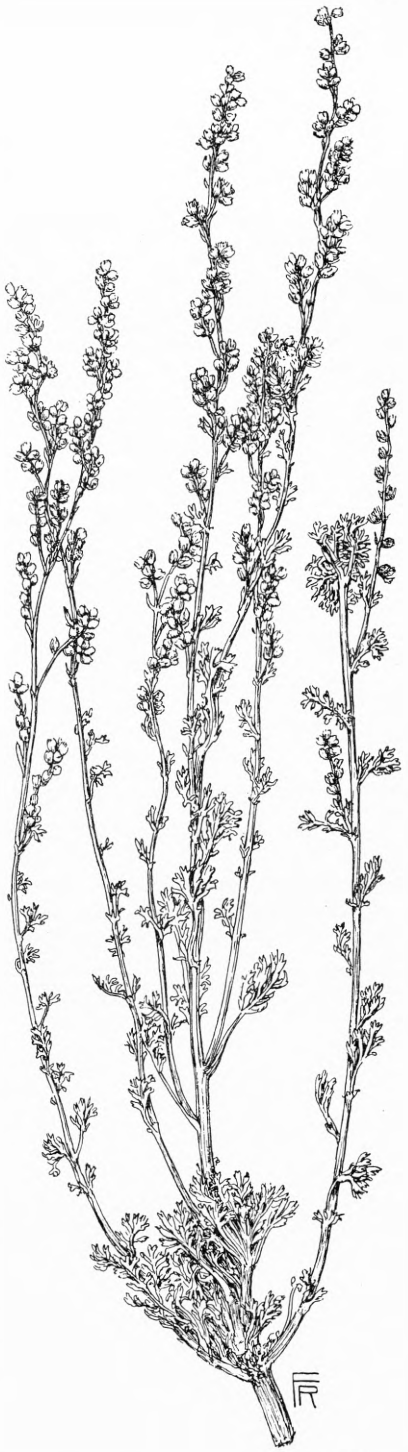


Fig. 40. *Artemisia afghanica* (K. 3287). $^3/_5$.

pressis quasi spicastrum inferne sublobato-interruptum formans, canescenti-flavescens. Capitula singula vel 2—3-na conglomerata sessilia; involucrum ad 3 mm longum basi attenuatum; phylla ± triseriata, anguste lanceolata, acutiuscula usque rotundata, exteriora fascia mediana herbacea praedita pubescenti-lanatula ± glabrescentia anguste hyaline marginata, interiora flavescentia nitentia latius hyalina. Capitula pauciflora. Corolla flava breviter laciniata. Achaenia ignota. — Species foliis crassiusculis brevibus sordide viridibus latiuscule laciniatis, inflorescentia stricta e capitulis ± glomeratis composita, capitulis paucifloris, involucri phyllis triseriatis exterioribus herbaceis lanatis interioribus membranaceis flavescentibus nitidis insignis.

C: Between Panjao and Upper Hari Rud, 2800 m, dominating on large areas (Köie 3287, Typus, hb. W., C., 3279, 3288, 3289, 3290). Kala Sarkari, dry slope 7000 ft., clumps 2 ft. high, 9.IX.1939 (Kz. 13936. hb. W., BPI.).

A. afghanica scheint in großen Teilen Afghanistans, besonders im zentralen Hochland, eine Charakterpflanze zu sein, die weite Strecken bedeckt. Sie ist einigermaßen variabel. Die verschiedenen Nummern von Köie entfernen sich mit geringen Schwankungen in Stärke und Dauerhaftigkeit der Behaarung nur wenig vom Typus, mit Ausnahme von no. 3279, die trotz des jugendlichen Entwicklungszustandes fast kahl ist; auch sind hier die Blattabschnitte viel länger und feiner als beim Typus.

Ferner liegen mir noch zwei Aufsammlungen von Koelz vor, nämlich:

NE: Kash District, 1000 ft., clumps, plant scented, 9.VIII.1937 (Kz. 12985, hb. W., BPI.). — **C:** Polat, 8000 ft., plant 3 ft. high, scented, 10.IX.1939 (Kz. 13939, hb. W , BPI.).

Ueber die Zugehörigkeit dieser beiden Aufsammlungen bin ich mir nicht klar geworden. No. 12985 ist durch sehr hohen Wuchs, stärker abstehende Infloreszenzäste und längere, in längere und feinere Fiedern geteilte Blätter abweichend; no. 1393 durch hohen Wuchs, reichblütige, langästige Infloreszenz. Die endgültige Einreihung und Begrenzung der *A. afghanica* wird sich erst feststellen lassen, wenn noch mehr, vor allem auch fruchtendes Vergleichsmaterial vorliegt.

A. annua L. — **N:** Baghlan, Versuchsfarm (N. 50/118). — **C:** Lorinj, 8000 ft., dry field, 4 ft. high, (Kz. 13718). — **NE:** Rubat, 8500 ft., in field, 3 ft. high, plant scented (Kz. 12828). Rustak, 2000 ft., garden weed, 4 ft. high, scented (Kz. 13131).

Artemisia chrysostachya Rech. fil. & Köie, n. sp. — Fig. 41 und 43.

Sect. *Abrotanum* Bess. — Partes subterraneae et basales deficientes; an perennis vel suffrutescens? Caulis 60—70 cm altus, stricte erectus, tenuiter sulcato-striatus, pallide viridis, internodiis mediis 3—4 cm longis, simplex vel subsimplex, inflorescentia tertiam vel quartam partem caulis longitudinis occupante, laxe lanato-tomentellus glabrescens. Folia caulina inferiora saepe valde elongata, petiolo plerumque longiusculo incluso 10—18 cm longa, ad 1.5 cm lata, ambitu anguste oblongo-lanceolata, bi- vel saepius tripinnatipartita, segmentis primi ordinis ± 12, laciniis ultimi ordinis filiformi-linearibus partim elongatis (2—) 3—6 mm longis mucronulatis; consistentia foliorum verosimiliter molliter herbacea, color laete viridis, indu-

Fig. 41. *Artemisia chrysostachya* (K. 2423). $^{2}/_{3}$.

Fig. 42. *Artemisia Codringtonii* (CODRINGTON s. n.). $^{4}/_{5}$.

mentum e pilis crispulis laxe dispositis evanescentibus consistens. Folia caulina sessilia, sensim breviora latiora minus composita, laciniis latioribus; folia superiora ambitu ovato-triangularia, folia summa ad lacinulas paucas reducta. Capitula in ramulis plurimum valde abbreviatis stricte erectis vel axi principali appressis corymboso-glomerata, spicastrum strictum angustum 20—30 cm longum inferne ± interruptum superne contiguum efficientia. Pedunculi 3—7 mm longi, tenues flavescenti-virides breviter laxe tomentello-puberuli, glabrescentes, saepe bracteolis paucis anguste linearibus acutis capitulo approximatis obsiti. Involucrum valde depresse globosum ± 4 mm diametro, phylla triseriata arcte imbricata, pallide virescenti-flavida glabrescentia, imprimis antice late scarioso-marginata, exteriora acuta, media et interiora apice rotundata. Flores aurei. Achaenia matura ignota, juvenilia brunescentia coronula brevi provisa. — Species pulcherrima caulibus strictis, foliis laete viridibus infimis iis *Achilleae Millefolii* L. aliquantum similibus, lacinulis longioribus tenuioribus, capitulis spicastra stricta longa angusta aurea formantibus, involucro triseriato phyllis glabrescentibus plurimis rotundatis late scarioso-marginatis valde insignis.

C: Hauz-i-Mahiha, 2600 m, 13.VII.1948 (Köie 2423, Typus, hb. W., C.). — **NE:** Daraim, 6000 ft., flowers yellow, 11.VIII.1937 (Kz. 13078, hb. W., BPI.). Faizabad, 1100—1900 m, 11.VII.1948 (E. 1352, hb. C.).

A. Cina Berg. — **C:** Lorinj, 8000 ft., dry slope, rose-purple, spotted darker (Kz. 13644, 13645, 13716). — **NE:** Pahin Shahr, 10000 ft. (Kz. 12346). Rubat, 8500 ft., dry ground (Kz. 12826).

A. Codringtonii Rech. fil., Oesterr. Bot. Zeitschr. 97:233 (1950). — Fig. 42 und 43. — **C:** Bamian, rocky slopes (Codrington s. n. hb. BM.).

"*Artemisiae Haussknechtii* Boiss. (Persia austro-occidentalis) habitu aliquantum similis, sed ab ea caulibus crassioribus minus copiose foliatis, indumento caulium et foliorum hirsuto-tomentoso nec sericeo, foliis abrupte decrescentibus, imprimis autem involucri phyllis anguste elliptico-lanceolatis latitudine triplo longioribus (nec orbiculatis vel orbiculari-ovatis, latitudini aequilongis vel summum sesquilongioribus), indumento involucri e pilis longioribus composito, corollis longioribus ± 3.5 (nec 2.5) mm longis, apice brevius et minus copiose hirsutis diversa."

A. Dracunculus L. — **C:** Bamian (N. 51/430). Am Seeufer des Band-e-Amir (N. s. n.). Farakulum, 2700 m (K. 2530). — **NE:** Minjan Deh, 2600 m (E. 1604). Sanglich, 3000 m (E. 1515).

A. glauca Pall. — **NE:** Khash Distr., 8000 ft., dry ground, no scent (Kz. 12922).

A. Herba-alba Asso — **NW:** Kalashahr, 8000 ft., dry ground (Kz. 14054). — **SW:** S. of Herat, 1100—1400 m (K. 2235, 3282). Farah, 800 m (K. 3452). Farah,

1700 ft. (Kz. 13248). — **N:** Khanabad, 1200 ft., field border (Kz. 12232). — **C:** Kala Sarkari, 7000 ft., dry slope (Kz. 13943 a). — **E:** Ghazni, 8000 ft., dry slope (Kz. 13202). — **SE:** S. of Mokur, 2000 m (K. 3281). Pirzada, 900 m (K. 2035).

A. lamprocaulos Rech. fil., Ann. Nat. Mus. Wien 55:6 (1944). — **N:** An der Strasse von Kundus nach West, gleich beim Austritt in die Steppe. (N. 50/117). — **SE:** S. of Mokur, 2000 m (K. 3291).

Species gracilitate omnium partium, caulibus ramisque atris nitentibus ramis

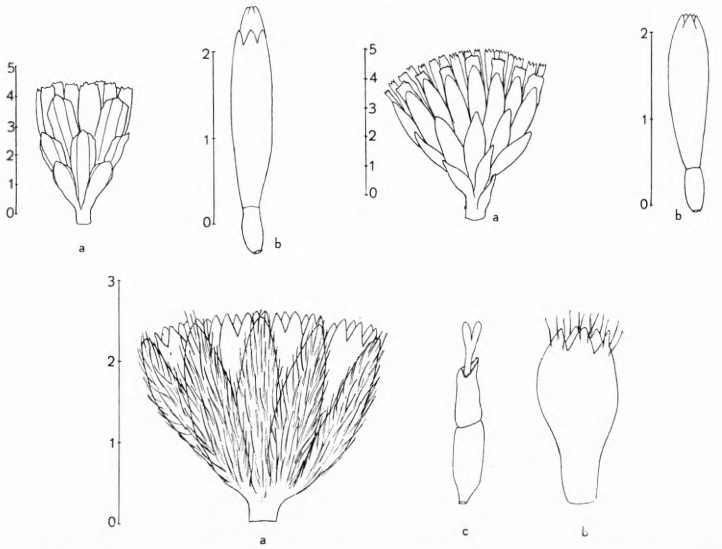


Fig. 43. Oben links: *Artemisia afghanica*, rechts: *A. chrysostachya*. a. Köpfchen, b. Einzelblüte. Unten *A. Codringtonii*. a. Köpfchen, b. Korolle, c. Fruchtknoten mit Griffel, Korolle z. T. entfernt.

inflorescentiae tenuissime filiformibus horizontaliter divergentibus saepe elongatis et intricatis, foliis parvis glabrescentibus, capitulis minutis irregulariter catenatis valde insignis.

A. macrocephala Jacquemont — **C:** Band-e-Amir, 2800 m (K. 2837). Seeufer, Band-e-Amir (N. 51/437). — 'Afghanistan' (Griffith 3194, hb. W.).

Die afghanische Pflanze ist viel kräftiger und dichter behaart als die himalayische.

A. persica Boiss. — **C:** Farakulum, 2800 m (K. 2552). — **NE:** Krunn, 9000 ft., clumps, 3 ft. high, scented (Kz. 12794). — **Nuristan:** Pronz, 2500 m (E. 1324). Zwischen Kotal-e-Agok und Alm bis Ort Waigel (N. 51/895). Urura Pass, in der Umgebung der Alm ober Kuschtos, ca. 3000 m (N. 51/633). — **E:** Nozi, 9000 ft., dry slope, clumps, strongly scented (Kz. 12034). Paghman, 7500 ft., meadow border, clumps, 3 ft., high, scented (Kz. 12065). Unteres bis mittleres Paghmantal (N. 50/893).

Die ostafghanischen Exemplare stimmen durch relativ hohen, reich verzweigten Wuchs und durch etwas mehr graues Indument mit Koelz 2718 (Ladak, Kashmir) auffallend gut

überein. Persische Exemplare dieser Art haben aufsteigende, nicht bis schwach verzweigte Stengel und sind durch schwächeres Indument mehr grünlich.

A. Roxburghiana Bess. ad int. — **Nuristan:** Gusalak, 1000—1600 m (N. 51/785). Ab Ort Darim aufwärts, 1900—2400 m (N. 51/1021).

Neubauer 785 und 1021 fallen durch zarten Wuchs, feine, verlängerte Infloreszenzäste, kleine, z. T. lang gestielte Köpfchen und z. T. auch durch relativ fein geteilte Blätter auf. Die Hüllen sind ziemlich dicht filzig. Habituell hat ein von Handel-Mazzetti als *A. Roxburghiana* var. *divaricata* Bge. bezeichnetes Exemplar aus China (Smith 4780) einige Aehnlichkeit.

A. scoparia L. — **N:** Akupruk, 5000 ft., dry plain, 18 inches (Kz. 13957). — **C:** Polat, 8000 ft., dry slope, 3 ft. (Kz. 13940). Farakulum, 2700 m (K. 3284). — **NE:** Rustak, 2000 ft., dry ground, (Kz. 13143). Kachari, 2300 m (E. 2075). — **Nuristan:** Zwischen Kotal-e-Agok und Alm bis Ort Waigel (N. 51/924). — **E:** Kabul, 7000 ft., dry plain, 2 ft. (Kz. 13491).

A. Tournefortiana Rchb. — **C:** Farakulum, 2700 (K. 2583). Lorinj Pass, 10000 ft., along spring (Kz. 13762). Dashtisufed, 6000 ft., along stream (Kz. 13545). — **E:** Kabul, westexponierter Hang über dem Fluss (N. 50/29). Kabul, an Bewässerungsgraben (N. 50/114).

A. Turczaninowiana Bess. — **NW:** Gharchi, 8500 ft., dry field (Kz. 14091). — **SW:** Dschawand östlich von Herat. (N. 50/359). — **C:** Hauz-i-Mahiha, 2600 m (K. 2428). Koh-i-Baba, 3400 m (K. 3292). Shibar Pass, 10000 ft., dry slope (Kz. 12161). Bamian, zentrales Gebirgsmassiv (N. 51/395). — **NE:** Khash Distr., 10000 ft. (Kz. 12976). — 'Aghanistan' (Griffith 3209, hb. W.).

A. vulgaris L. — **NE:** Parwara, 8500 ft., fields (Kz. 12811). Takia, 4500 ft., damp ground (Kz. 13091). Ishtakul, 11000 ft., field (Kz. 12587).

Hertia intermedia (DC.) O. Ktze. — **C:** Hauz-i-Mahiha, 2500 m (K. 2451). — **E:** Jagdalek, 5000 ft., open dry soil (Kz. 8252). Ghazni, 2400 m (K. 3275). Kabul, 6000 ft., dry slope (Kz. 11419). Kabul (Lindberg). Kabul (N. 50/888). Kabul, nach Süden exponierte Berglehne, sehr trocken und sandig (N. 51/18). — **Baluchistan:** Quetta, 1900 m (K. 3274).

Tussilago Farfara L. — **Nuristan:** Vama, 1900 m (E. 350). — **E:** Above Khudikhel, 8000 ft. (Kz. 11559). Kabul, im Schatten unter Felsen (N. 51/388).

Senecio chrysanthemoides DC. — **Nuristan:** Elasoon (E. 1674, 1712, 1743). Near Shtive, 3000 m (E. 1278). Auf dem Weg zwischen Aschpi Pass, ca. 3500 m, und dem Ort Kuschtos, ca. 2500 m (N. 51/722, 51/679).

Neubauer 679 und 722 unterscheiden sich von den übrigen afghanischen Pflanzen durch dichteres, mehr wolliges Indument.

S. coronopifolius Desf. — **SW:** Jija, 900—1400 m (K. 3582, 4027). — **C:** Panjao, 2700 m (K. 3272). Hauz-i-Mahiha, 2600 m (K. 2440). Bamian valley, 8000 ft., dry

banks, not common (CODRINGTON). — **NE:** Minjan Pass, 12500 ft. (Kz. 12773). — **Nuristan:** Gusalak, 1000 m (E. 1550, 205). Gusalak, 1600 m (E. 1493, 1495). Urura Pass, 3000 m, in der Umgebung der Alm ober Kuschtos (N. 51/629). — **E:** Begram near Charikar, 5000 ft. (CODRINGTON 57). Pulalam, 7000 ft. (Kz. 11872). Kabul, 6000 ft., dry slope (Kz. 11414). Kabul (LINDBERG). Kabul (N. 50/932). Oberes Paghmantal (N. 50/887). — **SE:** Pirzada, 900 m (K. 2006).

S. khorasanicus Rech. fil. & Aell., Oesterr. Bot. Zeitschr. 97:236 (1950). — Fig. 44. — **NW:** Chisht, 1700 m (K. 3706). — **C:** Bezud, ca. 3000 m (E. 1838). Band-i-Amir, 12000 ft. (CODRINGTON). Farakulum, 2700 m (K. 2534). — **NE:** Zebak (E. 1244).

"Inter species inter se affines sectionis *Croziserides* imprimis a *S. racemoso* M.B. notis sequentibus diversus: Foliis longioribus, basalibus et caulinis inferioribus longius petiolatis, indumento copiosiore, caule saepius monocephalo, si pleiocephalo capitulis lateralibus longe pedunculatis, capitulis omnibus maioribus, involucri phyllis rigidis induratis obtuse carinatis, ligulis numerosioribus ± 10."

Senecio Koelzii Rech. f., n. sp. — Fig. 45 und 46.

Sect. *Jacobaea* Thunb. — Perennis. Caulis erectus validus, internodiis mediis 5—8 cm longis, in sexta circiter parte superiore corymboso-ramosus, striato-sulcatus, floccosus valde glabrescens. Folia basalia non visa; caulina inferiora petiolo 3—5 cm longo suffulta, lamina obovata-oblonga, ad 10 cm longa, 4—5 cm lata, in tertia circiter parte superiore latissima, irregulariter lobato-sublyrata insuper sinuato-dentata lobis antrorsis, basin versus longe attenuata, apice ± acuta, consistentia in vivo verosimiliter crasse herbacea ± carnosa, in sicco coriaceo-membranacea, nervis pennato-reticulatis subtus prominentibus, supra atro- subtus pallide viridia, supra omnino glabrata subtus imprimis secus nervos ± floccosa ceterum glabrescentia; folia caulina superiora basi cordato-amplexicauli ± auriculato-dilatata sessilia, paulo increscentia, quam inferiora copiosius acutius angustius saepe ± laciniato-lobata; folia summa ramos inflorescentiae inferiores fulcrantia decrescentia ceterum ut caulina media anguste acute pinnato-lobata usque pinnatisecta. Pedunculi foliis nonnullis subfiliformibus obsiti crassiusculi erecto-patentes, 1—2 cm longi. Involucrum depresso-globosum oligophyllum, phylla 15—18, extimis diminutis squamiformibus paucis subuniseriata, interiora ad 6 mm longa, basi ± connata, ad 1.5 mm lata, lanceolato-linearia, dorso late herbacea, ad $^2/_3$ utrinque late hyaline marginata, margine in tertia parte superiore subito evanescente, longe acuminata. Flores verosimiliter aurei, marginales valde radiantes quam involucrum usque plus quam duplo longiores. Antherae muticae. Achaenia ad 3.5 mm longa, glabra, sulcato-striata, linearia, utrinque truncata. Pappus albus sublaevis fragilis ± 4 mm longus. — Differt a *S. diversifolio* Wall. foliis caulinis inferioribus distincte petiolatis nec sessilibus multo minus divisis lobis antrorsis, inflorescentia oligocephala, involucro oligophyllo phyllis exterioribus valde reductis subuniseriatis, interioribus multo minus numerosis, 15—18 tantum.

NE: Khash district, 10000 ft., flr. yellow; 9.VIII.1937 (KOELZ 13007, hb. W., BPI).

Fig. 44. *Senecio khorasanicus* (K. 3706 — a. Einzelblüte). $^{2}/_{3}$.

Fig. 45. *Senecio Koelzii.* Blütenstand, mittleres Stengelblatt (links) und unteres Stengelblatt (rechts). $^3/_4$.

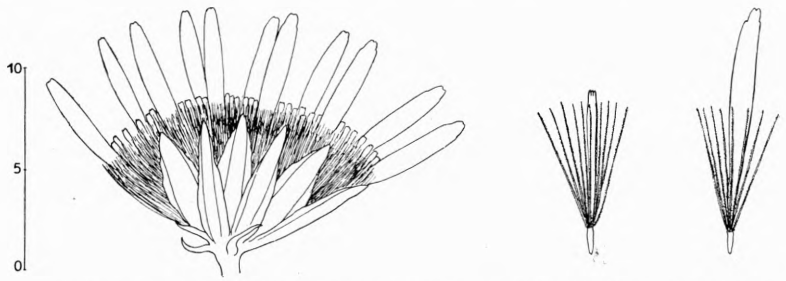


Fig. 46. *Senecio Koelzii.* Köpfchen, Scheibenblüte und Strahlenblüte.

S. vulgaris L. — **E:** Kabul (N. 50/931).

Ligularia persica Boiss. — **C:** Am Ufer des "Blauen Sees" von Band-e-Amir (N. 51/446). Farakulum, 2800 m) meadow (K. 2616).

Ligularia trigonophylla Rech. fil., n. sp.

Partes subterraneae deficientes, certe perennis. Caulis certe ultra 1 m altus, erectus fistulosus grosse profunde canaliculato-sulcatus, valde glabrescens brunescenti-purpurascens, remotissime paucifoliatus, superne corymboso-pauciramosus. Folia basalia deficientia; folium caulinum inferius longe (25 cm) petiolatum, petiolus crassus profunde canaliculato-sulcatus; lamina ambitu perlate triangulari-cordata, ex emarginatione 15 cm longa, 22 cm lata, basi perlate (6 cm) profunde (4 cm) emarginata, lobis basalibus ad 12 cm latis divergentibus rotundatis, apice acutiuscula, margine remote valde indistincte sinuato-dentata vel subintegra, consistentia in vivo ut videtur crasse molliter herbacea, in sicco crassiuscule membranacea, supra viridis valde glabrescens, subtus canescens araneoso-floccosa, nervis lateralibus utrinque ± 5 validis copiose reticulato-anastomosantibus subtus crasse prominentibus supra immersis. Folia caulina media et superiora valde decrescentia brevius petiolata, basi leviter late cordata vel subtruncata, apice acutiora, superiora breviter (ad 2 cm) petiolata, basi rotundata vel cuneata, ambitu ± late ovata, summa utrinque attenuata, ambitu anguste lanceolata. Rami inflorescentiae inferiores ad 15 cm longi patentes subnudi. Capitula ad extremos ramos corymboso-approximata. Ramificationes extremae et pedunculi foliolis lineari-lanceolatis acutis nonnullis obsiti. Involucrum ± 1 cm longum pentaphyllum; phylla ad 2.5 mm lata sese inferne tegentia, tenuiter membranacea brunea, anguste hyaline marginata, interdum pruinoso-farinosa, apice rotundata. Flores aurei, marginales longe radiantes, radiis ad 18 mm longis, ad 3 mm latis, copiose tenuiter parallele nervosis. Achaenia (immatura) 7 mm longa, subfusiformia glabra sulcata; pappus ad 8 mm longus, albus multiradiatus minutissime scabridus sublaevis deciduus. — Differt a *L. thyrsoidea* Ledeb. capitulis ad extremos ramos approximatis, foliis amplis latissime triangularibus basi profunde emarginatis margine saepius subintegris, imprimis autem achaeniis multo longioribus. — Affinis videtur *L. Thomsonii* (Clarke) Pojark., Bot. Mat. Herb. Akad. USSR **12**: 295 (1950).

NE: Khash district, 8000 ft., along stream, plant 3 ft. high, flowers yellow, 8.VIII.1937 (Koelz 12920, hb. BPI., frag. in hb. W.).

Gundelia Tournefortii L. — **NW:** Herat, 1400 m (K. 3881). Ardewan, 1400 m (K. 2266).

Echinops cephalotes Bge. — **SW:** Farah-Seistan, 600 m (K. 4050). — **SE:** Pirzada, 950 m (K. 2122).

Bestimmung zweifelhaft, da Köpfchen noch nicht voll entwickelt. Pflanze verzweigt, Blätter schmäler und länger bedornt als bei persischen Exemplaren. Auch sind viele Köpfchen in lange kräftige Dornen verwandelt.

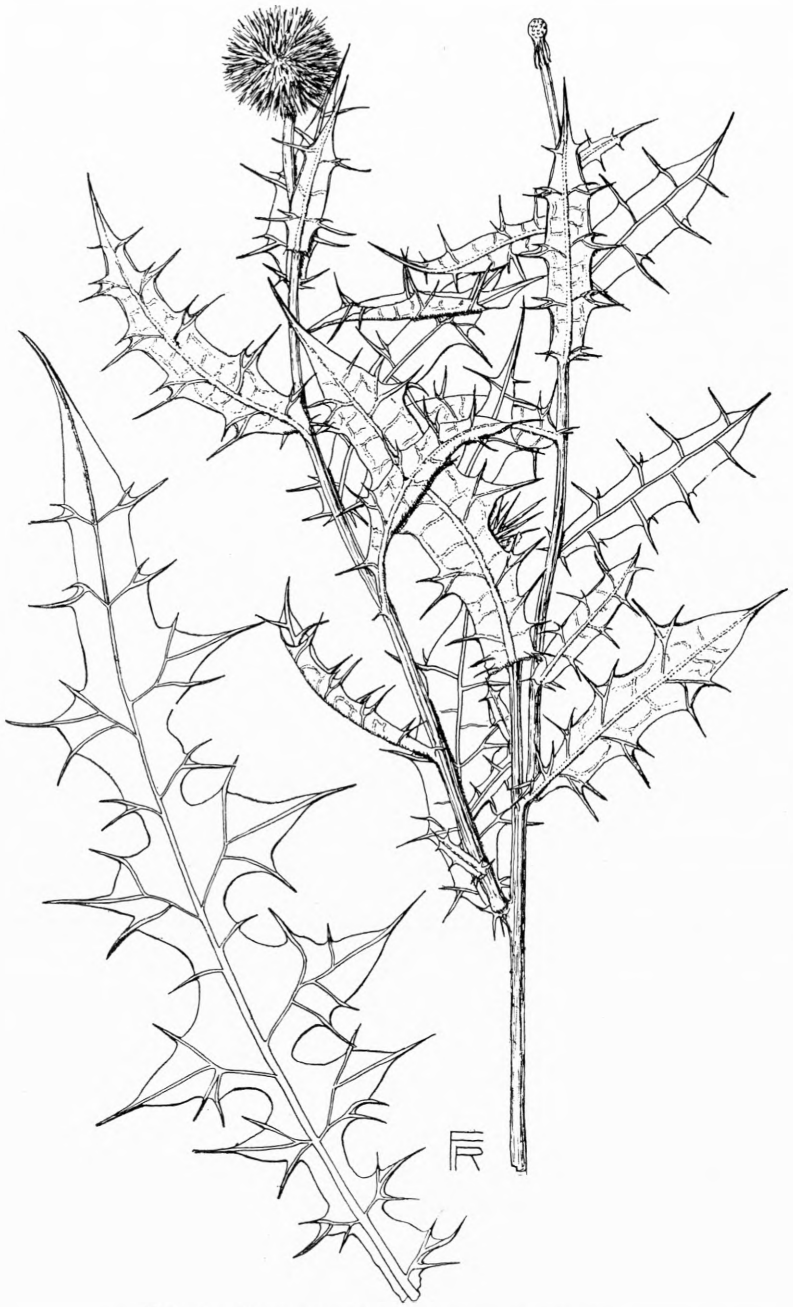


Fig. 47. *Echinops chloroleucus* (Kz. 12814). $^1/_2$.

Echinops chloroleucus Rech. fil., n. sp. — Fig. 47 und 48.

Sect. *Oligolepis* Bge. — Partes inferiores desunt, caulis verosimiliter modice elatus, superne in ramos plures ad 20 cm longos divisus, tenuiter sulcato-striatus, appresse albo-floccoso-tomentosus eglandulosus, internodiis 3—6 cm longis tota longitudine ut rami foliatus. Folia in sicco omnia crasse membranacea discoloria, supra laete flavescenti-viridia glandulis sessilibus perpaucis aspersa ceterum glabra nitidula, nervis flavis supra prominentibus marmorata, subtus densissime appresse niveo-tomentosa eglandulosa, nervis subtus valde prominentibus; folia caulina media ad 25 cm longa, spinis inclusis ad 10 cm lata, ambitu late lanceolata, basi ± attenuata

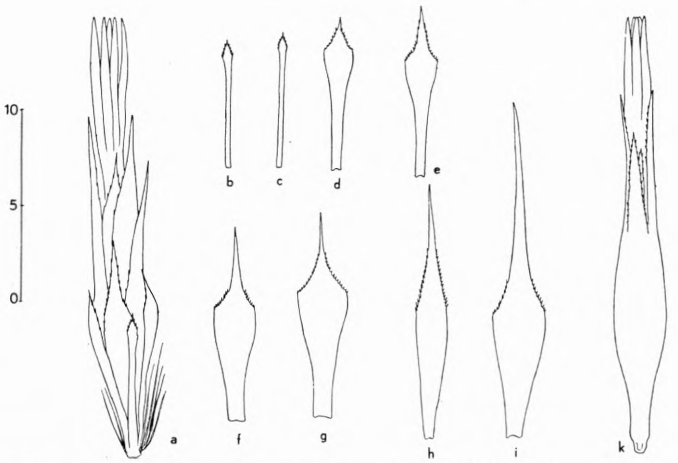


Fig. 48. *Echinops chloroleucus*. a. Einzelköpfchen, b—k. Hüllblätter von aussen nach innen.

sessilia, profunde pinnatilobata, lobis utrinque ± 4 maioribus et 1—2 minoribus basalibus late triangulari-lanceolatis in spinas stramineas vulnerantes 1—2 cm longas excurrentibus, spinis basalibus et lateralibus paucis 5—10 mm longis, sinibus latiusculis rotundatis separatis, lamina inter lobos continua 15—20 mm lata; folia caulina superiora lanceolata sessilia, non vel leviter et indistincte tantum lobata, spinis validioribus utrinque ± 4 horizontaliter patentibus ± 1 cm longis accessoriis minoribus perpaucis. Capitulum 4 cm diametro albido-virescens. Involucrum 2 cm longum; penicillus albus pauciradiatus dimidiam longitudinem involucri plerumque paulo superans; phylla omnia glabra nitidula albido-virentia, exteriora ± 5 quoque inferne fuscescenti-fasciata carinata, e basi cuneato-lineari subito spathulato-dilatata, breviter ± spinuloso-fimbriata et subito molliter spinoso-acuminata; phylla intermedia ± 4 longiora lanceolata a medio apicem versus paulo attenuata breviter paucifimbriata longe sensim spinoso-acuminata; phylla intima 5 in tubum inferne brunescentem superne pallidum coalita, prope apicem ± indistincte fimbriato-lacerata. Corolla alba (e collectore), laciniis anguste linearibus flaccidis. Antherarum tubus coerulescens (e collectore). Achaenia immatura hirsuta brunescentia, pappo coro-

Fig. 49. *Echinops chlorophyllus* (Kz. 11624). $^1/_2$.

nuliformi ca. 1 mm longo. — Affinis *E. echinato* DC., ab eo foliis latis inferioribus late, superioribus non lobatis magis discoloribus diversus.

NE: Parwara, 8500 ft., dry ground, flowers white with bluish anthers, 1.VIII.1937 (KOELZ 12814, Typus, hb. W., BPI.). — **Nuristan:** Gusalak, 1000 m (E. 1510, hb. C., fragmentum nondum florens).

E. chlorophyllus Rech. fil., Östr. Bot. Zeitschr. 97:243 (1950). — Fig. 49, 50. — **E:** Begram near Charikar, 5000 ft., 3.VI.1940 (CODRINGTON 52, Typus, hb. BPI.). Kabul, am felsigen Hang zum Munar Schakrie (N. 51/393). Islamabad, 4500 ft., dry slope (Kz. 11624).

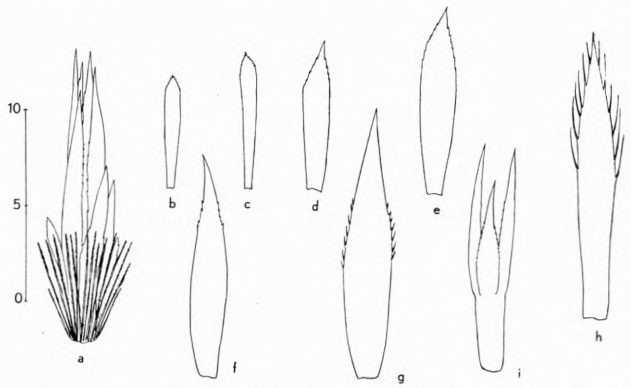


Fig. 50. *Echinops chlorophyllus*. a. Einzelköpfchen, b—i. Hüllblätter von aussen nach innen.

"Inter affines (sect. *Ritrodes* Bge.) involucri phyllis paucis 12—14, internis in tubum teretiusculum coalitis, penicillo pauciradiato, indumento e pilis et papillis omnibus glanduliferis consistente pilis eglandulosis omnino deficientibus insignis, hisce notis praesertim ab *E. ceratophoro* Boiss. et *E. jezdiano* Boiss. & Buhse involucri phyllis aequidem non numerosis excellentibus diversus."

Das Exemplar KOELZ 11624 stimmt in den wesentlichen Merkmalen mit dem Typus überein, nur ist das Indument noch dichter; es treten auch vereinzelte längere, aber durchaus drüsentragende Wollhaare auf.

E. echinatus DC. — **C:** Bamian, 2200 m (K. 2892). Binimang, 8000 ft., dry slope, bluewhite, clumps, $2^1/_2$ ft. high (Kz. 13886). — **NE:** Kachari, 2300 m (E. 1599). — **Nuristan:** Barikot (E. 1794).

Echinops kandaharensis Rech. fil. & Köie, n. sp. — Fig. 51 und 52.

Sect. *Oligolepis* Bge. — Planta humilis, 10—25 cm alta; caulis simplex, furcatus vel pauciramosus, ramis 6—10 cm longis, tenuiter sulcato-striatus, omnino albo-floccoso-tomentosus non glabrescens, pilis longioribus crispulis partim glanduliferis in parte superiore sparsim usque rarissime immixtis, tota longitudine foliatus. Folia basalia jam emarcida; caulina inferiora ambitu oblongo-lanceolata, ad 13 cm longa, spinis inclusis ad 5 cm lata, supra medium latissima, pinnatim sinuato-lobata lobis maioribus utrinque 3—6 late triangularibus apice longe tenuiter spinosis imprimis prope basin breviter spinuloso-lobulatis, lobis inferioribus 3—5 valde decrescentibus, rhachis in parte superiore laminae ad 2 cm lata, basin versus valde angustata fere interrupta. Folia media paulo decrescentia, basi dilatata sessilia, proportione latiora, brevius et minus copiose lobata et spinosa, folia summa subito valde diminuta. Folia omnia consistentia in sicco crasse membranacea, margine saepe revoluta, supra laete

Fig. 51. *Echinops kandaharensis* (K. 2064). $^{3}/_{5}$.

viridia glandulis subsessilibus sparse obsita, nervis persistenter albo-villosis marmorata, subtus appresse niveo-tomentosa nervis crasse prominentibus. Capitula ca. 4 cm diametro. Involucrum 16—18 mm longum glabrum. Penicillus eximie multiradiatus scabridulus, nitens, inferne brunescens superne candidus, $^2/_3$ vel $^3/_4$ involucri longitudinis attingens; phylla exteriora ca. 4 e basi filiformi superne subito spathulato-dilatata breviter paucifimbriato-denticulata apice breviter mucronulato-attenuata; media ± 5 e basi anguste cuneata infra vel in medio subito spathulato-dilatata membranaceo-alata, antice breviter paucifimbriata apice longe spinoso-attenuata rigida, prope basin fuscescentia superne pallide virentia vel indistincte coerulescenti-suffusa; intima 5 in tubum pentagonum atrum concreta, apice viridula

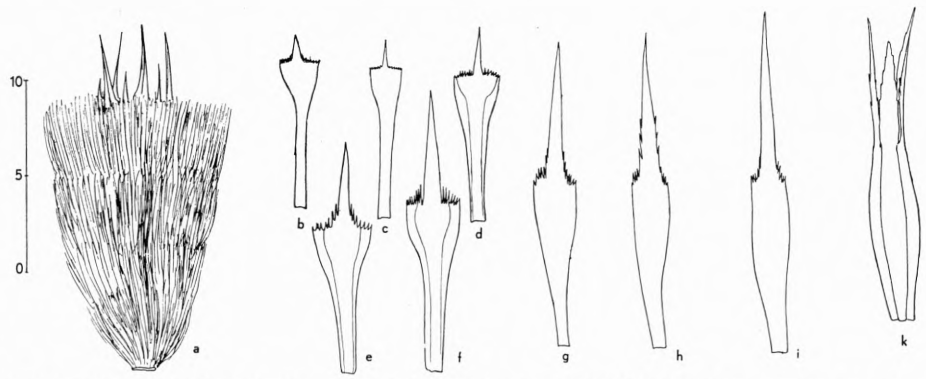


Fig. 52. *Echinops kandaharensis*. a. Einzelköpfchen, b—k. Hüllblätter von aussen nach innen.

spinescentia sat breviter fimbriata. Corolla ut videtur pallide coerulea. Achaenia juvenilia dense appresse sericea pappo cinerascenti ultra 1 mm longo coronata. — Differt ab *E. leucographo* Bge. glandulis in pagina superiore foliorum subsessilibus, penicilli proportione longioris radiis quoque numerosissimis scabridis nec barbellatis, involucro breviore 16—18 mm (nec 22—24 mm) longo, phyllis mediis alate spathulato-dilatatis breviter paucifimbriato-denticulatis (nec longe appresse pectinatis).

SE: Pirzada, 1000 m, 19.V.1948 (Köie 2064, hb. W., C.).

Echinops malacophyllus Rech. fil., n. sp. — Fig. 53 und 54.

Sect. *Ritro* Endl. — Caulis elatus, ca. 120 cm altus (e collectore), tantum pars superior ca. 25 cm longa ramum unicum arcuato-divergentem 25 cm longum ferens obvia; internodia superiora 3—6 cm longa. Caulis tota longitudine foliatus, tenuiter sulcato-striatus, pallide viridis, laxiuscule appresse floccoso-lanatus, inferne glabrescens, omnino eglandulosus. Folia basalia et caulina inferiora desunt; media consistentia in sicco tenuiter membranacea, in vivo certe molliter herbacea, discoloria, supra laete viridia pilis rigidulis brevibus albis eglandulosis valde laxe obsita glabrescentia, subtus appressissime albo-tomentosa, nervis subtus tenuiter prominentibus, basi cordato-semiamplexicauli latiuscule subpalmato-laciniata sessilia, ambitu ovato-

Fig. 53. *Echinops malacophyllus* (Kz. 13495). $^{3}/_{5}$.

oblonga, profunde conferte pinnatisecta, segmentis utrinque 5 subhorizontaliter patentibus vel leviter antrorsis, basi plerumque oblique lobato-dilatatis, apice longe lanceolato-productis in spinam tenuem non vulnerantem excurrentibus sinibus angustis ± acutis separatis, segmento terminali multo magis producto, margine omnino antrorse spinuloso-ciliata; folia superiora similia sensim decrescentia. Capitula ± 4 cm diametro pallide virescenti-coerulescentia. Involucrum (non complete evolutum) ad 18 mm longum; penicillus sordide albus modice multiradiatus, tertiam partem involucri longitudinis aequans; phylla omnia tenuiter membranacea glabra nitidula pallide viridia imprimis superne coeruleo-suffusa, exteriora ca. 5 abbreviata, e basi lineari-cuneata superne rhombico-spathulata usque rhombico-lanceolata, ibique longe fimbriata; phylla media et interiora ± 8 sensim longiora, omnia libera lanceolata paulo infra medium insensibiliter subrhombico-dilatata, apice in spinam non pungentem sensim attenuata, copiose longe appresse fimbriata. Corolla (juvenilis) coerulea. Achaenia (juvenilia) longe appresse pilosa, pappi radii membranacei squamiformes ca. 1 mm longi. — Differt ab *E. karatavico* Regel & Schmalh. involucro ut videtur paulo breviore, penicillo proportione longiore tertiam (nec quartam vel quintam) partem involucri longitudinis attingente, phyllis longe fimbriatis (nec integris vel denticulatis), caulis indumento floccoso-tomentoso eglanduloso, foliis consistentia tenuioribus mollioribus magis amplexicaulibus, segmentis angustioribus terminalibus longius protractis sinibus angustioribus separatis, in spinas breviores minus pungentes excurrentibus ceterum tantum spinuloso-ciliatis.

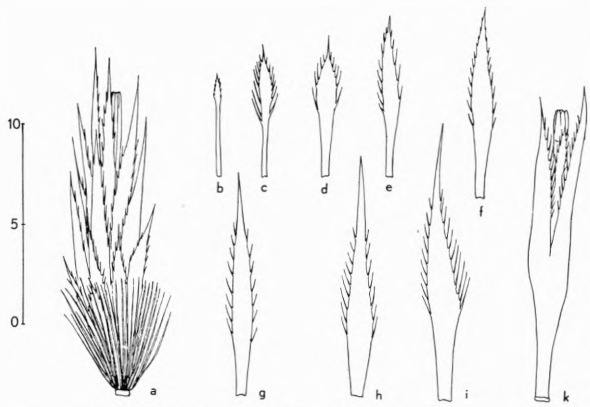


Fig. 54. *Echinops malacophyllus*. a. Einzelköpfchen, b—k. Hüllblätter von aussen nach innen.

E: Kabul, 7000 ft., field, weed, plant 4 ft. high, flowers blue-purple, 15.VIII.1939 (Koelz 13495, hb. W., BPI.).

E. paradoxus Rech. fil., Oesterr. Bot. Zeitschr. **97**:246 (1950). — Fig. 55. "Afghanistan" (Griffith 3255, Typus, hb. W.).

"Species habitu gracillimo, foliis ad nervos spinasque omnino reductis, capitulis involucrisque minutissimis valde insignis, cum alia specie vix comparanda; involucri phyllorum numero ad sect. *Oligolepidem* spectans sed phylla interna basi breviter tantum conjuncta."

Xeranthemum longepapposum Fisch. et Mey. — **SW:** South of Herat, 1400 m (K. 3263).

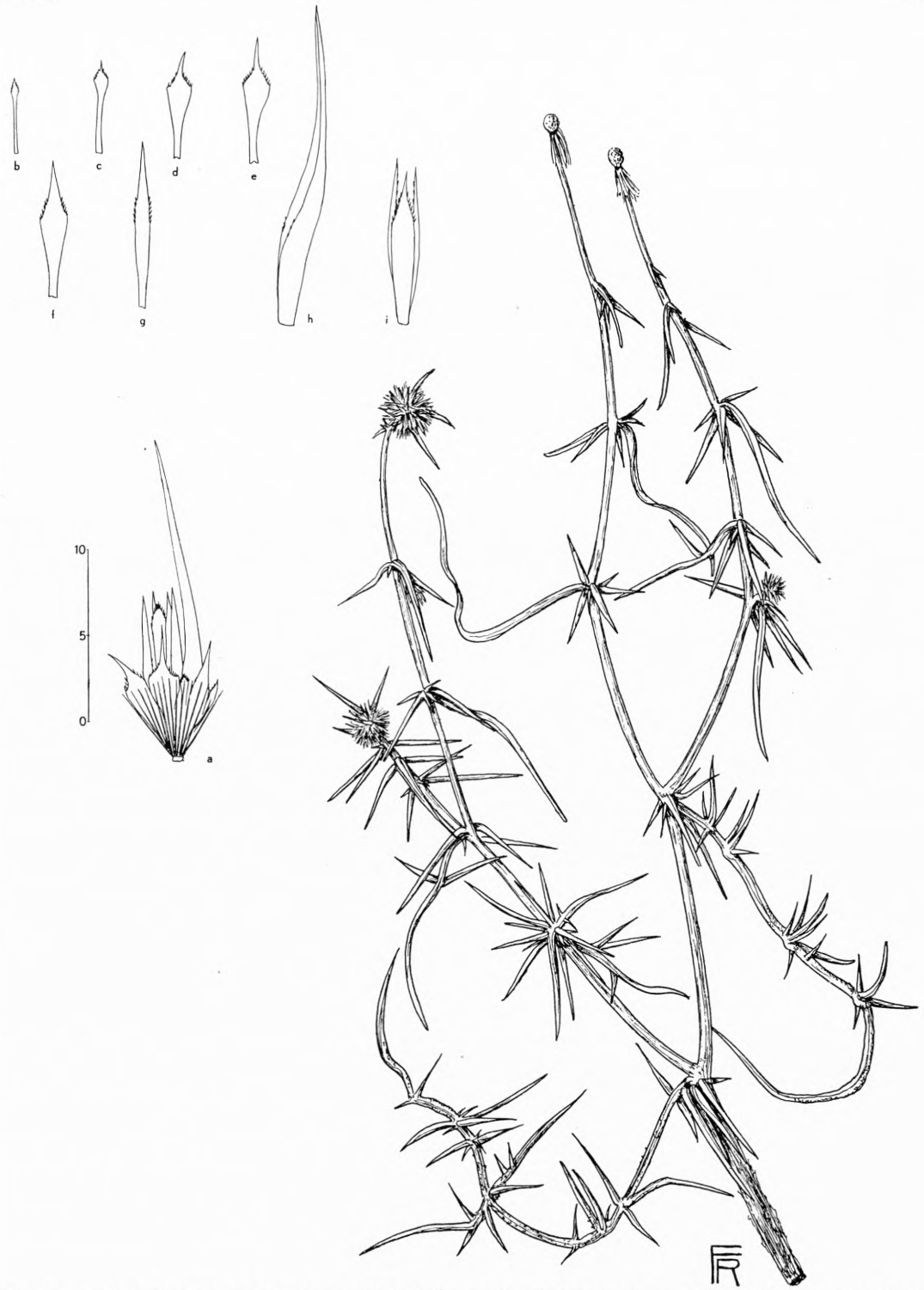


Fig. 55. *Echinops paradoxus* (Hb. GRIFFITH 3255 — a. Einzelköpfchen, b—i. Hüllblätter von aussen nach innen). Habitus $^3/_5$.

Atractylis cuneata Boiss. e descr. — **C:** Panjao, 2700 m (K. 2683). Hauz-i-Mahiha, 2500 m (K. 2478). Shibar, 2600 m (K. 3326). — **E:** Ghazni, 8000 ft., dry ground, anthers rose-purple (Kz. 13200).

Thevenotia persica DC. — **E:** Kabul, 7000 ft., dry plain, red-purple, 2 inches high (Kz. 13475).

Arctium platylepis (Boiss.). Sosn. e descr. — **NE:** Takia, 4500 ft., waste ground (Kz. 13092).

Cousinia (*Lamprocarpae*) ***acanthoblephara*** Rech. f. et Gilli, n. sp. — Fig. 56 und 66 A.

Biennis. Caulis (20—) 30 (—45) cm altus validus supra medium (vel rarius jam infra) in ramos nonnullos validos subcorymbose divisus. Folia omnia in sicco crassiuscule rigidule coriacea. Folia basalia breviter sed distincte crassiuscule petiolata; lamina 5—8 (—15) cm longa, (3—) 4 (—6) cm lata, apice late acuminata, basi breviter vel longe attenuata (rarius truncata vel subcordata) breviter elliptica vel ovata integra vel in tertia vel quarta parte inferiore minute 1—3-jugo pinnatolobata, lobis approximatis conjunctis minutis dimidia laminae latitudine semper multo brevioribus; utrinque appresse floccoso-tomentosa, indumento supra mox partim evanescente et partim areolato-persistente, subtus persistenter glaucescenti-albido; nervi laterales arcuato-pennati, a costa mediana crassa angulo 45—60° abeuntes crebre reticulato-anastomosantes, supra parum subtus tenuiter prominentes; lamina margine omnino crebre minute spinoso-ciliata. Folia caulina basi cordata sessilia, sensim decrescentia et gradatim angustiora longius spinosa et partim quidem distincte lobata; folia ramealia cordato-acuminata diminuta. Involucrum spinis exclusis ± 2 cm diametro, usque 2.5 cm longum, basi impressum, superne constrictum; phylla ± 50, rigide coriacea, e basi dilatata incrassata subsensim in spinas basi usque 4 mm latas supra applanatas usque concavas subtus nervo prominente carinatas attenuata, viridia, basi leviter araneoso-floccosa, ceterum valde glabrescentia; spinae involucri diametrum ad summum aequantes, squarroso-patentes, infimae reflexae; phylla intima molliuscule membranacea valde exserta superne ± 4 mm lata lanceolato-acuminata. Corolla purpurea ± 16 mm longa, pars basalis attenuata ± 6 mm longa, laciniae ± 2 mm longae. Achaenia (nondum matura) ± 2 mm longa obpyramidata, costata, apice breviter denticulata. — Inter affines habitu robusto, foliis crasse coriaceis basalibus integris vel prope basin minute paucilobatis omnino crebre spinoso-ciliatis, indumento supra areolatim secendente, involucri phyllis latiusculis insignis.

E: Berg am linken Ufer des Paghmantales, 2750 m, Gneiss-Sand, Blüte rosenrot, obere Involukralblätter violett überlaufen; 10.VI.1949 (Gilli 2546, Typus, hb. W.). Scher Darwasah bei Kabul, 1900 m, Gneiss-Schutthalde, Blüten rotviolett (Gilli 2555). Scher Darwasah bei Kabul, 1840 m, Gneiss; Korolle, Staubbeutel, Griffel und

Fig. 56. *Cousinia acanthoblephara* (GILLI 2546 — links äussere randständige Rosettenblätter). $^1/_2$.

Narbe rotviolett (GILLI 2554). Kabul (LINDBERG s. n.). — **C:** Kalkberg nordöstlich von Bamian, 2800 m, Lehmboden mit kleinem Kalkschutt (GILLI 2556).

Vergleiche Besprechung von *C. buphthalmoides* Reg. et Schmalh.

Cousinia (*Microcarpae*) ***acanthoptera*** Rech. f., n. sp. — Fig. 57 und 66 B.

Biennis, ad 60 cm alta, a basi iteratim divaricate ramosa. Caulis ramique teretes, laxe araneoso-floccosi glabrescentes, tenuiter leviter striati usque sublaeves, interrupte late irregulariter spinoso-alati. Folia basalia rosulata, ante florendum jam marcescentia, late breviter petiolata, 10—15 cm longa, 3—5 cm lata, ambitu oblongo-obovata vel oblongo-lanceolata, lyrato-pinnatifida vel -lobata, forma variabilia, lobis aut segmentis lateralibus utrinque 3—5 triangularibus sinuatis plurispinosis rachidi alatae late adnatis, nervis omnibus subtus valde supra tenuiter prominentibus validis reticulato-anastomosantibus, margine in spinas validos excurrentibus, lamina supra glabrescens, subtus dense usque laxe araneoso-floccosa; segmentum terminale sublyratum, interdum ± elongatum, quam lateralia plerumque non latius. Folia caulina omnia ± abbreviata, spinoso-lobata, sparse glanduloso-papillosa, laxe araneoso-floccosa, valde glabrescentia concoloria, omnia late alato-decurrentia, sed alae basi attenuatae saepe non complete decurrentes, nervis validissimis confertis prominentibus crebre reticulato-anastomosantibus in spinas longas (4—7 mm) vulnerantes sinibus angustis separatas excurrentibus; alae foliorum superiorum etsi non complete decurrentes quam lamina folii longiores et latiores. Capitula singula terminalia; involucrum in statu compresso absque spinis 2—2.5 cm diametro, ± 2 cm longum, depresso-hemisphaericum, basi truncatum et umbilicato-impressum; phylla 4—5-seriata, ca. 50—60, exteriora et media rigidissima, lanceolato-triquetra prope basin usque 4 mm lata, extima reflexa 10—16 mm, media erecto-patentia, 15—20 (—25) mm longa, dorso carinato-costata et parallele striata, valde pungentia, prope basin paulum lanato-floccosa ceterum sparse glanduloso-punctata, sordide viridia; phylla intima in appendicem tenuiter membranaceam pallide bruneam glabram flexibilem minute apiculatam margine eroso-denticulatam dilatata. Receptaculi setae albidae scabridae. Corolla rosea (e collectore) nondum complete evoluta, ca. 20 mm longa, tubus attenuatus quam limbus multo brevior. Achaenia ignota. — Valde affinis videtur *C. microcarpae* Boiss. a qua differt: foliis plurimis non complete decurrentibus multo rigidioribus, nervatura multo crassiore magis conferta et prominente, spinis multo numerosioribus et pluries longioribus et validioribus, planta in parte superiore involucro incluso multo magis glabrescente, involucri phyllis pluries latioribus multo rigidioribus.

C: Deh Kundi (E. 1883). — **E:** Charikar, 6000 ft., dry ground, flrs. rose-purple (Kz. 11814). Sirotai, 3350 m, dry slope, fl. rose, 19.VI.1937 (KOELZ 11959, Typus, hb. W., BPI.). Arbarp, 11 miles W of Kabul, 7000 ft. (CHAWORTH-MUSTERS s. n.). Paghman-Gebirge, buschiger Hang beim Königsschloss in Paghman, 2160 m (GILLI 2514).

Die Merkmale der *C. acanthoptera* scheinen nach dem mir augenblicklich vorliegenden Material ausserhalb der Variationsbreite der *C. microcarpa* zu liegen; sie stimmen laut Be-

Fig. 57. *Cousinia acanthoptera* (Kz. 11959). $^1/_2$.

schreibungen mit keiner der aus Turkestan beschriebenen Kleinarten überein. *C. microcarpa* Boiss. gehört zu den wenigen, weit verbreiteten Arten der Gattung: Khorasan, Afghanistan, Turkestan. Sie ist sehr variabel.

Ein mit *C. acanthoptera* in der dichten, kräftigen Bestachelung und den breiten, starren äusseren und mittleren Hüllschuppen übereinstimmendes Exemplar liegt vor von: Kabul, Darelfanum, 16.6.1950 (NEUBAUER 901, W). Es ist sehr niedrig, nur 15 cm hoch, ziemlich dicht wollig-flockig; Hülle kleiner, längste Hüllblätter nur 15 mm lang.

C. (*Spicatae*) *Actinia* Boiss., var. I. (Typus). — **E:** Kabul, Nebengipfel im Korogh-Massiv, 2800 m (GILLI 2507). Kabul, unter dem Gipfel eines 1740 m hohen Berges in der Tangi Gharu nächst dem Maipar (GILLI 2506). Kabul, Berg NNW vom Stausee Chord Kabul, Kalk, 2280 m, dürre Fruchtstände vom Vorjahr (GILLI 2508).

C. (*Spicatae*) *Actinia* Boiss., var. II. — **E:** Kabul, 2070 m, unter dem Gipfel des Aliabader Berges (GILLI 2505). Kabul, 1800 m, Berghang zwischen Tschardeh und Logartal (GILLI 2502). Kabul, Scher Darwasah, 2000 m (GILLI 2504). Kabul, 2770 m, felsiger Hang unter dem Gipfel des Korogh (GILLI 2503). Kabul, 2020 m, unter dem Gipfel eines Berges zwischen Scher Darwasah und Koh-e-Tschelsotun, (GILLI 2501) Kabul, 1920 m, Berghang westlich vom Asmai knapp unterhalb des Gipfels (GILLI 2500). Kabul, Pandscheschah, trockener Hang (N. 50/32).

Von *C. Actinia* var. I. (Typus) liegt ferner ein Blatt vom Sebroderakan bei Schewaki im Logartal, 2500 m, von *C. Actinia* var. II. Blätter von der Scher Darwasah — Koh-e-Tschelsotun — Kette bei Kabul aus Höhenlagen von 1840—2210 m vor (GILLI).

Die mir vorliegenden Exemplare dieser bisher wenig bekannten Art sind nicht einheitlich. Die eine Serie, repräsentiert durch den Isotypus im Hb. W. (GRIFFITH 3276) und durch GILLIS Planzen vom Korogh-Massiv, Chord Kabul und Tang-i-Gharru haben, übereinstimmend mit der Originalbeschreibung verlängert lanzettliche Grundblätter, die mehr als vier mal so lang als breit sind, und relativ schmale, lang dornige Stengelblätter; alle Blätter verkahlen abgesehen von Sitzdrüsen später fast vollständig. Die zweite Serie, repräsentiert durch alle übrigen Aufsammlungen von GILLI, ist gekennzeichnet durch kleinere, kurze Grundblätter, die höchstens doppelt so lang als breit sind, durch breitere, kurz dornige Stengelblätter; alle übrigen Blätter zeigen einen fein angepressten, etwas bläulich erscheinenden Filz, der besonders unterseits erhalten bleibt. In der Ausbildung der Hüllen und Blüten stimmen die beiden Rassen überein; das Indument der Hüllblätter ist bei der zweiten entsprechend dem der Blätter dichter und dauerhafter. Die Abbildung bei BORNMÜLLER, Rep. Beih. 108, Taf. 7 (1938) stellt offenbar die zweite Rasse dar. Da die auffälligen Blatt- und Indumentmerkmale anscheinend nicht mit solchen der Hülle und Blüten parallel gehen und da offenbar keine geographische Sonderung der beiden Rassen besteht, sehe ich zunächst von einer Benennung und höheren systematischen Bewertung ab.

C. (*Appendiculatae*) *afghanica* C. Winkl. — **NW:** Obeh, 1400 m (K. 3725) *Artemisia*-Steppe, 940 m, nördlich von Herat (GILLI 2524). — **SW:** Herat, Takht-Safar (LINDBERG 103). Jija, 900 m (K. 2240).

Cousinia (*Lamprocarpae*) ***ariana*** Bornm., Beih. Bot. Centralbl. 34/2:273 (1917), descr. emend. — Fig. 58 und 66 C.

Caespitosa caudicibus elongatis lignescentibus multifibrosis, collo residuis petiolorum emarcidis comosa. Caules 15—30 cm alti, simplices vel saepius in medio vel iam infra furcati vel pauciramosi, floccoso-araneosi glabrescentes, pallide brunei, tenuiter striato-sulcati, internodiis mediis 1.5—3 cm longis. Folia omnia consistentia in sicco crasse membranacea, in vivo verosimiliter potius molliuscula, utrinque subdense appresse araneoso-tomentella canescentia concoloria vel subtus magis albida, spinas brevissimas tenues non vulnerantes gerentia costa mediana subtus crasse convexa non glabrescens, nervi secundarii numerosi rectangulariter a costa mediana abeuntes subtus tantum tenuiter prominentes. Folia basalia non petiolata, 5—7 cm longa, 1—2.5 cm lata, saepe longitudinaliter complicata, conferte plicato-pinnatilobata, lobis irregularibus triangularibus vel late lanceolatis saepe confluentibus, in spinulam terminalem 1 (—2) mm longam angustatis spinulis lateralibus minutissimis, rachide 5—10 mm lata minutissime crispato- vel lobulato-spinulosa. Folia caulina non decurrentia basi cordato-auriculata breviter spinoso-lobata sessilia, infima in speciminibus validis basalibus similia, media et superiora valde decrescentia, ambitu cordato-triangularia vel -ovata, crispe spinuloso-plurilobulata, spina terminali ad 2 mm longa validiuscula; folia ramealia valde diminuta, rami infra capitula saepius longe (1—) 2—4 (—10) cm nudi. Capitula singula terminalia; involucrum depresso-semiglobosum usque breviter campanulatum, araneoso-floccosum glabrescens, 1.5—2 cm longum, 1.5—2.5 cm (in statu compresso) diametro, basi impressum; phylla plerumque 5-seriata, ca. 60—80, exteriora et media in spinas basi 1.5 (—2) mm latas, 3—6 mm longas subtriquetro-applanatas recurvo-patulas atrovirides excurrentia, intima e basi saepe atroviolascente in appendices ad 8 mm longas ad 3 mm latas late lanceolatas valde conspicuas tenuiter membranaceas pallide bruneas flexibiles molliter mucronulatas margine sub apice indistincte serrulatas dilatata. Receptaculi setae albae laeves, sub apice autem subscabridulae. Corolla ± 15 mm longa, in vivo verosimiliter purpurea vel rosea, in sicco omnino expallens, tubo tenui tertiam partem totius corollae occupante; laciniae ± 2.5 mm longae acutae. Antherarum tubus glaber, in vivo verosimiliter roseus, in sicco expallens. Achaenia ± 5.5 mm longa, superne fere 2 mm lata, compressa, basi attenuata, apice rotundata edentata, tenuiter longitudinaliter elevate lineata. — Inter affines habitu subcaespitoso, caudicibus elongatis lignescentibus multifibrosis, caulibus profunde furcatis vel pauciramosis, foliis plicato-lobatis molliusculis breviter non vulneranter spinulosis, mediis et superioribus valde decrescentibus, involucri phyllis plurimis brevibus latiusculis rigidulis recurvo-patulis, intimis autem longe lateque pallide appendiculatis insignis.

C: Koh-i-Baba, 3200 m, frequent between Farakulum and Kotal-i-Reg (K. 2674, hb. W., C.). Deh Kundi, 2800 m (E. 1918, unicum hb. C.). Zwischen Bamian und Koh-i-Baba, 3150 m (Gilli 2527).

Die Zugehörigkeit von Edelbergs Exemplar zu dieser Art steht nicht ganz fest. Nur ein einköpfiger Stengel ist vorhanden. Blätter länger, bis 6 mm bedornt, obere nicht so stark

Fig. 58. *Cousinia ariana* (K. 2674). $^3/_4$.

verkleinert, oberstes dem Köpfchen angenähert, Hülle etwas länger, Hüllschuppen etwas breiter, nur die untersten abstehend bis zurückgebogen.

Nach den mir vorliegenden authentischen bezw. vom locus classicus stammenden Exemplaren muss ich *C. ariana* Bornm. für zunächst verwandt mit *C. rava* Winkl. halten. Winkler stellt seine *C. rava* zu den *Lamprocarpae* (Achaenia ecostata obovata apice rotundata), Bornmüller seine *C. ariana* zu den *Odontocarpae* (Achaenia costata obpyramidata 3—5-gona

truncata denticulata). WINKLER sagt in seiner Beschreibung "achaeniis immaturis ecostatis rotundatis ....." . BORNMÜLLER hat überhaupt keine Achaenen gesehen, sondern er reiht seine Art offenbar wegen der von ihm hervorgehobenen Aehnlichkeit mit *C. Franchetii* bei den *Odontocarpae* ein. Das Sektionsmerkmal kommt also für die Unterscheidung der beiden Arten nicht in Betracht.

Tatsächlich scheint mir kein greifbarer Unterschied zwischen *C. rava* und *C. ariana* vorhanden zu sein. Erstere ist im Wuchs kräftiger, hat dementsprechend etwas grössere Blätter und breitere Köpfchen. Entgegen den Angaben in der Orginalbeschreiung scheint die durchschnittliche Hüllenschuppenzahl bei *C. rava* geringer als bei *C. ariana* zu sein. Uebrigens sind die Hüllschuppen bei letzterer etwas kürzer und schmäler. Wahrscheinlich werden sich nach Durchsicht weiteren Materials die beiden Sippen als vikariirende Unterarten einer Art auffassen lassen. Ich gebe eine Beschreibung nach KÖIES Exemplar, die die Diagnose BORNMÜLLERS in mehreren Punkten ergänzt.

C. (*Odontocarpae*) *auriculata* Boiss. — **C:** Hauz-i-Mahiha, 2500—2800 m (K. 3317). — **NE:** Gulbahar (N. 50/903).

Als eines der wichtigsten Merkmale dieser Art gegenüber *C. buphthalmoides* gelten die bei *C. auriculata* an der Spize angeblich deutlich 5-zähnigen Achänen, während sie bei *C. buphthalmoides* "obsolete mamillosi" sein sollen. Der Isotypus der *C. auriculata* in hb. W. zeigt winzige, kaum wahrnehmbare Zähnchen, beim Isotypus der *C. buphthalmoides* fehlen sie tatsächlich. Die Achänen der *C. auriculata* messen 5.5×2 mm (!!), die Achänen der *C. buphthalmoides* 4×1.5 bis 3.5×1.5 mm im Durchschnitt. Die Achänen der Pflanzen von KÖIE und NEUBAUER sind etwas kleiner als beim Typus der *C. auriculata.*

Die Grundblätter der Art waren bisher nicht bekannt. No. 3317 hat ein Grundblatt 11×5 cm, Basis verschmälert, oben kurz zugespitzt, nicht gelappt, nur mit 1—2 mm langen Dornen besetzt, dicklich flockig behaart. Nervennetz beiderseits, unterseits stärker vorspringend.

C. (*Lasiandrae*) *Baberi* Boiss. — **C:** Hauz-i-Mahiha, 2500 m (K. 2392). — **E:** Kabul, 7000 ft., dry plain (Kz. 13482). Kabul, Tschelsutun (N. 50/875). Kabul, 1600 m (K. 4043). Kabul, im Tal beim letzten Ort unterhalb Munar Schakrie (N. 51/394). Kabul, 1920 m, Aliabader Berg unter dem Gipfel (GILLI 2528). Kabul, 1840 m, Berghang zwischen Tschardeh und Logartal (GILLI 2529). Kabul, 1900 m, beim Grabmal Chodsche Safa am Scher Darwasah (GILLI 2530).

Cousinia bamianica Rech. f. et Köie, n. sp. — Fig. 59 und 66 D.

Certe perennis. Caulis ad 50 cm altus, stricte erectus validus, internodiis abbreviatis inferne copiose foliatus, foliis complete decurrentibus inferne late alatus, jam infra medium stricte ramosus, rami angulo $\pm$ 45 erecto-patentes foliis abbreviatis longe spinosis late spinoso-alato-decurrentibus suffulti. Folia inferiora ignota; caulina breviter lanceolata erecto-patentia vel cauli fere appressa, perlate complete decurrentia; alae sinuato-dentatae ipsae $\pm$ 5 mm latae, dentes spinis inclusis ad 2 cm lati, supra glabrescentes subtus tenuiter appresse canescenti-tomentosi, spinae vulnerantes stramineae 2—5 mm longae, nervi subtus prominentes glabrescentes. Folia superiora fere omnino ad alas late sinuato-dentatas longe spinosas et ad segmentum terminale in spinam rigidam ad 4 cm longam lamina basin versus angustissime revoluta alatam excurrens et spinulis basalibus paucis provisum reducta. Capitula breviter pedunculata, pedunculi 3—8 mm longi rigidi, partim lateraliter singuli vel saepius

Fig. 59. *Cousinia bamianica* (K. 2829). $^1/_2$.

bini vel terni, subspicate et terminaliter subcorymbose dispositi. Involucrum absque spinis 10—15 mm diametro, 10 mm longum, depresso-hemisphaericum basi rotundatum, pallide flavescenti-viride, valde laxe araneosum glabrescens; phylla 4—5-seriata non numerosa, crasse rigide membranacea sparse minute glanduloso-papillosa glabrescentia, nervo dorsali valido stramineo in spinam rigidissimam erecto-patentem vulnerantem excurrentia, extima lanceolata abbreviata, media e basi ovato-dilatata abrupte in spinam crassam oblique erecto-patentem capitata saepe longiorem attenuata, intima tenuiter membranacea flexibilia pallide brunea inermia in appendicem exsertam bruneam ovatam rotundatam vel acutiusculam interdum indistincte apiculatam interdum sublaceratam dilatata. Receptaculi setae laeves nitidae. Corolla ± 10 mm longa purpurea; laciniae ± 2.5 mm longae anguste lineares acutae. Achaenia 3—4—5 mm longa, anguste obpyramidata, basi subacuta, apice truncata, anguste subalato-paucicostata, costis albo- et nigro-variegatis, inter costas minutissime papillosa. Pappi setae subtaeniatae laeviusculae, achaenio breviores.

C: Nil Kotal, 3000 m, between Bamian and Band-e-Amir, 18.VIII.1948 (Köie 2829, Typus, hb. W., C.). Bamian, trockene Steppen, Blüten rotlila (N. 51/424, W.).

Cousinia (*Odontocarpae*) ***blepharobasis*** Rech. f. et Gilli, n. sp. — Fig. 60 und 66 E.

Dense caespitosa basi lignescens multicaulis, inferne foliis annorum praecedentium diu persistentibus intricatis dense obsita. Caules floriferi humiles 3—9 cm alti, internodiis abbreviatis usque ad summum 2 cm longis, simplices monocephali, foliis reductis paucis obsiti. Folia basalia non vel indistincte petiolata, basi valde applanata et dilatata, 2—3 mm lata ibique copiosissime spinuloso-ciliata; lamina ad 5 cm longa, ad 1.5 cm lata, ambitu oblongo-linearis, pinnata,

Fig. 60. *Cousinia blepharobasis* (Gilli 2545). $^1/_1$.

segmentis utrinque ± 10 complete bifidis, subverticillatim dispositis ad 10 mm longis aculeiformibus rigidis, inter se ± 3 mm remotis, in spinam terminalem tenuem ad 2 mm longam excurrentibus, omnino arcte revolutis supra glabrescentibus subtus appresse albo-tomentosis; rachis latiuscula ad medium laminae 1 (—1.5) mm lata, basi valde dilatata tota longitudine distincte alata sero glabrescens. Folia caulina (interdum 1—2 tantum evoluta) omnia valde reducta e basi dilatata lanceolato-subulata, apice longe tenuiter spinosa, basi spinis nonnullis provisa; folia summa lineari-subulata integra. Involucrum basi profunde impressum, subglobosum, in statu leviter compresso spinis exclusis ± 2 cm longum et latum, dense ochraceo-araneoso-floccosum; phylla 5—6-seriata, ca. 70—80, pallide flavescenti-viridia, margine minute cartilagineo-serrulata, prope basin 1—1.5 mm lata, applanata, superne glabrescentia, intima reflexa quam media paulo tantum breviora, media squarroso-patentia ut exteriora rigida, in spinas tenues excurrentia, nervo mediano elevato percursa; phylla intima latiora flexibilia erecta vix spinescentia pallide fusca opaca dense glanduloso-papillosa. Corolla roseo-purpurea in sicco demum brunescenti-expallens, ± 15 mm longa, tubo attenuato ± 5 mm longo, laciniis 2—2.5 mm longis. Antherarum tubus in sicco quidem expallens (an in vivo roseus?), glaber, paulo exsertus. Receptaculi setae pallidae, valde scabrae. Achaenia (nondum matura) ± 3 mm longa, 1.5 mm lata, obpyramidata, valde applanata, atra, elevate pluristriata, apice truncata, minute irregulariter paucidentata. — Habitu dense caespitoso humili *C. Mogensii* Rech. f. similis a qua differt: involucro copiose ochraceo-araneoso-floccoso, eiusque phyllis numerosioribus angustioribus extimis reflexis mediis squarroso-patentibus, foliorum rachide basi magis dilatata, foliis multo rigidioribus diutius persistentibus, receptaculi setis magis scabris.

E: Paghman-Gebirge, Aufstieg zum Hauz-e-Chas, 3400 m, zwischen 3100—3500 m die herrschende Art, von sehr wenigen, vereinzelten anderen Arten begleitet, polsterbildend. Korolle weiss, nur die Spitzen der Korollzipfel hell blau-violett, Staubbeutelröhre, Griffel und Narbe blauviolett. 28.VIII.1949 (Gilli 2545, hb. W.)

C. (*Odontocarpae*) *buphthalmoides* Reg. et Schmalh. — **C:** Panjao, 2700 m (K. 2711, 2684). — **E:** Below Sirotai, 8000 ft., dry ground, fl. rose (Kz. 11969). Begram near Charikar, 8000 ft. (Codrington 24). Kabul, 2000 m (Kz. 11413). Kabul, 1700 m (K. 4003). Fuss des Scher Darwasah bei Kabul, 1800 m, Gneiss-Schutt und Sand, Blüten rotviolett (Gilli 2557).

Die hier unter *C. buphthalmoides* zusammengefassten Exemplare stimmen weder miteinander noch mit dem Isotypus völlig überein, sodass ihre spezifische Zusammengehörigkeit nicht völlig erwiesen ist.

Der Isotypus, Griffith 3270, W., enthält Zweige einer offenbar kräftigen Pflanze. Wurzel, Hauptstengel, grundständige und untere Stengelblätter fehlen. Die oberen (aststständigen) Stengelblätter sind aus breit herzförmiger Basis kurz zugespitzt, laufen in einen kräftigen, bis 12 mm langen Enddorn aus; die übrigen Dornen der gezähnten bis kurzgelappten Blätter sind viel kürzer (3—5 mm) und zarter. Das flockige Stengelindument ist nur mehr in Resten vorhanden, auch die anfangs anliegend flockig-filzige Blattunterseite verkahlt stellenweise. Die Köpfchen haben (ohne Dornen) 2—2.5 cm Durchmesser und Länge, sind

spinnwebig behaart und verkahlen bis auf die Basis der Hüllschuppen weitgehend. Der kräftige, dornenartig verschmälerte Teil der Hüllschuppen ist 2—2.5 cm lang, an den mittleren Hüllschuppen abstehend, an den äussersten zurückgebogen. Die innersten Hüllschuppen sind bis 4 mm breit, lanzettlich zugespitzt, strohgelb bis blassbräunlich, auf der Fläche glatt, am Rand sehr fein gezähnelt.

Die Grundblätter waren bisher nicht bekannt: folia basalia 10—15 cm longa, ad 4 cm lata, breviter et indistincte petiolata, lyrato-pinnatifida, segmento terminali magis cordato-orbiculato, lateralibus rachidi oblique adnatis irregulariter alternatim longioribus et brevioribus partim liberis partim confluentibus, omnibus minute sinuato-spinoso-denticulatis, supra araneoso-floccosis canescenti-viridibus, subtus densius appresse tomentosis albidis.

Köie 2711 stimmt mit dem Isotypus (Griffith 3270, W.) im wesentlichen überein, so z. B. in der Form der kurzen, häufig sitzenden oberen Stengelblätter, in der Form und vor allem auch Farbe (schwärzlich überlaufen!) der Hüllschuppen! Als einziger Unterschied fallen bei Köie 2711 die weniger zahlreichen und nicht ganz so breiten innersten Hüllschuppen auf. In den Merkmalen der Hülle und der Blüten ähnlich ist Köie 2684, die nur durch niedrigen Wuchs und etwas kleinere Köpfchen abweicht. In diese Formenserie gehört auch Gilli 2557.

Etwas stärker weicht Koelz 11969 ab durch längere, relativ schmälere Dornen der Hüllschuppen, von denen besonders die unteren stark herabgebogen sind und oft den Durchmesser der Hülle an Länge übertreffen.

Eine andere Formenserie wird durch die folgenden, zumeist aus der näheren oder weitern Umgebung von Kabul stammenden Exemplare gebildet: Codrington s. n., Köie 4003, Koelz 11413. Pflanzen kräftig; Blätter oberseits stärker verkahlend, auch die Stengelblätter deutlich gelappt und meist kräftiger bedornt, Köpfchen relativ gross, Hüllschuppen (mit Ausnahme von Köie 4003) lang und schmal.

Als nächst verwandte Arten können meiner Meinung nach die folgenden gelten: *C. auriculata* Boiss. (Afghanistan), *C. oxytoma* Rech. f. (Ost-Afghanistan), *C. acanthoblephara* Rech. f. et Gilli (Gegend von Kabul), *C. schistosa* Rech. f. et Edelbg. (Nuristan), *C. lachnobasis* Rech. f. et Köie (SW.-Afghanistan). Ferner *C. glauciifolia* Kult. und *C. commixta* Kult. aus Turkestan, möglicherweise *C. Gilesii* Winkl., von der ich keine Belege gesehen habe. Die Unterschiede dieser Arten von *C. buphthalmoides* sind bei den einzelnen Arten, soweit sie aus Afghanistan bekannt sind, jeweils angeführt.

Auf Grund der herkömmlichen Sektionseinteilung gehört ein Teil der als verwandt angenommen Arten zu den *Odontocarpae* ("Achaenia costata obpyramidata 3—5-gona truncata denticulata") ein anderer Teil zu den *Lampocarpae* ("Achaenia ecostata obovata apice rotundata"). Da von mehreren Arten bisher keine oder doch keine voll ausgereiften Achaenen bekannt sind, lässt sich die hier angeschnittene Frage vorläufig nicht beantworten. Abgesehen von den bereits angegebenen Merkmalen lassen sich diese Arten im allgemeinen auch durch gewisse Blütenmerkmale auseinanderhalten, die bisher nicht oder nicht genügend beachtet worden sind.

Aus der Tabelle ergibt sich, dass für *C. buphthalmoides* Korollen von 20 mm Länge charakteristisch sind, bei denen das Längenverhältnis des Tubus zum Limbus der Korolle durchschnittlich 1:1 beträgt. *C. auriculata*, von der ich allerdings nur spärliches Material untersuchen konnte, zeigt in den Blütenmassen keine fassbaren Unterschiede gegenüber *C. buphthalmoides*. Bei *C. glauciifolia* ist dagegen die absolute Länge der Korolle geringer, ca. 16 mm, und der Tubus der Korolle nur etwa halb so lang als der Limbus. *C. lachnobasis* und *C. schistosa* verhalten sich in diesen Punkten wie *C. glauciifolia*. *C. oxytoma* weist ca. 18 mm lange Korollen auf, der Tubus der Korolle entspricht gleichfalls wie bei *C. glauciifolia*, *C. lachnobasis* und *C. schistosa* etwa nur der Hälfte des Limbus der Korolle. Die absolute Länge der entsprechend dem zygomorphen Korollbau etwas ungleichlangen Korollzipfel ist systematisch nicht verwertbar.

Art:	Samml. No.:	Kor. Lge.	Korolle: Tubus:Limbus	Lge. d. Kor.-Zipf.
buphthalm.	GRIFF. 3270	20 mm	1:1	3.5:3 mm
buphthalm.	CODR. 24	22 mm	1:1	3.5:3 mm
buphthalm.	GILLI 2557	20 mm	1:1	3.5:3 mm
buphthalm.	K. 4003	21 mm	1:1	4.5:3.5 mm
buphthalm.	K. 2711	21 mm	1:1	4.5:3.5 mm
buphthalm.	K. 2684	20 mm	1:1	3.5:3 mm
buphthalm.	K. 2684	20 mm	1:1	3.5:3 mm
buphthalm.	Kz. 11969	20 mm	9:10	3.5:3 mm
buphthalm.	Kz. 11413	21.5 mm	1:1	4.5:3.5 mm
auriculata	N. 903	18—20 mm	4:5	4.5:4 mm
auriculata	GRIFF. 3263	20 mm	1:1	4.5:4 mm
glauciifolia	Hb. Fl. As. med. 481	16 mm	1:2	3.5:3 mm
glauciifolia	REGEL (Sarawschan)	16 mm	6:10	3.5:3 mm
lachnobasis	K. 3889	16.5 mm	7:9 (—10)	3:2.5 mm
oxytoma	Kz. 13737	18—19 mm	1:2	4:3 mm
oxytoma	Kz. 11568	18 mm	1:2	4:3 mm
schistosa	E. 1116	16—17 mm	5:11	4.5:3 mm

C. (*Odontocarpae*) *carthamoides* Aitch. et Hemsl. — **Nuristan:** Netshingel, 3300 m (E. 1655). — **E:** Nozi, 10000 ft., dry slope, flrs. rose-purple (Kz. 12004).

No. 12004 stimmt im wesentlichen mit dem Typus von *C. carthamoides* (AITCH. 922) überein, unterscheidet sich durch weniger dicht dornig-gelappte Blätter, weniger kantigen, einköpfigen Stengel mit stark gestreckten Internodien und noch etwas breitere äusserste Hüllblätter. Dieselben unwesentlichen Unterschiede gegenüber *C. carthamoides* gelten mit Ausnahme der hier typischen Blätter auch für EDELBERG 1655.

Cousinia (*Spicatae*) ***catenata*** Rech. f., n. sp. — Fig. 61 und 66 F.

Verosimiliter perennis. Caulis 80—100 cm altus, stricte erectus, in tertia vel quarta parte superiore ramosus florifer, internodiis mediis 3—4 cm longis, in tertia parte inferiore tantum regulariter foliatus, foliis in parte media caulis subito valde decrescentibus, in tertia parte superiore fere omnino ad spinulas palmatas reductis, appresse floccoso-tomentosis indumento albo areolatim aegre secendente, ramis floriferis valde glabrescentibus. Folia basalia ignota, caulina infima ad 25 cm longa, spinis inclusis 5—6 cm, lobis sine spinis ± 3 cm, rachide ipsa ± 1 cm lata, basin versus sensim attenuata brevius et remotius spinigera, basi ipsa subauriculata sessilia, remote breviter subinterrupte sinuato-lobata margine revoluta, lobi rectangulariter patentes triangulares marginibus concavis in spinas validas 10—15 mm longas vulnerantes excurrentes, imprimis in dimidio superiore laminae cum lobis multo minoribus alternantes; lamina supra flavescenti-viridis dense glanduloso-papillosa, subtus dense appresse candide subsericeo-tomentosa; costa mediana subtus valde prominens, supra tenuis applanata usque leviter immersa; nervi secundarii pauci remoti rectangulariter in spinas abeuntes vel furcati aut subpalmati, subtus prominentes.

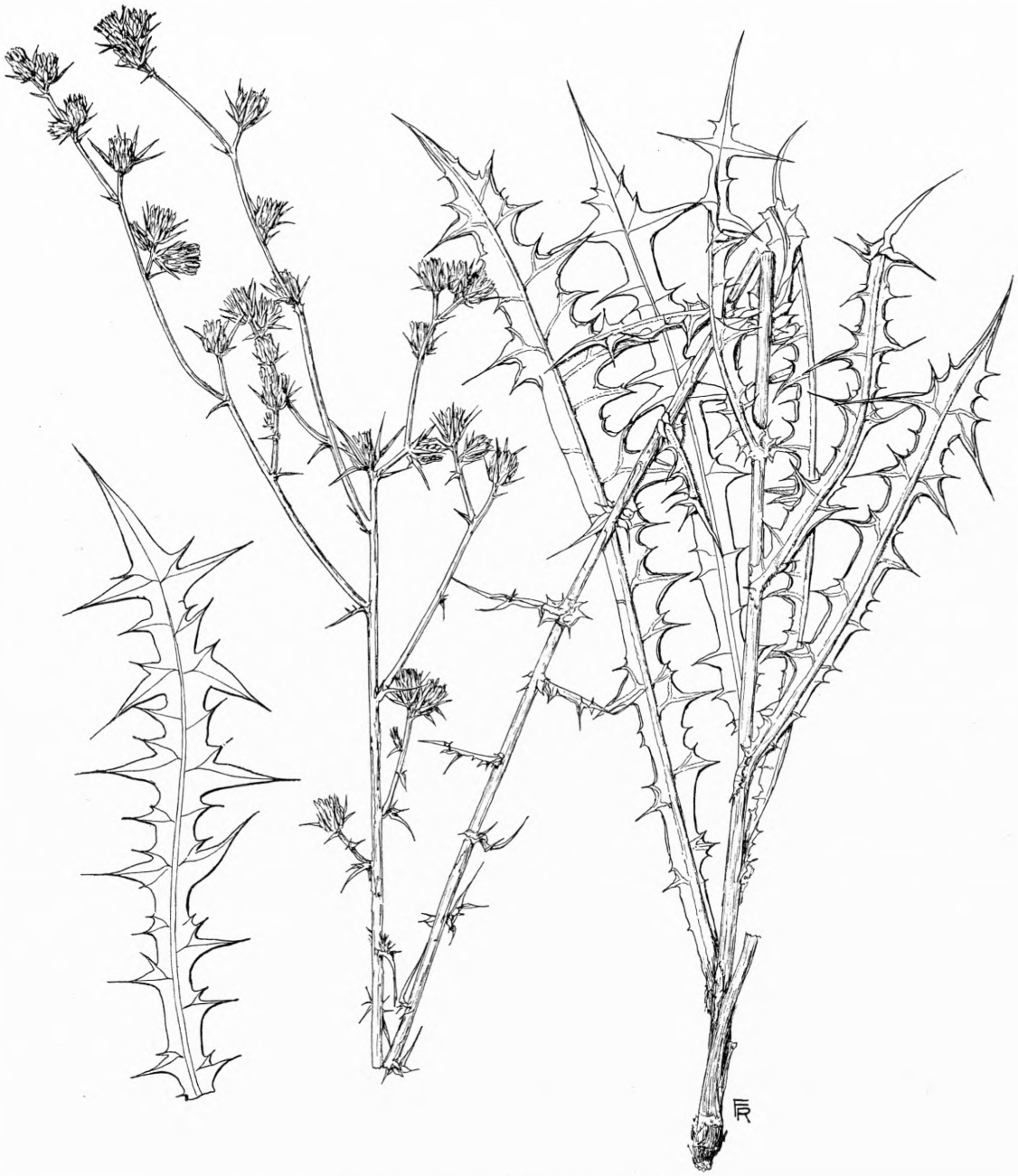


Fig. 61. *Cousinia catenata* (Kz. 13955). $^1/_2$.

Folia caulina media 15—30 mm longa, e basi latiuscule cordato-auriculata sessilia breviter lanceolato-attenuata, breviter paucilobata-spinosa lobis sinibus latis separatis, margine valde revoluta, spina terminalis longissima 15—20 mm longa. Rami inflorescentiae tenues erecto-patentes subflexuosi, capitulis numerosis in ramulis lateralibus brevibus singulis vel saepius 2—3-nis approximatis subracemoso-dispositis quasi catenatis. Involucrum basi plerumque foliis nonnullis fulcrantibus valde diminutis aut simplicibus lanceolatis aut pectinato-spinulosis suffultum breviter campanulatum basi rotundatum, absque spinis ± 1 cm longum, 7—8 mm diametro; phylla plerumque 4-seriata valde inaequalia; extima 3—7 in spinas tenues rigidas erecto-patentes capitula aequantes vel saepius usque plus quam duplo superantes transformata; phylla media lanceolata breviter appresse spinuloso-mucronulata, quam intima dimidio usque tertia parte breviora, intima linearia erecta minus rigida marginibus subparallelis, apice breviter mucronulato-acuminata, facie glanduloso-punctata primum paulum araneosa demum saepe fere complete glabrescentia, margine minutissime serrulata. Receptaculi setae albidae sublaeves infra apicem autem obsolete scabridae. Corolla in vivo sordide albida vel flavescens fuisse videtur, extus obsolete glanduloso-papillosa ± 8 mm tantum longa, tubo valde abbreviato ± 2 mm tantum longo. Achaenia vix 3 mm longa obpyramidata grisea longitudinaliter elevate striata, insuper ad angulos latiuscule alata, alis superne in auriculas productis. — Species valde insignis verosimiliter sectionem propriam sistens; inflorescentia subracemoso-ramosa speciebus ramosis Sectionis *Spicatarum* subsimilis, sed multis notis gravibus aliena: caule alato ramisque tenuibus, foliis angustis (divisione ac nervatura nonnullis speciebus generis *Echinops* similibus), capitulis minutissimis, involucri phyllis inter se valde diversis, extimis spiniformibus capitulum usque duplo superantibus, ceteris brevissime mucronulato-apiculatis, achaeniis minutissimis obpyramidatis longitudinaliter striatis, angulis alatis alis apice auriculatis.

N: Akupruk, 5500 ft., dry cliff, 11.IX.1939 (Koelz 13955, hb. W., BPI.).

Cousinia (*Homalochaetae*) ***chionophila*** Rech. f. et Köie, n. sp. — Fig. 62.

Perennis, caudicibus pluribus partim foliiferis partim caules floriferos emittentibus, collo tenui vix squamoso. Caulis nondum complete evolutus 8—10 (—20) cm altus paucinodus, internodio medio ca. 1.5—3 cm longo, simplex vel rarius capitulis usque ternis in summo caule approximatis, appresse candide araneoso-floccosus. Folia rosularia petiolo 4—6 cm longo suffulta; lamina foliorum omnium in sicco crassiuscule coriaceo-membranacea, utrinque subtus densius appresse albo-araneoso-floccosa, costa mediana latiuscula supra applanata subtus leviter convexa; nervi laterales validi utrinque subtus magis prominentes angulo recto a costa mediana abeuntes plerumque singuli in spinas loborum excurrentes, pauce vel non furcati non anastomosantes; lamina foliorum basalium ambitu lanceolata sine petiolo usque 15 cm longa, spinis exclusis 2—3 cm lata, subplana vel saepius sinibus involuto-crispatis pinnatilobata, lobi principales utrinque (7—) 10 (—12) breves triangulares, in spinas validas usque 1 cm longas horizontaliter patentes excurrentes, cum lobis

pluries minoribus et breviter spinulosis aequidem horizontaliter patentibus regulariter alternantes. Folia caulina similia paulo decrescentia, caulina inferiora quoque longe et distincte petiolata, petiolo non spinifero. Folia caulina superiora basi auriculata

Fig. 62. *Cousinia chionophila* (K. 2636). $^{2}/_{3}$.

adnata spinifera sessilia capitulis approximata eaque longe superantia ante anthesin quidem quasi involucrantia. Capitula nondum florentia tantum nota, spinis inclusis 4—5 cm diametro, involucri phyllis longe patentibus spiniferis horride erinacei; involucrum verosimiliter depresso-semiglobosum basi dense albo-araneosum impressum; phylla ca. 70—80, verosimiliter 4—5-seriata ad 25 mm longa, e basi 1.5 (—2) mm lata sensim subulato-attenuata viridia trinervia a medio glabrescentia in spinam

longiusculam stramineam abeuntia; phylla intima in appendicem anguste lanceolatam longe subulato-mucronulatam purpurascentem glabrescentem margine scabridulam attenuata. Flores achaeniaque ignota. — Statura humili, indumento albo, foliis rosularibus longe petiolatis, imprimis autem foliorum nervatura insignis; nervi secundarii pauci- vel non furcati, utrinque prominentes, rectangulariter a costa mediana abeuntes non anastomosantes in spinas validas vulnerantes rectangulariter patentes abeuntes in foliis bene evolutis cum spinis duplo brevioribus regulariter alternantes imprimis *C. kuramensi* Bornm. BBC 34/2:150 (1917) (Isotypus in W) valde affinis videtur, ab ea foliis pluries longioribus alternatim multilobatis multo longius armatis, basalibus et caulinis inferioribus longe petiolatis, foliis superioribus parum decrescentibus basi ± dilatatis capitulis approximatis eaque ante anthesin quidem fere involucrantibus, involucri phyllis numerosioribus angustioribus eis seriei intimae angustissimis longe subulato-spinosis sublaevibus diversa.

C: Koh-i-Baba, 3800 m, 24.VII.1948 (Köie 2636, hb. W., C.).

Cousinia (*Spicatae*) ***chlorothyrsa*** Rech. f. et Köie, n. sp. — Fig. 63 und 66 G.

Perennis. Caulis 80 cm altus, prope basin 6 mm diametro, stricte erectus simplicissimus, a tertia parte inferiore florifer, inferne eburneus glaber teres laevis, internodiis 3—5 cm longis regulariter foliatus. Capitula omnia glomerata sessilia, glomeruli inferiores ex axillis foliorum caulinorum diminutorum enati, superiores foliis fulcrantibus valde diminutis non prominentibus quasi aphylli contigui, spicastrum compactum formantes. Folia basalia et caulina inferiora non petiolata, ad 16 cm longa, 3—4 cm lata, pinnata; costa mediana eburnea glabra, prope basin ad 5 mm lata, subtus convexa, supra applanata, tota longitudine angustissime viridialata, ala arcte revoluta; pinnae inter se ± 1 cm remotae, rectangulariter patentes, 1—2 cm longae, 1—1.5 cm latae, supra atrovirides, glanduloso-papillosae, subtus appresse albo-tomentosae, saepe usque ad costam medianam albidam revolutae, in spinulam tenuissimam, ± 2 mm longam excurrentes, basi plerumque pinnula secundaria breviore subverticillatim disposita auctae. Folia caulina media capitula fulcrantia abbreviata, ambitu triangularia, e pinnis paucioribus longioribus longius spiniferis minus arcte revolutis composita. Folia summa e capitulis non exserta quoque pinnata. Involucrum 25 mm longum, subcylindrico-campanulatum, basi attenuatum; phylla ca. 60, in seriebus ± 5 disposita, omnia lanceolata viridia dense fusce glandulosa-papillosa, omnia erecto-patentia laxe disposita, extima circiter dimidiam longitudinem interiorum attingentia, caetera omnia subaequilonga, e basi lanceolato-dilatata sensim in spinam tenuem pungentem attenuata, dorso (interdum subindistincte) carinato-nervosa; series intima a caeteris vix diversa, aequidem herbacea sed minus rigida. Receptaculi setae fuscescentes scabridae. Corolla flava, ca. 18 mm longa, ex involucro breviter exserta, laciniae ± 4 mm longae lineares acutae subpatulae. Antherarum tubus lacteus glaber exsertus. Achaenia ignota. — Differt a *C. racemosa* Boiss. foliis omnibus pinnatis, involucri phyllis subaequalibus non imbricatis laxe dispositis dense glanduloso-papillosis. Differt a *C. hoplite* Bornm.

Fig. 63. *Cousinia chlorothyrsa* (K. 2770). $^1/_2$.

(Isotypus in Hb. Kew) caule in parte inferiore quoque eburnea laevi nec striato-sulcato, involucro breviore omnino densissime glanduloso-papilloso, phyllis angusti-oribus, flosculis flavis nec roseis.

C: Daulat Yar, 2400 m, 4.VIII.1948 (Köie 2770, hb. W., C.).

Fig. 64. *Cousinia chrysochlora* (K. 3322). $^{2}/_{3}$.

Cousinia (*Heteracanthae*) ***chrysochlora*** Rech. f. et Köie, n. sp. — Fig. 64 und 66 H.

Verosimiliter perennis. Caulis verosimiliter modice elatus (fragmenta tantum obvia), proportione crassus, in tertia parte superiore iteratim divaricate corymbose ramosus, internodiis mediis 3—4 cm longis, appresse araneoso-floccosus parum glabrescens. Folia rosularia et caulina inferiora ignota. Folia caulina media et superiora consistentia crassiuscule membranacea, utrinque laxe subtus paulo

densius araneosa canescenti-viridia, cauli profunde cordato-adnata, ad dimidia internodia tota latitudine decurrentia alis convexis, ambitu perlate cordato-ovata, brevissime perlate subsinuato-dentata, dentibus longitudine eorum multoties latioribus in spinam tenuem rigidam 3—4 mm longam excurrentibus; nervi a basi foliorum in laminam alasque fere radialiter abeuntes, pallidi, reticulato-anastomosantes, utrinque subtus magis prominentes; folia ramealia similia sensim diminuta; rami usque ad capitula dense foliati, folia extrema in involucri phylla minime quidem transientia. Capitula singula terminalia, involucrum cum spinis 2—3.5 cm latum, 1.5—2 cm longum, basi truncatum, superne constrictum; phylla plerumque 5-seriata, lanceolato-subulata basi indurata flavida adnata, sensim in spinam rigidam subtriquetram squarroso-patentem attenuata, nervo tenui dorso prominente in spinam vulnerantem abeuntia, prope basin ± tenuiter araneoso-contexta, apicem versus glabrata minutissime glanduloso-papillosa; phylla intima elongata tenuiter membranacea pallida in apicem molliusculam sensim attenuata, margine scabride serrulata. Receptaculi setae candidae laeves. Flores numerosi. Corolla in sicco quoque flava, 16—18 mm longa, laciniis acutis 3—4 mm longis. Antherarum tubus flavus glaber. Achaenia submatura 4 mm longa, 2 mm lata compresso-subtriquetra, basin versus subrotundato-attenuata, apice truncata, grisea, indistincte obscure maculata, indistincte irregulariter transverse elevate nervulosa. — Affinis *C. lachnosphaerae* Bge. sed differt involucri phyllis rigidioribus minus numerosis nec patulis recurvis, indumento totius plantae imprimis involucri minus denso planta itaque virente nec canescente, corolla etiam in sicco intense flava non expallente. Differt a *C. Gabrielae* Bornm. et a *C. gedrosiaca* Bornm. et Gauba involucro multo minus dense araneoso, phyllis brevioribus, floribus in sicco quoque intense flavis, planta tota indumento minus denso virente.

SW: Inter Dilaram et Herat, 1100 m, 8.VI.1948 (Köie 3322, hb. W., C.).

C. (*Orthacanthae*) *congesta* Bge. — **NW:** Obeh, 1700 m (K. 3763). Kishlik, 700 m (K. 4046). — **Baluchistan:** Khojak Pass, 1900 m (K. 3257).

Cousinia (*Foliaceae*) ***consanguinea*** (Bornm.) Rech. f., sp. n. — Fig. 65 und 66 I.

Syn. *C. scariosa* Rgl. ssp. *consanguinea* Bornm. in B.B.C. 34/2:282 (1916). — "Afghanistan" (Griffith 3273, hb. K.).

Differt a *C. scariosa* Rgl. foliis omnibus pinnatisectis, capitulis minoribus spinis inclusis 4 (—5) mm (nec 6 mm) diametro, involucri phyllis e basi angustiore multo longius attenuatis inferioribus reflexis, mediis magis patentibus.

Schon Bornmüller hat l. c. erwogen, ob nicht *C. consanguinea* spezifisch von *C. scariosa* abzutrennen wäre. Griffith 3273 ist im Herb. Kew anscheinend ausschliesslich durch *C. consanguinea* und nicht durch *C. scariosa* typica vertreten. Von letzterer liegt mir ein Zweigstück im Hb. Kopenhagen vor. Auch der untere Stengelteil mit Grundblattrosette ist vorhanden. Die Grundblätter sind ebenfalls durchaus fiederschnittig (Bornmüller hat nur Stengelblätter gesehen). Da das Merkmal der durchaus fiederschnittigen Blätter, wie sich nun zeigt, mit demjenigen der kleinen Köpfchen und der aus etwas schmälerer Basis viel plötzlicher in eine

Fig. 65. *Cousinia consanguinea* (Bornm.) Rech. fil. (GRIFFITH 3273). $^1/_2$.

um ein Mehrfaches längere Spitze auslaufenden Hüllschuppen parallel zu gehen scheint, zögere ich nicht, die schon von BORNMÜLLER unter Vorbehalt vermutete spezifische Trennung durchzuführen.

C. (*Orthacanthae*) *decurrens* Regel. — **C:** Sarasia, 9500 ft., dry slope, 1 ft., yellow with purple stamens (K. 13842). — **NE:** Faizabad, 1150 m (E. 1415). — **E:** S. of Kabul (K. 3324). Hügel nordöstlich von Ghasni, 2260 m (GILLI 2522). — **SE:** S. of Mokur, 2000 m (K. 3325).

C. (*Neurocentrae*) *deserti* Bge. — **NW:** Ardewan, 1300 m (K. 2263). — **SW:** Zwischen Herat und Farah, 1500 m (GILLI 2523).

Vergleiche bezüglich *C. deserti* Rech. f. in Österr. Bot. Zeitschr. 100:456 (1953).

Cousinia (*Pectinatae*) ***Edelbergii*** Rech. f., n. sp. — Fig. 67.

Perennis caudice tenui atro-corticoso. Caulis 40 cm et ultra altus stricte erectus, tota longitudine aequaliter foliatus internodiis mediis ± 3 cm longis, in quinta circiter parte superiore tenuiter corymbose pauciramosus, tenuiter sulcato-striatus, appresse laxiuscule subfloccoso-tomentellus subpurpurascens. Folia rosularia verosimiliter non numerosa ante florendum iam marcescentia breviter petiolata, basi petioli membranacea valde dilatata (5—8 mm), elevate multistriato-nervosa. Folia omnia crasse coriaceo-membranacea, in sicco quoque rigida, utrinque subtus densius appressissime floccoso-tomentella, supra pallide canescenti-virentia subtus albida; nervi secundarii utrinque ± 10 infimi approximati angulo recto a costa mediana basi leviter dilatata supra applanato-canaliculata abeuntes, tenues ex indumento paulum tantum prominentes; nervi tertiarii copiose reticulato-anastomosantes indumento fere omnino occulti; lamina utrinque brevissime spinoso-lobata, lobi palmato-triangulares spinas tres usque quinque divergentes proferentes, spina mediana validiore ad 5 mm longa, crispate sursum et deorsum flexi sese lateraliter tegentes. Folia caulina inferiora ad 8 cm longa, spinis inclusis ad 5 cm lata, cordato- vel elliptico-ovata subsessilia vel brevissime petiolata; folia caulina numerosa valde decrescentia, omnia basi profunde cordata sessilia minime quidem decurrentia lobis brevioribus paucioribus spinis — imprimis terminali — proportione latioribus. Folia ramorum valde diminuta lanceolata virentia longe flavide spinoso-pectinata, in involucri phylla transientia. Capitula valde juvenilia nondum evoluta phyllis exterioribus quidem lanceolatis spinoso-pectinatis. — Habitu, foliorum forma foliis caulinis valde decrescentibus imprimis autem involucri phyllis spinoso-pectinatis procul dubio ad Sect. *Pectinatas* pertinet. A speciebus paucis adhuc notis huius sectionis indumento, nervatura foliorum habitu gracili diversa.

C: Deh Kundi, 2700 m (EDELBERG 1885, unicum C.).

Cousinia (*Odontocarpae*) ***elasoonensis*** Rech. f. et Edelbg., n. sp. — Fig. 68 und 78 A.

Perennis collo pauciramoso. Caulis erectus validus simplex submonocephalus vel subsimplex, ad 35 cm altus, prope basin ad 6 mm crassus, tota longitudine dense albo-floccoso-araneosus, internodiis brevibus dense regulariter foliatus, infra capitulum longiuscule (ad 6 cm) nudus. Folia basalia ad 10 cm longa, spinis inclusis

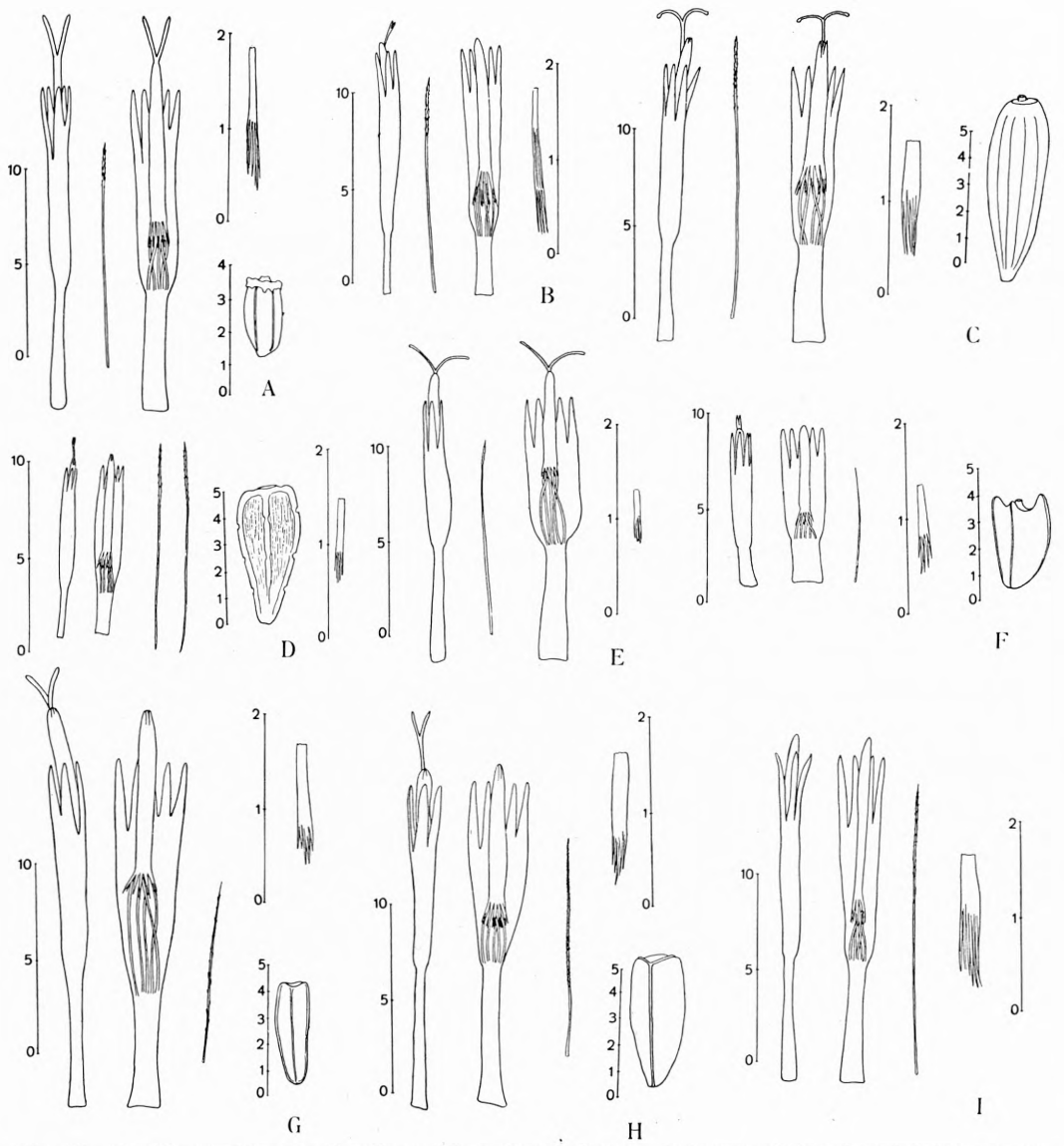


Fig. 66. Korolle geschlossen, Korolle geöffnet, Spreuschuppe, Antherenanhängsel und Achäne von: A *Cousinia acanthoblephara*, B *C. acanthoptera*, C *C. ariana*, D *C. bamianica*, E *C. blepharobasis*, F *C. catenata*, G *C. chlorothyrsa*, H *C. chrysochlora*, I *C. consanguinea*.

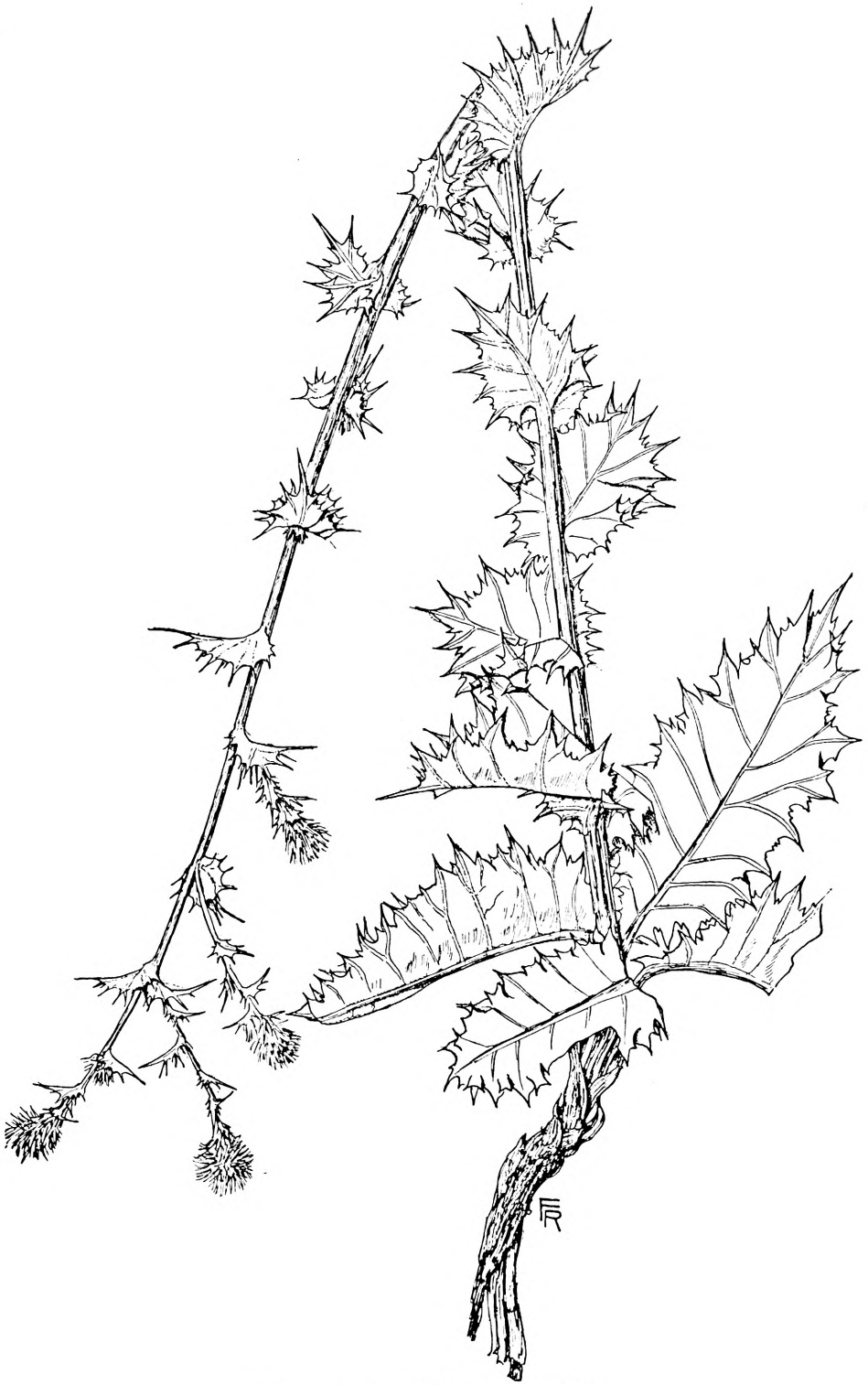


Fig. 67. *Cousinia Edelbergii* (E. 1885). $^{2}/_{3}$.

Fig. 68. *Cousinia elasoonensis* (E. 1731). $^1/_2$.

2—2.5 cm lata, non vel valde indistincte petiolata, pinnata; rachis continua 5 (—10) mm lata; pinnae 7—10-jugae subaequilongae vel subalternatim irregulariter longiores et breviores, lanceolatae, prope basin vel lateraliter utrinque spinulis singulis usque paucis auctae, nervo crasso stramineo glabrescente utrinque prominente in spinam terminalem (3—) 5—7 mm longam vulnerantem excurrente percursae. Lamina foliorum omnium in sicco crassiuscula subcoriacea, subtus appresse laxiuscule usque subdense floccoso-tomentella, supra viridis laxe appresse araneosa demum glabrescens; nervi secundarii crassi flavi, tertiarii tenues tamen utrinque prominuli, laxe irregulariter anastomosantes. Folia caulina numerosa (10—15), erecto-patentia usque cauli fere appressa, basi cordato-dilatata adnata usque subdecurrentia, absque spinis prope basin 2—4 cm lata, ambitu ovato-oblonga usque ovato-lanceolata, superiora apice magis attenuata protracta longius spinifera, indumento ut in foliis basalibus sed lobis minus distinctis, spinis magis aequalibus. Capitula singula terminalia, absque spinis 3—4 cm diametro; involucrum depresso-semiglobosum, basi impressum dense araneosum; phylla $\pm$ 5-radiata, $\pm$ 70, omnia intimis exceptis subaequilonga, primum appressa deinde erecto- usque subsquarroso-patentia, e basi indurata sublanceolato-dilatata crasse rigide subtriquetro-subulata, exteriora longissima ad 3.5 cm longa, purpurascentia, in spinam terminalem stramineam glabrescentem 2—3 mm longam excurrentia. Phylla seriei intimae manifeste breviora, minus rigida, papilloso-scabrida lanceolato-dilatata molliuscule membranacea.

Receptaculi setae glabrae. Flores ab involucri phyllis superati, corolla ± 16 mm longa parte basali tenui ± 6 mm longa, laciniis acutis ad 4 mm longis. Antherarum tubus roseus glaber. — Affinis videtur imprimis *C. Thomsonii* Clarke, *C. Franchetii* C. Winkl. (e descr.), *C. Trollii* Bornm., a quibus autem combinatione characterum sequentium diversa: Caulibus validis simplicibus monocephalis, foliis basalibus lanceolatis pectinato-pinnatis, caulinis proportione brevibus latis vix lobatis sed spinas longas proferentibus, indumento floccoso-araneoso non valde denso, capitulis permagnis, corollis purpureis.

Nuristan: Elasoon, 3200 m, 7.VII.1949 (Edelberg 1731, Typus, hb. W., C.). Ibidem (E. 1735, hb. C.). Berg NNO von Kamdesch, 2800 m (Gilli 2512).

C. (*Odontocarpae*) *elegans* Aitch. et Hemsl. — **C:** Bamian, 8000 ft., dry uplands (Codrington s. n., BM.).

Unentwickelte Bruchstücke, Bestimmung daher zweifelhaft. Vom Typus durch schmälere, oberseits spinnwebige Blattabschnitte verschieden.

C. (*Xiphacanthae*) *eryngioides* Boiss. — **NW:** Khoshbai, 8000 ft., dry slope, pl. 2 feet high, fl. rose-purple (Kz. 14146, hb. W., BPI.).

C. (*Xiphacanthae*) *fraternella* Bornm. — **C:** Doulat Yar, 2400 m (K. 2766). Bamian, trockene Steppe (N. 51/425). Bamian, 2300 m (K. 2812).

Cousinia (*Odontocarpae*) ***eurylepis*** Rech. f., n. sp. — Fig. 69 und 78 B.

Perennis, pluricaulis, rhizomate suffrutescente multifibroso. Caulis 30—60 cm (e collectore) altus, teres, glaber, pallidus, leviter striatus, internodiis mediis ± 3 cm longis, in tertia vel quarta parte superiore corymbose pauciramosus vel in speciminibus macris breviter furcatus, tota longitudine foliatus. Folia rosularia 10—12 cm longa, spinis inclusis ultra 3 cm lata, ambitu lanceolata, petiolo indistincto, pinnata, segmentis utrinque ± 15 complete bifidis subverticillatim dispositis 15—20 mm longis tenuissimis aculeiformibus in spinam terminalem tenuissimam excurrentibus arcte revolutis, supra viridibus glanduloso-papillosis, subtus canescenti-tomentellis, inter se 4—8 mm remotis; rachis eburnea crassa fragilis, subtus subcarinato-convexa, supra applanata, angustissime revolute alata. Folia caulina inferiora basi subamplexicauli dilatata membranacea brunea sessilia, segmentis magis confertis, lamina abbreviata, ceterum rosularibus similia. Folia caulina superiora abbreviata, ambitu lanceolato-triangularia, paucipinnata, pinnis subsimplicibus nec bilobis subverticillatis vel ad summum spinula basali accessoria instructis, ut rachis minus arcte revoluta. Folia summa in involucri phylla sensim transientia, basi lobulo spiniformi uno alterove aucta vel subintegra. Capitula singula terminalia; involucrum spinis inclusis 3—5 cm diametro, ± 2.5 cm longum; phylla ± 40, in seriebus 4—5 disposita, pallide flavido-viridia, minute pallide glanduloso-papillosa, perlata, 5 usque saepe 10 mm lata, longitudine valde variabilia: 12—30 mm, exteriora et media ca. 1 cm supra basin subsensim vel subito in spinam longitudinaliter complicatam vulnerantem nervo longitudinali valido percursam attenuata; phylla seriei paenultimae et intimae

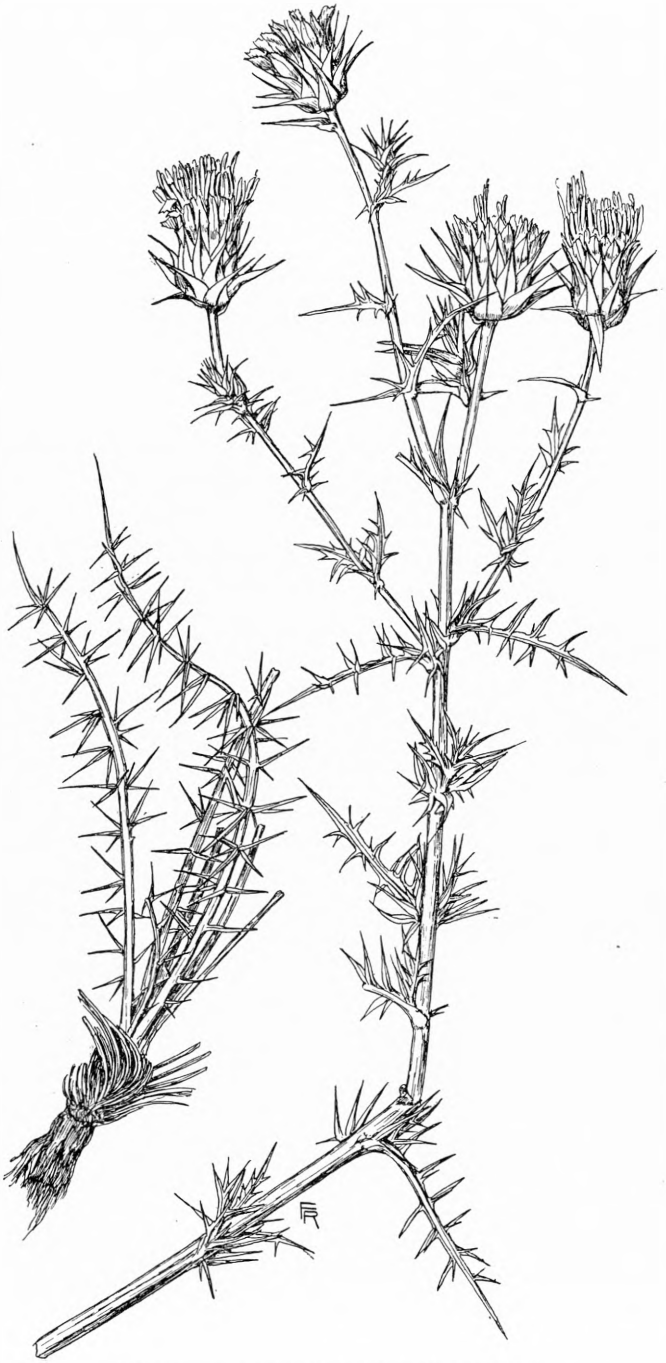


Fig. 69. *Cousinia eurylepis* (Kz. 13770). $^1/_2$.

tenuiter membranacea flexibilia, in appendicem latam dilatata, omnino dense flavide glanduloso-papillosa, margine irregulariter tantum fimbriato-denticulata. Corolla viva roseo-purpurea (e collectore), in sicco expallens ± 2 cm longa, laciniis anguste lanceolatis acutis vix 3 mm longis. Antherarum tubus roseus expallens glaber valde exsertus. Receptaculi setae pallidae scabridulae. Achaenia 6—7 mm longa, ca. 3 mm lata, oblanceolato-triangularia, valde compressa, basin versus sensim attenuata, apice aut abrupte aut subrotundato-truncata et obtuse ± indistincte crassiuscule marginata, tenuiter longitudinaliter elevate striata, grisea, irregulariter nigro-maculata, subnitidula. — Inter affines insignis capitulis magnis, involucri phyllis perlatis non numerosis, intimis apice lanceolato-dilatatis denticulato-laceratis glanduloso-papillosis.

C: Lorinj Pass, 3350 m, dry slope, pl. 2 ft. high, fl. rose-purple, 27.VIII.1939 (Koelz 13770, hb. W., BPI.).

Cousinia (*Nudicaules*) ***ghazniensis*** Rech. f. et Gilli, n. sp. — Fig. 70 und 78 C.

Basi lignosa, pluricaulis. Caules ad 30 cm alti, internodiis mediis ± 2 cm longis, tenues rigidi pallide brunei appresse floccoso-lanati imprimis superne glabrescentes, fere a basi tenuiter rigide subsquarroso-ramosi, cum ramis tota longitudine foliati. Folia rosularia numerosa, 6—7 cm longa, ± 3 cm lata, rigida, non petiolata, subverticillatim pectinata; rachis angusta integra; segmenta principalia 5—6-juga, inter se 5—7 mm remota, majora ± 2 cm longa, ± 2 mm lata, linearia, usque ad nervum medianum crassum revoluta, apice in spinam stramineam vulnerantem ad 3 mm longam excurrentia, supra appresse floccoso-lanata, canescentia, subtus densius tomentosa albida. Folia caulina omnia crasse coriacea rigida, quam rosularia multo minora, infima tantum pectinato-paucilobata; rachis late alata; segmenta breviter oblique triangularia, ut rachis revoluta, in spinam rigidam terminalem ± 2 mm longam excurrentia; folia caulina media et superiora lanceolata, omnia valde diminuta, rigide patentia, spina terminali longiuscula et lobis 1—2-jugis basi approximatis spiniferis provisa; folia ramealia numerosa integra ramis appressa, spinis basalibus nullis. Involucrum ± 13 mm longum, ± 6 mm latum, basi manifeste angustatum, superne constrictum, flavescenti-virens; phylla 5-seriata, crasse coriacea, lanceolata, integra, subsensim in spinam vulnerantem patulam usque subrecurvam 2—5 mm longam excurrentia, parce appresse albo-floccoso-araneosa et imprimis interiora glandulis sessilibus flavis aspersa; phylla seriei intimae in appendicem molliuscule scariosam latam breviter molliter mucronulatam excurrentia. Receptaculi setae laeves. Corolla in vivo rosea (?), in sicco expallens ± 9 mm longa, tubus ± 2 mm tantum longus, laciniae ± 2 mm longae. Antherarum tubus roseus glaber. Achaenia ± 3.5 mm longa quadrangule compressa, basi attenuata, superne truncata, griseo-brunescentia, opaca indistincte atro-maculata. — Differt a *C. leptacantha* Rech. f. et Köie habitu foliisque rosularibus rigide subverticillatim pectinatis, involucro basi attenuato, phyllis rigidioribus rigidius spinosis parcissime floccosis, floribus achaeniisque. Affinis quoque *C. Griffithii* Boiss.

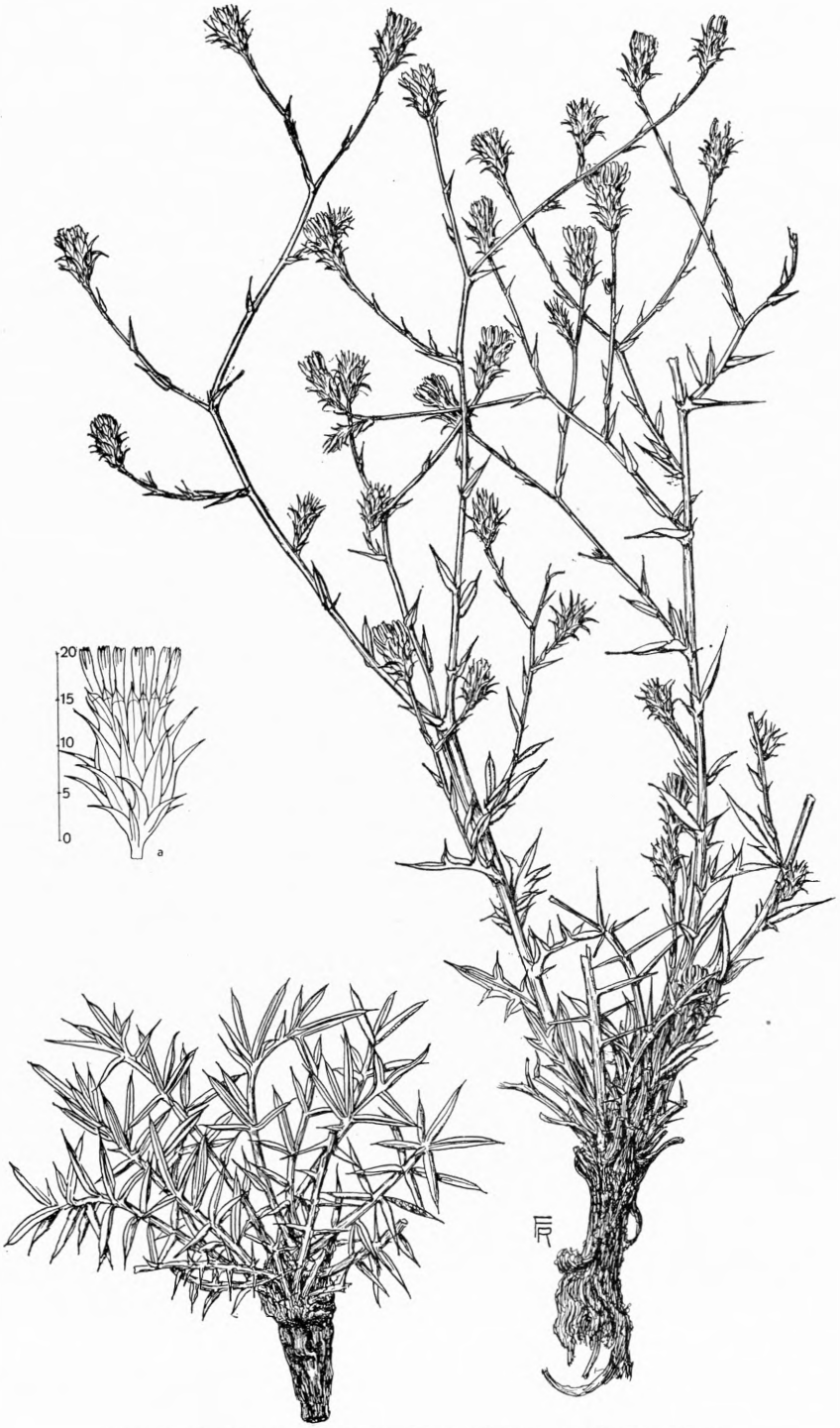


Fig. 70. *Cousinia ghazniensis* (Gilli 2544 – a Köpfchen). $^1/_2$.

E: Hügel nordwestlich Ghasni, 2260 m, Blumenkronblt., Griffel und Narbe weisslich, Staubbeutelröhre rosa, 22.IX.1950 (GILLI 2544, Typus, hb. W.). *Artemisia*-Steppe am Ufer des Stausees Schakewardak nächst dem Hotel, 2130 m (GILLI 2552, hb. W.).

Cousinia (*Inermes*) ***Gillii*** Rech. f., n. sp. — Fig. 71 und 78 D.

Perennis, inermis. Caespites parvos efficiens, basi indurata, pluricaulis. Caules floriferi ad 25 cm alti erecti, in quarta vel quinta parte superiore breviter iteratim corymbose ramosi, internodiis mediis ± 3 cm longis, foliis omnino decurrentibus regulariter alati, alae integerrimae 1—1.5 mm latae. Folia omnia molliter herbacea omnino inermia, supra canescenti-virentia laxius, subtus albida densius appresse araneoso-tomentosa. Folia basalia et caulina infima 6—10 cm longa, lobis inclusis 6—20 mm lata, anguste lanceolata, apicem acutam versus sensim longe attenuata, in petiolum alatum saepe indistinctum longe attenuata, prope basin olbis linearibus patentibus utrinque 1—3 saepe provisa vel lamina infra medium irregulariter inciso-paucilobata rarius omnino ± integra; folia caulina decrescentia imprimis angustiora, linearia, inferne breviter anguste paucilobata, folia caulina summa linearia integerrima. Capitula numerosa ad extremos ramos conglobata breviter pedunculata vel subsessilia. Involucrum ± 7 mm longum, 3—4 mm diametro, basi ± anguste rotundatum non vel indistincte impressum superne paulo attenuatum, omnino araneoso-tomentosum; phylla 4-seriata, apice breviter herbacea crassiuscule subulato-triquetra erecto- vel subsquarroso-patula brevissime spinuloso-mucronulata, omnia intimis rectis tenuioribus exceptis apice subaequalia. Receptaculi setae albidae laeves usque subscabridae. Corolla brevissima, ± 7 mm longa, tubo attenuato vix 2 mm longo, lobis linearibus acutis 1—1.5 mm longis, in sicco pallide flavescenti-carnea. Antherarum tubus glaber, in sicco intense purpureo-violascens. Achaenia nondum matura. — Valde affinis *C. molli* Schrenk, Fisch. et Mey. et praecipue *C. pseudomolli* C. Winkl., differt a posteriore foliis inferioribus plurimis lobatis, capitulis numerosioribus conglobatis, involucro breviore, involucri phyllis abbreviatis, corolla breviore.

E: Berghang südöstlich von Surobi, 1500 m, Korolle, Griffel und Narbe weiss, Staubbeutelrohre violett, 29.V.1951 (GILLI 2559, hb. W.).

Cousinia (*Inermes*) ***glaphyra*** Rech. f. et Köie, n. sp. — Fig. 72 und 78 E.

Perennis caudicibus tenuibus lignescentibus caespitans vel pluricaulis, caules plures tenues deflexos vel ascendentes 5—15 cm longos emittens; internodia media 5—15 mm longa, caulis laxe araneoso-floccosus glabrescens pallide brunescens fuscescens, profunde furcatus vel interdum iam infra medium pauciramosus tunc ramis omnibus longitudinem caulis principalis subaequantibus, rarius caulis simplex vel subsimplex, semper ut rami tota longitudine aequaliter foliatus. Folia omnia herbacea mollia integra, praeter spinulam terminalem tenuissimam vix vulnerantem subinermia interdum prope basin spinula una alterave rudimentaria evoluta, utrinque appresse subtus densius cano-tomentosa non glabrescentia, margine anguste revoluta,

Fig. 71. *Cousinia Gillii* (GILLI 2559). $^{2}/_{3}$.

interdum hypophylla tenuiter membranacea late squamaeformia elevate tenuiter striato-nervosa glabrescentia ad imam basin caulis evoluta. Folia basalia florendi tempore marcescentia verosimiliter breviter vel indistincte petiolata, lamina ad 3 cm

Fig. 72. *Cousinia glaphyra* (K. 2738). $^1/_1$.

longa, 1—3 cm lata, linearis acuta integerrima margine valde revoluta. Folia caulina ab infimis ad media interdum increscentia demum iterum decrescentia, basi indistincte lobulato-dilatata vel subdilatata vel angustata cauli brevissime subdecurrenti-adnata, si basi dilatata ibique interdum subspinuloso-paucidenticulata, 1—3 cm longa, (1—) 2—3 cm lata, cauli fere appressa vel erecto-patentia, in spinulam ter-

minalem basi tenuissimam sensim attenuata, costa mediana tenuis supra tenuiter immersa subtus tenuiter prominente, nervis secundariis non evolutis. Capitula singula terminalia; involucrum campanulato-cylindricum 11—14 mm longum absque spinis in statu compresso 5—9 mm latum, basi breviter rotundatum vel subattenuatum, superne paulo constrictum laxe araneosum demum ± glabrescens; phylla 5—6-seriata, ca. 75—80, basibus appressa regulariter imbricata, sat tenuiter herbaceo-membranacea in spinam (1—) 2—3 (—4) mm longam herbaceam nervo tenuissimo pallido percursam erecto- vel rarius subrecurvo-patulam sensim attenuata; phylla seriei intimae in appendicem breviter exsertam lanceolatam acutam molliter spinulosam tenuiter membranaceam pallide bruneam facie exteriore papillosam margine minutissime interdum indistincte serrulatam sensim attenuata. Receptaculi setae prope apicem subscabridae ceterum tenues laeves. Corolla in sicco quidem albida (an in vivo purpurascens?), ± 1 cm longa, tubo filiformi dimidiam longitudinem partis limbi tantum attingente, laciniae ± 2 mm longae acutae. Antherarum tubus glaber in sicco roseus. Achaenia matura ad 4 mm longa, vix 1.5 mm crassa, basi breviter subrotundato-attenuata, superne rotundato-truncata, leviter tantum compressa, sectione transversali elliptica, costata estriata non marginata, laevia, grisea, transverse atro-lineata. — Differt a *C. Komarovii* (O. Ktze). C. Winkl. statura humillima, foliis minutis vix decurrentibus, indumento densiore molliore, involucri brevioris phyllis magis patulis minus distincte nervatis, floribus brevioribus minus numerosis, achaeniarum costis apice non dentato-marginatis.

C: Panjao, 2800 m, 31.VIII.1948 (Köie 2738, hb. W., C.).

Cousinia (*Nudicaules*) ***gymnoclada*** Rech. f. & Köie, n. sp. — Fig. 73.

Caudex lignescens crassus copiose atro-fibrosus, collo ad 4.5 cm crasso residuis foliorum crassissimis rigidis comoso-incrassato. Caulis juvenilis ca. 40 cm longus erectus, planta adulta certe multo elatior. Folia rosularia non petiolata, ± 20 cm longa, ± 10 cm lata, ambitu obovato-oblonga, in tertia circiter parte anteriore latissima, basin versus cuneato-attenuata, apice rotundata vel abrupte attenuata, ad tertiam circiter partem latitudinis lobata, lobi utrinque usque 10, late triangulares, sese basi partim tegentes, apice in spinam validam pallidam 10—18 mm longam valde vulnerantem abrupte excurrentes, basi utrinque lobulis spiniferis accessoriis 1—2 divergentibus in vivo evidenter sursum et deorsum flexis aucti; lamina supra in statu juvenili laxe subfloccoso-tomentella et glandulis sessilibus nitentibus minutis obsita, demum fere complete glabrata subnitida flavescenti-viridis, subtus persistenter appresse candide tomentosa; costa mediana prope basin ultra 3 mm lata, subtus convexa, supra applanata; nervi secundarii utrinque 8—11, utrinque supra magis prominentes, crebre regulariter reticulato-anastomosantes. Folia caulina numerosa jam infima valde diminuta, lamina absque spinis 3—5 cm longa, 1.5—2.5 cm lata, ambitu obovata usque subspathulata, utrinque spinis 7—11 a basi apicem versus sensim increscentibus terminali ad 2 cm longa provisa. Lamina foliorum caulinorum superiorum valde reducta angusta, folia summa anguste lanceolata,

longe rigide spinoso-pectinata, spinis utrinque 5—8, spina terminali quam laterales usque duplo longiore. Folia ramos fulcrantia lanceolata, inflorescentia itaque subnuda, minutissima brevius spinosa, summa in involucri phylla transientia. Rami inflorescentiae cum axi principali albidi glaberrimi laevissimi, erecti elongati

Fig. 73. *Cousinia gymnoclada* (K. 4045). $^{2}/_{5}$.

saepe ± flexuosi, breviter remote pauciramosi vel capitula pauca lateralia remota subsessilia praeter capitulum terminale proferentes. Involucrum (juvenile) absque spinis ca. 2 cm longum et fere aequilatum, basi profunde impressum, superne valde constrictum; phylla 4—5-seriata basi 3—4 mm lata, late ovata crasse cartilaginea flavo-viridia, margine scabridula dorso subenervia, minute flavide glanduloso-papillosa, apice abrupte in spinam subaequilongam stramineam valde vulnerantem erecto-patentem attenuata. Cetera ignota. — Species eheu valde incomplete nota

valde memorabilis caudice colloque crassissimo, foliis rosulatis late obovatis breviter late lobatis, caulinis numerosis omnibus valde diminutis longissime spinoso-pectinatis, inflorescentia ampla subaphylla, involucri phyllis late ovatis longe spiniferis subenerviis glanduloso-punctatis.

NW: Herat, 1200 m, 5.V.1949 (Köie 4045, hb. W., C.).

Cousinia (*Odontocarpae*) ***Jacea*** Rech. f. & Edelberg, n. sp. — Fig. 74 und 78 F.

Suffrutescens pluricaulis, collo residuis foliorum emarcidorum copiose comoso. Caules floriferi 20—40 cm alti, appresse floccoso-tomentelli demum omnino glabrescentes pallide brunei tenuiter striati, internodiis mediis 2—5 cm longis, in quarta parte superiore corymbose pauciramosi, rarius subsimplices, ramis tenuibus subdivaricatis capitula singula terminalia proferentibus nudis vel foliis perpaucis valde reductis obsitis. Folia basalia et caulina inferiora non vel valde indistincte petiolata; rachis prope basin dilatata applanata utrinque longe spinoso-ciliata, ceterum supra applanata subtus convexa, angustissime (interdum subcuneato-) revolute alata, in spinam terminalem lateralibus saepe sublongiorem et validiorem excurrens; lamina ambitu linearis, 8—12 cm longa, 2—3 cm lata, pinnata, segmentis utrinque 15—25 bifidis subverticillatim dispositis tenuiter aculeiformibus, plerumque 10—15 mm longis, ± 1 mm latis, arcte revolutis, in spinam tenuem 1.5—3 mm longam excurrentibus, supra araneoso-floccosis demum plerumque complete glabratis, subtus persistenter appresse albo-tomentosis. Folia caulina media similia, sensim decrescentia, segmentis minus numerosis terminali magis elongato. Folia ramos fulcrantia paucipinnata, segmento terminali quam lateralia usque duplo longiore; folia ramealia si evoluta pauca, prope basin sublobato-paucidentata vel omnino integra, lanceolata, in involucri phylla quasi transientia. Capitula singula terminalia; involucrum hemisphaericum vel brevissime campanulatum, basi ± rotundato-truncatum usque subumbilicatum, in statu compresso 2—2.5 (—3) cm diametro, ± 2 cm longum, phylla 55—80, ± 5-seriata, glabra, serierum duarum exteriorum late lanceolata, 3—4 mm lata, in spinam vulnerantem sed tenuem 2—3 mm longam subabrupte attenuata, crasse membranacea, pallide flavescenti-viridia, saepe subhorizontaliter patentia; phylla serierum trium interiorum in appendices subaequales ovato-sphathulatas ad 6 mm latas excurrentia, tenuiter membranacea, pallide brunea, margine minute lacerato-denticulata, nervo mediano tenui abrupte in mucronulum molliusculum ad summum 1 mm longum excurrente dilatata, quo modo *Centauream Jaceam* L. aliquantum in mentem revocantia. Corolla roseo-purpurea ± 16 mm longa, laciniis anguste linearibus acutis porrectis ad 4 mm longis. Antherarum tubus roseus glaber breviter exsertus. Receptaculi setae superne subdilatatae indistincte scabridae. Achaenia ignota. — Valde diversa ab omnibus affinibus involucri phyllis serierum trium interiorum in appendices subaequales ovato-spathulatas tenuiter membranaceas pallide bruneas lacerato-denticulatas breviter mucronulato-apiculatas dilatatis, phyllis serierum duarum exteriorum quoque viridibus crasse membranaceis pro sectione latis.

NE: Weran, 3000 m, 21.VII.1948 (Edelberg 1466, hb. W., C.).

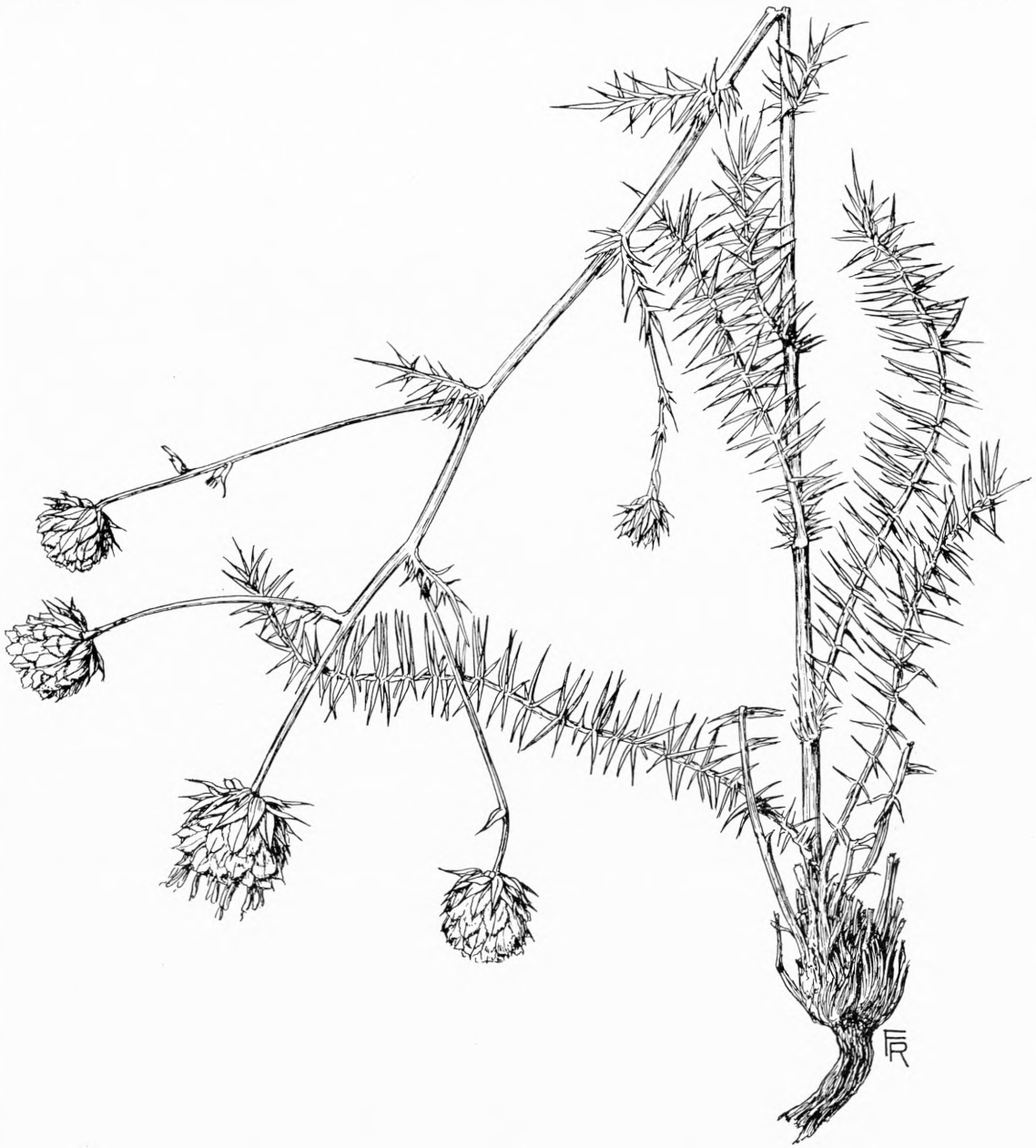


Fig. 74. *Cousinia Jacea* (E. 1466). $^{2}/_{3}$.

Cousinia (*Homalochaetae*) ***khashensis*** Rech. f., n. sp. — Fig. 75 und 78 G.

Perennis. Caulis verosimiliter erectus, in speciminibus nostris mutilatus; caulis secundarius 18—22 cm altus, in tertia parte superiore breviter corymboso-ramosus vel furcatus, paucifoliatus, appresse albo-araneoso-floccosus inferne glabrescens.

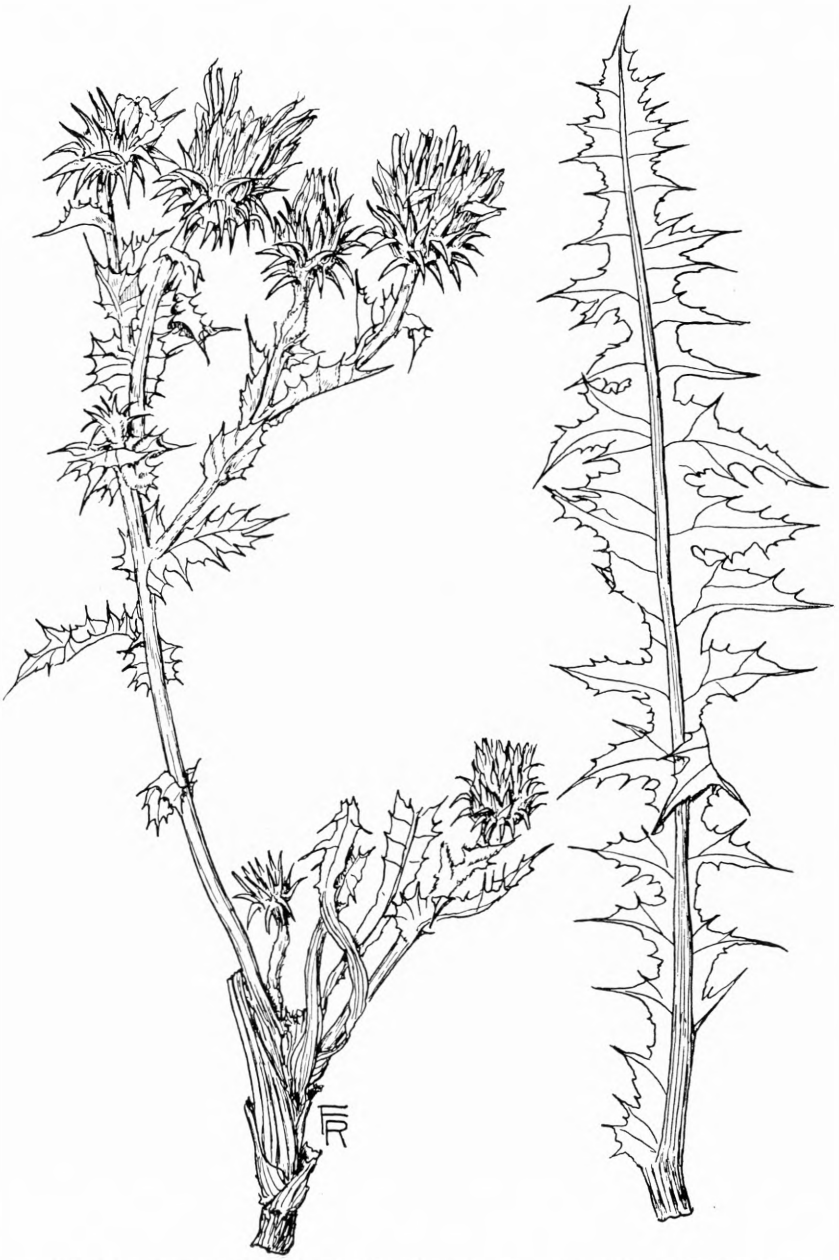


Fig. 75. *Cousinia khashensis* (Kz. 12990 — b unteres Stengelblatt). $^4/_5$.

Folia basalia ignota; caulina inferiora ad 18 cm longa, spinis inclusis ad 4.5 cm lata, pinnatolobata, lobi usque 12-jugi sinibus rotundatis separati rectangulariter divergentes vel paulum recurvi, (1—) 1.5—2 (—3) cm longi, acuti, apice in spinam tenuem stramineam vulnerantem ± 3 mm longam abeuntes, lateraliter in foliis bene evolutis lobis pluribus spiniferis provisi, itaque bipinnati in foliis ceteris tantum spinoso-dentati; lamina consistentia in sicco coriaceo-membranacea, supra laxe appresse araneosa pallide viridis, subtus densius appresse arachnoideo-tomentosa albida; nervi subtus prominentes calvescentes. Folia caulina media et superiora et ramealia valde diminuta, basi cordata non vel vix decurrente sessilia, ambitu ovata, remote spinosa, non vel prope basin indistincte tantum lobata. Capitula singula terminalia. Involucrum sine spinis (1.5—) 2—2.5 cm diametro, depresso-semiglobosum basi umbonatum, superne constrictum, ochraceo-araneosum parum vel paulo glabrescens; phylla ± 6-seriata, ± 60, consistentia crasse rigide coriacea, e basi dilatata valde appressa in mucronem triquetrum nervo prominente percursum sat abrupte attenuata, in spinam vulnerantem excurrentia, intima deflexa, media patentia, interna erecta, atroviridi-olivacea, apicem versus glabrescentia, intima molliora exserta ad 4 mm lata sordide albo- vix roseo-suffusa. Receptaculi setae scabridae. Corolla viva rosea (e collectore), sicca expallens, ± 15 mm longa, tubo ca. 6 mm longo sensim ampliato, laciniis linearibus ± 3 mm longis. Antherarum tubus pallidus glaber. Achaenia ± 4.5 mm longa, compressa, basi subito rotundato-attenuata, superne rotundato-truncata, atrata, indistincte minute pallidius maculata, indistincte longitudinaliter striata. — Differt a *C. kuramensi* Bornm. foliis inferioribus distincte bipinnatis, superioribus proportione brevioribus, vix vel brevissime tantum decurrentibus, caule superne corymboso-pleiocephalo, capitulis minoribus, involucri lana ochracea nec candida, phyllis brevioribus angustioribus, exterioribus et mediis magis recurvis. — Differt a *C. rava* C. Winkl. (typo in Hb. C. comparato) notis similibus et involucri phyllis minus numerosis.

NE: Khash Distr., 10000 ft., fl. rose, 9.VIII.1937 (Koelz 12990, hb. W., BPI.).

Cousinia (*Odontocarpae*) ***Mogensii*** Rech. f., n. sp. — Fig. 76 und 78 H.

Dense caespitosa basi lignescens multicaulis, collo residuis foliorum annorum praecedentium dense comoso. Caules humiles (fragmentarii tantum obvii) 15 (—20?) cm alti, internodiis 1—2 cm longis, subsimplices vel subramosi (capitulo axillari non complete evoluto) an interdum tenuiter pauciramosi, tota longitudine foliati, foliis summis autem interdum valde reductis. Folia basalia et caulina inferiora non vel valde indistincte petiolata, rachide prope basin applanato-dilatata utrinque copiose spinuloso-ciliata; lamina 5—7 cm longa, 1—1.5 cm lata, ambitu lanceolato-linearis, pinnata, segmentis utrinque 12—15, complete bifidis, subverticillatim dispositis 3—8 mm longis tenuiter aculeiformibus, inter se 3—5 mm remotis, in spinam terminalem tenuissimam ± 1 mm longam excurrentibus, omnino arcte revolutis supra floccoso-tomentellis canescenti-viridibus, subtus appresse albido-tomentosis; rachis tenuis persistenter albido-floccoso-tomentella vix glabrescens, tota longitudine an-

Fig. 76. *Cousinia Mogensii* (K. 3327). $^1/_1$.

gustissime revolute alata, subtus leviter convexa, supra applanata. Folia caulina sensim paulo decrescentia, inferioribus omnino similia, segmentis minus numerosis partim quidem longioribus latioribus minus arcte revolutis utrinque magis virentibus; folia summa in speciminibus nonnullis paucilobata vel subsimplicia valde reducta anguste lanceolata glabrata, in involucri phylla quasi transientia. Capitula singula terminalia, involucrum depresso-semiglobosum basi umbilicato-impressum, in statu leviter compresso 1.5—2 cm diametro, 1.5 cm longum, omnino pallide flavescenti-viride; phylla 3—4-seriata, 50—60, pallide flavido-viridia margine minutissime (exteriora interdum minus distincte) cartilagineo-serrulata, prope basin 2—2.5 mm lata, exteriora saepe vix dimidiam longitudinem interiorum attingentia, patula, lanceolata acuta vel in spinulam vix distinctam attenuata; phylla intermedia sensim elongata, nervo in parte superiore phylli distinctiore percursa in spinulam sublongiorem excurrentia erecto-patula; phylla intima in parte inferiore ut cetera viridia rigidula, in parte superiore tenuiter membranacea brunea sensim lanceolato-attenuata non pungentia, margine distinctius ciliolata, facie exteriore imprimis apicem versus minute glanduloso-papillosa. Corolla roseo-purpurea, in sicco expallens, ± 12 mm longa, laciniis linearibus acutis ± 2.5 mm longis porrectis. Antherarum tubus pallide roseus glaber paulum exsertus. Receptaculi setae pallidae, scabridae. Achaenia (nondum matura) ± 5 mm longa, ± 1.5 mm lata, sublinearia, basin versus paulo tantum attenuata, indistincte alata, apice breviter rotundato-truncata vix dentata, brunescentia, indistincte longitudinaliter striata. — Inter affines habitu dense caespitoso, foliis ambitu angustis brevibus tenuiter conferte pinnatis, caulibus floriferis humilibus, involucro praeter papillos phyllorum intimorum glabro, phyllis pauciseriatis angustis breviter spinulosis, intimis apice anguste acute membranaceo-appendiculatis insignis.

C: Band-e-Amir, 2800 m, 20.VIII.194 (Köie 3327, hb. W., C.).

Cousinia (*Odontocarpae*) ***Koelzii*** Rech. f., n. sp. — Fig. 77 und 78 I.

Perennis, ima basi lignescens, collo fibroso, pluricaulis. Caulis ca. 50 cm altus, erectus, teres, tenuissime sulcato-striatus appresse araneoso-floccosus ± glabrescens, internodiis mediis ± 5 cm longis, in quarta vel quinta parte superiore breviter iteratim corymbose ramosus ramis strictis erecto-patentibus. Folia basalia rosulata numerosa, petiolo plerumque distincto usque 3 cm longo, lamina ad 10 cm longa, ad 2.5 cm lata, ambitu anguste lanceolata, pinnata, rachis ± 1.5 mm crassa, appresse floccoso-tomentella, tota longitudine angustissime herbaceo-alata, pinnae saepe plus quam 20-jugae, 3—6 mm inter se remotae, ad 15 mm longae, ± 1 mm latae, rectangulariter patentes, basales et apicales sensim breviores, plurimae basi pinnulis plerumque brevioribus liberis sed aequilatis subverticillatim dispositis auctae, supra virides, subtus persistenter appresse albo-tomentosae, margine arcte revolutae, nervus medianus tenuis pallidus sensim in spinulam tenuem vix pungentem ad 2 mm longam excurrens. Folia caulina inferiora similia sensim breviora, pinnis magis confertis ± 10-jugis quam in foliis basalibus non magis approximatis. Folia caulina superiora ambitu latiora, pinnis ± 5-jugis antrorsis cum rachide margine

Fig. 77. *Cousinia Koelzii* (Kz. 12377). $^{2}/_{3}$.

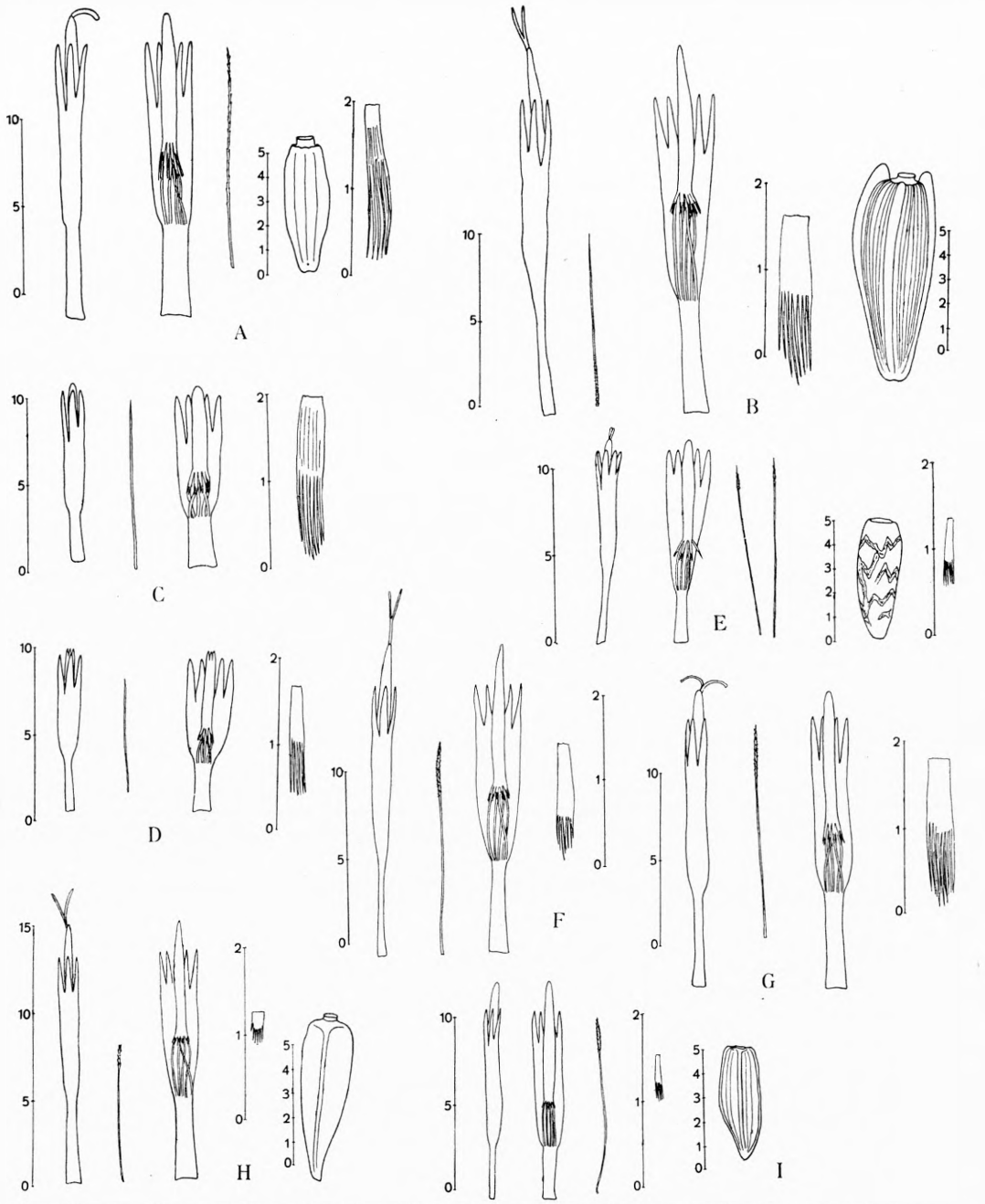


Fig. 78. Korolle geschlossen, Korolle geöffnet, Spreuschuppe, Antherenanhängsel und Achäne von: A *Cousinia elasoonensis*, B *C. eurylepis*, C *C. ghazniensis*, D *C. Gillii*, E *C. glaphyra*, F *C. Jacea*, G *C. khashensis*, H *C. Mogensii*, I *C. Koelzii*.

minus arcte revolutis, segmento terminali elongato longius spinifero. Folia ramealia subsimplicia vel basi spinulis approximatis minutis aucta, summa in involucri phylla quasi transientia. Capitula singula terminalia; involucrum absque spinis 10—12 mm longum et latum, basi late truncato-rotundatum usque leviter impressum, superne leviter constrictum, araneoso-floccosum demum glabrescens; phylla ± 5-seriata, ca. 80—90, omnia anguste lineari-subulata tenuissime spinescentia, erecta usque subhorizontaliter patula, nervo pallido tenui subtus prominente percursa, margine scabridula; phylla media similia, intima in appendicem breviter exsertam acutam lanceolatam brunescentem dense papillosam opacam flexibilem non spinescentem abeuntia. Receptaculi setae scabrae. Corolla roseo-purpurea (e collectore), ± 12 mm longa, laciniis linearibus acutis ca. 2 mm longis. Antherarum tubus purpurascens glaber. Achaenia (immatura) ± 3 mm longa, basi subito breviter attenuata, compressa, apice truncata, breviter irregulariter saepe indistincte paucidentata, non distincte marginata, indistincte longitudinaliter paucistriata. — Inter affines foliis basalibus ± distincte petiolatis, inflorescentia breviter stricte corymbose ramosa, involucro minuto phyllis numerosissimis angustissimis insignis.

NE: Painshahr, 2250 m, fl. rose purple, 15.VII.1937 (Koelz 12377, bh. W., BPI.).

Cousinia (*Lamprocarpae*) ***kotandarica*** Rech. f. et Gilli, n. sp. — Fig. 79 und 85 A.

Planta humilis vix 20 cm alta; caulis validus ad 3 mm crassus, ascendens, internodiis mediis 4—6 cm longis, a basi fere in ramos paucos foliatos monocephalos divisus, appresse canescenter arachnoideo-tomentosus. Folia basalia ignota. Folia caulina inferiora spinis exclusis 14 cm longa, ± 3 cm lata, basi profunde cordata et distincte (1 cm) late decurrentia, ambitu oblongo-linearia, consistentia crasse membranacea subcoriacea, utrinque appresse subtus densius canescente arachnoideo-tomentosa; nervi validi flavescentes angulo recto a costa mediana abeuntes, utrinque subtus magis prominentes, in spinas validas utrinque usque 8, 1—2 cm longas excurrentes; sinus inter dentes denticulis tenuioribus armati; folia caulina superiora sensim breviora, basi longius (ad 3 cm) et latius (ad 1.5 cm) decurrentia. Involucrum spinis exclusis globoso-campanulatum ca. 2.5 cm longum et latum, basi ± impressum, superne constrictum, dense canescenter arachnoideum; phylla ± 60, e basi sensim in spinam ad 2 cm longam triquetram, supra applanatam glabrescentem prope basin ad 2 mm latam in phyllis externis reflexam in ceteris patentem attenuata; phylla intima quoque rigidula inferne purpurea apice lanceolato-subspinosa brunescentia non dilatata non prominentia. Corolla purpurea 20—22 mm longa, tubo attenuato 10—11 mm longo, laciniis ± 2 mm longis. Receptaculi setae albidae scabridae. Achaenia (submatura) 4 mm longa, 1.5 mm lata, basin versus sensim attenuata, apice truncata non denticulata, tenuiter longitudinaliter striata, brunescentia quasi argenteo-suffusa, interdum indistincte transversaliter subrugosa. — Affinis videtur *C. auriculatae* Boiss. (isotypo in Hb. W. comparato), a qua differt: statura humili sed valida, foliorum spinis longioribus validioribus, foliis superioribus

longius latiusque decurrentibus, involucro maiore, involucri densius araneosi phyllis in spinam longiorem sensim (nec abrupte) attenuatis, phyllis intimis quoque rigidis subspinosis apice non dilatatis.

E: Paghman-Gebirge östlich von Kotal-i-Kotandar, 3980 m, vereinzelt unter

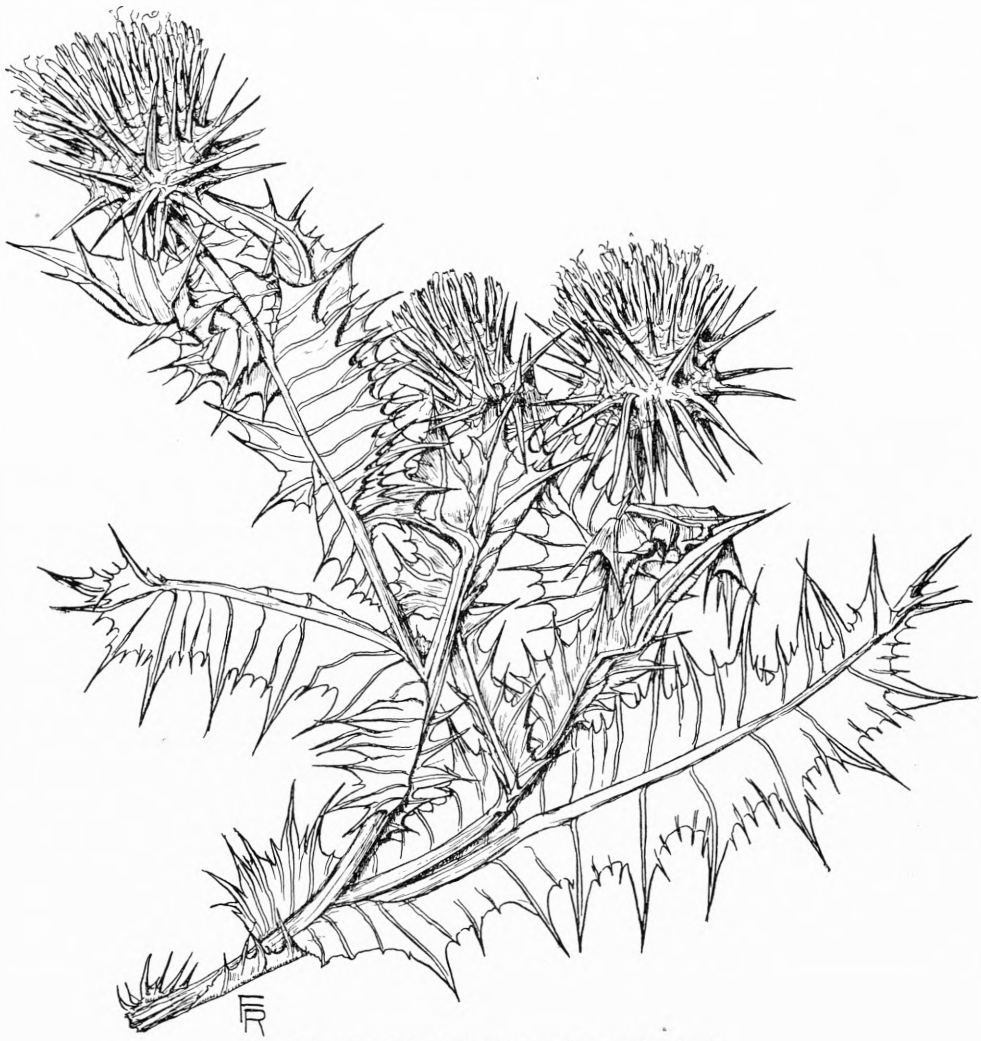


Fig. 79. *Cousinia kotandarica* (Gilli 2547). $^2/_3$.

Cousinia polyneura nahe der Kammhohe. Bildet auf der Westseite des Passes zwischen 4000 und 4200 m die herrschende Pflanze. Blumenkrone, Staubgefässe und Narbe violett, 10.IX.1949 (Gilli 2547, hb. W.).

Cousinia (*Lamprocarpae*) ***lachnobasis*** Rech. f. et Köie, n. sp. — Fig. 80 und 85 B.

Perennis, collo crebre longe gossypino-lanato, pluricaulis. Caules arcuato-

ascendentes vel erecti, 15—25 cm longi, sat validi, a basi in ramos plures partim elongatos iterum ramosos foliosos capitula singula ferentes divisi, ut tota planta persistenter canescente appresse floccoso-tomentosi. Folia omnia consistentia in sicco crasse membranacea nec coriacea; folia basalia non petiolata, 8—15 cm longa, 1.5—3 cm lata, oblongo-linearia, basin versus sensim longe, apicem acutam versus plerumque brevius attenuata, irregulariter leviter latiuscule vix lobate dentata, dentibus in spinas tenues flavescentes 1.5—4 mm longas abeuntibus; costa mediana lata supra applanata; nervatura pennato-reticulata, utrinque tenuiter subtus magis prominens; indumentum appresse tomentosum utrinque persistens, supra laxius canescens, subtus densius albidum. Folia caulina sensim breviora proportione latiora, basi dilatata profunde cordata sessilia non (vel brevissime indistincte) decurrentia, ambitu ovato-oblonga usque ovato-triangulari, quam basalia densius tomentosa, distinctius sublobato-dentata et validius spinosa; spina terminalis saepe elongata. Involucrum ad 2 cm longum et latum, basi leviter impressum superne constrictum, densiuscule persistenter canescente araneoso-floccosum; receptaculi setae albae scabrae; phylla ± 50, rigida virescentia, e basi indurata parum dilatata in spinas basi ± 2 mm latas rigidas vulnerantes supra elevate uni- usque subtrinervias sensim attenuata; spinae phyllorum exteriorum tenuiores breviores ± reflexae, phyllorum intermediorum involucri diametro longiores horride patentes, internae erectae; phylla intima molliuscula membranacea anguste lineari-lanceolata sensim longe attenuata pallida ciliolata exserta. Corolla in sicco quidem pallide carnea ± 16 mm longa, tubus attenuatus ± 7 mm longus, laciniae 2.5—3 mm longae. Antherarum tubus concolor. Achaenia submatura ± 4 mm longa, ± 2 mm lata, compresse obpyramidata, basin versus ± attenuata, superne truncata subdenticulata, longitudinaliter elevate paucistriata et valde indistincte elevate subvenuloso-rugulosa, atrobrunescentia indistincte nigro-maculata. — Inter affines radice verosimiliter perenni, collo lanato, indumento omnino persistente, foliis basalibus non petiolatis oblongo-linearibus vix lobatis tenuibus longiuscule spinosis, involucri phyllis e basi vix dilatata longissime tenuiter spiniferis, achaeniis maiusculis atris insignis, quibus characteribus imprimis a *C. buphthalmoide* Rgl. et Schmalh. eiusque affinibus bene distincta.

SW: Jija, 900 m, 9.V.1949 (Köie 3889, Typus, hb. W., C.). Ibidem 800 m, 10.IV.1949 (K. 4041, hb. W., C.).

C. (*Heteracanthae*) *lachnosphaera* Bge. — **NW:** Obeh, 1700 m (K. 3642). Nördlich Herat, 940 m, *Artemisia*-Steppe (Gilli 2518). — **SW:** Herat (K. s. n.).

Von Köie liegt nur eine Blattrosette und ein vorjähriger Blütenstand vor. Bestimmung daher nicht ganz sicher. Köpfe etwas kleiner als bei meinen Belegen aus Khorosan. Hüllschuppen mehr zurückgebogen. Die Pflanzen aus Herat von Gilli und Köie weichen von meinen Khorasaner Exemplaren der *C. lachnosphaera* durch etwas breitere, starrere und mehr grüne Hüllschuppen und gelbliches Indument der Hülle ab.

Cousinia (*Foliaceae*) ***lamprophyllaria*** Rech. f., n. sp. — Fig. 81 und 85 C.

Perennis pluricaulis (caules duo secundarii 30—40 cm longi tantum adsunt,

Fig. 80. *Cousinia lachnobasis* (K. 3889). $^{2}/_{3}$.

caulis primarius verosimiliter multo elatior, 75 cm e coll.). Folia basalia et caulina infima petiolo brevi crassiusculo laminae latitudinem vix aequante suffulta; lamina ad 20 cm longa, spinis inclusis ad 5 cm lata, ambitu late lanceolata, infra medium latissima, consistentia in sicco crasse coriacea, supra flavescenti-viridis, araneosa et flavide glandulosa, glabrescens, subtus pallidior persistenter laxe araneosa et glandulis flavis aspersa, nervis pallidis crassis utrinque prominentibus percursa, nervi secundarii in spinas validas stramineas vulnerantes ad 15 mm longos lobos laminae terminantes excurrentes; lobi trilobi, lobus medianus anguste triangularis elongatus, laterales spinis paulo brevioribus patulis arcuati. Folia caulina in caulibus secundariis pauca subito valde decrescentia, breviter lanceolata basi spinoso-dilatata sessilia, spina ad 20 cm longa terminata, lamina valde reducta lobis lateralibus minutis triangulari-elongatis valde spinigeris. Capitula in ramis saepe 2—3-na approximata, terminale sessile, lateralia breviter pedunculata, foliis nonnullis valde reductis suffulta, spinis inclusis 3—4 cm diametro. Involucrum breviter cylindraceo-hemisphaericum 2.5—3 cm longum, basi impressum, araneosum; phylla valde numerosa ± 80, ± 6-seriata, exteriora et media e basi late breviter lanceolata crasse rigide herbaceo-coriacea subito in spinam stramineam vulnerantem 1 cm longam patentem attenuata, costa valida mediana prominente percursa; phylla serierum interiorum trium tenuiter membranacea candida nitentia flexibilia inermia glabra, flores primum superantia demum subaequantia. Flosculi albi (e collectore), 18—20 mm longi, glandulosi, laciniis 3 mm longis. Antherarum tubus roseo-purpureus. Achaenia 6 mm longa, superne 2.5 mm lata, valde compressa, basin versus paulo attenuata, basi rotundata apice truncata, pallide brunneo-cinerascentia, indistincte alato-marginata, indisticte longitudinaliter striata. Receptaculum copiose setosum, setae sublaeves nitentes. — Affinis videtur *C. scariosae* Reg., a qua differt foliis angustioribus longius spinosis, capitulis minoribus, involucri phyllis angustioribus persistenter araneosis multo mollioribus.

NW: Safedsang, 3350 m, dry slope, $2^1/_2$ ft. high, flowers white with rose-purple anthers, 24.IX.1939 (Koelz 14002, hb. BPI.).

C. (*Lasiandrae*) *lasiandra* Bge. — **SW:** Jija, 900 m (K. 3888).

Cousinia (*Nudicaules*) ***leptacantha*** Rech. f. & Köie, n. sp. — Fig. 82 und 85 D.

Perennis. Caulis 60 cm altus stricte erectus tenuiter striatus, in dimidio superiore iteratim corymbose ramosus, primum imprimis inferne laxe araneosus, superne autumno fere omnino glabrescens, internodiis inferioribus et mediis valde abbreviatis ± 1.5 cm longis crebre foliatus, foliis decurrentibus spinoso-alatus. Folia basalia ignota; caulina inferiora ad 5 cm longa, ad 3 cm lata, basi dilatata alato-decurrentia, lamina pectinatim pinnatifida fere omnino ad rachidem et ad nervos laterales in spinas tenues rectangulariter patentes ad 15 mm longas reducta, alae decurrentes similiter spinosae; folia supra appresse araneoso-tomentosa canescentia, demum interdum glabrescentia, subtus tomento candido intertexto appressissimo persistente. Folia caulina media et superiora similia sed lamina melius evoluta, basis

Fig. 81. *Cousinia lamprophyllaria* (Kz. 14002). $^1/_2$.

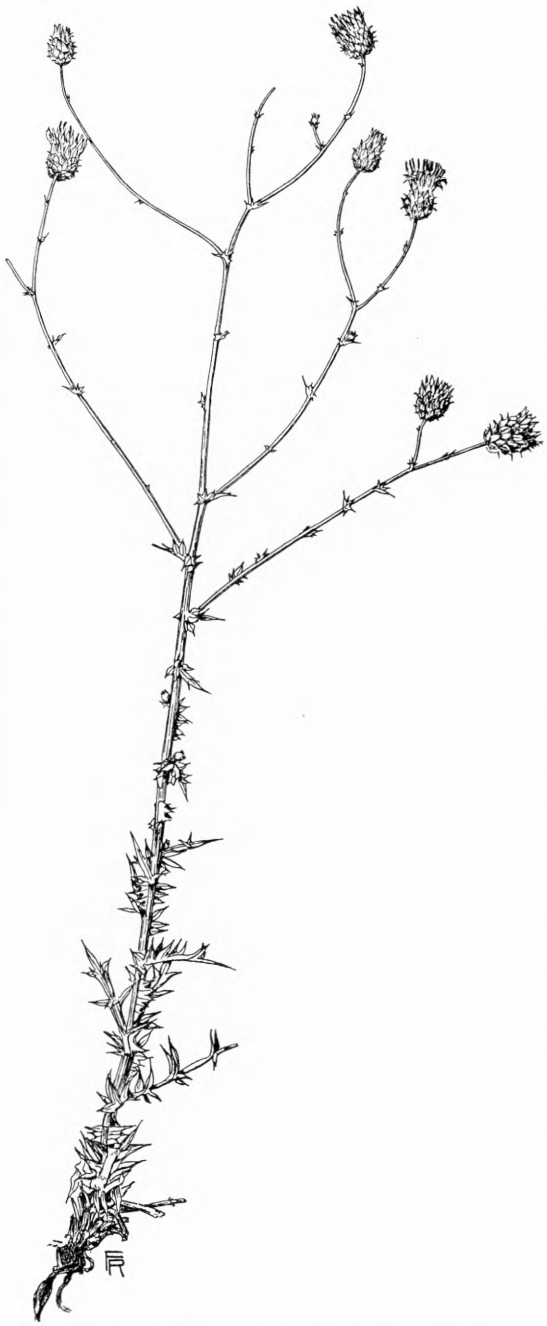


Fig. 82. *Cousinia leptacantha* (K. 2764). $^{2}/_{5}$.

latius auriculato-dilatata, rachis et segmenta parenchymate quasi cuneato-alata; folia caulina summa et ramealia subito valde decrescentia, breviter vel non decurrentia, segmento terminali in spinam longiusculam, lateralibus prope basin folii approximatis in spinas breviores transformatis. Capitula ad extremos ramulos tenues nudos singula terminalia, 8—12 mm longa, 7—10 mm (spinis exclusis) diametro, breviter campanulata, basi rotundato-truncata leviter umbilicato-impressa, superne paulo constricta. Involucri phylla in seriebus 5—6 arcte imbricata araneosa demum glabrescentia, maturitate coriacea brunea, marginibus et imprimis interna prope apicem in lamina quoque scabridula, basi late lanceolata appressa subito in appendicem 2—5 mm longam tenuiter spiniformem falcato-recurvam contracta, series interna quoque appendice breviter molliter recte spinuligera dilatata membranacea provisa. Flores purpurei 10 mm longi, laciniis brevissimis 1—1.5 mm tantum longis. Antherarum tubus laete purpureo-viridis. Receptaculi setae laeves nitentes. Achaenia 2—2.5 mm longa, ± saepe subtriquetro-compressa, basi attenuata, apice truncata, pallide grisea, irregulariter tenuiter striata usque interdum subalata. — Affinis *C. Griffithianae* C. Winkl., differt involucris polyphyllis multo latioribus, basi ± umbilicatis, foliis inferioribus quidem decurrentibus, eorum laciniis brevioribus.

C: Qala Sakawa, 2500 m, 3.VIII. 1948 (Köie 2764, Typus, und 3319, hb. W., C). Hochfläche ober den Seen von Band-e-Amir, 2950 m (Gilli 2539, differt a typo foliis breviter tantum decurrentibus). — **NW:** Burchao Pass, 3000 m, dry slope, 2 ft. high (Kz. 14114).

Cousinia (*Lampocarpae*) ***malurensis*** Rech. f., n. sp. — Fig. 83 und 85 E.

Verosimiliter perennis. Caulis ad 60 cm altus (e collectore) fragmentarie tantum obvius, in tertia vel quarta parte superiore breviter corymbose ramosus, internodiis mediis ± 4 cm longis, tenuissime striatus, appresse albo-araneoso-floccosus ± glabrescens. Folia basalia et caulina inferiora probabiliter similia petiolo crassiusculo 4 cm longo suffulta; lamina 12—15 cm longa, 4—5 cm lata, ambitu late lanceolata, consistentia in sicco crasse coriacea, ad dimidiam circiter latitudinem conferte pinnatolobata, lobis utrinque 7—10 rectangulariter divergentibus sed leviter deorsum curvatis triangularibus in spinam usque 4 mm longam abeuntibus basi crispatis in statu compresso sese tegentibus lobulis utrinque breviter spinigeris utrinque plerumque duobus aucti; nervatura utrinque subtus crassius prominens; indumentum utrinque subtus paulo densius appressissime tomentosum; lamina supra albidovirescens, subtus alba. Folia caulina perpauca tantum valde fragmentaria adsunt, non decurrentia basi attenuato-subcordata sessilia, spinoso-paucilobata ± crispata, spinis brevibus 1—3 mm tantum longis; folia ramealia summa valde diminuta ovato-lanceolata subintegra apice breviter mucronulata dense albo-tomentosa concoloria. Capitula singula terminalia; involucrum 15—18 mm longum, diametro absque spinis 8—13 mm breviter campanulatum basi rotundatum persistenter laxiuscule usque subdense araneosum, phylla plerumque 5-seriata, ca. 50—60, exteriora e basi late vel anguste lanceolata

Fig. 83. *Cousinia malurensis* (Kz. 14088). $^1/_2$.

appressa sensim usque fere abrupte in spinam tenuem attenuata; spina in phyllis extimis et mediis patula, in extimis 1—5 mm tantum longa, in mediis longissima 11—17 mm longa subhorizontaliter patens, in intimis brevis 2—5 mm longa erecto-patula usque porrecta; phylla intima in appendicem molliusculam tenuiter membranaceam lanceolatam tenuiter apiculato-spinulosam rectam vel leviter extrorsam pallide bruneam facie papillosam margine minutissime serrulatam protracta. Receptaculi setae albidae laeves. Corolla (sordide vel pallide? "old-red" e collectore) rosea, ± 15 mm longa, tubo tenui dimidiam longitudinem limbi attingente; laciniae 2—3 mm longae. Antherarum tubus glaber roseus, in sicco expallens. Achaenia (verosimiliter non complete matura) ad 5 mm longa, ad 1.5 mm lata, basin versus attenuata, apice anguste rotundata edentata brunea concoloria, praeter strias longitudinales laevia. — Caulibus tenuibus elatis floccoso-tomentosis demum glabrescentibus, inflorescentia laxe corymbose ramosa, foliis inferioribus conferte crispate spinoso-lobatis, nervis secundariis rectangulariter abeuntibus demum saepe recurvis, indumento appressissimo concolori, foliis ramealibus valde reductis, involucri phyllorum mediorum spinis tenuibus patentibus involucri diametro longioribus, achaeniis longis angustis insignis.

NW: Malur Pass, 3350 m, dry ground, pl. 2 ft. high, fl. old-rose, 4.IX.1939 (Koelz 14088, hb. W., BPI.).

C. (*Lampocarpae*) *microcarpa* Boiss. — **NW:** Sauzak, 2000 m (K. 2219). Ardewan, 1500 m (K. 2259). Kishlik, 700 m (K. 3958). — **C:** Deh Kundi, 2700 m (E. 1893, 1926). — **NE:** Faizabad, 1100—1900 m (E. 1606). Khash district, 9000 ft., dry ground, fl. deep rose-purple (Kz. 12924, hb. W., BPI.). — **E:** Nozi, El. 9000 ft., dry ground, fl. white, anthers tipped purple (Kz. 12036). Nozi, El. 9000 ft., dry ground, fl. rose (Kz. 12044).

C. (*Constrictae*) *minuta* Boiss. — **SW:** Herat, 1000 m (K. 3949). Jija — Herat, 1500 m (K. 3856). — **NE:** Ruka, 1800 m (K. 2926). — **E:** Begram near Charikar, 5000 ft. (Codrington 2, 22, 23). Kabul, Pandscheschah (N. 50/902). Kabul, Scher Darwasah, 1800 m (Gilli 2526). Kulali, in desert (Kz. 11386). — **SE:** Pirzada, 900 m (K. 2028). Steppe nördlich von Kandahar, 1070 m (Gilli 2525).

Cousinia (*Drepanophorae*) ***modesta*** Rech. f. et Köie, n. sp. — Fig. 84 und 85 F.

Biennis vel perennis? Radix fusiformis verticalis, a collo non squamoso multicaulis. Caules humiles, 7—15 cm longi, a medio vel paulo infra vel supra furcati vel ± divaricato-pauciramosi, arcuato-ascendentes vel suberecti, tenues, internodiis 1.5—2 cm longis, teretes, pallide brunescentes, laxe subappresse floccoso-lanati parum glabrescentes, tota longitudine foliati, non alati. Folia basalia florendi tempore jam marcescentia petiolo longiusculo (2—2.5 cm) suffulta; lamina lanceolata, 2—3 cm longa, ± 5 mm lata, margine ± revoluta, in medio vel supra latissima, integra vel remote paucilobato-serrata, interdum autem lamina interrupte anguste pinnata rachide anguste alata lobulato-spinulifera, segmentis horizontaliter patentibus, anguste

linearibus revolutis mucronulatis, in vivo molliter herbacea, omnino inermis, apice et lobulis tantum breviter cartilagineo-mucronulatis, utrinque subtus densius appresse floccoso-lanata, supra canescenti-viridis, subtus albida, costa mediana distincta subtus prominente supra immersa, nervis ceteris evanescentibus. Folia caulina gradatim paulo decrescentia, consistentia et nervatura ut folia basalia, basi lobulato- vel subhastato-cordata vel in foliis superioribus truncata vel attenuata sessilia, lan-

Fig. 84. *Cousinia modesta* (K. 2524). $^1/_2$.

ceolata vel oblongo-attenuata, integra vel paucilobata, minute cartilagineo-mucronulata. Capitula in ramis tenuibus brevibus vel elongatis singula terminalia; involucrum 10—15 mm longum, absque spinis 8—12 mm diametro, breviter campanulatum, basi rotundato- vel truncato-umbilicatum, superne evidenter constrictum, araneoso-floccosum; phylla ± 5-seriata, ca. 50—60, exteriora recurvo-patula, media erecto-patula, intima porrecta, tenuia, 0.5 (—1) mm lata, viridia, in spinulam glabratam vix vulnerantem sensim attenuata, nervo tenui pallido subtus prominente percursa; phylla intima in appendicem angustam lanceolatam molliter spinulosam scariosam pallidam glabram inferne purpurascentem attenuata, quam flores breviora vel eos subaequantia. Receptaculi setae glabrae albidae. Corolla ± 9 (—11) mm longa, glabra, in vivo verosimiliter flava, in sicco purpurascens, tubo attenuato tertiam partem corollae longitudinis circiter aequante; laciniae 2 mm longae. Antherarum tubus purpureus glaber. Achaenia juvenilia ca. 3 mm longa, basin versus attenuata, compressa, apice truncata edentata, brunea, indistincte longitudinaliter striata. —

Differt a *C. Olgae* Reg. et Schmalh. involucris angustioribus, involucri phyllis minus numerosis brevioribus, indumento magis appresso, foliis caulinis superioribus mollioribus magis patulis brevissime tantum mucronulatis, corollis purpureis nec aureis, achaeniis verosimiliter minoribus; foliis quoque *C. apterae* Aitch. et Hemsl. similis, ab ea autem characteribus supra dictis involucri et florum diversa.

C: Farakulum, 2700 m, 18.VII.1948 (Köie 2524, Typus, W., C.). Bamian, 2650 m (Gilli 2537). Daulat Yar, 2400 m (K. 2769, hb. W., C.). — **E:** Arbarp, 11 miles W. of Kabul, 7000 ft., (Chaworth-Musters s. n.). Kabul (Honigberger s. n., hb. W., sub *C. Olgae* Reg. et Schmalh., det. Bornmüller). Kabul, bei Gulbagh, 1850 m (Gilli 2536). Paghmangebirge, 2170 m (Gilli 2535). Begram near Charikar (Codrington s. n., hb. BM.). Charikar, 6000 ft., dry ground, fl. yellow, becoming rose-purple (Kz. 11815, hb. W., BPI.). Ghazni, 2400 m (K. 3316, hb. W., C.).

Diese Art ist offenbar mit *C. Olgae* Reg. und *C. aptera* Aitch. et Hemsl. nah verwandt. Ob die hier durchgeführte spezifische Trennung gerechtfertigt ist, wird sich erst feststellen lassen, wenn die Variationsbreite und geographische Verbreitung aller drei Arten genauer bekannt ist. Nach den bisher vorliegenden Exemplaren ist *C. modesta* in fast allen Teilen ziemlich variabel.

C. Olgae Reg. et Schmalh. und *C. aptera* Aitch. et Hemsl. werden von ihren Autoren in verschiedene Sektionen gestellt, nämlich *C. Olgae* zu den *Drepanophorae*, *C. aptera* zu den *Squarrosae*. Diese Einteilung ist vollkommen unhaltbar. Tatsächlich sind die beiden Arten miteinander sowie mit *C. modesta* so nah verwandt, dass sie vielleicht sogar richtiger nur als Rassen einer Art aufzufassen wären.

Cousinia (*Odontocarpae*) *multiloba* DC. s. l.
(Typus: — Aucher-Eloy 3492, non vidi).

Schon aus Bornmüllers Bemerkung in Oesterr. Bot. Zeitschr. **62**:392 (1912) kann man auf mangelnde Korrelation der Hüllen- und Behaarungsmerkmale dieser ausserordentlich variablen Art schliessen. Meine Naturbeobachtungen im Jahre 1948, besonders im Shahvar-Gebirge bei Shahrud, haben dies bestätigt.

Aus Afghanistan sind zwar mehrere nah verwandte Arten beschrieben worden, *C. multiloba* selbst ist jedoch bisher nur in der var. *Afghanorum* Bornm. Beih. Bot. Centrbl. **34**/2:281 (1917) angegeben. Bornmüller nennt keinen Fundort. Auf dem mir vorliegenden Isotypus im Hb. Kew ist zu lesen: "Near summit of Akrobat". Diese Varietät ist durch kräftigen Wuchs, lange, kräftige Aeste, Blätter mit mehr als 3 cm langen, 3 mm breiten Abschnitten, und ausserordentlich breite, (12 mm !! am mir vorliegenden Exemplar; Bornmüller gibt nur 7 mm an) abstehende, verkahlte Hüllschuppen von über 3 cm Länge gekennzeichnet.

Von den in dieser Arbeit neu beschriebenen Arten erinnert *C. eurylepis* durch die Breite der Hüllschuppen an *C. multiloba* var. *Afghanorum*, ist aber durch zarten Wuchs, kurz- und feingliedrige Blätter, etwas langgestreckte Hüllen mit dicht drüsigen Hüllblättern deutlich verschieden.

Die nun folgenden kurz charakterisierten Formen lassen sich meiner Meinung nach gegenwärtig nicht durch fixe Merkmale von *C. multiloba* abgrenzen. Ich lasse sie daher unbenannt und kennzeichne sie durch römische Ziffern.

Var. I. Caulis gracilis, 25—30 cm altus laxe araneosus, superne saepe breviter furcatus. Foliorum segmenta ± 2 cm longa, ± 2 mm lata, supra laxe araneosa viren-

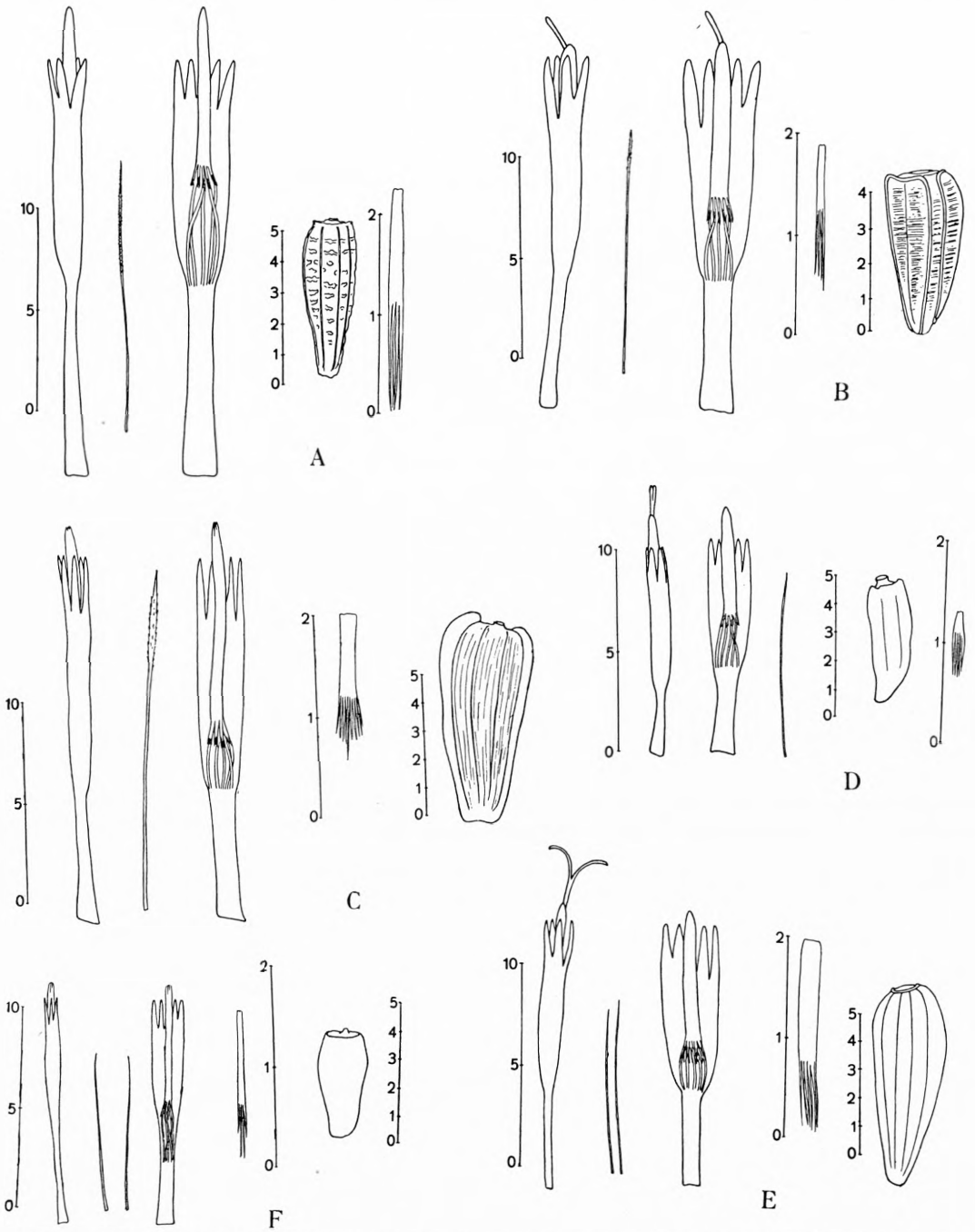


Fig. 85. Korolle geschlossen, Korolle geöffnet, Spreuschuppe, Antherenanhängsel und Achäne von: A *Cousinia kotandarica*, B *C. lachnobasis*, C *C. lamprophyllaria*, D *C. leptacantha*, E *C. malurensis*, F *C. modesta*.

tia. Involucrum 2—2.5 cm diametro. Squamae lana ochracea araneoso-contextae non glabrescentes, extimae e basi 5—7 mm lata subito in spinam sat tenuem deflexam 5—10 mm longam contractae.

C: Lorinj Pass, 12000 ft., dry plain, 18 inches high, fl. rose-purple, 27.VIII.1939 (Kz. 13769, hb. W., BPI.). — **NW:** Safedsang, 10000 ft., dry slope, 18 inches high, fl. rose-purple, 24.IX.1939 (Kz. 14003, hb. W., BPI).

Var. II. Varietati praecendenti similis sed foliorum segmenta subbreviora sublatiora, caulis pleiocephalus, involucri phylla angustiora 4—5 mm lata, breviora, externa non recurva sed patula, valde laxe araneosa, verosimiliter demum glabrescentia.

C: Qala Sakawa, 2500 m (K. 3321, hb. W., C.).

Var. III. Varietati secundae similis sed foliorum segmenta longiora, ad 2.5 longa et tenuiora, ad 1.5 mm lata, supra subglabra atroviridia. Involucrum laxe araneosum calvescens, phylla exteriora ± 5 mm lata spina erecto-patente.

C: Farakulum, 2700 m, frequent (K. 2531, hb. W., C.). Unaipass, 3150 m (Gilli).

Var. IV. Elata, tota appresse persistenter candide tomentosa, foliorum segmenta ± 2 cm longa, ± 2 mm lata non glabrescentia. Involucrum 1.5—2 cm diametro; squamae tomento candido intertextae, basi 3—5 mm latae, subito in spinam brevem tenuem 3—5 mm tantum longam erecto-patentem attenuatae.

C: Hochfläche ober den Seen von Band-e-Amir, 2800 m (Gilli).

Cousinia (*Heteracanthae*) ***myriolepis*** Rech. f. et Köie, n. sp. — Fig. 86 und 94 A.

Verosimiliter perennis. Caulis certe elatus ad minimum 50 cm altus mutilatus tantum obvius, basi fere 2 cm crassus, profunde sulcato-striatus, internodiis mediis 3—5 cm longis, a basi longe iteratim ramosus, floccoso-tomentosus, imprimis superne fere omnino glabrescens pallide bruneus. Folia basalia ignota. Folia caulina inferiora ad 12 cm longa, spinis inclusis ad 8 cm lata, basi profunde cordata sessilia, ambitu ovata usque ovato-elliptica, in vivo ut videtur crasse molliter herbacea, nervatura straminea pinnato-reticulata supra impressa subtus valde prominens, indumentum supra laxiuscule appresse araneosum canescens, subtus dense molliter floccoso-tomentosum albidum; lamina ad tertiam circiter partem lobata, lobi utrinque usque 10, sese basi partim tegentes, in spinam validam stramineam ± 10 mm longam abrupte excurrentes, basi lobulis accessoriis brevius spiniferis utrinque singulis usque binis ± divergentibus aucti. Folia ramos secundarios fulcrantia valde diminuta breviter cordata subradiatim nervosa et spinosa, nervis subtus valde prominentibus, spina terminali ceteris plus quam duplo longiore et validiore. Capitula semper singula terminalia sed partim e ramulis lateralibus interdum valde abbreviatis orta; involucrum cum spinis quasi globosum 15—18 mm longum et latum sed de facto basi truncato-rotundatum et impressum superne valde constrictum; phylla ± 7 (!!) -seriata numerosissima densissime et valde regulariter disposita, pallide viridia, basi leviter araneoso-contexta, superne complete glabrescentia, omnia angustissime lineari-

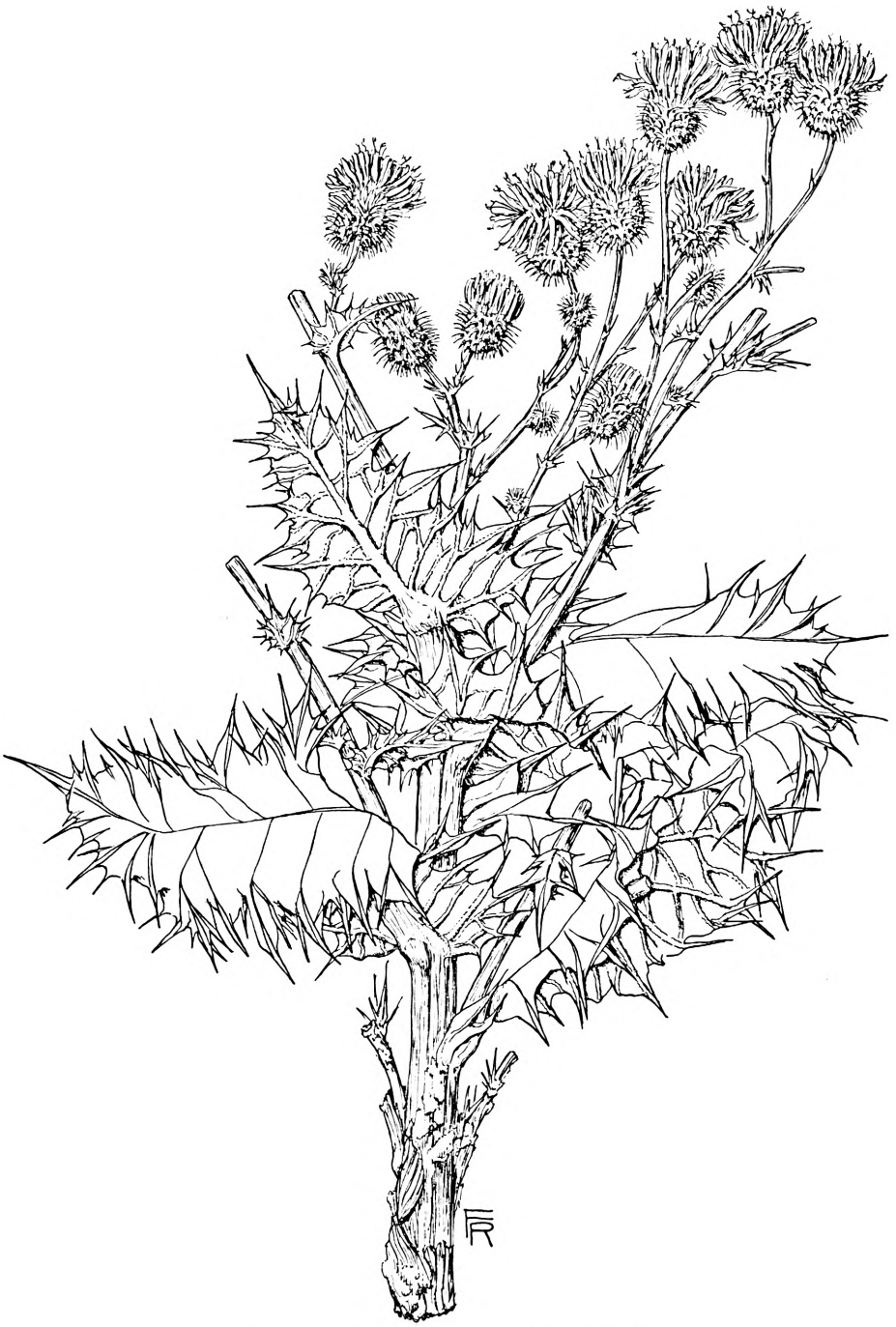


Fig. 86. *Cousinia myriolepis* (K. 2805). $^{3}/_{5}$.

subulata, omnia eis seriei intimae exceptis in spinam tenuissimam 2—4 mm longam eleganter recurvam excurrentibus; phylla intima in spinulam molliorem interdum (non semper) subrectam excurrentia. Receptaculi setae candidae laeves. Corolla in sicco sordide alba, ± 15 mm longa, tubus dimidiam longitudinem limbi tantum attingens; laciniae acutae 2—3 mm longae. Antherarum tubus pallide roseus glaber expallens. Achaenia juvenilia ad 3.5 mm longa, ± 1.8 mm lata, compresso-subtriquetra, basi ± attenuata, apice rotundato-truncata, atra, lineis paucis longitudinalibus brunescentibus paulum prominentibus percursa. — Species involucri phyllis ± 7 (!!) -seriatis omnibus in spinam tenuissimam elegantissime recurvam abeuntibus insignis, me judice *C. lachnosphaerae* Bge. affinis, a qua praeter notas indicatas foliis minus rigidis, eorumque indumento molliore minus appresso, capitulis multo minoribus multo numerosioribus, involucris glabrescentibus virescentibus et achaeniis longe diversa.

C: Shibar Pass, 2600 m, 15.VIII.1948 (Köie 2805, Typus, hb. W., C.). Am Fuss des Schibarpasses (Ostseite) auf Schutthalden unter Kalkfelsen, 2700 m (Gilli 2513, hb. W.).

Wäre wegen der streng zurückgebogenen Hüllschuppen eigentlich unter den *Drepanophorae* einzureihen, ein neuer Beweis für die schon von verschiedenen Autoren (Bornmüller, Juzepzuk) betonte Künstlichkeit dieser Anordnung.

Aus der unmittelbaren Verwandtschaft der *C. myriolepis* liegen noch zwei Aufsammlungen aus Zentral-Afghanistan vor:

C: Panjao, 2700 m (K. 2686, hb. W., C.). Qala Sakawa, 2500 m (K. 3329, hb. W., C.).

Köie 2686 (Var. I.) weicht vom Typus durch weniger stark verkahlende Stengel und Aeste, reicher und grösser beblätterte Aeste, ganz anliegendes Indument der Blätter, grössere Köpfchen (etwa anderthalbmal so gross), dichteres Indument der Hüllen, mehr abstehende, nur zum kleinsten Teil herabgebogene Dornen der Hüllschuppen.

Köie 3329 (Var. II.) ist der No. 2686 in Beblätterung, Indument und Grösse der Köpfchen ähnlich, doch ist hier der Spinnwebenfilz der Hülle noch dichter und die Dornen der Hüllblätter sind mit Ausnahme der innersten durchaus stark herabgebogen. Künftige Untersuchungen in der Natur und an reicherem Herbarmaterial werden zeigen, ob die Zusammenziehung dieser drei Formen gerechtfertigt ist.

Cousinia (*Heteracanthae*) ***myriotoma*** Rech. f. et Köie, n. sp. — Fig. 87.

Biennis vel perennis? Radix fusiformis lignescens verticalis ad 15 mm crassa caulem singulum proferens. Tota planta omnino inermis. Caulis 100—120 cm altus, collo lanatus, e rosula foliorum ortus, teres, glaberrimus laevis eburneus, a basi fere iterum iterumque corymbose ramosissimus, inflorescentiam foliis superioribus paucis valde diminutis non alatis subaphyllam amplissimam efficiens. Folia rosularia non vel indistincte petiolata; lamina ad 15 cm longa, ad 5—8 cm lata, omnino inermis, bipinnata vel irregulariter subtripinnata vel vario modo e laciniis 1—3(—4) mm latis irregulariter composita, ambitu variabilis, anguste lanceolata vel oblonga, omnino molliter herbacea, supra valde laxe floccosa glabrescens viridis, subtus appresse

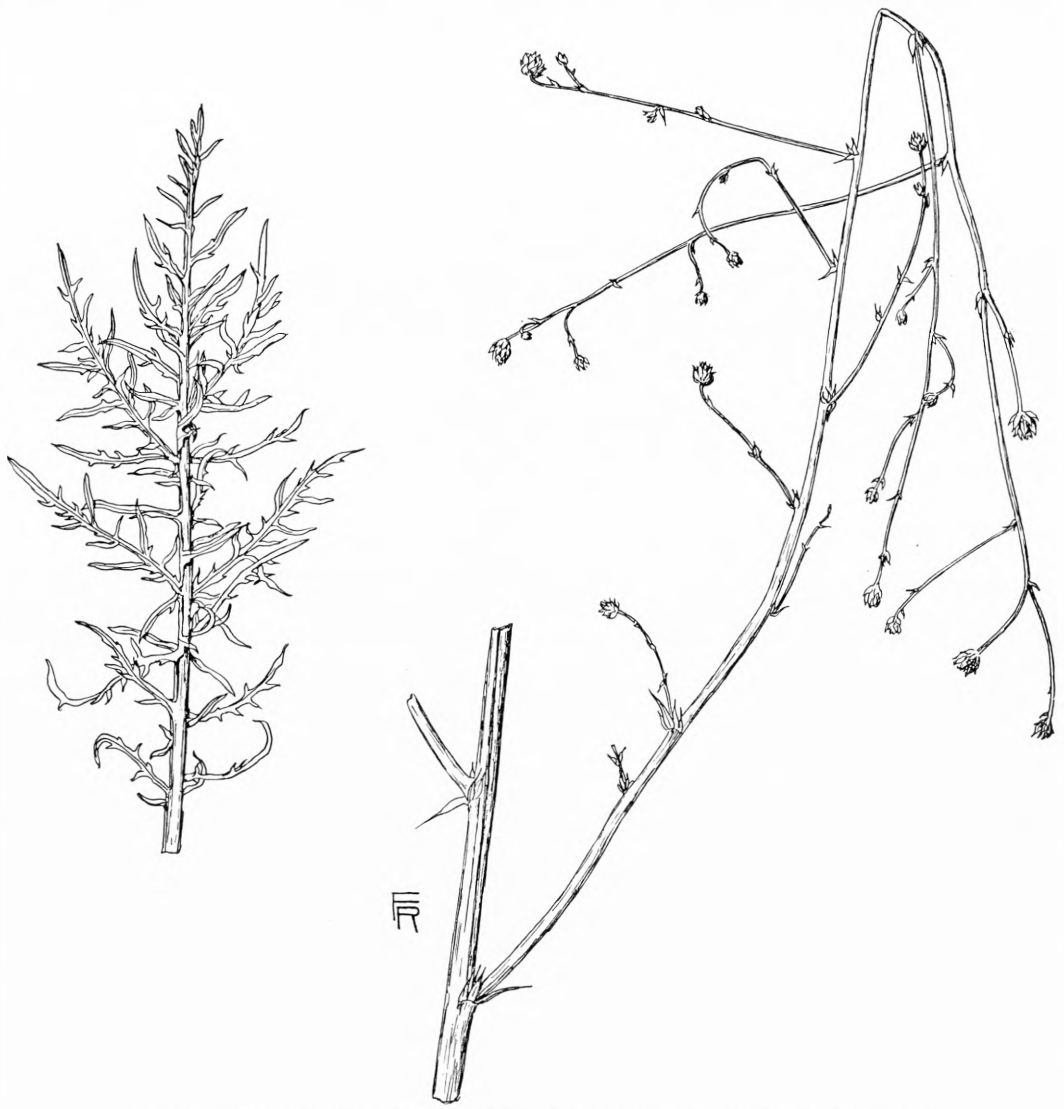


Fig. 87. *Cousinia myriotoma* (K. 3848 — Grundblatt und Blütenstandsast). $^{3}/_{5}$.

albo-floccoso-tomentosa; costa mediana crassa, prope basin 3—4 mm lata, supra applanata, subtus valde convexa, omnino anguste (1—2 mm) alata; pinnae numerosae valde irregulares partim elongatae valde compositae ad 5 cm longae, partim breviter lobuliformes vario modo alternantes rectangulariter vel erecte patentes; lacinulae ultimi ordinis margine anguste revolutae, apice acutae submuticae vel saepius breviter interdum obsolete cartilagineo-mucronulatae. Folia caulina infima basalibus similia paulo tantum minora, media jam valde diminuta angustius remotius pinnata utrinque viridia valde glabrescentia; folia caulina superiora et ramealia valde reducta,

omnia non decurrentia, e laciniis anguste linearibus utrinque glabratis valde revolutis palmato-pinnatis subdistinctius cartilagineo-mucronatis composita; folia ramealia summa ad lacinulas squamiformes 1—2 cm longas reducta. Capitula numerosissima, plurima in ramulis tenuissime filiformibus terminalia. Involucrum 11—12 mm longum, prope basin 5—6 mm diametro, e basi rotundata ovato-cylindricum superne valde attenuatum, flavescenti-viride; phylla ± 4-seriata, plerumque 30—34, externa abbreviata ovato-rhombica, media ovata, interna lanceolata, arcte imbricata, integra, apice brevissime extrorse cartilagineo-mucronulata, sub apice intensius viridia, nervo mediano imprimis apicem versus prominulo subcarinata, appresse tomentella et minute flavide glanduloso-punctata, intima apicem versus membranacea straminea, mollius recte mucronulata. Receptaculi setae pallide stramineae, scabridae. Corolla verosimiliter in vivo rosea vel purpurea, in sicco expallens, glanduloso-punctata, ± 10 mm longa; tubus tertiam circiter partem corollae longitudinis aequans. Achaenia ignota. — Affinis videtur *C. Griffithianae* Boiss. habitu, capitulis minutis etc., sed ab ea notis sequentibus diversa: foliis maioribus mollioribus bi- vel tripinnatis eorumque indumento copioso molli, foliis caulinis magis reductis, involucri phyllis brevissime mucronulatis. — Species memorabilis foliis valde dissectis *C. alatae* Schrenk., *C. bipinnatae* Boiss., *C. schizopterae* Juzepcz. similis, sed folia omnia non decurrentia, caulis omnino exalatus. Ceterum inflorescentia amplissima subaphylla, involucro parvo oligophyllo, phyllis breviter extrorse cartilagineo-mucronulatis insignis.

SW: 50 km S. of Herat, 1500 m, 8.V.1949 (Köie 3848, Typus, hb. W., C.). Zwischen Herat und Farah, 1500 m (Gilli 2521, hb. W.).

Die Beschreibung wurde bezüglich der Blütenmerkmale nach Gilli 2521 ergänzt.

Cousinia Neubaueri Rech. f., n. sp. — Fig. 88 und 94 B.

Verosimiliter perennis, caespitosa, surculos steriles et caules floriferos emittens. Caules floriferi ad 30 cm alti stricte erecti, in parte summa furcati vel breviter stricte pauciramosi, internodiis inferioribus appresse lanatis valde abbreviatis densissime foliati, internodiis superioribus valde glabrescentibus 5—10 mm longis, foliis ibique valde diminutis. Folia omnia rigidissima, pinnata, persistentia, rhachide pinnisque angustissime revolute alatis, appresse cano-floccoso-tomentellis, in spinas tenues vulnerantes excurrentibus. Folia inferiora ad 7 cm longa, ad 2.5 cm lata, pinnis plerumque 5—6-jugis, ± antrorsis, superioribus inter se ad 1 cm remotis, ad 2 cm longis, ad 1.5 mm latis, basi pinnulis brevibus spiniformibus subverticillatim dispositis auctis; folia media sensim, superiora valde decrescentia, basi paulo dilatata subincrassata palmato-spinosa sessilia, breviter paucipinnata. Capitula singula terminalia, foliis non suffulta. Involucrum depresso-semiglobosum, basi umbilicatum, 10—12 mm longum, ± 15 mm latum; phylla ± 4-seriata, ca. 40—50, exteriora et media e basi appressa 4—6 mm lata sensim usque ± abrupte in spinam terminalem patentem 4—8 mm longam attenuata, crasse coriacea, virescenti-flava, elevate longitudinaliter striata, glabra, margine regulariter utrinque rigide pectinato-

ciliata, ciliis utrinque 7—8, 0,5—1.5 mm longis, concoloribus; involucri phylla intima tenuiora membranacea pallida recta breviter spinulosa brevissime ciliolata, nervo centrali prominulo percursa, breviter exserta. Corolla in sicco sordide albida (an in vivo rosea?), 12—14 mm longa, limbo quam tubo subduplo longiore, limbi laciniis linearibus ± 2.5 mm longis. Receptaculi setae prope apicem subdilatatae scabridulae. Achaenia (immatura) ± 4mm longa, polygonali-compressa transversaliter sublamellato-scabrida, superne crasse membranaceo-coronulata, coronula crenulata; pappus setiformis subpersistens flavus, 2—3 mm longus. — Species achaeniis coronulatis, foliis anguste spinoso-pinnatis persistentibus, involucri phyllis pectinato-ciliatis valde insignis verosimiliter sectionem propriam sistens.

C: Band-e-Amir, trockene Steppe, 24.—30.VIII.1951 (NEUBAUER 51/489, hb. W.).

C. Neubaueri lässt sich wegen der mit einem häutigen Krönchen versehenen Achänen mit keiner der mir bekannten Arten vergleichen. Sie wäre offenbar am richtigsten als Repräsentant einer neuen, monotypischen Sektion aufzufassen. Die fast vollständig auf Mittel- und Seitennerven reduzierten starren, stechenden, durch mehrere Vegetationsperioden erhalten bleibenden Blätter erinnern durch letztere Eigenschaft an *C. Stocksii* C. Winkl. und an die Sektion *Neurocentrae*. Wegen der starr kämmig gefransten Hüll-

Fig. 88. *Cousinia Neubaueri* (N. 489). $^2/_3$.

schuppen könnte *C. Neubaueri* unter den *Pectinatae* eingereiht werden, von denen aber keine der bekannten Arten auch nur die geringste Aehnlichkeit aufweist. Von den erwähnten Eigenschaften der Laub- und Hüllblätter abgesehen, erinnert *C. Neubaueri* habituell am ehesten an *C. multiloba* DC. und die zahlreichen, sich um diese gruppierenden Arten der Sekt. *Odontocarpae*.

Cousinia (*Heteracanthae*) ***neurophylla*** Rech. f. et Köie, n. sp. — Fig. 89 und 94 C.

Collo copiose fibroso. Caulis ad 50 cm altus, apice capitulum unum pedunculatum alterum subsessile ferens vel caulis superne breviter pauciramosus, internodiis mediis 7—9 cm longis, superne furcatus vel probabiliter stricte pauciramosus, araneoso-floccosus paulum glabrescens tunc pallide bruneus tenuiter striato-sulcatus. Folia omnia consistentia in sicco crasse coriaceo-membranacea, primum utrinque laxiuscule appresse araneoso-tomentella indumento subtus persistente canescentiglaucescentia supra ± evanescenter pallide flavescenti-viridia, costa mediana crassa supra applanata subtus valde convexa, nervatura utrinque, subtus crassius prominente conferta, nervis secundariis numerosis validioribus, saepe profunde subpalmato-furcatis plurimis ± rectangulariter excurrentibus, nervis 3—5-nis in spinam quemque abeuntibus. Folia basalia petiolata, petiolus 4—6 cm longus in foliis juvenilibus basi gossypino-floccosus, in adultis basi ± membranaceo-dilatatus, interdum purpurascens; lamina 15—20 cm longa, spinis inclusis 3—5 cm lata, ambitu anguste lanceolata, pinnatilobata, lobi usque 10-jugi conferti ± crispati breves longitudine interdum latiores irregulariter palmato-rotundati vel subflabellato-plurilobulati plerumque spinas 5—7, 2—6 mm longas terminali lateralibus paulo longiore proferentes. Folia caulina non numerosa, basi auriculato-semiamplexicaulia, non decurrentia, auriculo spinoso-lobato, ceterum basalibus similia. Folia ramealia pauca, valde diminuta cordato-ovata breviter sublobato-spinulosa spina terminali lateralibus usque duplo longiore. Capitula singula terminalia; involucrum depresso-globosum ± 2 cm longum et latum vel longitudine paulo latius, basi manifeste truncato-umbilicatum persistenter floccoso-araneosum fusco-ochraceum; phylla 7—8-seriata, numerosissima (semper longe ultra 100), omnia serie intima excepta in spinas tenues flavescenti-virides apicem versus stramineas glabrescentes abeuntia; spinae fere omnes serie intima excepta recurvo-patulae, extimae abbreviatae, mediae ± 5 mm longae; phylla intima in appendices subulato-lanceolatas pallide bruneas papillosas molliter spinosas ± extrorsas sensim attenuata. Receptaculi setae laeviusculae albidae. Corolla ± 18 mm longa, in vivo rosea vel purpurea, in sicco expallens, tubo quam limbo tertia parte breviore. Antherarum tubus roseus usque purpureo-violaceus, glaber. Achaenia matura ignota, juvenilia obpyramidata truncata costata videntur. — Foliorum consistentia ac nervatura involucro multiseriato polyphyllo fusco-araneoso, receptaculi setis sub apice tantum scabridulis *C. xanthacanthae* Reg. comparanda, a qua foliis breviter obtusilobatis breviter spinosis involucro depresso-globoso basi umbilicato, phyllis brevioribus omnibus recurvis diversa.

C: Farakulum, 2900 m, more frequent above 3000 m, 21.VII.1948 (Köie 3328, Typus, unicum C., fragm. W.). — **NE:** Porande-Tal, Seitental des Pandscherflusses bei Basarak (Gilli 2510). — **E:** Paghman-Gebirge, 2870 m (Gilli 2509), 3300 m (Gilli 2511).

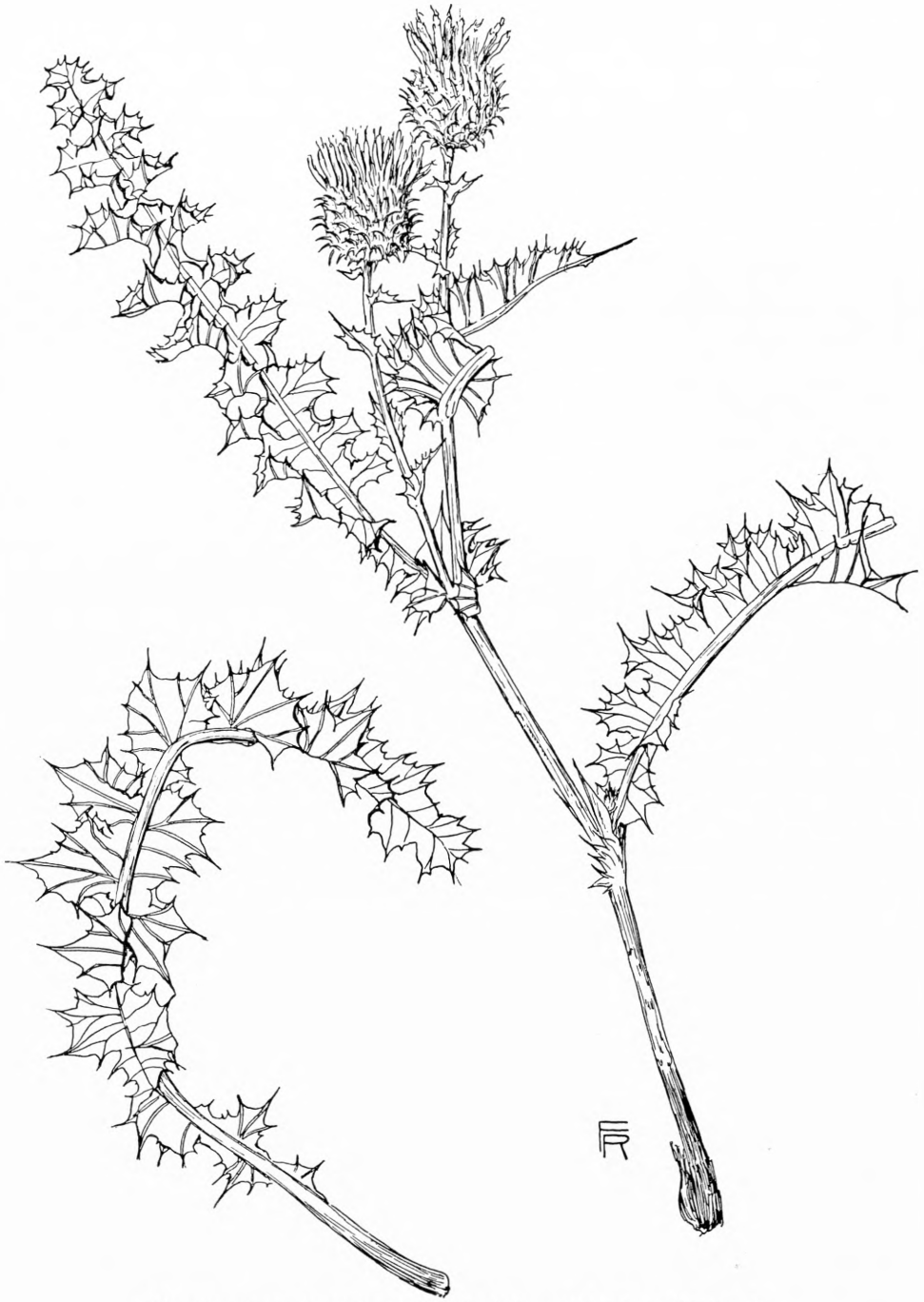


Fig. 89. *Cousinia neurophylla* (K. 3328 — links Grundblatt). $^{3}/_{5}$.

Erinnert in den Köpfchen an *C. lachnosphaera* Bunge und Verwandte; nach Winkler käme man auf die *Drepanophorae* (Künstliche Sektion). Die Beschreibung ist bezüglich des Wuchses nach Gilli's Exemplaren ergänzt.

C. (*Odontocarpae*) *Newesskyana* C. Winkl. — **Nuristan:** Parun (E. 2047, hb. W., C.).

Stimmt mit der Orginalbeschreibung in Acta Horti petrop. 11:333 (1892) sowie mit einem von Paulsen (No. 1262) im Pamir gesammelten Exemplar im wesentlichen überein. Die Blattabschnitte bei Edelbergs Pflanze sind an den unteren Blättern zahlreicher und etwas länger, die Hüllen mehr verkahlend, der Mittelnerv der Hüllblatter stärker vorspringend, manchmal ist links und rechts noch ein feiner seitlicher Parallelnerv angedeutet. Die Blüten sind trocken schwefelgelb, der Antherentubus blass schmutzig-rosa.

Cousinia nobilis Rech. f., n. sp. — Fig. 90 und 94 D.

Radix deest sed planta certe perennis. Caulis 150 cm altus (e collectore), prope medium ca. 1 cm crassus, stricte erectus, eburneus, glaberrimus nitidulus, verosimiliter usque ultra medium dense foliatus, internodiis mediis ± 3 cm tantum longis, superne aphyllus, ibique laxe iteratim ramosus, omnino glaberrimus. Folia basalia et inferiora non visa; caulina media ad 30 cm longa, ad 3 cm lata, erecto-patentia, linearia, basi attenuata et ± leviter cordata sessilia, apice sensim in spinam tenuem attenuata; costa mediana crassa eburnea glabra supra plana subtus valde prominens; nervi secundarii angulo recto abeuntes, in spinas patentes 5—10 mm longas excurrentes, supra prope basin spinulam 5—8 mm longam e lamina prominentem emittentes; nervi ultimi ordinis laxe subrectangulariter reticulati; lamina in sicco tenuiter coriacea supra brunescens, glabra, minutissime remote albido-papilloso-punctata sublaevis, subtus tomento densissimo appresso sericeo candida, marginibus parallelis revolutis raro remote et ± obsolete lobato-dentata; folia superiora sensim paulo decrescentia. Capitula ad extremos ramos solitaria. Involucrum fructiferum tantum 15 mm longum, ± 7 mm latum, basi rotundatum superne paulo attenuatum; involucri phylla plerumque 4-seriata, indurata, omnia arcte imbricata valde appressa, apice brevissime apiculato-mucronulata, pallide brunea, imprimis intima apicem versus minute papillosa, ceterum glabrescentia, omnia integerrima. Achaenia ± 4 mm longa, valde compressa usque compresso-triquetra, superne 2 mm lata, basin versus rotundato-attenuata, indistincte longitudinaliter costata, pallide griseo-virentia, opaca, subgranulata; pappus setiformis sordide albus achaenium subaequans, scaber, valde fragilis. Receptaculi setae laeves. Flores ignoti. — Species pulcherrima, indumento sericeo insignis, nullae aliae comparanda.

C: Polat, 2700 m, dry slope, 10.IX.1939 (Koelz 13951, hb. BPI., W.).

C. (*Drepanophorae*) *Olgae* Regel et Schmalh. — **C:** Chigzar, 9000 ft., dry slope, pl. 1 ft. high, fl. yellow (Kz. 13954, hb. W., BPI.). Shanbashak Pass, 9000 ft., dry slope, pl. 18 inches high, fl. yellow (Kz. 13871, hb. BPI.).

C. aptera Aitch. et Hemsl. (Kurrum Valley, Aitch. 971, Typus, K.) wird von Aitchison und Hemsley sowie von Winkler bei den *Heteracanthae* eingereiht. Sie gehört jedoch nach Wuchs und Hüllenform unbedingt in die nächste Verwandtschaft der *C. Olgae* Rgl. et Schmalh.

Fig. 90. *Cousinia nobilis* (Kz. 13951 — Teil des Blütenstandes und mittleres Stengelstück). $^1/_3$.

(ein Exemplar, nicht der Typus, im Hb. W.: "In faucibus Pamulan, REGEL, V. 1882"), die bei den *Drepanophorae* (offenbar richtig) eingereiht wird. Die Blüten des Wiener Exemplars von *C. Olgae* sind auch heute noch leuchtend goldgelb, in WINKLERS Schlüssel wird sie unter den rotblühenden Arten eingereiht (Orginalbeschreibung nicht gesehen).

Mit REGELS Exemplar stimmen KOELZ 13871 und 13954 im wesentlichen überein. Charakteristisch sind ausser der goldgelben Blütenfarbe die relativ breiten, schwach geteilten, dem Stengel anliegenden wolligflockigen oberen Stengelblätter. Die Zahl der Hüllblätter ist dagegen bei REGELS Pflanze etwas grösser, die Köpfchen breiter, die Hüllschuppen feiner und länger.

Cousinia (*Spicatae*) ***oophora*** Rech. f., n. sp. — Fig. 91 und 94 E.

Perennis. Caulis 45 cm altus, prope basin 8 mm diametro, superne vix tenuior, simplex eburneus glaberrimus, in tertia parte inferiore foliis paucis subito decrescentibus obsitus, in parte media folia et capitula ambo valde reducta sessilia proferens, in tertia parte superiore capitula normaliter evoluta sessilia racemose disposita proferens. Folia basalia petiolo brevi 15—30 mm longo basi ad 8 mm crasso valde applanato candido suffulta; lamina spinis inclusis ad 15 cm longa, ad 9 cm lata,

Fig. 91. *Cousinia oophora* (Kz. 14137 — rechts Grundblatt). $^1/_2$.

ambitu oblongo-lanceolata, basi abrupte contracta usque subcordata, apice acuta, utrinque ad tertiam circiter partem dupliciter spinoso-lobata; lobi in vivo sursum et deorsum flexi, in sicco sese omnes valde tegentes; pars centralis laminae plana; lobi primi ordinis in spinas stramineas pungentes 5—8 mm longas excurrentes utrinque ultra 10, lobi secundi ordinis brevius spinosi sinibus separati; nervi inferiores approximati angulo subrecto a costa mediana crassa abeuntes, superiores angulo ± 60° abeuntes, omnes crebre reticulato-anastomosantes, supra albidi ± applanati glabrescentes, subtus prominentes appresse tomentelli; indumentum utrinque appresse araneoso-tomentellum albidum; consistentia in sicco crassiuscule coriacea. Folia caulina inferiora similia, subito valde diminuta brevius lobata, sub- vel complete sessilia. Capitula omnia sessilia; involucrum ± 3 cm longum, ± 2 cm diametro, latiuscule ovato-campanulatum, basi late rotundatum leviter impressum, superne leviter constrictum, inferne araneosum; phylla plerumque 5-seriata, infima anguste lineari-subulata basi appressa apice erecto-patula, cetera omnia appressa, rigidula, pungentia; phylla intermedia sensim latiora minus pungentia, intima ad 2 mm lata flexilia glabrata nitidula acuta extremo margine scabridula. Receptaculi setae stramineae nitidulae sublaeves. Flosculi in vivo sordide rosei ("old rose" coll.), in sicco expallescentes, involucrum paulo superantes, laciniis 3—4 mm longis. Antherarum tubus in sicco quidem pallide stramineus. Achaenia ± 6 mm longa, ± 2 mm lata, valde compressa, sordide albida, indistincte minute irregulariter nigro-punctulata vel maculata, laevia, subnitida, basi subito attenuata, apice truncata.

NW: Burchao-Pass, 3350 m, dry slope, fl. old-rose, 13.X.1939 (Koelz 14137, unicum BPI., frag. W.).

Cousinia (*Lamprocarpae*) ***oxytoma*** Rech. f., n. sp. — Fig. 92 und 94 F.

Biennis. Caulis (10—) 25 (—35) cm altus, gracilis, profunde plurifurcatus. Folia omnia consistentia in sicco membranacea fragilia, supra tenuiter appresse araneoso-tomentosa demum glabrescentia canescenti- usque laete viridia, subtus densius persistenter appresse tomentosa, glaucescentia usque albida. Folia basalia usque 15 cm longa, 6 cm lata, non vel valde indistincte petiolata, interrupte pinnata, segmentis principalibus 4—6-jugis, usque bipinnata, rachide imprimis in parte superiore folii anguste spinoso-alata; segmenta omnia tenuiter sed longiuscule spinosa; nervi utrinque tenuiter subtus distinctius prominentes. Folia caulina sensim decrescentia, basi cordato-dilatata non vel brevissime decurrenter sessilia, spinoso-lobata, spinis quam in foliis basalibus imprimis in lobo terminali saepe elongato longioribus. Involucrum spinis exclusis ± 2 cm longum et latum, basi impressum, superne constrictum; phylla ± 50 crasse coriacea viridia, e basi dilatata et incrassata subito in spinam triquetram supra applanatam attenuata, basi paulo floccoso-araneosa, demum glabrescentia, praeterea glandulis flavis sessilibus copiose obsita; spinae phyllorum involucri diametrum ± aequantes exteriorum reflexa quam media patula non vel paulo tantum breviora; phylla intima molliuscule membranacea, apice lanceolato-dilatata acuta non spinosa membranacea purpurascentia exserta. Corolla

purpurea, ± 18 mm longa, tubus ± 8 mm longus, laciniae 3—3.5 mm longae. Achaenia (submatura) ca. 2.8 mm longa, 1.1 mm lata, oblonga compressa pallide brunea laevia, basin versus paulo attenuata, superne rotundato-truncata, valde indistincte longitudinaliter paucistriata. — Habitu gracili, humili, foliis basalibus interrupte anguste pinnatis saepe bipinnatis, consistentia tenuibus tenuiter sed longiuscule spinosis, foliis caulinis quoque spinoso-lobatis, involucro glabrescente, phyllis longe tenuiter spinosis a *C. buphthalmoide* Reg. et Schmalh. eiusque affinibus diversa.

C: Lorinj Pass, 10000 ft., dry slope, 4 inch. high, fl. rose-purple (Kz. 13737, hb. W., BPI.). — **Nuristan:** Vaigel, 1500 m, 31.V.1948 (E. 875, hb. W., C.). — **E:** Mamakhel, 5000 ft., dry slope, herb. 18 inch. high, fl. rose-pink (Koelz 11568, Typus, hb. W., BPI.).

Cousinia (*Odontocarpae*) ***parviceps*** Rech. f. et Köie, n. sp. — Fig. 93 und 94 G.

Caudices crasse lignosi fibroso-corticosi multicipites caespites formantes. Caules floriferi (5—) 10—20 (—30) cm alti, tenues stricte erecti pallide brunei interdum purpurascentes, simplices vel in parte superiore furcati usque pauciramosi, leviter appresse floccoso-tomentelli, imprimis in parte superiore omnino glabrescentes, internodiis mediis 7—20 mm longis. Folia rosularia numerosa, forma et magnitudine valde variabilia: omnia supra laxe appresse tomentella viridia, costa mediana tenuiter immersa, margine revoluta, subtus densissime appresse albo-tomentosa costa mediana valde prominente, aut minuta 20—30 mm longa, 2—4 mm lata, anguste oblanceolata, subintegra, basin versus ut apice sensim longe attenuata, apice breviter spinulosa; aut imprimis basin versus oblique inciso-paucilobata lobis apice minute spinulosis basi cuneato-decurrentibus; aut majora ad 5 cm longa, ad 2 mm lata, breviter vel indistincte petiolata, pinnata; rachis ± 1.5 mm crassa rigidula subtus valde convexa supra applanata, omnino persistenter appresse albo-tomentosa, tota longitudine anguste revolute alata; pinnae ± 5-jugae, saepe confertae aut interdum ad summum 3—4 mm inter se remotae, ± 10 mm longae, 2 (—3) mm latae, subrectangulariter patentes vel aliquantum antrorsae, margine revolutae, apice in spinam tenuem ad 2 mm longam attenuatae, basi pinnula brevi angusta saepe ad spinam reducta subverticillatim disposita auctae, supra appresse tomentellae canescenti-virides subtus dense appresse albo-tomentosae. Folia caulina inferiora basi brevissime spinuloso-decurrentia sessilia, iam inferiora plerumque valde diminuta, paucipinnato-lobata margine minus revoluta indumento minus denso; folia summa sensim ± simplicia lanceolata breviter spinulosa ± recurvo-patula. Capitula singula terminalia; involucrum 11—13 mm longum, 6—7 mm diametro, subcylindrico-campanulatum, basi breviter rotundatum vel subimpressum, phylla 5-seriata, ± 50, e basi late ovata vel ovato-lanceolata abrupte in spinulam tenuem 2—3 mm longam in phyllis exterioribus et mediis semper recurvam attenuata, flavescenti-viridia indurata, costa mediana crassiuscule prominente praeterea indistincte longitudinaliter striata, margine scabridula, facie tenuiter araneosa ± glabrescentia; phylla seriei paenul-

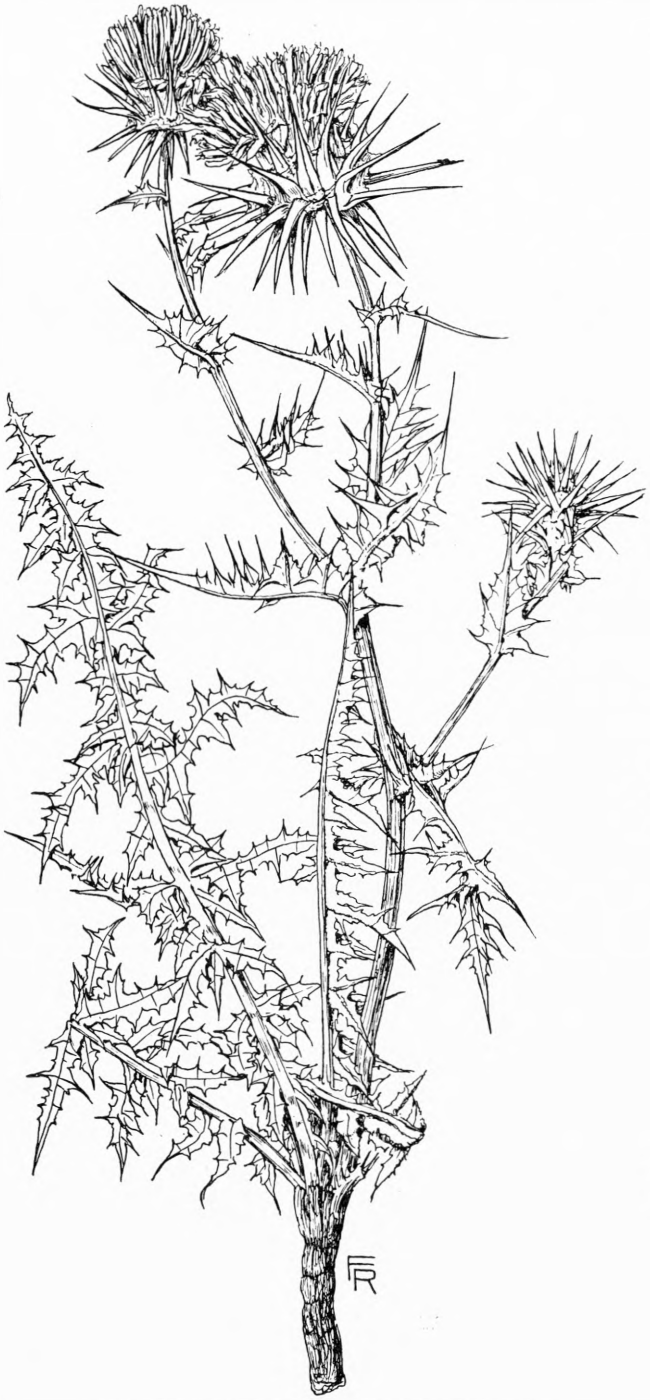


Fig. 92. *Cousinia oxytoma* (Kz. 11568). $^{2}/_{3}$.

Fig. 93. *Cousinia parviceps* (K. 2685). $^{1}/_{2}$.

timae in mucronulum tenuem contracta, phylla seriei intimae in appendicem scariosam brunescentem vel purpurascentem late lanceolatam breviter flexibiliter mucronulatam dilatata. Receptaculi setae candidae laeves. Corolla ± 11 mm longa intense purpurea, laciniis angustis acutis ± 2.5 mm longis. Antherarum tubus glaber, in vivo roseus videtur, in sicco expallens. Achaenia valde iuvenilia ± 2 mm longa subprismatica elevate lineata apice truncata pallide brunea. — Species caespitosa humilis, foliis partim quidem subverticillatim pinnatis modo sectionis *Odontocarpae* sed involucro *C. Autranianam* C. Winkl. et *C. leptacantham* Rech. f. sectioni *Nudicaules* (?) adnumerandis in mentem revocat.

C: Panjao, 2700 m, 28.VII.1948 (Köie 2685, Typus, hb. W., C.). Panjao, 2900 m, 15.VII.1948 (K. 2463, hb. W., C.). Gipfelregion eines Kalkberges nordöstlich von Bamian, 3140 m (Gilli 2538).

Diese Art ist offenbar mit *C. leptacantha* Rech. f. et Köie und *C. stereoneura* Rech. f. et Köie nah verwandt und möglicherweise durch hybride Zwischenformen verbunden.

Unter K. 2685 liegt ein 30 cm hohes, verzweigtes Exemplar mit der typischen Form der Grundblätter wie bei den *Odontocarpae*, nämlich mit schmalen, fast wirtelig gestellten Blattabschnitten, während das zweite unter derselben No. liegende Exemplar nur bis 15 cm hohe, meist einfache Stengel und zumeist schwach gelappte, einige wenige ganzrandige und wenige deutlich pinnate Rosettenblätter hat. In den Hüllen und Blüten stimmen beide Exemplare vollkommen überein. Die No. 2463 ist in sich einheitlich, die Blätter sind bei sämtlichen vier Individuen pseudoverticillat-pinnat, das Indument auch oberseits dichter, die Stengelblätter weniger reduziert, die Hüllen etwas breiter, am Grund sämtliche etwas eingedrückt, die innersten Hüllblätter mit grossem, breitem glänzendem Anhängsel.

Cousinia (*Spicatae*) ***pineticola*** Rech. f. et Gilli, n. sp. — Fig. 95 und 103 A.

Caulis vix 50 cm altus, prope basin 4 mm diametro, stricte erectus, simplicissimus, in tertia parte superiore florifer, eburneus brunescens glaber laevis teres, internodiis mediis ± 2 cm longis, collo residuis foliorum comoso. Capitula omnia sessilia, inferiora in axillis foliorum diminutorum singula remotiuscula, superiora ± 3-na conglomerata glomerulis contiguis spicastrum brevem formantia. Folia basalia et caulina inferiora subconformia, ad summum 16 cm longa, 3 cm lata, saepe breviora angustiora, indistincte petiolata, rachide prope basin remote longe setaceo-spinosa; lamina pinnata, costa mediana albida supra applanata angustissime alata, ala arcte revoluta, pinnae subverticillatae numerosissimae, saepe ultra 20, inter se 3—5 mm remotae, supra laete virides, subglabrae, subtus appresse albido-tomentosae, ad costam medianam usque revolutae, in spinam tenuissimam ± 2 mm longam excurrentes. Folia caulina decrescentia, sessilia, pinnis minus numerosis, ceterum basalibus similia; folia capitula fulcrantia involucris breviora. Involucrum ± 20 mm longum, ± 8 mm latum, cylindricum, basi rotundato-attenuatum; phylla ± 70, in seriebus ± 5 disposita, exteriora anguste lanceolato-subulata 0.8—1 mm tantum lata valde abbreviata, in spinulam erecto-patulam excurrentia, media similia sensim longiora ut exteriora glabra inferne pallide straminea superne virentia, apice tenuiter spinosa, interiora ad 2 mm lata pallida minus rigida, molliter subspinoso-

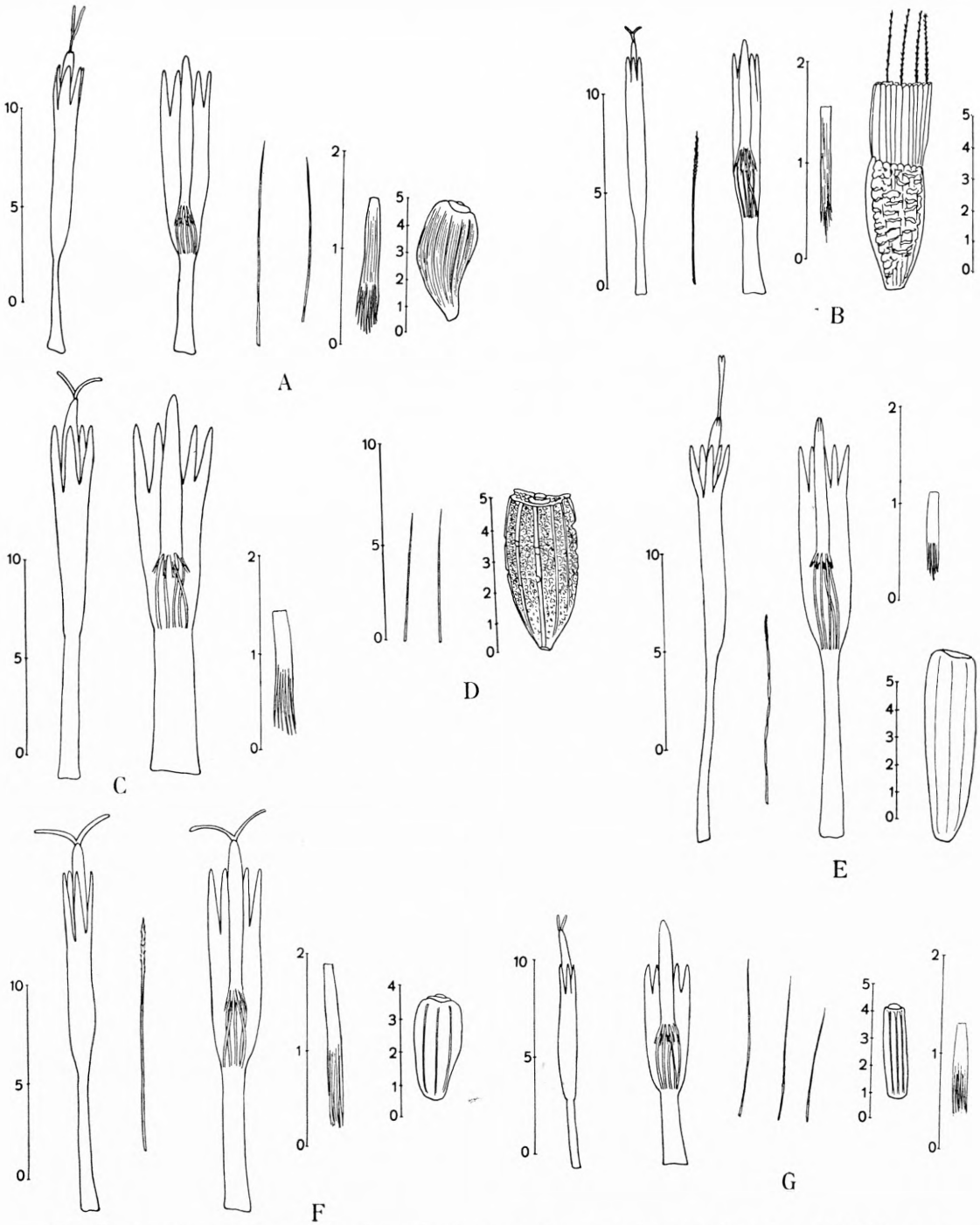


Fig. 94. Korolle geschlossen, Korolle geöffnet, Spreuschuppe, Antherenanhängsel und Achäne von: A *Cousinia myriolepis*, B *C. Neubaueri*, C *C. neurophylla*, D *C. nobilis*, E *C. oophora*, F *C. oxytoma*, G *C. parviceps*.

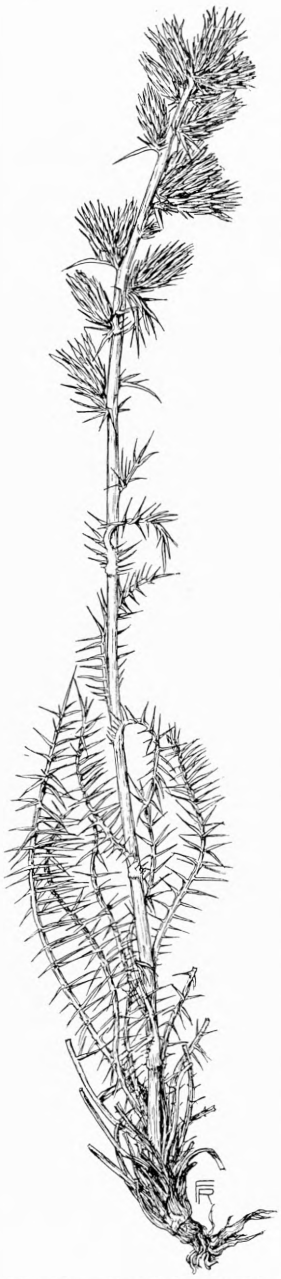


Fig. 95. *Cousinia pineticola* (Gilli 2543). $^{2}/_{5}$.

acuminata, dense flavide glanduloso-punctata. Receptaculi setae albidae superne scabridae. Corolla albida, ± 18 mm longa, exserta, tubus filiformis ad 6 mm longus; laciniae 3 mm longae. Antherarum tubus violaceus glaber. Achaenia (submatura) ± 5 mm longa, ± 1.8 mm lata, compressa, basin versus attenuata, superne rotundato-truncata, subdenticulata, brunea, glabra, longitudinaliter costato-striata. — Differt ab affinibus imprimis capitulis parvis, involucri phyllis angustissimis, longe spiniferis, exterioribus et mediis abbreviatis, interioribus multo latioribus pallidis.

Nuristan: Föhrenwald im Nedschrabtal (Seitental des Pandscherflusses zwischen Gulbahar und Surobi) ober Schechan, Wald von *Pinus Gerardiana*, 2580 m, 12.IX.1951 (Gilli 2543, hb. W.).

Korolle weisslich, Staubbeutelröhre, Griffel und Narbe violett.

Cousinia (*Odontocarpae*) ***polyneura*** Rech. f., n. sp. — Fig. 96 und 103 C.

Perennis, pluricaulis collo squamis bruneis membranaceis nonnullis comoso. Caulis 50 cm altus, erectus vel leviter arcuatus paucinodus, internodiis mediis 7—10 cm longis, appresse araneoso-lanatus, sub lana aegre detersili pallide bruneus tenuiter sulcato-striatus, simplex, monocephalus. Folia in sicco coriaceo-membranacea, fragilia, subtus dense appresse albo-lanata, supra glabrescentia, discoloria, costa mediana supra applanata subtus valde convexa, nervatura utrinque (subtus magis) tenuiter prominente valde conferta, nervis binis vel ternis in spinam quemque abeuntibus. Folia basalia breviter vel indistincte petiolata, ad 12 cm longa, spinis inclusis ad 4.5 cm lata, ambitu lanceolata, omnino irregulariter longe et brevius anguste pinnatipartita, rachis quam pinnae latior, pinnae ± 15-jugae, rectangulariter patentes, in spinam terminalem tenuem pungentem stramineam 4—7 cm longam abeuntes. Folia caulina pauca, sensim decrescentia, basi saepe valde dilatata cordata sessilia, rachide in foliis superioribus gradatim latiore, pinnis plurimis prope basin palmato-approximatis ceteris perpaucis; spina terminalis longissima. Involucrum sine spinis ± 2 cm diametro, subglobosum, basi umbilicatum, albo-floccoso-araneosum glabrescens; phylla ± 6-seriata, ± 80, basi 1—2 mm lata, atroviridia rigidula, nervo mediano validiore in spinam flavescentem abeunte, nervis lateralibus parallelis tenuibus plerumque pluribus; phylla exteriora recurva, media patentia, interiora erecta, intima anguste

Fig. 96. *Cousinia polyneura* (Kz. 12147). $^{3}/_{5}$.

lanceolata sensim attenuata pallida ciliolata flexibilia. Receptaculi setae inferne laeves superne scabridae. Corolla viva sordide rosea ("old rose", e collectore) ± 15 mm longa, tubo tenui 4—5 mm longo, laciniis angustis acutis 3 mm longis. Antherarum tubus roseus expallens glaber. Achaenia ± 4 mm longa, vix ultra 1 mm lata, compressa brunescenti-grisea, indistincte elevate pallidius striata, superne attenuata subdenticulata. — Foliorum nervatura *C. xanthacanthae* Rgl. similis et quasi inter hanc speciem et gregem *C. multilobae* DC. intermedia; a priore imprimis foliorum inferiorum segmentis angustis et involucri phyllis latis diversa.

E: Paghman, 9000 ft., dry slope, in clumps, fl. old-rose, 27.VI.1937 (Koelz 12147, Typus, hb. W., BPI.). Paghman-Gebirge, 3730 m, Gneiss (Gilli 2550, hb. W.). Paghmangebirge, östlich von Kotandar, 3980 m (Gilli 2515, hb. W.). Paghmangebirge, 3300 m (Gilli 2516, hb. W.). — **C:** Koh-i-Baba, 3500 m (K. 2637, hb. W., C.). Koh-i-Baba, 4000 m, Schutthalde (Gilli 2548, hb. W.). Kammregion der Koh-i-Baba — Kette bei Bamian, 3780 m, Gneiss (Gilli 2549, hb. W.).

Cousinia (*Spicatae*) ***pseudactinia*** Rech. f., n. sp. — Fig. 97 und 103 C.

Perennis, ima basi lignoso-fibrosa, collo leviter lanato. Caulis 45 cm (—90 cm, e collectore) altus, prope basin 4 mm crassus, tenuis, rigide erectus, internodiis mediis 3—4 cm longis, teres, ut tota planta omnino appresse persistenter albo-floccoso-tomentosus, a medio vel iam infra in ramos paucos elongatos stricte erectos divisus, tota longitudine laxe aequaliter foliatus. Folia basalia ignota. Folia omnia crasse rigide membranacea, utrinque appresse tomentella pallide glauco-virentia concoloria, nervatura tenuiter pennato-reticulata utrinque prominula, costa mediana crassa pallida supra applanata subtus convexa; folia caulina inferiora absque spinis 6 cm longa, 3 cm lata, ambitu oblongo-lanceolata, basin versus sensim attenuata, spinoso-auriculato-amplexicaulia, apice breviter attenuata, breviter remote sinuato-dentata dentibus triangularibus in spinam 4—9 mm longam tenuem vulnerantem abrupte attenuata, prope basin spinulis accessoriis minutis tenuibus interdum aucta; folia caulina media sensim breviora nec autem angustiora, basin versus vix vel non attenuata late cordata sessilia, summa ramos fulcrantia latitudine vix longiora ambitu late ovato- vel triangulari-cordata. Folia summa capitula glomerata fulcrantia eis breviora valde diminuta in spinam terminalem longissimam attenuata. Capitula plurima 2—4-na conglomerata in ramulis valde abbreviatis lateralibus ut ad extremos ramos principales sessilia inflorescentias subracemosas efficientia. Involucrum ad 15 mm longum, 10—12 mm diametro, breviter subconico-campanulatum, persistenter araneoso-floccosum; phylla ± 5-seriata, ± 70, omnia arcte appressa, exteriora tenuiter spiniformia tertiam vel quartam partem interiorum attingentia, media lanceolato-subulata basi virentia superne straminea in spinam elongatam longitudinem phyllorum intimorum aequantem sensim attenuata, intima in appendicem lanceolatam tenuiter membranaceam pallide bruneam opacam facie exteriore papillosam margine scabridulam apice breviter attenuatam excurrentia. Receptaculi setae albae laeves. Corolla

Fig. 97. *Cousinia pseudactinia* (Kz. 13859). $^{2}/_{3}$.

± 9 mm longa, sordide alba, laciniis angustis acutis ad 3 mm longis. Antherarum tubus laete purpureus non expallens, glaber. Achaenia matura ± 3.5 mm longa, ± 2 mm lata, obverse pyramidata compressa, basin versus sensim angustata, superne truncata et utrinque leviter vel indistincte subauriculata vel obtuse subdenticulata, pallide brunea, crassiuscule marginata, valde indistincte tenuiter longitudinaliter striata; pappi setae interdum subpersistentes, non numerosae scabridulae, dimidiam longitudinem achaenii circiter aequantes. — Differt ab *C. Actinia* Boiss. indumento albido appresso omnino persistente, involucro quoque araneoso-tomentoso, phyllis intimis appendice lanceolata breviter attenuata nec spathulato-dilatata mutica provisis.

C: Baligali Pass, 3000 m, dry slope, pl. 3 ft. high, fl. white, stamens rose-purple, 30.VIII.1939 (Koelz 13859, Typus, hb. W., BPI.). Terak, 3000 m, dry slope, shrub 2 ft. high (Kz. 13894, hb. W., BPI.).

Die Köpfchen von 13894 sind bis 2 cm lang, am Grund deutlich verschmälert, ansonsten stimmen die Exemplare gut mit dem Typus überein.

Cousinia pseudocirsium Rech. f., n. sp. — Fig. 98 und 103 D.

Perennis. Caulis ad 1 m altus, stricte erectus, supra basin 5 mm crassus, in tertia parte superiore breviter pauciramosus, teres, tenuiter sulcato-striatus pallidus, minute glanduloso-papillosus, internodiis elongatis mediis saepe ultra 10 cm longis. Folia basalia ignota. Folia omnia pinnatipartita, rachide et segmentis 5 mm latis margine revolutis, sensim in spinas vulnerantes ad 5 mm longas stramineas abeuntibus, segmenta angulo recto abeuntia, nervi straminei subtus prominentes, lamina discolor supra flavescenti-viridis pilis brevibus crassis glanduliferis flavescentibus scabrida, subtus appresse tomentosa nivea. Folia caulina inferiora 15 cm longa, 5 cm lata, basi paulo dilatata spinosa sessilia, segmento terminali valde elongato ad 4 cm longo, segmentis lateralibus utrinque 10. Folia caulina superiora sensim decrescentia, proportione latiora. Folia ramorum valde diminuta, prope basin lobis spinigeris paucis praedita, summa linearia subintegra concoloria dense fusco-glandulosa, in involucri phylla sensim permutata. Capitula singula terminalia. Involucrum breviter late campanulatum 3—4 cm latum, 3 cm longum, basi late rotundatum vel subtruncatum; phylla integerrima numerosissima omnino dense glandulis sessilibus fuscis punctato-scabrida, 6—7-seriata, omnia intimis exceptis e basi indurata olivacea 3 mm lata, sensim in spinam herbaceo-membranaceam erecto-patentem vel in inferioribus interdum subrecurvam attenuata spina tenui straminea terminata, nervo subtus prominente percursa. Involucri phylla seriei intimae tenuiter membranacea flexibilia subenervia aequidem dense glanduloso-punctata, margine scabrida. Receptaculi setae scabridae. Flosculi flavi, ultra 2 cm longi, involucrum superantes; laciniae 6—7 mm longae, sensim attenuatae, acutae, subpatulae. Antherarum tubus albidus glaber nitidus, longe exsertus. Achaenia immatura 8—9 mm longa, supra medium latissima fere 4 mm lata, valde compressa, perlate suberoso-marginata, utrinque rotundato-truncata, glabra, laevia non striata, pallide brunescenti-straminea; pappus scabridus subpersistens dimidium achaenium subaequans. — Species valde insignis

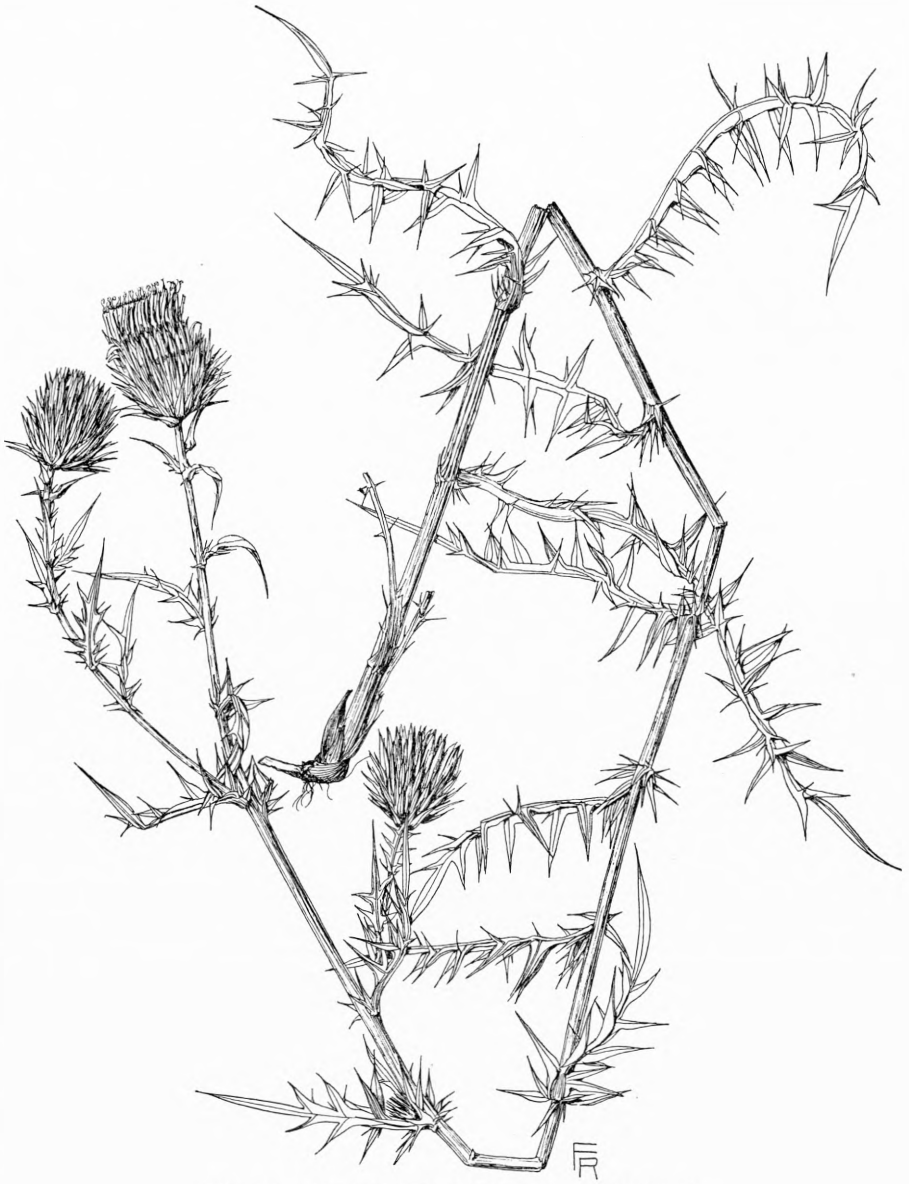


Fig. 98. *Cousinia pseudocirsium* (Kz. 13040). $^{2}/_{5}$.

probabiliter sectionem propriam sistens: habitu *Cirsii* speciem e sectione *Epitrachys* simulans, involucro dense fusco-glanduloso, involucri phyllis numerosis angustis, receptaculi setis scabridis, corollae tubo profunde in lacinias subpatulas fisso, achaeniis maximis plane compressis late suberoso-alatis, pappo subpersistente scabrido.

NE: Daraim, 2850 m, fl. yellow, anthers white, pl. 3 ft. high, 9.VII.1937 (Koelz 13040, Typus, hb. W., BPI.).

Fig. 99. *Cousinia pseudostenolepis* (E. 1356). $^1/_2$.

C. (*Odontocarpae*) ***pseudostenolepis*** Rech. f. et Edelbg., n. sp. — Fig. 99 und 103 E.

Differt ab affini *C. stenolepide* Rgl. et Schmalh. caule verosimiliter ab initio glabro, foliis supra glabris nitentibus nec araneoso-floccosis eis quoque inflorescentiae ramos fulcrantibus ut ramealia superiora non lobatis sed minute tantum spinoso-denticulatis, involucri phyllis in spinas longiores tenuiores attenuatis plurimis reflexis usque refractis, floribus numerosioribus.

NE: Faizabad, 1100—1900 m (EDELBERG 1356, hb. W., C.).

Von der ebenfalls reichblutigen *C. radians* Bge. vor allem durch die mehr als doppelt so langen, zumeist herabgebogenen äusseren und mittleren und die schmäleren und kürzeren innersten Hüllschuppen verschieden.

C. (*Lampocarpae*) *pulchella* Bge. — **NE:** Daraim, 8500 ft., flrs. rose-purple (Kz. 13054).

Cousinia pulvinaris Rech. f. et Köie, n. sp. — Fig. 100.

Pulvinos extensos verosimiliter convexos formans (e collectore). Surculi foliiferi basi lignosi fibrosi ad 1 cm crassi abbreviati copiose foliati. Caules floriferi fragmentarii anni praecedentis tantum obvii verosimiliter ultra 50 cm longi, inferne sat copiose foliati, superne ut videtur nudi, stricte erecti, apice breviter corymbose ramosi, capitula pauca partim sessilia partim terminalia proferentes. Folia surculorum sterilium cum petiolo 5 cm longa, cum spinis 3 cm lata, breviter crasse (5—10 mm) interdum indistincte petiolata. Lamina oblongo- usque obovato-spathulata, crasse rigide membranacea, juvenilis flavoviridis glanduloso-punctata glabrata, copiose sinuato-dentata, dentibus utrinque 5—7 triangularibus in spinas rigidas vulnerantes ad 3 mm longas sensim excurrentibus; lamina basin versus cuneato-attenuata, apice ambitu rotundata sed in spinam lateraliter sublongiorem abiens; nervi utrinque subtus magis prominentes, medianus supra applanatus, laterales angulo fere recto abeuntes, tertiarii vix visibiles. Folia caulina decrescentia, proportione verosimiliter angustiora. Capitula anni praecedentis valde fragmentarie tantum obvia, depresso-hemisphaerica absque spinis ca. 3 cm diametro, ca. 15 mm longa; phylla exteriora et media basi ad 5 mm lata, lanceolata, sensim in spinas validas ad 15 mm longas subarcuato-patentes attenuata. Cetera ignota. Planta evidenter serotina.

SW: Jija, 1200 m, big tufts on rock. 10.IV.1949 (KÖIE 4047, hb. C.).

Habituell der *C. rhabdodes* Bornm. et Rech. f. ähnlich, die ebenfalls spätblühend und nur fragmentarisch bekannt ist, aber in den feinen, kurzen Hüllschuppen, übrigens auch in der feinen, erhabenen Netznervatur der Blätter wesentlich verschieden ist.

BORNMÜLLER reiht *C. rhabdodes* mit Vorbehalt bei den *Spicatae* ein, obwohl (vg. Abb.) die Anordnung der Köpfchen wenigstens an einigen deutlich ausgebildeten Seitenästen deutlich korymbos ist. Die systematische Stellung beider höchst bemerkenswerter Arten bleibt wegen Mangelhaftigkeit des Materials vorläufig unsicher.

C. (*Odontocarpae*) *pycnoloba* Boiss. (Syn. *C. scala* Aitch. et Hemsl. fide Boiss. Suppl. Fl. or.). — **E:** Koh Gaworgin südlich vom Stausee Tschakewardak, 2700 m,

Fig. 100. *Cousinia pulvinaris* (K. 4047). $^{3}/_{5}$.

(GILLI 2520). Gipfel eines Kalkberges NW vom Stausee Tschakewardak, 2540 m (GILLI 2519).

C. (*Spicatae*) *racemosa* Boiss. — C: Farakulum, 2800 m (K. 2682).

Cousinia (*Odontocarpae*) ***ramulosa*** Rech. f., n. sp. — Fig. 101 und 103 F.

Basi lignescens pluricaulis, collo paucifibroso. Caulis erectus, verosimiliter ultra 50 cm altus, teres pallide brunescens laxe araneoso-floccosus demum imprimis in parte superiore fere complete glabratus, internodiis mediis 3—5 cm longis, laxe foliatus, in dimidio superiore iteratim corymbose ramosus, ramis tenuibus angulo ± acuto abeuntibus remote minute foliatis. Folia basalia numerosa rosulata, non vel vix petiolata, basi subito breviter dilatata 3—5 mm lata fuscescentia glabrata membranacea elevate tenuiter striata, ibique margine spinulis erecto-patentibus pectinato-ciliata; lamina ad 15 cm longa, ad 3.5 cm lata, ambitu lineari-lanceolata, pinnata; rachis tenuissima fragilis, vix ultra 1 mm crassa, pallida, floccoso-tomentella, angustissime in parte inferiore vix manifeste herbaceo-alata; pinnae usque 20-jugae, inter se ± 5 mm remotae, a basi ad $^2/_3$ laminae longitudinis sensim increscentes rectangulariter patentes, ad summum 15 mm longae, ± 1 mm latae, basi pinnulis brevioribus usque subaequilongis liberis subverticillatim dispositis auctae, supra virides demum ± complete glabratae, saepe fere ad nervum medianum tenuem pallidum convolutae, subtus appresse albido-tomentellae; nervus medianus in spinam tenuissimam 1—2 mm longam excurrens. Folia caulina inferiora similia sed abbreviata, pinnis ± 15-jugis magis approximatis. Folia caulina superiora ramos inflorescentiae fulcrantia ambitu triangulari-lanceolata 3—4-jugo-pinnata, rachide latius alata pinnisque sublatioribus minus arcte revolutis, spinis longioribus usque 3 mm, terminali usque 4 mm longa. Folia ramealia numerosa valde decrescentia, basi pinnulis spinoso-lobiformibus reductis aucta usque simplicia, superiora in involucri phylla quasi sensim transientia. Capitula singula terminalia et in ramis partim abbreviatis sublateralia partim ± approximata. Involucrum juvenile ovato-cylindricum, adultum anguste ovato-campanulatum 20—25 mm longum, absque spinis 12—14 mm diametro, basi rotundatum persistenter araneoso-floccosum, superne leviter constrictum, phylla plerumque 4-seriata, ± 60, exteriora e basi ± 2 mm lata sensim in spinam patulam usque 15 mm longam vulnerantem sensim attenuata, rigide membranacea pallide flavido-viridia, basi flavescentia indurata, apicem versus glabrescentia, nervo pallido valido percursa, margine minutissime papilloso-ciliolata; phylla media similia; intima tenuiter membranacea, in appendicem pallide bruneam lanceolatam acutam longissime exsertam molliter spinescentem dense papillosam opacam attenuata. Receptaculi setae scabrae. Corolla in sicco quidem manifeste flava, ± 15 mm longa, laciniis linearibus, acutis, 2.5—3 mm longis. Antherarum tubus glaber, in vivo roseus in sicco expallens. Achaenia submatura 5 mm longa, 2 mm lata, basi attenuata, apice truncata indistincte paucidenticulata, pallide brunea, laevia, valde indistincte longitudinaliter paucistriata. — Insignis caule elato copiose iteratim tenuiter

Fig. 101. *Cousinia ramulosa* (Kz. 12978). $^1/_2$.

corymbose ramoso, foliis ramealibus numerosis basi lobulis spinosis paucis auctis usque lanceolatis indivisis; involucris sat anguste ovato-campanulatis copiose persistenter floccoso-araneosis phyllis in spinas sat breves erecto-patentes herbaceas attenuatis intimis anguste lanceolatis scariosis, floribus evidenter flavis.

NE: Khash Distr., 3350 m, 9.VIII.1937 (Koelz 12978, hb. W., BPI.).

Die Angabe des Sammlers „flowers rose" bezieht sich offenbar auf den Antherentubus, nicht auf die Korolle.

Cousinia (*Homalochaetae*) ***robusta*** Rech. f., n. sp. — Fig. 102 und 103 G.

Radix deest sed planta verosimiliter perennis. Caulis ad 1 m altus, inferne ad 15 mm crassus, brunescens, sulcato-striatus, laxiuscule breviter glanduloso-pilosus, internodiis mediis ± 5 cm longis, a medio breviter ramosus florifer. Folia basalia et caulina infima non visa; caulina inferiora et media ad 12 cm longa, ad 4 cm lata, ambitu lineari-lanceolata, consistentia rigide coriacea, pallide flavescenti-viridia concoloria; rachis pallida nitidula supra plana subtus convexa prope basin valde dilatata ad 1 cm lata, nervi secundarii angulo recto abeuntes, in lobos spinis tenuibus rigidis ad 2 mm longis terminatos excurrentes; lamina omnino brevissime glanduloso-pilosa, profunde dense late pectinato-lobata, lobi prope basin 5—10 mm lati, breviter conjuncti, rectangulariter patentes utrinque 15—20, inferiores prope basin plerumque lobis accessoriis brevioribus aucti. Folia superiora ramos fulcrantia abbreviata, basi magis dilatata, apicem versus magis attenuata. Capitula depresso-globosa, spinis inclusis 5—6 cm diametro, ad extremos ramos singula. Involucrum araneosum, phylla quadriseriata valde numerosa saepe ultra 80, virescentia, rigide coriacea, exteriora et media squarroso-patula vel inferiora reflexa, costa mediana valida straminea in spinam ad 2 mm longam vulnerantem excurrente percursa, nervis secundariis parallelis interdum visibilibus; phylla intima minus rigida erecta, quam flosculi ut videtur breviora. Flosculi roseo-purpurei 15—23 mm longi, laciniis 3—4 mm longis tubo multo brevioribus. Antherarum tubus purpureus glaber nitidus. Receptaculi setae laeves. Achaenia immatura 5 mm longa, compressa brunescentia laevia, basin versus attenuata indistincte longitudinaliter paucicostata; pappus valde deciduus quam achaenia longior, albus, nitidus, laeviusculus. — Differt a *C. chamaepeuce* Boiss. et ab affinibus: caule multo validiore, colore flavido-viridi totius plantae, indumento glanduloso nec arachnoideo-floccoso, rachide foliorum perlata, segmentis brevibus latis breviter spinulosis.

C: Lorinj Pass, dry slope, 3550 m, 3 ft. high, flowers rose-purple, 27.VIII.1939 (Koelz 13774, hb. BPI.).

C. (*Brachyacanthae*) *rufidula* Bornm. — **NW:** Badghis (Aitchison 365, hb. C.). Obeh, 1700 m (K. 3765). *Artemisia*-Steppe nördlich von Herat, 940 m (Gilli 2531). — **SW:** S. of Herat, 1000 m (K. 2231), 1200 m (K. 3934).

Frisch ausgetriebene Blattsprosse und überwinterte Köpfchen stimmen in allen vergleichbaren Merkmalen mit dem Isotypus im Hb. C. (Aitchison 753) überein. Der Typus ist im Juli gesammelt, die Köie'schen Exemplare wenigstens teilweise (3934:29/4) zu einer wesentlich früheren Jahreszeit. Damit dürfte im Zusammenhang stehen, dass die Hüllen grünlich, nicht rötlich (Bornmüller), tatsächlich rotbraun und kurzfilzig, nicht äusserst schwach filzig sind.

Das Indument von 3934 ist kurz angedrückt wie beim Typus, bei 2231 etwas mehr abstehend und dadurch kurz wollig wirkend. Aitchison 365 (Badghis, hb. C) mit vorjährigen Köpfchen halte ich ebenfalls für *C. rufidula*.

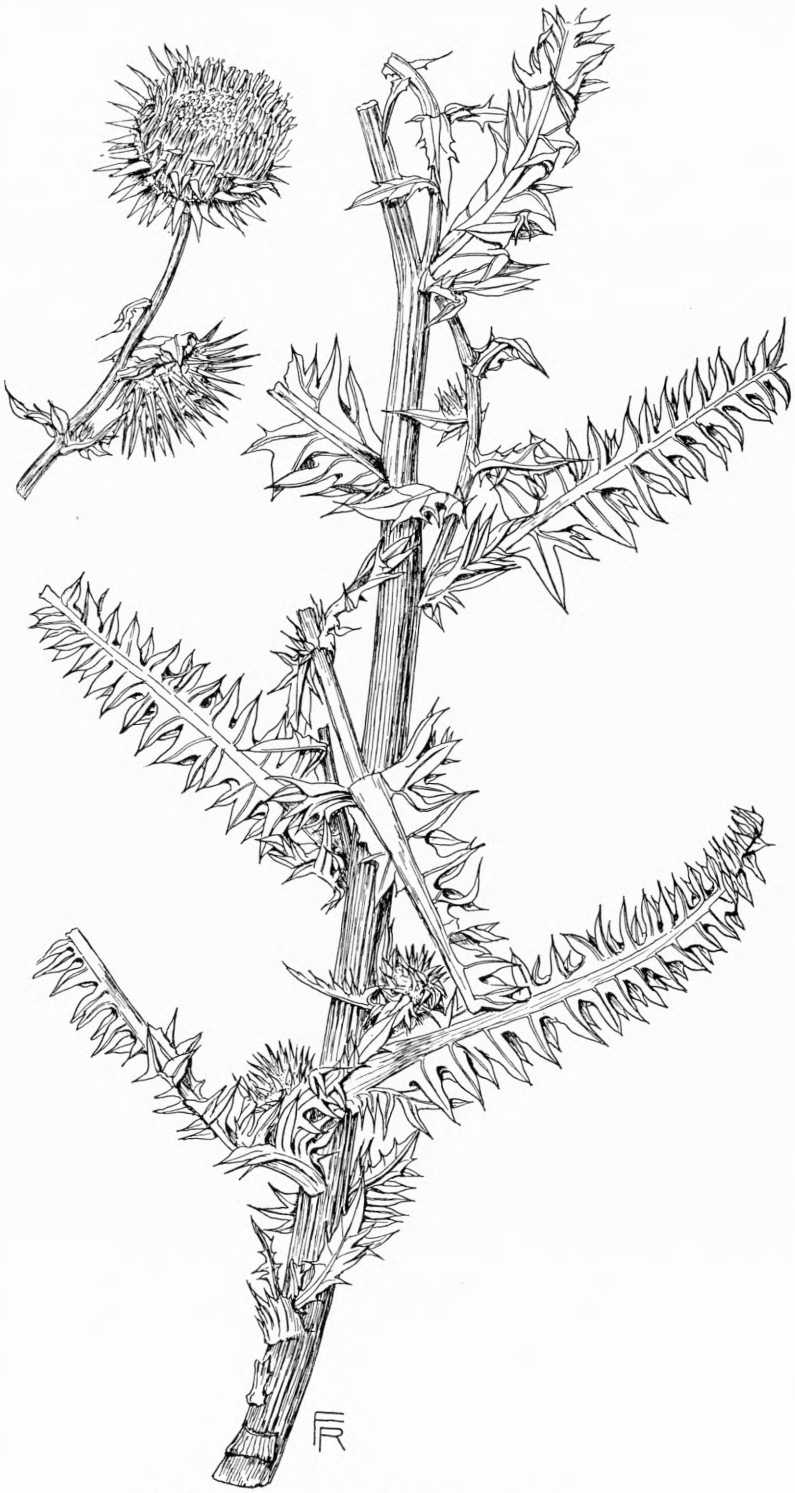


Fig. 102. *Cousinia robusta* (Kz. 13774). $^1/_2$.

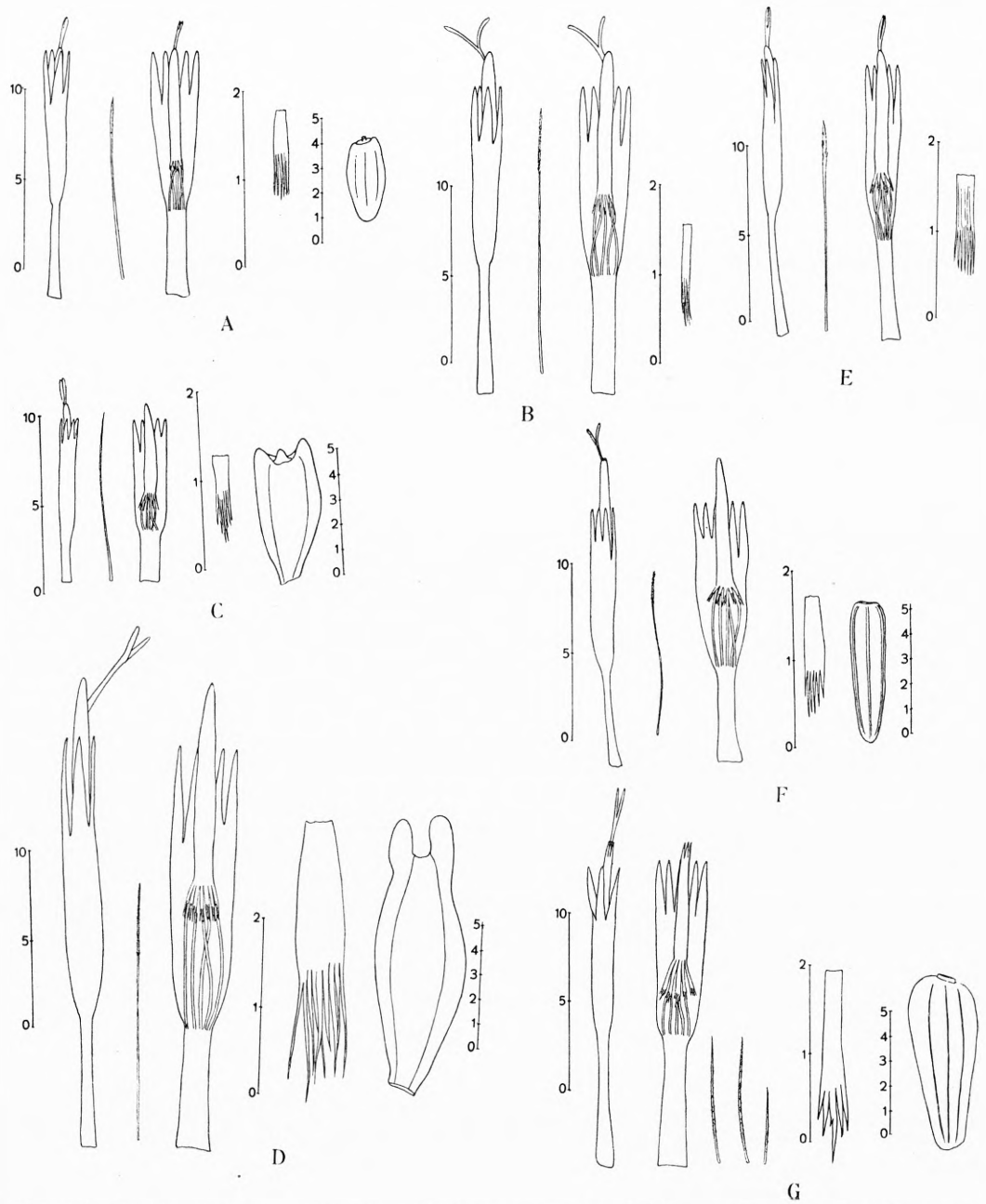


Fig. 103. Korolle geschlossen, Korolle geöffnet, Spreuschuppe, Antherenanhängsel und Achäne von: A *Cousinia pineticola*, B *C. polyneura*, C *C. pseudactinia*, D *C. pseudocirsium*, E *C. pseudostenolepis*, F *C. ramulosa*, G *C. robusta*.

C. (*Foliaceae*) *scariosa* Reg. — **E:** Tschakewardak unter dem Gipfel eines Kalkberges NW vom Stausee, 2540 m (GILLI 2534).

C. (*Odontocarpae*) *Scheibeana* Bornm. — **NE:** Khash Distr., 10000 ft., in clumps, flrs. old rose (Kz. 13006). Parun-Minjan Pass, 3500 m (E. 1260).

E. 1260 und K. 13006 stimmen mit der Abbildung habituell in der Form der mittleren Stengelblätter und Form, Grösse und Behaarung der Köpfchen gut überein, unterscheiden sich aber:

1) durch an den seitenständigen Aesten regelmässig vorhandene, eiförmig-lanzettliche, kurz bedornte, ganzrandige Blätter;

2) durch das Fehlen der den Köpfchen genäherten 3-teiligen, reduzierten Stengelblätter;

3) durch "old-rose" (trocken schmutzig rosa), nicht weissliche Blütenfarbe.

Das Merkmal der ganzrandigen oberen Stengelblätter teilt die vorliegende Pflanze übrigens mit der gewiss nahe verwandten *C. Thomsonii* Clarke (laut authentischem Exemplar aus Kew), die unter anderem im übrigen durch grössere Hüllschuppen und doppelt so lange, sparrig abstehende Hüllblätter verschieden ist.

Cousinia (*Odontocarpae*) ***schistosa*** Rech. f. et Edelberg, n. sp. — Fig. 104 und 113 A.

Verosimiliter biennis, radix verticalis fusiformis paucifibrosa, e collo caules plures foliaque numerosa rosulata emittens. Caules erecti vel ascendentes, ± 20 cm alti, tenues, internodiis mediis ± 3 cm longis, tenuiter striati, laxe floccoso-tomentelli glabrescentes, a medio vel a tertia parte superiore divaricate tenuiter corymboso-ramosi floriferi, tota longitudine foliati. Folia omnia tenuiter molliter herbaceo-membranacea, discoloria, subtus tenuiter appresse araneoso-tomentella albida vel glaucescenti-canescentia, supra laxissime arachnoidea glabrescentia et sparse glanduloso-punctata laete viridia, nervatura tenuissima praeter costam medianam vix prominente. Folia rosularia ad summum 10 cm longa, 2 cm lata, interrupte lyrato-pinnatifida, verosimiliter breviter petiolata (1.5 cm); segmentum terminale ceteris pluries maius, ± 3 × 2 cm, plerumque oblique ovato-triangulare, basi subcordatum vel rotundatum vel attenuatum, apice valde acutum, margine minutissime remote spinulosum; segmenta lateralia basin versus decrescentia, ad summum 1 cm longa, 5 mm lata, basin versus attenuata rachidi ± oblique adnata, angustissime decurrentia, cum lobulis vel denticulis alternatia, margine ut segmenta terminalia. Folia caulina inferiora similia, media et superiora valde decrescentia, basi auriculato-cordata spinuloso-lobulata sessilia, non decurrentia, ambitu ovata vel oblonga vel summa lanceolata, saepe recurva, irregulariter spinuloso-lobulata spinulis quam in foliis infimis sublongioribus, subtus indumento densiore albà. Capitula singula terminalia; involucrum absque spinis ± 15 mm longum, ± 12 mm diametro, cylindrico-campanulatum, basi subtruncato-rotundatum et leviter umbilicato-impressum, valde laxe araneosum glabrescens, flavescenti-viride; phylla ± 6-seriata, ± 80, omnino subulato-lanceolata usque linearia, dorso nervo pallido tenui subcarinata,

Fig. 104. *Cousinia schistosa* (E. 1116). $^{3}/_{4}$.

subtriquetra, extima et exteriora a basi in spinam 3—5 mm longam tenuem, ± 0.5 mm latam recurvam vel patulam sensim attenuata; phylla seriei paenultimae applanata latiora ad 1 mm lata, sub apice interdum leviter constricta, margine minutissime serrulata, apice breviter spinoso-acuminata; phylla intima in appendicem tenuiter scariosam pulchre purpureo-roseam nitentem glabram elongato-lingulatam molliter spinosam, basi fere 2 mm latam erectam abeuntia. Receptaculi setae imprimis in parte superiore subscabridulae. Corolla pulchre roseo-purpurea 16—18 mm longa, tubo filiformi 5 mm longo, laciniis 3—4.5 mm longis. Antherarum tubus roseus. Achaenia nondum matura. — In proximam affinitatem *C. buphthalmoidis* Boiss. pertinet a qua differt: foliis tenuibus mollibus subinermibus, involucris parvis, involucri phyllis angustissimis brevibus spinis involucri diametro semper duplo vel magis brevioribus, corollae parte basali proportione dimidio breviore.

Nuristan: Kamdesh, 1900 m, 20.VI.1948 (EDELBERG 1116, hb. W., C.). Substr. (e residuis in radice foliisque) verosimiliter mico-schistaceum (inde nomen).

Könnte nach dem Wortlaut des WINKLER'schen Schlüssels fast unter den *Inermes* eingereiht bezw. gesucht werden, wo die Art absolut nicht hingehört!!

C. (*Heteracanthae*) *schizoptera* Juzepzuk, Act. Inst. Bot. Acad. Sc. URSS. — **NW:** Obeh-Chisht, 1700 m (K. 4042). — **SW:** Herat, 1100 m (K. 3813). Between Dilaram and Herat, 1100 m (K. 3320).

C. (*Uncinatae*) *spuria* Juzepzuk (e descr.). — **NE:** Daraim, 8500 ft., 6 ft. high, flrs. rose-purple (Kz. 13048).

Cousinia (*Heteracanthae*) ***stenocalathia*** Rech. f., n. sp. — Fig. 105 und 113 B.

Certe perennis, multicaulis. Caules 30—40 cm alti, tenues, prope basin ca. 4 mm diametro, a basi iteratim divaricate corymbose ramosi, appresse albo-floccoso-lanati, internodiis mediis 3—5 cm longis, tota longitudine copiose foliati. Folia omnia consistentia rigide membranacea, supra pallide flavo-viridia nitentia, subtus appresse albo-tomentosa glauco-virentia, nervis utrinque prominentibus, secundariis angulo fere recto a costa mediana abeuntibus, tertiariis crebre reticulato-anastomosantibus subtus tantum prominentibus. Folia caulina infima ad 12 cm longa, ad 8 cm lata, supra medium latissima, basi ad tertiam partem vel ad medium internodium late cuneato-decrescentia, antice late rotundata, omnino late leviter subduplicato-sinuato-dentata, dentibus brevibus perlate triangularibus in spinas rigidas 2—5 mm longas excurrentibus. Folia superiora sensim paulo decrescentia, superiora internodiis abbreviatis partim complete decurrentia, summa capitula conglobata congesta involucrantia. Involucrum ± 15 mm longum, ± 3 mm diametro, anguste cylindricum, basi attenuatum, omnino appresse araneoso-tomentellum virescens, oligophyllum, phyllis 4—5-seriatis omnibus — extimis et intimis rectis exceptis — in mucronem induratum 2—3 mm longum rectangulariter patentem vel subrecurvum excurrentibus; phylla intima membranacea pallide brunea nitidula flexibilia, in mucronem non

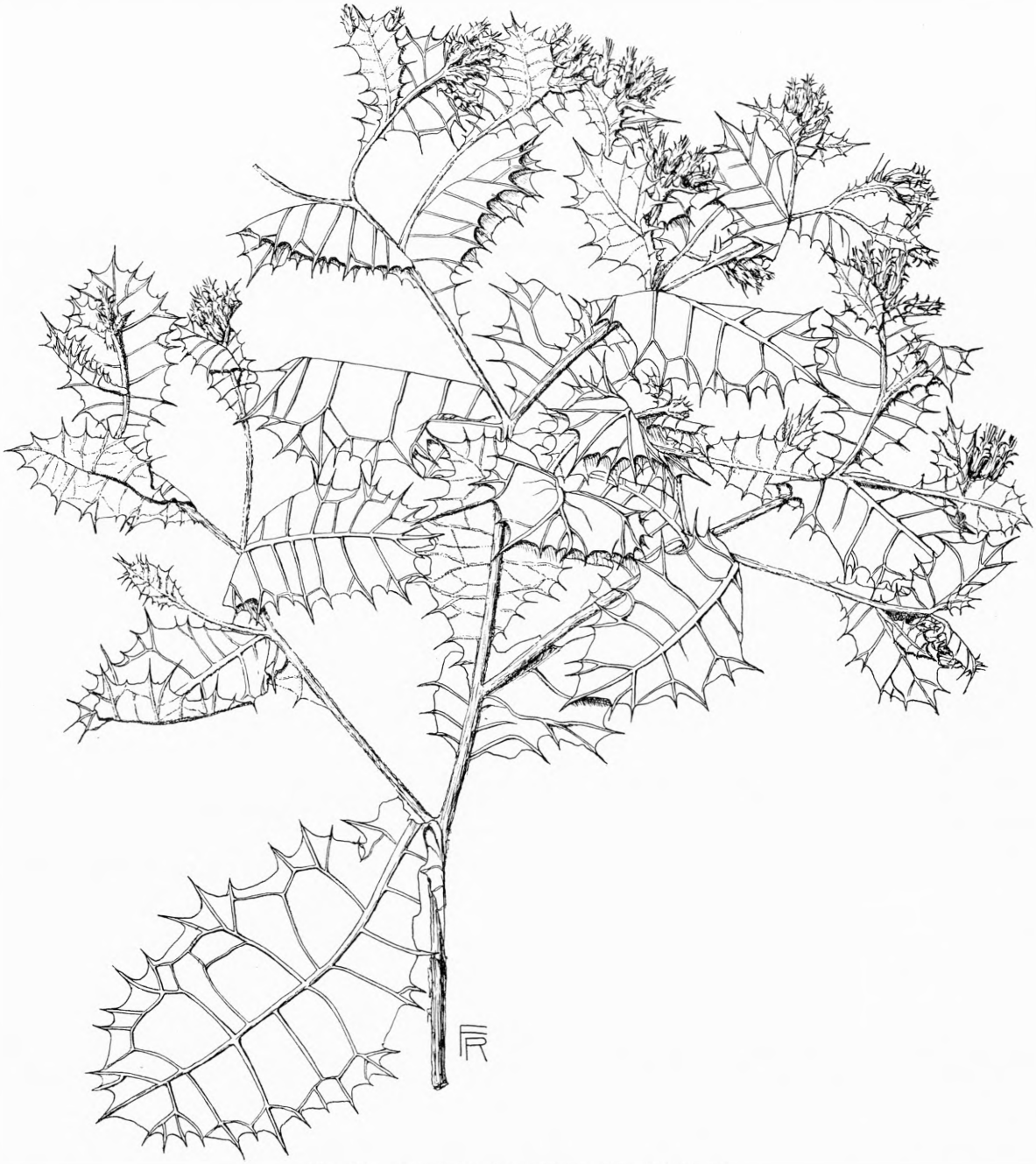


Fig. 105. *Cousinia stenocalathia* (Kz. 12852). $^1/_2$.

pungentem rectum longe sensim attenuata. Receptaculi setae pallidae, laeves. Flores plerumque terni, corollae tubus ± 10 mm longus, flavus, limbus in lacinias vix 3 mm longas anguste lanceolatas acutas fissus. Antherarum tubus glaber roseo-violaceus, in sicco expallens. Achaenia minuta ± 1.5 mm longa, bruneo-grisea, basin versus attenuata, superne truncata, compresso-subtriquetra, longitudinaliter sublamellato-costata. — Affinis videtur *C. leucocitrinae* Kult. (mihi e descriptione tantum notae) et *C. tetanocephalae* Bornm. et Gauba; insignis capitulis anguste cylindricis basi attenuatis appresse araneoso-tomentellis, phyllis in spinas rigidas rectangulariter patentes usque subrecurvas excurrentibus, foliis discoloribus supra nitidis ad dimidia internodia late cuneato-decurrentibus, achaeniis minutis sublamellato-costatis, floribus flavis.

NE: Hasratsaid, 2700 m, dry ground, in clumps, fl. yellow, 2.VIII.1937 (Koelz 12852, hb. W., BPI., Typus). Jurm, 1650 m, 6.VII.1948 (E. 1416, hb. C.).

Das zweite Exemplar ist fragmentarisch, stimmt im wesentlichen mit dem Typus überein, nur sind die Köpfchen etwas länger, die Blüten etwas grösser, die Blattlappen deutlicher ausgeprägt und länger bedornt.

Cousinia (*Foliaceae*) ***stereolepis*** Rech. f., n. sp. — Fig. 106 und 113 C.

Verosimiliter perennis. Caulis validus elatus ad 85 cm altus (e collectore), inferne ad 7 mm crassus, erectus subflexuosus fragilis, internodiis valde elongatis mediis 7—9 cm longis, laxe floccoso-tomentellus valde glabrescens eburneus, in quinta circiter parte superiore breviter stricte corymbose ramosus. Folia basalia et caulina inferiora desunt, caulina media basi semiamplexicauli sessilia non decurrentia, ibique spinoso-auriculata, lamina ambitu ovato- usque oblongo-subtriangularis ad 15 cm longa, spinis inclusis ad 9 cm lata, costa mediana pallida dilatata prope basin ad 5 mm lata subtus convexa supra applanata vel leviter concava, tota longitudine latiuscule (3—4 mm) alata, ut lamina supra flavescenti-viridis laxe floccoso-tomentella glabrescens, subtus dense appresse persistenter albo-floccoso-tomentosa; lamina pinnata; pinnae utrinque 3—4, non oppositae sed semper alternantes, profunde bi- vel subtrifidae, prope basin ± 1 cm latae, nervis binis usque subternis validissimis pallidis utrinque prominentibus, in spinas tenues vulnerantes ad 5 mm longas excurrentibus sensim attenuatae; pinnae inter se 2—3 cm remotae planae (nec subverticillatim dispositae), lobulo tertio rachidi appresso vel parallelo interdum rudimentario vel valde diminuto. Folia caulina superiora non visa verosimiliter diminuta valde caduca. Rami inflorescentiae erecto-patentes subflexuosi, inferiores ad 10 cm longi interdum furcati, ceteri breviores simplices monocephali. Capitula singula terminalia, involucrum absque spinis 20—25 mm longum et latum, breviter campanulatum usque depresso-hemisphaericum; phylla ± 4-seriata, ± 70, rigide coriacea flavescentia, tota facie exteriore papilloso-scabra, exteriora basi valde dilatata 8—10 mm lata ibique distincte usque subindistincte parallele 3—5 nervia, in spinam inferne applanatam superne subtriquetram 2—3 cm longam patentem valde vulnerantem subabrupte attenuata; phylla interna sensim minus dilatata non vel valde indistincte nervosa, minus patentia minus vulnerantia; interna in

appendicem lanceolato-subulatam flexibilem tenuiter membranaceam opacam facie asperam erectam stramineam enerviam sensim attenuata. Receptaculi setae breves scabrae. Corolla ± 15 mm longa roseo-purpurea glanduloso-papillosa (e collectore) tubo quam limbo plus quam dimidio breviore; laciniae lineares acutae ad 3 mm longae. Achaenia ad 9 mm longa, ± 4 mm lata, foliaceo-applanata pallide brunea submaculata fere laevia vel indistincte longitudinaliter subelevato-striata circumcirca perlate suberoso-alata, ala pallida laevis nitida imprimis in parte superiore fere 1 mm lata, utrinque in auriculas elongato-rotundatas ± 1.5 mm longas ± 1 mm latas protracta. Pappus pauciradiatus tertiam circiter partem ± achaenii aequans scaber fragilis fugax. — Species inter affines foliis grosse remote alternatim paucipinnatis, pinnis profunde palmatilobatis valde spinosis, spinis planis basi dilatatis, involucri phyllis numerosis omnino papilloso-scabris exterioribus valde dilatatis longissimis, achaeniis maximis perlate alatis apice biauritis insignis.

NW: Bandichakawak, field, 3000 m, collected for feed, fl. rose-purple, 29.IX. 1939 (Koelz 14050, hb. W., BPI.).

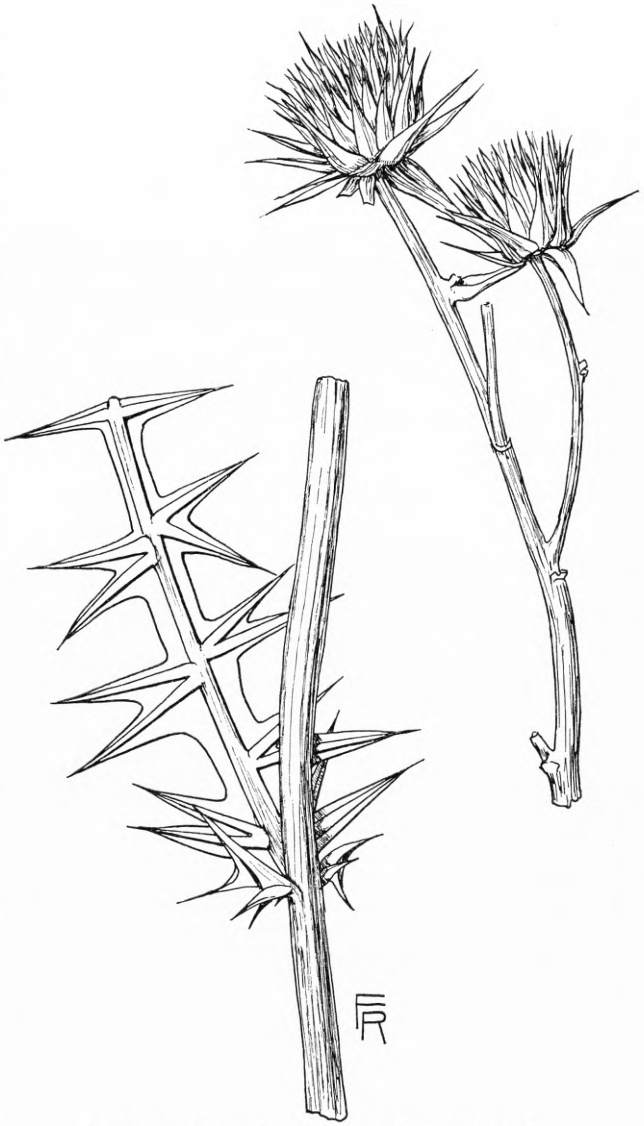


Fig. 106. *Cousinia stereolepis* (Kz. 14050). $^{2}/_{3}$.

Cousinia (*Odontocarpae*) ***stereoneura*** Rech. f., n. sp. — Fig. 107 und 113 D.

Suffrutescens caespitosa multicaulis. Caules ad 30 cm alti, tenues straminei, laeves, imprimis inferne floccoso-lanati, superne quoque omnino glabrescentes, internodiis mediis 3—4 cm longis, a medio interdum furcato-ramosi, ramis tenuibus erecto-patentibus. Folia rosularia basalia et caulina inferiora 3—6 cm longa, 1—2 cm lata, ambitu lanceolata, pectinato-pinnata, costa mediana demum incrassata ligne-

Fig. 107. *Cousinia stereoneura* (Kz. 13814). $^1/_2$.

scens persistens indurata spinescens, anguste alata; pinnae utrinque usque 7 rectangulariter patentes nervo aequidem indurato persistente spinescente percursae, in foliis maioribus ± 1 cm inter se remotae, anguste revolute alatae, supra lanato-tomentellae ± glabrescentes, subtus persistenter albido-tomentosae. Folia caulina perpauca, media subito valde decrescentia, nervis minus rigidis, pinnis multo minus numerosis brevioribus. Folia ramealia perpauca valde diminuta linearia integra spinuloso-acuminata, cauli appressa. Capitula singula terminalia. Involucrum absque spinis 12—14 mm longum, 7—10 mm diametro, campanulatum, basi breviter rotundatum vel fere attenuatum laxe araneosum glabrescens; involucri phylla 4—5-seriata, ca. 45—55, basi indurata pallide brunea imbricata, media subito in spinam tenuem patentem vulnerantem 8—12 mm longam attenuata; spina phyllorum extimorum abbreviata ± reflexa, interiorum abbreviata porrecta; phylla intima exserta tenuiter scariosa ± flexibilia purpurascentia, in appendicem pallidiorem lanceolatam molliter spinulosam excurrentia. Corolla roseo-purpurea, 10—12 mm longa, laciniis anguste lanceolatis acutis porrectis ca. 2 mm longis. Antherarum tubus pallide roseus glaber breviter exsertus. Receptaculi setae pallidae laeves. Achaenia nondum matura ± 3 mm longa, sublinearia, basin versus paulo tantum attenuata, apice subrotundato-truncata, tenuiter longitudinaliter lineato-costata, atrobrunea, laevia. — Species in sectione insignis foliorum rachidibus modo *C. Stocksii* vel specierum sectionis *Neurocentrae* induratis, persisten-

tibus, praeterea capitulis minutissimis angustis, involucri phyllorum spinis pro ratione tenuissimis longis, achaeniis longis angustis.

C: Sabz Pass, 3350 m, dry slope, fl. rose-purple, 28.VIII.1939 (KOELZ 13814, Typus, hb. W., BPI.). Kalkberg nordöstlich von Bamian, 3000 m, oberflächlich verkrusteter, von Kalkschutt bedeckter Lehmboden (GILLI 2540). Bamian, 2900 m, stark verkrusteter, mit kleinem Schieferschutt bedeckter Lehmboden (GILLI 2541, differt a typo involucri phyllorum spinis magis recurvis).

C. (*Orthacanthae*) *Stocksii* C. Winkl. — **SW:** Jija, 1000 m (K. 4044). — **SE:** Pirzada, 900 m (K. 2087). Halbwüste zwischen Farah und Girischk, polsterbildend (GILLI 2517). Halbwüste nördlich von Kandahar, 1070 m (GILLI).

C. (*Heteracanthae*) *Sven-Hediniana* Bornm., B.B.C. 34/2:268 (1917). — **NW:** Badghis (AITCH. 486, 515, hb. C.). — **SW:** Herat, 1300—1500 m (K. 2285, hb. W., C.).

Diese Art wurde ursprünglich von AITCHISON und HEMSLEY mit *C. chamaepeuce* Boiss. verwechselt. Von BORNMÜLLER wurde sie, offenbar durch diese Verwechslung verleitet, zur Sektion *Homalochaetae* gestellt und nur mit *C. chamaepeuce* verglichen. Tatsächlich ist aber *C. Sven-Hediniana* der *C. lachnosphaera* Bge., die im selben Gebiet heimisch ist, ausserordentlich ähnlich und muss also zu den *Heteracanthae* übertragen werden. Die Aehnlichkeit geht so weit, dass die Möglichkeit einer spezifischen Abgrenzung ernstlich angezweifelt werden muss. Da mir *C. lachnosphaera* nun aus dem angrenzenden Khorasan in ihrer Variationsbreite gut bekannt ist, bleiben eigentlich nur mehr die grösseren Köpfchen der *C. Sven-Hediniana* als Unterschied. — Was die Sektionszuteilung betrifft, so sind hierfür nach WINKLERS Mantissa p. 190 die Achänen massgebend, die bei Sekt. *Homalochaetae* "ecostata obovata apice rotundata" sind, bei Sekt. *Heteracanthae* dagegen "costata obpyramidata 3—5-gona truncata denticulata". BORNMÜLLER hat von seiner *C. Sven-Hediniana* nur unreife Achänen gesehen: "achaeniis laevibus striato-angulatis, apice rotundatis". Der Passus "striato-angulatis" lässt immerhin die Vermutung zu, dass die reifen Achänen gerippt sind. Die Achänen von KÖIE 2285, die mit dem Isotypus übereinstimmt, sind knapp über 4 mm lang, etwa 2 mm breit, schmal verkehrt pyramidenförmig, etwas zusammengedrückt, vierkantig, die Kanten kaum heller als die schwärzlichen Flächen, kerbig-unterbrochen, die Flächen matt, etwas uneben; Achänen an der Spitze abgerundet, gestutzt, nicht gezähnt. Die abgerundete Spitze würde zu *Homalochaetae* führen, die verkehrt pyramidale, vierrippige Gestalt dagegen zu *Heteracanthae!* — Die fast durchaus zurückgekrümmten Hüllschuppen sprächen für *Drepanophorae!* — Also ein neuer Beweis für die Künstlichkeit und Unhaltbarkeit des WINKLER'schen Systems.

Cousinia tragacanthoides Rech. f. et Gilli, n. sp. — Fig. 108, 109 und 113 E.

Suffruticosa, dense caespitosa, erinacea. Caules floriferi 4—10 cm longi, e caespitibus saepe breviter tantum exserti, monocephali, internodiis infimis valde abbreviatis, mediis ± 10 mm longis, tenuiter sulcato-striati, appresse araneoso-tomentelli, demum ± glabrescentes. Foliorum rachides induratae persistentes. Folia omnia appresse araneosa canescentia, lamina ad alas angustissimas revolutas secundum rachides primarias est secundarias reducta, rigida, patentia, plerumque trijugo-pinnata; pinnae simplices integrae rigidae basi quoque spinulis non auctae, ± antrorsae, ad 15 mm longae, ± 1 mm latae, spinosae. Folia caulina superiora decrescentia, patentia, basi aliquantum dilatata, palmatim spinosa sessilia, non de-

Fig. 108. *Cousinia tragacanthoides* (GILLI 2558). $^1/_1$.

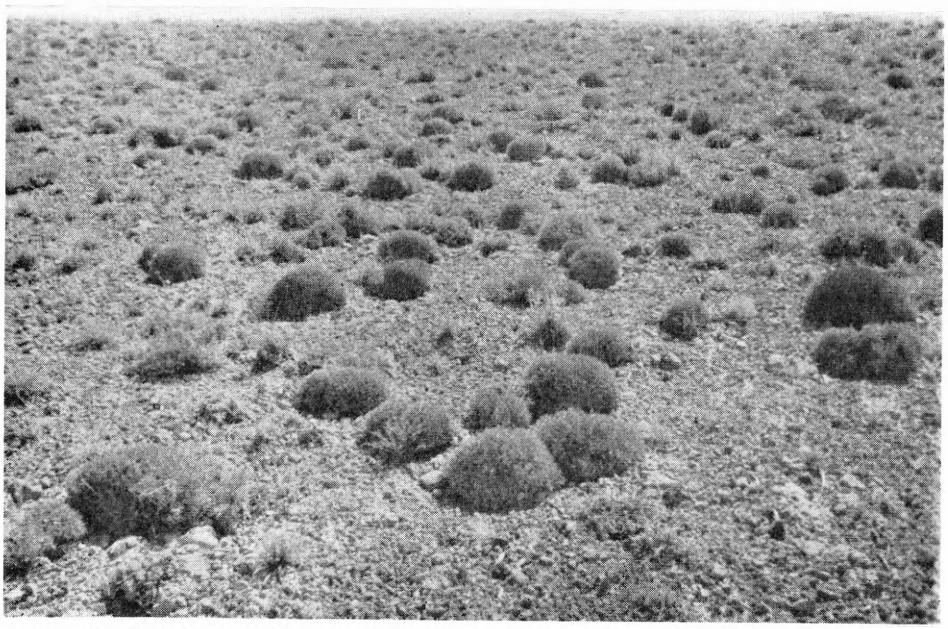


Fig. 109. Kalkberg bei Bamian. Polsterbildende *Cousinia tragacanthoides*. – Phot. GILLI.

currentia, 1—2-jugo-pinnata usque subintegra, ceterum inferioribus similia. Capitula singula terminalia. Involucrum absque spinis 12—13 mm longum, ± 8 mm diametro, basi rotundatum vel subimpressum, superne attenuatum, phylla ca. 30—40, plerumque 4-seriata, flavescenti-viridia subglabra demum brunescentia, rigide coriacea, basi dilatata ad 3 mm lata appressa utrinque saepe breviter paucispinulosa, supra basin in spinam latam applanatam rigidissimam patentem vel ± recurvam 8—12 mm longam vulnerantem abeuntia; costa mediana flavescens subtus prominens, nervis ± indistinctis parallelis nonnullis; phylla mediana in spinas breviores erecto-patentes attenuata; phylla intima in appendices late lanceolatas molliusculas scariosas albidas vel brunescentes molliter spinuloso-acuminatas margine minutissime denticulatas excurrentia. Flores achaeniaque nondum evoluti. — Species peculiaris, probabiliter in affinitatem remotiorem *C. multilobae* DC. inserenda, habitu tragacanthoide, phyllis exterioribus basi attenuatis spinuliferis in spinam terminalem latam applanatam excurrentibus, foliis omnino ad rachides spinosas reductis insignis.

C: Kalkberg nordwestlich von Bamian, 3000 m. Oberflächlich verkrusteter, mit Kalkschutt bedeckter Lehmboden. Die *Cousinia* bildet grosse Dornpolster. 18.VII. 1949 (Gilli 2558, hb. W.).

C. (*Uncinatae*) *umbrosa* Bge. — **NW:** Bandar, 7000 ft., dry slope, 6 ft., rose-purple (Kz. 14111). — **C:** Lorinj, 8000 ft., along field, 3 ft., (Kz. 13714).

C. (*Odontocarpae*) *verticillaris* Bge. — **C:** Koh-i-Baba, 3200—3800 m (K. 2639).

Cousinia (*Heteracanthae*) ***xanthacantha*** Regel, descr. emend. — Fig. 110 und 113 F.

Perennis verosimiliter pluricaulis, collo paucifibroso inter fibras lanato. Caulis 50—60 cm altus stricte erectus paucinodus, internodiis mediis 7—8 cm longis, tenuiter sulcato-striatus, pallide bruneus, laxe araneoso-floccosus valde glabrescens, in tertia parte superiore breviter corymbose pauciramosus. Folia omnia consistentia in sicco coriaceo-membranacea sed fragilia, utrinque laxe araneosa sed sub indumento evidenter nitidula, concoloria canescenti-viridia, costa mediana supra applanata subtus valde convexa, nervatura utrinque subtus crassius prominente valde conferta nervis creberrime reticulato-anastomosantibus 3—5-nis in spinam quemque abeuntibus. Folia basalia verosimiliter breviter petiolata (petiolus deest); lamina ± 15 cm longa absque spinis 3—3.5 cm lata, ambitu anguste lanceolata, pinnatilobata, pinnae ± 15-jugae valde confertae crispatae rectangulariter patentes in spinam terminalem validissimam vulnerantem stramineam usque 1 cm longam abeuntes, prope basin utrinque spinis pluribus accessoriis longioribus et brevioribus saepe alternantibus erecto-patentibus auctae. Folia caulina perpauca, sensim decrescentia, media basalibus omnino similia, basi conferte plurispinosa vix auriculata sessilia, non decurrentia. Folia summa ramos fulcrantia abbreviata, e basi profunde et late auriculato-cordata subpalmatim longe spinosa breviter lanceolata, longe spinoso-lobata, lobis paucis, spina terminali longissima valida ad 15 mm longa; folia ramealia pauca valde diminuta, summa quoque spinoso-pectinata capitulis valde approximata.

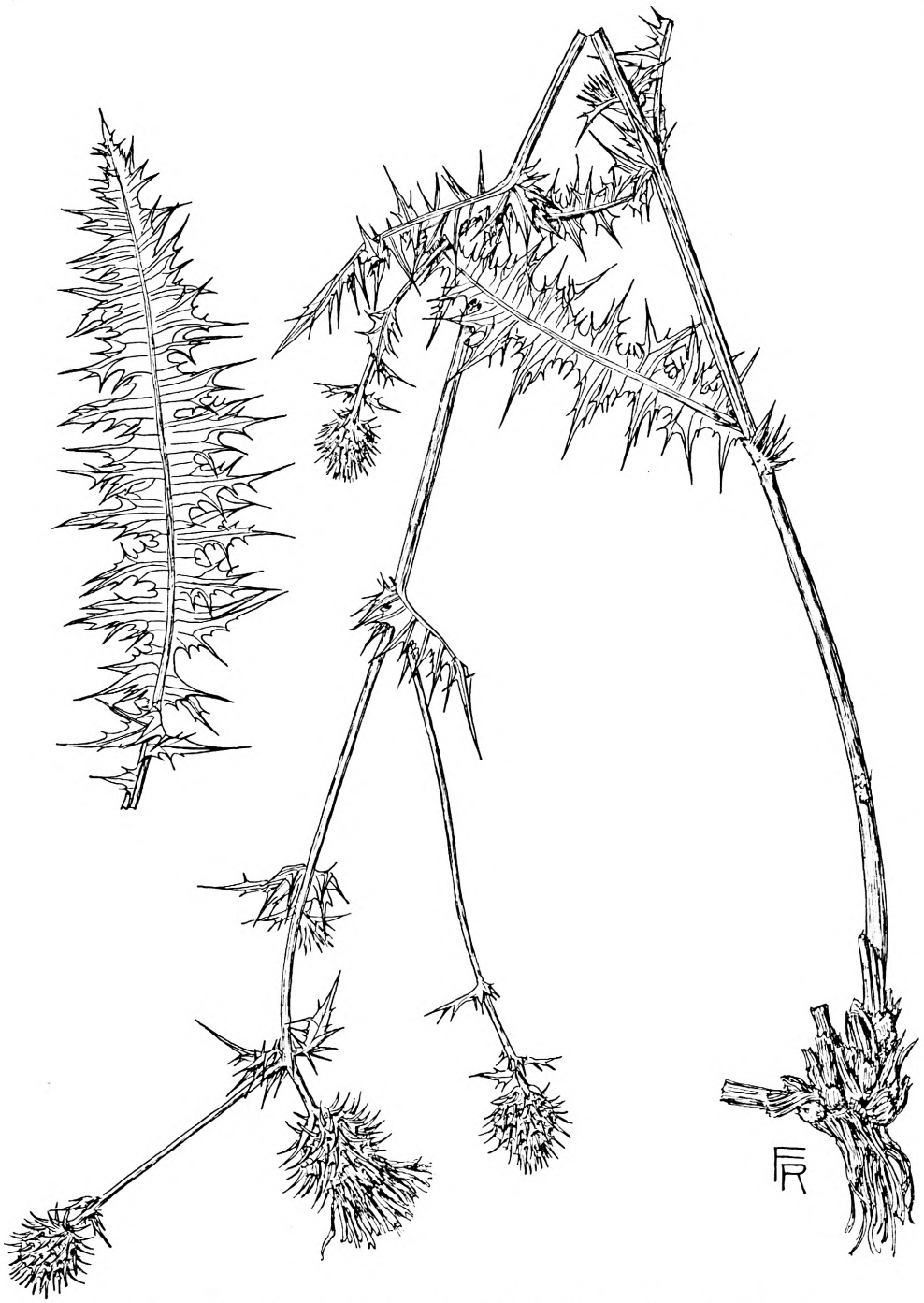


Fig. 110. *Cousinia xanthacantha* Regel (Kz. 12108 — links unteres Stengelblatt). $^{3}/_{5}$.

Capitula singula terminalia; involucrum absque spinis ± 2 cm longum et latum subglobosum, persistenter fusce araneoso-floccosum; phylla ± 8-seriata, numerosissima (longe ultra 100), omnia serie intima excepta in spinas tenues atrovirides glaucescentes stramineo-apiculatas abeuntia; spinae extimae subrecurvae ± 5 mm longae, ceterae squarroso- usque erecto-patentes ad summum 1 cm longae; phylla intima in appendicem scariosam anguste subulato-attenuatam flexibilem pallide bruneam papillosam abeuntia. Receptaculi setae inferne laeviusculae, sub apice scabridae. Corolla alba (e collectore), in sicco subflavescens, ± 18 mm longa, tubo filiformi ± 7 mm longo, laciniis angustis acutis ± 3 mm longis. Antherarum tubus roseus (e collectore), in sicco flavescenti-bruneus, glaber. Achaenia valde immatura ad 3 mm longa, pallida sublinearia longitudinaliter elevate striata. — Caule elato paucinodo, foliis confertis pinnato-lobatis longe spiniferis, nervatura conferta utrinque valde prominente, involucro subgloboso fusce arachnoideo, phyllis ± 8-seriatis numerosissimis, corollis albis insignis.

E: Paghman, 7500 ft., dry slope, fl. white, anthers rose, 7.VI.1937 (Kz. 12108, hb. W., BPI.). Paghman-Gebirge, 2750 m, Berge am linken Ufer des Paghmantales (Gilli 2532). Paghman-Gebirge östlich von Kotal-i-Kotandar, 3500 m (Gilli 2533).

Cousinia (*Spicatae*) ***xanthothyrsa*** Rech. f. et Gilli, n. sp. — Fig. 111 und 113 G.

Radix tenuis. Caulis singulus ± simplex stricte erectus, ca. 30 cm altus, prope basin ca. 3 mm crassus, eburneus, glaber laevis teres, internodiis mediis ± 2 cm longis, collo vix comoso. Capitula omnia in axillis foliorum singula sessilia remotiuscula, summa tantum approximata, spicastrum dimidiam circiter caulis longitudinem occupans formantia. Folia basalia et caulina inferiora subconformia, ad 7 cm longa, 3 cm lata, non petiolata, rachide prope basin breviter setaceo-spinosa; lamina pinnata, costa mediana crassiuscula anguste revolute alata valde fragilis, pinnae ± 6-jugae, inter se ± 5 mm remotae, ad 15 mm longae, prope basin ca. 2 mm latae, supra floccoso-tomentosae glabrescentes, subtus appresse persistenter albotomentosae, margine valde revolutae, in spinam vulnerantem ad 3 mm longam excurrentes, basi pinnulis ± brevioribus subverticillatim dispositis auctae. Folia caulina sensim decrescentia, sessilia, pinnis minus numerosis, segmento terminali longiore longius spinifero, in folia capitula fulcrantia eaque superantia vel aequantia sensim transientia. Involucrum ± 2 cm longum, 7—8 mm latum, cylindricum, basi attenuatum; phylla ca. 30—40, in seriebus ± 4 disposita, omnia e basi paulo dilatata lanceolato-subulata, basi ± 2 mm lata, exteriora quam media non vel vix breviora, omnia erecto-patula, in spinas longiusculas stramineas saepe leviter extrorsas excurrentia, omnia pallide flavescenti-viridia, glabra, margine minutissime cartilagineo-serrulata; phylla intima minus rigida breviter molliter lanceolato-spinosa, pallescentia, superne flavide papillosa. Receptaculi setae laeves albidae. Corolla flava, ± 15 mm longa, tubus filiformis ± 6 mm longus, laciniae 2—3 mm longae. Antherarum tubus glaber, in sicco pallide carneo-stramineus. Achaenia (immatura) ca. 4 mm longa, oblongo-linearia, pallide brunea, indistincte longitudinaliter

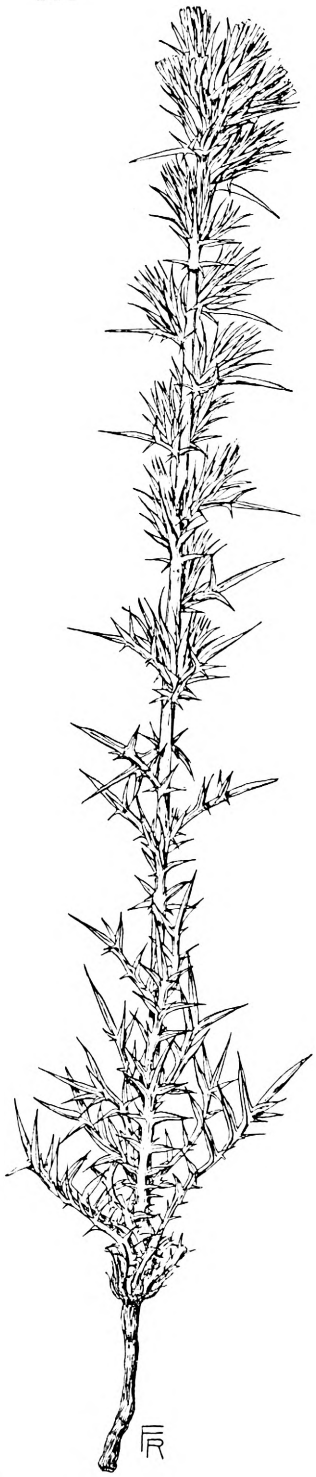


Fig. 111. *Cousinia xanthothyrsa* (Gilli 2542). $^1/_2$.

Fig. 112. *Cousinia xanthula* (Kz. 14001). $^3/_5$.

striata, pappus multiradiatus pallide stramineus, quam achaenia longior, scabridus. — Differt a *C. chlorothyrsa* Rech. f. et Köie statura gracili, capitulis singulis remotiusculis, foliis brevibus latiuscule paucipinnatis, involucro minore glabro oligophyllo.

E: Bei Tschakewardak, *Artemisia*-Steppe zwischen Stausee und E-Werk, 2160 m; Korolle grünlich-weiss, Staubbeutelröhre hellviolett, Griffel und Narbe weiss, 6.VIII.1949 (Gilli 2542, hb. W.).

Cousinia (*Odontocarpae*) ***xanthula*** Rech. f., n. sp. — Fig. 112 und 113 H.

Basi lignosa caespitosa, collo longe copiose fibroso. Caulis 30—60 cm altus, tenuis, prope basin 4 mm diametro, internodiis mediis ± 4 cm longis, albidus vel pallide stramineus, teres, glaber, laevis, in quarta parte superiore breviter corymbose ramosus florifer. Folia basalia et caulina inferiora adulta non visa; petioli foliorum basalium applanati, utrinque copiose pectinato-spinosi. Folia ambitu lanceolata, lamina omnino in lacinias utrinque ± 10 tenuiter spiniformes angulo recto patentes subverticillatim dispositas valde glabrescentes fissa. Folia caulina non decurrentia, laciniis inferioribus ± 5 basi approximatis, superioribus ± 2 remotis, terminali elongata ad 2—2.5 cm longa valde vulnerante. Capitula singula terminalia; involucrum spinis exclusis 12—15 mm diametro latitudine subaequilongum, basi rotundatum usque umbilicato-impressum 4—5 seriatum, araneoso-lanatum; phylla extima e basi brevissime dilatata in spinas validas vulnerantes 20—25 mm longas supra applanatas patentes vel recurvas fere omnino transformata, nervo valido dorsali percursa. Phylla intermedia spinas sensim paulo breviores et minus validas ferentia; phylla intima anguste lanceolata erecta flexibilia flavescentia non spinosa subenervia, minutissime spinuloso-ciliolata, quam flores multo breviora. Flosculi ± 20 mm longi flavi, laciniis ± 2 mm longis acutis linearibus. Antherarum tubus in vivo roseus, in sicco expallens, glaber, nitidus. Achaenia ignota. — Species flaviflorae in sectione perpaucae; differt quoque a *C. flava* Bornm. (mihi e descriptione tantum nota) caule glaberrimo, involucro dense et persistenter araneoso-tomentoso, phyllis intimis breviter sed distincte exsertis, in capitulis complete evolutis basi umbilicato-impresso (nec truncato-rotundato); differt a *C. stephanophora* C. Winkl. (e descr.) foliis basalibus verosimiliter vix (nec longe) petiolatis prope basin copiose pectinato-ciliatis, foliorum segmentis angustissimis (nec 4 mm latis), involucri phyllis intimis apice attenuatis (nec dilatatis).

NW: Safedsang, 3350 m, dry slope, fl. yellow with rose anthers, 24.IX.1939 (Koelz 14001, hb. W., BPI.).

Saussurea aphylla Rech. fil., n. sp. — Fig. 114.

Inferne suffrutescens et squamis bruneis membranaceis obsita cortice brunea nitente longitudinaliter striata. Planta a basi iteratim stricte ramosa ad 75 cm alta; rami teretes, tenuiter striati, obsolete puberuli, pallide virides, extremi 4—8 cm longi monocephali. Folia caulina in parte media plantae pauca tantum obvia, ramificationes fulcrantia, ca. 2 cm longa, vix 2 mm lata, anguste lineari-oblanceolata, supra

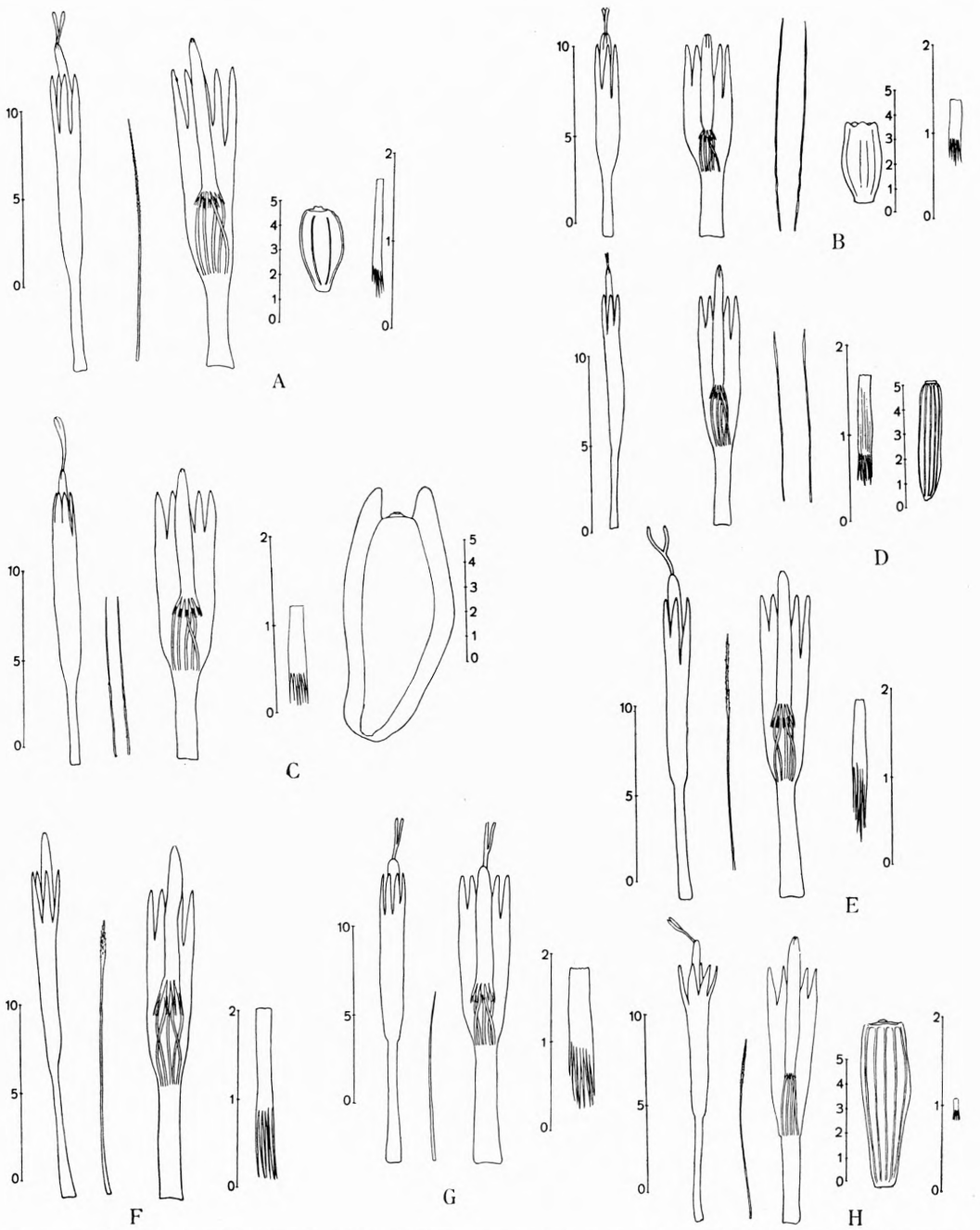


Fig. 113. Korolle geschlossen, Korolle geöffnet, Spreuschuppe, Antherenanhängsel und Achäne von: A *Cousinia schistosa*, B *C. stenocalathia*, C *C. stereolepis*, D *C. stereoneura*, E *C. tragacanthoides*, F *C. xanthacantha*, G *C. xanthothyrsa*, H *C. xanthula*.

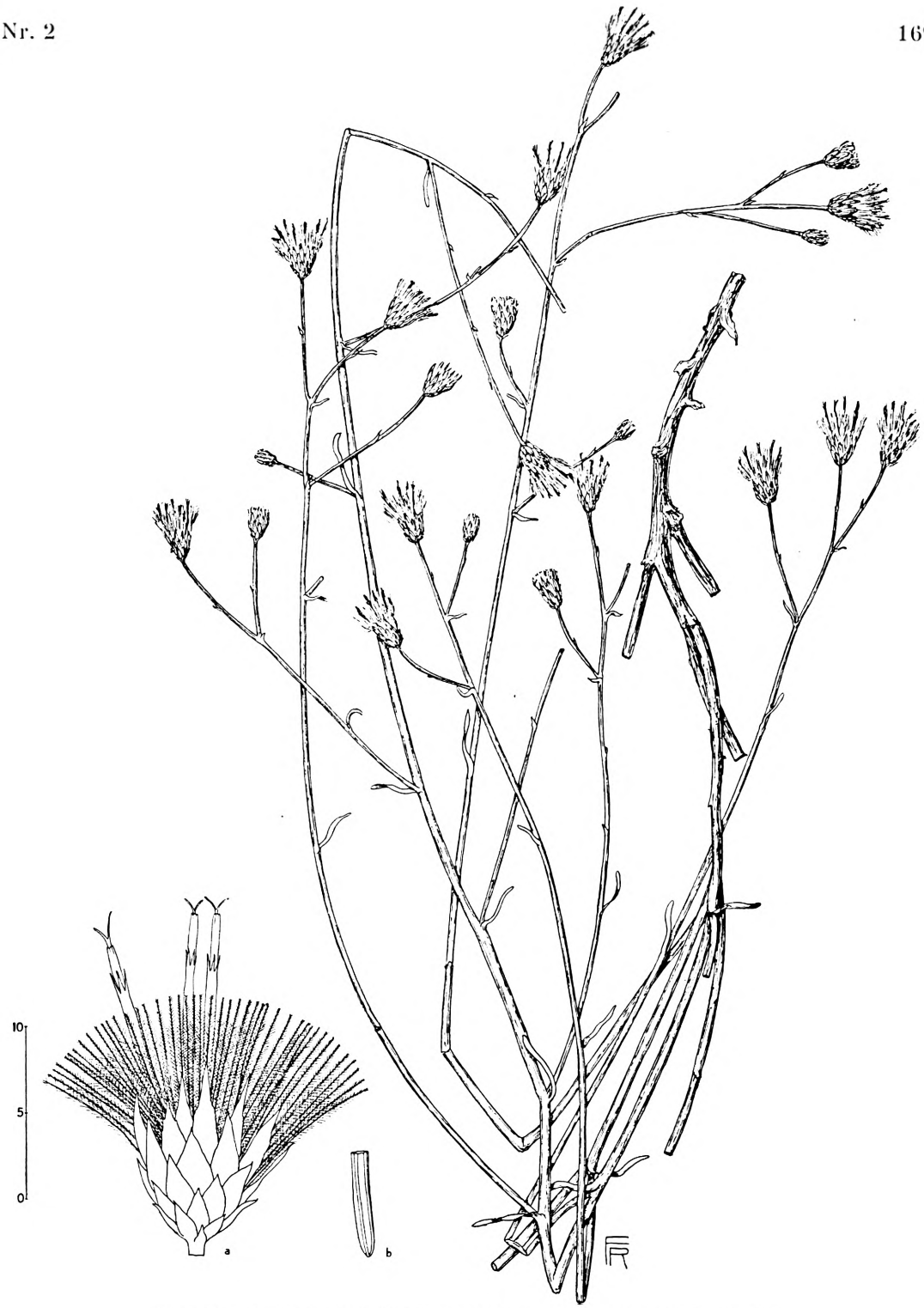


Fig. 114. *Saussurea aphylla* (Kz. 13655 — a Köpfchen, b Achäne). $^1/_2$.

medium latiora, basin versus longe fere petioliformi-attenuata, apice acutiuscula, margine integra, sparse pubescenti-scabrida ± glabrescentia, uninervia; folia superiora valde decrescentia angustiora, summa 1—2 mm longa filiformi-linearia, patula. Involucrum anguste campanulatum, basi rotundatum vel fere attenuatum, ± 1 cm longum, in statu compresso superne paulo ampliatum 6—8 mm latum; involucri phylla plerumque 5-seriata arcte imbricata appressa, pallide viridia pubescenti- vel subfloccoso-lanata ± glabrescentia, ab exterioribus ovato-acutis ad interiora linearilanceolata sensim increscentia, exteriora et media apice brevissime herbaceo-acuminata. Flores roseo-purpurei, involucro duplo fere longiores, numerosi, non radiantes. Achaenia immatura ± 3 mm longa, glabra, costato-angulata, imprimis superne rugulosa; pappus ca. 1 cm longus albus multiradiatus, radiis uniserialibus aequalibus plumosis basi in discum concretis. — Species habitu suffrutescente scopario multiramoso, foliis inconspicuis angustis valde memorabilis.

C: Lorinj, 8000 ft., dry slope, flowers rose-purple, 26.VIII.1939 (Koelz 13655, hb. W., BPI.).

S. brassicifolia (Bornm.) Rech. f., nom. nov.; Syn.: *Jurinea brassicifolia* Bornm., Fedde Rep. Beih. 108,1:55 (1938). — **Nuristan:** Vama, 1400 m (E. 525). Asmai, 900 m (E. 1618). Kamdesh (E. 1144).

Einreihige, fast gleichlange Pappusborsten machen die Uebertragung dieser Art von *Jurinea* zu *Saussurea* notwendig.

Möglicherweise ist diese Art mit *S. candicans* Clarke aus dem Himalaya identisch. Authentisches Vergleichsmaterial ist augenblicklich nicht zugänglich.

S. chthonocephala Bornm., Fedde Rep. Beih. l. c., pag. 59. — **NE:** Minjan Pass, 13500 ft., gravel, flr. rose-lavender, rare (Kz. 12755).

S. Kerstanii (Bornm.) Rech. f., nom. nov.; Syn.: *Jurinea Kerstanii* Bornm. Fedde Rep. Beih. l. c., pag. 56. — **NE:** Minjan Pass, 12000 ft., fl. rose, clumps (Kz. 12715).

Einreihige, fast gleichlange Pappusborsten machen die Uebertragung dieser Art von *Jurinea* zu *Saussurea* notwendig.

S. nuristanica (Bornm.) Rech. f., nom. nov.; Syn.: *Jurinea nuristanica* Bornm., Fedde Rep. Beih. l. c., pag. 52. — **Nuristan:** Shtive, 2600 m (E. 1306).

Einreihige, fast gleichlange Pappusborsten machen die Uebertragung dieser Art von *Jurinea* zu *Saussurea* notwendig.

S. albescens Hook. f. & Thoms. — **NE:** Kail, 7500 ft., along stream, herb. $2^1/_2$ ft. high, fl. rose-purple (Kz. 11673). Daulatshah, 7000 ft., dry slope, flr. purplish (Kz. 11639).

S. amplifolia (Bornm.) Rech. f. var. ***agrestis*** (Bornm.) Rech. f. nom. nov.; Syn. *Jurinea amplifolia* Bornm., Fedde Rep. Beih. 108,1:54 (1938). — **Nuristan:** Ashpei, 2100 m (E. 1734). Pashki, 2300 m (E. 1177). Nishei, 1300 (E. 808). Vaigel (E. 2049).

Fig. 115. *Saussurea polyptera* (K. 2931 — a unteres Stengelblatt). $^{2}/_{3}$.

Einreihige, fast gleichlange Pappusborsten machen die Uebertragung dieser Art von *Jurinea* zu *Saussurea* notwendig.

Blattform, Behaarung der Hüllen und Form des Involukrums sind bei dieser Art ziemlich variabel.

Saussurea polyptera Rech. f. & Köie, n. sp. — Fig. 115 und 116.

Partes subterraneae et basis caulis deficientes, sed planta certe perennis, tota atroviridis subglabra. Caulis ultra 70 cm altus, stricte erectus, in tertia parte superiore stricte corymboso-pauciramosus, internodiis mediis 2—3 cm longis, tota longitudine late decurrenti-alatus, alis 1—3 mm latis, tenuiter herbaceis remote sinuato-dentatis complete decurrentibus, dentibus minute scarioso-mucronulatis non pungentibus. Fragmentum folii ut videtur basalis obvium 15 cm longum, 5 cm latum, inferne grosse sinuato-paucilobatum, supra scabridum glabrescens, subtus laxiuscule araneoso-tomentellum. Folia caulina omnia ambitu oblongo-lanceolata, inferiora ad 10 cm longa, ad 2 cm lata, imprimis basin versus remote sinuato-dentata, in dimidio superiore subintegra, consistentia in vivo ut videtur tenuiter molliter herbacea, in sicco tenuiter membranacea, glabra, imprimis subtus glandulis minutis flavis sessilibus aspersa, nervatura laxe reticulato-pennata, subtus pallida. Folia superiora decrescentia, proportione angustiora. Involucrum 15 mm longum, in statu fructifero basi attenuatum superne patens; phylla ± 5-seriata, laxe ± irregulariter imbricata anguste lanceolata, in apicem acutam rectam sensim attenuata, margine ± obsolete ciliolata ceterum glabra. Corolla (marcescens) ut videtur in vivo rosea vel purpurea, ca. 14 mm longa. Achaenia matura ± 6 mm longa, atro-brunea, nitidula, subtetragona, imprimis margine scabrida, coronula membranacea denticulata flavescenti provisa. Pappus ± 10 mm longus, albus, plumosus, basi coalita deciduus. — Differt a *S. salsa* (M.B.) Ledeb. foliis omnibus longe et late decurrentibus, involucri maioris phyllis numerosioribus (30—35 nec 20—25), longius tenuius attenuatis, imprimis autem achaeniis subtetragonis praesertim secus angulos scabridis, pappo ± 10 mm (nec ± 11 mm) longo, brevius sparsius et magis appresse plumoso.

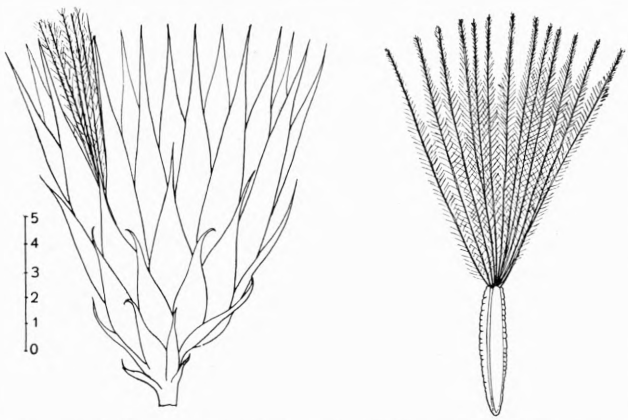


Fig. 116. *Saussurea polyptera*. Köpfchen und Achäne mit Pappus.

NE: Panjshir, Ruka, 2100 m, 10.X.1948 (Köie 2931, hb. W., C.).

Jurinea carduiformis Boiss. — **SE:** Pirzada, 1000 m (K. 2066). — **SW:** Jija, 1000 m (K. 4048).

Fig. 117. *Jurinea mallophora* (K. 2852 — a Köpfchen, b Achäne mit Pappus). $^1/_1$.

J. dumulosa Boiss. e descr. — **SW:** Jija, 1200 m (K. 3714).

J. Kerstani Bornm., Fedde Repert. Beih. 108.1:56 (1938). — **NE:** Minjan Pass, 12000 ft., flr. rose, clumps (Kz. 12715).

Jurinea mallophora Rech. fil. & Köie, n. sp. — Fig. 117.

Sect. *Stechmannieae* Boiss. — Suffrutex crassissime lignosa bruneo-corticosa pulvinos densos formans; caudices residuis foliorum emarcidorum squarroso-comosi et copiose gossypino-lanati. Folia anguste linearia, plurima basalia rosulata, 2—7 cm longa, 1.5—2 mm lata, flexuosa, plerumque arcte revoluta (rarius ± plana et tunc obsolete irregulariter sinuato-dentata), apice obtusiuscula, costa mediana supra tenuiter immersa subtus albida prominente percursa, in pagina superiore canescenti-viridia laxe tomentella, subtus densius albide araneoso-tomentosa. Folia caulina 1—3 vel subnulla, breviora, ceterum basalibus omnino similia. Caules floriferi 1.5—2 cm longi, rigiduli crassiusculi simplices tenuiter sulcato-striati. Involucrum ad 2 cm longum, campanulatum, basi rotundatum, superne in statu fructifero quidem valde dilatatum, laxe irregulariter imbricatum; phylla plerumque 4-seriata, exteriora et media crasse membranaceo-herbacea pallide viridia tomentella enervia, omnia squarroso-patula recurva in spinulam rigidam pungentem sensim attenuata, intima brunescentia porrecta tenuiora non pungentia. Flores ignoti. Achaenia matura ± 4 mm longa, albida, sulcato-angulata, superne ± distincte transverse rugulosa; pappus plumosus albus, radiis valde inaequalibus ad summum 15 mm attingentibus. — Species valde insignis, habitu in sectionem *Subacaules* spectans sed pappo plumoso, foliorum et involucri phyllorum structura sectioni *Stechmannieae* adnumeranda; ab omnibus speciebus huius sectionis habitu humili lignoso-pulvinato valde diversa.

C: Band-i-Amir, 2800 m, 20.VIII.1948 (Köie 2852, Typus, hb. W., C.). Band-i-Amir, stachelige Polster bildend (N. 51/482).

Jurinea megalantha Rech. f., n. sp. — Fig. 118.

Planta verosimiliter elata; pars superior caulis ca. 40 cm longus tantum adest, fistulosus, canaliculatus, laxe subaraneoso-floccoso-pubescens inferne glabrescens, in racemos quinque erecto-patentes aphyllos monocephalos 10—20 cm longos divisus. Folia inferiora ignota; folia ramos infimos fulcrantia vix 3 cm longa, ca. 1.5 cm lata, basi cordato-semiamplexicauli sessilia, in sicco crasse membranacea, supra flavescenti-viridia glabrescentia, subtus canescenti-viridia laxe appresse araneoso-puberula, apicem versus longe attenuata, utrinque profunde sinuato-paucidentata; dentes acuti, ad 6 cm longi, ad 2 cm lati. Rami superiores foliis valde reductis suffulti. Involucrum basi subumbonato-rotundatum, oligophyllum; phylla ca. 30—36, laxe valde irregulariter imbricata indistincte triseriata, omnia appressa, herbaceo-membranacea prope basin flavescentia, apicem versus virescentia et imprimis margine purpurascentia, costa mediana imprimis apicem versus prominente, ceterum indistincte elevate paucistriata, araneoso-puberula glabrescentia et parce glandulosa,

margine minute papilloso-subserrulata usque subintegra; phylla extima breviter lanceolata 2—5 mm longa, intima in apicem longissimam setiformem attenuata cum apice ad 25 mm longa. Flores speciosi, 25 mm longi, in vivo intense rubri (e collectore) in sicco roseo-expallescentes; tubus filiformis 12 mm longus, in limbum subaequilongum vel sublongiorem abrupte geniculato-ampliatus, limbo in lacinias anguste lineares ± 5 mm longas fisso. Antherarum tubus glaber corollam circiter aequans, pallide carneo-brunescens. Stylus longe exsertus, stigma profunde bilobum, lobis eleganter recurvis. Achaenia (valde iuvenilia) brunescentia, subprismatica, striato-costata, 2.5 mm longa, in parte superiore papillis antrorsis appressis obsita; pappus multiradiatus albus breviter plumosus, radiis plurimis 9 mm longis intimis binis plerumque 15 mm longis. — Species quamquam eheu valde incomplete nota tamen involucri florum achaeniorum pappi characteribus, imprimis corollae tubo longissimo limbo permagno, involucri phyllis in setam longissimam attenuatis egregia verosimiliter in sectionem *Pinnatae* Boiss. prope *J. chaetocarpam* Ledeb. mihi e descriptione tantum notam inserenda.

SE: Sarwand, Katawas. Trocken-sandiger Berg. Gipfelnähe. 9.V.1949 (Neubauer 49/340).

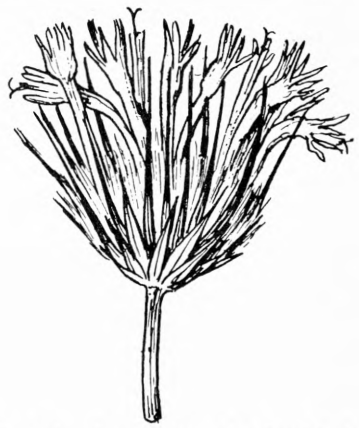


Fig. 118. *Jurinea megalantha* (N. 340, Köpfchen).

J. nuristanica Bornm., Fedde Repert. Beih. 108.1:52 (1938). — **Nuristan:** Shtive (E. 1306).

J. rhizocephala Schrenk — **E:** Kabul, Wazirabad, trockener Tümpelboden (N. 50/31).

Aegopordon berarioides Boiss. — **Baluchistan:** Quetta, 1500 m (K. 3266).

Carduus Edelbergii Rech. fil., n. sp. — Fig. 119.

Verosimiliter perennis. Partes subterraneae et basis caulis deficientes. Caules certe ad 40 cm vel ultra alti subrecti vel arcuato-flexuosi, laxe araneosi, jam infra medium ramosi, ramis inferioribus capitula serius florentia proferentibus; caules ramique partibus extremis nudis infra capitula exceptis omnino continue sinuato-spinoso-alati. Folia caulina media et superiora basi attenuata sessilia, ad 5 (—8) cm longa, 1.5—2 cm lata, superiora proportione sensim angustiora, omnia ambitu lanceolata, pinnatilobata, rhachide ± 5 mm lata, lobis oblique triangularibus utrinque ± 6 in spinas tenues stramineas 3—4 mm longas excurrentibus praeterea spinuloso-ciliatis, utrinque viridia, valde laxe araneosa; folia superiora lanceolato-linearia, brevius plurilobata, brevius spinosa. Capitula ad extremos ramos nudos saepe singula (vel capitula 1—2 lateralia serius florentia evoluta), in statu compresso ± 3 cm longa et lata. Involucrum depresso-hemisphaericum basi impressum, phyllis ± 6-

Fig. 119. *Carduus Edelbergii* (E. 1148 — links mittleres Stengelblatt). $^1/_2$.

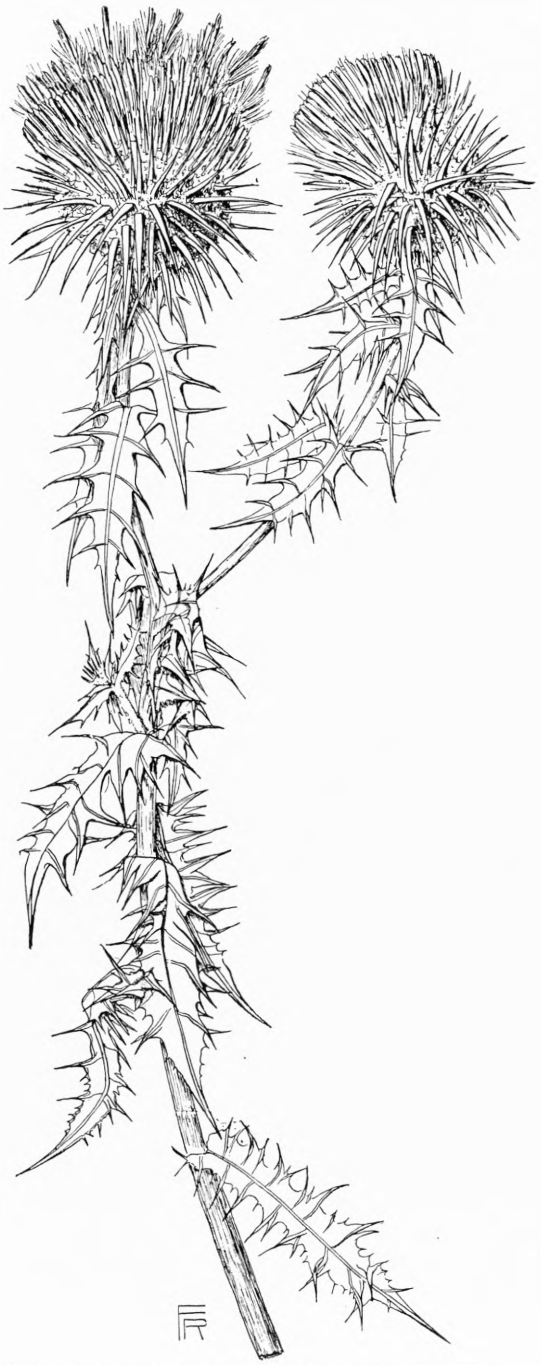


Fig. 120. *Carduus lachnocephalus* (Kz. 13744). $^1/_2$.

seriatis omnibus herbaceo-membranaceis, mediis 1.5—2 mm latis, omnibus serie intima erecta excepta squarroso- vel arcuato-patentibus apice patente usque 8 mm longa tenuiter spinosa. Flosculi purpurei, limbo in lacinias anguste lineares ± 5 mm longas fisso. Pappus 11—14 mm longus, multiradiatus albus minutissime scabridulus. Achaenia ignota. — Species nova in affinitatem *C. hamulosi* Ehrb. et *C. uncinati* M.B. spectat, ab iis imprimis involucri phyllis multo latioribus egregie differt.

Nuristan: Parun-Kamdesh, 21.VI.1948 (Edelberg 1148, Typus, hb. W., C.). Ibidem (E. 1149, planta albiflora, hb. W., C.). Pashki, 2300 m (E. 1313, hb. C.).

Carduus lachnocephalus Rech. f., n. sp. — Fig. 120 und 121.

Radix ignota sed planta evidenter non annua. Caulis ad 60 cm altus (e collectore), subarcuato-erectus, teres subfistulosus, tenuiter sulcato-striatus, in tertia vel quarta parte superiore furcato-ramosus, pallide roseo-suffusus, araneoso-floccosus, inferne glabrescens, internodiis omnibus abbreviatis, tota longitudine dense usque ad capitula foliatus. Folia omnia consistentia rigide membranacea atroviridia concoloria, copiose breviter sinuato-lobata et longiuscule tenuiter stramineo-spinosa, nervis utrinque tenuiter prominentibus, laxiuscule araneoso-floccosa, demum glabrescentia nitidula. Folia caulina inferiora et media ad 8 cm longa absque spinis 1—1.5, cum spinis ad 3 cm lata, basi cordata sessilia, non decurrentia, ambitu late vel oblongo-linearia, lobis spiniferis principalibus utrinque ± 10, plurimis basi et margine spinulis accessoriis nonnullis auctis, lobo terminali longiore in spinam validiorem excurrente; folia superiora vix decrescentia, proportione breviora latiora, lobis lateralibus minus numerosis. Capitula spinis inclusis ± 7 cm diametro. Involucrum dense persistenter gossypino-floccoso-lanatum sordide album; involucri phylla numerosissima, viridia rigidula lineari-aculeata, apicem versus glabrescentia, e basi leviter sensim dilatata ± 3 mm lata appressa sensim attenuata, in spinam tenuem pungentem stramineam excurrentia, exteriora refracta, media recurva, interiora erecto-patentia, intima tenuissima molliora membranacea basi pallida superne purpureo-suffusa. Corolla roseo-purpurea ± 3 cm longa, laciniis ± 4.5 mm longis anguste linearibus acutis porrectis. Antherarum tubus in sicco expallens glaber breviter exsertus. Achaenia nondum matura ± 5.5 mm longa, ± compressa, basin versus attenuata, superne truncata, pallide brunea sublaevia. Pappi radii sordide albi inaequales 12—20 mm longi, basi in annulum ab achaenio aegre secendentem concreti, scabridi, numerosi. — Species foliis rigidis araneosis demum glabrescentibus nitidulis, caule tota longitudine foliato, capitulis magnis globosis, involucro dense persistenter gossypino-floccoso, phyllis numerosissimis tenuissimis extimis refractis valde insignis.

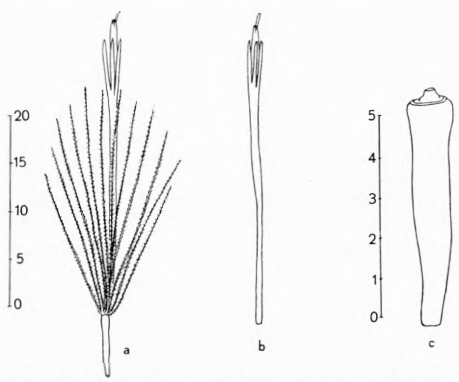


Fig. 121. *Carduus lachnocephalus*. a Blüte, b Korolle, c Achäne.

C: Lorinj Pass, 3350 m, dry slope, fl. rose-purple, 27.VII.1939 (Koelz 13744, hb. W., BPI.).

C. pycnocephalus L. — **NW:** Kishlik, 700 m (K. 3984).

Cirsium[1] *acarna* (L.) Moench. — **NW:** Zehnadis, 8000 ft., dry slope (Kz. 14030). — **C:** Binimang, 8000 ft., dry slope (Kz. 13879). — **NE:** Ruka, 1800 m (K. 2927).

C. argyracanthum DC. — **NE:** Krunn, 9000 ft., (Kz. 12793). Kachari, 2300 m (E. 1439). — **Nuristan:** Gusalak, 1000 m (E. 1565).

C. arvense (L.) Scop. — **SW:** Herat (Lindberg). — **C:** Baligali Pass, field, 9000 ft. (Kz. 13847). — **E:** Kabul, Guzar Gah, Gartenunkraut (N. 50/915).

C. arvense (L.) Scop. var. *horridum* Wimmer et Grab. — **C:** Lorinj, weed, 8000 ft. (Kz. 13007). — **NE:** Kachari, 2300 m (E. 1598). — **E:** Begram near Charikar, 5000 ft. (Codrington 25).

C. arvense (L.) Scop. var. *incanum* (Fisch.) Led. — **N:** Khanabad, 1200 ft., in fields (Kz. 12217). — **E:** Pulalam, 7000 ft., (Kz. 11829). Sirotai, 10000 ft., in fields (Kz. 11918).

C. arvense (L.) Scop. var. *mite* Neilr. — **C:** Farakulum, 2800 m (K. 2553).

C. esculentum (Siev.) C. A. Mey. ssp. *caucasicum* (C. A. Mey.) Petr. — **C:** Farakulum, 2900 m (K. 2504). Band-i-Amir, an feuchten und quelligen Plätzen, niedrige Pfl. (N. 51/492).

C. Griffithii Boiss. — **C:** Lorinj, 8000 ft., along stream, flr. cream, 3 ft. (Kz. 13641). Shibar Pass, 2500 m (K. 2804). — **NE:** Khash distr., 10000 ft., along stream, flr. cream, 3.5 ft. (Kz. 12997). — **E:** Mamakhel, 4000 ft., along stream, flr. cream, 2 ft. (Kz. 11577).

Cirsium Koeieanum Petr., n. sp. — Fig. 122 und 123.

Radix obliqua, elongato-fusoidea, sublignosa. Caulis rectus, ut videtur ad 1 m altus, albidus, striato-sulcatus, arachnoideus, subremote foliosus, apice tantum ± ramosus, ramis abbreviatis, 1—3 cm longis, raro subelongatis, tunc usque 8 cm longis, nudis, in apice tantum bracteoso-foliosis 1—4-cephalis. Folia radicalia utrinque parce arachnoidea supra etiam laxe spinuloso-strigosa, in petiolum angustissime alatum remote spinuloso-dentatum paulatim attenuata, ambitu lanceolata, usque ad medium circiter dense sinuato-pinnatilobata, lobis inaequaliter 3—4-dentatis, dentibus divergentibus triangularibus, paulatim attenuatis, et in spinas subvalidas, usque 1 cm longas, obscure stramineas excurrentibus, margine spinuloso-ciliata; caulina inferiora et media lineari-lanceolata, basi semiauriculato-semiamplexicauli sessilia, non, raro brevissime decurrentia, subremote sinuato-dentata, dentibus triangularibus, abruptiuscule attenuatis et in spinas subvalidas stramineas

[1] Gattung *Cirsium* bearbeitet von F. Petrak, Wien.

Fig. 122. *Cirsium Koeieanum* (K. 2930). $^{2}/_{5}$.

exurrentibus; caulina superiora et suprema gradatim minora, remote sinuato-dentata, dentibus saepe fere omnino ad spinas terminales reductis. Capitula in apice caulis et ramorum solitaria vel 2—4 aggregata, breviter pedunculata vel subsessilia, bracteis nonnullis subaequilongis, raro parum longioribus, linearibus, elongato-acuminatis, in parte inferiore tantum remote sinuato-dentatis suffulta oblongo-

ovoidea, cum flosculis 3—4 cm longa, 20—23 mm lata, basi abruptiuscule contracta et attenuata, nec excavata. Involucri parcissime arachnoidei foliola exteriora et media e basi anguste ovato-oblonga attenuata, apicem versus subcarinata et in spinas erecto-patentes, 4—6 mm longas, validas excurrentia; interiora et intima gradatim longiora, lineari-lanceolata vel linearia, ad apicem interdum purpurascentia, in spinas rigidiusculas erecto-patentes excurrentia. Corollae pallide purpureae limbus vix ad medium inaequaliter quinquefidus laciniis angustissime linearibus, parum attenuatis, obtusiusculis, a tubo vix vel satis distinctus, eoque parum brevior. Filamenta parcissime et brevissime crispule papilloso-pilosa. Pappus sordide albus, flosculis parum brevior, setis plumosis, apice saepe tantum scabridis et levissime incrassatis. Achaenia matura ignota. — Species nova pulchra characteristica gregi *C. bracteosi* DC. proxima esse videtur, sed ab omnibus speciebus huius gregis habitu, colore cinereo-virescente foliorum et involucri phyllis numerosissimis angustis valde diversa.

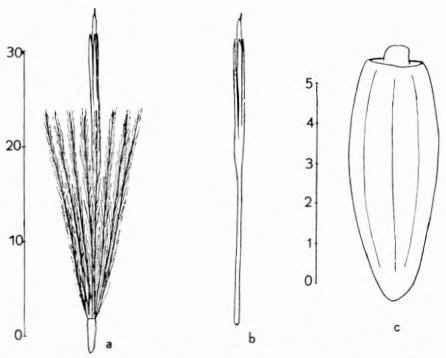


Fig. 123. *Cirsium Koelleanum*. a Blüte, b Korolle, c Achäne.

NE: Ruka, 1800 m, 6.X.1948 (Köie 2930, hb. W., C.).

C. vulgare (Savi) Airy-Shaw. — **NW:** Zehnadis, 8000 ft., field (Kz. 14029). — **C:** Dasht-i-Sufed, 6000 ft., along stream (Kz. 13546). Kamard, 6000 ft., along stream (Kz. 13572). — **NE:** Khash district, 10000 ft. (Kz. 12996). Daraim, 8500 ft., in field (Kz. 13062a).

C. vulgare (Savi) Airy-Shaw. var. *hypoleucum* Rchb. — **C:** Ghorband, 1600 m (K. 3256).

C. pyramidale Hausskn. et Bornm. — **C:** Shibar Pass, 2500 m (K. 2806). Hauz-i-Mahiha, 2600 m (K. 2431).

C. rhizocephalum C. A. Mey. — **C:** Sabz Pass, 10000 ft., spring edge (Kz. 13807).

C. Schelkownikowii Petr. — **NW:** Safedsang, 10000 ft., dry slope (Kz. 13985). — **C:** Hauz-i-Mahiha, 2600 m (K. 2430). — **NE:** Khash district, 8000 ft., along stream (Kz. 12914).

C. sorocephalum Fisch. et Mey. — **NW:** Burchao Pass, 10000 ft., dry slope (Kz. 14127). — **C:** Lorinj, 8000 ft., dry slope (Kz. 13700).

C. Wallichii DC. — **NE:** Jurm, 7000 ft., in field (Kz. 12969). Khash district, 8000 ft., stream edge (Kz. 12919). — **Nuristan:** Gusalak, 1000 m (E. 1185).

Onopordon Acanthium L. — **NE:** Hazratsaid, 8000 ft., in field (Kz. 12849). Iskan, 1550 m (E. 1454).

O. leptolepis DC. — **SW:** Takhe-Safar, Herat (LINDBERG). — **E:** Begram near Charikar, 5000 ft. (CODRINGTON 59). Kabul, Aliabad (N. 50/873). — **SE:** Kajkai, 1000 m (K. 2181).

Zoegea purpurea Fresen. — **SW:** Jija, 900 m (K. 4049). — **Baluchistan:** Quetta, 1600 m (K. 3261).

Tricholepis chaetolepis (Boiss.) Rech. fil., Oesterr. Bot. Zeitschr. **97**: 251 (1950). Syn. *Jurinea chaetolepis* Boiss., Diagn. ser. **2**, 3:50 (1856); *Tricholepis spartioides* Clarke, Compos. Ind. 241 (1876). — "Afghanistan" (GRIFFITH 1194, non vidi; GRIFFITH 3291, hb. W.). — **Nuristan:** Zwischen Ort Waigel und Nischai (N. 51/744).

Die Beschreibungen beider Arten sind auf GRIFFITH no. 1194 gegründet, die ich nicht gesehen habe. Dagegen befindet sich im Wiener Herbar ein Exemplar mit der Ettikette no. 3291, das mit der oben zitierten Beschreibung vollkommen übereinstimmt. Der Artname *chaetolepis* muß als der ältere als gültig angenommen und zu *Tricholepis* übertragen werden. — Weitere Bemerkungen siehe RECHINGER fil. l. c.; es hat dort „*chaetolepis*" statt „*chartolepis*" zu heissen.

Serratula latifolia Boiss. — **C:** Deh Kundi, 2700 m (E. 1892).

Rhaponticum integrifolium C. Winkl. — **NE:** Daraim, 6000 ft., fl. yellow, 4 ft. high (Kz. 13079). Faizabad, 1100—1900 m (E. 1358).

Acroptilon repens (L.) DC. — **SW:** Herat, 900 m, fields (K. 4040). — **N:** Tashkurgan, 1200 ft. (Kz. 13178). — **C:** Hauz-i-Mahiha, 2500 m (K. 2360). Lorinj, 8000 ft., field weed (Kz. 13707). — **NE:** Parwara, 8500 ft., field border (Kz. 12812). Daraim, 6000 ft., (Kz. 13082). Faizabad (E. 1359). Iskan, 1600 m (E. 1601). Kachari, 2300 m (E. 1456). — **E:** Kabul, Gartenunkraut (N. 50/909, 51/198), Tagao, 6000 ft., dry ground (Kz. 11781). — **SE:** Kalat, 7500 ft., dry ground (Kz. 13206).

Amberboa moschata L. — **SW:** Herat, 1000 m (K. 3859).

Centaurea Balsamita Lam. — **NE:** Khash Distr., 8000 ft., in field (Kz. 12961). Faizabad, 1100—1900 m (E. 1363).

C. Bruguieriana (DC.) Hand.-Mzt. ssp. *Belangeriana* (DC.) Bornm. — **SE:** Pirzada, 900 m (K. 2083).

C. Codringtonii Rech. fil., Oesterr. Bot. Zeitschr. 97 : 253 (1950). — **C:** Bamian valley, 8000 ft., river bank, common (CODRINGTON s. n. Typus, hb. BM.). Farakulum, 2800 m (K. 2608). Aoi Khurak, 9000 ft., field (Kz. 13801). Sarasia, 9500 ft., field (Kz. 13843). Bamian (N. 51/408). — **NW:** Safedsang, 10000 ft., along stream (Kz. 14009).

Adde ad diagnosim: Caulis ad 1 m altus a medio virgato-ramosus ramis erectis monocephalis; folia basalia petiolis ad 15 cm longis suffulta; lamina 15—25 cm longa, ambitu lanceolata latitudine 4—6-plo longior, anguste lyrato-pinnatisecta lobis antrorsis acutis utrinque 2—3, rarius folia integra. Achaenia 5 mm longa, compressa,

Fig. 124. *Centaurea heratensis* (K. 3817). $^{3}/_{5}$.

pallide virenti-brunescentia nitentia; pappus scaber, brunescens, radiis exterioribus squamiformibus, interioribus achaenio paulo longioribus.

Ich hatte die Art ursprünglich in die Sektion *Phalolepis* eingereiht und mit *C. pergamacea* DC. verglichen. WAGENITZ in Flora 152:257 (1955) hat auf die weitgehende Aehnlichkeit in den vegetativen Teilen und im Bau des Involukrums mit *C. glastifolia* L. hingewiesen, die häufig als *Chartolepis glastifolia* (DC.) Cass. abgetrennt wird. *C. glastifolia* hat jedoch gefiederten Pappus — dies das Hauptmerkmal der Gattung *Chartolepis* — während der Pappus von *C. Codringtonii* rauh und übrigens nur wenig länger als die reife Achäne ist.

C. depressa M.B. — **NW:** N. of Herat, 1500 m (K. 3911). — **C:** Aoi Khurak, 9000 ft., field (Kz. 13778). — **NE:** Gulbahar, 5000 ft., fields (Kz. 11443). — **E:** Tscharikar, Feldunkraut (N. 50/908). Begram near Charikar, 5000 ft. (CODRINGTON). Kabul, bought in market, fl. cobalt blue, said to be wild (Kz. 8256). — **SE:** Pirzada, 900 m (K. 2097).

Centaurea (*Phaeopappus*) ***heratensis*** Rech. fil. & Köie, n. sp. — Fig. 124 und 125.

Sect. *Macrocephalae* Boiss. — Perennis, collo residuis petiolorum crassis comoso. Caulis 10—20 cm altus, erectus simplex crassus, sub capitulo incrassatus, tenuiter sulcato-striatus, internodiis mediis 1—3 cm longis. Tota planta flavescenti-viridis, minute sparse papillosa et paulum floccosa, deinde valde glabrescens et laevigata. Folia basalia et rosularia petiolo incluso ad 10 cm longa, 2—3 cm lata, lyrato-paucipinnata, segmentum terminale oblongo-lanceolatum acutum integrum ad 5 cm longum, 2 cm latum, segmenta lateralia utrinque 1—2 (—3) ad 15 mm longa ad 6 mm lata horizontaliter patentia rhachide late alata conjuncta; petiolus brevis ad summum 2 cm longus. Folia in sicco rigida coriaceo-membranacea, nervatura pennato-reticulata utrinque tenuiter sed distincte prominens. Folia caulina sensim decrescentia, omnia plerumque ultra dimidium internodium decurrentia, inferiora oblongo-lanceolata basin versus saepe sublobato-paucidentata, superiora sensim angustiora oblongo-linearia integerrima, apice cartilagineo-mucronulata. Capitulum singulum terminale, floribus inclusis 5—6 cm longum; involucrum ± 4 cm longum prope basin in statu leviter compresso 3.5 cm diametro, basi late rotundatum, superne valde contractum; phylla ± 4-seriata, arcte regulariter imbricata, crasse rigide coriacea, pallide virescenti-flavescentia, glabra laevia ± distincte stramineo-marginata, exteriora et media appendice patula pallide brunea triangulari-lanceolata in mucronem tenuem pungentem 3—6 mm longum inferne pectinato-paucilaceratum excur-

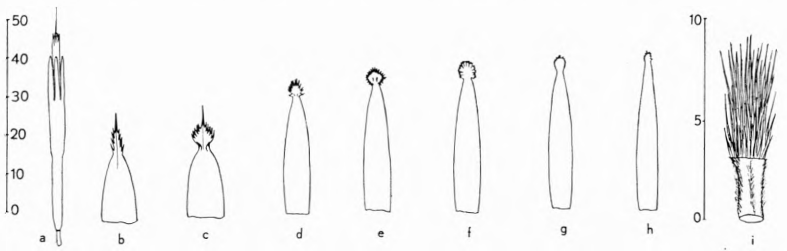


Fig. 125. *Centaurea heratensis*. a Korolle, b–h Hüllblätter von aussen nach innen, i Achäne mit Pappus.

rentia; appendix phyllorum intimorum constrictione a phyllo magis separata ambitu elliptico-orbicularis breviter lacerata inermis. Flores in sicco quidem pallide flavescentes, non radiantes, involucro tertia parte usque dimidio fere longiores, tubo ± 4 cm, limbo in lacinias anguste lineares fisso, vix 1 cm longo. Antherarum tubus pallidus, corollam paulo superans. Achaenia (juniora) atrata longe appresse sericeo-villosa, subprismatica, pappo stramineo inaequali ad 6 mm longo sublaevi. — Differt a *C. armena* (Jaub. & Sp. sub *Phaeopappo*) caulibus foliisque multo magis glabrescentibus, foliis magis coriaceis mediis et superioribus longe decurrentibus, appendice involucri phyllorum in mucronem longiusculum quam ciliae laterales 2—3-plo longiorem excurrente, achaeniis (junioribus quidem) atratis longe appresse sericeo-villosis, pappo proportione breviore.

SW: 50 km S. of Herat, 1500 m, 8.V.1949 (Köie 3817, Typus, hb. W., C.). Herat (K. 2241 — specimina minora; K. 2286 — specimen elatius ultra 30 cm altum, capitulo deficiente). — **NW:** Obeh-Chisht (K. 3707, specimen junius capitulo inevoluto, residuis phyllorum anni praecedentis, foliis nondum decalvatis).

C. iberica Trev. — **NW:** Zehnadis, 8000 ft., field (Kz. 14021). — **N:** Khanabad, 1200 ft., field (Kz. 12211). — **C:** Kamard, 6000 ft., along stream (Kz. 13620). — **E:** Giri, 7000 ft., dry slope (Kz. 11512). — **SE:** Kajkai, 1000 m (K. 2153).

C. pulchella Ledeb. — **C:** Band-i-Amir, 2800 (K. 2847). Farakulum, 2700 m (K. 2514). — **E:** Kabul, Aliabad (N. 50/878, 50/912).

C. virgata Lam. var. *squarrosa* (Willd.) Boiss. — **NW:** Gharchi, 8500 ft., dry field (Kz. 14090). — **C:** Dasht-Sufed, 6000 ft., dry ground (Kz. 13547). Kamard, 6000 ft., dry slope (Kz. 13581). — **NE:** Rustak, 4000 ft., dry ground, bushy plant, fl. rose-purple (Kz. 13123). — **E:** Paghman, Ort (N. 50/881). Unteres Paghmantal (N. 50/879). Begram near Charikar, 5000 ft. (Codrington s. n. hb. BM.). Charikar, 6000 ft., dry ground (Kz. 11818). — **SW:** S. of Herat, 1700 m (K. 2282, 3323).

Ein äusserst polymorpher, noch ungeklärter Formenkreis.

Rhaponticum pellucidum (Rech. f.) Rech. f., comb. nov. — Syn. *Centaurea pellucida* Rech. fil., Oesterr. Bot. Zeitschr. 97:251 (1950). — **C:** Band-i-Amir uplands, 12000 ft. (Codrington s. n. Typus, hb. BM.). Band-i-Amir, 2800 m (K. 2856).

Ich hatte die Art ursprünglich in die Sektion *Phalolepis* von *Centaurea* eingereiht. Wagenitz in Flora 142:251 f (1955) stimmt auf Grund pollemorphologischer Erwägungen und unter Hinweis auf den Pappus — rauh, einfach, innerste Borsten etwas verbreitert aber nicht kürzer — für eine Uebertragung zu *Rhaponticum*, die hiermit vollzogen wird.

Oligochaeta leucosmerinx Rech. fil. & Köie, n. sp. — Fig. 126.

Plantula annua nana; radix elongata tenuis. Caulis valde abbreviatus 1—3 cm longus vel subnullus, albus nitidulus glaber laevis; capitula pauca usque ± numerosa breviter pedunculata vel subsessilia, foliis pluribus subrosulatim congestis duplo superata. Folia petiolo longiusculo incluso 2—3 cm longa, ± 5 mm lata, lanceolata acuta,

basi sensim attenuata, margine integra, costa mediana tenui albida percursa ceterum subenervia, utrinque glabra laevia, margine autem setis albis rigidis ad laminam usque 2 mm ad petiolum usque 4 mm longis copiose ciliata. Involucrum ± 12 mm longum, in statu compresso ca. 4 mm latum, basi attenuatum foliis nonnullis parvis oblanceolatis vel subspathulatis rigide ciliatis involucratum. Involucri phylla pauca triseriata tenuiter membranacea pallide viridia glabra laevia in appendicem molliter albido-membranaceam acutam integram sensim excurrentia, longitudinaliter striata. Flores non numerosi, jam emarcidi, flavi (e collectore). Achaenia matura 3 mm longa, pallide brunea nitidissima, coronata, basi attenuata. Pappus albus laevis nitidus, e radiis inaqualibus numerosis compositus, radii longissimi ultra 5 mm longi. —

Fig. 126. *Oligochaeta leucosmerinx* (K. 2396 — a Achäne mit Pappus). $^1/_1$.

Differt ab *O. albispina* Bge. sub *Microloncho* foliis perlonge rigide ciliatis capitula duplo superantibus, achaeniis plus quam duplo longioribus, floribus flavis nec roseis.

C: Hauz-i-Mahiha, 2500 m, 12.VII.1948 (Köie 2396, hb. W., C.).

Wagenitz spricht sich in Flora 142:256 (1955) für eine generische Abtrennung gewisser bisher meist zu *Microlonchus* oder auch zu *Centaurea* gestellter Arten, nämlich *O. divaricata* (F. et M.) C. Koch und *O. minima* (Boiss.) Briq. aus, wobei pollenmorphologische Erwägungen eine wesentliche Rolle spielen. Für *O. leucosmerinx* ist zwar die Untersuchung des Pollens noch ausständig, wegen der vollständigen Uebereinstimmung in der Ausbildung der Achänen muss die neue Art jedenfalls bei *Oligochaeta* eingereiht werden.

Carthamus lanatus L. — **N:** Baghlan, 3000 ft., field borders (Kz. 12177).

C. oxyacantha M.B. — **N:** Baghlan, 3000 ft., field borders (Kz. 12178). — **NE:** Rustak, 4000 ft., dry ground (Kz. 13127). — **Nuristan:** Jalalabad-Becken, häufiges Unkraut auf Brachen (N. 51/858). — **SE:** Kajkai, 1000 m (K. 2163).

Pertya Aitchisonii C. B. Clarke (e descr.). — **Nuristan:** Elasoon (E. 1778). Zwischen Kotal-e-Agok und Alm bis Ort Waigel. (N. 51/917).

Cichorium Intybus L. — **C:** Ghorband, 1800 m (K. 3315). Hauz-i-Mahiha, 2500 m (K. 2387). Lorinj, 8000 ft., in field (Kz. 13672). — **Nuristan:** Kushtos, ca. 1800 m (E. 1115). — **E:** Begram (CODRINGTON).

Koelpinia linearis Pall. — **NW:** Qala Nau, 900 m (K. 3965). — **SW:** Herat, 1000 m (K. 4026). Jija, 1400 m (K. 3586, 4025). — **C:** Farakulum, 2800 m (K. 2566). — **NE:** Faizabad (E. 1346). — **Nuristan:** Gusalak, 1000 m (E. 1512). Kantivo, 700 m (E. 719). — **E:** Kabul, Aliabad (N. 51/99, 51/106, 51/120). Kabul, Scher Darwasa (N. 51/57). Saintlot, zwischen Molif und Tscharikar (N. 50/930). Pulalam, 7000 ft., fl. yellow (Kz. 11856). Khudikhel, 7000 ft., fields (Kz. 11549). — **SE:** Pirzada, 900 m (K. 2076).

Acanthocephalus Benthamianus Regl. & Schmalh. — **NW:** Kishlik, 700 m (K. 4039). — **Nuristan:** Nishei, 1300 m (E. 803).

Heteracia Szowitzii F. & M. — **NW:** Kishlik, 700 m (K. 4038).

Garhadiolus Hedypnois (F. & M.) Jaub. & Sp. — **NW:** Kishlik, 700 m (K. 4018). Obeh-Chisht, 1400 m (K. 4019). — **SW:** Jija, 1000 m (K. 4020). — **C:** Lorinj, 8000 ft., field weed, 1 inch, yellow (Kz. 13689). — **NE:** Basarek, Pandschirtal (N. 50/925). — **E:** Pulalam, 7000 ft., fl. yellow (Kz. 11846). Tscharikar, Bachbett bei Top Tara (N. 50/924).

G. papposus Boiss. et Buhse — **NW:** Kishlik, 700 m (K. 3983). — **SW:** Jija, 1200 m (K. 3587). — **E:** Kabul, Fels bei Aliabad (N. 51/107). Kabul (N. 50/926). — **SE:** Kajkai, 1000 m (K. 2165).

Helminthia echioides (L.) Gärtn. — **E:** Laghman, 4000 ft., field border (Kz. 11609).

Picris afghanica Rech. fil. & Köie, n. sp. — Fig. 127.

Sect. *Eupicris* DC. — Perennis. Caulis 6—10 cm altus, in tertia parte superiore iteratim paniculato-ramosus, grosse sulcato-striatus, omnino purpurascens, setis rigidis partim glochidiatis hispidus. Folia basalia oblongo-lanceolata ad 8 cm longa, 3 cm lata, in tertia parte superiore latissima, acuta leviter sinuato-dentata, utrinque setis longioribus et brevioribus rigidis pro magna parte glochidiatis hispida. Folia caulina basi rotundata vel leviter cordata sessilia, integra vel remote sinuato-denticulata, nervo mediano valido saepe rufescente percursa, omnino hispida. Folia ramos fulcrantia anguste lanceolata, valde diminuta. Pedunculi 1—3 cm longi plerumque stricti, fructiferi sursum non vel vix incrassati. Involucrum ± 12 mm longum, basi rotundatum, phyllis exterioribus abbreviatis lanceolatis acutis patulis, interioribus erectis vel conniventibus medio atroviridibus glanduloso-setosis, margine pallide viridibus et anguste albido-scariosis. Ligulae flavae. Achaenia ± 6 mm longa, vix 1 mm diametro, basi apiceque longiuscule attenuata. Pappus sordide albus deciduus, 7 mm longus. — Differt a *P. hieracioide* L. habitu graciliore, caule iteratim corymboso-

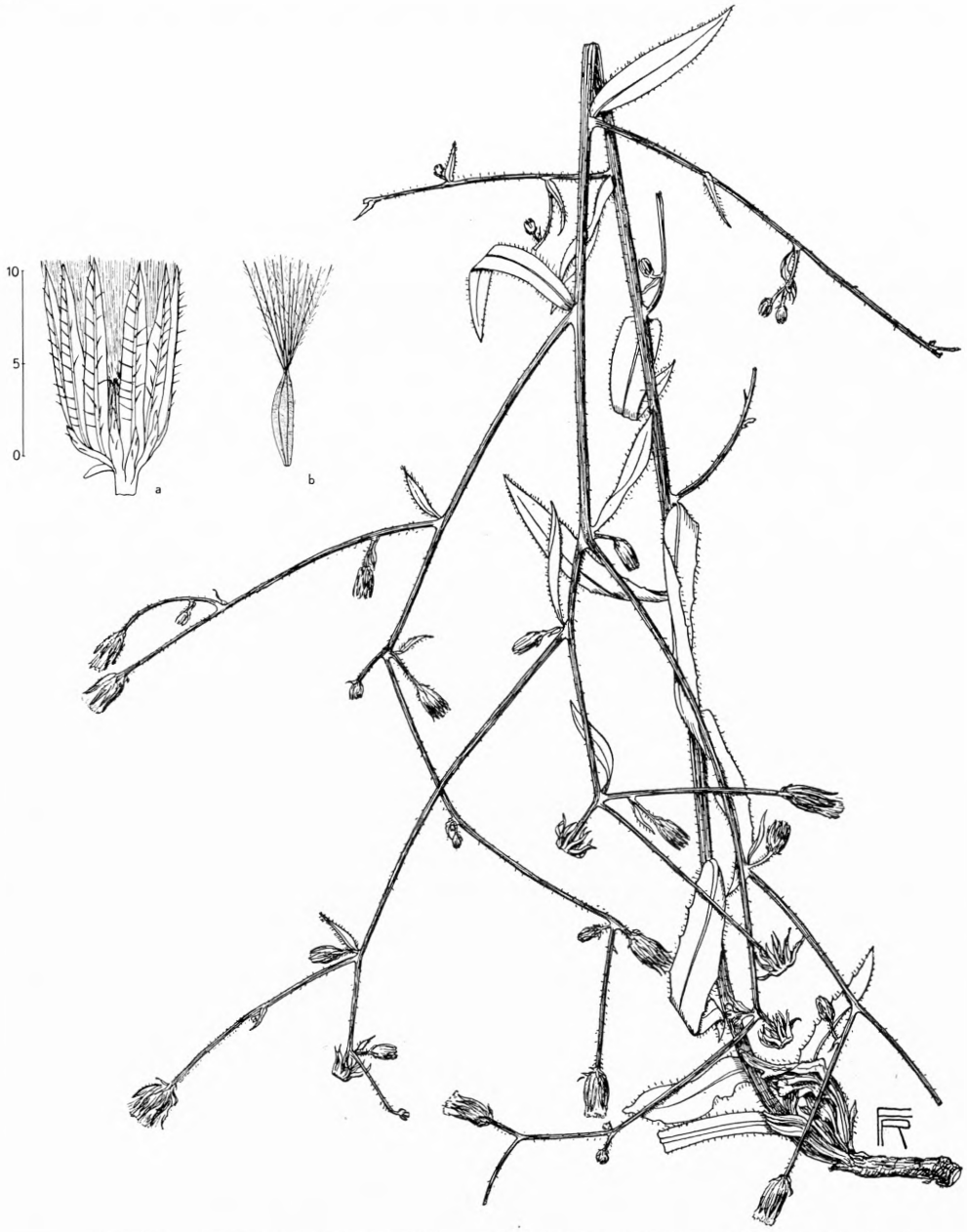


Fig. 127. *Picris afghanica* (K. 2294 — a Köpfchen, b Achäne mit Pappus). $^1/_2$.

Fig. 128. Links: *Tragopogon afghanicus* (Kz. 13798 — oberer Stengelteil eines Fruchtexemplares und Fruchtköpfchen). Rechts: *T. collinus* (K. 3711). $^1/_2$.

ramoso indumento sparsiore sed in parte inferiore caulis longiore et rigidiore, capitulis angustioribus cylindricis, involucri phyllis dorso atroviridibus lateraliter dilute viridibus anguste hyaline marginatis, indumento involucri longiore et rigidiore, achaeniis longioribus basi apiceque longius attenuatis; differt a *P. nuristanica* Bornm. cui habitu gracili ramificatione et indumento similis capitulis maioribus, involucri phyllis dorso anguste atroviridibus, achaeniis longioribus utrinque longius attenuatis.

E: Paghman, 2100 m, 8.VII.1948 (Köie 2294, Typus, hb. C.). — **C:** Panjao, 2700 m (K. 2747, hb. W., C.). Hauz-i-Mahiha, 2600 m (K. 2408, hb. C.). — **NE:** Hazratsaid, 8000 ft., in field, pl. 3 ft. high, fl. yellow (Kz. 12854, hb. W., BPI.).

P. nuristanica Bornm., Fedde Rep. Beih. 108.1:68 (1938). — **NE:** Miyan Deh, 2550 m (E. 1605). — **Nuristan:** Shtive, 2600 m (E. 1284). Zwischen Kotal-e-Agok und Alm bis Ort Waigel (M. 51/930).

Tragopogon afghanicus Rech. fil. & Köie, n. sp. — Fig. 128 und 129.

Verosimiliter biennis. Caulis 25—35 cm altus, erectus validus subsimplex vel profunde furcatus vel interdum a basi ramosus, ramis arcuato-erectis, internodiis brevibus crebre foliatus, tenuiter striatus, glaber, basin versus ± violascenti-suffusus, superne flavescenti-virens, sensim valde clavato-incrassatus, pedunculo infra capitulum fructiferum in statu compresso interdum ultra 1 cm diametro. Folia basalia in statu fructifero jam emarcida diffracta; folia caulina basi eximie fere inflate vaginato-dilatata, striato-multinervia, glabra laevia, sensim tenuiter caudato-attenuata, elongata flaccida, simulac flavescenti- et glaucescenti-viridia, media et superiora caules subaequantia. Involucrum fructiferum 7—9 cm longum, pappum superans; phylla e basi dilatata 8—10 mm lata sensim longe caudato-attenuata, inferne membranaceo-marginata superne caudata flaccida, tenuiter multistriato-nervosa, glabra laevia flavescenti-viridia, imprimis prope basin interdum ± glaucescenti-pruinosa. Achaenia ± 15 mm longa, sectione transversali 4—5-angulata, tenuiter longitudinaliter striato-costata, secus costas scabrida vix muriculata, sensim in rostrum pallidum duplo longius sub pappo breviter clavato-incrassatum ibique floccosum sensim attenuata. Pappus flavescens plumosus inaequalis, ad 3 cm longus. — Differt a *T. Kraschenikowii* S. Nikit. habitu humili, pedunculis valde incrassatis, rostro quam achaenium duplo nec triplo longiore, pappo flavescente nec rufescente.

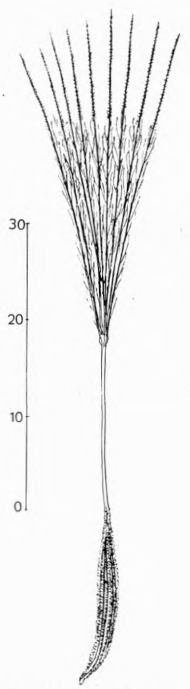


Fig. 129. *Tragopogon afghanicus.* Achäne mit Pappus.

C: Qala Sakawa, 2500 m, 3.VIII.1948 (Köie 3312, Typus, hb. C.). Aoi Khurak, field edge, 9000 ft., plant 18 inches high, 18.VIII. 1939 (Kz. 13798, hb. W., BPI.).

Die Beschreibung ist bezüglich der Blätter nach Koelz 13798 ergänzt.

T. collinus DC. sensu lato — det. M. Ownbey — Fig. 128 rechts. — **NW:** Obeh — Chisht, 1700 m (K. 3711).

Fig. 130. *Tragopogon agrostiphyllus* (K. 3311 — a Achäne mit Pappus). $^2/_3$.

Tragopogon agrostiphyllus Rech. fil. & Köie, n. sp. — Fig. 130.

Radix fusiformis elongata verosimiliter biennis. Caules plures ad 25 cm longi tenues glaucescentes tenuiter pallide striati, subsimplices vel saepius profunde furcati, internodiis mediis 4—5 cm longis, superioribus magis elongatis, pedunculis fructiferis superne paulum incrassatis. Folia omnia tenuissime lineari-filiformia flaccida glaucescentia paucinervia (nervis 3—5), prope basin paulum dilatata gossypino-floccosa ceterum glabra. Folia basalia numerosa, basi vaginiformi-dilatata, pallide membranacea, ad 10 cm longa; folia caulina sensim breviora summa ca. 3 cm longa. Flores ignoti. Involucrum fructiferum 4.5—5 cm longum pappum paulo superans; phylla anguste lanceolata, prope basin ± 5 mm lata, anguste membranaceo-marginata, apicem versus sensim longe attenuata pallide flavescenti-viridia et ± glaucescenti-subpruinosa, tenuiter longitudinaliter striato-nervosa, glabra. Achaenia ± 15 mm longa carneo-brunescentia, tenuiter longitudinaliter costato-striata, omnino dense minute pallide muriculata, in rostrum ± 6 mm longum pallidum apice subito infundibuliformi-dilatatum attenuata. Pappus ± 2 cm longus, multiradiatus, radiis inaequalibus plumosis, primum sordide albis deinde purpurascenti-violascentibus. — *T. agrostiphyllus* monente M. Ownbey *T. angustissimo* S. Nikit. proximus videtur et cum eo accuratius comparandus.

C: Farakulum, 2700 m, 19.VII.1948 (Köie 3311, hb. W., C.). — **E:** Paghman, Begtut, Geröll, 21. VIII. 1951 (V. 2215 b, hb. W).

T. gracilis Don — **C:** Lorinj Pass, 10000 ft., dry slope (Kz. 13758). — **NE:** Sanglech, 11500 ft. in field, fl. yellow (Kz. 12650). — **Nuristan:** (E. 2064). Kantivo, 2200 m (E. 688). Shtive, 2800 m (E. 1045). — **E:** Mittleres Paghmantal (N. 50/904).

T. longirostris Bisch. — det. M. Ownbey. — **NW:** Qala Nau, 800 m (K. 3809).

Scorzonera afghana Rech. fil., Oesterr. Bot. Zeitsch. 97:264 (1950). — Fig. 131 und 137 — **NW:** Chisht, 1600 m (K. 3687). — **C:** Band-i-Amir (Codrington s. n., Typus, hb. BM.). Koh-i-Baba, 3100 m (K. 2655). — **Nuristan:** Kantivo, 2300 m (E. 663). — **E:** Tscharikar, Top Tara (N. 50/907).

"Differt ab affini *S. turcomanica* H. Krasch. & Lipsch. rhizomatis collo brevi vel subnullo, foliis angustioribus complicatis vel convolutis, indumento minus appresso imprimis inferne subcrispulo, capitulis acheniisque minoribus, pappo breviore stramineo nec griseo-violaceo, ligulis roseis vel purpurascentibus nec flavis."

S. cenopleura Bge. — **NW:** Qala Nau, 800 m (K. 3800).

S. circumflexa H. Krasch. & Lipsch. — **SW:** Jija, 1200 m (K. 4036).

S. Codringtonii Rech. fil., Oesterr. Bot. Zeitschr. 97:263 (1950). — Fig. 132 und 137. — **C:** Band-i-Amir (Codrington s. n. una cum *S. afghana*, Typus, hb. BM.).

"Habitu similis *S. Litwinowii* H. Krasch. & Lipsch., a qua squamis basalibus perlatis tenuiter membranaceis, caulibus valde abbreviatis, indumento breviter hirsuto-tomentoso nec longe lanato-floccoso, involucri phyllis brevibus magis patulis, ligulis atropurpureo-violaceo-striatis nec flavis diversa."

Scorzonera crassicaulis Rech. f., n. sp. — Fig. 133.

Sect. *Piptopogon* (sensu Lipschitz). — Radix crassa, verosimiliter perennis, verticalis ca. 1.5 cm diametro, collo residuis foliorum copiose squamoso. Caulis 25 cm altus, crassus, inferne ca. 1 cm diametro, internodiis mediis 2—3 cm longis, profunde sulcato-striatus, a basi breviter ramosus, copiose foliatus. Folia inferiora graminea, multinervia, fructificationis tempore iam emarcida, glabrata, 2—3 mm lata; folia superiora multo latiora 6 mm, partim usque 10 mm lata, multinervia, laxe floccoso-tomentella, valde glabrescentia, pallide viridia. Capitula in ramis 0.5—1 cm longis 2—3 mm crassis terminalia. Involucrum fructicationis tempore 6—7 mm longum, e phyllis laxe imbricatis plerumque 4-seriatis compositum; phylla extima 1 cm longa, 7 mm lata, sequentia ca. 2 cm longa, 7 mm lata, phylla seriei tertiae 3.5 cm longa, seriei intimae 5—6—7 cm longa, ± 4 mm lata, omnino tenuiter herbaceo-membranacea, indistincte longitudinaliter striata, dorso minute floccosa glabrescentia, anguste hyaline marginata, nitentia, extima breviter, intima longe attenuata. Flores ignoti. Achaenia (matura) ca. 1.5 cm longa, in rostrum circiter 1.5 saepius 2 cm longum sensim attenuata, albida, profunde sulcata. Pappus fere 3 cm longus, stramineus, longe albido-plumosus. — Differt a *S. Albertoregelia* C. Winkl. caule quam capitula 4—5 plo longiore nec eis breviore, capitulis cum pappi setis 6.5 (nec

Fig. 131. *Scorzonera afghana* (Codrington s. n.). $^{1}/_{1}$.

Fig. 132. *Scorzonera Codringtonii* (Codrington s. n.). $^{4}/_{5}$.

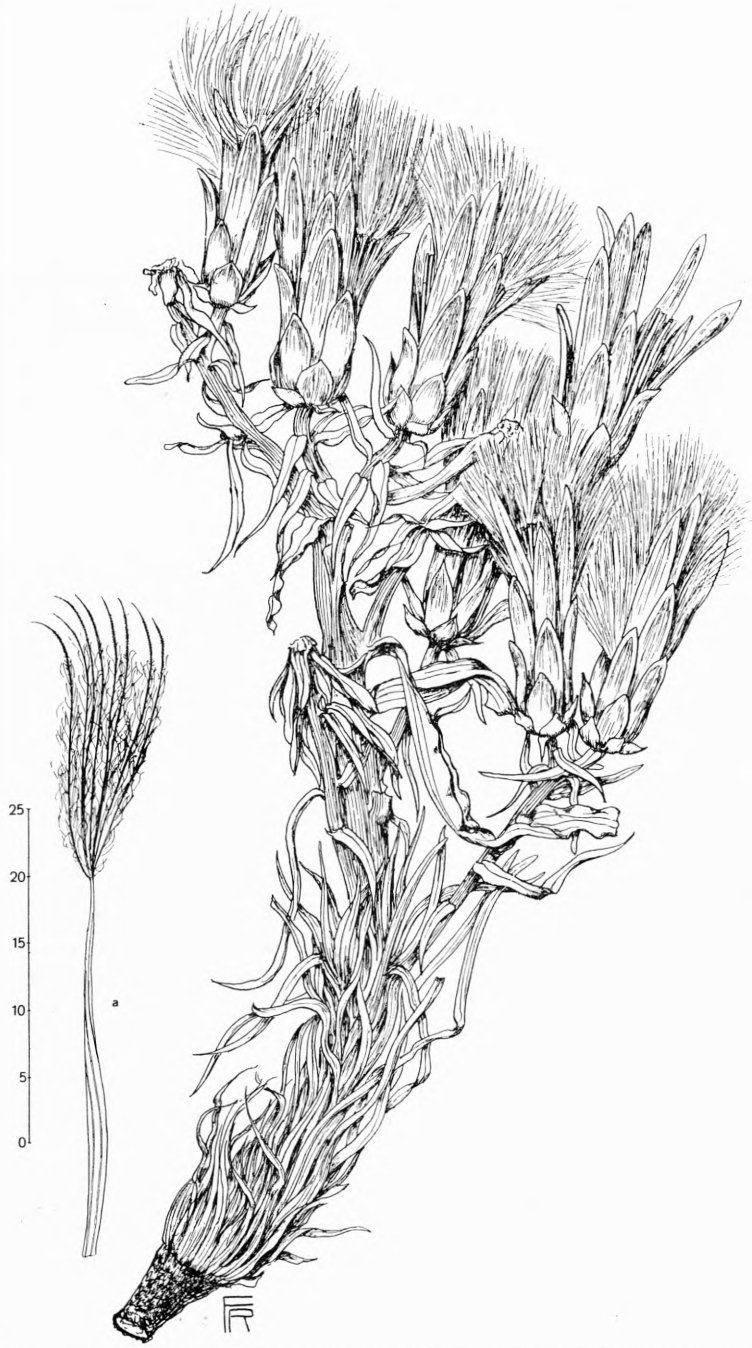


Fig. 133. *Scorzonera crassicaulis* (K. 2341 — a Achäne mit Pappus). $^{3}/_{5}$.

4.5) cm longis, involucri 4 (—5)-nec 3-seriati phyllis fere imbricatis multo longioribus intimis ad 5.5 (nec 4.2) cm longis, foliis imprimis superioribus multo latioribus usque 10 (nec 2) mm latis, multi- (nec tri-) nerviis.

C: Hauz-i-Mahiha, 2500 m, 10.VII.1948 (Köie 2341, hb. C.).

S. ferganica H. Krasch. (e descr.). — **C:** Farakulum, 2800 m (K. 2491). — **E:** Pulalam, 7000 ft. (Kz. 11835).

Stimmt mit der Beschreibung überein, doch sind die Köpfchen kleiner (15 mm nicht 20—25 mm), was vielleicht mit dem Entwicklungszustand zusammenhängen könnte.

Scorzonera Koeieana Rech. fil., n. sp. — Fig. 134 und 137.

Sect. *Euscorzonera* DC. Subsect. *Pulvinares* Boiss. — Perennis caespitosa collo incrassato minute squamoso inter squamas lanato. Folia omnia basalia scapos aequantia vel paulo superantia, ad 8 cm longa, anguste lanceolato-linearia, basi apiceque sensim attenuata, basi ipsa membranaceo-dilatata, supra medium plerumque latissima ad 3 mm lata integerrima, crassiuscula, trinervia, saepe in sicco longitudinaliter plicata et subfalcato-curvata, prope basin villosula, ceterum appressissime breviter puberula. Caules tenues ad 8 cm longi, tenuiter sulcato-striati, scapiformes vel foliis rudimentariis anguste lanceolato-linearibus ± squamiformibus sparse obsiti. Involucrum floriferum ± 12 mm longum, in vivo verosimiliter cylindricum, basi breviter rotundatum, fructiferum valde elongatum ad 25 mm longum, phyllis non numerosis irregulariter subseriato-imbricatis; phylla omnia herbacea, anguste membranaceo-marginata, nervo unico tenui percursa, minute appresse farinoso-puberula, imprimis apicem versus glabrescentia; exteriora ± 7 lanceolata acuta 3—5 mm longa; interiora 5—7 circiter triplo longiora basi ad 3 mm lata saepe subaequalia vel longitudine inter se paulum diversa. Ligulae

Fig. 134. *Scorzonera Koeieana* (K. 3309). $^1/_1$.

luteae, extus purpureo-suffusae atrius striatae, involucro paulo usque ad summum sesquilongiora. Achaenia 13 mm longa profunde sulcato-costata, glabra laevia pallida, superne insensibiliter attenuata. Pappus ad 20 mm longus, inferne flavescens, superne purpureo-violascens. — Differt a *S. rigida* Auch. collo squamis minutis tantum obsito, foliis latioribus, involucrorum maiorum phyllis anguste tantum hyaline marginatis farinoso-puberulis.

C: Hauz-i-Mahiha, 2800 m, 12. VII.1948 (Köie 3309, Typus, hb. W., C.). Shanbashak Pass, dry plain, 9300 ft., plant 6 inches high, 31.VIII. 1939 (Kz. 13867, hb. W., BPI.). Farakulum, 2700 m (K. 2516, hb. C.). Unaipass (N. 51/514, 51/543). — **NE:** Weran, 3000 m (E. 1461, hb. C.).

S. laciniata L. s. l. — **NW:** Qala Nau, 800 m (K. 3860). Qala Nau, 1200 m (K. 3928). — **C:** Qala Sakawa, 2500 m (K. 2757). Panjao, 2700 m (K. 2718). Farakulum, 2700 m (K. 2580). — **E:** Nozi, 9000 ft., dry slope (Kz. 12026). Kabul (N. 50/905, 50/906). Kabul, Guzar Gah, unter Weiden und *Eleagnus* am Flussufer (N. 51/28).

Die afghanischen Exemplare von *S. laciniata* sind mit Ausnahme eines einzigen alle viel breitblättriger als die europäischen.

S. picridioides Boiss. — **SW:** Jija, 1200—1400 m (K. 3583).

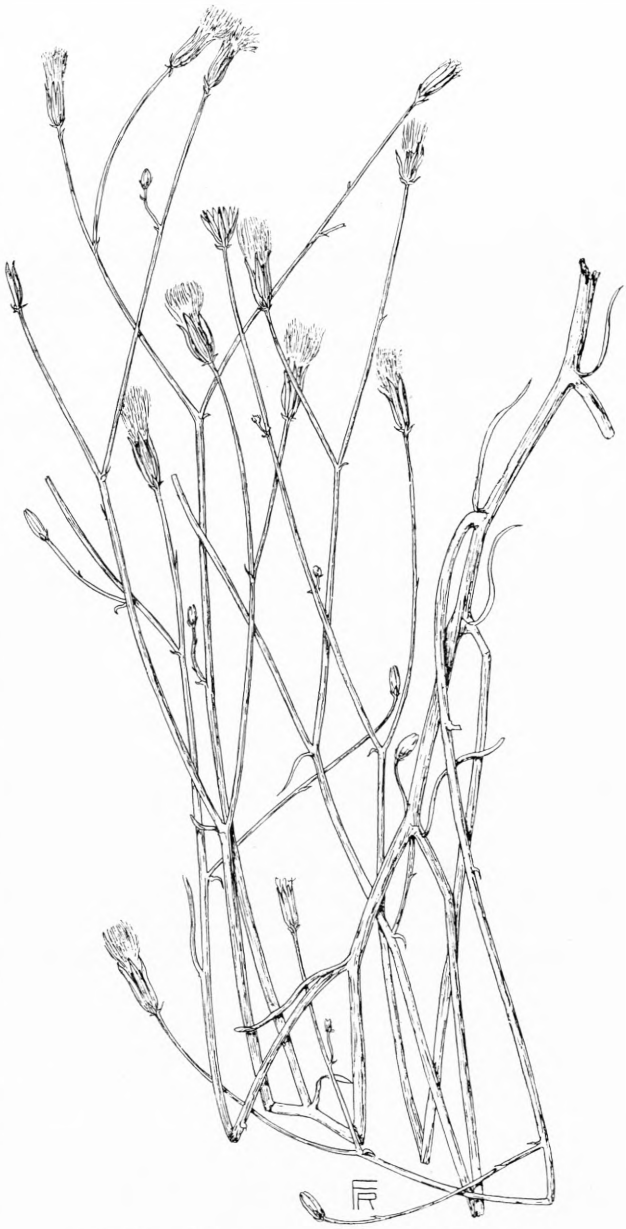


Fig. 135. *Scorzonera polyclada* (K. 4013). $^1/_2$.

Scorzonera polyclada Rech. fil. & Köie, n. sp. — Fig. 135 und 137.

Sect. *Euscorzonera* DC. Subsect. *Intricatae* Boiss. — Verosimiliter perennis, 40—60 cm alta, pluricaulis. Caulis a basi iteratim longe virgato-ramosus valde glabrescens, tenuiter striatus, pallide viridis, internodiis omnino elongatis, ramis

angulo acuto divergentibus. Folia basalia non visa; caulina inferiora ad 5 cm longa, ca. 1 mm lata, anguste linearia integerrima acuta, puberula valde glabrescentia; caulina media et superiora similia sensim breviora; summa valde abbreviata squamaeformia. Pedunculi 3—6 cm longi, tenues stricti. Involucrum floriferum ca. 10 mm, fructiferum ad 15 mm longum, tenuiter cylindricum oligophyllum; phylla biseriata, exteriora interioribus 4—5-plo breviora subpatula; interiora quinque linearia herbaceo-membranacea ± indistincte hyaline marginata, virescentia interdum purpureo-suffusa, farinoso-puberula secus nervum medianum tenuem ± glabrescentia, apice obtusiuscula usque subacuta. Ligulae flavae concolores, involucrum aequantes. Achaenia ± 11 mm longa, pallida, laevia, angulato-costata, basi apiceque non vel vix attenuata. Pappus 12—15 mm longus, sordide albus, flavescenti-purpurascens, plumosus. — Differt a *S. tortuosissima* Boiss. habitu elatiore, internodiis elongatis, caulibus ramisque indumento laxo cito evanescente viridibus, ramis angulo acuto abeuntibus, foliis inferioribus quidem longioribus, involucris angustioribus, phyllis saepius obtusiusculis apice brevius attenuatis.

C: Farakulum, 2700 m (K. 2515, hb. C.). — **E:** E. of Kabul, 1700 m, 28.V.1949 (Köie 4013, Typus, hb. W., C.). Ghazni, 2400 m (K. 3301, hb. C.).

S. pusilla Pall. — **SW:** Jija, 1000 m (K. 4035).

S. radicosa Boiss. — **NW:** Safedsang, 10000 ft., along stream (Kz. 13994). — **C:** Sabz Pass, 10000 ft., spring meadow (Kz. 13819).

Scorzonera tunicata Rech. fil. & Köie, n. sp. — Fig. 136 und 137.

Sect. *Pseudo-Podospermum* Lipsch. et H. Krasch. — Rhizoma elongatum incrassatum ad 3 cm diametro, crasse atro-corticosum, collo tunica persistente residuis foliorum emarcidorum pallide brunea membranacea glabra proviso. Caulis subscapiformis simplex, ad 20 cm longus, arcuatus vel subrectus, in parte infima foliis paucis provisus vel subnudus monocephalus, ad basin capituli in statu florendi quidem non vel vix sensibiliter incrassatus, farinoso-puberulus albescens. Folia basalia numerosa scapum ± aequantia, linearia vel rarius antice paulum dilatata lineari-lingulata, latitudine variabilia 3—12 mm lata, saepe valde crispata, costa mediana applanata taeniaeformi pallide percursa, primum pulverulento-tomentella alba demum glabrescentia virescentia. Involucrum floriferum 20—22 mm longum basi subrotundato-attenuatum, supra basin in statu compresso ad 11 mm diametro, superne paulo constrictum oligophyllum phyllis intimis apice divergentibus; phylla extima late ovato-triangularia ad 1 cm lata acuta, intima ovato- usque late lanceolata saepe obtusiuscula, omnia dense breviter persistenter albo-farinoso-puberula, nervis vix conspicuis. Ligulae flavae extus purpureo-suffusae, involucro ± sesquilongiores. Achaenia ignota. — Differt a *S. colorata* H. Krasch. habitu humiliore, collo tunica densa e basibus foliorum emarcidorum membranaceis composita proviso, involucro breviore densius farinoso-puberulo, nervis non prominentibus. Affinis quoque *S. mucidae* Rech. fil., Aell., Esf., Oesterr. Bot. Zeitschr. **97**:264 (1950).

Fig. 136. *Scorzonera tunicata* (K. 3710). $^1/_2$.

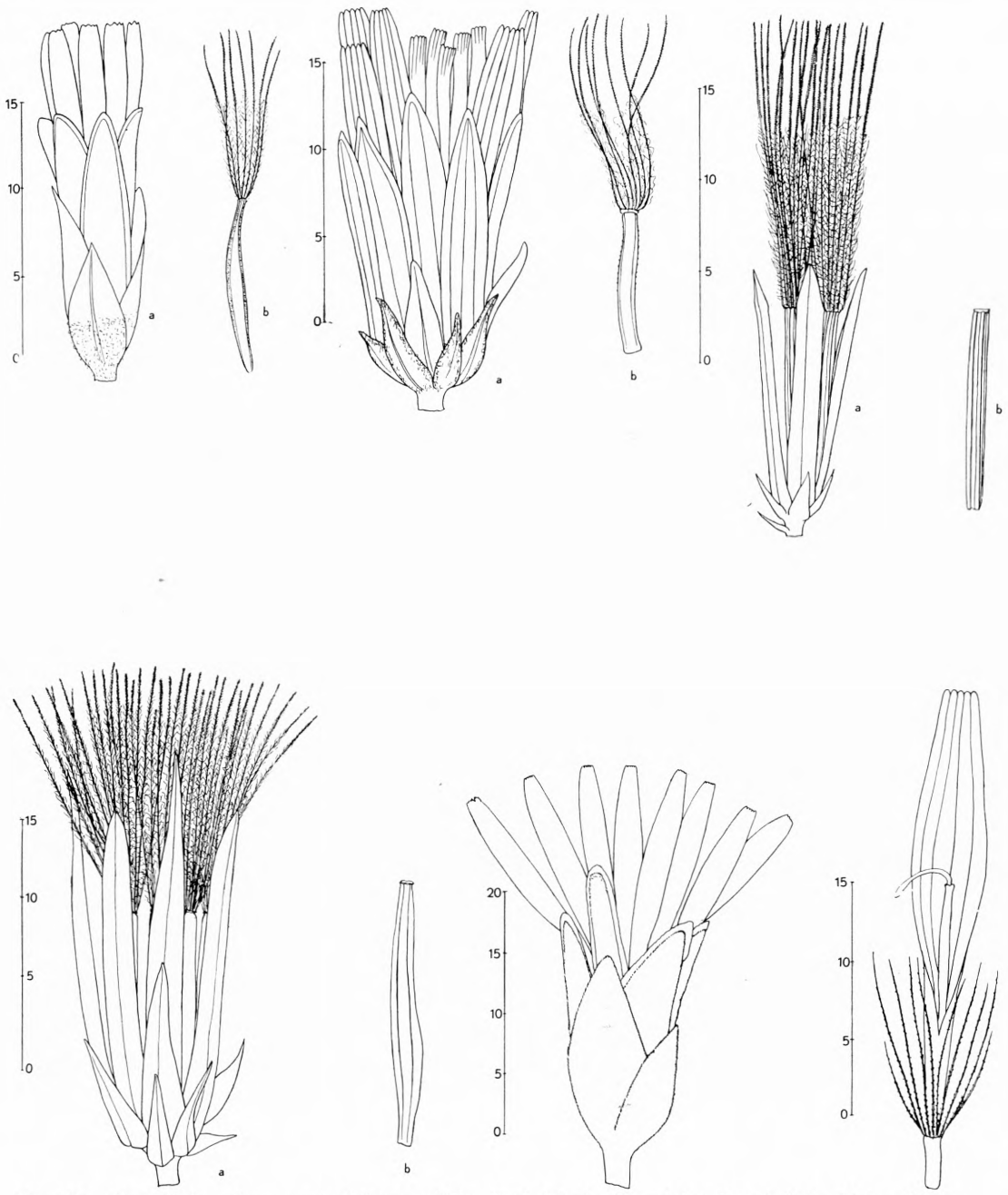


Fig. 137. Oben links: *Scorzonera afghana*, mitte: *S. Codringtonii*, rechts: *S. polyclada*. Unten links: *S. Koeieana*, rechts: *S. tunicata*, Köpfchen und Achäne.

SW: Jija, 1200 m, 12.IV.1949 (Köie 3710, Typus, hb. W., C.). Jija, 1200 m (K. 3566, hb. C.). Herat, 1200 m (K. 4034, hb. W., C.). — **NW:** Obeh, 1400 m (K. 3726, hb. W., C.). — **C:** Deh Kundi (E. 1970, hb. C.).

Die übrigen Exemplare sind weniger hoch und kräftig als der Typus, stimmen aber sonst gut überein. E. 1970 ist durch Anthokyanreichtum, besonders durch purpurn beränderte Hüllschuppen und rötlichen Pappus ausgezeichnet.

S. turcomanica H. Krasch. et Lipsch. — **NE:** Sanglich, 3000—3600 m (E. 1489). — **E:** Bagrami, Nedjerau-Tal, in der oberen Waldzone, ca. 3000 m (N. 51/206).

Heteroderis pusilla (Boiss.) Boiss. — **SW:** Jija, 900 m (K. 4021).

H. Stocksiana Boiss. (e descr.). — **NW:** N. of Herat, 1100 m (K. 4023). — **SW:** Jija, 900—1200 m (K. 4022). — **C:** Hauz-i-Mahiha, 2500 m (K. 3298). — **E:** Kabul, Aliabad (N. 50/934). — **SE:** Pirzada, 900 m (K. 2075).

Chondrilla Bornmülleri Haeckel, Fedde Rep. Beih. 108.1:69 (1938). — **NE:** Daraim, 8500 ft. (Kz. 13030).

Ch. juncea L. — **E:** Begram near Charikar, 5000 ft. (Codrington 21). Paghman (N. 50/890).

Launaea acanthodes (Boiss.) O. Ktze. — **SW:** Jija, 1000 m (K. 4033). — **SE:** Pirzada, 1000 m (K. 2073).

L. fallax (J. & Sp.) Muschler. — **SE:** Kajkai, 1000 m (K. 3299).

L. secunda (Clarke) Hook. fil. — det. V. Täckholm — Fig. 141 und 145 — **Nuristan:** Derin-Elasoon, 6.VII.1949 (E. 1710). Ashpei, 2000 m, 11.VII.1949 (E. 1668, hb. C.). — **N:** Aqtscha, Flussau (N. 50/120, hb. W.).

Verosimiliter perennis. Caulis stricte erectus, 60—100 cm altus, in tertia parte inferiore foliatus, in tertia parte superiore parce virgato-ramosus, ramis elongatis strictis tenuibus floriferis. Caulis teres tenuiter sulcato-striatus glaucescens, internodiis mediis ad 10 cm longis. Folia basalia rosulata ad 16 cm longa, ad 5 cm lata, in tertia parte anteriore latissima, obtuse runcinato-lobata lobis retrosis, margine minute albide scarioso-denticulata, consistentia ut videtur in vivo subcarnosa, in sicco crassiuscule membranacea, colore supra atroviridi, subtus pallidiore glaucescente, utrinque glabra laevia. Folia caulina similia, basi rotundato-auriculata semiamplexicauli sessilia. Capitula pedunculis tenuibus copiose squamatis ad 1 cm longis plerumque brevioribus suffulta singula vel usque terna in racemos elongatos aphyllos laxe usque densiuscule disposita. Involucrum ± 1 cm longum, in statu compresso vix 3 mm latum, anguste cylindricum triseriatum; phylla seriei exterioris et intermediae anguste lanceolata albo-scarioso-marginata acuta; phylla intima quam

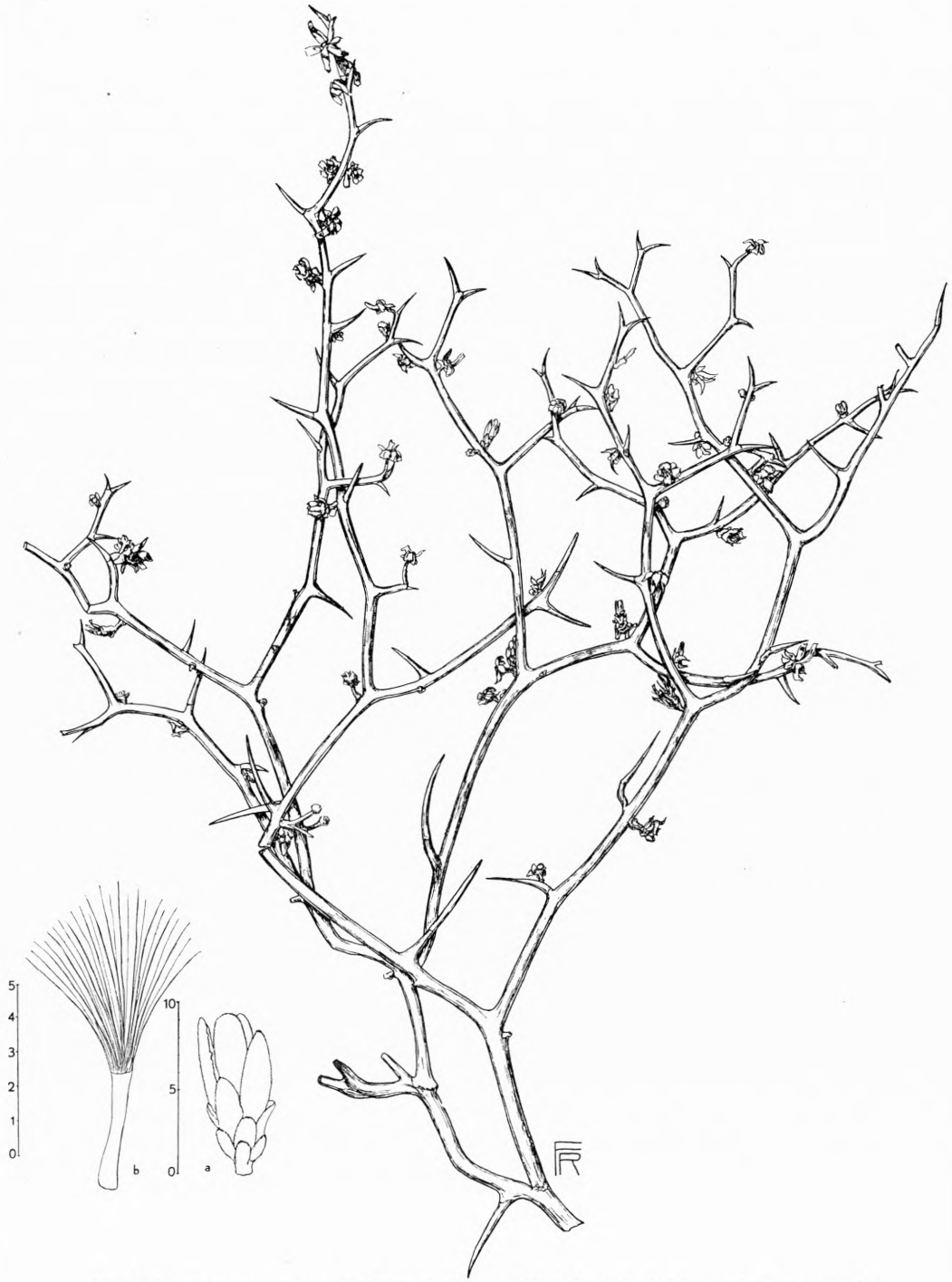


Fig. 138. *Launaea tomentella* (Kz. 13208 — a Köpfchen, b Achäne mit Pappus). $^1/_2$.

Fig. 139. *Sonchus lachnocephalus* (Kz. 11588). $^{2}/_{3}$.

exteriora 3—4-plo longiora anguste linearia acuta, dorso pallide viridia, saepe nervo mediano tenui roseo percursa, anguste albo-scarioso-marginata; phylla omnia glabra. Ligulae in sicco flavae concolores, involucro dimidio circiter longiores. Achaenia juniora 5 mm longa, pallide longitudinaliter costata et sulcata, apice non rostrata. Pappus albus persistens ± 5 mm longus. — Species foliis in parte inferiore caulis congestis, caule stricte erecto superne aphyllo virgate pauciramoso, capitulis paucifloris in racemos longos dispositis, achaenus erostribus insignis.

L. stenocephala (Boiss.) Burkill (e descr.) — **SE:** Pirzada, 900 m (K. 2036, 3833).

Launaea tomentella Rech. fil., n. sp. — Fig. 138.

Basis deficiens. Caules validi, inferne 5 mm diametro, a basi iteratim divaricate intricate ramosissimi teretes, pallidissime virides, tenuissime longitudinaliter striati, omnino tenuissime floccoso-puberuli, spinas rectangulariter divergentes validas vulnerantes apice stramineas proferentes; spinae in parte inferiore plantae ad 3 cm longae, sursum sensim decrescentes, 1.5—1 (—0.7) cm longae. Planta omnino aphylla. Capitula breviter crasse pedunculata usque subsessilia plerumque singula lateralia. Involucrum anguste cylindricum, e phyllis 3—4-seriatis laxe imbricatis crasse scariosis dense persistenter albo-tomentellis apice rotundatis persistens. Flosculi e collectore lutei. Achaenia matura 4.5 mm longa, fusiformia, pallide brunea, tenuiter longitudinaliter sulcata et costata, indistincte transversaliter subrugosa, basi longius apice brevius acuminata ± leviter curvata, indistincte 4—5-gona. Pappus candidus ± 4 mm longus, deciduus. — Differt a *L. acanthode* (Boiss.) O. Ktze. indumento tenuiter floccoso puberulo totius plantae, colore pallidissime viridi, involucris dense albotomentellis, achaeniis anguste fusiformibus distincte longitudinaliter costato-sulcatis subangulatis, pappo 4 mm longo deciduo.

SE: Kalat, dry ground, 8000 ft., bushy, fl. yellow, 13.X.1937 (Koelz 13208, Typus, hb. W., BPI.). — **E:** Harirud valley (Aitchison 723, hb. K, St, fide Täckholm). "Afghanistan" (Griffith, hb. K, fide Täckholm).

Mulgedium tartaricum L. — **C:** Panjao, 2700 m (K. 2720). Baligali Pass, 9000 ft., field, 3 ft., blue purple (Kz. 13848). Band-i-Amir, Feldunkraut auf Brachen und abgeernteten Feldern an den Seen. (N. 51/469). — **NE:** Hazratsaid, 8000 ft., dry ground 3 ft., fl. purple (Kz. 12860). Ptili, 2600 m (E. 1518).

Sonchus asper (L.) Mill. — **NW:** N. of Sauzak, 1200 m (K. 3919). — **C:** Sarasia, 9500 ft., field, 2 ft., yellow (Kz. 13840). — **Nuristan:** Gusalak, 1000 m (E. 251). — **E:** Tagau, 6000 ft., damp ground, yellow (Kz. 11800).

Sonchus lachnocephalus Rech. fil., n. sp. — Fig. 139 und 140.

Perennis. Caulis erectus 30—50 cm altus, internodiis paucis mediis valde elongatis ultra 10 cm longis, interdum jam infra medium longe pauciramosus, rarius praeter inflorescentiam subcorymbosam subsimplex, herbaceus, in sicco sulcato-

striatus, usque ad inflorescentiam glaber, a basi ad medium plurifoliatus. Folia omnia consistentia in sicco crassiuscule membranacea glabra, supra laete usque obscure viridia, subtus pallide glaucescenti-viridia, copiose tenuiter pennato-reticulato-nervosa, costa mediana pallescente basin versus dilatata, sinuato-subruncinato-lobata et copiose cartilagineo-spinuloso-denticulata; folia basalia rosulata, 10—13 cm longa, ± 3 cm lata, ambitu oblongo-lanceolata, plerumque supra medium latissima, basi ± petioliformi-attenuata, lobis utrinque usque 4 acutis vel obtusiusculis horizontaliter patentibus vel paulum retrorsis, sinibus latis rotundatis separatis, lobo terminali multo maiore; folia caulina inferiora basi late cordato-amplexicaulia sessilia, lobis basalibus rotundatis, proportione angustiora minus profunde lobata; folia summa e basi auriculata linearia paucidentata usque subintegra. Capitula in ramis corymbose divergentibus usque 5 cm longis disposita. Involucrum basi late rotundatum cum pedunculis imprimis prope basin densissime persistenter niveo-lanato-floccosum, omnino eglandulosum, phyllis exterioribus nonnullis brevibus, interioribus lineari-lanceolatis apicem versus attenuatis apice ipsa subspathulato-rotundatis 10—12 mm longis flavescenti-viridibus superne ± purpureo-suffusis. Ligulae luteae, extus purpureo-striatae. Achaenia 3—3.5 mm longa, utrinque attenuata, bruneo-aurata, costis tribus crassis longitudinalibus percursa, inter costas interdum linea parallela tenuissima evoluta, praeterea tenuissime vel indistincte transverse rugosa (usque sublaevia). Pappus niveus ± 6 mm longus. — Habitu *S. arvensi* L. similis, differt ab eo pedunculis et involucris omnino eglandulosis densissime candide lanato-floccosis parum glabrescentibus, achaeniis angustioribus crasse tricostatis, inter costas tenuissime vel indistincte longitudinaliter lineatis (nec subaequaliter quinquecostatis).

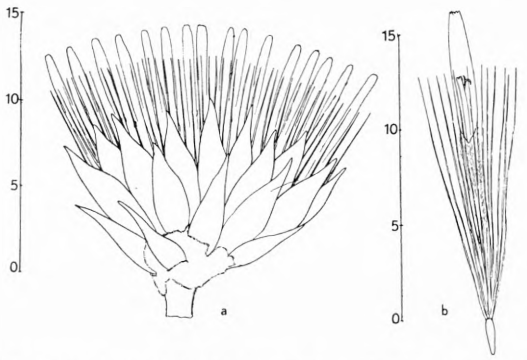


Fig. 140. *Sonchus lachnocephalus*. a Köpfchen, b Einzelblüte.

E: Mamakhel, 4000 ft., along stream, flowers yellow, 23.V.1937 (Koelz 11588, Typus, hb. W., BPI.). — **Nuristan:** Gusalak, 1000 m (E. 131, 253, 1156, 1573, hb. C.).

S. maritimus L. — **NW:** Zehnadis, 8000 ft., along stream, 18 inches, gold (Kz. 14019, 14019a). — **SW:** Herat, 1000 m (K. 3950). — **SE:** Pirzada, 900 m (K. 3305).

S. oleraceus L. — **Nuristan:** Nishei, 1200 m (E. 820). — **SE:** Pirzada, 900 m (K. 3306).

Lactuca dissecta Don. — **NE:** Kail, 8000 ft., dry slope, lavender (Kz. 11676). Panjshir, 1900 m (K. 3995). — **Nuristan:** Gusalak, 1000 m (E. 1508). — **E:** Kabul (Honigberger, hb. W.). Bagrami, Nedjerau-Tal (N. 51/292).

Fig. 141. *Launaea secunda*. (E. 1710). $^1/_2$.

L. glaucifolia Boiss. e descr. — **SW:** Jija, 900—1400 m (K. 4037). — **C:** Panjao (K. s. n.). Nil Kotal, 3000 m (K. 3307).

Lactuca Edelbergii Rech. f., n. sp. — Fig. 142 und 145.

Sect. *Mulgedioides* Boiss. — Partes subterraneae desunt, planta certe perennis. Caulis ad 70 cm altus erectus basi ultra 1 cm crassus, validus, in sicco brunescens profunde sulcato-striatus, internodiis mediis ad 10 cm longis, infra inflorescentiam quartam vel quintam partem occupantem non ramosus, in dimidio inferiore copiose foliatus, foliis superne subito valde decrescentibus subnudus. Folia basalia et caulina inferiora petiolo ad 5 cm longo suffulta, lamina ad 20 cm longa, ad 9 cm lata, ambitu oblongo-obovata, in tertia circiter parte anteriore latissima, lyrato-runcinata; lobus terminalis permagnus, ad 9 cm longus et latus, cordato-triangularis, late leviter sinuato-dentatus dentibus cartilagineis et laxe breviter glanduloso-ciliatus; lobi medii et basales decrescentes, 2—3 cm longi, 1—2 cm lati, horizontaliter patentes vel paulum retrorsi; costa mediana basin versus valde dilatata pallida. Folia caulina inferiora *Soncho oleraceo* L. similia, basi auriculato-cordata semiamplexicaulia, ambitu oblongo-lanceolata, ad 18 cm longa, ad 6 cm lata, late obtusiuscule runcinato-lobata; folia summa subito valde decrescentia basi auriculato-cordata, ambitu lanceolata, apice acuta, non vel vix lobata vix sinuata subintegra. Folia omnia ut videtur in vivo molliter carnoso-herbacea, in sicco crassiuscule membranacea, subtus et margine laxe breviter glanduloso-pilosa, ceterum glabra, supra atrius subtus pallidius viridia; nervatura tenuis pennato-reticulata. Inflorescentia corymbosa, ramis sub ineunte anthesi erecto- vel subarcuato-patentibus, inferioribus ad 8 cm longis iteratim breviter ramosis; folia ramos fulcrantia valde diminuta late rotundato-auriculata breviter lanceolata acuta. Capitula numerosa, ad extremos ramos ± approximata, pedunculis brevibus pallide glanduloso-setosis suffulta. Involucrum 13 mm longum, in statu compresso ad 7 mm latum, campanulato-cylindricum, pallide viride; phylla 16—22 irregulariter triseriata appressa, extima intimis ca. triplo, media duplo breviora, lanceolato-linearia acuta, prope basin 1.5—2 mm lata, exteriora dorso copiose pallide glanduloso-setosa. Ligulae luteae, ca. 15 mm longae. Achaenia juvenilia ambitu elliptico-orbicularia, compressa, perlate hyaline alata, brevissime rostrata. Pappus niveus, ca. 6 mm longus, sublaevis deciduus. — Species nova foliis superioribus valde diminutis, pedunculis et involucro copiose pallide glanduloso-setosis, imprimis autem achaeniis in statu juvenili late ovato-ellipticis late hyaline marginatis brevissime rostratis insignis, habitu speciebus nonnullis sectionis *Mulgedioidis* Boiss. similis.

Nuristan: Vama, 1400 m, 4.V.1948 (Edelberg 523, 524, Typus, hb. W., C.).

L. longifolia (Wall.) DC. — **Nuristan:** Nishei (E. 784, 1109).

L. orientalis L. — **NW:** Safedsang, 10000 ft., dry slope (Kz. 14005). — **SW:** S. of Herat, 1000 m (K. 2224). — **C:** Hauz-i-Mahiha, 2500 m (K. 2376). Bamian (N. 51/400). Panjao, 3000 m (K. 2735). Lorinj, 8000 ft., 18 inches, yellow (Kz. 13658). Binimang,

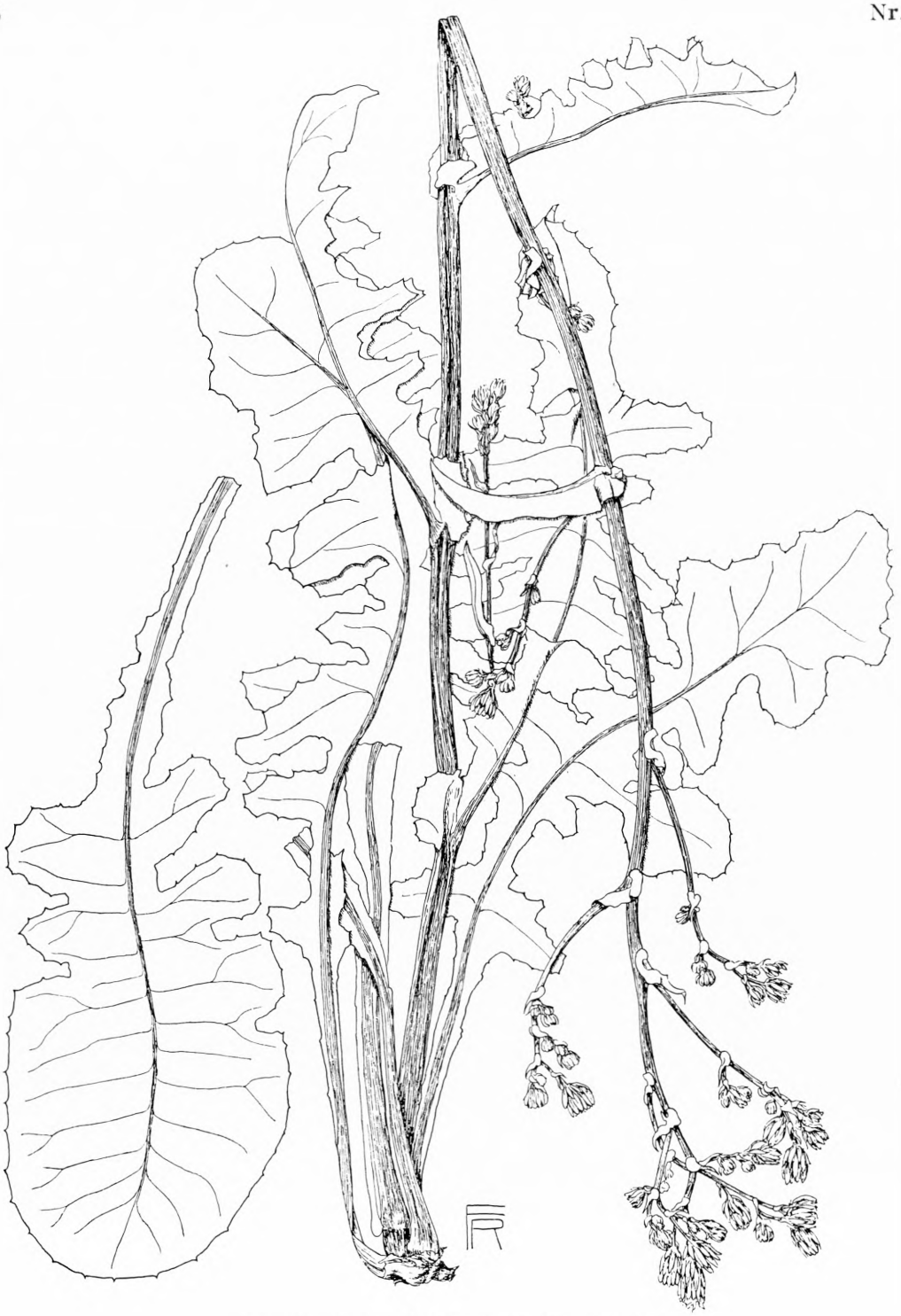


Fig. 142. *Lactuca Edelbergii* (E. 523, 524). $^1/_2$.

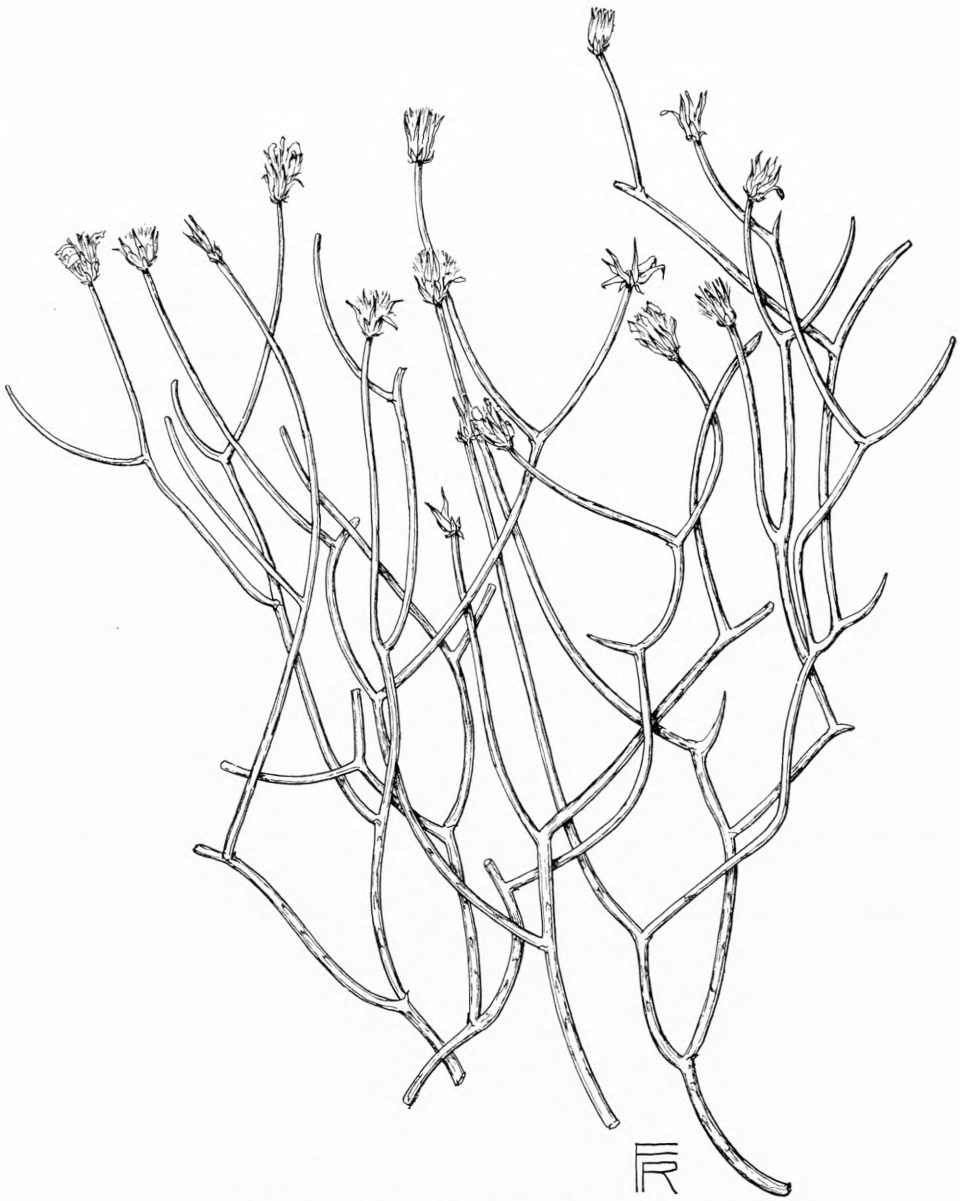


Fig. 143. *Lactuca intricatissima* (Kz. 13740). $^{2}/_{3}$.

8000 ft., cliff face, 18 inches, yellow (Kz. 13880). **NE:** Sanglech, 11500 ft., stream bed, fl. yellow (Kz. 12611). — **E:** Kabul, Aliabad (N. 50/886). Guzar Gah (N. 50/105). Oberes Paghmantal (N. 50/889). — **SE:** Kalat, 8000 ft., bushy, fl. yellow (Kz. 13209). Pirzada, 1000 m (K. 2114, 3437).

Lactuca intricatissima Rech. fil., n. sp. — Fig. 143 und 145.

Basis deest sed planta verosimiliter perennis. Caulis a basi iteratim dichotome

Fig. 144. *Lactuca Koelzii* (Kz. 12616). $^1/_2$.

divaricate intricate ramosissimus, pallide viridis teres glaber tenuiter striatus, omnino aphyllus, ad basin ramorum tantum squamis minutissimis triangulari-lanceolatis acuminatis herbaceis indistincte membranaceo-marginatis indivisis. Capitula in pedunculis 1—4 cm longis non incrassatis terminalia. Involucrum 7—8 mm longum, oligophyllum basi attenuatum superne ± patulum; phylla exteriora valde abbreviata, triangulari-lanceolata, intima uniseriata aequalia 7—8 mm longa anguste lanceolata a basi apicem versus sensim angustata, tenuiter herbaceo-membranacea tenuissime longitudinaliter striata, glabra laevia, anguste hyaline marginata, apice subito paulum membranaceo-dilatata vel subcorniculata saepe purpurascentia. Ligulae roseae vel lavandulaceae (e collectore) involucro subduplo longiores. Achaenia submatura 3—4 mm longa, leviter curvata, paulum compressa, basi attenuata apice breviter crasse rostrata, pallide brunea, tenuiter longitudinaliter striata. Pappus 4 mm longus, albus multiradiatus scabridulus. — Species aphylla habitu intricato-ramosissimo *Launeae acanthodi* (Boiss.) O. Ktze vel *Scorzonerae tortuosissimae* Boiss. simillima, *Chondrillae piestocarpae* Boiss. (mihi e descr. tantum notae) quoque similis videtur sed characteribus involucri et achaeniorum potius *Lactucae* sect. *Scariolae* adnumeranda.

C: Lorinj Pass, 10000 ft., dry slope, plant 1 ft. high, fl. rose, 27.VIII.1939 (Koelz 13740, Typus, hb. W., BPI.). — **NW:** Burchao Pass, 9000 ft., dry slope, plant 1 ft. high, fl. lavender, 12.X.1939 (Kz. 14124, hb. W., BPI.).

Lactuca Koelzii Rech. fil., n. sp. — Fig. 144 und 145.

Sect. *Scariola* DC. — Perennis, verosimiliter multicaulis. Caules 20—30 cm alti, erecti, flexuosi, in dimidio superiore divaricato-ramosi, internodiis mediis 2—3 cm longis, teretes, laeves non striati, inferne purpurascenti-violascentes, superne pallide virides glaucescentes. Planta involucris exceptis omnino glabra. Folia infima squamaeformia brunea scariosa; folia caulina inferiora 4 cm longa, 1—1.4 cm lata, in tertia parte anteriore latissima, ambitu oblongo-lanceolata usque oblongo-obovata, basin versus attenuata sessilia, extremo margine minute scarioso- et sinuato-denticulata ceterum integra, apice obtusa vel acutiuscula; folia caulina

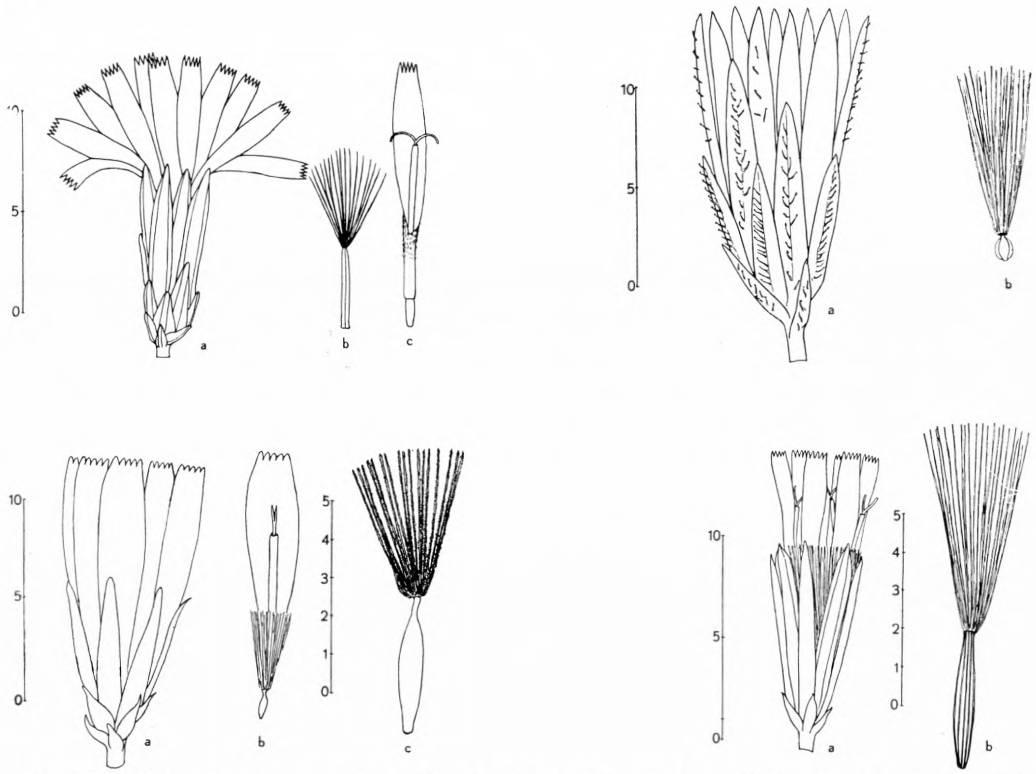


Fig. 145. Oben links: *Launaea secunda*, rechts: *Lactuca Edelbergii*. Unten links: *L. intricatissima*, rechts: *L. Koelzii*.

superiora valde decrescentia inflorescentiae ramos fulcrantia, anguste lanceolata acuta. Capitula pedunculis 2—4 mm tantum longis suffulta. Involucrum cylindricum ± 1 cm longum, phyllis biseriatis extimis brevissimis anguste lanceolatis acutis intimis anguste linearibus acutis omnibus medio fascia atroviridi percursis, margine pallide viridibus, dorso albido-floccosis paulum glabrescentibus; phylla interiora sub apice corniculo pallido praedita. Ligulae aureae (e collectore), involucro dimidio circiter longiores. Achaenia 4 mm longa, anguste linearia, pallida, tenuiter sulcato-costata, apice paulo attenuata non rostrata. Pappus 6 mm longus albus persistens. — Affinis *L. Clarkei* Hook. fil. mihi e descr. tantum notae achaeniis non rostratis et caule flexuoso; differt ab ea radice perenni nec annua, foliis oblongo-ovatis minute scariose sinuato-denticulatis nec linearibus runcinato-pinnatifidis, capitulis plurimis solitariis, involucri phyllis dorso atrovirescentibus, floccosis nec dilute viridibus glaberrimis.

NE: Sanglech, 11500 ft., stream bed, fl. gold, 24.VII.1937 (Koelz 12616, hb. W., BPI.).

L. saligna L. — **NW:** Zehnadis, 8000 ft., along stream (Kz. 14028). — **SW:** Farah, 1700 ft., fields, fl. purple-yellow (Kz. 13254). — **C:** Lorinj, 8000 ft., along

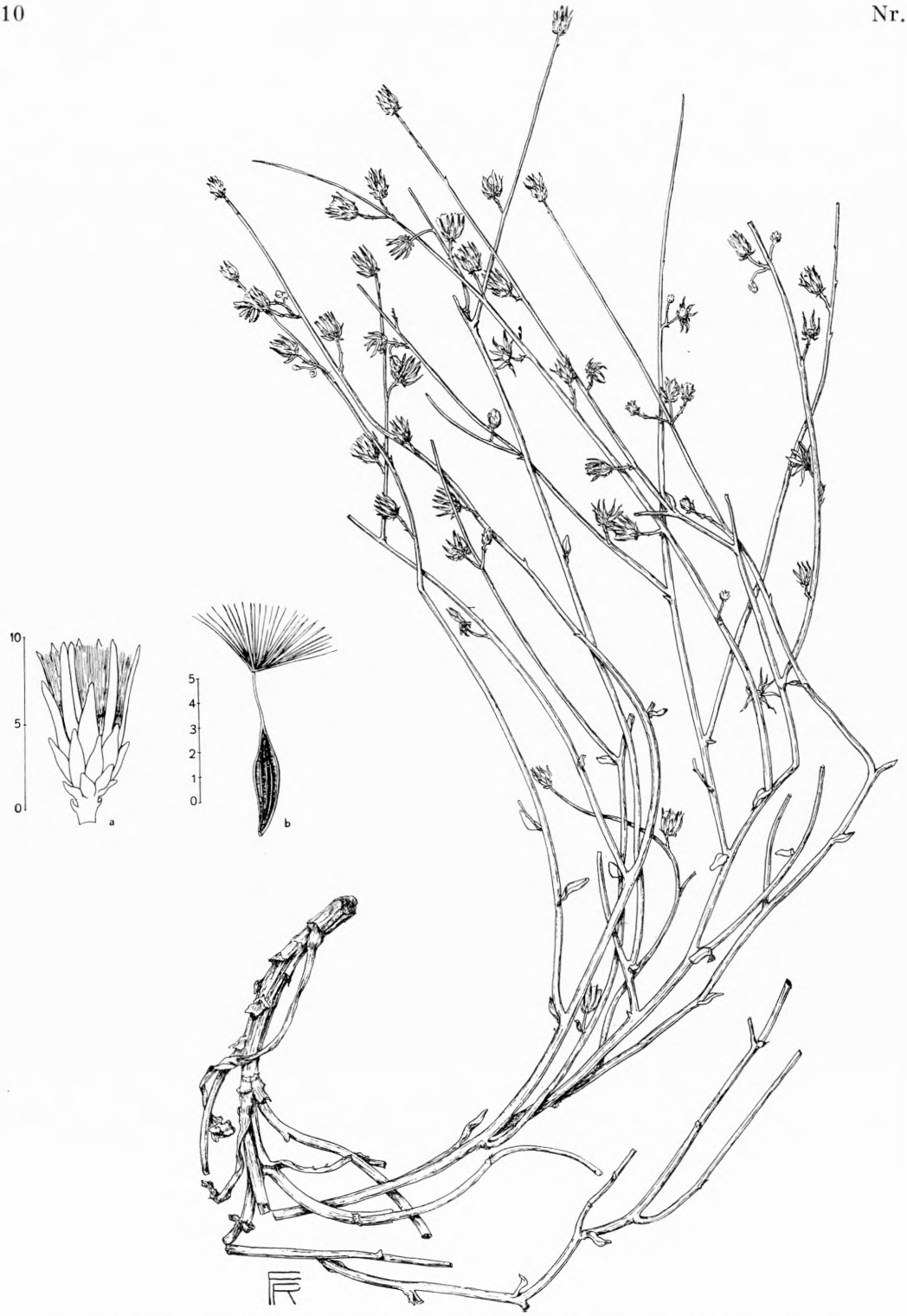


Fig. 146. *Lactuca scoparia* (K. 2911 — a Köpfchen, b Achäne mit Pappus). $^1/_2$.

stream, $2^1/_2$ ft. high, yellow (Kz. 13629). Farakulum, 2800 m (K. 3308). — **NE:** Faizabad (E. 1345). — **E:** Kabul, Gartenunkraut (N. 50/891). — **SE:** Kajkai, 1000 m (K. 2173).

L. scariola L. — **N:** Tashkurgan, 1200 ft., field, 3 ft., high, yellow (Kz. 13188). Khanabad, 1200 ft., field border, 4 ft., yellow (Kz. 12228). — **Nuristan:** Vama, 1300 m (E. 1228).

Lactua scoparia Rech. fil. & Köie, n. sp. — Fig. 146.

Sect. *Scariola* DC. — Verosimiliter perennis. Partes subterraneae desunt. Caulis 60—80 cm altus, a basi iteratim stricte virgato-ramosus, internodiis mediis 3—4 cm longis, viridis vix glaucescens, tenuiter sulcato-striatus, in statu fructifero subaphyllus. Capitula in ramis brevibus rarius elongatis singula lateralia et terminalia pedunculis squamosis. Involucrum 9—11 mm longum, in statu compresso 5—6 mm latum, campanulato-cylindricum, phyllis 4-seriatis laxe imbricatis, omnibus glabris laevibus exterioribus ovato-lanceolatis mediis oblongo-lanceolatis, interioribus anguste lineari-lanceolatis omnibus pallide viridibus ± purpurascentibus anguste scarioso-marginatis atrato-apiculatis. Ligulae verosimiliter violaceae (e collectore), Achaenia 3—4 mm longa, leviter curvata, utrinque attenuata, sulcato-costata, immatura laete rubra matura atrata, rostro tenui pallido 3 mm longo praedita. Pappus albus persistens ± 4 mm longus. Planta habitu *Chondrillae* characteribus achaeniorum et pappi autem ad *Lactucam* sect. *Scariolam* pertinet. Ceterum habitu scopario involucri et achaeniorum characteribus insignis.

NE: Ghorband, 1800 m, 26.VIII.1948 (Köie 2911, Typus, hb. W., C.). Parwara, 8500 ft., river bed, clumps, fl. gold (Kz. 12816, hb. W., BPI.). — **C:** Lorinj, 8000 ft., dry slope, pl. 3 ft. high, fl. rose (Kz. 1939, hb. W., BPI.). Hauz-i-Mahiha, 2600 m (K. 2426, hb. C.).

Ixeris afghanica Rech. f. et Köie, n. sp. — Fig. 147.

Rhizoma atrobruneum verticale pluriceps, collo squamis membranaceis bruneis lanceolatis paucis obsito. Caules floriferi 10—15 cm longi, tenues, pallide virides, glabri, plerumque a medio iteratim tenuiter corymbose ramosi, internodiis mediis 2 mm longis. Folia basalia rosulata, lamina a petiolo vix distincta 5 cm longa, sub apice rotundata latissima 7—11 mm lata, irregulariter runcinato-pinnatilobata, consistentia in sicco tenuiter papyracea, colore laete subglaucescenti-viridi. Folia caulina paucidentata, plurima integra, anguste linearia, 1—2 (—3) cm longa, 1—1.5 mm lata, obtusiuscula, erecto-patentia vel axibus fere appressa. Pedunculi tenuissimi ad 1 cm longi, demum saepe arcuato-divaricati. Involucrum 7 mm longum, basi 1.5 mm latum, phyllis exterioribus brevissime lingulatis demum reflexis, interioribus angustissime linearibus basin albido-calloso-incrassatis, post florendum divergentibus, omnino glabris. Flores ignoti. Achaenia subfiliformia 2 mm longa, in rostrum 0.5 mm longum attenuata; pappus albus multiradiatus

Fig. 147. *Ixeris afghanica* (K. 2445 — a Achäne mit Pappus). $^1/_1$.

subscabridulus. — Differt a ceteris speciebus habitu, foliorum valde dimorphorum forma.

C: Hauz-i-Mahiha, 2600 m, 13.VII.1948 (Köie 2445, Typus, hb. W., C.).

Crepis[1] *Aitchisonii* Boiss. — **Nuristan:** Pashki, 2400 m (E. 944, hb. C., UC.).

C. crocea (Lam.) Babc., University of California Publications in Botany, 22:503 (1947). — **E:** Nozi, 3050 m, limestone rock (Kz. 12000, hb. US., UC.).

C. flexuosa (DC.) Benth. et Hook. f. — **NE:** Sanglech, 3500 m, stream bed (Kz. 12621, hb. US., UC.).

[1] Gattung *Crepis* bearbeitet von Ernest B. Babcock, Berkeley, USA. — Cfr. Supplementary Notes on *Crepis* IV: Some Species of Iran and Afghanistan. — University of California Publications in Botany, Volume 26, No. 2, pp. 213—222.

C. foetida L. ssp. *aghanistanica* Babc., University of California Publications in Botany, 26.2:213 (1952). — **SE:** Kajkai, 1000 m, 27.V.1948 (K. 2136, Typus, hb. C.). — **NE:** Asasaid, 1600 m (E. 1609, hb. C.).

A subsp. *commutata* differt receptaculis non paleaceis; a subsp. *vulgari* et *rhoeadifolia* differt caulibus numerosis, foliis caulinis non laciniatis, indumento intermedio, antheris brevibus, achaeniis marginalibus longioribus rostro tenui.

C. Koelzii Babc., University of California Publications in Botany, 26.2:216 (1952). — **NE:** Minjan Pass, 4000 m (Kz. 12765, Typus).

"This distinctive species certainly belongs in subsection *Strictae* of section 10, *Berinia* (cf. Babcock, The Genus Crepis, Part II, Univ. Calif. Publ. Bot. **22**:483 (1947)). Its closest relative is *C. turcomanica* of southwestern Turkestan, from which species it differs in many characters, but especially in the pinnatifid leaves, smaller flower heads with shorter florets, much broader outer involucral bracts, the indumentum, and particulary in the reddish brown achenes with only ten to twelve ribs and the persistent pappus".

C. Kotschyana Boiss. — **NW:** Kishlik, 700 m (K. 3986). — **SW:** Jija (K. 4027).

C. oreades Schrenk. — **NE:** Sanglich, 3000—3600 m (E. 1488).

C. pulchra L. ssp. *turkestanica* Babc., University of California Publications in Botany, 22:667 (1947). — **C:** Hauz-i-Mahiha, 2600 m (K. 2468).

C. sancta (L.) Babc. ssp. *bifida* (Vis.) Thell., Babcock in University of California Publications in Botany 22:736 (1947). — **SW:** Jija, 800—1200 m (K. 4024). — **C:** Panjao, 2700 m (K. 2699). Hauz-i-Mahiha, 2500 m (K. 2390). — **Nuristan:** Kantivo, 2100 m (E. 722). Pashki, 2300 m (E. 930). Ibid. 2400 m (E. 1019). — **E:** Charikar, 5000 ft. (Codrington 18, 54 A).

C. sancta (L.) Babc. ssp. *obovata* (Boiss. et Noë) Babc., University of California Publications in Botany 22:741 (1947). — **C:** Deh Kundi (E. 1906). — **Nuristan:** Gusalak (E. 1544).

Hieracium[1] *caucasicum* Naeg. & Pet. ssp. *Hohenackeri* Sch. Bip. — **NE:** Daraim, 8500 ft., thicket, flr. yellow, 3 ft. (Kz. 13067). Variation mit drüsigen Hüllen, cfr. ssp. *semifallax* Zahn.

H. maculatum Sm. ssp. *Pollichiae* Sch. Bip. var. ***albopilosum*** v. Soest, n. var. Involucris dense albopilosis, eglandulosis, subfloccosis, foliis immaculatis supra pilosis, ligulis distincte ciliolatis. — **Nuristan:** Pashki, 2400 m (E. 1004).

Diese Pflanzen haben sehr viel Aehnlichkeit mit den europäischen; im Orient kommen abweichende Formen vor, var. *sub-Pollichiae* Litw. et Zahn ist eine solche, var. *albopilosum* bildet durch reichliche Behaarung ein anderes Extrem. Var. *sub-Pollichiae* kommt im Kaukasus vor. Die Art hat ihr Verbreitungsgebiet bis zum NW—Himalaya.

[1] Gattung *Hieracium* bearbeitet von I. L. van Soest, den Haag,

H. racemosum Waldst. et Kit. — **NE:** Daraim, 8500 ft. (Kz. 13068).

Eine merkwürdige Pflanze! Schade, dass das Exemplar zu unvollständig für eine sichere Bestimmung ist. Die hellen Früchte weisen auf *H. racemosum* gr. *crinitum* (oder auf *H. sparsum*). Die Hüllblätter weisen auch auf *H. crinitum*; vielleicht sind sie etwas dunkler. Leider fehlen Blüten und die unteren Blätter.

Ich glaube nicht, dass die Pflanze etwas mit der *Sabauda* oder der *Hololeia* gr. (*H. sparsum*) zu tun hat. Es scheint mir eine Form von *H. racemosum* Waldst. et Kit. zu sein (gr. *crinitum*, subgr. *barbatum* Zahn), die noch weiter geklärt werden müsste, aber nicht identisch ist mit schon beschriebenen Unterarten dieser Subgrex. Ist es wirklich *H. racemosum*, so bedeutet dies eine kleine Erweiterung des Areales in östlicher Richtung! Habituell hat die Pflanze Aehnlichkeit mit *H. brevifolium* (*umbellatum-racemosum*), das aber dunklere Früchte und Hüllen und etwas rauheres Indument hat.

H. sparsum Friv. ssp. *staraeplaninae* Zahn. — **Nuristan:** Pashki, 2300 m (E. 1184, 1314).

Die Beschreibung Zahns stimmt genau mit diesen Pflanzen überein.

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II. TRIFOLIUM ARVENSE AND SOME OTHER PAUCIENNIAL HERBS

BY

TYGE W. BÖCHER, KAI LARSEN AND KNUD RAHN

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BIANCO LUNOS BOGTRYKKERI A-S

I. Introduction.

In a previous paper (BÖCHER, LARSEN & RAHN 1953) the genotypical variation of the duration of life, growth and development in annuals was touched on at the demonstration of some cases of inhibition of flowering in certain cultures of *Kohlrauschia*. In *Trifolium arvense*, which is the main subject in the present paper, a similar inhibition occurs very frequently, thus inviting further study.

On the whole the variation in this species is very interesting, and cytologically the species is remarkable by its content of so far one tetraploid among very many diploid populations scattered over large parts of Europe. The other species mentioned in what follows may in different ways contribute to the knowledge of the geographical distribution of certain hereditary and fundamental biological properties in annual or pauciennial herbs.

As in the case of the material mentioned in our previous paper, the present material is to a great extent based on seed samples collected during a journey to SW-Europe in 1949 which was supported by the Carlsberg Foundation. In this journey Director HOLGER S. DAHL together with the two first authors took part. The material was cultivated in the experimental areas of the Botanical Gardens of the University of Copenhagen.

II. *Trifolium arvense* L.

Cytology. The chromosome number $2n = 14$ was already found by BLEIER (1925) and is further mentioned by KARPECHENKO (1925), although his drawing only shows 13 chromosomes. $2n = 14$ was later established by ARUTIUNOVA (1940) and LÖVE & LÖVE (1944). As compared with other species of clover *T. arvense* according to ARUTIUNOVA is distinguished by having a normal two-armed chromosome, which is satellited.

Our material was fixed in MÜNTZING's modification of NAVASHIN-KARPECHENKO's fixative. The number $2n = 14$ occurred in 30 cultures; only in one, no. 3093 from Wroclaw in Silesia the tetraploid number $2n = 28$ was found. The diploids had always two and the tetraploid four large satellites and frequently the connecting link between the satellite and the rest of the chromosome was very long and invisible

(fig. 1 b, c, e). In such cases, however, it was possible to see the connection when using phase-contrast microscopy (fig. 1 d). As described in *Taraxacum* by SØRENSEN & GUDJONSSON (1946, figs. 16—18), the satellites in *Trifolium arvense* are often bent in such a way that they project more or less vertically from the metaphase plane. They were larger than those pictured by ARUTIUNOVA, a fact which may be due to a different fixation technique.

Altogether 37 diploids and one tetraploid is known in *T. arvense*. This confirms the idea that the chance of finding diploid and tetraploid races within the same species

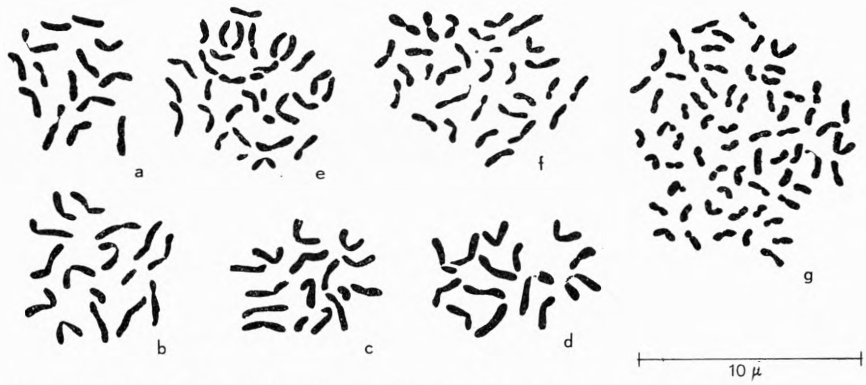

Fig. 1. Mitoses from root tips. a—d diploid, e tetraploid *Trifolium arvense* (a no. 2874, b—c no. 2929, d no. 2923, e no. 3093). f *Kohlrauschia velutina* no. 3303. g *Galium aparine* no. 1639. The connections to the satellites are invisible in figs. b, c (two satellites), and e (four satellites). In fig. a they were visible owing to particularly successful staining, in fig. d only when observed in a phase-contrast microscope. In fig. f two minute satellites and two very short chromosomes are seen. In fig. g the two large chromosomes which may have arisen by fusion of four short chromosomes are seen on the right (at 1 and 3 o'clock).

is fairly great provided that the investigations are extended to cover many strains from a large area (cp. BÖCHER & LARSEN 1955).

The tetraploid strain was cultivated in 1952 (Table 3). It was very early, without any inhibition of flowering. It resembled very much some of the southern races among the diploids. Unfortunately no plants from this experiment were dried and, therefore, it was impossible to make a closer study of the size of the seeds, the pollen, and the stomata which might have distinguished the tetraploid from the diploids.

Experimental cultivations. Five experiments were made in 1950, 1951, 1952, 1953, and 1954.

1950 (Table 1): 14 cultures (6 from southern, 4 from central, and 4 from northern Europe) were grown in a sandy experimental field at Tokkekøb Hegn, Zealand. In Table 1 the material is arranged according to earliness of flowering. All southern strains were very early and flowered between June 15th and July 30th after being sown early in April. Maximum speed of development was achieved by no. 1671 from the highlands in the eastern part of the Pyrenees. It required 50 days only from germination to flowering. As compared with the other southern cultures

Table 1. *Trifolium arvense. Cultivations 1950* (sandy soil).
Each culture consisted of 7–16 individuals.

Cult. no.	Origin. Seeds collected by us in nature or from wild sources through Bot. Gardens (*)	2 n	Approxim. no. of days from germination to flowering	Height (H) in cm Mean and range[1]	Breadth (B) in cm Mean and range[1]	Size index $\frac{B \times H}{100}$	Length of heads in cm Mean and range[1]	Habit of plants in the autumn
1671	S. France, Formiguères, alt. 15—1600 m	14	50	20 {11 25	24 {19 30	4.8	2.9 {2.5 3.5	No basal leaves. Stem erect, much branched, with long internodes (open structure). Fruits ripe or already shed.
2394	France, Rouen*	14	75	22 {16 27	24 {20 34	5.3	2.9 {2.0 3.5	
2441	Portugal, Coimbra*	14	75	27 {16 40	34 {22 44	9.2	3.0 {2.0 3.5	
2393	France, Dijon*	14	75	29 {24 35	39 {27 48	11.3	3.7 {3.0 4.5	
1732	S. France, Béziers, Roque Haute	14	85	17 {12 28	24 {15 40	4.1	1.9 {1.5 3.0	
1631	S. France, Luchon, bottom of valley	14	85	23 {17 28	55 {48 78	12.7	2.3 {2.0 3.5	
1706	S. France, Bouleternère (maquis)	14	85	33 {24 38	70 {47 35	23.1	2.6 {2.0 3.5	
1304	S. France, Contis de Bains. Dunes	14	100	20 {14 25	49 {30 68	9.8	2.6 {2.0 3.5	Basal leaves retained, ± plagiotropic growth.
2333	Denmark, Amager (the Sound)	14	100	about 8	about 32	about 2.6	about 2.1	
2247	Denmark, Boserup	14	130	—	—	—	—	Basal leaves retained. Only $^2/_3$ of plants with late flowering.
2442	Hungary, Budapest*	14	140—?	—	—	—	—	Basal leaves retained. A few plants with very late flowering.
2395	Germany, Frankfurt a.M.*	14	140—?	—	—	—	—	
2207	Denmark, Gadevang	14	(?)	—	—	—	—	Only basal leaves, no flowering stems.
2293	Denmark, Kregme	14	(?)	—	—	—	—	

[1] The ranges indicated in braces.

Table 2. *Trifolium arvense,*
The batches consisted of 7–11 individuals

Cult. no.	Origin (cf. Table 1)	2 n	Approx. no. of days from germination to flowering	Cultures in pots in		
				Height (H) in cm Mean[1]	Breadth (B) in cm Mean[1]	Size index $\frac{B \times H}{100}$
1671	S. France, Formiguères, alt. 15—1600 m	14	60—70	16 {11 26	45 {35 57	7.2
2804	Portugal, Sacavem*	14	60—70	34 {27 38	48 {43 59	16.3
2441	Portugal, Coimbra*	14	60—70	31 {24 38	55 {50 61	17.1
2759	Portugal, Lisbon*	14	60—70	38 {35 44	43 {38 50	16.3
1732	S. France, Roque Haute	14	80—90	20 {10 24	49 {42 60	9.8
1706	S. France, Bouleternère	14	80—90	24 {17 34	55 {42 64	13.2
1631	S. France, Luchon	14	80—90	26 {13 38	85 {79 97	22.1
2758	Yugoslavia, Ljubljana*	14	100—110	..	..	..
2779	Austria, Graz*	14	100—110	..	..	..
2696	Denmark, Ræbild Bakker	14	100—110	40 {37 45	61 {50 70	24.4
2654	Denmark, Nøddebo Huse	14	130—150	..	..	..
2677	Denmark, Muldbjergene	—	130—150	..	..	..
2665	Denmark, Bulbjerg Huse	14	130—150	..	..	..
2690	Denmark, Lild Strand	—	160—170	..	..	..

[1] Mean values and the ranges indicated in braces.

Cultivations 1951.
(in cult. 2654, 2665 and 2577 : 2–6).

Bot. Gardens		Cultures in the experimental field (clay)					Habits of plants in the autumn
Approx. dry weight pr. plant in g	Length of heads in cm Mean[1]	Height (H) in cm Mean[1]	Breadth (B) in cm Mean[1]	Size index $\frac{B \times H}{100}$	Approx. dry weight pr, plant in g	Length of heads in cm Mean[1]	
3	3.1 (2.0 – 4.0)	..	..	..	..	..	No basal leaves, fruits ripe or already shed about September 1st.
4	3.2 (2.4 – 4.1)	17 (10 – 21)	30 (22 – 40)	5.1	3	2.6 (2.1 – 4.0)	
6	3.0 (2.3 – 3.6)	16 (10 – 24)	28 (13 – 40)	4.5	4	2.1 (1.2 – 3.0)	
8	3.2 (2.2 – 3.5)	21 (15 – 30)	42 (37 – 45)	8.8	8	2.7 (2.4 – 3.1)	
6	2.7 (1.8 – 3.8)	14 (12 – 15)	26 (20 – 31)	3.6	2	2.4 (1.8 – 2.8)	
7	2.3 (1.0 – 3.0)	..	..	..	..	..	
9	2.3 (2.0 – 2.8)	18 (11 – 23)	47 (37 – 61)	8.5	8	1.8 (1.4 – 2.1)	
..	..	46 (41 – 56)	89 (75 – 97)	40.9	12	2.2 (1.8 – 2.8)	No basal leaves, fruits ripe or shed about October 8th.
..	..	26 (14 – 39)	69 (39 – 94)	17.9	6	1.5 (1.2 – 1.8)	
8	2.1 (1.5 – 2.8)	31 (20 – 43)	50 (26 – 68)	15.5	6	2.2 (1.5 – 3.5)	
..	..	10 (6 – 14)	38 (24 – 43)	3.8	5	1.7 (1.1 – 2.2)	Basal leaves frequently retained, fruits ripe or almost ripe about October 8th.
..	..	about 13	about 47	about 6	6	about 2	
..	..	about 15	about 35	about 5	6	about 2	
..	..	..	..	..	..	..	Basal leaves retained. Flowering commenced on October 8th.

no. 1671 was a rather gracile type and had a low production of matter. Its contrast was no doubt the tall growing no. 1706 from Mediterranean maquis in the eastern Pyrenees (fig. 2). All southern plants very soon lose their basal leaves and get an open shoot structure. Only no. 1305 from the dunes on the Bay of Biscay resembles northern races in keeping the basal leaves. It behaved almost like the Danish no. 2333 from a sandy field on the Sound. In all other cultures the basal

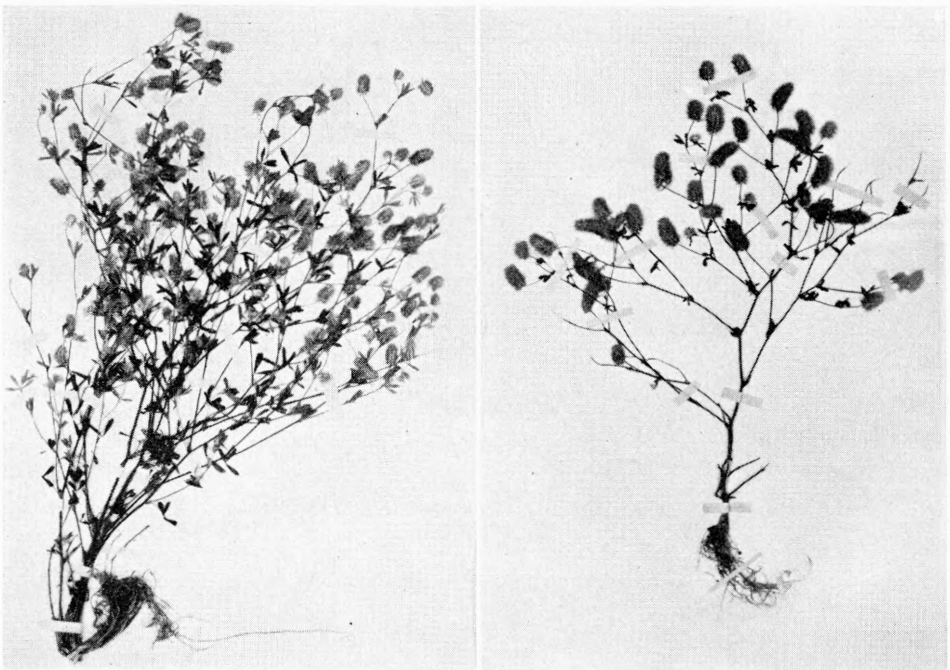

Fig. 2. Two very different Mediterranean races of *Trifolium arvense* in the experiment 1950 (collected Sept. 6th). Left, no. 1706 from a subtropical vegetation in the lowlands; right, no. 1671 from a montane vegetation in the Pyrenees. No. 1671 is very early and has a much lower production of matter. This was very great in no. 1706 (the figure shows only one fourth of a vigorous specimen). $\times$ $^1/_4$.

leaves were retained. They either formed short flowering shoots or did not succeed in flowering at all. Sometimes, however, the stems began to stretch without any floral initiation. Some individuals of these cultures, which were kept in pots in the garden and behaved in a similar manner, were unable to winter.

1951 (Table 2): 14 cultures (including 5 of the strains cultivated in 1950) were grown in pots in the Bot. Gardens or on a loamy experimental field at Albertslund, Zealand. The field soil was rather unfavourable to most of the strains. Plants cultivated in the field were always smaller than those cultivated in pots or cultivated in 1950 on sandy soil.

The flowering and development of the plants correspond to the results from the 1950-experiment. All southern plants were early and without inhibition of flower-

ing, while in a number of northern strains the floral initiation was checked more or less.

Among the cult. nos. from Denmark no. 2696 deviated from the others by developing quite normally although it was late. Its behaviour and size was almost

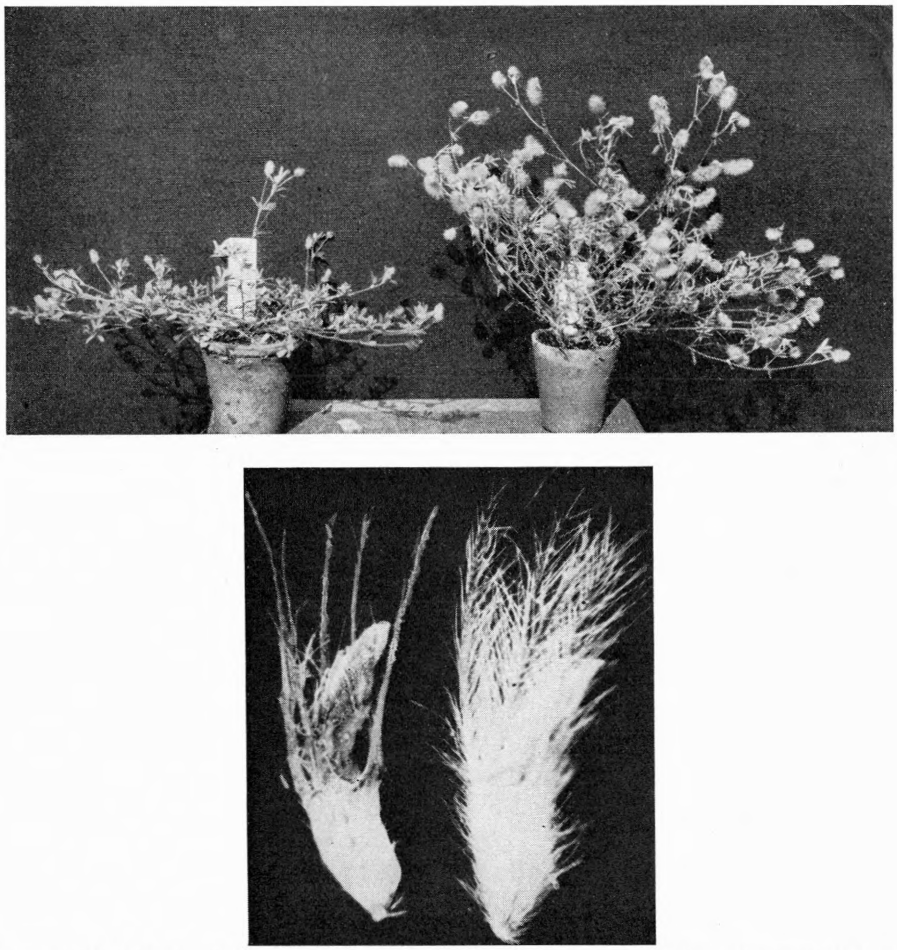

Fig. 3. Above on the left no. 3256 (*Trifolium gracile*) and, on the right, no. 3646 (*T. arvense*) from the 1954 experiment (Table 5). Note the horizontal growth of all secondary stems in *T. gracile*. Below flower of *T. gracile* (no. 3256, on the left) compared with a flower of *T. arvense* (no. 1706).

like the two continental, tall growing samples from Graz and Ljubljana. Of the plants which retained their basal leaves none was able to winter. On the other hand some few plants of southern origin were able to stand the winter and flowered again in 1952.

1952 (Table 3): 19 cultures chiefly from Northern Europe. Seeds of 5 of the cult. nos. were sown partly in September 1951 (denoted as A) partly in April 1952. The two batches differed very much. All plants which germinated in the autumn

Table 3. *Trifolium arvense, Cultivations 1952.*

All cultures diploid ($2n = 14$) with the exception of no. 3093, which was tetraploid ($2n = 28$). A: Seeds of cult. numbers denoted as A were sown partly in April 1952, partly early in September 1951. The latter plants (A or autumn batch), which were exposed to low temperatures and short days during the winter, had all a normal development and flowering.

I. Cultures liable to inhibition of stem elongation and flowering.

a. Inhibition complete.

A. 2871. Denmark, Kramnitze, Lolland (A batch ± erect, 20—25 cm high).
A. 2874. — Rosenvold, E. Jutland (A batch ± erect, about 30 cm high).

b. Inhibition strong, but not complete, 5—20 per cent. of the plants flowering.

A. 2882. Denmark, Østerild, NW. Jutland (A batch ± erect, 10—20 cm high).
2929. — Bulbjerg, —
2928. — Haderup, C. Jutland.
2907. — Nakkehoved, N. Zealand.
A. 2872. Sweden, Öland, Greby Alvar (A batch ± erect, 12—15 cm high).
3098. Poland, Puszczykŏwko.

c. Inhibition distinct, but about 50 per cent. of the plants flowering.

A. 2873. Denmark, Randbøl, C. Jutland (A batch with spreading stems, 10—20 cm high).

II. Cultures producing numerous elongated flowering stems.

d. Most plants produce elongated flowering stems; in many plants these, however, wither at an early stage.

2954. Denmark, Kaas, NW. Jutland. Plants more or less prostrate.
2926. — Hvide Sande, W. Jutland. Plants with spreading stems.
2923. Sweden, Gotland, Gammelgarn. Plants with spreading stems, about 10 cm high.
2906. Finland. Åbo region. Irjala[1]. Plants 10—17 cm high with spreading stems.
3097. Hungary. Budapest (*). Plants with spreading or almost horizontal stems.

e. Almost all plants with normal development and flowering.

2955. Sweden, Fårö, Ajkesvik[2]. Plants 20—25 cm high, with up to 40 cm long ascending shoots.
3096. Poland, Osawa Gora. Plants vigorous almost as in 1953 (Table 4).
3093. — Wraclaw (*). Plants ± erect, 10—25 cm high, very early.
3094. Madeira ((*) seeds from Lisbon). Plants erect or very ascending, 23—27 cm high, very early.

[1] Seeds collected by Dr. J. JALAS (dry rock vegetation).
[2] Seeds collected by Dr. B. PETTERSSON (*Festuca polesica* among *Ammophila* near the beach).

flowered about July 9th and had ripe fruits in August—September. The plants from the spring could be divided into five groups (a—e Table 3) according to the degree of inhibition of flowering. Southern and som(continental strains have a normal development, but most Danish plants are more or less prevented from flowering when sown in April. The three samples mentioned first in Group d from dunes resembled nos. 1304 and 2333 (Table 1), which came from similar habitats.

1953 (Table 4): 6 cult. nos., some of which were repeated from the 1952-experiment, were sown early and germinated about April 1st. After transplantation

Table 4. *Trifolium arvense, Cultivations 1953.*
The batches consisted of 8–14 individuals.

Cult. no.	Origin (cf. Table 1)	2 n	Group in Table 3	Length of photoperiod unaltered					Length of photoperiod $9^1/_2$ hours				
				Per cent. flowering plants (Sept.)	Height (H) in cm Mean[1]	Breadth (B) in cm Mean[1]	Size index $\frac{B \times H}{100}$	Length of heads in cm Mean[1]	Per cent flowering plants (Sept.)	Height (H) in cm Mean[1]	Breadth (B) in cm Mean[1]	Size index $\frac{B \times H}{100}$	Length of heads in cm Mean[1]
3094	Madeira (*), from Lisbon	14	e	100	25 {21 31	41 {35 49	10.3	2.5 {2.0 3.0	100[4]	19 {12 26	47 {33 58	8.9	2.1 {1.5 3.0
3096	Poland, Osawa Gora	14	e	100	42 {35 48	71 {58 84	29.8	3.1 {2.5 4.0	100[5]	21 {17 25	60 {47 77	12.6	2.0 {1.0 2.5
2923	Sweden, Gotland (Gammelgarn)[2]	14	d	100	30 {19 39	56 {44 66	16.8	3.8 {2.0 6.0	33	Flowering plants not fully developed in Sept.			
3261	Jersey (Ch. Isl.), Bouley Bay (dry slope)	..	..	100	31 {24 40	61 {41 92	18.9	3.0 {2.5 3.5	22	about 16—19	about 38—40	about 7	about 2
2872	Sweden, Öland, Greby Alvar[3]	14	b	100	19 {17 21	37 {32 45	7.0	2.4 {1.5 3.0	0	..	..	..	..
2871	Denmark, Kramnitze (sandy field on the sea)	14	a	100	19 {12 27	45 {22 86	8.6	2.0 {1.5 2.5	0	..	..	..	..

[1] Mean values and the ranges indicated in braces.
[2] Seeds collected by Dr. B. Pettersson (sandy beach).
[3] Seeds collected by Dr. R. Sterner (dry grassland).
[4] Habit of plants almost identical in the two batches.
[5] Habit of plants different from those in the other batch. They had far more leaves and were not reddish as a result of a high content of anthocyanine.

Table 5. *Trifolium arvense and T. gracile, Cultivations 1954.*
The batches consisted of 8–14 individuals.

Cult. no.	Species	Origin	2 n	Group in table 3	Height (H) in cm Mean[1]	Breadth (B) in cm Mean[1]	Size index $\frac{B \times H}{100}$	Length of heads in cm Mean[1]	Per cent flowering plants (Sept.)
3256	*T. gracile*	Denmark, Vittrup	14	e	20 { 13 / 24	50 { 32 / 64	10.0	2.4 { 2.1 / 3.0	100
3646	*T. arvense*	Poland, Lodz*	14	e [2]	21 { 12 / 37	52 { 30 / 71	10.9	1.8 { 1.4 / 2.7	100
				b [3]	{ 13 / 15	{ 56 / 62	8.3	Not fully developed	22
3530	*T. arvense*	Austria, Graz*	14	e	28 { 21 / 41	68 { 51 / 85	19.0	1.8 { 1.5 / 2.0	100
3525	*T. arvense* ssp. *longisetum*	Turkey Princes Isl.[4]		e	15 { 11 / 17	20 { 17 / 25	3.0	2.3 { 1.7 / 3.0	100

[1] Mean values and the ranges indicated in braces.
[2] Seeds germinated 1st of April.
[3] Seeds germinated 27th of April. Only two plants had elongated flowering stems which could be measured.
[4] Seeds collected by Dr. MORTEN LANGE.

of the seedlings severally in pots they were divided into two batches and placed in frames, one batch in a frame with unaltered day length and one batch in a frame where the length of the photoperiod was reduced to $9^1/_2$ hours. The first type of treatment induced in all cases a normal development and flowering whereas the effect of short days caused such strains as in earlier experiments had a reduced flowering to behave in quite a similar manner, thus two of them, nos. 2871 and 2872, which belonged to Groups a and b in Table 3, remained completely vegetative.

Some few plants distributed in the two types of environment and originating from Vittrup in Central Jutland and Poznan in Poland behaved like nos. 2871 and 3096, respectively.

1954 (Table 5). In this experiment two strains of typical *T. arvense* were compared with *T. arvense* ssp. *longisetum* Boiss. and what has been called ssp. *gracile* Ser. (cp. ASCHERSSON & GRÄBNER 1906—10, pp. 530—534). The culture of the Mediterranean ssp. *longisetum* deviated by its small size (size index only 3) and extremely rapid development. It flowered 60 days after germination and was nearly withered and with ripe seeds in August about 120 days after germination. Already in the first days of September new seedlings had germinated in the pots. Whereas the material of ssp. *longisetum* by no means is clearly separated from some of our Mediterranean strains of typical *T. arvense*, this cannot be said about the culture of ssp. *gracile*, which in our opinion would better be treated as a species (*T. gracile* Thuill. in Flor. Par. ed. 2 (1799), p. 383).

The culture in question (no. 3256) originated from plants found outside a poultry yard where they probably had been introduced with the forage. The plants grew very slowly and were very late, thus still in full flower in the first days of October. Their appearence deviated strongly from all other strains cultivated by us. The stems were dark reddish and the anthocyanine content of the whole plant sometimes very high. The pubescence was very feeble. The leaflets were sublinear to cuneiform and the calyx was almost glabrous even if the lobes sometimes terminated in a few hairs. Some few short and stiff hairs bristling from the dorsal side of the base of the flower may like the narrow calyx lobes facilitate dispersal by animals, fig. 3 (left). The late flowering was without connection with any inhibition effect and the plant lost its basal leaves very soon. Its chromosome number was also $2n = 14$.

Summary of the cultivations with Trifolium arvense. Varied environment experiments (Tables 2 and 4) have revealed that, as regards quantitative characters (size, length of heads, dry matter production), *T. arvense* is subject to much modification, the phenotypical variation being frequently very great. On the other hand, the same characters are evidently determined by a genetical variation of a similar magnitude. The material does not allow any calculation of standard errors. The differences between several of the smallest and the tallest of the cultures, however, are so large that even the ranges do not overlap.

The anthocyanine content in stems and leaves varies much and is modified by changes in environment. It appeared, however, that the tendency towards red colouration was particularly strong in the strains from Mediterranean habitats. In this respect no. 1726 from a maquis at Argèles (cultivated in a few specimens in 1950) was rather extreme although it could not compare with *T. gracile* from Vittrup in Central Jutland (see above).

Numerous investigations have elucidated the interplay between photoperiodic and temperature stimulation of flowering, see e. g. Murneek & Whyte (1948) and Whyte (1946) and, as regards hereditary differences in reaction to photoperiodism and temperature, Clausen, Keck, & Hiesey (1948), and Böcher (1945). While the mutual relations of the components of this intricate temperature-day length complex must be left to the physiologists, the whole complex may by genecologists be treated as a unity and denoted as a TDL complex. It frequently manifests itself as a winter effect (the interplay of low temperatures and short days), which in nature involves winter-annuality.

In the case of *Trifolium arvense* the experiments in 1952 and 1953 make it very probable that the delay or inhibition of flowering in a number of the cultures must be the result of a dependence on the TDL complex. The early germination in 1953 involved that the seedlings were exposed to rather low temperatures and short days. The subsequent treatment of the plants, however, showed that a normal further development depends on the presence of long-day conditions. The conclusion must be that the majority of races of *Trifolium arvense* occurring in Denmark depend on the TDL complex or a winter effect, which in nature usually will manifest itself in

a winter-annual development, more rarely in a summer-annual one, if the germination takes place very early. All southern and a number of eastern races, on the other hand, appear to be completely independent of any winter effect.

III. *Kohlrauschia prolifera* (L.) Kunth and *K. velutina* (Guss.) Reichb.

Cytology. To our earlier chromosome countings (fig. 1 in BÖCHER, LARSEN, & RAHN 1953) a few additions may be made. It has been possible to some extent to fill in the gap in the range of the western tetraploid crypto-species with the finding of two tetraploid populations on the Channel Island Jersey. The area of the diploids has further been extended to Northern Spain (no. 3323 from the Barcelona region) and the Sabini Mts. near Rome (no. 3297).

Of special interest is some material from Portugal (no. 3303) of *K. velutina*, which had a pair of very short chromosomes (fig. 1 f), as was the case with the material described in our earlier paper (no. 913, cf. Table 8).

Experimental cultivations. Four experiments were undertaken (1950, 1951, 1952, and 1953) comprising in all 42 cult. nos. of *K. prolifera* and 2 of *K. velutina*.

Table 6 is a survey showing the difference between diploids and tetraploids in the four experiments. The two most important expressions of the size of the plants, the height and the breadth of the head, appear in all four experiments to be greatest in the tetraploids if regard is paid to the mean of the average values.

On the other hand it is evident that the ranges of the average values overlap to a great extent, and, therefore, we have no hopes of being able to use the differences in size for a distinction between diploids and tetraploids, this being further rendered impossible because the quantitative characters are greatly liable to be modified by

Table 6. *Kohlrauschia prolifera.*

	Diploids			Tetraploids		
	No. of strains	Height in cm Mean[1]	Breadth of heads in cm Mean[1]	No. of strains	Height in cm Mean[1]	Breadth of heads in cm Mean[1]
1950	7	40 {23 51}	1.3 {0.7 2.9}	5	58 {53 63}	1.6 {1.1 2.2}
1951	7	42 {28 57}	1.2 {0.7 1.8}	7	45 {37 49}	1.6 {1.1 2.3}
1952	5	34 {22 44}	1.1 {1.0 1.3}	3	42 {39 46}	2.0 {1.7 2.5}
1953	4	58 {41 78}	1.7 {1.3 2.0}	3	66 {63 68}	2.0 {1.8 2.1}

[1] Mean and range of average values indicated in braces.

changes in environment. The behaviour of *Kohlrauschia prolifera* clearly resembles that of British forms of *Valeriana officinalis* (SKALINSKA 1947).

Among diploids two from montane stations in the Pyrenees (no. 1696 fig. 3b in the previous paper) and the Sabini Mts. (no. 3297) were very low and with ascending stems from the base. The latter was cultivated separately in the experimental field in 1953. It deviated strongly from all preceding cultures in the same field and only reached a mean height of 24 cm (range 15—34 cm). The breadth was about 80 cm and the breadth of the heads 1.7 cm (1.2—2.6 cm). Another comparatively low-growing diploid (no. 2880) is from Hammershus on Bornholm in the Baltic. It clearly

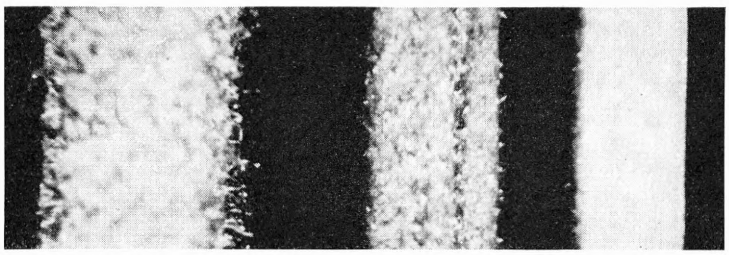

Fig. 4. Stems of *Kohlrauschia* showing types of pubescence. The glabrous stem on the right is diploid *K. prolifera* (no. 1627), the scabrous stem in the middle tetraploid *K. prolifera* (no. 3249), and the glandular hairy stem on the left is *K. velutina* (no. 913).

differed from the taller populations nos. 2879 and 2850 from the south coast of the same island (Exp. 1952).

The differences mentioned in our earlier paper as to inhibition or delay of stem formation and flowering were studied again in 1953 using the same day length differences as for *Trifolium arvense* (cf. Table 4). While the experiences from 1953 are summarized in Table 8, Table 7 contains a survey of the three previous experiments. It appears that most populations with complete or partial inhibition of flowering are diploid originating from northern or central Europe. Only one of the southern tetraploids did not flower when cultivated in Denmark. This behaviour may be due to late germination or to long-day influence.

Seeds of three cult. nos. in the Exp. 1952 were also sown in the autumn of 1951 (denoted as A in front of the no. in Table 7) and had in all cases quite a normal development and flowering whereas inhibitory effects were demonstrated in two of these cultures when the seeds were sown in the first days of April. The two Arnager populations (nos. 2879 and 2850) differed in degree of inhibition. On the natural habitat (a south-facing slope) a large number of plants were investigated in the spring. They appeared all to have germinated in the autumn.

Comparatively short days in a certain period, perhaps combined with low temperatures, may apparently be a requirement of many strains of *Kohlrauschia*. Short days, however, will later have a similar inhibitory effect as was found in *Trifolium arvense*. This appears from the varied environment experiment 1953 (Table 8),

Table 7. *Kohlrauschia prolifera.*

Cultivations 1950 (I), 1951 (II), 1952 (III). Date of germination indicated.
A: Seeds of cult. nos. denoted as A were sown partly in the spring of 1952, partly early in Sept. 1951. The latter plants (A or autumn batch) had all a normal development and flowering.

I. Cultures liable to inhibition of stem elongation and flowering.

a. Inhibition complete.

2801. France, Strasbourg * (II, germ. 10.5.)
A. 2879. Denmark, Arnager 1, Bornholm (III, germ. 16.4.) ..... 2n = 30
3114. Poland, Osawa Gora (III, germ. 16.4.)

2539. Portugal, Lisbon * (I, germ. 10.5.) ..... 2n = 60

b. Inhibition rather strong, 5—60 % of the plants flowering.

2389. Germany, Marburg * (I, germ. 21.4.)
3388. — Frankfurt a. M. * (I, germ. 21.4.) ..... 2n = 30
2390. France, Dijon * (II, germ. 21.4.)
1191. Denmark, Samsø (I, germ. 16.4.)

c. Inhibition rather weak, up to 95 % of the plants flowering, stem formation, however, delayed and poor.

2233. France, St. Cecilia, Rhone valley (I, germ. 17.4.)
2234. — Orange, Rhone valley (I, germ. 17.4.)
2496. — Strasbourg * (I, germ. 16.4.)
A. 2880. Denmark, Hammershus, Bornholm (III, germ. 16.4.) ..... 2n = 30
2850. — Arnager 2, Bornholm (III, germ. 16.4.)
3113. Hungary, Budapest 2 * (III, germ. 16.4.)

II. Cultures producing numerous elongated stems terminating in flowering heads. Almost all plants with normal development and flowering.

1510. France, Gêtre in the Pyrenees (I, germ. 16.4., II, 24.4.)
1627. — Luchon in the Pyrenees (I, germ. 16.4., II, 27.4.)
1696. — Mt. Louis in the Pyrenees (I, germ. 16.4.)
1700. — Bouleternère maquis (I, germ. 16.4., II, 27.4., III, 8.4.)
2762. — Caen * (II, germ. 27.4)
2497. Austria, Graz * (I, germ. 16.4., II, 24.4.) 2n = 30
2785. Hungary, Budapest 1 (II, germ. 24.4.)
2282. Denmark, Kregme, N. Zealand (I, germ. 14.4.)
2700. — Jernhatten, peninsula Djursland (II, germ. 27.4.)
2963. Sweden, Karums alvar, Öland[1] (III, germ. 16.4.)
A. 2878. — Tingslådeåsen, Gotland[2] (III, germ. 16.4.)

1430. Spain, Villa Nueva, Old Castile (I, germ. 16.4., II, 24.4.)
1472. — Soria (I, germ. 14.4., II, 24.4.)
2763. Portugal, Lisbon * (II, germ. 24 4)
2806 — Sacavem * (II, germ 10.5.)
2483. — Coimbra * (I, germ. 16.4., II, 24.4., III, 16.4.) 2n = 60
1715. France, Port Vendres (I, germ. 16.4., II, 24.4.)
1733. — Béziers, (I, germ. 16.4., II, 24.4., III, 16.4.)
3111. Madeira * (III, germ. 16.4.)

[1] Seeds collected by Dr. R. Sterner.
[2] Seeds collected by Dr. B. Pettersson.

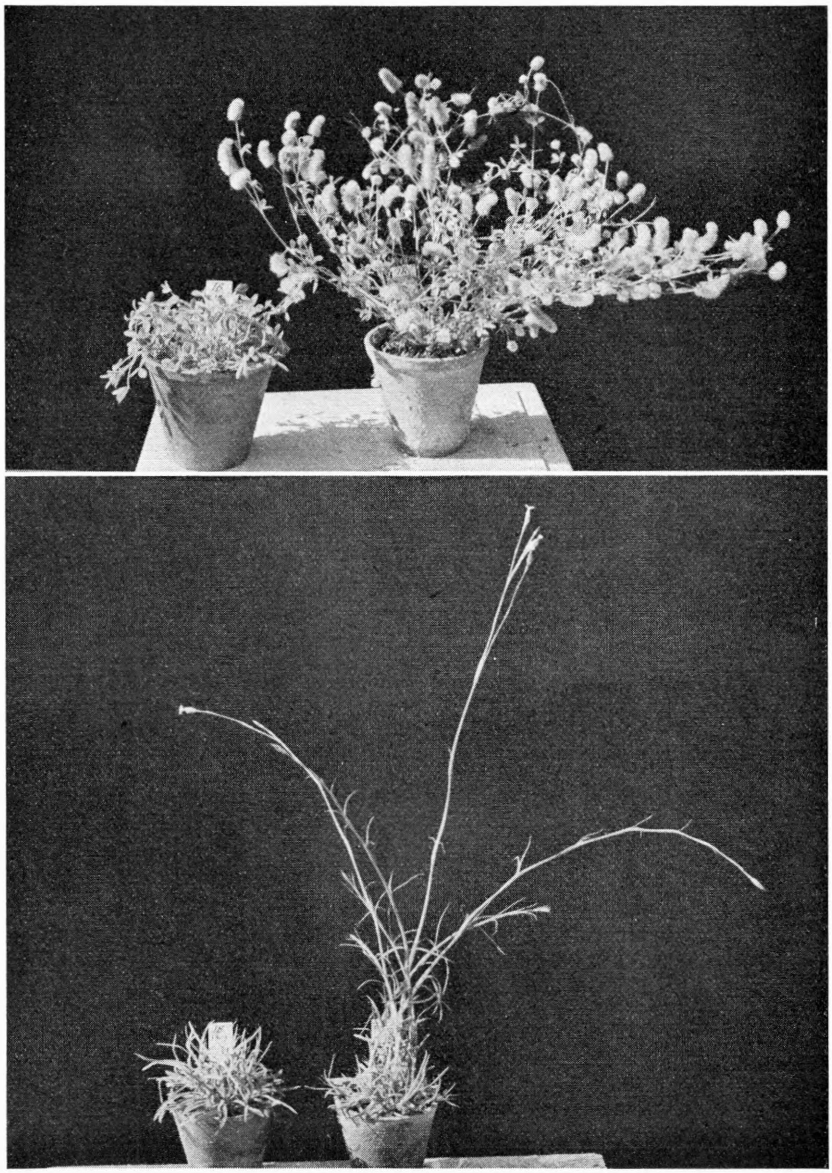

Fig. 5. Varied environment experiment 1953: *Trifolium arvense* (no. 2923 from Gotland) and *Kohlrauschia velutina* (no. 3303 from Portugal). Cultivated in short (left) and long days (right), photographed August 11th. In both cases the inhibition of flowering in the short-day plants was not complete as the plants started flowering in September.

Table 8. *Kohlrauschia.* Nos. 913 and 3303 *K. velutina,* the other nos. *K. prolifera.* Mean plants were available only the

Cult. no.	Origin	2 n	Length of photo-				
			Sandy soil				
			Height cm	Breadth of head, cm	No. of main shoots	Breadth of stem leaves mm	Diameter of flower mm
913	Belgium, Antwerp (Bot. Gardens)	30	33 { 28 / 37	1.7 { 1.5 / 2.0	1— very few	2.4	4—6
3303	Portugal, Sacavem*	30	72 { 60 / 79	1.8 { 0.8 / 2.5	6	2.8	8
1696	S. France, Mt. Louis (montane station)	30	..	not investigated			
3324	Poland, Tomice	30	..	not investigated			
3365	Poland, Poznan	30	{ 66 / 70	{ 0.8 / 1.1	{ 6 / 6	{ 2 / 3	{ 9 / 9
3323	Spain, Tossa near Lloret de Mar, Barcelona[2]	30	..	not investigated			
3325	Hungary, Budapest 3*	30	70 { 54 / 78	1.7 { 0.9 / 2.7	many	3.0	10
1700	S. France, Bouleternère	30	38 { 33 / 40	1.9 { 1.7 / 2.2	very few	2.1	11
1715	S. France, Port Vendres	60	56 { 48 / 60	1.9 { 1.5 / 2.5	8	2.0	11
3248	Jersey, Ch. Isl., Ouens Bay	60	62 { 45 / 71	1.8 { 1.3 / 2.2	8	2.5	10
3249	Jersey, Ch. Isl., The Quennevais	60	62 { 59 / 67	1.9 { 1.7 / 2.1	7	2.6	11
3321	Spain, Soria	60	{ 73 / 81	{ 1.9 / 2.0	{ 7 / 8	{ 4.5 / 5.0	{ 11 / 11

[1] Very early, showing no signs of checking of the flowering and soon without basal leaves.
[2] Seeds from Prof. T. TUTIN.
[3] See fig. 5.

Cultivations 1953.
values calculated for batches of 9—15 specimens. When very few ranges are given (in braces).

period unaltered					Length of photoperiod $9^1/_2$ hours					
Garden soil					Garden soil					
Height cm	Breadth of head cm	No. of main shoots	Breadth of stem leaves mm	Diameter of flower mm	Height cm	Breadth of head cm	No. of main shoots	Breadth of stem leaves mm	Diameter of flower mm	Inhibition effect
34 {24 46	2.0 {1.4 2.4	1— very few	2.0	4—6	not investigated					none[1]
85 {77 93	1.8 {1.2 2.5	9	3.4	8	48 {40 56	0.7 {0.4 1.1	1.4	3.3	—	rather strong[3]
{50 56	{0.8 1.7	many	{2.5 3.0	{10 11	Only basal leaves					total
78 {69 87	1.3 {1.1 1.5	many	4.1	11	Only basal leaves					total
{71 75	{1.0 1.1	{6 7	{3 3	{7 8	Only basal leaves					total
43 {38 51	1.9 {1.6 2.2	4	2.2	10	45 {37 51	1.0 {0.7 1.3	1—2	2.1	8	very weak or none
71 {65 78	1.6 {1.0 2.1	many	2.9	11	43 {40 47	0.8 {0.5 1.0	many	3.3	10	very weak or none
41 {38 44	2.0 {1.5 2.5	very few	2.3	10	42 {37 50	1.1 {0.9 1.4	very few	2.2	9	none
63 {56 68	2.1 {1.7 2.5	9	2.2	11	43 {32 55	0.7 {0.4 1.0	0—5	3.5	10	43 % total 57 % weak
67 {62 72	1.8 {1.5 2.0	8	2.7	10	37 {29 41	0.6 {0.5 1.0	0—1	4.0	10	7 % total 93 % rather strong
68 {57 87	2.1 {1.7 2.8	8	2.4	11	36 {22 43	0.9 {0.6 1.2	2	3.4	10	rather strong
{86 89	{1.5 2.0	{7 13	{4 5	{11 12	{57 60	{0.5 0.6	{1 2	{5 6	{10 10	weak or none

in which the effect of short days varied from being very limited (e. g. narrow heads) to almost total inhibition of flowering. The inhibition was most pronounced in the diploids, but was absent in plants which were not subjected to short days in summer and which owing to early sowing were exposed to winter conditions during germination.

Very slight differences were found between plants cultivated in sandy soil and in ordinary well-manured garden soil. The difference between the two types of soil, however, was not very great as the sandy soil was not pure. The phenotypical variation of *Kohlrauschia prolifera* is on the whole great. For no. 1700 seven measurements from different environments and years of cultivation are at hand. The mean heights vary between 51 and 28 and the mean diameter of the heads between 2.9 and 1.1 cm.

The two strains of *Kohlrauschia velutina* (nos. 913, and 3303) cultivated in 1953 (Table 8) are very different but identical as to taxonomic important characters, both having bracts and pubescence of the *velutina*-type (fig. 4) and prickly seeds, which are only 0.9—1.3 mm in length. No. 3303 is a tall race which is rather late and keeps its basal leaves until late. No. 913, on the other hand, is low, with small flowers, very early and without basal leaves. It flowers two months after germinating, whereas no. 3303 takes three months to get into flower. It was also cultivated in two earlier experiments (1947 and 1952) and attained mean heights between 20 and 34 cm and mean breadths of the heads between 1.7 and 2.3 cm. No. 3313, which kept its basal leaves, was influenced by the day length (fig. 5 and Table 8). The flower and stem formation was clearly checked but in September almost all plants of the short-day batch had 1—2 flowering shoots.

Summary of the cultivations with Kohlrauschia. The tetraploid material exhibits rather a limited variation. It consists of generally coarse races with rigid stems and rather broad heads. As a rule the basal leaves are not retained and the plants are independent of the winter-effect. The material from Jersey (nos. 3248—3249) deviated by its scabrous stems (fig. 4) and the leaves which were ciliated along the margins in their basal part.

The diploid material can be divided into two groups corresponding to the two species *K. prolifera* and *K. velutina*, which both show very great variation. In the former we have found races with coarse, rigid, erect stems and races with slender ascendent stems, races which retain their basal leaves and races which only transitorily have basal leaves. Those keeping their basal leaves most frequently depend on the winter effect, and are furthermore of northerly or continental origin. The Mediterranean races are widely different. In all cases they are independent of the winter effect, but they may have a very open erect shoot structure without basal leaves (lowland races, e. g. no. 1700 fig. 3c in the previous paper) and they may retain a basal rosette and from this have a large number of ascendent or even partly procumbent stems (montane races or ecotypes).

IV. *Galium aparine* L.

Cytology. FAGERLIND (1934, 1937) and HOMEYER (1935) have tried to count the chromosomes in *Galium aparine* without reaching a definite number. The species seems to comprehend tetraploid, hexaploid as well as octoploid races (2n about 44, 66 and 88). We have examined root tips of 11 strains originating from different parts of Europe and only found one number, viz. 2n = 64. As appears from fig. 1g, two of the chromosomes are particularly large and may have arisen by fusion of two short chromosomes. This would be in agreement with the basic number of the genus which no doubt is 11.

Experimental cultivations were undertaken in 1950 and 1951 and are considered in Table 9. Later some few additional samples were cultivated. At least five ecotypes or races may be distinguished, which either may be discrete or more probably ranges of a large clinal variation.

(1) Mediterranean, summer-annual and very early race. The plants develop very fast and wither already in August. The seedlings are coarse and erectly growing. It is hardly ever winter annual; in both winters no seedlings were observed beneath the spruce twigs on which the plants were climbing. No. 2482 (Table 8) and no. 3080 from Madeira which was cultivated in 1952.

(2) Mediterranean, probably not strictly annual race, for the plants when cultivated in Denmark sometimes winter and flower two subsequent summers. The seedlings coarse and erectly growing and the plants very rich in anthocyanine. No. 1471 (Table 9).

(3) Southern, indifferent race which can be summer annual as well as winter annual. During the winter numerous seedlings were observed beneath the old withered plants. The seedlings were upright or ascendent and the plants had a very great production of dry matter. Nos. 1207, 1253, and 1639, Table 9.

(4) Northern, rather late-flowering race without inhibition of flowering. Seedlings adpressed, plants green till late in the autumn; otherwise as the preceding race, although not with so great a production of dry matter. Nos. 2082 and 2265 (Table 9) and among later cultivations no. 3117 from Strasbourg, no. 2440 from Poznan, and no. 3254 from Jutland (Palsgaard wood). No. 2299 from the beach at Sletten (the Sound) may also belong here although no wintering plants or seedlings were observed.

(5) Northern, very late race with a tendency towards inhibition of flowering and, therefore, presumably mostly winter annual in nature. Seedlings small and adpressed. Stems creeping, not climbing. Flowering very late or more or less checked if germination takes place in April. Two morphologically different strains: no. 2691 from a wood in Jutland with narrow leaves, and no. 2614 from a pebble beach on Gotland in the Baltic with short and broad leaves.

Table 9. *Galium aparine. Cultivations 1950—1951.*
Each culture consisted of 10—12 individuals.

Cult. no.	Origin	2n[2]	Approx. no. of days from germin. to flowering	Habit of seedlings	Length of stems in cm 40 days after germin.	Habit and behaviour of plants in September	Wintering of plants cultivated during the preceding summer	Length of leaves (L) mm Mean[1]	Breadth of leaves (B) mm Mean[1]	Leaf index L:B
2482	Portugal, Coimbra*	64	50[3]	Erect	16	Completely withered	None	Leaves rather short, not measurable in September		
1471	Spain, Pamplona	64	80	Erect	15[4]	Green and flowering. Rather large	Some plants able to winther	27 {22 37}	4.5 {4 6}	6.0
1207	France, Noyon ...	64	60	Intermediate	10	Fruiting. Very large	None	28 {17 33}	4.4 {3 5}	6.4
1639	France, Luchon ..	64	70	Adpressed	8	Green and flowering. Very large plants	Very few able to winter	30 {25 36}	4.0 {3 6}	7.5
1253	France, Celle St. Avant	64	75	Adpressed	8		None	32 {23 37}	4.0 {3 5}	8.0
2265	Denmark, Roskilde		90	Adpressed	10	Green ± flowering and fruiting. Rather large	Very few able to winter	33 {28 40}	4.4 {3 5}	7.5
2082	Denmark, Ermelunden	64	100	Adpressed	—	Green and flowering	A few plants able to winter	—	—	—
2299	Denmark, Sletten	64	100	Adpressed	—	Green, flowering, fruiting	None	—	—	—
2691	Denmark, Buderupholm	64	120—130	Adpressed	8	Creeping, not climbing. Flowering just commenced	None	23 {19 25}	3.3 {2 5}	7.3
2614	Sweden, Gotland	64	130 or more	Adpressed	8	Creeping, not climbing. No or very few flowers	None	22 {17 26}	5.0 {4 6}	4.4

[1] Mean values and ranges (in braces).
[2] 2n = 64 was further counted in a strain from Palsgaard, Denmark (no. 3254) and from Poznan, Poland (no. 2440).
[3] Germination of seeds 3 days before the other strains.
[4] Stems and leaves with high contents of anthocyanine.

In *Galium aparine* the genotypical variation mainly concerns the behaviour of the seedlings and the reaction to the annual climatic changes. The species contains winter annuals, summer annuals, and indifferent races, and Race 2 approaches the two-year flowering biennial type, which is an important and not casually occurring type in *Calamintha*.

V. *Calamintha acinos* (L.) Clairv.

Cytology. The chromosome number 2n = 18 was in 1940 found by SCHEERER and later corroborated by LÖVE & LÖVE (1944). Our material had also 18 chromosomes in somatic cells (9 different strains mentioned in Table 10 and three strains cultivated 1953–54 from Edenderry in Eire, Termignon in France (alt. 1300 m), and Frederikssund in Denmark). The strain no. 1539 from Cirque de Gavernie in the Pyrenees seems to be intermediate between *C. acinos* and *C. alpina*. The latter species according to REESE (1953) has also the chromosome number 2n = 18.

Experimental cultivations were undertaken in 1950—1952 and the results are considered in Table 10. The variation is fairly moderate but very interesting. 7 different types may be distinguished. These types may represent ranges within an almost continuous variation, as even a very deviating race, such as no. 1539, which is closely related to *C. alpina*, may be connected with typical *C. acinos* through intermediate types. Herbarium studies reveal that *C. acinos* and *C. alpina* where they meet in the European mountains are not sharply separated. Typical *C. alpina* is perennial with 1.5—2 cm long flowers and the nerves on its leaves are not prominent, whereas *C. acinos* is annual or pauciennial with more prominent nerves and flowers, which are shorter than 1 cm. In *C. alpina* the flowers are frequently placed in a few more or less aggregate whorls, whereas *C. acinos* has many separate whorls. Our material from Gavarnie (about 1300 m above the sea) is intermediate as to size of the flowers and has many separate whorls and prostrate growth. It is further distinctly perennial. It is important to note that hardly any segregation appeared in the material, which was collected as seeds in a natural population. Another culture (no. 1454), which was raised from seeds collected in a xerophilous grassland vegetation in the Sierra Cebollera in N. Spain (12—1300 m above the sea) was also prostrate and showed a clear tendency towards perenniality and had rather large flowers. The Sierra Cebollera material and the Gavarnie material may probably be the results of introgressive hybridization (cf. ANDERSON 1949, BAKER 1951) and represent two different end-results which both owing to back-crossing and outscreening by the habitat of a vast number of segregants have become stabilized and do not vary more than any population of the parental species. It is also possible, however, that such well-differentiated intermediate populations with a very restricted potential variability are to be understood as isolated remnants of a former continuous variation covering both *C. acinos* and *C. alpina* as its two extremes. During the last glaciation this cline may have been

Table 10. *Calamintha acinos*, Each culture consisted

Cult. no.	Origin	2 n	Duration of life (years)	Approx. no. of days from germination to flowering	Habit
1676	S. France, Formiguères, altitude 15—1600 m	18	1	50	Erect
2508	France, Bas Dauphiné (Isère)	18	1	70	Erect
2509	S. France, Montpellier*	18	1 (2)	60	Erect
1644	S. France, Nebias at Quillan	18	1—2	60	Erect
2380	Germany, Frankfurt a. M.*	18	(1) 2 (3)	60	Erect
2702	Denmark, Jernhatten, Djursland	18	(1) 2	70	Erect
2727	Denmark, Kongerslev, Himmerland.....	..	(1) 2	80	Erect-prostrate
2286	Denmark, Kregme, N. Zealand	18	2	70	Prostrate-ascendent
2659	Denmark, Løgstør, Himmerland.....	..	(1) 2	70	Prostrate-ascendent
1454	Spain, Poveda, altitude 12—1300 m	18	2—3	50	Prostrate
1539	S. France, Gavarnie, altitude 1300 m	18	2+	70	Prostrate

[1] Mean values and the ranges indicated in braces.

disrupted. Some populations were isolated in pockets in the mountains, and if they were small and exposed to a severe climate the opportunity for a differentiation of a discrete race may have been great.

The seven different types may be described as follows.

(A) Perennial alpine type clearly related to *C. alpina*, no. 1539. Perennial and large-flowered. First leaves circular, whereas in *C. acinos* they are more or less ovate. Stems prostrate with many separate whorls.

(B) Subperennial montane type probably related to *C. alpina*, no. 1454. Prostrate early-flowering and in many respects reminding of the preceding type,

Cultivations 1950—1952.
of 10—20 individuals.

Mean height[1], cm			Mean length[1] of longest shoot, cm			Types see p. 24–26
Sept. 1951		Sept. 1952	Sept. 1951		Sept. 1952	
Germin. April 1950	Germin. April 1951	Germin. April 1951	Germin. April 1950	Germin. April 1951	Germin. April 1951	
..	12.4 (6–17)	..	..	28 (17–36)	..	Ca
..	24.6 (17–31)	..	..	32 (15–47)	..	Cb
..	16.8 (11–25)	..	..	33 (12–46)	..	Cb
14.0 (12–25)	13.6 (6–23)	..	23 (15–40)	22 (16–43)	..	Cc
24.0 (16–32)	22.3 (11–31)	28.6 (17–42)	36 (22–56)	42 (25–55)	38 (27–47)	Cd
..	20.9 (14–30)	35.2 (14–49)	..	36 (30–41)	33 (16–58)	Cd
..	16.7 (4–31)	30.5 (20–43)	..	38 (16–45)	42 (27–53)	Cd
15.0 (11–18)	10.8 (5–16)	23.0 (13–35)	22 (16–24)	36 (27–43)	27 (17–39)	Ce
..	9.9 (7–13)	16.2 (12–32)	..	29 (26–36)	24 (17–38)	Ce
Not measurable in Sept. 1951 (had withered and ceased flowering already in July)						B
8.4 (3–17)	4.0 (3–7)	about 3—4	23 (19–34)	41 (23–58)	about 40	A

but not perennial when grown in Denmark. Deviated from all other strains by its early fruiting and withering in the second summer. Nevertheless some plants were able to winter in the second winter and might probably have survived still further.

(C) Pauciennial types, all belonging to *C. acinos.*

(a) montane, annual, very early race with low, erect, and tender shoots no. 1676.

(b) annual lowland race, rather late, coarse, and erect with many stems from the base, no. 2508 and 2509, the latter with thick stems. The plants sown 1950 had in October of the same year up to 50 and 30 cm long stems, respectively.

(c) annual or two-year flowering "biennial" race with erect growth and low tender stems and rather large flowers, no. 1644.

(d) two-year flowering "biennial" (occassionally three-year flowering) race with erect growth (nos. 2390, 2702, and 2727, the latter population segregating in erect, more or less ascendent or even almost prostrate individuals). Presumably a very widely distributed race in central and northern Europe.

(e) prostrate-ascendent race which otherwise resembles (d). Nos. 2286 and 2659, both strains from slopes facing west, unprotected and exposed to heavy wind from the sea (fjord).

VI. *Discussion and Conclusions.*

(1) ***Clinal variation and race discrimination.*** As pointed out recently by BAKER (1953) there may be a tendency towards clinal variation in outbreeding species and towards race or ecotype discrimination in inbreeding species. This view seems to contribute to a resolution of the difference of opinion between those workers who formulate their conclusions in terms of clines and those who believe in a discontinuous nature of variation and describe this as a series of discrete races or ecotypes. On the other hand BAKER's view does not exclude that clinal and discontinuous variation are more or less connected with the absence or presence of sharp climatic boundaries (cp. BÖCHER 1949). BAKER mentions *Veronica officinalis* as an instance of an outbreeding species with clinal variation. In this species, the continuity in variation is most striking when continental material is considered, whereas clear-cut ecotypes seem to occur in the Faeroes (cp. fig. 6 in BÖCHER 1944). Here, however, the species according to HAGERUP (1951) is self-pollinating, a fact which supports BAKER's hypothesis.

In *Trifolium arvense* and *Kohlrauschia prolifera* a sufficient number of cultures is at hand for a discussion of the nature of their variation. Both species seem to be outbreeders although self-pollination may be rather frequent in the case of *T. arvense*. If self-pollination by preference occurs in certain parts of their geographical ranges this can be supposed to involve a localized discontinuity. In this connection it is remarkable that diploid *Kohlrauschia* may be at the point of producing an ecotype in the mountains of southern Europe. Among our cultures it appears to be a discrete race, but its discrimination can only be established through studies of many cultures from different altitudes.

In the case of *Trifolium arvense* we have only found approaches to a clear-cut morphological race differentiation in material from Mediterranean and montane stations in the south as well as from dunes and similar habitats in the west. We do not, however, think that the strains in question can be regarded as more than extremes in a clinal variation. Nor do the data presented in Tables 1—4 give any evidence for concluding that the physiological variation is discontinuous in this species. Its

variation in reaction to the TDL complex resembles the cline found by OLMSTED (1944) in side-oats grama grass. The clinal variation, however, only applies to typical *T. arvense*. From this species to the closely related *T. gracile* there is a great distance, the nature of which ought to be studied by experimental crossings.

The limited number of cultures of *Galium aparine* and *Calamintha acinos* indicate a great range of variation which may be clinal or not. In *Calamintha* two cultures from wind-exposed slopes and two from more sheltered slopes in Denmark indicate an enrichment of prostrate biotypes in the windy habitats. Two other cultures from Southwest European mountains indicate introgressive hybridization (see p. 23).

(2) ***Geographical distribution of important hereditary characters.*** The geographical distribution of certain genes or gene-complexes can be discussed without considering the degree of continuity in the variation and may from a gene-ecological standpoint be of particular interest. First of all we may try to overlook the physiological variation as to earliness and reaction to the TDL complex. In Tables 1, 2, and 9 the cultures are arranged according to the beginning of flowering. But whereas the differences in earliness of 50 to 85 days in the first-mentioned cultures of *Trifolium arvense* in the 1950 experiment (Tab. 1) must be assumed to be independent of the complex, the other strains in that experiment which have a very delayed flowering, are late as a result of not having been exposed to low temperatures or short days during germination. Also in *Kohlrauschia* and *Galium* the beginning of flowering is independent of or dependent on the TDL complex. If we try only to consider earliness differences between strains which are independent and therefore develop normally as summer annuals, we find a clear tendency towards early flowering in a southerly direction in Europe, in *Trifolium* and *Calamintha* culminating with the montane races from Formiguères (nos. 1671 and 1676), in diploid *Kohlrauschia* with the peculiar type from Bouleternère (no. 1700, cf. Table 4 in the previous paper). With the exception of *Calamintha acinos* all species exhibit a clear geographical distribution of the dependence on the TDL complex. In most cases northern races show different degrees of such a dependence, whereas southern (and some of the northern or continental) races are independent.

It is not quite intelligible why such characters as involve winter annuality are selected in the north. All southern strains which in their natural habitats may be summer annuals are able to carry through quite a normal development also when cultivated as summer annuals in Denmark. Of course winter annuality will advance the time of stem stretching and flowering and this early development may be necessary in climates where the natural vegetation is dominated by perennials which later in the period of growth will cover the ground and compete with or kill the smaller annuals. Very many annuals certainly occur in open spots on dry slopes or in "white dunes" in Denmark, where the competition even in summer is not very strong, but here the surface of the soil will soon be too dry. This indicates that the greater moisture in the soil during the spring connected to some extent with the reduced competition may be decisive. In Mediterranean Europe, however, the winter is wet and there-

fore we ought also there to find races which show adaptations to the complex of winter conditions. In fact such races seem to occur in Portugal and Spain, e. g. *Kohlrauschia velutina* from Sacavem (Table 8, fig. 2) the tetraploid *K. prolifera* from Lisbon (Table 4 in our previous paper, on p. 299 by mistake called diploid; Table 7 in the present paper), and perhaps *Galium aparine* from Pamplona in Spain (Table 9, no. 1471).

Size and production of dry matter. It is obvious that the size and dry-matter production is very much influenced by environmental changes, and from the experimental data presented in Tables 4 and 8 it appears that changes in the length of the photoperiod in many strains produce very great size differences. This implies that size differences even between cultures in the same experiment cannot be compared unless the cultures can be considered indifferent as to the TDL complex or show the same reaction to this complex of factors. The matter is further made difficult because no sharp limits can be drawn between the different physiological behaviours (see e. g. the almost continuous variation from very great to almost no difference in size between the two batches in Table 4).

If we only consider the first-mentioned cultures in Tables 1 and 2, the size of which seem to be independent of the TDL complex, we may conclude that in the south of Europe *Trifolium arvense* embraces two different small-sized types, viz. a lowland type (no. 1732) and a highland type (no. 1671). Large-sized types occur in Mediterranean lowlands as well as in continental areas (e. g. 1706 in Table 1, 2758 in Table 2), but may also occur in the north (e. g. no. 2696). It is not possible to ascertain whether all northern strains which show different degrees of inhibition or delay of flowering are low-growing. The experiment in Table 4 discloses the two last-mentioned cultures as small and low-growing and experiment 3 (A-cultures) that nos. 2882, 2872, and 2873 are small, whereas no. 2871 is medium-sized and no. 2874 rather large.

The size differences in *Kohlrauschia* in the experiment in Table 8 (photoperiod unaltered) are independent of the TDL complex, and therefore we can without hesitation regard so great differences as e. g. between no. 913 and 3303 and between nos. 1700 and 3325 as significant. In the experiment in 1950 (cf. Table 7) there are four southern and two northern diploids without delay of the stem formation and flowering. The mean heights of the southern strains were 51, 44, and 39 cm (lowland) and 23 cm (no. 1696 from the highlands); the two northern strains reached 31 and 39 cm in mean heights. It is clearly the montane race which deviates significantly from the rest, whereas no difference can be recorded between northern and southern strains.

Duration of life. Within clearly annual species such as *Trifolium arvense* and the two species of *Kohlrauschia* the variation in duration of life is greatly governed by the reaction to the factors of the TDL complex. There are, however, also great differences which follow the earliness differences mentioned above and are unaffected by the winter conditions. Very short life was found e. g. in *Kohlrauschia* no. 1700 and *Galium aparine* nos. 2482 and 3080. In a species like *Calamintha acinos*, which is not strictly annual, the variation in the duration of life is very great and

there the material strongly suggests a geographical distribution similar to that found in *Prunella vulgaris*. The southern races of *Calamintha* are strictly annuals, whereas the northern live 2—3 years. Finally, presumably as a result of introgression from *C. alpina*, some plants from montane stations are perennial.

(3) ***Hereditary life-form vacillation.*** Experiences with life form vacillation in species like *Viola tricolor* (CLAUSEN 1922) *Prunella vulgaris* (BÖCHER 1949), *Gossypium hirsutum* (HUTCHINSON 1951), *Arabis holboellii* (BÖCHER 1954), and *Calamintha acinos* render it necessary to discuss the life-form concept and some of the life-form classes used most. We must first accept that such species which consist of races with different life-forms cannot be placed within one class of life-form, but should in all phytogeographical statistics of life-forms be placed in those life-form classes to which they can belong unless it is shown that the flora or vegetation in question has only one race belonging to a single life-form class. A consequence of this may be that the life-form concept can always be used in connection with races, but in the case of species only when these are rigid and do not vary with regard to their life-form.

Two life-form classes which are generally accepted and much used may here be discussed, viz. the so-called winter annual and biennial life-form. The material presented in Tables 4 and 8 shows that the influence of the factors of the TDL complex need not be long. Only a few days' exposure to cold and short days may suffice for bringing about a normal development and flowering. Early germination in the spring, therefore, may frequently give almost the same result as germination in the autumn. Consequently we must redefine the concept of winter annuality so that it concerns only such plants the normal development of which depend on the winter effect.

The biennial life-form class is generally defined as plants which in the first year form a rosette on the ground and do not flower, but which next year flower and die after the ripening of their fruits. We have found several cultures of *Calamintha* and *Arabis holboellii* which are biennial, but which flower in both growing seasons. In *Arabis* the most luxuriant flowering is in the first year, in *Calamintha* in the second year because a comparatively long time is spent the first year in a vegetative "reinforcement stage". In *Calamintha* even three-year-flowering specimens were observed. This species cannot be classed as a hapaxanthic herb, neither is it a perennial. In RAUNKIÆR's life-form system it belongs to at least three classes, the therophytes, the hemicryptophytes, and the chamaephytes. Thus it is impossible to place it in one of the generally accepted life-form classes.

It is to be expected that the experimental methods now so much used in botanic research will soon bring about a recasting of the life-form classes. As a contribution to such a renewed treatment we have introduced the term *pauciennial* as a superior life-form class covering all plants with a very limited duration of life and without any vegetative power of production. Pauciennials can be hapaxanthic (flowering only once) or not (two- or three-year flowering).

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GEOGRAPHICAL VARIATION IN *APODEMUS SYLVATICUS* AND *A. FLAVICOLLIS* (*RODENTIA, MURIDAE*) IN EUROPE, WITH SPECIAL REFERENCE TO DANISH AND LATVIAN POPULATIONS

BY

ERIK URSIN

København 1956
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Synopsis.

The following characters have been investigated: The length of tail, hind foot, and skull in relation to the length of head and body; the length of the tooth row and, in some cases, the length of individual teeth; the number of tail rings (literature only); the colour patterns of the chest and, more peripherically, other pelage characters.

In *A. sylvaticus* there seems to be, in western Europe, a more or less gradual change in the proportionate length of several parts of the animal from the north-east towards the west and the south. The western and southern populations are more like *A. flavicollis* than are the north-eastern ones.

A flavicollis shows a considerable local variation in proportionate length of several parts of the body. Regular geographical variation was observed in the shape of the collar which reaches its highest development in north-western Europe.

Four European species of *Apodemus*, namely, *A. mystacinus*, *A. flavicollis*, *A. sylvaticus*, and *A. microps* are shown to be to some extent distinguishable from each other by the proportionate length of various parts of the body.

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Introduction.

The present investigation is based primarily on material belonging to the Zoological Museum of the University of Copenhagen which possesses large collections from Denmark and Latvia. The Danish material was collected by several persons and during many years while the entire Latvian material was collected by Dr. HANS JOHANSEN in August-December 1938 and in July-August 1939. The author is indebted to Dr. MAGNUS DEGERBØL, keeper of vertebrates, and to Dr. JOHANSEN, for permission to work up the collections. Material from other countries has been studied, although not in detail, in the British Museum where the staff of mammalogists was most helpful during my short stay. Dr. K. ZIMMERMANN has been kind enough to place at my disposal an interesting series of skins of *Apodemus flavicollis* from Norway, belonging to the Humboldt University of Berlin. Financial support was rendered by the Danish State Research Foundation, by the University of Copenhagen, and by the JAPETUS STEENSTRUP Foundation. The English language was revised by Mrs. AGNETE VOLSÖE.

The condylobasal length of skulls and the alveolar length of the upper tooth row were measured by the author. A test has shown that the tooth row measurements do not differ essentially from those of MILLER (1912). Body measurements were carried out by several persons, usually on fresh material. Some Danish specimens preserved in alcohol were measured by the author. Hind foot measurements do not include claws. The head-and-body of Danish specimens was measured to the anus, and the tail was measured from the anus to the tip, excluding hairs. Latvian specimens were measured to (and from) the base of the tail. The difference in the measuring technique seems, however, to have affected the results very little.

In the map, Fig. 1, are indicated the Danish localities from which material is available. The localities in Latvia are Antini (57°00′ N. 23°30′ E.), Planupe (57°00′ N. 23°20′ E.), and Koknese (56°40′ N. 25°30′ E.).

The Tail.

The tail length of the two species in Denmark and Latvia is shown in Tables 1—2. As far as sufficient material is available it has been divided into size groups according to length of head and body (Tables 3—4). The contents of Tables 3 and 4 are shown

diagrammatically in Fig. 2. Within the range of body length of the available material there seems to be an almost straight-line relationship between body length and tail length. Small specimens of both species have proportionately longer tail than larger

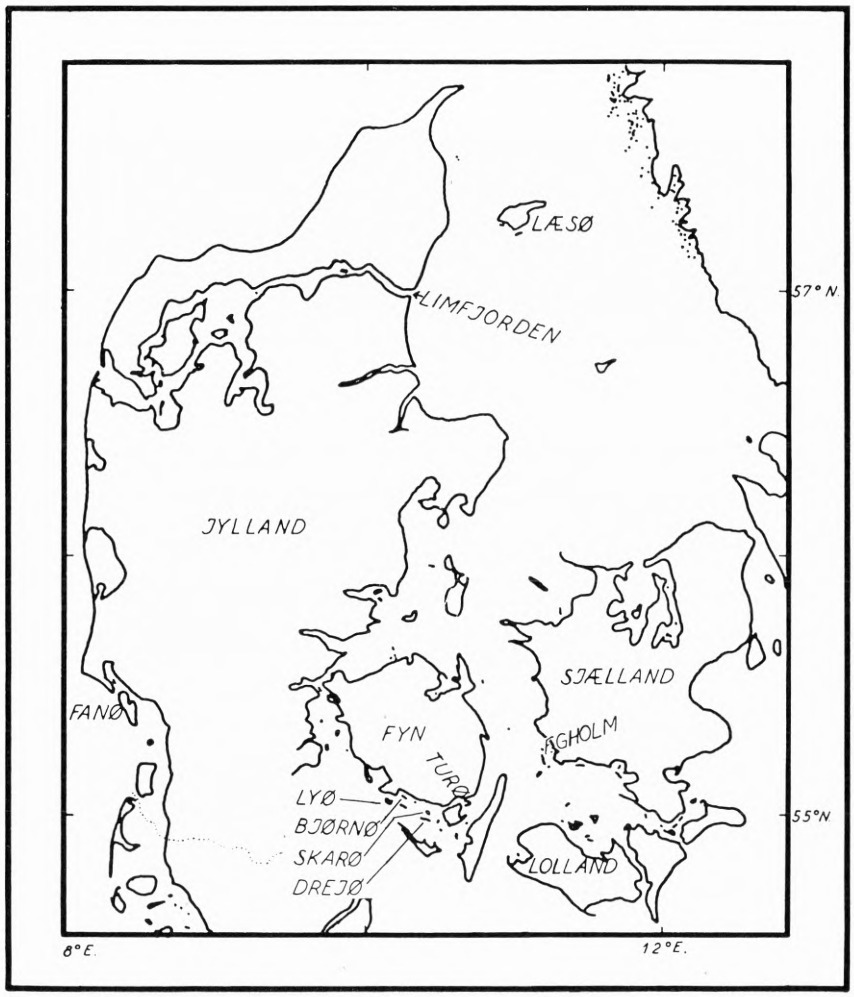

Fig. 1. Map of Denmark with indication of the localities referred to in text.

ones. There is in Denmark and Latvia not much overlapping of the relative tail length of the two species. Only the smaller size-groups of *A. flavicollis* from Koknese (Latvia) are within the range of *A. sylvaticus*.

A comparison of series of *A. sylvaticus* of equal body length shows for most size-groups that the tail is significantly longer in Sjælland than in Jylland. The specimens from two small Danish islands, Skarø and Drejø, resemble those from Jylland while the Latvian series (from Antini) is more like that from Sjælland.

The two series of Latvian *A. flavicollis* (from Antini and Koknese) are distinct from each other. The difference is significant for most size-groups in spite of the small number of observations from Koknese. The Danish series (from Sjælland and Jylland) bear most resemblance to that from Koknese. Both in Sjælland and Jylland the tail is signi-

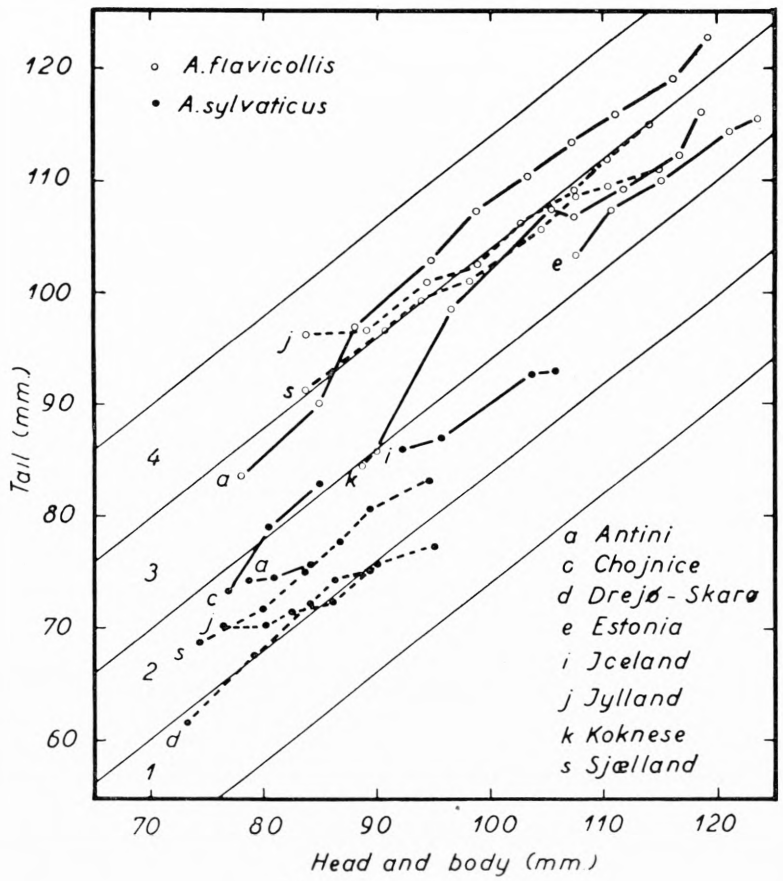

Fig. 2. Cf. text p. 5.

ficantly shorter than in Antini. The tail length is probably not identical in the two Danish series (cf. the diagram, Fig. 2) because in the present material the tail for all size groups was found to be longer in Jylland than in Sjælland. The difference is, however, difficult to prove statistically because generally the standard deviation of the mean is approximately as large as the difference between the means. Significance is, however, approached when the tail/body ratio is calculated for each specimen of the two series and the mean values of this ratio are compared. For Jylland is found $t/b = 1.0395 \pm 0.0127$ and for Sjælland $t/b = 1.0105 \pm 0.0082$. The difference is significant at the 5 % level.

TABLE 1. Measurements of *Apodemus sylvaticus*. Mean values and standard

Locality		Tooth-wear	Head & body		Tail	
			N.	M. ± S.D.	N.	M. ± S.D.
Latvia	Antini	All stages of wear	12	82.08 ± 1.57	12	74.17 ± 2.08
Denmark	Jylland		113	85.49 ± 0.66	109	72.91 ± 0.34
	Sjælland		34	84.77 ± 1.30	34	75.74 ± 1.42
	Fanø		9	85.83 ± 2.36	9	76.94 ± 1.55
	Læsø		8	90.00 ± 2.14	8	81.88 ± 2.74
	Egholm		7	93.93 ± 3.22	7	83.93 ± 1.81
	Skarø		13	85.19 ± 1.85	11	72.50 ± 1.78
	Drejø		15	82.50 ± 2.18	13	69.81 ± 2.38
	Bjørnø		11	86.14 ± 2.53	8	71.88 ± 3.59
	Lyø		8	86.25 ± 3.63	7	68.21 ± 3.84
	Bornholm		16	86.17 ± 1.25	11	73.86 ± 3.69
	Various islands		30	90.26 ± 1.41	25	75.10 ± 1.13
Latvia	Antini	Teeth worn	1	86	1	66
Denmark	Skarø		1	95	0	
	Other loc.		8	96.25 ± 2.95	7	81.07 ± 3.47
Denmark	Drejø	m^3 developing	1	66	1	53

[1] Cf. Figs. 2, 7 and 11; text p. 8.

TABLE 2. Measurements of *Apodemus flavicollis*. Mean values and standard

Locality		Tooth-wear	Head & body		Tail	
			N.	M. ± S.D.	N.	M. ± S.D.
Latvia	Antini	All stages of wear	148	104.0 ± 0.9	143	110.5 ± 1.0
	Koknese		20	104.0 ± 3.0	20	101.7 ± 3.3
	Planupe		10	116.0 ± 3.3	7	111.8 ± 2.5
Denmark	Jylland		42	103.0 ± 1.4	40	106.5 ± 1.6
	Sjælland		82	104.8 ± 1.0	77	105.6 ± 1.0
	Lolland		13	106.3 ± 2.8	12	107.5 ± 2.5
	Turø		8	95.0 ± 5.4	7	88.9 ± 5.6
	Fyn		6	102.5 ± 3.7	5	101.5 ± 1.9
	Various islands		15	105.5 ± 2.8	12	105.8 ± 2.1
Latvia	Antini	Teeth worn	11	117.5 ± 1.8	10	121.0 ± 1.7
	Koknese		4	116.2 ± 6.9	4	115.0 ± 4.4
	Other loc.		2	120	2	117
Denmark	Various loc.		9	115.8 ± 3.5	5	118.4 ± 2.5
Latvia	Antini	m^3 developing	7	76.8 ± 2.0	6	79.2 ± 2.5
	Koknese		3	88.2 ± 1.8	3	79.2 ± 1.8

deviations of the mean for various localities in Denmark and Latvia.

Hind foot		m^{1-3}		Condylob. length			Length group[1]		
N.	M. ± S.D.	N.	M. ± S.D.	N.	Head & body	M. ± S.D.	Tail	Hind foot	Condylob. length
12	20.67 ± 0.17	11	3.52 ± 0.03	9	83	21.38 ± 0.26	1	1	1
113	20.82 ± 0.08	34	3.81 ± 0.03	32	(87)	22.21 ± 0.17	2	1	2
34	20.79 ± 0.20	20	3.83 ± 0.04	19	..	22.22 ± 0.29	1	1	..
9	20.17 ± 0.34	0	..	0	..	..	2	0	..
8	21.12 ± 0.20	0	..	0	..	..	2	1	..
7	21.50 ± 0.22	4	3.90 ± 0.06	5	94	22.75 ± 0.49	2	1	1
13	20.88 ± 0.18	10	3.56 ± 0.03	6	(88)	21.90 ± 0.20	2	1	1
15	20.17 ± 0.30	11	3.50 ± 0.03	6	89	21.90 ± 0.20	1	1	1
11	20.68 ± 0.23	5	3.82 ± 0.06	5	86	21.50 ± 0.55	1	1	1
8	20.75 ± 0.25	6	3.82 ± 0.04	3	91	22.00 ± 0.65	1	1	1
16	21.19 ± 0.29	10	3.84 ± 0.05	10	..	22.02 ± 0.17	2	1	..
30	21.13 ± 0.15	14	3.90 ± 0.04	12	(93)	22.95 ± 0.33	1	1	2
1	20	1	3.6	1	86	22.7	..	..	..
1	21.2	1	3.5	1	95	22.7	..	..	..
8	21.50 ± 0.38	11	3.96 ± 0.05	9	..	23.72 ± 0.28	2	1	..
1	17.5	1	3.7	0	..	..	..	..	..

deviations of the mean for various localities in Denmark and Latvia.

Hind foot		m^{1-3}		Condylob. length			Length group		
N.	M. ± S.D.	N.	M. ± S.D.	N.	Head & body	M. ± S.D.	Tail	Hind foot	Condylob. length
146	24.99 ± 0.10	137	4.42 ± 0.01	75	106	25.60 ± 0.20	4	4	3
19	23.74 ± 0.37	18	4.29 ± 0.04	11	112	25.55 ± 0.30	3	2	2
9	25.11 ± 0.52	8	4.49 ± 0.05	4	119	27.68 ± 0.43	3	3	3
42	24.12 ± 0.17	24	4.30 ± 0.03	19	104	25.77 ± 0.25	4	3	3
82	24.49 ± 0.12	57	4.30 ± 0.02	21	107	25.73 ± 0.22	3	3	3
13	24.81 ± 0.29	23	4.26 ± 0.03	18	104	25.59 ± 0.38	3	3	3
8	23.50 ± 0.46	4	4.22 ± 0.03	2	106	23.90	2	3	..
6	24.67 ± 0.40	0	..	0	..	..	3	4	..
15	24.63 ± 0.31	5	4.28 ± 0.09	4	101	25.50 ± 0.80	3	3	3
8	25.94 ± 0.40	11	4.55 ± 0.04	8	119	27.44 ± 0.19	4	4	3
4	24.75 ± 0.48	4	4.38 ± 0.05	2	113	26.45	3	3	..
2	25.75	2	4.65	1	122	28.7	..	..	..
9	24.86 ± 0.40	11	4.39 ± 0.05	10	..	27.28 ± 0.20	..	3	..
7	22.86 ± 0.34	7	4.26 ± 0.05	3	73	20.17 ± 0.07	3	4	..
2	23.00	3	4.13 ± 0.04	1	80	22.1	..	..	..

TABLE 3. *Apodemus sylvaticus*. Length of tail in relation to length of head & body.

Head & body (Intervals)	Latvia			Denmark								
	Antini			Jylland			Sjælland			Skarø & Drejø		
	N.	Head & body	M. ± S.D.	N.	Head & body	M. ± S.D.	N.	Head & body	M. ± S.D.	N.	Head & body	M. ± S.D.
65—79	..	..	..	24	76	70.21 ± 1.00	8	74	68.75 ± 3.50	6	73	61.67 ± 2.39
70—84	9	79	74.17 ± 2.64	58	80	70.26 ± 0.58	14	80	71.79 ± 2.22	12	79	68.75 ± 2.06
75—89	10	81	74.50 ± 2.39	77	83	71.59 ± 0.55	24	84	75.00 ± 1.51	16	84	72.19 ± 1.55
80—94	8	84	75.62 ± 1.64	73	86	72.57 ± 0.64	24	87	77.71 ± 1.29	17	86	74.26 ± 1.21
85—99	..	..	..	47	91	75.90 ± 0.94	17	90	80.74 ± 1.14	11	90	75.23 ± 1.06
90—104	..	..	..	28	95	77.32 ± 1.32	7	95	83.21 ± 2.02	..	..	..

TABLE 4. *Apodemus flavicollis*. Length of tail in relation to length of head & body.

Head & body (Intervals)	Latvia						Denmark					
	Antini			Koknese			Jylland			Sjælland		
	N.	Head & body	M. ± S.D.	N.	Head & body	M. ± S.D.	N.	Head & body	M. ± S.D.	N.	Head & body	M. ± S.D.
70—84	9	78	83.6 ± 2.9	..	..	..	..	..	..	..	..	..
75—89	10	85	90.0 ± 1.9	..	..	..	4	84	96.2 ± 5.6	4	84	91.2 ± 6.2
80—94	18	88	96.9 ± 2.6	7	89	84.6 ± 3.1	6	89	96.6 ± 4.6	11	91	96.6 ± 2.0
85—99	35	95	102.8 ± 1.4	6	90	85.8 ± 3.4	12	95	100.8 ± 2.4	17	94	99.2 ± 1.6
90—104	52	99	107.1 ± 1.1	5	96	98.5 ± 4.0	18	99	102.5 ± 1.8	27	98	101.0 ± 1.2
95—109	77	103	110.4 ± 0.9	6	106	107.5 ± 1.3	23	103	106.2 ± 1.6	44	104	105.8 ± 1.0
100—114	75	107	113.3 ± 0.8	8	108	106.9 ± 1.1	24	108	109.0 ± 1.5	50	108	108.6 ± 1.0
105—119	68	111	116.0 ± 0.8	9	112	109.2 ± 1.9	17	110	111.9 ± 2.0	44	110	109.3 ± 1.1
110—124	43	116	119.1 ± 1.0	6	117	112.5 ± 3.2	10	114	115.0 ± 2.5	21	115	111.0 ± 1.6
115—129	24	119	122.9 ± 0.9	4	119	116.2 ± 3.2	..	..	..	..	..	..

In Tables 5—8 are compiled from the available literature the measurements of *A. sylvaticus* (L.), *A. flavicollis* (MELCH.), *A. mystacinus* (DANFORD and ALSTON), and *A. microps* KRATOCHVÍL and ROSICKÝ from various localities in Europe and the non-European Mediterranean area. In Fig. 3 the tail length has been plotted against the length of head and body. Material from the British Isles was kept separate in Fig. 4 owing to the high degree of specialization obtained on many small islands. In the diagrams, Figs. 2—4, is drawn a series of straight lines approximately parallel to the graphs of the body/tail relationship in Fig. 2. The intervals between successive lines are numbered 1—5 so that the most short-tailed animals are found in interval 1 and the most longtailed ones in interval 5. Accordingly, they are said to belong to group 1 and group 5 respectively. Most populations of *A. sylvaticus* belong to group 3 and,

TABLE 5. *Apodemus sylvaticus* (and *A. microps*). Published measurements of European (excl. British) and Mediterranean populations.

Reference	Subspecies	Locality	N.	Measurements					Length group[1]		
				Head & body	Tail	Hind foot	Skull C.B.	No. of tail rings	Tail	Hind foot	Skull C.B.
STEIN 1938 p. 507	*sylvaticus*	Frankfurt Oder	8	81.5	74.2	..	..	..	2	..	..
ZIMMERMANN 1936 p. 125	—	Houthem, Holland	9	93.6	88.3	22.1	..	156	2	2	..
— — —	—	Langeoog, Friesian Isl.	7	92.3	98.2	23.0	..	161	4	3	..
— — —	—	Wesermünde	7	88.9	80.8	21.6	..	150	2	2	..
— — —	—	Sylt, Friesian Islands	7	87.3	82.3	21.3	..	144	2	1	..
— — —	—	Lüneburg	76	90.8	81.3	20.8	..	143	2	1	..
— — —	—	Bellinchen (Mark)	6	89.4	76.1	21.3	..	151	2	1	..
— — —	—	Buch (Mark)	36	86.1	78.8	20.7	..	143	2	1	..
— — —	—	Reipzig (Mark)	7	82.4	74.0	22.3	..	131	2	3	..
— — —	—	Zempelburg, Poland	17	80.5	77.5	..	..	163	2	..	..
— — —	—	Jugoslavia	14	86.4	83.2	20.9	..	..	3	1	..
— — —	*dichrurus*	—	26	93.6	89.2	22.2	..	..	2	2	..
— — —	*sylvaticus*	Bulgaria	17	93.3	81.7	23.1	..	173	2	3	..
HAGEN 1954 p. 11	*dichrurus*	S. Sicily	7	93.6	86.3	22.0	23.8	174	2	2	2
— — —	—	Saloniki, Greece	9	96.8	88.5	23.2	24.8	..	2	3	3
— — —	—	Lewadia, Greece	6	97.5	93.3	22.8	25.0	..	3	2	3
— — —	—	Ossagebirge, Greece	8	102.6	100.5	23.4	..	..	3	2	..
— — —	—	NE Sicily	12	103.2	96.4	23.7	26.4	163	2	3	4
VON LEHMANN 1954 p. 24	*sylvaticus*	Liechtenstein	11	97	90	22.3	..	..	2	2	..
HEINRICH 1951 p. 107	—	Holstein	29	81.8	76.4	20.9	..	..	2	1	..
— — —	—	Oberbayrische Ebene	20	89.8	89	21.8	..	..	3	2	..
— — —	—	Bayrische Oberpfalz	40	90	89.9	21.8	..	..	3	2	..
— — —	—	Bodensee	11	91	91	22	..	..	3	2	..
— — —	—	Berchtesgaden	9	91	91	21.6	..	..	3	1	..
— — —	—	Allgäu	19	87	88.8	21.9	..	..	3	2	..
NEUHÄUSER 1936 p. 226	*tauricus*	Asia Minor	10	98.2	101.2	21.3	23.5	..	2	1	2
HILZHEIMER 1911 p. 16	*flavo-brunneus*	Württemberg	5	99.0	85.4	21.8	..	..	2	1	..
HEINRICH 1929 p. 189		Chojnice, Poland, total	17	80.5	77.5	..	..	..	3	..	..
— — —		— h. & b. 70–84	12	77.0	73.6	..	..	..	2	..	..
— — —		— — 75–89	10	80.5	79.1	..	..	..	3	..	..
— — —		— — 80–94	10	85.1	83.2	..	..	..	3	..	..
HEROLD 1951 p. 237		Rhön, Germany	56	83.7	82.5	22.2	..	158	3	3	..
ZIMMERMANN 1953 p. 37	*dichrurus*	Crete	35	93.5	89.4	21.7	23.3	175	3	1	2
BARRETT-HAMILTON 1900 p. 426	*hayi*	Morocco	9	96.1	97.3	22.1	..	..	3	1	..
HANZÁK & ROSICKÝ 1949 p. 26	*sylvaticus*	Slovakian mountains	10	86.5	84.4	21.5	..	..	3	2	..
HANZÁK, priv. communication	—	Böhmen-Böhmerwald	12	93.0	86.3	22.3	22.2	..	2	2	1
KRATOCHVÍL & ROSICKÝ 1953 p. 5	—	Krkonoše	13	93.2	84.9	21.9	..	..	2	2	..
— — —	—	Jižní Čechy	7	93.8	88.5	21.9	..	..	2	1	..
— — —	—	Linkov	10	94.9	89.3	21.9	..	..	2	1	..

[1] Refering to the diagrams.

TABLE 5 (continued).

Reference	Subspecies	Locality	N.	Measurements				No. of tail rings	Length group[1]		
				Head & body	Tail	Hind foot	Skull C.B.		Tail	Hind foot	Skull C.B.
KRATOCHVÍL & ROSICKÝ											
1953 p. 5	*sylvaticus*	Jeseníky	18	95.6	84.5	22.2	..	..	2	2	..
— — —	—	Přerov	8	97.7	83.4	21.7	..	..	2	1	..
— — —	—	Lednicko	8	92.3	87.1	21.4	..	..	2	1	..
— — —	—	Velkomeziříčsko	11	96.1	86.1	22.3	..	..	2	2	..
— — —	—	Rožnavsko	26	90.1	80.1	21.7	..	..	2	2	..
— 1952 p. 60	—	Č.S.R., total	120	93.6	84.0	21.9	..	..	2	1	..
— — —	*Apodemus microps*	Southern Slovakia	19	87.9	79.3	19.2	..	..	2	— 1	..
FELTEN 1952 p. 191	*sylvaticus*	Rhein/Main	146	88.3	85.3	21.6	22.1	162	3	2	2
DEGERBØL 1939 p. 42	*grandiculus*	Iceland, total	31	99.6	90.0	23.3	23.7	144	2	2	2
		—, h. & b. 85–99	14	92.1	86.5	..	23.3	..	2	..	2
		— — 90–104	17	95.8	87.2	..	..	..	2	..	..
		— — 95–109	18	103.6	92.8	..	..	..	2	..	..
		— — 100–114	17	105.8	92.9	..	24.0	..	2	..	1
MILLER 1912 p. 805	*sylvaticus*	Bergen, Norway	10	96.1	98.3	22.1	..	..	3	1	..
— — —	—	Liége, Belgium	10	94.3	92.3	22.0	..	..	3	2	..
— — —	—	Gers, France	10	93.1	85.5	20.5	..	..	2	0	..
— — —	—	Brunswick, Germany	10	94.3	87.1	21.3	..	..	2	1	..
— — —	—	Gageni, Roumania	7	93.0	85.3	21.5	..	..	2	1	..
— — —	—	Bern, Switzerland	10	96.0	93.7	22.2	..	..	3	2	..
— — —	—	Ticino, Switzerland	7	96	97.4	22.5	..	..	3	2	..
— — p. 809	*callipides*	Leon, Spain	10	100.3	92.3	23.0	..	..	2	2	..
— — —	—	Luchon,Haute-Garonne	8	98.7	102.5	22.7	..	..	3	2	..
— — —	—	Ariège, France	10	98.2	100.8	22.7	..	..	3	2	..
— — p. 811	*dichrurus*	Sorrento, Italy	5	100.8	94.6	21.9	..	..	2	1	..
— — —	—	Genoa, Italy	7	102.8	87	22	..	..	2	1	..
— — —	—	Greece	6	100.2	101.0	22.1	..	..	2	1	..
— — —	—	Nîmes, France	10	104.2	97.9	22.9	..	..	3	2	..
— — —	—	Granada, Spain	8	105.8	109.5	24.1	..	..	3	3	..
— — —	—	Alicante, Spain	10	104.4	103.2	23.2	..	..	3	2	..
— — —	*creticus*	Crete	6	84.6	87.8	21.5	..	..	3	2	..

[1] Refering to the diagrams.

particularly, to group 2. Group 1 and group 4 are sparsely represented. In *A. flavicollis* group 3 dominates, seconded by group 4 and even by group 5. Group 2 is represented only by two short series without much importance. Thus the overlapping of the relative tail length of the two species is considerable. *A. mystacinus* is represented by 5's and large 4's and, therefore, overlaps with the most long-tailed forms of *A. flavicollis*. *A. microps* from the Č.S.R. (group 2) does not differ in tail length from *A. sylvaticus*. British *Apodemus,* with the exception of the unquestionable flavicollis from

TABLE 6. *Apodemus flavicollis*. Published measurements of European and Near-Eastern populations.

Reference	Subspecies according to quoted author	Locality	N.	Measurements				No. of tail rings	Length group[1]		
				Head & body	Tail	Hind foot	Skull C.B.		Tail	Hind foot	Skull C.B.
STEIN 1938 p. 507	*flavicollis*	Frankfurt Oder	14	106.0	108.1	..	..	..	3	..	..
ZIMMERMANN 1936 p. 125	—	Usedom, Pommern	24	103.8	102.0	24.6	..	..	3	3	..
— — —	—	Mecklenburg	5	103.4	106.4	24.4	..	201	3	3	..
— — —	—	Bellinchen (Mark)	18	102.3	103.8	24.5	..	203	3	3	..
— — —	—	Buch (Mark)	17	98.1	102.9	23.4	..	210	4	3	..
— — —	—	Reipzig (Mark)	15	100.8	100.8	23.9	..	209	3	3	..
— — —	—	Lüneburg	19	100.0	103.0	..	..	197	3	..	..
— — —	—	Zempelburg, Poland	5	99.0	104.4	..	..	..	4	..	..
— — —	—	Tatra	8	98.3	103.1	24.6	..	193	4	4	..
— — —	—	Jugoslavia	11	102.5	105.2	23.8	..	..	3	3	..
— — —	*brauneri*	Jugoslavia	22	99.0	101.2	23.5	..	..	3	3	..
— — —	*flavicollis*	Bulgaria	35	99.0	99.7	24.5	..	204	3	4	..
VON LEHMANN 1954 p. 24	—	Liechtenstein	3	104	115	24	..	..	4	3	..
HEINRICH 1951 p. 115	—	Holstein	59	100.2	105.2	..	..	..	4	..	..
— — —	—	Bodensee	18	103	111	..	..	..	4	..	..
— — —	—	Allgäu	6	94.1	101.3	..	..	..	4	..	..
— — p. 122	*alpinus*	Steiermark	8	98	115.9	24.4	..	..	5	4	..
— — —	*flavicollis*	Steiermark	4	100	103.2	23.9	..	..	3	3	..
— — p. 115	*alpinus*	Berchtesgaden	38	96.7	112.6	..	..	..	5	..	..
— — —	—	Allgäu	36	95.1	117.5	..	..	..	5	..	..
NEUHÄUSER 1936 p. 226	*saturatus*	NE Asia Minor	3	108	115	24.0	25.2	..	4	2	2
REINWALDT 1927 p. 33		Estonia, total	35	113.3	107.7	24.9	26.4	..	3	3	2
		— h. & b. 100–114	21	107.6	103.2	24.6	25.4	..	3	3	2
		– — 105–119	21	110.8	107.4	24.6	25.7	..	3	3	2
		— — 110–124	20	115.0	109.8	24.9	26.4	..	3	3	2
		— — 115–129	13	121.2	114.3	25.3	27.3	..	3	3	2
		— — 120–134	10	123.7	115.7	25.6	28.0	..	3	3	3
HILZHEIMER 1911 p. 16	*fennicus* + *wintoni*	Finland	6	110.2	104.8	24.3	..	..	3	3	..
HEINRICH 1929 p. 192		Chojnice, Poland	5	99.0	104.4	..	..	..	4	..	..
BARRETT-HAMILTON 1900 p.426	*princeps*	Bustenari, Roumania	16	107.9	108.5	23.9	..	..	3	2	..
KRATOCHVÍL and ROSICKÝ											
— 1953 p. 4		Krkonoše, Č.S.R.	23	103.2	101.8	24.3	..	..	3	3	..
— — —		Střední Čechy, Č.S.R.	9	103.5	105.2	24.8	..	..	3	4	..
— — —		České Středohoří, Č.S.R.	27	108.9	106.1	25.0	..	..	3	3	..
— — —		Jeseníky, Č.S.R.	97	103.7	99.1	24.7	..	..	3	4	..
— — —		Beskydy, Č.S.R.	7	103.0	98.6	23.7	..	..	3	3	..
— — —		Lanžhot, Č.S.R.	15	105.4	103.0	24.4	..	..	3	3	..
— — —		Českomoravská, Č.S.R.	7	98.5	98.0	24.2	..	..	3	3	..
— — —		Rožnavsko, Č.S.R.	86	105.4	104.3	24.3	..	..	3	3	..
— — —		Nízké Tatry, Č.S.R.	11	105.3	107.1	24.3	..	..	3	3	..
— — —		Vysoké Tatry, Č.S.R.	10	106.1	98.2	24.6	..	..	2	3	..

TABLE 6 (continued).

Reference	Subspecies according to quoted author	Locality	N.	Measurements					Length group[1]		
				Head & body	Tail	Hind foot	Skull C.B.	No. of tail rings	Tail	Hind foot	Skull C.B.
KRATOCHVÍL and ROSICKÝ											
— 1953 p. 4		Belanské Tatry, Č.S.R.	7	102.1	100.1	23.7	..	..	3	3	..
— — —		Vihorlat a okolí, Č.S.R.	16	107.4	111.3	24.5	..	..	4	3	..
— 1952 p. 60–61		Č.S.R., total	378	104.6	101.5	24.6	..	..	3	3	..
FELTEN 1952 p. 197		Rhein/Main	58	99.4	107.2	23.8	24.8	201	4	3	3
MILLER 1912 p. 830	*flavicollis*	Haute-Garonne, France	5	110	106.2	24.8	..	..	3	3	..
— — —	—	Haute-Savoie, France.	6	98.8	100.3	25.5	..	..	3	5	..
— — —	—	Harz, Germany	5	106.8	110.6	25.3	..	..	4	4	..
— — —	—	Bustenari, Roumania.	10	109.3	108.3	24.4	..	..	3	3	..
— — —	—	St. Cergues, Vaud, Swz.	6	108.5	102.3	25.9	..	..	3	4	..
— — —	—	Les Plans, Vaud, Swz.	4	102.7	119.7	25.7	..	..	5	5	..
Zool. Mus. Berlin (unpubl.)	subsp. nov.?	Lillehammer, Norway.	10	99.6	98.2	..	..	..	3	..	..

[1] Refering to the diagrams.

TABLE 7. Published measurements of British and Icelandic populations of *Apodemus*.

Reference	Subspecies according to quoted author	Locality	N.	Measurements			Length group[1]	
				Head & body	Tail	Hind foot	Tail	Hind foot
BARRETT-HAMILTON 1900 p. 423	*intermedius*	Great Britain	93	92.4	86.9	22.6	2	2
MILLER 1912 p. 804	*sylvaticus*	Ireland	5	97	83.7	22.3	2	2
— — —	—	Isle of Man	10	95	84	22.2	2	2
— — —	—	Cromarty, Scotland	5	95.6	87.2	22.6	2	2
— — —	—	Oxfordshire, England.	10	96.5	90.1	22.1	2	2
— — —	—	Scilly Islands	6	95.5	88	22.2	2	2
— — p. 824	*hebridensis*	Lewis, Outer Hebr.	4	108	97.5	24.6	2	3
— — p. 825	*hirtensis*	St. Kilda	3	99.3	92.3	24.1	2	3
— — p. 826	*fridariensis*	Fair Isle	10	108.5	102.4	(24-26.2)	3	3
— — p. 831	*wintoni*	Herefordshire, Engl.	6	108.6	107.5	24.1	3	3
BARRETT-HAMILTON and HINTON 1911 p. 517	*sylvaticus*	East Aberdeenshire, Sc.	6	94	92.2	21.6	3	1
— — p. 516	—	Surrey, England	40	87.6	86.2	21.9	3	2
— — —	*butei*	Bute, Inner Hebr.	17	88.1	78.4	22.0	2	2
— — p. 537	*hamiltoni*	Rum, Hebr.	5	103.8	95.6	24.2	2	3
— — —	*cumbrae*	Gr. Cumbrae, Inner Hebr.	6	93	90.3	22.8	3	3
— — —	—	Tiree, Hebr.	4	102.5	84.2	23.1	1	2
— — —	*maclean*	Mull, Inner Hebr.	5	97	87.4	23.2	2	3

[1] Refering to the diagrams.

TABLE 7 (continued).

Reference	Subspecies according to quoted author	Locality	N.	Measurements			Length group[1]	
				Head & body	Tail	Hind foot	Tail	Hind foot
BARRETT-HAMILTONandHINTON								
— 1911 p. 537	*maclean*	Jura, Hebr.	3	97.6	78.5	22.6	1	2
— — —	—	Islay, Hebr.	9	93.3	81.6	22.5	2	2
— — —	*fiolagan*	Arran, Inner Hebr....	9	98.3	84.5	23.5	2	3
— — —	*hebridensis*	Lewis, Outer Hebr. ..	7	90.4	85.8	23	2	3
— — p. 536	—	— — ..	14	95.8	87.8	23.2	2	3
— — p. 541	*hirtensis*	St. Kilda	42	111	100	25.0	2	3
— — p. 544	*fridariensis*	Fair Isle	6	109.5	103.2	24.1	3	2
— — —	*granti*	Yell, Shetland	9	101.5	91.8	24.0	2	3
— — p. 550	*wintoni*	England	32	103.9	109.5	23.8	4	3
MONTAGU 1922 p. 935	*ghia*	Gigha, Hebr.	3	95.8	..	23.4	..	3
— — p. 936	*tural*	Islay, Hebr.	13	93.6	84.6	23.1	2	3
— — —	*larus*	Jura, Hebr.	4	90.8	89.9	22.8	3	3
PEARSON 1944 p. 139.....	*sylvaticus*	England	162	88.6	90.3	22.9	3	3
DEGERBØL 1939, p. 42.....	*grandiculus*	Iceland	31	99.6	90.0	23.3	2	2

[1] Refering to the diagrams.

TABLE 8. *Apodemus mystacinus*. Published measurements of European and Near-Eastern populations.

Reference	Subspecies	Locality	N.	Measurements				Length group[1]		
				Head & body	Tail	Hind foot	Skull C B.	Tail	Hind foot	Skull C.B.
ZIMMERMANN 1953 p. 33	*epimelas*	Balkan	23	115	127	26.7	28.72	5	5	5
— — —	*mystacinus*	Asia Minor, Syria, Palestine.....	12	119	128	24.9	27.57	4	3	3
— — —	*smyrnensis*	Western Asia Minor	3	110	126	25	27.9	5	3	4
— — —	*euxinus*	Northern Asia Minor	6	117	129	25.2	27.42	5	3	3
— — —	*rhodius*	Rhodos	9	113	128	25.8	27.85	5	4	4
— — —	—	Crete	24	109	120	24.7	27.56	4	3	4
AHARONI 1932 p. 232..	*pohlei* (as *A. flav.*)	Syria	9	106.2	122.8	24.4	27.8	5	3	5

[1] Refering to the diagrams.

England (*A. f. wintoni* (BARRETT-HAMILTON)) are within and cover the range of continental *A. sylvaticus*. The British insular forms which by ELLERMAN (1951, see below) have been referred to *A. flavicollis* have not particularly long tails.

The geographical variation of the tail length in *A. sylvaticus* and *A. flavicollis* is shown in the maps, Fig. 5. In *A. sylvaticus* group 1 in western Europe is restricted to

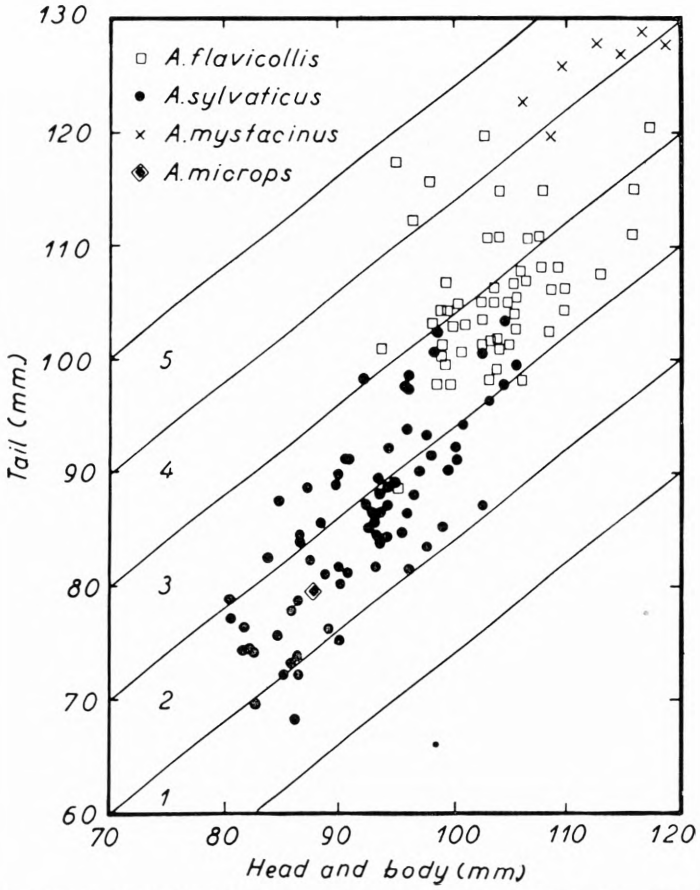

Fig. 3. European (excluding British) and Near-Eastern populations. Cf. text p. 8.

the north-eastern range of the species (Latvia and Danish islands). The occurrence of group 1 populations on two Scottish islands is probably not reliable because the available series contain only 3 and 4 specimens, respectively. Jylland and northern Germany are dominated by group 2 while in southern Germany and in the Mediterranean region groups 2 and 3 seem to be of approximately equal abundance. Groups 2 and 3 also dominate in the British Isles. The series from Langeoog (Friesian Islands), belonging to group 4, is unique among European *A. sylvaticus*.

A. flavicollis does not show the same regular geographical variation as *A. syl-*

vaticus. In *A. flavicollis* groups 3 and 4 seem to be equally represented in northern and southern Europe. In the Alpine region, however, populations occur with an extraordinarily long tail (group 5). They have been described as *A. f. alpinus* HEINRICH 1951. They are known only from HEINRICH's localities in southern Germany and perhaps from Vaud in Switzerland (MILLER 1912). Von LEHMANN's few specimens from Liechtenstein (large 4's) may be *alpinus*, too. *A. f. pohlei* AHARONI from Syria is very long-tailed, but it is probably an *A. mystacinus*. ELLERMAN's objection (1951 p. 568) that as regards dental characters it is a true *A. flavicollis*, does not seem valid

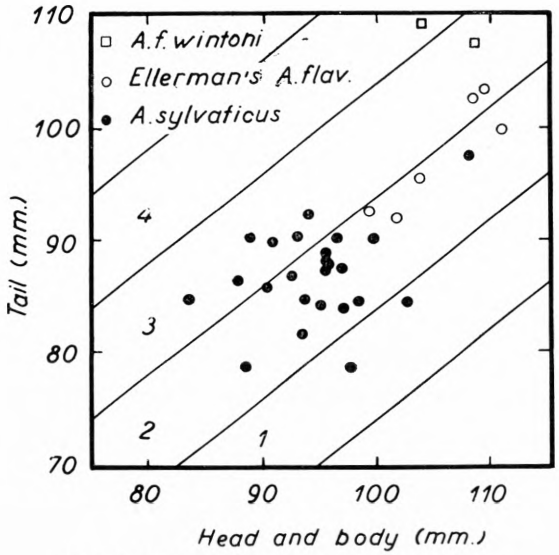

Fig. 4. British populations. Cf. text p. 10.

because ZIMMERMANN (1953) has shown a considerable overlapping of the dental characters of *A. flavicollis* and *A. mystacinus*.

Tail rings were not counted during the present investigation but information is available in the literature (Tables 5 and 6, Fig. 6). In *A. sylvaticus* the same geographical variation occurs in the number of rings as in the tail length. Accordingly, the number of rings does not seem to vary geographically in a regular way in *A. flavicollis* in which the tail length also does not vary. Tail ring counts of *A. f. alpinus* are not available.

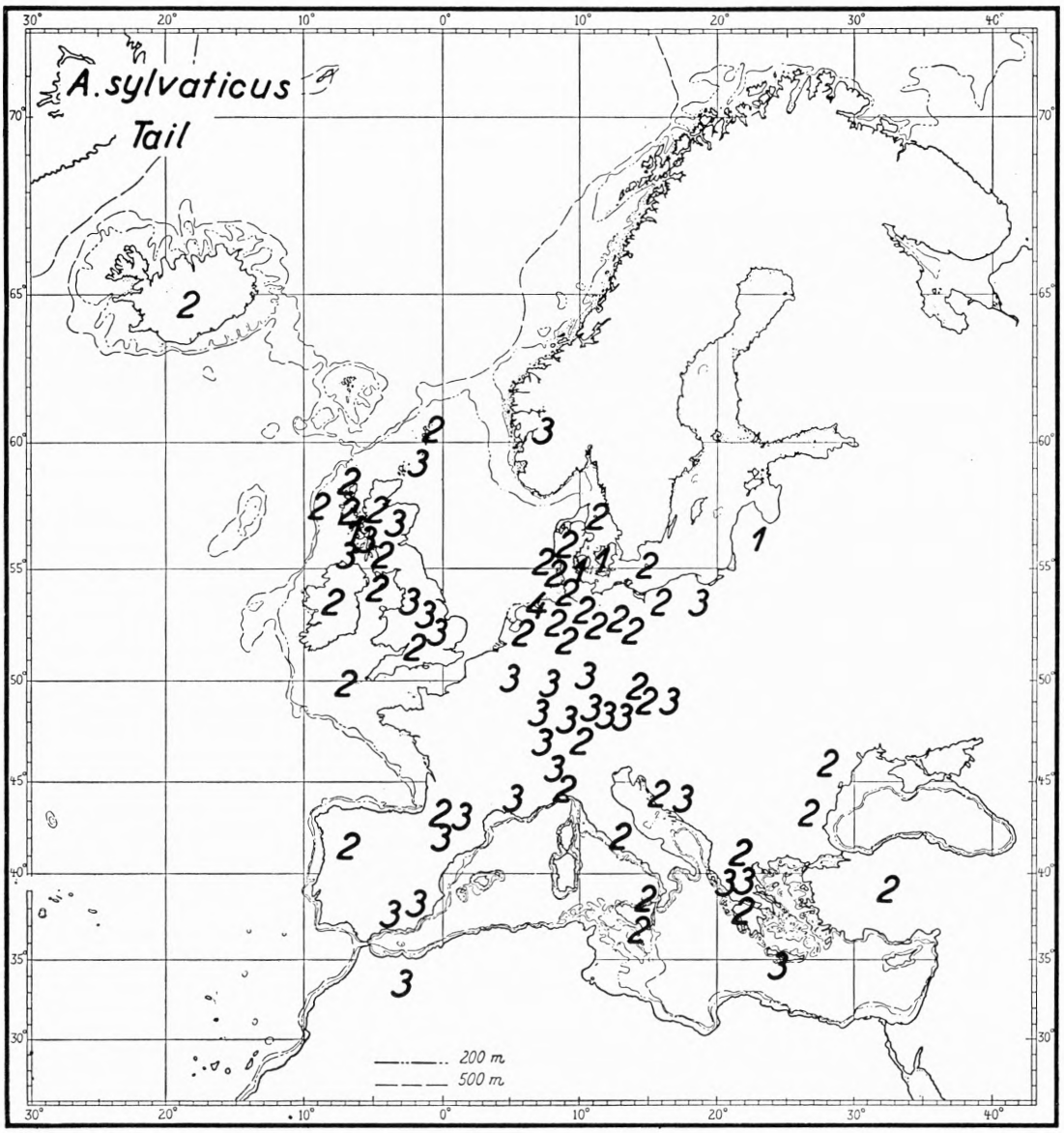

Fig. 5. Relative length of tail. The figures refer to the grouping adopted in Figs. 3 and 4. "1" indicates the shortest tails, "5" the longest.

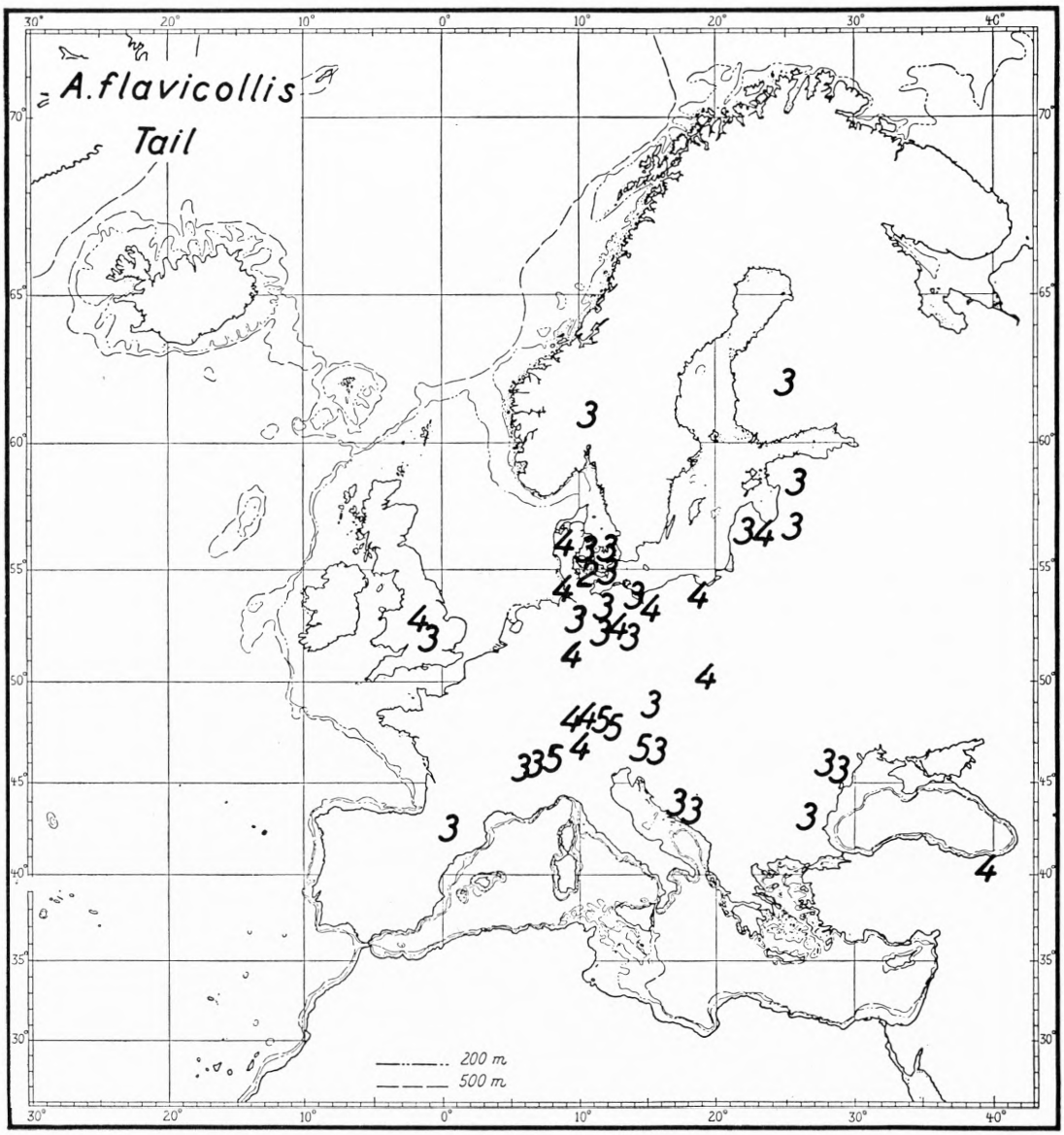

Fig. 5.

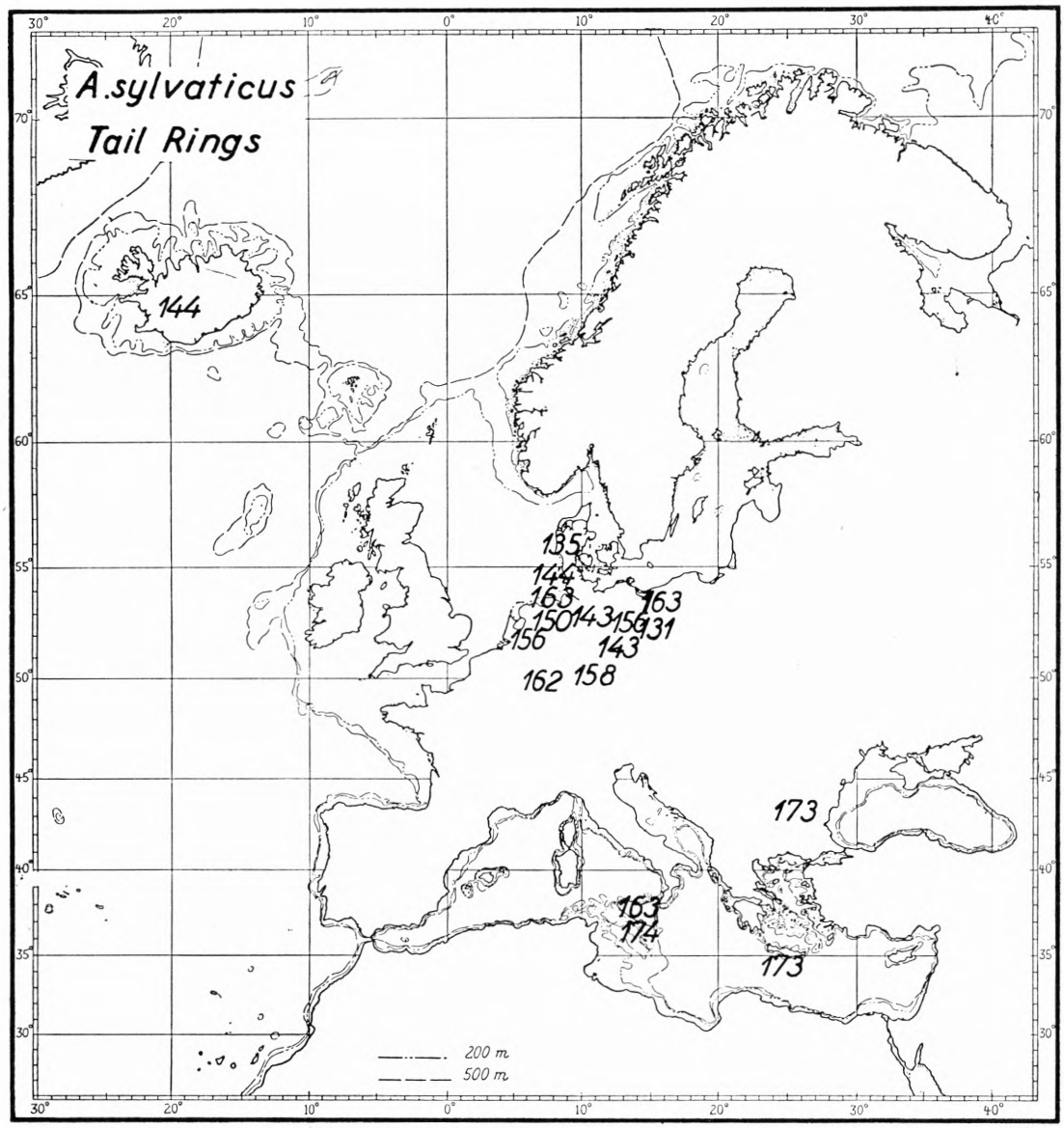

Fig. 6. Cf. text p. 15.

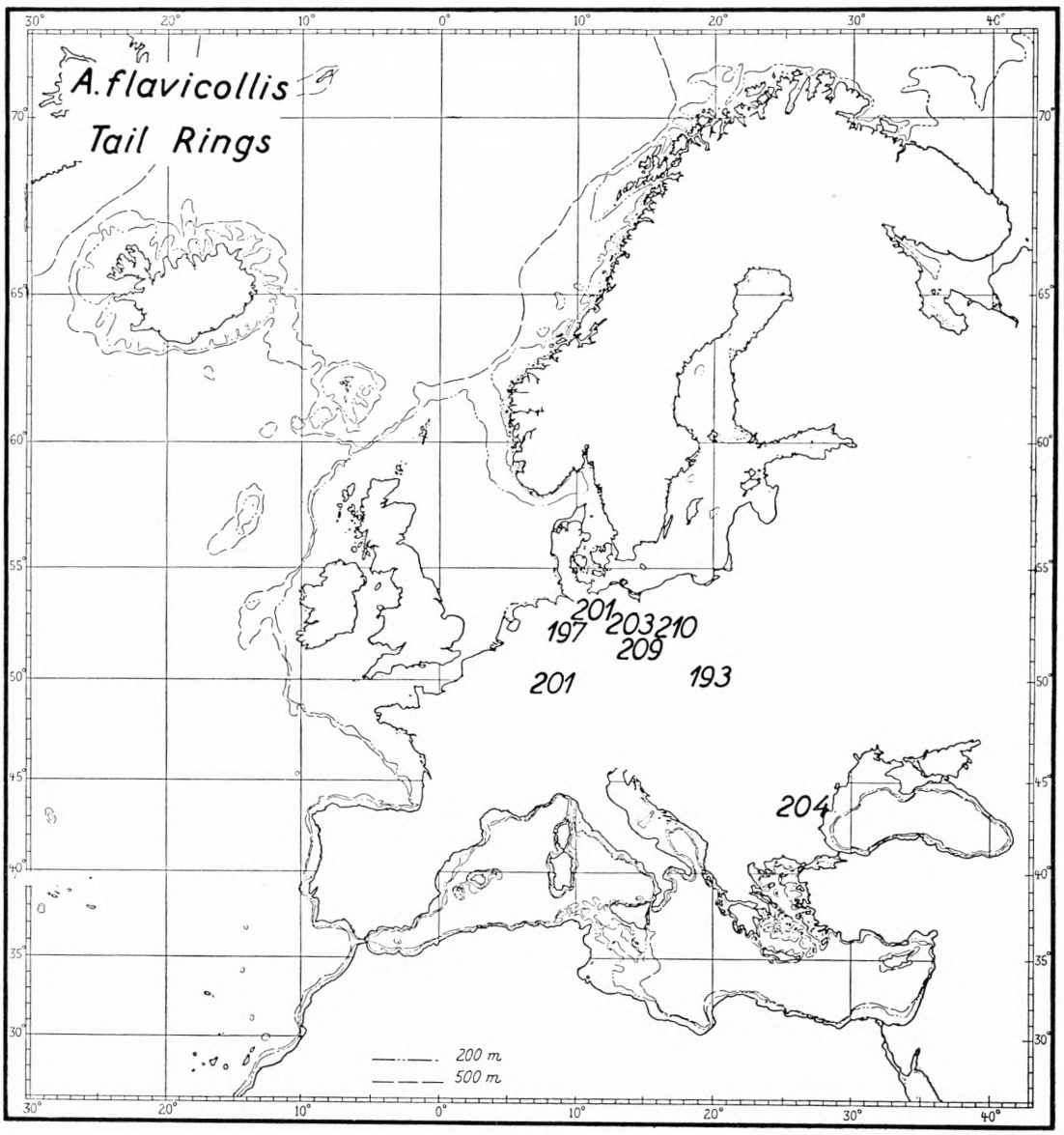
A. flavicollis
Tail Rings
201
197
203
210
209
201
193
204
200 m
500 m

Fig. 6.

The Hind Foot.

The length of the hind foot of *A. sylvaticus* and *A. flavicollis* in Denmark and Latvia is shown in Tables 1—2 and, divided into groups according to body size, in

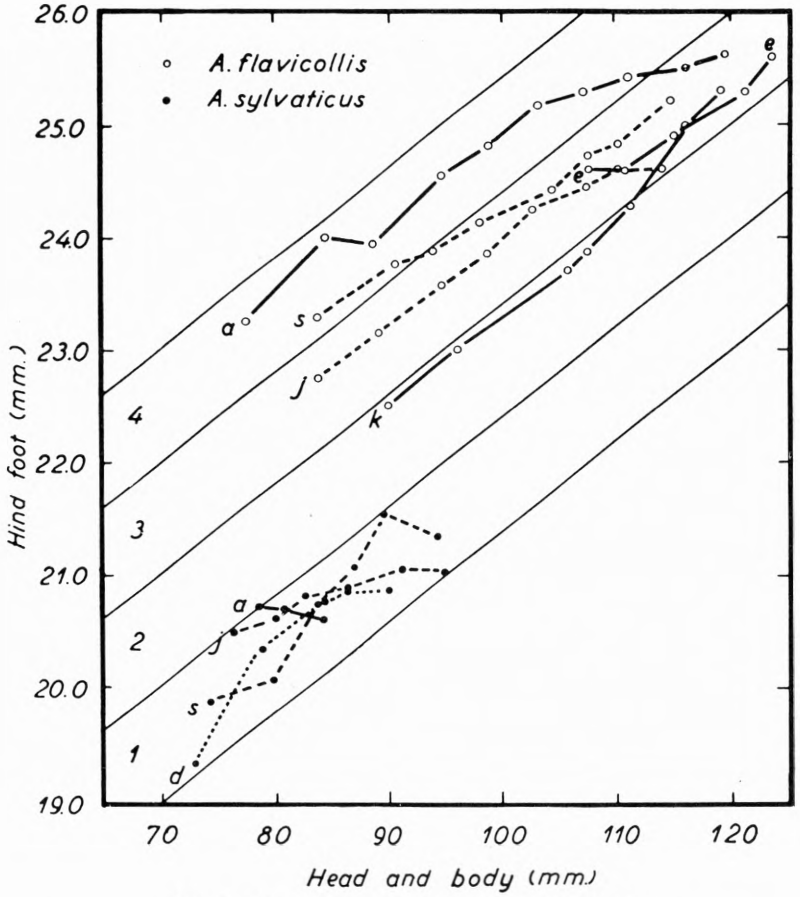

Fig. 7. Lettering as in Fig. 2. Cf. text p. 20.

Tables 9—10. The contents of the latter tables are shown diagrammatically in Fig. 7. A straight-line relationship between the body length and the length of the hind foot seems to be approximated. The oblique straight lines in Fig. 7 show the relationship and indicate a convenient grouping of the material. In both species the hind foot seems to be proportionately longer in small examples than in large ones. It is relatively shorter in *A. sylvaticus* than in *A. flavicollis*. The material of *A. sylvaticus* is not sufficient to demonstrate differences, if such occur, between Danish and Latvian series

TABLE 9. *Apodemus sylvaticus*. Length of hind foot in relation to length of head & body.

Head & body (Intervals)	Latvia			Denmark								
	Antini			Jylland			Sjælland			Skarø & Drejø		
	N.	Head & body	M. ± S.D.	N.	Head & body	M. ± S.D.	N.	Head & body	M. ± S.D.	N.	Head & body	M. ± S.D.
65—79	..	..	..	24	76	20.50 ± 0.19	8	74	19.88 ± 0.50	7	73	19.36 ± 0.46
70—84	9	79	20.72 ± 0.11	58	80	20.62 ± 0.10	14	80	20.07 ± 0.31	14	79	20.36 ± 0.25
75—89	10	81	20.70 ± 0.10	81	83	20.80 ± 0.08	24	84	20.75 ± 0.26	18	84	20.78 ± 0.18
80—94	8	84	20.62 ± 0.19	77	86	20.89 ± 0.09	24	87	21.08 ± 0.19	19	86	20.87 ± 0.14
85—99	..	..	..	51	91	21.07 ± 0.12	17	90	21.56 ± 0.16	13	90	20.88 ± 0.18
90—104	..	..	..	28	95	21.04 ± 0.16	7	95	21.36 ± 0.26	..	..	..

TABLE 10. *Apodemus flavicollis*. Length of hind foot in relation to length of head & body.

Head & body (Intervals)	Latvia						Denmark					
	Antini			Koknese			Jylland			Sjælland		
	N.	Head & body	M. ± S.D.	N.	Head & body	M. ± S.D.	N.	Head & body	M. ± S.D.	N.	Head & body	M. ± S.D.
70—84	11	78	23.27 ± 0.31	..	..	..	..	..	..	..	..	..
75—89	11	84	24.00 ± 0.23	..	..	..	4	84	22.75 ± 0.63	5	84	23.30 ± 0.49
80—94	19	89	23.95 ± 0.21	..	..	..	6	89	23.17 ± 0.36	11	91	23.77 ± 0.24
85—99	36	95	24.56 ± 0.17	6	90	22.50 ± 0.57	12	95	23.58 ± 0.31	18	94	23.89 ± 0.23
90—104	55	99	24.82 ± 0.14	5	97	23.00 ± 0.63	19	99	23.87 ± 0.24	28	98	24.14 ± 0.21
95—109	79	103	25.18 ± 0.10	7	106	23.71 ± 0.57	25	103	24.26 ± 0.21	47	104	24.44 ± 0.18
100—114	77	107	25.29 ± 0.11	9	108	23.89 ± 0.46	26	108	24.46 ± 0.18	53	108	24.73 ± 0.17
105—119	67	111	25.42 ± 0.12	9	111	24.33 ± 0.44	18	110	24.61 ± 0.19	47	110	24.84 ± 0.17
110—124	41	116	25.51 ± 0.18	5	116	25.00 ± 0.45	10	114	24.60 ± 0.28	22	115	25.23 ± 0.18
115—129	22	120	25.64 ± 0.24	3	119	25.33 ± 0.68	..	..	..	..	..	..

or between Danish series mutually. The hind foot length of *A. flavicollis* is liable to considerable variation. It is shortest in Koknese and longest in Antini. The Danish series (Jylland and Sjælland) are intermediate between the Latvian ones. The graph for Sjælland runs throughout above that for Jylland although the difference between these localities is not statistically significant. It seems, however, as if the *A. flavicollis* of Sjælland is characterized by a slightly shorter tail (see above) and longer hind foot than is found in that occurring in Jylland. The hind foot length in Antini is for most groups of body size significantly different from that found in the other three localities. The Koknese values are significantly different from those for Sjælland, but not for the Jylland values with which they slightly overlap in the larger specimens.

The diagrams, Figs. 8—9, show the body/hind foot relationship in non-British and British *Apodemus* populations. The diagrams are based on Tables 1—2 and 5—8.

Outside the British Isles the relative length of the hind foot of *A. sylvaticus* is fairly distinct from that of the other species considered. *A. sylvaticus* is largely confined to groups 1 and 2 (cf. the figures). *A. microps* (known from Slovakia only) has an

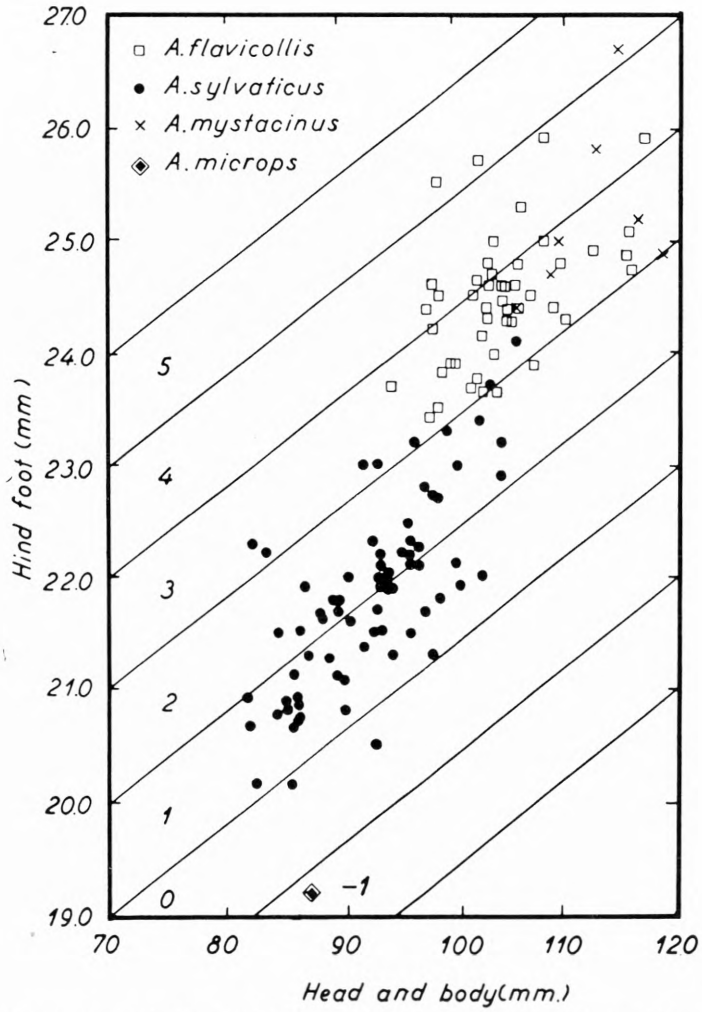

Fig. 8. European (excluding British) and Near-Eastern populations. Cf. text p. 22.

extremely short hind foot (group — 1). *A. flavicollis* and *A. mystacinus* are represented in group 3 and sparsely in groups 4 and 5. The three series of *A. flavicollis* with the longest hind foot were collected in the Swiss-French frontier region. One of these series is further characterized by a very long tail (*A. f. alpinus*?). The various subspecies of *A. mystacinus* are separated primarily by pelage characters (cf. ZIMMERMANN 1953, p. 32). It seems, however, that the proportionately long hind foot is a

useful additional distinguishing character for the continental European form, *A. m. epimelas* NEHRING. The English *A. f. wintoni*, without doubt a *flavicollis*, has a comparatively short hind foot (group 3, only slightly above group 2) while many other British *Apodemus* populations have longer feet (cf. Fig. 9). ELLERMAN (1951) referred several specialized British insular forms to *A. flavicollis* owing to their large skull while previous authors have referred all British *Apodemus* except *A. f. wintoni* to *A. sylvaticus* or erected new species for them. ELLERMAN's British *A. flavicollis* except *A. f. wintoni* have been given a separate signature in the diagrams. They are generally

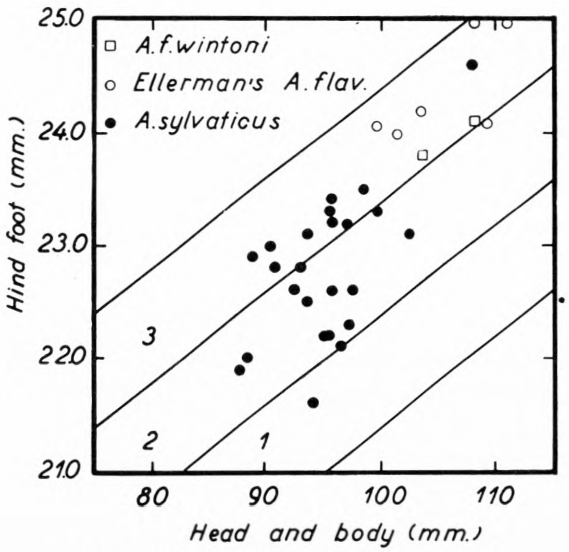

Fig. 9. British populations. Cf. text p. 23.

characterized by an extraordinarily long hind foot. This supports ELLERMAN's opinion that they ought to be referred to *A. flavicollis*. However, throughout the British Isles, there is a tendency in *A. sylvaticus* towards prolongation of the hind foot as compared with conditions in other northern European populations. On small British islands there is also a tendency towards large size (BARRETT-HAMILTON and HINTON 1911). The populations which ELLERMAN referred to *A. flavicollis* perhaps represent the extreme development of this evolutionary line. The isolated populations may also be regarded as belonging to a "fringing form" (RICHARDS 1935). RICHARDS called attention to the interesting phenomenon that within several species of animals the isolated populations on small islands off the British coast have peculiarities in common although they are exposed to quite different climatic conditions on the northern islands compared with those on the southern ones. Like BARRETT-HAMILTON and HINTON (1911—21 p. 436) he considered them survivors of a fauna element which previously inhabited the British mainland. The problem is complicated, and probably cannot be solved at present. There is, however, not much doubt that the British *Apodemus* populations

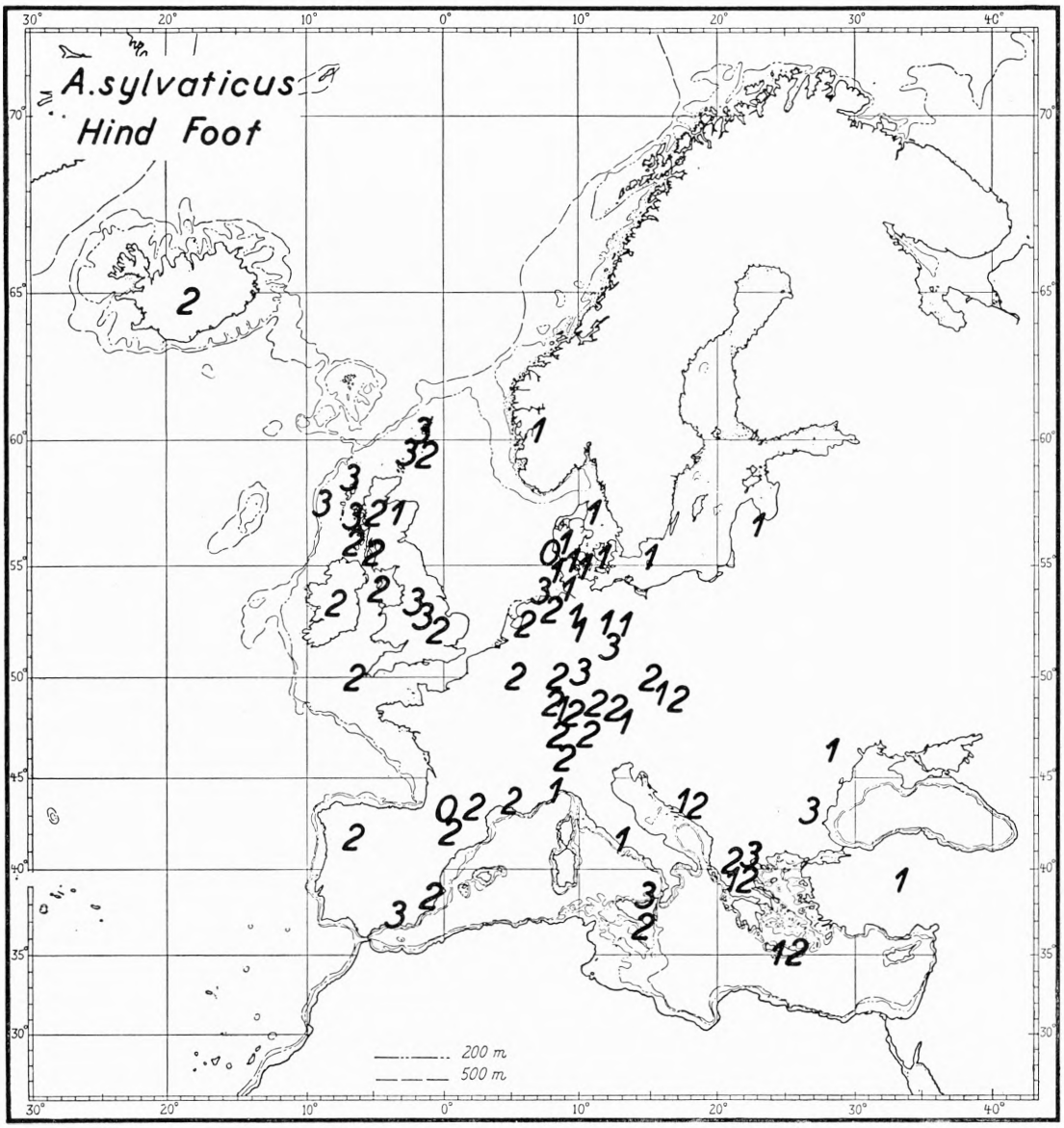

Fig. 10. Relative length of hind foot. "0" indicates the shortest hind feet, "5" the longest. Based on the diagrams, Figs. 8 and 9.

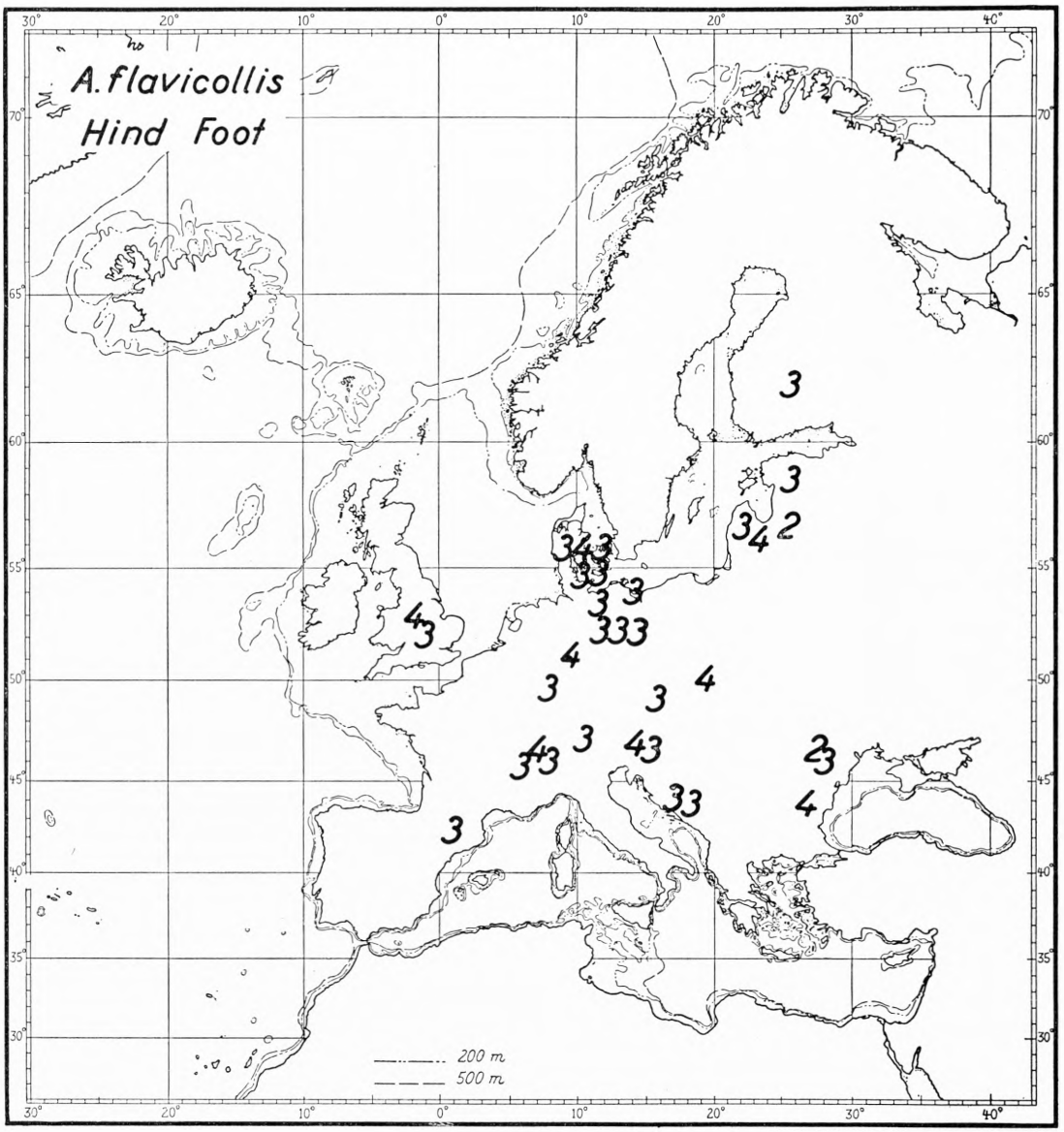

Fig. 10.

are of high age because they are so divergent from each other that a recognizable form seems to exist on almost every island where the genus is represented. Provisionally, it seems most adequate to consider all British *Apodemus* except *A. f. wintoni* as representatives of *A. sylvaticus*.

The geographical variation of the hind foot length of *A. sylvaticus* and *A. flavicollis* is shown in Fig. 10. In the former the hind foot is shortest in Denmark, northern Germany, and Latvia where group 1 predominates. In central Europe group-2-series are in majority. In southern Europe and in Great Britain even group 3 is represented. The pattern of variation is approximately the same as for the tail length (Fig. 5). However, the occurrence of short-tailed and short-footed populations in southern Europe (e. g. Gers, France: tail, group 2; hind foot, group 0, if the measurements are reliable) perhaps indicates the existence of a more complicated pattern of variation than described here.

A regular geographical variation of the hind foot length does not seem to occur in European *A. flavicollis* although individual populations differ considerably from each other. Populations with an extremely long hind foot and others with an extremely short one may occur close to each other, for instance in Latvia (see above).

The Condylobasal Length.

The condylobasal length of the skull in *A. sylvaticus* and *A. flavicollis* from Denmark and Latvia is shown in Tables 1—2 and, in relation to body size, in Tables 11—12 and Fig. 11. As in previous diagrams the relation between the measurements seems to approach a straight line. The condylobasal length is usually proportionately greater in *A. flavicollis* than in *A. sylvaticus*. The Koknese *flavicollis* is, however, within the range of *A. sylvaticus*. The difference in condylobasal length between the Koknese

TABLE 11. *Apodemus sylvaticus*. Condylobasal length in relation to length of head & body.

Head & body (Intervals)	Latvia			Denmark								
	Antini			Jylland			Islands except Skarø & Drejø			Skarø & Drejø		
	N.	Head & body	M. ± S.D.	N.	Head & body	M. ± S.D.	N.	Head & body	M. ± S.D.	N.	Head & body	M. ± S.D.
70— 84	6	79	21.17 ± 0.34	..	..	..	..	..	..	..	..	..
75— 89	7	82	21.50 ± 0.31	22	83	21.91 ± 0.20	12	85	21.83 ± 0.36	..	..	..
80— 94	7	84	21.64 ± 0.26	21	85	22.12 ± 0.18	18	88	22.28 ± 0.21	8	88	21.88 ± 0.19
85— 99	..	..	..	11	91	22.59 ± 0.16	19	92	22.55 ± 0.20	9	90	22.06 ± 0.18
90—104	..	..	..	7	98	22.93 ± 0.21	15	96	22.97 ± 0.20	..	..	..
95—109	..	..	..	..	..	..	9	100	23.39 ± 0.31	..	..	..

TABLE 12. *Apodemus flavicollis*. Condylobasal length in relation to length of head & body.

Head & body (Intervals)	Latvia						Denmark								
	Antini			Koknese			Jylland			Sjælland			Lolland		
	N.	Head & body	M. ± S.D.	N.	Head & body	M. ± S.D.	N.	Head & body	M. ± S.D.	N.	Head & body	M. ± S.D.	N.	Head & body	M. ± S.D.
70– 84	4	75	20.98 ± 0.81	..	..	..	..	..	..	..	..	..	..	..	..
75– 89	4	86	23.18 ± 0.63	..	..	..	..	..	..	..	..	..	..	..	..
80– 94	6	88	23.17 ± 0.47	..	..	..	..	..	..	..	..	..	..	..	..
85– 99	11	94	24.04 ± 0.36	..	..	..	5	94	24.66 ± 0.43	..	..	..	..	..	..
90–104	19	100	24.55 ± 0.18	..	..	..	9	100	25.51 ± 0.33	..	..	..	10	96	24.35 ± 0.23
95–109	38	104	25.35 ± 0.13	..	..	..	11	102	25.57 ± 0.27	12	104	25.32 ± 0.21	6	102	25.35 ± 0.51
100–114	44	108	25.76 ± 0.14	..	..	..	11	106	25.88 ± 0.18	13	108	25.78 ± 0.20	5	106	26.06 ± 0.49
105–119	43	111	26.35 ± 0.11	8	111	25.19 ± 0.28	7	109	25.83 ± 0.22	15	112	26.12 ± 0.22	6	113	26.87 ± 0.26
110–124	27	116	26.97 ± 0.13	6	116	25.68 ± 0.55	5	116	26.50 ± 0.45	..	..	..	6	118	27.25 ± 0.29
115–129	16	120	27.36 ± 0.16	..	..	..	2	120	27.20	..	..	..	..	..	..

series and other series of *A. flavicollis* is statistically significant except for the comparison Koknese-Jylland.

The diagram, Fig. 12, shows the ratio between the condylobasal length and the length of head and body in European and Near-Eastern populations of *A. sylvaticus*, *A. flavicollis*, and *A. mystacinus*, compiled from Tables 1, 2, 5, 6, and 8. Material from the British Isles is not available. The skull of *A. mystacinus* is very large (groups 3—5) as compared with other forms. *A. flavicollis* is usually found in group 3 but also occurs scattered in group 2. *A. sylvaticus* has usually a proportionately short skull (groups 1 and 2), but a few series have skulls of medium or large size. Two short series of *A. s. dichrurus* from Greece are referred to group 3, but perhaps it is not advisable to lay stress on such scattered observations. Of considerable interest is HAGEN's (1954) observation to the effect that two distinct forms of *A. sylvaticus* occur in Sicily. The form observed in southern Sicily is an ordinary *A. sylvaticus* which according to its colour may be referred without difficulty to *A. s. dichrurus* Raf. It has a group 2 skull and is further characterized by the total absence of collar and pectoral spot. The form collected in north-eastern Sicily is vividly coloured with brown back and almost white under-parts. Is has a distinct pectoral spot. The skull is extremely large, as in *A. mystacinus*, and seems to have a somewhat angular appearance like that of *A. flavicollis*. The pelage characters resemble those of *A. f. princeps* (BARR.-HAM.). The length of the hind foot is within the range of overlapping of *A. sylvaticus* and *A. flavicollis*, while the tail length and the number of tail rings is as in *A. sylvaticus*. The present author suspects that the *Apodemus* of north-eastern Sicily is, in fact, an aberrant form of *A. flavicollis* which species is otherwise not known from Sicily. However, to avoid confusion it is probably advisable to retain the dubious Sicilian form as an *A. sylvaticus* until more material becomes available.

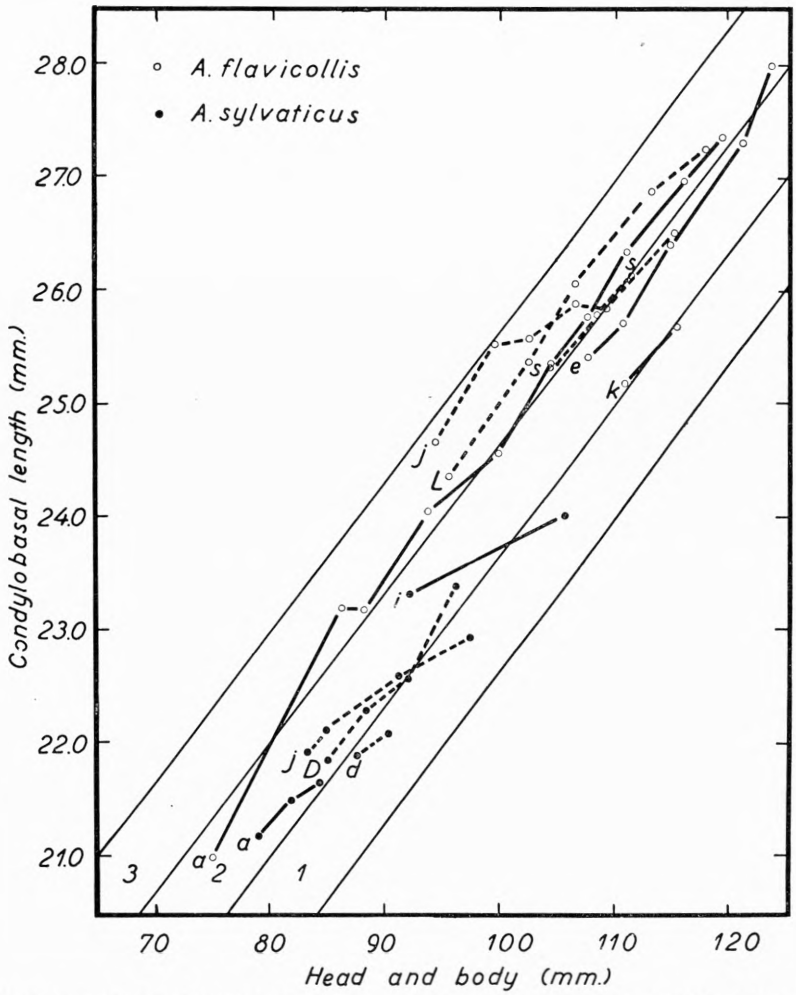

Fig. 11. Lettering as in Fig. 2 except L: Lolland, and D: Danish islands excluding Skarø and Drejø.

The Teeth.

The mean alveolar length of the maxillary tooth row in *A. sylvaticus* and *A. flavicollis* from Denmark and Latvia is shown in Tables 1—2. Specimens with worn teeth seem to have a slightly longer tooth row than younger ones. The difference has been proved statistically for the Antini *flavicollis* (Table 2) in which it was found to be significant at the 1 $^{0}/_{00}$ level. The dimensions of individual teeth probably do not change with age. However, as the teeth become worn they may change their position a little and it seems as if the roots become more protruding. The difference between

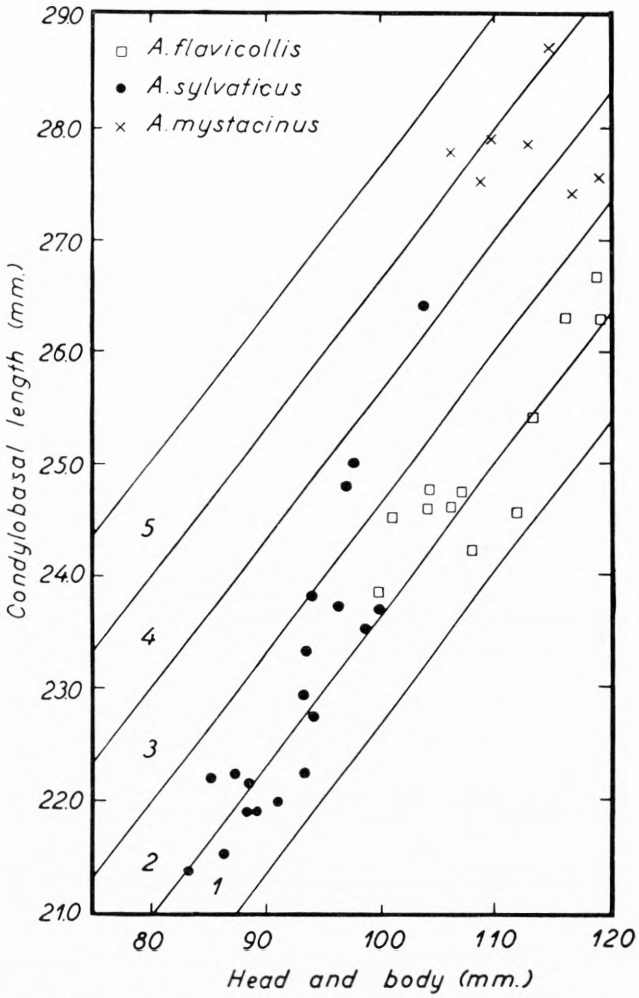

Fig. 12. European and Near-Eastern populations. Cf. text p. 27.

young and old animals is, however, not very great. In most series the increase in tooth row length amounts to about 0.1 mm.

A. sylvaticus. Two groups of localities may be distinguished in Denmark and Latvia (Table 1). One has a mean length of the tooth row of 3.50—3.56 mm. It contains the single Latvian locality from which material is available (Antini) and two small Danish islands, Skarø and Drejø, situated near eachother south of the island of Fyn. They cover 1.9 and 4.1 sq. km., respectively. Another group contains all Danish localities except Skarø and Drejø; the mean length of the tooth row ranges from 3.81—3.90 mm. The difference between the two groups of localities is highly significant for most of the possible comparisons between individual series. Differences

TABLE 13. *Apodemus sylvaticus*. Micrometer readings of the length (M. ± S. D.) of individual molars and of the tooth rows. Crown measurements. Unit: 0.0374 mm.

Locality	N.	Maxillary tooth row				Mandibular tooth row			
		m^1	m^2	m^3	m^{1-3}	m_1	m_2	m_3	m_{1-3}
Lyø.....	6	48.00 ± 1.21	31.83 ± 0.60	22.00 ± 0.52	98.50 ± 1.12	45.00 ± 1.26	31.67 ± 0.43	25.33 ± 0.34	101.17 ± 1.54
Bjørnø ..	5	49.00 ± 0.49	32.60 ± 0.26	22.20 ± 0.49	100.80 ± 0.49	47.00 ± 0.45	32.00 ± 0.45	25.60 ± 0.41	102.00 ± 0.55
Sjælland.	11	48.91 ± 0.53	30.73 ± 0.36	22.36 ± 0.45	100.82 ± 0.74	46.18 ± 0.63	31.00 ± 0.19	24.91 ± 0.28	100.27 ± 0.71
Jylland..	11	47.91 ± 0.86	31.00 ± 0.49	22.82 ± 0.54	99.82 ± 1.68	46.45 ± 0.58	31.18 ± 0.69	24.27 ± 0.52	99.82 ± 1.33
These combined	33	48.55 ± 0.42	31.30 ± 0.25	22.52 ± 0.25	100.12 ± 0.64	46.15 ± 0.28	31.24 ± 0.27	24.88 ± 0.23	100.55 ± 0.57
Skarø ...	10	46.00 ± 0.70	29.60 ± 0.62	20.60 ± 0.31	94.70 ± 1.14	43.00 ± 0.56	29.60 ± 0.62	23.50 ± 0.27	94.81 ± 1.36
Drejø ...	11	46.64 ± 0.58	29.73 ± 0.45	19.09 ± 0.56	93.73 ± 1.00	45.09 ± 0.44	29.64 ± 0.28	22.18 ± 0.44	96.00 ± 0.60
Antini (Latvia)	11	44.36 ± 0.53	30.45 ± 0.37	21.64 ± 0.43	93.64 ± 0.82	42.27 ± 0.49	29.27 ± 0.38	24.18 ± 0.38	94.82 ± 0.88

TABLE 14. *Apodemus sylvaticus*. Relative size of individual molars and of the tooth rows (micrometer readings). Cf. Table 13.

	Maxillary tooth row				Mandibular tooth row			
	m^1	m^2	m^3	m^{1-3}	m_1	m_2	m_3	m_{1-3}
Normal Danish populations.....	100	100	100	100	100	100	100	100
Skarø.....	95	95	92	95	93	95	94	94
Drejø.....	96	94	85	94	98	95	89	95
Antini.....	91	97	96	94	92	94	97	94

TABLE 15. *Apodemus sylvaticus*. P-values for comparison of the length of teeth in various localities. As "normal" Danish populations are considered the specimens from Lyø, Bjørnø, Sjælland, and Jylland. Cf. Tables 13 and 14 and text p. 31.

Teeth	19–20 degrees of freedom			41–42 degrees of freedom		
	Comp. with Skarø	Comp. with Antini		Comp. with normal Danish populations		
	Drejø	Skarø	Drejø	Antini	Skarø	Drejø
m^1.....	> 0.1	0.1	0.01	0.001	0.01	0.05
m^2.....	> 0.1	> 0.1	> 0.1	0.1	0.01	0.01
m^3.....	0.05	0.1	0.01	0.1	0.001	0.001
m^{1-3}.....	> 0.1	> 0.1	> 0.1	0.001	0.001	0.001
m_1.....	0.01	> 0.1	0.001	0.001	0.001	0.05
m_2.....	> 0.1	> 0.1	> 0.1	0.001	0.01	0.01
m_3.....	0.1	> 0.1	0.01	> 0.1	0.01	0.001
m_{1-3}.....	> 0.1	> 0.1	> 0.1	0.001	0.001	0.001

between localities belonging to the same group are not significant. The material of specimens with worn teeth is scarce, but indicates the same difference between the two groups. A closer examination shows that the mutual resemblance of series with short tooth rows (Antini, Skarø, and Drejø) is superficial only. Micrometer readings of the crown length of individual teeth and of the entire tooth row have been carried out for Antini, Drejø, Skarø, Bjørnø, Lyø, Sjælland, and Jylland. The mean values and standard deviation of the means are shown in Table 13. The four Danish localities which may be considered "normal" (Lyø, Bjørnø, Sjælland, and Jylland) have been treated separately, but the values for these localities combined have been calculated, too. In Table 14 the mean values for the short-toothed series are expressed as percentages of the mean values for "normal" Danish populations. The statistical significance of the differences is shown in Table 15, expressed as P-values. (A P-value of 0.01 corresponds to significance at the 1 % level, etc.). Usually, the P-value expresses only the probability of the existence of a real difference. When, as on the present occasion, the number of degrees of freedom is constant for a series of comparisons the P-values also give some information about the relative size of the differences. When comparing Skarø and Drejø we find only one difference which is significant at the 1 % level, namely, in m_3 which is shorter in the Drejø series. It is hardly advisable to lay stress on the doubtful difference observed in m^3 ($P = 0.05$) because when eight possible combinations are available a single difference at the 5 % level is not unlikely to occur, even if no real difference exists. The comparison Antini-Drejø shows conspicuous differences between these localities. m 1 of both jaws is significantly shorter in the Antini series while m 3 is significantly longer. The mean values for Skarø seem to indicate a reduction particularly of m^3 and m_1. A comparison with "normal" Danish populations clearly shows this tendency. In a way, the Skarø series is intermediate between those from Antini and Drejø each of which shows reduction of the same end of both tooth rows, namely, the front end in the Antini series and the hind end in the Drejø series. It is noteworthy that although not all differences between "normal" populations and such with short tooth rows are statistically significant, all the observed mean values are actually lower in the short-toothed series than in the "normal" ones (Table 14).

It is difficult to decide on the relationship between the short-toothed and the long-toothed populations. If we dare adopt the point of view that evolution within the *Murinae* generally tends towards reduction of the hind part of the tooth row (although Simpson (1945) finds it extremely difficult to trace the evolutionary trends within the group) we may consider the Antini population a primitive form while the Drejø population is a particularly advanced form. The Skarø population, however, does not fit into this scheme because its maxillary tooth row is of the "advanced" type while the mandibular tooth row is "primitive". At any rate, it does not seem warranted to believe in any close relationship between the Antini form and the two insular short-toothed forms. The latter are probably microgeographical races developed after the isolation of the islands from the continent about 7000 years ago (cf. Ursin 1949a and b, with further references). They may be even younger because

TABLE 16. *Apodemus sylvaticus*. Length (in mm.) of the maxillary tooth row in Europe, excluding Denmark and Latvia, and in Asia Minor.

Reference	Name used by quoted author	Area	N.	m^{1-3}
MILLER 1912	*A. s. sylvaticus*	Ireland	10	3.82
— —	—	Scotland	6	3.83
— —	—	England	16	3.84
— —	—	Scilly Islands	4	3.95
— —	—	Jersey	3	4.00
— —	—	Norway	11	3.75
— —	—	Holland-Belgium	9	3.87
— —	—	Northern France	12	3.83
— —	—	Germany	23	3.81
— —	—	Austria-Hungary	3	3.93
— —	—	Roumania	4	3.85
— —	—	Switzerland	20	3.98
— —	*A. s. sylv.? A. s. dichrurus?*	Turin, Italy	10	3.98
— —	*A. s. callipides*	Southern France	9	3.93
— —	—	Spain-Portugal	8	4.00
— —	*A. s. creticus*	Crete	4	3.90
— —	*A. s. dichrurus*	Southern France	9	3.98
— —	—	Genoa, Italy	7	3.83
— —	—	Sorrento, Italy	7	3.94
— —	—	Spain	21	4.07
— —	—	Balearic Islands	6	4.27
— —	—	Sicily	21	4.17
— —	—	Greece	9	3.89
— —	*A. hebridensis*	Lewis, Outer Hebrides	3	4.07
— —	*A. hirtensis*	St. Kilda	9	4.11
— —	*A. fridariensis*	Fair Isle	10	4.16
NEUHÄUSER 1936	*A. s. tauricus*	Asia Minor	10	3.85
FELTEN 1952	*A. s. sylvaticus*	Rhein/Main	144	4.0
Dr. HANZÁK (private communic.)	—	Böhmen-Böhmerwald	12	3.75
Zool. Mus. Copenhagen[1]	*A. s. grandiculus*	Iceland	21	4.02
Brit. Mus. London[2]	*A. s. mosquensis*	Volsk, Saratov, Russia	8	3.40

[1] Degerbøl's material (1939). Alveolar measurements by the present author.
[2] Measured by the author.

there is no evidence that the recent mammalian fauna of the Danish islands is as old as the islands themselves. On the contrary, *A. sylvaticus* is known to be able to invade islands without use of any landbridge, because it occurs on the island of Læsø (see Fig. 1) which according to JESSEN (1897, p. 9) has not been connected with the mainland since several thousand years ago it was submerged. The reduction of the tooth row in the two Danish insular populations is somewhat similar to that previously observed in the Lyø stock of *Microtus agrestis* in which was observed a tendency towards simplification of the second maxillary tooth. According to HINTON (1926)

and ZIMMERMANN (1952) evolution within the *Microtinae* seems continuously to work towards simplification of the molar structure so that the Lyø *M. agrestis* is probably an advanced form while the variety with complicated molar structure occurring in Scandinavia (COLLETT 1912, p. 123; URSIN 1949a) is more likely to be an ancient one, as already suggested by ZIMMERMANN (1950) who lists the Scandinavian *M. agrestis* among the "fringing forms" of the species. It is tempting to regard the relationship of the "advanced" *A. sylvaticus* from Drejø and the, as it seems, "ancient" Antini form in a similar way. This would, however, probably be premature, because the geographical variation of the length of the tooth row of the species, particularly in eastern Europe, is imperfectly known.

The available information of the geographical variation of the tooth row length in *A. sylvaticus* has been listed in Table 16 and is shown in a map, Fig. 13, too. Fairly low mean values (about 3.85 mm.) are found in Denmark, northern Germany and France, the British mainland, Ireland, and perhaps in south-eastern Europe and Asia Minor. Higher values are primarily found on the small islands off the British coast and in southern Europe. The affinities of the Czechoslovakian populations seem doubtful. HANZÁK and ROSICKÝ (1949) found very low values, but Dr. HANZÁK has informed me that the material may have included several specimens of *A. microps* KRAT. & ROS. 1952. Dr. HANZÁK most kindly forwarded 12 tooth row measurements of true *A. sylvaticus*, but even these show a low mean value (3.75 ± 0.04 mm.). *A. microps*, also measured by Dr. HANZÁK, has an extremely short tooth row (3.31 ± 0.03 mm.; N. = 10). The difference between the values for the two species is highly significant. HANZÁK and ROSICKÝ (l. c.) also found very short tooth rows in *A. flavicollis* (see below). Perhaps their method of measuring is not quite identical with that adopted by MILLER (1912) who is responsible for most of the information available. The occurrence of long-toothed forms in southern Europe roughly corresponds with the distribution of *A. s. dichrurus* RAF. and *A. s. callipides* CABR. MILLER's series of *A. s. sylvaticus* from Switzerland, however, has a long tooth row (3.98 mm.) and so has FELTEN's German material from the Rhein/Main area (4.0 mm.). The Antini series (3.52 mm.) is unique in continental western Europe. It may have affinities to *A. s. mosquensis* OGNEV which is known to the present author only from a series of skulls from Volsk, Saratov, Russia, seen in the British Museum. The latter series, however, may as well belong to the species which is known as *A. microps*. Even the Antini series may belong to *A. microps* although it has not the extremely short hind foot which seems to characterize the Slovakian *A. microps*. Still another possibility is that the Antini series represents a local form, a microgeographical race without more importance to systematics than the two Danish insular forms with short tooth rows.

A. flavicollis. The Antini series has a longer tooth row than other series from Denmark and Latvia with the exception of that from Planupe. The difference between Antini and the third Latvian locality, Koknese, is statistically significant at the 1 $^0/_{00}$ level if the whole material is compared irrespective of the age of the animals. If the few old animals with worn teeth are compared the difference is significant at the 5 $^0/_0$

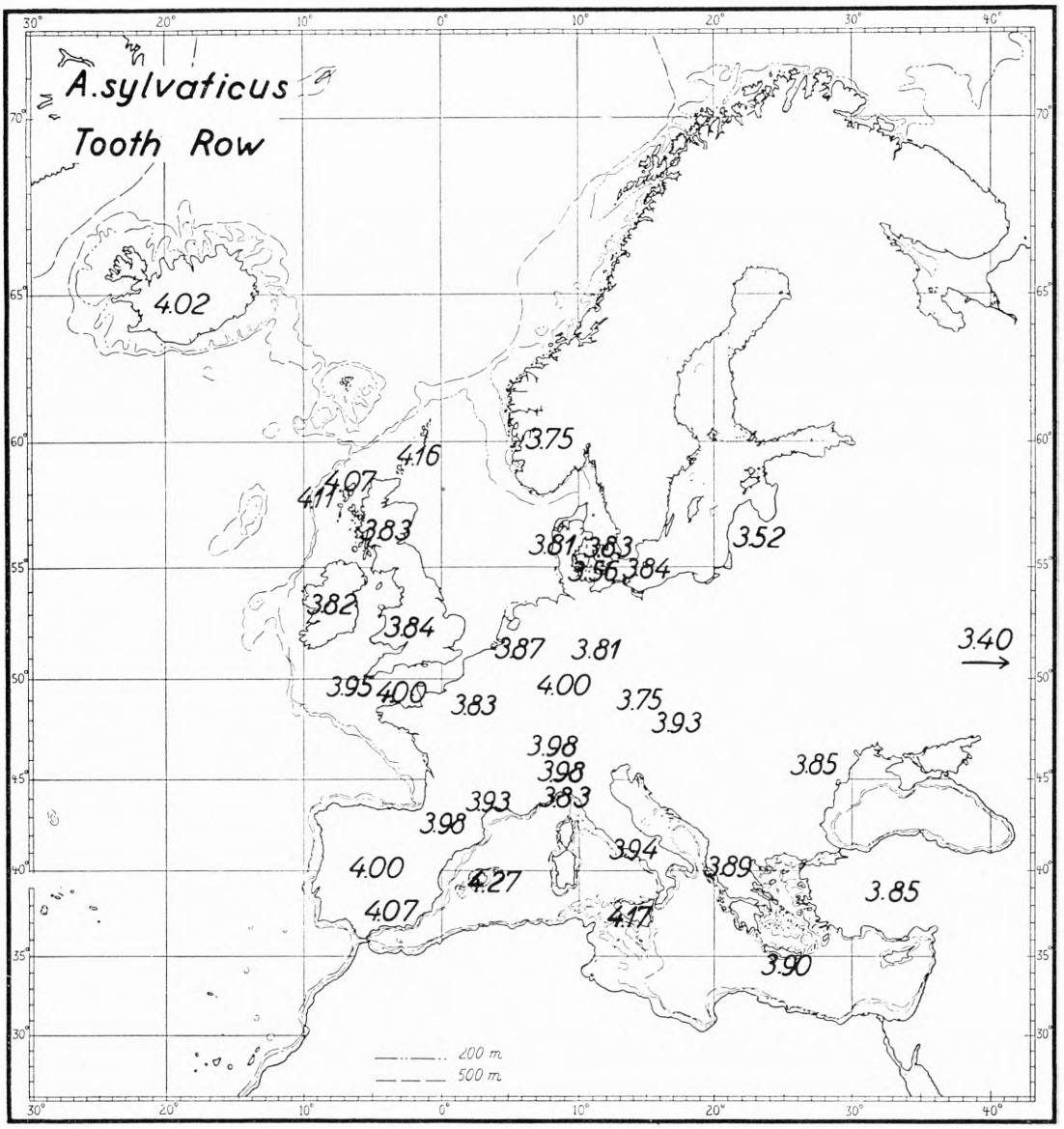

Fig. 13. Length (in mm.) of the tooth row. Cf. text p. 33.

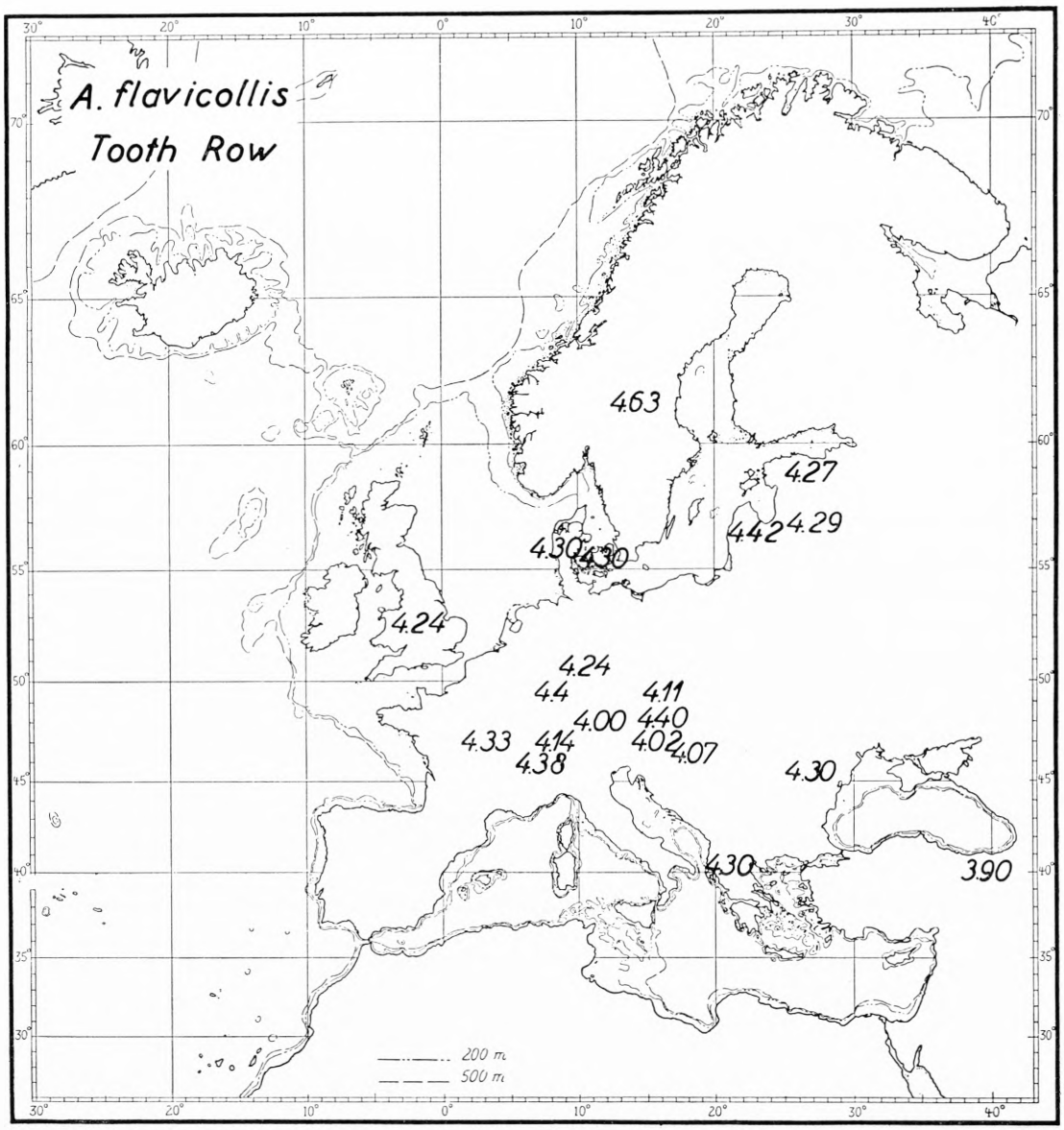
A. flavicollis
Tooth Row
4.63
4.27
4.42
4.29
4.30
4.30
4.24
4.24
4.4
4.11
4.00
4.40
4.33
4.14
4.02
4.07
4.38
4.30
4.30
3.90
200 m
500 m

Fig. 13.

TABLE 17. *Apodemus flavicollis*. Published measurements of the maxillary tooth row in Europe and Asia Minor.

Reference	Subspecies	Area	N.	m^{1-3}
MILLER 1912	*flavicollis*	Sweden	7	4.63
— —	—	Denmark	4	4.35
— —	—	France	6	4.33
— —	—	Germany	10	4.24
— —	—	Austria-Hungary	9	4.40
— —	—	Roumania	12	4.30
— —	—	Switzerland	25	4.38
— —	—	Greece	6	4.30
— —	*wintoni*	England	9	4.24
REINWALDT 1927	*flavicollis*	Estonia	16	4.27
NEUHÄUSER 1936	*saturatus*	NE Asia Minor	3	3.90
HANZÁK and ROSICKÝ 1949	*flavicollis*	Č. S. R.	16	4.11
HEINRICH 1951	*alpinus*	Allgäu	10	4.00
— —	—	Steiermark	8	4.02
— —	*flavicollis*	Bodensee	8	4.14
— —	—	Steiermark	3	4.07
FELTEN 1952	—	Rhein/Main	57	4.4

level only. The difference between Antini (all stages of tooth wear) and the Danish series is highly significant, too.

The available information about the geographical variation of the length of the tooth row of *A. flavicollis* in Europe is listed in Table 17 and shown in a map, Fig. 13. The range of the mean values is considerable although perhaps partly due to variation in the method of measuring and of the age of the animals measured. The mean values of MILLER's measurements are within the range of variation of the Latvian and Danish series with the single exception of the extremely high value for Sweden. No regular geographical variation is seen in MILLER's material. REINWALDT's series from Estonia, consisting predominantly of old animals, is like that from Koknese and, therefore, distinct from the Antini series. Several figures referring to central Europe (HANZÁK and ROSICKÝ, HEINRICH) are low. HANZÁK and ROSICKÝ, however, also give very low values for *A. sylvaticus* (see above) so that another method of measuring than that adopted by MILLER may be suspected. According to NEUHÄUSER (1936) the tooth row of *A. f. saturatus* from Asia Minor is extremely short. The long tail and the occasional existence of a complete collar seem to be the only *flavicollis* characters left in this form which is supposed (NEUHÄUSER) to be closely related to the Caucasian *A. f. fulvipectus* OGNEV.

Like other parts of the body the length of the tooth row of *A. flavicollis* seems to be subject to considerable local variation although no regular geographical variation can be traced at present.

Pelage Characters.

A. sylvaticus. Several authors have paid attention to the occurrence of the buff or orange pectoral spot which has been observed to vary geographically. According to LÖHRL (1938, p. 128) and HEINRICH (1951, p. 105) it occurs in southern Germany in about 90 % of the specimens, but is usually absent in north-eastern Germany. HEROLD (1951, p. 238) found it to be rare in Rhön, central Germany. ZIMMERMANN (1936, p. 127) who collected most of his material in Brandenburg, found that in most specimens the spot was absent or only slightly indicated. In Latvia (Antini) the spot is just traceable in a few of the 12 specimens available, completely absent in the others. The 88 Danish skins may be divided into three groups. The majority (49 specimens) have a large pectoral spot which is sometimes prolonged caudally to the belly. In 18 skins the spot proper is absent, but a buff midventral line is developed behind the front legs. The same pattern was observed in 2 among 35 German skins in the British Museum. The remaining 21 Danish skins are like the Latvian ones: the spot is absent or only traceable. The difference between Latvian and Danish series is obvious even when skins from the same season are compared. 57 English skins (Brit. Mus.) had the spot well developed while it was absent or only traceable in 2 skins. A series of 12 skins from Switzerland contained 11 specimens with a large spot and 1 without spot.

The above evidence seems to show that in north-eastern Europe and in central Germany a form occurs which is characterized by the absence of the pectoral spot in most specimens. North-west of this region (Denmark, Gr. Britain) and south of it, too, (southern Germany, Switzerland) the spot or a midventral line is usually developed. Matters are, however, even more complicated: The smaller of the two *Apodemus* forms occurring in Sicily (the true *A. s. dichrurus*) has no pectoral spot while the larger one (which is perhaps an *A. flavicollis*?) has a large spot (HAGEN 1954, p. 8). The *A. s. dichrurus* of Crete in this respect is like the smaller of the Sicilian forms. The geographical variation of the pectoral spot seems to follow other lines than the variation of several other characters described above.

The present investigation has not added much to the knowledge of the variation of other pelage characters. The under-parts seem to be slightly more whitish in Latvia than in Germany, Switzerland, the British mainland, and Denmark. The general pallor of the back and sides of the Mediterranean populations (*A. s. dichrurus*) has been described by several authors, particularly by MILLER (1912). The colour of the differentiated forms restricted to small islands off the British coast has been described by a. o. BARRETT-HAMILTON and HINTON (1911—21).

Apodemus flavicollis. The geographical variation of the ventral breast-band or collar has been studied particularly by BARRETT-HAMILTON (1900) who found that the populations of north-western Europe including England usually have a broad collar, while those living in south-eastern Europe often have a pectoral spot only.

TABLE 18. *Apodemus flavicollis*. Shape of the collar in Denmark and Latvia.
Groups: 1. Pectoral spot only.
2. Pectoral spot faintly connected with the sides of the body.
3.–6. Broad collar: 3. Pectoral spot extending about 5 mm. behind the collar.
4. Pectoral spot extending about 8 mm. behind the collar.
5. Pectoral spot extending 10—15 mm. behind the collar.
6. Pectoral spot extending to belly (cf. Table 19).

			Group					Total
			1.	2.	3.	4.	5.	
Latvia	Locality	Antini	13	27	29	28	7	104
		Planupe	1	1	2	3	..	7
		Koknese	3	5	6	1	..	15
		Various localities	1	..	2	..	..	3
		Total	18	33	39	32	7	129
	Season	July-September	11	22	26	23	5	87
		October-December	7	11	13	9	2	42
	Head & body	No. measured	18	33	39	32	7	129
		Mean length	112.8	110.1	107.6	108.9	110.4	109.4
		Standard dev. of mean	1.8	1.6	1.4	1.3	3.8	0.7
Denmark	Locality	Sjælland	..	..	52	17	2	71
		Jylland	..	1	7	4	..	12
		Lolland	..	..	3	5	10	18
		Various islands	..	1	6	2	1	10
		Total excl. Lolland	..	2	65	23	3	93
	Season (Lolland omitted)	January-June	..	..	16	6	1	23
		July-December	..	2	49	17	2	70
	Season (Lolland)	January-June	..	..	2	3	6	11
		July-December	..	..	1	2	4	7
	Head & body (Lolland omitted)	No. measured	..	1	43	20	2	66
		Mean length	..	107.5	107.5	109.5	110.0	108.2
		Standard dev. of mean	..	..	1.2	1.6	..	0.9
	Head & body (Lolland)	No. measured	..	..	3	5	7	15
		Mean length	..	..	99.2	109.5	106.1	105.8
		Standard dev. of mean	..	..	4.5	5.4	2.8	2.4

He created the subspecific names *wintoni* and *princeps* for these forms. Owing to a misunderstanding of MELCHIOR's Danish text (1834) he did not realize that two forms of *Apodemus* occur in Sjælland which is considered the type locality for *A. flavicollis*. He considered the latter a synonym of "*Mus sylvaticus typicus*" because he had seen specimens of this form from Sjælland. MILLER (1912) restricted the name *A. f. wintoni* to cover the English population and used *A. f. flavicollis* for all other western European populations.

TABLE 19. *Apodemus flavicollis.* Shape of the collar in Europe. Material belonging to the British Museum, London, and to the Zoological Museums of the Universities of Berlin and Copenhagen. Grouping as in Table 18 (which see).

Area	Group						Total
	1.	2.	3.	4.	5.	6.	
Norway	..	..	..	2	3	1	6[1]
England	..	..	..	9	22	..	31
Lolland (Denmark)	..	..	3	5	10	..	18
Estonia-Leningrad	..	..	2	3	..	1	6
Denmark (excl. Lolland)	..	2	65	23	3	..	93
Latvia	18	33	39	32	7	..	129
Central Europe	12	7	12	3	2	..	36
South-eastern Europe	38	19	16	4	2	..	79

[1] Collar proper very broad, about 12 mm. as against usually about 7 mm. in groups 3–5. Four juveniles from the same locality, not included in the table, had very broad collars, too.

Table 18 shows the variation of the shape of the collar in Danish and Latvian populations. The shape does not seem to be influenced by the season of the year or the size (age) of the animals. All Danish skins have a complete collar although in a few specimens it is only slightly traceable. In Latvia, about 15 % of the specimens have a pectoral spot only, and the collar proper is just traceable in further 25 %. In the series from the Danish island of Lolland the collar (or rather: the pectoral spot of the collar) usually extends further caudally than in other Danish series.

The geographical variation of the shape of the collar in Europe is shown in Table 19, based on material investigated by the author. Extreme development of the collar is seen in a small series from Lillehammer, Norway. The collar is very broad in this series, measuring about 12 mm. from the cranial to the caudal border as against about 7 mm. in broad-collared specimens from other localities. The Norwegian skins also show a considerable caudal prolongation of the median part of the collar (the pectoral spot). Such prolongation also occurs in English skins, and partly in those from Lolland, too. In other series from Denmark and in that from the Estonia-Leningrad area a complete and usually broad collar is developed but with a single exception the pectoral spot is not much prolonged caudally. All the above mentioned skins are of the "*wintoni*" type, as BARRETT-HAMILTON (1900) has it. The series from Latvia, from localities scattered over central Europe, and from south-eastern Europe are characterized by a high proportion of skins without complete collar and usually without much caudal prolongation of the pectoral spot. They are of BARRETT-HAMILTON's "*princeps*" type.

BARRETT-HAMILTON and HINTON (1911—21) called attention to the resemblance of the Norwegian *A. flavicollis,* as described by COLLETT (1912) with the English *A. f. wintoni.* REINWALDT (1927, p. 30) further pointed out that the Estonian stock rather more resembled the English and probably also the Norwegian form than the

continental *A. f. flavicollis* as this was described by MILLER (1912, p. 289): "chest spot frequently not forming complete collar". REINWALDT's description seems to show that the Estonian *A. flavicollis* is intermediate between the Latvian and the Danish ones. In Estonia a caudal prolongation of the pectoral spot was not rare but, on the other hand, a few specimens were seen in which a complete collar was not formed. HILZHEIMER's (1911) description of *A. flavicollis* from Finland points even more in the "*wintoni*" direction. HEROLD (1932) found that 16 specimens from the island of Usedom on the South-Baltic coast all had broad collars with the pectoral spot faintly developed. Much like these are 39 specimens from Rhön in central Germany which were described by HEROLD (1951). Rhön seems to be the southernmost locality from which has been described a series with complete collars throughout. FELTEN (1952) in a series of 59 specimens from the Rhein-Main area found only 33 specimens with complete collar. HEINRICH (1951) says that in northern Germany the complete collar is an almost constant character while near Bodensee and in Steiermark several specimens were obtained which had the pectoral spot only. Of particular interest is his long-tailed *A. f. alpinus* which shows an extreme development of the "*princeps*" condition. In this form a complete collar is perhaps never developed. The "large *A. s. dichrurus*" from Sicily (HAGEN 1954) which as already mentioned is perhaps an *A. flavicollis* has a well-developed pectoral spot but no collar. *A. f. saturatus* from Asia Minor "often" has a complete collar (NEUHÄUSER 1936) and, therefore, seems to be of the "*princeps*" type.

All things considered, there is not much doubt that the *A. flavicollis* of north-western Europe is characterized particularly by an extreme development of the collar. Fig. 14 gives a provisional survey of the geographical variation of the chest pattern in western Europe.

There seems to be some correlation between the shape of the collar and the colour of the under-parts, although the geographical variation of the colour in short series is somewhat obscured by seasonal changes. The English form is extremely dark. 14 of the 28 skins seen in the British Museum are darker than the darkest Danish skin. The short series from Norway and from the Estonia-Leningrad area are also darker, on an average, than Danish specimens. Skins from central and south-eastern Europe were not found to be different from Danish skins but perhaps the material was too small. A comparison of Danish and Latvian skins collected from July to December shows that in Latvian specimens the under-parts are more bright white than in Denmark. The series from Lolland does not differ in this respect from other Danish series. HEINRICH's *A. f. alpinus* (1951) is said to have more greyish underparts than *A. f. flavicollis* from the Alpine region. In the colour of the under-parts the former is obviously distinct from other populations with the reduced "*princeps*" collar type.

The back and sides are more reddish in Denmark than in Latvia. It has not been possible to trace the further geographical variation of this character, probably owing to a considerable seasonal variation. English skins, however, seem to be even more reddish than Danish ones.

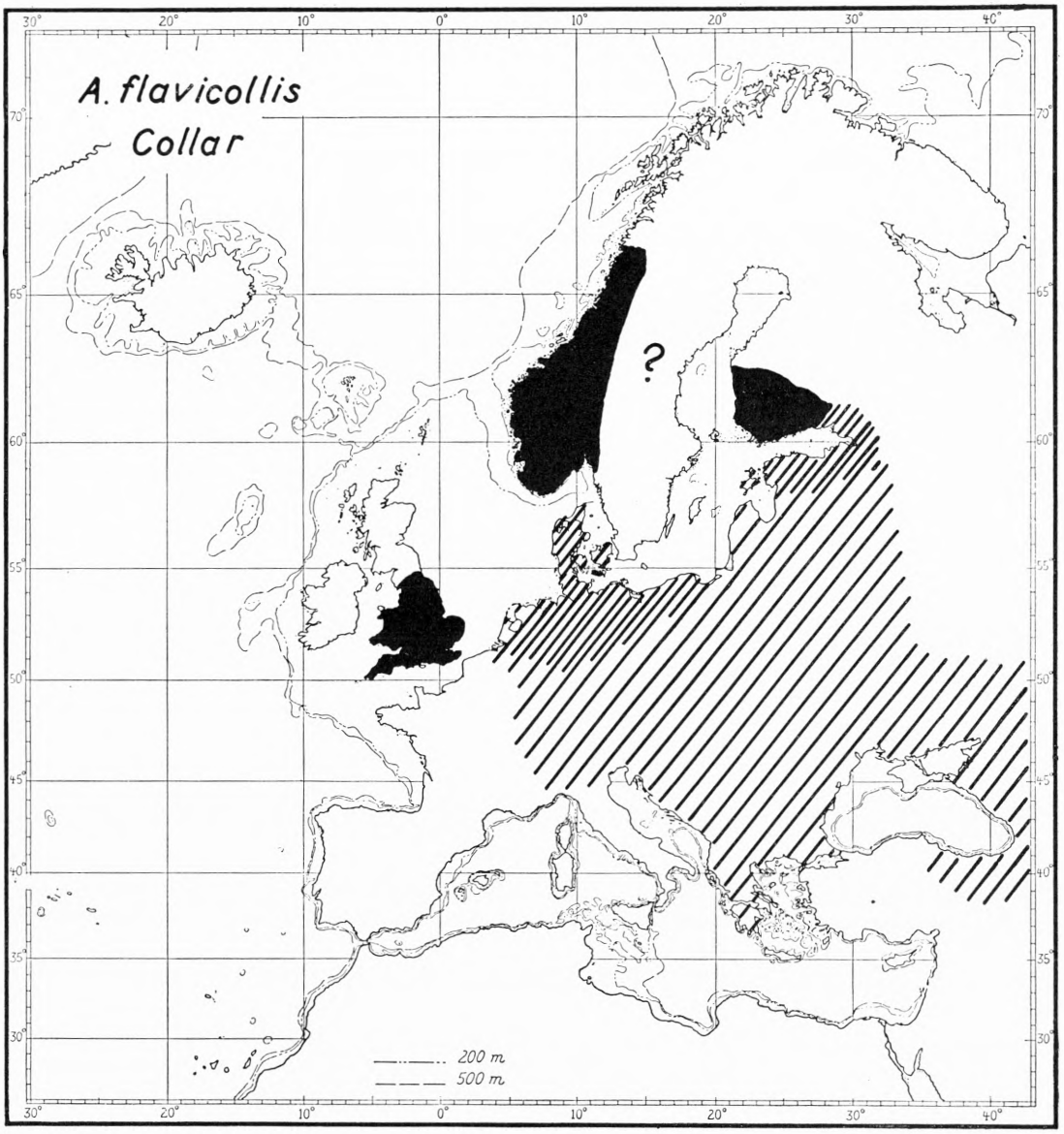

Fig. 14. Provisional survey of the geographical variation in western Europe of the development of the collar and the pectoral spot in *A. flavicollis*. The map is not supposed to be correct in detail. Cf. text p. 39.
Black: Collar broad with long pectoral spot (*"wintoni"* condition).
Dense hatching: Collar complete, usually with short pectoral spot (intermediate form).
Open hatching: Complete collar frequently not formed. Pectoral spot usually short (*"princeps"* condition).

General Remarks.

A. sylvaticus. Populations with a short tooth row, with a low number of tail rings, and with proportionately short tail and hind foot are found in the north-eastern part of western Europe (Denmark and Latvia). The size or relative size of these parts of the body, and the number of tail rings, seem to increase towards the west and the south, the maximum for most characters being reached on some of the small islands off the British coast and in the Mediterranean part of western Europe. The geographical variation of the length of head and body was not considered during the present investigation, but information in the literature (notably MILLER 1912) seems to show that the body size also increases from the north-east towards the west and the south. The large size of several British insular forms recalls the observations by DEGERBØL (1933, 1940) who found large-sized forms of the house mouse (*Mus musculus*) on the Faroe islands and of the badger (*Meles meles*) on a Danish island (Sjælland). Populations with extraordinarily short tooth rows occur in Latvia and on two small Danish islands. These populations do not seem to be closely related because the proportionate length of individual teeth varies considerably from one of these populations to another. The two Danish insular forms are probably microgeographical races developed on the islands where they occur, perhaps as an effect of isolation (a so-called "SEWALL-WRIGHT effect"). The relationship and systematic value of the Latvian short-toothed form is obscure at present. Affinities to *A. s. mosquensis* OGNEV may be suggested but the problem probably cannot be solved until the distribution, variation and systematic value of *A. microps* KRAT. et ROS. become known. *A. microps* is in Slovakia an extremely short-footed and short-toothed form which does not appear to be geographically isolated from populations of *A. sylvaticus.*

A. sylvaticus is widely distributed in the Danish archipelago, but nevertheless no distinguishable insular forms have been traced as yet, except in the two cases of a slight peculiarity in dental characters. In this respect the contrast with British populations is striking. On the small islands north, west, and south of the British mainland a multitude of distinguishable isolated forms occur, many of which have been given subspecific or even specific names of their own. The differences between individual populations may be considered the result of a highly effective isolation of long duration. At present only little is known about the maximum age of these populations. There is, however, not much doubt that it considerably exceeds the 5,000—10,000 years which have probably passed after the Danish archipelago became isolated from the continent. More difficult to understand than the difference between the isolated British populations is their mutual similarity. Most of them seem to have evolved towards the *flavicollis* characters (large animals with proportionately long tail and hind foot), especially on the more remote islands as the Shetlands and Fair Isle. RICHARDS (1935) called attention to the fact that such similarity between British insular forms is probably not to be explained as an effect of climate, because the climate of the islands

north and west of the British mainland is different from that of the Channel Islands. Several authors, as for instance STEJNEGER (1908) and BARRETT-HAMILTON and HINTON (1911—21, p. 436) consider the mammals of these small islands survivors of a previous mammalian fauna which inhabited the British mainland and continental Europe. RICHARDS (1935) termed such remainders "fringing forms". ZIMMERMANN (1950) studied the occurrence of "fringing forms" within European voles (*Microtinae*) and found several interesting examples. If the British insular populations of *A. sylvaticus* are taken to represent a fringing form the populations of southern Europe should perhaps be included in this, too. Except in colour there seems, as mentioned above, to be a certain similarity between the British and the south European *A. sylvaticus,* both of which show several *flavicollis* characters as for instance large size, long feet, and long tooth-rows. The fringing form may be considered an old inhabitant of western Europe that became so mixed up with an eastern relative that most of western or at least central Europe is now inhabited by intermediate forms. The Danish populations may or may not represent the pure eastern form. An investigation of the Scandinavian populations would perhaps throw more light on this problem. It must, however, be remembered that the validity of the theory of "fringing forms" is questioned by DEGERBØL (1940) who found that what might be termed "fringing form characters" occur in the Faroe house mouse which in all probability was introduced by man within historical times.

An alternative explanation of the geographical variation of *A. sylvaticus* in western Europe may be based on the cline concept. The gradual change of the characters of the northern form occurring in Denmark into those of the western (British) and southern (central European and Mediterranean) forms much resembles the features of a cline. However, it seems difficult to explain a cline formation of this type because the climatic change from Denmark towards the west is not the same as the change towards the south. DEGERBØL (1939, p. 41) and HEINRICH (1951) have called attention to the resemblance of the geographical variation in Denmark and Germany of *A. sylvaticus* and *Microtus arvalis.* The frequency of the "simplex" tooth character of the latter species is particularly high in Denmark and decreases rapidly towards the south (ZIMMERMANN 1935, 1952). It is at present difficult to see whether there is a causal connection or only a superficial resemblance between the geographical variation of the two species.

Besides the above two attempts towards an explanation of the geographical variation in *A. sylvaticus* still another seems close at hand. It has special bearing upon the development of the British insular forms. The mutual similarity of these may result from an orthogenetical trend in evolution. The term "orthogenetical" is here used in the wide sense of the word (as by ZIMMERMANN 1952, p. 493), not postulating the existence of any inner urge for directed evolution. Just as in many families of rodents the evolution seems to work towards development of rootless molars (see ELLERMAN 1940—41, or any other monographic work on rodents), there may occur within isolated populations of *A. sylvaticus* an evolutionary trend towards develop-

ment of certain, partly *flavicollis*-like, characters which may prove to be the fittest. If, further, microgeographical races play an important rôle in evolution as suggested by e. g. DOBZHANSKY (1941, p. 175) it does not seem excluded that particularly advanced forms simultaneously have evolved by selection on a number of small islands provided, that the size of the populations (i. e. the size of the islands) is suitable for a highly effective selection to work.

It would probably be premature to revise the nomenclature of the *A. sylvaticus* of western Europe, particularly because the Swedish form which must retain the name *A. s. sylvaticus* (L.) is not known in details. It still seems convenient to use the name *A. s. dichrurus* RAF. for the pallid Mediterranean form. A nomenclatorial separation of the form occurring in Denmark and northern Germany from the vividly coloured populations of central and parts of southern Europe will probably prove to be inconvenient owing to the gradual change of most characters (other than colour?) into those of *A. s. dichrurus*. Therefore, the name *A. s. callipides* CABRERA which seems to have been applied to transitional forms should probably be abandoned.

A. flavicollis. The size and proportions of this species do not seem to be subject to regular geographical variation in western Europa. Local variation is, however, considerable. The only character which has been found to vary geographically throughout the area is the colour pattern of the neck and chest (see Fig. 14). In northern Europe a complete collar is formed in practically all specimens. It is usually much prolonged caudally as a mid-ventral pectoral spot. In central and south-eastern Europe the collar is considerably reduced and often represented by a short pectoral spot only. Intermediate forms with complete although not very broad collar and usually with a short pectoral spot occur in Denmark and in the Estonia-Leningrad area. This geographical variation was observed, although not in detail, by BARRETT-HAMILTON (1900) who applied the subspecific names *wintoni* and *princeps* for the north-western and south-eastern forms, respectively. This terminology is convenient but, unfortunately, it is necessary to retain the name *A. f. flavicollis* (MELCHIOR) for the population occurring on the island of Sjælland which is considered the type locality. This population is intermediate in character. Perhaps it will prove advantageous to use the name *A. f. flavicollis* for the intermediate populations and for those of the *princeps* type so that *A. f. princeps* (BARR.-HAM.) becomes synonymous with *A. f. flavicollis*. The name *A. f. wintoni* (BARR.-HAM.) then covers the English, Norwegian, and Finnish populations. If the two latter turn out to possess peculiarities of their own, making them worthy of subspecific recognition (and they are not unlikely to do so) they should perhaps, with the English "true" *wintoni*, form a "*wintoni*-group" as opposed to a "*flavicollis*-group". The population of the island of Lolland (Denmark), although slightly more *wintoni*-like than other Danish populations, is still intermediate and should be referred to *A. f. flavicollis*. The Alpine longtailed form *A. f. alpinus* HEINRICH, seems to be worthy of subspecific recognition although its distribution and relationship with other central European populations is not yet known in detail.

At present it seems difficult to decide on the origin of the differentiation of the western European *A. flavicollis* into two groups according to chest colour patterns. The restriction of *A. f. wintoni* to the northern or north-western range of the species perhaps indicates an adaptation to the climatic conditions in northern Europe although the climatic similarity of Finland and England is, indeed, not very conspicuous. It is also possible that *A. f. wintoni* is to be considered a "fringing form" which previously had a wider distribution in Europe.

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A COMPARATIVE STUDY OF THE GENITAL SEGMENTS AND THEIR APPENDAGES IN MALE TRICHOPTERA

BY

ANKER NIELSEN

København 1957
i kommission hos Ejnar Munksgaard

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Introduction.

Though in Trichoptera the genital segments and their appendages of the ♂♂ play a major role in taxonomy, their morphology has been little known. It is true that there exists a very great number of descriptions which in an excellent way serve their purpose: to provide reliable criteria for distinguishing the various species. From the point of view of comparative morphology, however, they are of little value. They are almost exclusively concerned with structures which can be seen without dissection, and oftener even with structures only which are seen projecting from the posterior end of pinned specimens. The musculature, so important for the understanding of the homologies of the structures in question, has been entirely neglected. In most cases, probably, the descriptions therefore give no clue for estimating the real morphological value of the structures, neither as compared with other insects, nor as compared with other members of the order. SCHMID's valuable and extensive studies of the Limnophilidae (1953, 1954, 1955) to some extent suffer from the same defects. The only attempt giving a comparative morphology of the genitalia of the whole order, so far made, is ZANDER's work (1901). He gives very interesting information about the development of the gonopods and the phallus during metamorphosis. The morphological part of the work, however, is very summary, and his main conclusion, that the order as to the structure of the genitalia falls into two distinct groups, one comprising the Limnophilidae, and another comprising all the remaining families, is far from the truth.

The aim of the present paper is to make good these deficiencies, and also to provide material to elucidate the phylogeny of the order. It is hoped that the work may be followed up with a parallel study of the ♀♀. The following species were examined:

Annulipalpia

Rhyacophilidae	Rhyacophilinae	*Rhyacophila nubila* Zett.
	Glossosomatinae	*Agapetus fuscipes* Curt.
Psychomyidae		*Lype phaeopa* Steph.
		Tinodes waeneri L.
		Psychomyia pusilla Fabr.
Philopotamidae		*Wormaldia occipitalis* Pict.

Polycentropidae	Polycentropinae	*Polycentropus flavomaculatus* Pict.
		Holocentropus dubius Steph.
	Ecnominae	*Ecnomus tenellus Ramb.*
Hydropsychidæ	Hydropsychinae	*Hydropsyche angustipennis* Curt.
Hydroptilidæ	Orthotrichiinae	*Orthotrichia tetensii* Kolbe
	Hydroptilinae	*Agraylea multipunctata* Curt.
		Hydroptila occulta Eat.

Integripalpia

Beraeidae	Sericostomatinae	*Sericostoma pedemontanum* MacL.
	Beraeinae	*Beraea maurus* Curt.
Leptoceridae		*Leptocerus cinereus* Curt.
Molannidae		*Molanna angustata* Curt.
Odontoceridae		*Odontocerum albicorne* Scop.
Lepidostomatinae		*Lasiocephala basalis* Kol.
Brachycentridae		*Oligoplectrum maculatum* Fourcr.
Phryganeidae		*Agrypnia pagetana* Curt.
Limnophilidae	Limnophilinae	*Limnophilus flavicornis* Fabr.
		Stenophylax stellatus Curt.
	Ecclisopteryginae	*Ecclisopteryx guttulata* Pict.
	Apataniinae	*Apatania arctica* Boh.
	Goërinae	*Silo nigricornis* Pict.

These 26 species cover all subfamilies represented in the North European fauna. (Owing to lack of suitable material *Caborius dubius* Steph. was not examined. SCHMID —1955—has transferred this species to the genus *Ironoquia* Bks., which he includes in the subfamily Discomoecinae set up by him. It may be right to transfer *dubius* to this genus, but to me the justification for removing the species from the Limnophilinae seems doubtful). As to those systematic groups which are not represented in Denmark, I have tried to utilize the available descriptions. For reasons mentioned above, this has been possible only to a very limited extent.

The study has been carried out exclusively on material preserved in alcohol. The work was done at the Zoological Museum, Copenhagen. For grants received from the Carlsberg Foundation I wish to express my sincere thanks.

Some remarks on the taxonomy employed in the list above. Like ULMER (1951, pp. 39—40), and for the same reasons I include *Agapetus* Curt. in the Glossosomatinae. The subfamily Ecnominae are oftener included in the Psychomyidae. The immature instars, however, clearly show that *Ecnomus* is a polycentropid, and the genital segments of the ♂, also, are more like those of the Polycentropinae than those of the Psychomyidae. In a previous paper (1943b) I have given evidence, based upon the ontogenetic development, that the Beraeinae and the Sericostomatinae are so closely

related that they ought to be joined in one family. For this I proposed the name Beraeidae in order to avoid confusion with the old, quite unnatural "family" Sericostomatidae. (Cp. p. 94). In the same paper I set up the subfamily Ecclisopteryginae. Later SCHMID (1955) has renamed this subfamily Drusinae. The latter, no doubt, is a more handy name, but according to the rules of priority Ecclisopteryginae must be valid. *Apatania arctica:* SCHMID (1953, pp. 145—46) has shown that the division into the genera *Apatania, Apatidea,* etc., cannot be upheld. Hence, he provisionally considers the species in question as constituting one genus, *Apatania* Kol., though this is very heterogeneous. This point of view is accepted here. Previously (1943b), on the basis of the morphology and biology of the immature instars, I have given evidence that the subfamily Goërinae belongs to the Limnophilidae. The structure of the genital segments of the ♂ (and the ♀) supports this view. (Cp. p. 143).

The posterior abdominal segments successively taper much. Segment VIII is the last typical abdominal segment with separate tergum and sternum. Its posterior border to a greater or less degree overlaps Segment IX, sometimes so much that the latter is partly or entirely concealed. Also in some other respects Segment VIII may be slightly modified, and on some of the preceding segments, too, modifications may be found in the shape of various processes—structures which will not be treated in the present paper.

Segment IX is typically synscleritous, i. e. its sclerotization forms a complete annulus of varying length. Generally the lengths of the dorsal and the ventral side are more or less reduced by indentations from the oral or the anal end, or from both ends. Especially the dorsal side is often so much reduced that it forms only a sclerotic transverse bridge. In rare cases the ventral side is longer than the lateral side. In the Psychomyidæ and the Polycentropinae Segment IX, probably secondarily, is dissclerites, and the reduced dorsal part is so intimately associated with Segment X that Segment IX, to a superficial view, might seem to lack the dorsal side. In *Wormaldia* and *Ecnomus* the much reduced dorsal part of Segment IX has the same association with Segment X, but is still continuous with the lateral part of the segment through a narrow sclerotic bridge. Similar conditions are probably found in *Hydropsyche.*

In many cases a good deal of the oral part of Segment IX has an apodemal character. The apodemal part possibly must be considered a strongly developed antecosta, though also in such cases a marginal thickening of the apodeme may be seen. In rare cases the antecosta is interrupted dorsally or ventrally, or on both these sides. Still rarer is the condition that the ventral side of the segment is partly membranous.

Segment IX is often the site of secondary sutures, most frequently laterodorsal or lateroventral longitudinal sutures. The former are found in the Hydroptilidae (pp. 68, 77, 82), *Sericostoma* (p. 85), *Odontocerum* (p. 101), *Agrypnia* (p. 114), the Limnophilinae (pp. 119, 124) and *Apatania* (p. 133). In *Sericostoma* the laterodorsal suture perhaps is homologous with that of the Hydroptilidae; in both cases the IX/X

muscle (see below) originates dorsally to the suture. In the other Integripalpia mentioned, this muscle, however, originates ventrally to the suture, so the latter is scarcely homologous with that of the Hydroptilidae. On the other hand, it is very likely that there is a mutual homology between these Integripalpia. A lateroventral longitudinal suture occurs in *Agapetus* (p. 20), *Hydropsyche* (p. 65), *Orthotrichia* (p. 68), *Agraylea* (p. 77), *Lasiocephala* (p. 106) and *Silo* (p. 137). It may very well be homologous in all these forms.

The posterior end of Segment IX forms a more or less deep, chiefly membranous depression, the *genital chamber*. From this the following structures arise: dorsally Segment X, ventrally the inferior appendages, and between Segment X and the inferior appendages the copulatory organ, the phallus.

Segment X is so varying in shape that it is difficult to give a general account. It is always much lower, and nearly always much narrower than Segment IX. In most cases the ventral side is more or less concave and partly encloses the phallus. Sometimes the concavity is so pronounced that the segment forms a functional tube. In the literature Segment X is known under the names 'dorsal plate', 'penis-cover', 'upper penis-cover', and 'Rückenschuppe'. The 'intermediate appendages' are processes on Segment X. They are not homologous in all cases.

Segment X may be membranous to a great extent, but the overwhelming rule is that the greater part of the dorsal and lateral sides is sclerotized. In almost all cases the sclerite (or the sclerites) of Segment X is (are) continuous with that of Segment IX. The connection is generally with the lateral side of Segment X through sclerotizations at the bottom of the genital chamber. Sometimes the dorsal sides of the two segments, also, are continuous, and in such cases it may be difficult to draw the boundary between them. The length of Segment X varies much. In extreme cases (Ecclisopteryginae and especially Limnophilinae) it is so much reduced that the sclerites of the segment appears as situated in the bottom of the genital chamber.

Despite the sclerotic connection between the two segments, the dorsal intersegmental musculature is well developed (except in *Hydropsyche*). There is only one muscle (the IX/X muscle; figs. 1 and 2, *6*), which originates laterodorsally on the antecosta of Segment IX. Sometimes the origin spreads over the whole lateral part of the antecosta, or it may shift to a lateroventral position. More rarely (*Agraylea*, *Hydroptila*) it spreads in a dorso-median direction, which may result in the muscle becoming unpaired. In some few cases the origin extends into the surface of Segment IX, and in *Agapetus* it stretches over almost the entire length of this segment. Generally the muscle is inserted to Segment X in such a way as to act as a depressor. The sclerotic parts connecting the two segments by their elasticity constitute an antagonist. In specialized cases the muscle may have other functions. In the Psychomyidae, *Wormaldia*, and the Polycentropinae the intersegmental dorsal musculature between Segments VIII and IX is incorporated in the genital complex.

Segment X carries a pair of movable *superior appendages* (''appendices præanales''). Typically they are large and may even exceed the segment itself in length.

In many cases, however, they are very small, and in about half of the forms they are entirely lacking. (In such cases the term superior appendages sometimes has been applied to other parts of Segment X). The reduction of the appendages, no doubt, has taken place independently in various systematic groups. Sometimes the superior appendages are sclerotically continuous with Segment X itself. They never have any musculature of their own, but in the Polycentropidae the IX/X muscle is attached to the superior appendage.

In *Rhyacophila* (figs. 3 and 4, pp. 16 and 17) the posterior edge of Segment IX is protracted into an unpaired *dorsal process* (*2*), and orally on the dorsal side of Segment X another dorsal process (*3*) arises. The two processes are united, though by membrane only. In *Lype* a dorsal process (fig. 9, *9*, p. 25; 10, *5*, p. 27) is found, which probably is homologous with the dorsal process on Segment X in *Rhyacophila*, and in *Wormaldia* and perhaps *Hydropsyche* such a process is indicated. In some Integripalpia (*Leptocerus*, p. 94; *Oligoplectrum*, p. 111; *Silo*, p. 137) there is a well developed, paired or unpaired dorsal process, which very likely has arisen by fusion of processes on Segments IX and X. In many other Integripalpia (*Molanna?*, p. 99; *Odontocerum*, p. 102; *Lasiocephala*, p. 106; *Agrypnia*, p. 114; *Apatania*, p. 133) a dorsal process is found in a more or less rudimentary state.

More rarely (*Sericostoma*, p. 85) the posterior edge of Segment IX is protracted into an unpaired ventral process, which may be bifurcated (*Mystacides azurea* L.). Generally the lateral side of Segment IX is longer than the dorsal and ventral sides, the posterior edge thus making a lateral bulging. As to the *lateral process* ("intermediate process", "side piece") of the Hydroptilidæ see pp. 68, 77 and 82.

What on the preceding and following pages is called Segment X is a composite structure. Since Venter IX, in all probability, has been obliterated as an external structure by the formation of the ejaculatory duct (Anker Nielsen 1957), the ventral side of this structure in reality belongs to Segment XI. A distinct *Segment XI* comprising epiproct and paraprocts is, however, developed in *Rhyacophila* only (pp. 16—17). In the Polycentropidae (pp. 47, 54 and 62) there are well developed paraprocts carrying accessory copulatory processes. Such processes are seen in *Tinodes vaeneri* (p. 32) also. In other forms the paraprocts have either been reduced or fused with the sclerotization of Segment X s.str. (Cp. also pp. 40 and 151).

Cerci are scarcely present in any Trichopteron ♂, though in *Hydropsyche instabilis* Curt. (p. 63) and *Molanna* (p. 99) there are structures which perhaps might be interpreted as such.

In some forms the *anus* is very distinct. In others it is difficult to localize.

The *inferior appendages* (*gonopods*). In *Rhyacophila*, only, the two appendages are separate from one another, and this condition is probably secondary. Othervise they are mutually united, at least by membrane. In the majority of cases, however, they are also sclerotically united with each other and with an unpaired sclerite (the *basal plate;* figs. 7 D, *6*, p. 22; 51, *4*, p. 92; 63, *5*, p. 112; o.a.) situated at the bottom of the genital chamber between and above the two appendages. (The basal plate of

course must be considered as an integrating part of the inferior appendages). Generally the median sides, also, of the two appendages are sclerotically continuous with each other and with the basal plate. This may be much reduced or entirely lacking. In the latter case the sclerotic connection between the two appendages—if any—is effected in other ways. The posterior edge of Segment IX generally overlaps the bases of the inferior appendages a little. Rarely there is a simple articulation between the posterior edge of Segment IX and the inferior appendages.

The inferior appendages are typically divided into a proximal and a distal joint (*coxopodite* and *harpago*, resp.). In very many forms, however, they are one-jointed. This condition may have arisen in three ways: 1. By reduction of the harpago. Incipient stages are seen in *Beraea* (fig. 51, p. 92), and *Odontocerum* (fig. 57, p. 103). 2. By fusion of the two joints. Incipient stages are seen in *Tinodes* (fig. 16, p. 35), *Leptocerus* (fig. 54, p. 96) and *Lasiocephala* (fig. 60, p. 108). The whole evolution may be followed within the genus *Tinodes*. In *T. waeneri* (p. 34) the two joints are sclerotically continuous on the lateral side. In *T. pallidula* MacL. (KIMMINS 1949) the one-jointed condition is established. The distal end of the appendage in the latter species has approximately the same shape as the harpago in the former. 3. By fusion of the coxopodite with Segment IX. An incipient stage is seen in *Psychomyia* (fig. 19, p. 39), but in no form studied by me this condition is fully established.

Four pairs of extrinsic muscles are attached to the inferior appendages (figs. 1 and 2): *anterior* and *posterior dorsals*, and *anterior* and *posterior ventrals*. The *anterior dorsal muscle* (7) generally originates on the lateroventral part of the antecosta of Segment IX, but the origin may shift more or less in a dorsal direction. It is inserted laterally, laterodorsally, or dorsally on the proximal edge of the coxopodite. The *anterior ventral muscle* (*8*) originates on the ventral part of the antecosta of Segment IX (ventrally to the lateroventral longitudinal suture if this is present), and is inserted proximally on the median side of the appendages. In *Agraylea* and *Hydroptila* this muscle is paired; in all other forms studied by me it is unpaired. In case of the anterior muscles being especially strong, their origins may spread more or less over the surface of Segment IX. The *posterior dorsal muscle* (*9*) originates laterodorsally and anally in Segment IX and is inserted on the basal plate. Its crossing with the anterior dorsal is above the latter. In *Rhyacophila* and the *Beraeidae* the *posterior ventral muscle* (*10*) originates lateroventrally and anally in Segment IX. This was probably the condition in the ancestors of the Trichoptera, but still it is likely that it is secondary in the two groups mentioned. In the vast majority of forms this muscle stretches between the ventroproximal part of the appendage itself and the basal plate. In the Limnophilinae (p. 127) the ventral attachment is partly on the appendage, partly on Segment IX, but this obviously is a secondary condition arisen in connection with the strong reduction of the inferior appendages in this subfamily. In *Lype* and *Wormaldia* the muscle stretches between the dorsal and the ventral side of the coxopodite, and in the Hydroptilidae (pp. 72, 80, and 83) the relations of this muscle are very deviating.

In *Rhyacophila* and the Limnophilidae the posterior ventral muscle has shifted its dorsal (anterior) attachment to the phallus. In *Psychomyia* the insertion of the anterior ventral muscle has shifted to the phallus, and the same perhaps is the case

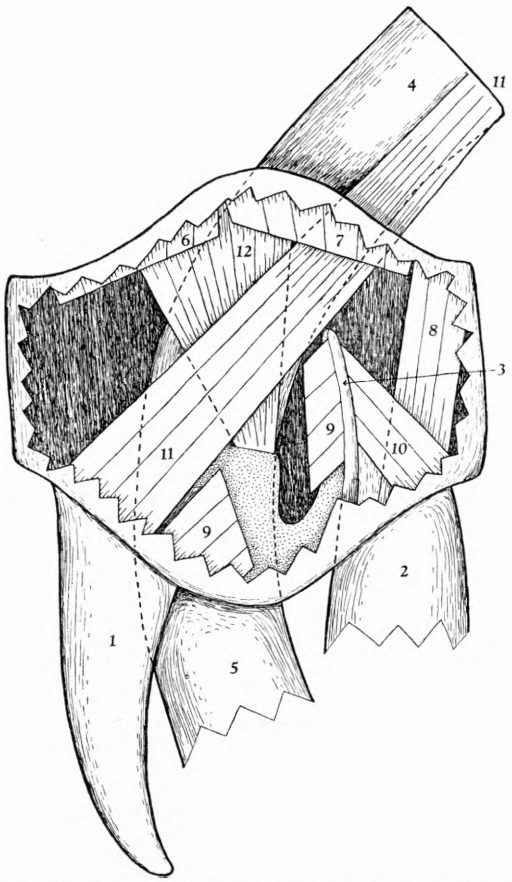

Fig. 1. Diagram showing the musculature of the genital segments, as seen from the right side. The greater part of the right half of Segment IX has been broken off, so that a large "window" is formed. *1:* Segment X ("intermediate appendage"). *2:* right inferior appendage; (its greater part has been broken off). *3:* basal plate of the inferior appendages. *4:* phallic apodeme. *5:* phallus; (its distal part has been broken off). *6:* the IX/X muscle; (only its extreme proximal end is left). *7—10:* muscles of the inferior appendage; *7:* anterior dorsal (only its proximal end is left), *8:* anterior ventral, *9:* posterior dorsal (its middle part is removed), *10:* posterior ventral. *11—12:* phallic muscles; *11:* posterior, *12:* anterior.

with the anterior dorsal muscle in *Apatania* and *Silo*. In *Leptocerus*, finally, the posterior dorsal muscle has shifted its dorsal (proximal) attachment to the phallus.

All four muscles are not present in all forms. In extreme cases (*Limnophilus*, p. 121; *Ecclisopteryx*, p. 131) no muscles at all are inserted on the inferior appendages.

The movements of the inferior appendages are adduction and abduction, levation and depression. The sclerotic connection between the two appendages is generally

of such a sort as to allow the former set of movements. It is often difficult to judge which part the individual muscles take in these movements. Obviously it differs in the various forms. This will be discussed to some extent in the special part. The posterior dorsal muscle must principally act as a depressor by raising the basal plate. By pulling the latter backwards it may act also as an abductor. In the Beraeidae, in which the posterior ventral muscle takes its origin on Segment IX, it may act as a levator and an abductor. In other forms it probably causes movements of the basal plate, through which it may influence the movements of the phallus (cp. below). As mentioned above, this in some cases has resulted in one of the muscle attachments having shifted to the phallus.

Finally, the inferior appendages has an intrinsic *flexor of the harpago*, originating on the lateral side of the coxopodite (generally for the greater part of the length of this joint) and inserted medially and proximally on the harpago. In *Silo* this muscle is divided into two portions. It goes without saying that it is lacking in forms with one-jointed appendages.

The shape of the copulatory organ, the *phallus*, is extremely variable. Generally speaking, it can only be said that it is a tubular organ, as a rule sclerotized to its greater extent. And in some cases even this characterization perhaps is not appropriate. The proximal end of the phallus is lowered into a usually very deep depression, the *phallocrypt*. The relation between this and the basal plate of the inferior appendages varies. In some cases the basal plate is situated on the floor of a small pocket, the entrance of which is separated from that of the phallocrypt. In other cases it is situated on the floor of (the posterior part of) the phallocrypt. In still other cases, in which the basal plate is very small, it simply lies on the floor of the genital chamber outside the entrance to the phallocrypt. In practically all forms a *phallic apodeme* is formed by fusion of the proximal end of the phallus with the anterior part of the wall of the phallocrypt. The apodeme may be partly membranous, but typically it is sclerotized. An unusual form of the phallic apodeme is described by TILLYARD (1925, p. 278) in the genus *Hydrobiosis* MacL., which "have a long, slender penis, coiled up inside the abdomen in the form of a spring" (according to the figure a watch-spring).

In the following the term phallocrypt means only that part which lies beyond the apodeme. It may be entirely membranous, or it may be sclerotized to a greater or smaller extent, and this sclerotization again may be continuous with the inferior appendages (*Hydropsyche, Lasiocephala, Apatania, Silo*) or with Segment X (*Agapetus, Tinodes*—cp., however, below—*Psychomyia*). In *Rhyacophila* there is an articulation between the phallus and the inferior appendage through a sclerite in the wall of the phallocrypt.

No appreciable morphological significance can be attributed to the boundary between the phallic apodeme and the phallocrypt. It simply depends on the extent to which a fusion has taken place. In some cases (e. g. *Limnophilus;* fig. 70, p. 123) the apodeme is only short, whereas the phallocrypt is very deep. In other cases (e. g.

Polycentropus; fig. 25, p. 50) the apodeme is large, but the phallocrypt shallow, possibly reduced to a circular furrow (*Leptocerus;* fig. 55, p. 97) or entirely obliterated (*Tinodes;* fig. 17, p. 36). In the two last-mentioned forms the apodeme as well is much reduced.

In the following the term phallus means that part of the copulatory organ which

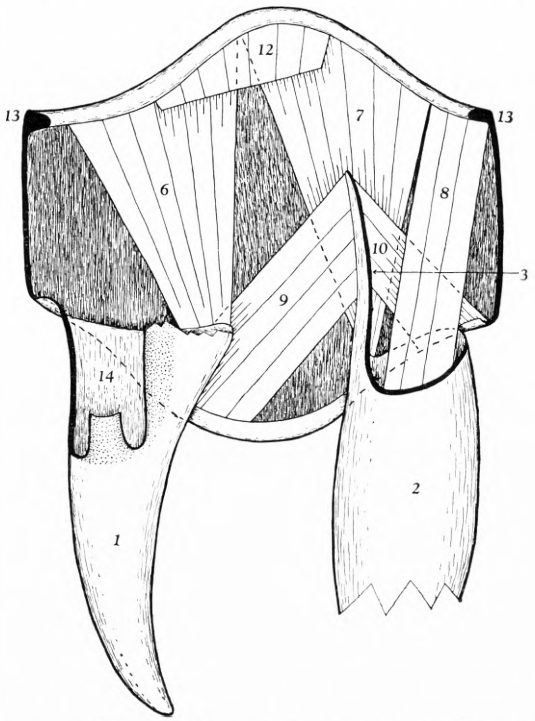

Fig. 2. Diagram showing the musculature of the genital segments. Sagittal section through Segments IX and X; left half as seen from the inside. The phallus and the membranous wall of the genital chamber have been removed. *1:* Segment X ("intermediate appendage"). *2:* left inferior appendage; (its greater part has been broken off). *3:* basal plate of the inferior appendages. *6:* IX/X muscle. *7—10:* muscles of the inferior appendage; *7:* anterior dorsal, *8:* anterior ventral, *9:* posterior dorsal, *10:* posterior ventral. *12:* the posterior phallic muscle; (only its proximal end is left; the whole anterior muscle has been removed together with the phallus). *13—13:* the antecosta of Segment IX. *14:* rectum.

lies beyond the phallic apodeme. In its original shape it was probably divided into a *phallobase* and an *aedeagus*. Among the forms studied here this condition is seen in its typical form only in the Glossosomatinae (fig. 8, p. 23) and the Limnophilidae (fig. 70, p. 123), it is true, but its occurrence in these two distantly related groups indicates that it must be the original one. A typical phallobase is perhaps found also in *Rhyacophila kervillei* Nav. (Schmid 1952, p. 638, fig. 6) and in the genus *Chimarrha* Steph. (Barnard 1934, p. 382). In the two groups mentioned the phallobase is much shorter, but thicker than the aedeagus. Its distal part is invaginated as a membranous *endotheca,* which is almost as long as the phallobase itself, and from the bottom of

which the chiefly sclerotized aedeagus arises. In the Glossosomatinae, the Limnophilinae, and the Ecclisopteryginae the outside of the phallobase (the *phallotheca*), as well is membranous. In *Silo* (fig. 82 B, C, p. 142) the phallotheca is sclerotized proximally, in *Apatania* (fig. 78 B, p. 136) to its greater extent. By means of blood pressure the endotheca can be everted, and the aedeagus thus protracted. The retraction is performed by the *aedeagal retractor muscles*, which originate in the phallic apodeme or (*Apatania*) the phallotheca and is inserted on the aedeagus. — In *Holocentropus dubius* (fig. 29, p. 55) the phallus is divided into two parts, which probably represent the phallobase and the aedeagus, resp., but the latter cannot be withdrawn into the former.

In the majority of the Trichoptera, however, the phallus is undivided. This condition may have arisen in three ways: (1) By a strong development of the phallobase, accompanied by sclerotization of the phallotheca and reduction of the aedeagus. Stages of this development are seen in *Oligoplectrum* (fig. 64, p. 113), *Odontocerum* (fig. 58, p. 105) and *Polycentropus* (fig. 26, p. 51). The final result (figs. 56 F, p. 100, 67, o. a.) is that the copulatory organ is formed by the phallobase, which contains an eversible sac, the endotheca, in the bottom of which the ejaculatory duct opens. This type is seen in *Wormaldia, Ecnomus, Sericostoma, Molanna* and *Agrypnia*, and possibly in *Hydropsyche* also. (2) By obliteration of the endotheca and subsequent fusion of the sclerotized phallotheca with the aedeagus. This process no doubt has taken place in *Lasiocephala* (p. 110), probably in *Rhyacophila* (p. 20), and perhaps in the Psychomyidae (p. 37) and *Leptocerus* (p. 98). In the two latter forms it has been connected with a reduction of the aedeagal retractor. (3) By reduction of the whole phallobase, a direct continuation being established between the phallic apodeme and the aedeagus. An initial stage is probably seen in *Beraea* (p. 94), and the final result (though in a modified form) possibly in the Hydroptilidae (p. 85). This process is accompanied by a reduction of the aedeagal retractor. The undivided phallus of the Psychomyidae and of *Leptocerus* may also have arisen in this way.

The original shape of the aedeagus certainly is that found in the *Rhyacophilidae* (figs. 6, p. 19 and 8, p. 23): it is divided into a dorsal and a ventral branch; the ejaculatory duct opens on the former. In some species of the genus *Chimarrha* Steph., also, the aedeagus seems to have two branches, the ventral in the shape of a "process, which is apically trifid", whereas the dorsal branch appears to be membranous (Barnard 1934, p. 382). In *Stactobia* MacL., too, the aedeagus seems to be divided into a dorsal and a ventral branch (Ulmer 1950, p. 296, fig. 1 a), the former with the opening of the ejaculatory duct, the latter subdivided into 2—4 long spines. (It appears that Vaillant—1951—in this genus has confused Segment X and the phallus). More or less distinct vestiges of such a division is found in the Psychomyidae (p. 37) and in *Polycentropus* (p. 50). It can possibly be traced also in the Hydroptilidae and in many Integripalpia. In the Hydroptilidae the distal end of the aedeagus is hollowed out like a spoon on the dorsal side, and at the bottom of the "spoon" the ejaculatory duct opens on a papilla (*Agraylea*, figs. 43 A, p. 78, 45 C, p. 81; *Hydroptila*) or on a more strongly sclerotized area (*Orthotrichia*, fig. 42, p. 75). The "spoon" probably repre-

sents the ventral branch, the papilla—which in *Orthotrichia* is reduced—the dorsal branch. In *Lasiocephala* (fig. 61 A, p. 109), *Limnophilus* (fig. 70 D, p. 123), and *Silo* (fig. 82 A, p. 142) the ejaculatory duct likewise opens into a spoon-like depression. In *Beraea* (p. 94), *Leptocerus* (p. 98), *Odontocerum* (p. 104), and *Oligoplectrum* (p. 114) the "spoon" has developed into a cavity, the *phallotremal cavity*, at the bottom of which is the opening of the ejaculatory duct surrounded by a *phallotremal sclerite*. In the two first-mentioned forms the aedeagal retractor is lacking, in the two last-mentioned it is inserted on the phallotremal sclerite, and in *Oligoplectrum*, at least, the phallotremal cavity is eversible. It will be seen that in the Hydroptilidae and the Integripalpia it is the dorsal branch which is reduced. In *Psychomyia* (p. 42) and *Holocentropus* (p. 56), on the other hand, it appears that the ventral branch is reduced. In those cases in which the aedeagus on the whole is reduced, the reduction of course has befallen both branches.

In some forms the phallus is provided with appendages which generally are called titillators, but should more appropriately be called *parameres* (cp. Anker Nielsen 1957). In *Agapetus* there is an unpaired, pasively movable appendage (fig. 8, *6*, p. 23) arising from the proximal end of the aedeagus. In *Odontocerum* (fig. 58, p. 105) and the Limnophilidae (fig. 73, p. 128, o. a.) there are paired, passively movable appendages, which arise from the bottom of the endotheca beside the aedeagus or from the proximal end of the latter. In *Rhyacophila* (fig. 6, p. 19), too, there are paired appendages arising from deep, tubular pockets on the undivided phallus, but they are actively movable, the aedeagal retractor being inserted on them. Parameres have been described also in some Philopotamidae (see p. 44). Most probably the parameres are homologous in all the forms mentioned.

In the Hydroptilidae (figs. 37 C, p. 69, 45 A, p. 81) an unpaired, immovable *titillator* is found arising distally to the middle of the undivided phallus (which probably represents the aedeagus only). It is unlikely that it is homologous with the parameres of the other forms. (As to the Hydroptilidae, see also pp. 84—85, 68—69, and 146).

More or less distally the ejaculatory duct—at least fairly often—is surrounded by a packet of close-set unicellular glands. Generally the outermost part of the duct is more or less highly sclerotized.

The intrinsic musculature of the phallus has already been mentioned. There are two pairs of extrinsic muscles (figs. 1 and 2). The *posterior phallic muscle* (*11*) originates laterodorsally or laterally in the posterior part of Segment IX, above the origin of the posterior dorsal muscle of the inferior appendage. In *Polycentropus* the greater part and in Holocentropus the whole of its origin has shifted to Segment X (or, strictly speaking, to Segment XI: the paraprocts). It is inserted on the phallic apodeme or on the anterior part of the phallocrypt. The *anterior phallic muscle* (*12*) originates laterally, lateroventrally, or laterodorsally on the antecosta of Segment IX. Oftener its origin dorsally overlaps a part of the origin of the IX/X muscle and ventrally a part of the origin of the dorsal posterior muscle of the inferior appendages. The phallic muscle then lies medially to the two last-mentioned muscles. It is in-

serted on the phallic apodeme or on sclerotized parts of the phallocrypt. The crossing between the two phallic muscles is such that the anterior lies above the posterior. In *Rhyacophila* and some Limnophilidae there are two pairs of posterior phallic muscles, a dorsal and a ventral pair, the posterior ventral muscle of the inferior appendages having shifted its origin to the phallus. In other Limnophilidae there is only one pair of posterior muscles, but this is the ventral pair; the usual, dorsal pair of muscles is lacking. In *Psychomyia* there are two pairs of anterior phallic muscles, the anterior ventral muscle of the inferior appendage having shifted its insertion and developed into a phallic muscle. In *Leptocerus*, finally, the posterior dorsal muscle of the inferior appendage is attached to the phallus, and the same perhaps is the case with the anterior dorsal in *Apatania* and in *Silo*. — In the Psychomyidae the posterior phallic muscle is lacking, and in *Tinodes* the same is the case with the anterior one. — Generally the posterior muscle is a protractror, the anterior one a retractor, but the two muscles may have other functions.

In this study some weight has been attached to the genital musculature. Nevertheless, in most cases the muscles have been omitted in the figures. This has been done in order not to complicate the drawings too much—or to augment their number too much. It is hoped that the verbal descriptions, as compared with the two diagrams (figs. 1 and 2), will make conditions intelligible.

Like most of the rest of the body the exposed parts of the genitalia are covered with setae, though generally the genital chamber and the phallus are devoid of such. In the special descriptions mention of setae has been made only in those cases where they are remarkable by their size or shape, where they are present on parts normally lacking setae, or, finally, where they lack on parts normally provided with setae. As to current entomological terms the reader is referred to Snodgrass (1935). Here it is only to be pointed out that the term seta always means a seta and nothing else, that setae always are called setae and never spines or the like, and that such terms as spines, spinules, etc., always designate simple cuticular processes and never setae.

As to the figures the following should be noted: With a few exceptions—which are mentioned in the legends—figures seen in dorsal, lateral, or ventral view are orientated so that the anterior end points upwards, figures seen in posterior view so that the dorsal side faces upwards. If anything else is not expressly stated, fine dotting indicates membranous areas.

Special Part.

Rhyacophila nubila.

Segment IX (figs. 3 and 4, *1*). Ventrally the posterior edge has a broad and deep indentation, so that the length in the middle of the ventral side is only a small fraction of that of the lateral side. On the dorsal side the posterior edge is slightly indented, but in the middle of the indentation it is protracted again to a flat, horizontal dorsal process (*2*), which is narrow, with approximately parallel sides and a rounded distal end. Ventrally—along the bases of the inferior appendages— the posterior edge of the segment is sharp. Dorsally it is rounded. On each side of the root of the dorsal process the inflected part of the sclerite is especially strong, and there—as described below—it is continuous with that of Segment X (fig. 5C, *8*).

Orally from the dorsal side of Segment X rises a large, sclerotized dorsal process (figs. 3A and 4A, *3;* fig. 5, *5*), which in a dorsal view entirely conceals the rest of the segment (fig. 4A, *4*). It is scalelike and lies horizontally below the process of Segment IX. Already at its base it is considerably broader than the latter, and the width increases much towards the bilobed distal end. Its dorsal side is connected by membrane with the ventral side of the process of Segment IX. A horizontal section through this membranous part, however, is much narrower and shorter than the dorsal process of Segment IX, so that the margins of the latter overlap the dorsal process of Segment X rather much.

Laterally to the dorsal process of Segment IX, the anterior end of Segment X projects rather far below the posterior margin of Segment IX. At the bottom of the narrow cavity thus formed the sclerite of Segment X is bent sharply in a dorsal direction and is continuous with that of Segment IX (fig. 5C, *8*).

Segment X itself is short and tubular. The dorsal side is sclerotized (fig. 5, *3*), and the sclerite is continuous with the ventral side of the dorsal process. On the connecting, almost vertical part, there are a pair of low, longitudinal keels, and between them a shallow concavity, which is continued, narrower, on Segment X itself. An internal ridge runs along the very descendent lateral margin of the sclerite. On this ridge the IX/X muscle is inserted. It originates dorsally on the antecosta of Segment IX. The most dorsal fibres are almost horizontal, the ventral ones are very descendent. A contraction of this muscle must cause a depression of Segment X. In this movement

the dorsal process of Segment IX no doubt takes part, since the membrane connecting the two dorsal processes is rather close. Hence, the elasticity of the dorsal process of Segment IX possibly is the chief antagonist of the IX/X muscle.

Anally on the dorsal side of Segment X there is a smaller sclerite (fig. 5, *9*), which to its greater extent takes the shape of a pair of backwards directed prongs. The posterior edge of the large sclerite (D, *4*) projects above the unpaired portion of the small

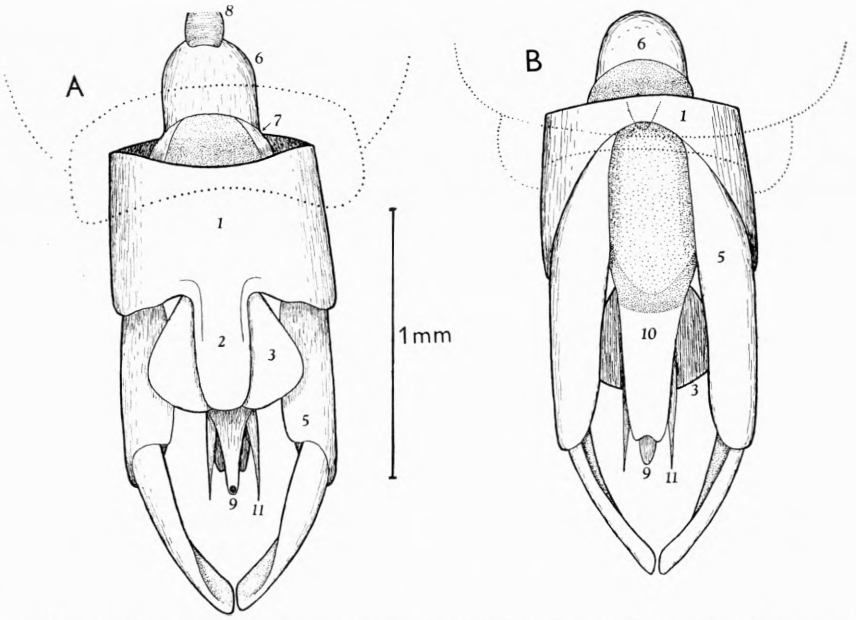

Fig. 3. *Rhyacophila* nubila. Segments IX and X in dorsal (A) and ventral view (B). Coarsely dotted lines: outline of (Segment VII and) Segment VIII. *1:* Segment IX. *2:* dorsal process of Segment IX. *3:* do. of Segment X. *5:* coxopodite. *6:* phallic apodeme. *7:* "horn" issued from the proximal end of the phallus and lying in the wall of the phallocrypt (= fig. 6, *3*). *8:* ejaculatory duct. *9:* dorsal, *10:* ventral branch of phallus. *11:* paramere.

sclerite (*10*). This portion (which like the prongs is very thick-walled) is formed as a narrow and very deep, horizontally lying cup, which may be called a hollow apodeme. It is no doubt justifiable to consider the whole structure (*9* + *10*) as an epiproct. On the dorsal side of the apodeme, muscles (D, 15) are inserted which originate on the dorsal proces of Segment X at the point where the latter joins the sclerite of Segment IX. This part of Segment X may be considered as the antecosta, and the muscles as dorsal intersegmental muscles between Segments X and XI. The very descendent muscles possibly must cause a depression of the prongs of the epiproct.

Lateroventrally Segment X carries a pair of sclerites (*11*), the dorsal edges of which overlap the lateral margins of the (large) dorsal sclerite. The membranous area between the two lateroventral sclerites forms a pair of low longitudinal folds. Anteriorly the two sclerites are united and continued as a narrow sclerotic stripe far into

the phallocrypt, the dorsal wall of which is a direct continuation of the ventral side of Segment X. It is no doubt justifiable to consider these structures (the lateroventral sclerites and the interjacent folds as well as the unpaired sclerotic stripe) as paraprocts.

Rhyacophila thus is remarkable by possessing a distinct Segment XI, comprising both an epiproct and a pair of paraprocts.

The anus is a vertical slit on the descendent membranous area between the epiproct and the paraprocts. From a narrow, transverse area immediately anteriorly

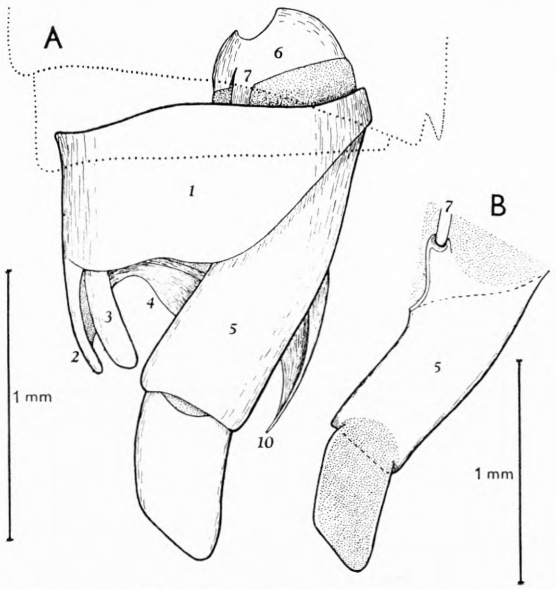

Fig. 4. *Rhyacophila nubila*. A: Segments IX and X in lateral (right) view. B: left inferior appendage in median view. *4:* Segment X itself. Other numbers as in fig. 3.

to the origin of the X/XI muscle, delicate muscle fibres spread out like a fan (*14*) and are inserted on the wall of the rectum. Similar fibres (*16*) stretch between the epiproctal apodeme and the rectum.

Superior appendages are lacking.

The inferior appendages (figs. 3 and 4, *5*) are elongate, sagittally compressed and of a simple shape. They are two-jointed, and the harpago is smaller than the coxopodite. Laterally the distal edge of the latter to some extent overlaps the proximal end of the former. Medially the harpago and the distal end of the coxopodite are membranous. Medio-dorsally the sclerite of the coxopodite projects considerably farther proximally than on the lateral side, and stretches into the wall of the phallocrypt. There it has a simple ginglymus to receive the condylus on the "horn" of the phallus. There is no connection between the two appendages. On the contrary, they are rather widely separate. Dorsally the bases of the appendages are rather much overlapped by the posterior edge of Segment IX. In a ventral direction the overlapping decreases,

and quite ventrally the inferior appendages and Segment IX have fused, though there is a distinct, separating suture.

The strong anterior dorsal muscle originates partly from the surface of Segment IX. It is inserted dorsally on the proximal margin of the coxopodite (a good deal dis-

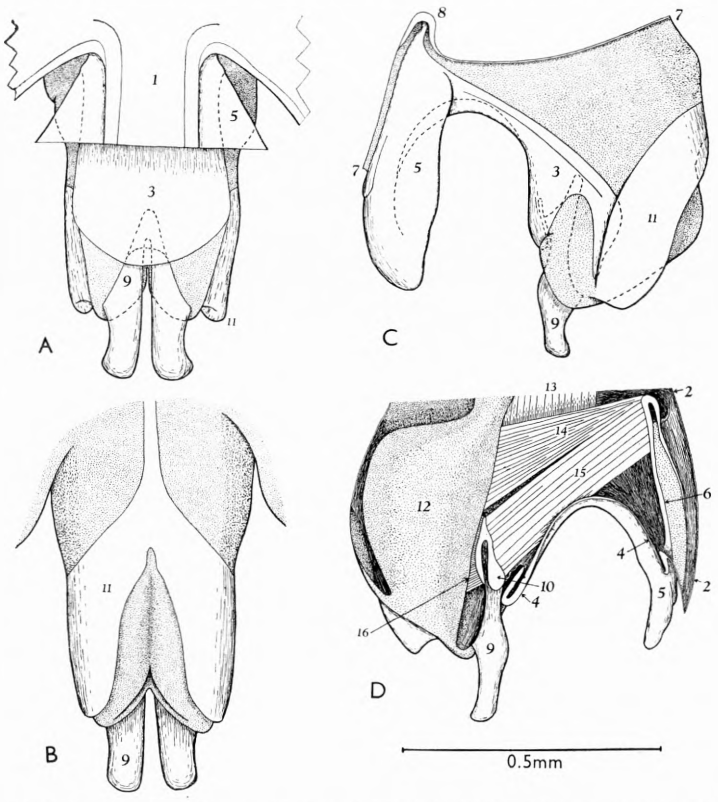

Fig. 5. *Rhyacophila nubila*, Segment X. A: in dorsal view (with the adjacent parts of Segment IX; the distal part of the dorsal processes has been cut off). B: in ventral view. C: in lateral (right) view. D: sagittal section; right half as seen from the inside. *1:* dorsal process of Segment IX. *2:* cut edge through the dorsal side of this process. *3:* Segment X itself. *4:* cut edge through 3. *5:* dorsal process of Segment X. *6:* dorsomedian margin of the sclerite of *5* (not a cut edge; dorsally to *6* the membrane connecting the two dorsal processes is seen). *7—7:* cut edge at the boundary between Segments IX and X. *8:* point of sclerotic connection between Segments IX and X. *9:* epiproct. *10:* cut edge through the unpaired part of *9*. *11:* paraproct. *12:* rectum. *13:* the IX/X muscle. *14:* muscle bands from Segment X to the rectum. *15:* muscle from Segment X to the epiproct. *16:* muscle bands from the epiproct to the rectum.

tally to the ginglymus mentioned). It may cause a levation of the appendage. Its chief function, however, is probably to be an antagonist to the posterior phallic muscle. The posterior ventral muscle has been transformed into a phallic muscle. Other extrinsic muscles are lacking. The flexor of the harpago originates laterally from the dorsal half of the coxopodite and is inserted on the membranous median side of the harpago.

The phallus (fig. 6) is undivided. Including the phallic apodeme, somewhat

more than the proximal half is rather thick, sagittally compressed, and with a feebly marked, dorsal longitudinal keel. The chiefly membranous phallocrypt is rather deep, especially so on the dorsal side. The phallic apodeme (2) is rather strongly sclerotized. Otherwise the proximal, thicker part is feebly sclerotized, or—distally, towards the distal, more slender part—quite membranous. Laterodorsally, on the boundary be-

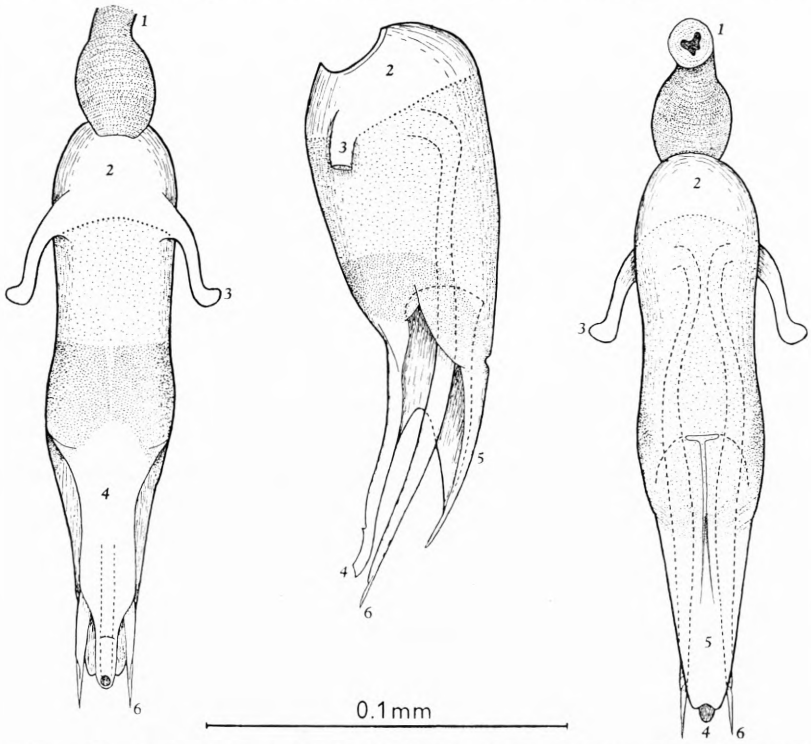

Fig. 6. *Rhyacophila nubila*; phallus in dorsal, lateral (right) and ventral view. *1:* ejaculatory duct. *2:* phallic apodeme. *3:* "horn" issued from proximal end of phallus (= figs. 3 and 4, 7). *4:* dorsal and *5:* ventral branch of phallus. *6:* paramere.

tween the phallic apodeme and the phallus itself a pair of strong, backwards directed "horns" (*3*) rise. These horns (figs. 3 and 4, 7) lie as sclerotic rods in the wall of the phallocrypt. Their distal ends, however, are free processes, articulating with the ginglymi on the coxopodites described above.

There is no anterior phallic muscle. The posterior muscle originates approximately midway between Segment IX and the inferior appendages. It is inserted on the phallic apodeme immediately dorsally to the root of the "horn". In addition there is a much stronger muscle, originating posteriorly and lateroventrally in Segment IX and inserted laterally on the proximal edge of the phallic apodeme. As already mentioned, it is a transformed muscle of the inferior appendage.

The slender distal part of the phallus is divided into a dorsal and a ventral branch, which both are sclerotized. The flattened ventral branch (5) tapers gradually towards

the slightly bilobed distal end. The dorsal branch (*4*), too, is flattened. It falls into a longer and broader proximal part (though narrower than the ventral branch) and a much narrower distal part. Across the dorsal side of the latter there is a sharp ridge, which in a lateral view resembles a forwards projecting tooth. The ejaculatory duct opens dorsally on the distal end of the dorsal branch, which is bent somewhat upwards. The two branches are connected by an unpaired, longitudinal, sclerotic lamella, the distal edge of which is deeply indented. On each side of the lamella there is a depression, from the membranous bottom of which a slender, rod-like, and sharply pointed paramere rises. The proximal part of the paramere is lowered into a deep and narrow, tubular cavity, which stretches to the proximal end of the phallus. Its distal end is flattened and subjected to a torsion of about 90°. The aedeagal retractor originates on the whole phallic apodeme and is inserted on the proximal ends of the paired parameres. The latter can probably be protracted by blood pressure.

The morphology of the phallus. A comparison with *Agapetus* (p. 23) and the Limnophilidae (p. 121) indicates that the origin of the parameres must mark the boundary between the phallobase and the aedeagus. From a morphological point of view the origin of the parameres in *Rhyacophila* is the points from which their tubular sheaths are invaginated. The conclusion is that the thicker proximal part of the phallus represents the phallobase, whereas the slenderer, two-branched distal part represents the aedeagus. Or, more precisely: the proximal, feebly sclerotized part is the phallotheca, the middle membranous part is the permanently everted endotheca, and the two-branched distal part is the aedeagus.

The movements of the phallus. The posterior phallic muscles generally are protractors. In *Rhyacophila,* however, the articulation between the phallus and the inferior appendages does not allow any high degree of protraction. The chief movements possibly are levation and depression, made possible by the two sets of posterior muscles. The axis of these movements is the transverse line between the two articulations. A simultaneous contraction of the ventral phallic muscles and the anterior dorsal ones of the inferior appendages must result in a very strong levation of the phallus. That the latter movement is the more powerful of the two is in good agreement with the fact that the opening of the ejaculatory duct has a dorsal position.

Agapetus fuscipes.

Dorsally as well as ventrally the posterior edge of Segment IX (fig. 7, *3*) is slightly indented. The two concavities are separated by a rounded corner, situated dorsally to the middle of the lateral side, the ventral indentation being considerably broader than the dorsal one. The dorsal side of the segment is somewhat flattened, especially so anally. On the ventral side a pair of longitudinal sutures are seen. They do not reach the posterior border. Anteriorly, bending medially, they unite with the antecostal suture.

As compared with other Trichoptera, Segment X (*4*) is very large. It is somewhat sagittally compressed. The ventral side is very concave, and the edges of the concavity are bent so much inwards that for at large stretch anally to the middle they entirely or almost touch each other. The posterior half or Segment X thus forms a functional tube, enclosing the phallus. Orally to the middle the edges diverge, the tube being reduced to a semitube.

Segment X carries a pair of strong, triangular, lateroventral sclerites. Ventrally they bend round the rather sharp edges of the (semi)tube and continue for a short stretch on the inside of the latter. Their anal corners are produced into upwards curved extensions, the extreme distal ends of which project as free spines. A comparison with *Rhyacophila* makes it possible that these sclerites—at least partly—represent the paraprocts. Orally the two sclerites are connected by a dorsal, transverse bridge. The greater, anal part of the dorsal side, however, is membranous. The anus is found on the very oblique (descendent) posterior end of the segment.

For a little more than the dorsal half the sclerotization of Segment X is continuous with that of Segment IX. Dorsally the two segments are separated merely by a declivity. Laterally the posterior edge of Segment IX projects beyond the anterior end of Segment X, and increasingly so in a ventral direction. A pair of very deep pockets (shown by broken lines in fig. 7 A, C) thus are formed beside Segment X. Dorsally the pockets are sclerotized throughout, ventrally on the median side (belonging to Segment X) only. Ventrally the bottoms of the pockets (i. e. the anterior corners of Segment X) even project further forwards than does the anterior margin of Segment IX. Below Segment X, also, the genital chamber consequently is very deep, forming a horizontal, membranous area.

As mentioned above, the ventral side of Segment X forms a tube. The greater, oral part of the dorsal side of the latter is sclerotized. This "internal" sclerite—which is separated from the external sclerites by rather broad membranous stripes—continues directly in the sclerotic dorsal wall of the phallocrypt (see below).

The firm connection between Segments IX and X would make it probable that the IX/X muscle was lacking. Nevertheless, this muscle is present, though rather feeble. It originates from the dorsal side of Segment IX for almost the entire length of the segment (not from the antecosta), and is inserted on the sclerite of Segment X near the ventro-anterior corner. The muscle is sagittally compressed. In a lateral view its fibres are very descending, almost vertical; in an anterior or posterior view they are converging ventrally. The muscle probably performs a closing movement of the ventral slit on Segment X.

Superior appendages are lacking.

The inferior appendages (fig. 7 A—C, *5*, D) are elongate and one-jointed. In a lateral view their shape is simple, ovate. The median side is concave, so that two toothed edges are formed. Proximally the ventral edge projects further inwards than the dorsal one, distally it is converse. A little proximally to the middle a tooth is seen between the two edges. The median sides of the two appendages are sclerotically con-

tinious at their bases. The basal plate (fig. 7 D, *6*) is a long, slender, spatulate rod, lying in the ventral wall of the genital chamber. The anterior ventral muscle is very strong. It originates to a great extent from the ventral surface of Segment IX, and is inserted on the line where the median sides of the two appendages unite. (There there is an internal, low, but strong, vertical ridge). Since the fibres are ascendent, this

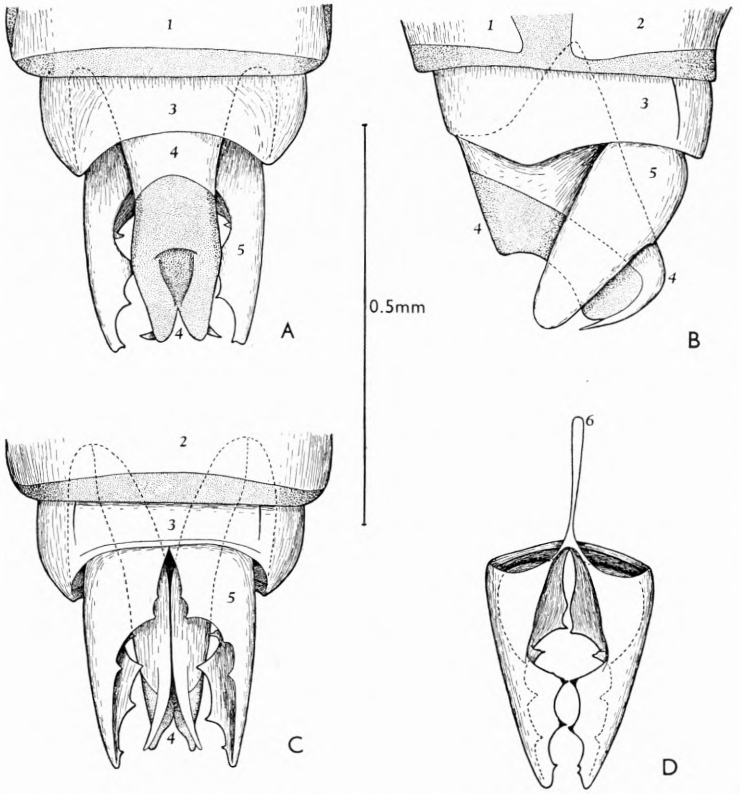

Fig. 7. *Agapetus fuscipes*. A—C: posterior end of abdomen in dorsal (A), lateral (right, B), and ventral view (C). The broken lines indicate the outline of that part of Segment X which is concealed by Segment IX, and in A and C also a horizontal optical section through the sclerotization of the genital chamber. D: inferior appendages in dorsal view. *1:* anal part of Tergum VIII. *2:* anal part of Sternum VIII. *3:* Segment IX. *4:* Segment X. *5:* inferior appendage. *6:* basal plate of the inferior appendages.

muscle probably acts both as a levator and as an adductor. The anterior and posterior dorsal muscles are considerably feebler. They are antagonists to the first-mentioned muscle. The anterior dorsal one is inserted laterally on the proximal edge of the appendage, the posterior one dorsally on the anterior end of the basal plate. They possibly act as an abductor and a depressor, respectively. The posterior ventral muscle is lacking.

The phallus (fig. 8). The phallocrypt is very deep, and the anterior end of the phallic apodeme (*1*) even reaches the oral end of Segment VIII. In the posterior part

of the phallocrypt the dorsal wall is sclerotized, forming a direct continuation of the "interior" sclerite of Segment X. In an anterior direction the sclerite widens and eventually covers the whole wall of the anterior end of the phallocrypt. The phallus is long and slender and curved somewhat downwards. The curvature is most pronounced a little proximally to the middle, i.e. at a point which in the state of repose

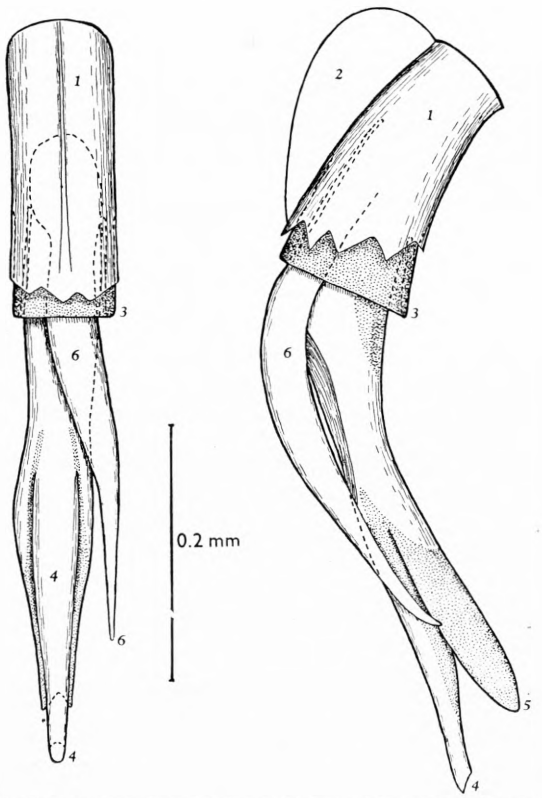

Fig. 8. *Agapetus fuscipes*. Phallus in dorsal and lateral (right) view. *1:* phallic apodeme; (the greater part of the phallocrypt has been broken off). *2:* longitudinal ridge on the phallic apodeme and the phallocrypt. *3:* phallobase. *4:* dorsal and *5:* ventral branch of the aedeagus. *6:* paramere.

is situated at the boundary between the "tube" of Segment X and the phallocrypt. Since the position of the distal part of the phallus is given by the "tube" of Segment X (somewhat descendent), the proximal part of the phallus and the phallocrypt become somewhat ascendent.

The phallus is divided into a short, membranous phallobase (*3*) and a well developed, chiefly sclerotic aedeagus (*4*, *5*). The aedeagal retractor originates in the phallic apodeme and is inserted on the dorsal side of the aedeagus at the point where the curvature is strongest. There is an unpaired, strong, and strongly sclerotized paramere (*6*), which arises dorsally from the base of the aedeagus. (Its ventral side is

much more thick-walled than the dorsal side). The paramere, which is somewhat shorter than the aedeagus, is curved like a sabre in such a way that its distal end comes to lie to the right side of the aedagus. On the dorsal side the latter has an asymmetric impression to receive the paramere. The connection between the paramere and the aedagus is membranous. The former thus is freely (but passively only) movable in relation to the latter.

As in *Rhyacophila* the distal part of the aedeagus is divided into a dorsal (*4*) and a ventral branch (*5*). The ventral branch is membranous, and its thin-walled distal end is slightly bilobed. Proximally its dorsal side is concave and embraces the ventral side of the slenderer and longer dorsal branch. The latter has a membranous ventral side and a sclerotic dorsal side. Quite distally, however, it is wholly sclerotized, and there the opening of the ejaculatory duct is found on the obliquely cut-off distal end. As distinct from conditions in *Rhyacophila*, this opening is directed somewhat downwards.

The posterior phallic muscle is by far the strongest muscle in the genital segments. It is inserted laterally and dorsally on the phallic apodeme and on the anterior part of the phallocrypt. Part of the insertion is on an unpaired, apodemal, dorsal, longitudinal ridge (*2*), which anteriorly is higher and narrower, posteriorly lower and broader. The possible protraction of the phallus must be of a very small extent, since the membranes separating the "internal" and the external sclerite of Segment X scarcely allow any greater movements between these parts. Hence, though the fibres (in a lateral view) run rather parallel to the phallocrypt, there is reason to believe that the chief function of the muscle is to raise the latter (and the phallic apodeme) and thus lower the distal part of the phallus. (In this connection the leverage of the apodemal ridge is probably of some importance). By this movement the phallus is removed from the "tube" of Segment X. During preparation it was seen that this is possible without severing the parts. The opposite movement must be due to elastic forces, since the anterior phallic muscle is lacking.

Lype phaeopa.

Apparently somewhat more than the dorsal half of Segment IX is entirely lacking. The remainder of the segment (figs. 9, *7* and 10 A, *1—3*) is rather long. The posterior edge is slightly indented; the concavity is limited by obtusely angled, though rounded, corners. The anterior edge has a very deep parabolic indentation. In this way the segment gets a pair of lateral forwards directed wings, which to a great extent are of an apodemal character. Owing to the reduction of the dorsal part, Segment IX is not seen from the dorsal side, but Segment X follows immediately behind Segment VIII.

As in *Rhyacophila* Segment X (fig. 9 A, C *8*; fig. 10 A, *4*) has a dorsal process (fig. 9 A, C, *9*; fig. 10 A, *5*). It is much shorter and narrower than the segment itself. Orally it is sagittally compressed, anally it is much flattened dorsoventrally. The

anterior end of Segment X itself has almost the same width as Segment IX. In an anal direction it is tapering, both in a dorsal and in a lateral view. In transverse section it is approximately triangular with a rather sharp dorsal side and a flattened ventral side. The greater, middle part of the latter, however, is very concave, and the edges

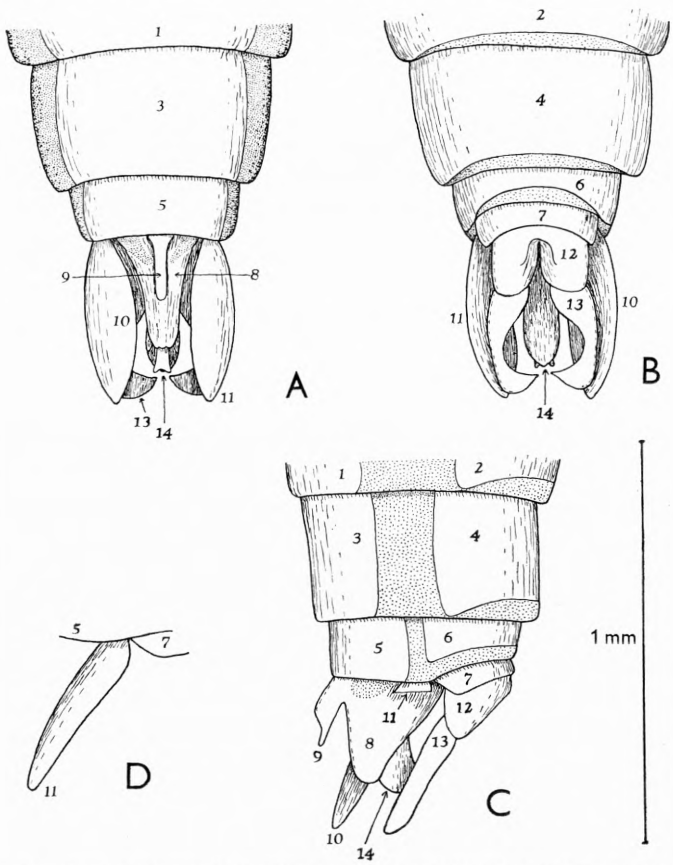

Fig. 9. *Lype phaeopa*. A—C: posterior end of abdomen in dorsal (A), ventral (B), and lateral (right), view (C). D: right superior appendage in lateral view. *1:* anal part of Tergum VI. *2:* anal part of Sternum VI. *3:* Tergum VII. *4:* Sternum VII. *5:* Tergum VIII. *6:* Sternum VIII. *7:* Segment IX. *8:* Segment X. *9:* dorsal process of Segment X. *10:* left superior appendage. *11:* right do. (in C cut off near its base). *12:* coxopodite. *13:* harpago. *14:* phallus.

of the concavity are approached so much (fig. 11 A, *4*) that the segment forms more than half of a tube. Quite orally it even forms a complete tube (see below), enclosing the phallus.

The dorsal process is completely sclerotized. Segment X itself, also, is sclerotized to its greater extent. Orally on the lateral side, however, there is a rather large membranous area. The narrower ventral end of this area overlaps the dorsal edge of Segment IX in the shape of a soft process (figs. 10 A and 11, *6*), carrying the large

superior appendage (fig. 9, *10* and *11;* fig. 11, 7), the shape of which reminds of a hare's ear and which projects far beyond the anal end of Segment X. On the anterior end of the dorsal process there is a transverse internal ridge (figs. 10 A and 11 B, *8*), which continues on a sclerotized stripe along the anterior margin of the membranous area.

On the ventral side the sclerite reaches the anterior end of Segment X. The two sides of the sclerite there are united through a transverse bridge below the entrance to the phallocrypt. Laterally the sclerite is connected with the posterior corner of Segment IX by another short transverse bridge (fig. 11, *9*) lying at the bottom of the genital chamber. In the middle of the latter bridge runs a suture (*10*); bending round the posterior edge of Segment IX it is continued on the lateral side of this segment as a longitudinal suture (fig. 10 A, *11*), which orally joins the antecosta. (On the homologies of this suture see *Tinodes waeneri*, p. 31, and *Psychomyia pusilla*, p. 40).

The phallic sheath formed by Segment X has a membranous dorsal wall. The lateral walls are sclerotized—to the greatest extent orally—and these sclerites are continuous with the external sclerotization of Segment X.

The anus is found on a membranous area on the posterior end of Segment X.

To Segment X the following muscles are attached: (1) A rather feeble muscle, originating from the antecosta of Segment IX at the anterior end of the suture *11* and inserted on the ventral side of the sclerite of Segment X orally to the middle. (2) Also a rather feeble muscle, originating from the anterior end of the dorsal edge of Segment IX and inserted on the lateral (ventral) part of *8*. (3) Muscle bands, originating from the antecosta of Segment VIII and converging posteriorly to their unpaired median insertion on the dorsal side of *8*. — (3), no doubt, is the usual, dorsal intersegmental muscles between Segments VIII and IX. This indicates that 8 in reality is the reduced and (probably secondarily) detached dorsal part of Segment IX, which has been intimately associated with Segment X. Conditions in *Polycentropus* (p. 48) give the key to understanding the muscles (1) and (2). These have the same mutual position as the correspondingly numbered muscles in *Polycentropus* and hence probably are their homologues. This means that (1) is the IX/X muscle, whereas (2) is a muscle originally associated with the paraproct which has shifted its anal insertion to the dorsal part of Segment IX. (It will be seen that it then actually has become an intrasegmental muscle).

As to the functions of the muscles, (1) and (2) probably are antagonists, which may cause a nodding movement of Segment X. The pivot for this movement must be the sclerotic connection between Segment X and the posterior corner of Segment IX. Since this bridge must yield some elastic resistance, it is a little peculiar that the two rather feeble muscles act through short levers only. The muscles (3) act through a much longer lever. These muscles partly may move the IX/X complex as a whole, partly, assisted by the ventral VIII/IX muscles, raise Segment X. This levation possibly is the principal active movement of Segment X. The opposite movement, chiefly

due to elastic forces (the bridge between Segments IX and X) must, of course, be of the same strength.

The inferior appendages (figs. 9A—C, 10A, *12—13*) are two-jointed. The harpago is considerably longer than the coxopodite, especially so dorsally. The distal margin of the latter being indented and the proximal margin of the former correspondingly bulging. In a lateral view the appendages have a very simple shape. In a ventral (or dorsal) view the median side of the harpago is very concave; the claw-

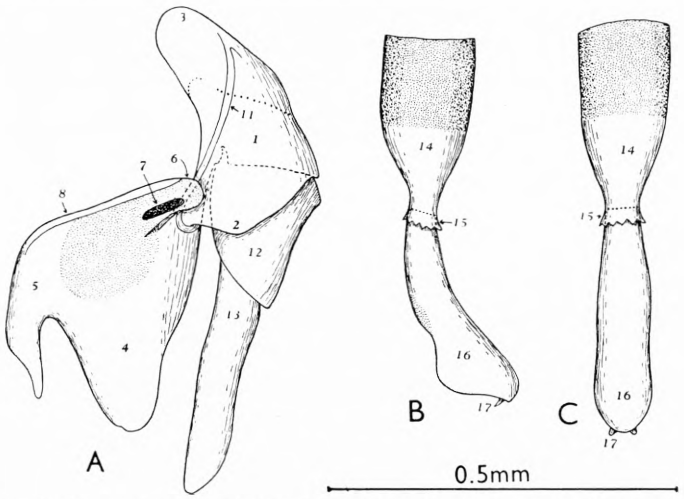

Fig. 10. *Lype phaeopa*. A: Segments IX and X in lateral (right) view; the phallus has been removed. B and C: phallus in lateral (right, B) and ventral view (C). *1:* Segment IX. *4:* body of Segment X. *5:* dorsal process of Segment X. *7:* cicatrice left by removal of superior appendage. *12:* coxopodite. *13:* harpago. *14:* phallic apodeme; (its distal boundary is indicated by a coarsely dotted line). *15:* internal (or anterior) part of phallocrypt; (the external part has been broken off). *16:* phallus. *17* = fig. 12, *3*. Other numbers: see text.

like distal end is curved inwards. Proximally the two appendages have fused to a great extent. On the ventral side that area which surround the cleft between the distal parts of the coxopodites is much impressed. The impression is bounded by a thickened, but sharp ridge in the shape of a U with backwards directed opening.

The anterior ventral muscle is very strong. It originates from the antecosta of Segment IX between the two sutures *11* and is inserted on the bottom of the cleft between the two coxopodites. The posterior dorsal muscle originates in Segment IX at 2 (fig. 10A) and is inserted on a short tonguelike apodeme on the small basal plate. Since abduction and adduction of the coxopodites seem impossible, the two muscles must be a levator and a depressor, respectively. The posterior ventral muscle is formed by bands which run parallel from the dorsal to the ventral side of the coxopodite. Their only possible function seems to be a flattening of the latter, a movement the significance of which is a puzzle to me. The anterior dorsal muscle is lacking. The flexor of the harpago is rather weak.

The phallus (fig. 9A—C, *14*) has a very large apodeme (fig. 10B, C, *14*), almost

as long as and considerably thicker than the phallus itself. It is bottle-shaped and tapers anally towards the collar-like connection with the free part of the phallus. More than the oral part of the apodeme is membranous and very thin-walled. It is entirely filled up by the ejaculatory duct, which has a very strong circular musculature. The phallus (*16*) itself is undivided, slightly clavate, and its distal part is somewhat sagittally compressed. The proximal end is lowered into a very short, sclerotic phallocrypt (*15*).

For about the distal half the dorsal side of the phallus is membranous. On the

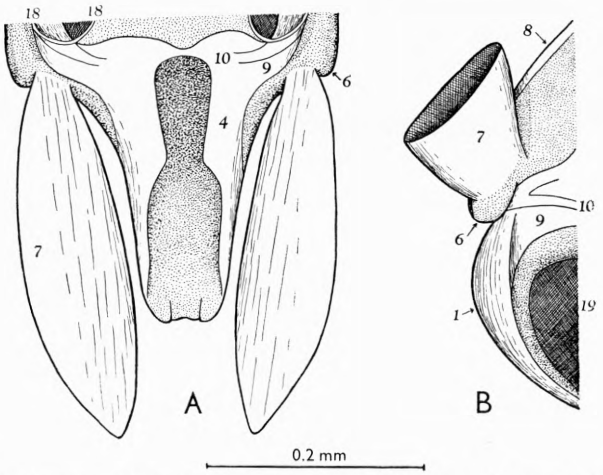

Fig. 11. *Lype phaeopa*. A: Segment X in ventral view. B: the extreme left part of Segments IX and X in posterior view. *1:* Segment IX. *4:* body of Segment X. *7:* superior appendage (in B cut off near its base). *18—18:* cut edge after removal of Segment IX. *19:* cicatrice left by removal of inferior appendage. Other numbers: see text.

thickened distal end (fig. 12) there is a cavity, which opens distally and dorsally. On the lateral and ventral walls of this cavity there is a sclerite, which is broader than long and in transverse section forms approximately three quarters of a circle. The distal margin of the sclerite is protracted backwards as a free fold. Laterodorsally this is low (*1*). In a ventral direction it becomes higher, and on the ventral side it comprises the whole length of the sclerite (and even more than that), a lip (*2*), sclerotized on both sides, thus being formed. In the middle the posterior edge of this lip is protracted into a flattened, backwards directed process (*3*), the upwards bent distal end of which is bilobed (fig. 10 B, C, *17*). Above the base of the lip rises a short, upwards and backwards directed tube (fig. 12, *4*) with the opening of the ejaculatory duct (*5*). The tube is sclerotized ventrally and laterally, but membranous on the greater, distal part of the dorsal side. The strong aedeagal retractor originates on the whole of that part of the dorsal side of the phallus (itself) which is sclerotized, and is inserted dorsally on the proximal end of the tube. It must act as a levator of the tube. Its antagonist is elastic forces: the ventral side of the tube is sclerotically connected with

the lip. (Nor can it be excluded that the lip takes part in the movement. Its membranous connection with the main sclerite of the phallus may make this possible). The ventral side of the tube is protracted forwards as an apodeme, the significance of which is a little doubtful.

The morphology of the phallus will be discussed under *Tinodes waeneri* (p. 37).

The oral half of Segment X entirely encloses the phallus. The distal end of the latter, however, lies below the anal half of Segment X. The two structures resemble the upper and the lower jaw of a beak. The very strong anterior phallic muscle ori-

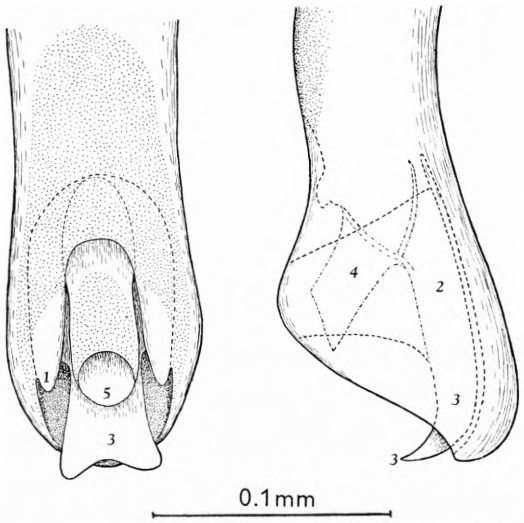

Fig. 12. *Lype phaeopa*. Distal end of phallus in dorsal and lateral (right) view. For explanation see text.

ginates from the antecosta of Segment IX dorsally to the suture *11* (fig. 10 A) and is inserted on the phallocrypt. The (membranous) connection between the latter and the sheath formed by Segment X must limit the extent of a retraction, and hence possibly transform the pull of the muscle into a levation of the distal part of the phallus, moving the two jaws of the "beak" towards each other. (The musculature associated with Segment X also may play some role in this connection). The "beak" possibly is the principal grasping organ in the genital apparatus. There are no posterior phallic muscles.

Tinodes waeneri.

The posterior end of Segment VIII to a great extent overlaps the oral part of the genital segments, especially so dorsally and laterally. The genital chamber is very deep, particularly its dorsal part, which projects forwards as far as the posterior end of Segment VII. The distal part of the phallus has a simpler shape than that of *Lype*. In all other respects conditions in Tinodes are more complicated than in *Lype*.

In Segment IX the same principle is seen as in *Lype:* the reduced dorsal part is entirely detached from the ventral part and intimately associated with Segment X.

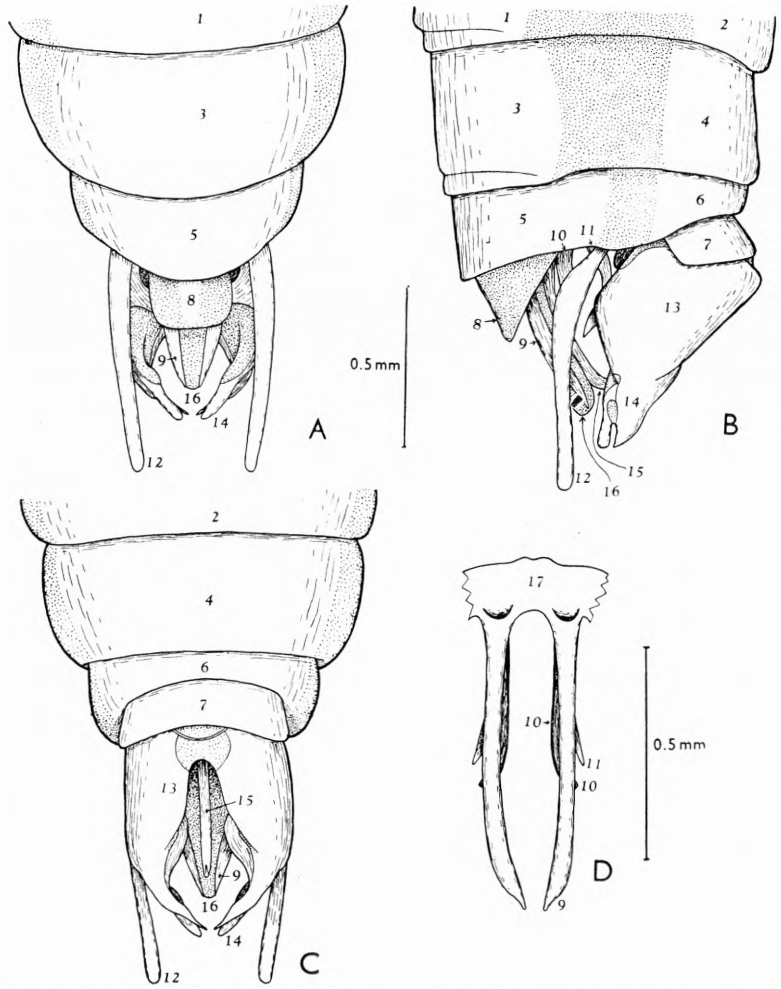

Fig. 13. *Tinodes waeneri.* A—C: posterior end of abdomen in dorsal (A), lateral (right, B), and ventral view (C). D: paraproctal processes in dorsal view. *1:* anal part of Tergum VI. *2:* anal part of Sternum VI. *3:* Tergum VII. *4:* Sternum VII. *5:* Tergum VIII. *6:* Sternum VIII. *7:* Segment IX. *8:* Segment X (fig. 14, *13*). *9—11* branches of paraproctal process (figs. 14 and 15, *14—16*); *9:* dorsal, *10:* intermediate, *11:* ventral branch. *12:* superior appendage (figs. 14 and 15, *17*). *13:* coxopodite. *14:* harpago. *15:* proximal, unpaired process on basal plate of inferior appendages (figs. 14, *22*; 16, *3*). *16:* phallus. *17:* sclerite of the genital chamber (as seen from the haemocoelic side; the lateral parts have been broken off; figs. 14 and 15, *6*).

The structure thus formed takes the shape of a soft "upper lip" (figs. 13A, B, *8;* 14, *13*) of the genital chamber. The lateral margin of the upper lip is steeply ascendent and joins the descendent posterior edge of the ventral part of Segment IX (figs. 13B, C, *7;* 14, *1*) under an approximately right angle. In situ this "mouth angle" is con-

cealed by the overlapping posterior border of Segment VIII (fig. 15 A, *25*). Along the anterior margin of the upper lip there is a narrow sclerotic area (fig. 14, *2*), probably representing the dorsal part of Segment IX. On the lateral side the sclerite *2* is subjected to a torsion of 90° so that its most lateral part (*2 b*) gets the character of a semicylindrical sclerotization at the bottom of the furrow between Segment VIII and the upper lip. On the dorsal side the sclerite *2* widens to an unpaired sclerotized stripe, which almost reaches the posterior end of the lip.

The rod-like superior appendages (fig. 13, *12;* figs. 14 and 15, *17*) are very long and are that part of the genital apparatus which projects farthest backwards. They rise from the inside of the edge of the genital chamber at the "mouth angle". Their lateral sides are sclerotically continuous with the lateral (or ventral) ends of the sclerite *2*.

The ventral part of Segment IX (figs. 13, *7;* 14, *1, 3*) is very long. This is especially so on the ventral side, where the anterior edge is very bulging and stretches a good deal into Segment VII. To its greater extent, however, the ventral part of Segment IX has the character of an apodeme (*3 a*).

At the bottom of the genital chamber there is an unpaired sclerite (figs. 14 and 15, *6*) in the shape of an inverted U, which dorsally encircles the proximal end of the phallus. (It is not, however, directly connected with the latter; see below). The arms of the U are placed very obliquely (descendent) and taper in a ventral direction. The narrow ventral end is a direct continuation of the inflected posterior edge of the ventral part of Segment IX, and is again sclerotically continuous with the median side of the superior appendage. Since the latter, as mentioned above, is continuous with the dorsal part of Segment IX (the sclerite *2*), a sclerotic connection between the two parts of the segment thus is established. Both above and below the base of the superior appendage a membranous area is seen. In a dorsal direction the arms of the U widen. Its base (fig. 13 D, *17*) is almost horizontal (though a little ascendent), which means that it lies anteriorly on the ventral side of the upper lip. Along the anterior margin of the arm of the U a suture (fig. 15, *6 a*) runs. It marks the origin of a high, lamella-like apodeme (fig. 14, *3 b*), which forms a direct continuation of the apodeme *3 a*, and which (in a lateral view) is pointed dorsally. The suture *6 a*, no doubt, is homologous with the suture *10* in *Lype* (fig. 11). Like the latter it passes below the base of the superior appendage.

At the boundaries between the base and the arms of the U a pair of large and complicated backwards directed processes issue from the sclerite. Proximally the processes are sagittally compressed, but they very soon become divided into three branches: a dorsal one (figs. 13, *9;* 14 and 15, *14*), an intermediate one (figs. 13, *10;* 14 and 15, *15*) and a ventral one (figs. 13, *11;* 14 and 15, *16*). For some distance the bases of the two latter ones are united. All three branches are curved a little inwards. The dorsal branch, which is by far the longest, is curved somewhat downwards, and applied to the distal part of the phallus. The two dorsal branches form parts of a tripartite phallus-guide, the third part of which is formed by an unpaired process on

the inferior appendages (fig. 13 B, C, *15*). The distal ends of the intermediate and the ventral branch are again curved slightly outwards.

It might perhaps be inferred that the three-branched processes alone represent Segment X, and that the upper lip is formed exclusively of the dorsal part of Segment IX. The fact, however, that the upper lip is penetrated by the rectum shows that it

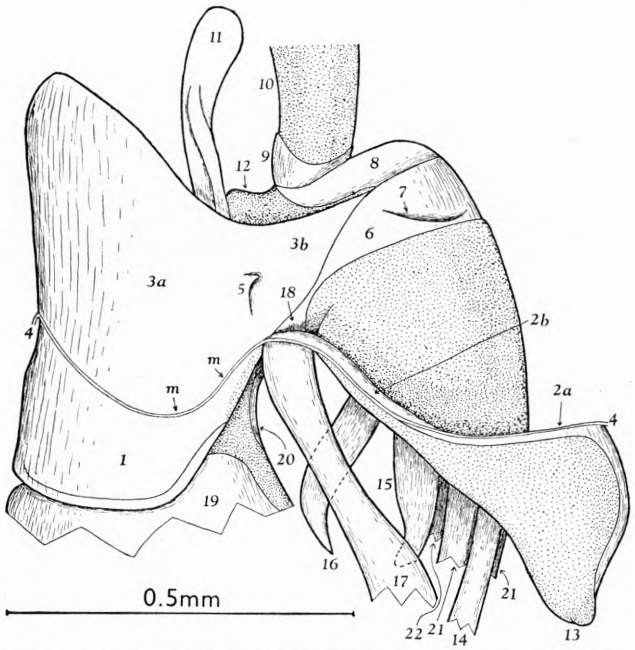

Fig. 14. *Tinodes waeneri*. Segments IX and X in lateral (left) view. *1:* non-apodemal, ventral part of Segment IX. *2:* dorsal part of Segment IX; *a* as seen from the external side, *b* from the haemocoelic side. *3:* apodemal part of Segment IX. *4—4:* cut edge through intersegmental membrane between Segments VIII and IX. *5:* origin of paraproctal muscle. *6:* sclerite of the genital chamber (as seen from the haemocoelic side). *7:* origin of the paraproctal process. *8:* sclerite connecting *6* with the phallus (as seen from the haemocoelic side). *9:* phallic apodeme. *10:* ejaculatory duct. *11:* apodeme on the basal plate of the inferior appendages. *12:* membranous part of the genital chamber (as seen from the haemocoelic side). *13:* Segment X. *14—16:* branches of the paraproctal process (distal part of 14 broken off). *17:* superior appendage (distal part broken off). *18:* origin of the superior appendage (as seen from the haemocoelic side). *19:* coxopodite (distal part broken off). *20:* basal plate of the inferior appendages. *21:* phallus (distal part broken off). *22:* unpaired process on the basal plate of the inferior appendages (distal part broken off). *m—m:* between the arrows the IX/X muscle originates. For further explanation see text.

contains at least the main part of Segment X. The anus is situated on the posterior border of the upper lip. To me it seems justifiable to homologize the processes in *Tinodes* with those of the paraprocts in *Polycentropus* (pp. 46—47). This means that the sclerite shaped like an inverted U represents the fused paraprocts. In *Lype* the latter have fused also with the sclerite of Segment X, and their processes are lost.

Three pairs of muscles are associated with the upper lip: (1) A sagittally compressed muscle originating from the apodeme *3* (fig. 14) between the arrows *m—m*, just anteriorly to the line of union between Segments VIII and IX, and inserted on

the dorsal part of *2b*. This muscle bridges the "mouth angle" and is enclosed in the overlapping fold of Segment VIII (fig. 15A, *25*). (2) A rather small muscle originating from a process (fig. 14, *5*) on the external side of the apodeme *3* and inserted on *2*

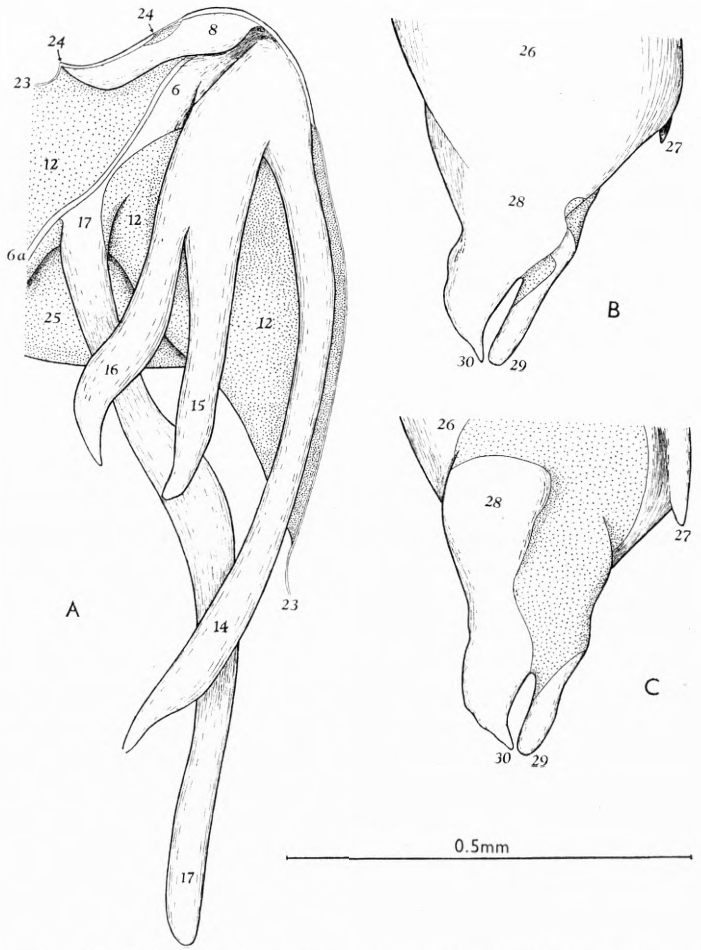

Fig. 15. *Tinodes waeneri*. A: right half of the genital chamber as seen from the inside (median view); the dorsal side of Segment X has been removed. B: distal end of left inferior appendage in lateral view. C: do. of right do. in median view. Numbers as in fig. 14 (*6*, *8*. and *12*, however, are seen from the external side). Further: *6a:* suture on the sclerite of the genital chamber. *23—23:* cut edge arisen by sagittal section through the genital chamber. *24—24:* between the arrows the phallus has been attached. *25:* overlapping posterior border of Segment VIII. *26:* coxopodite. *27:* spine on the dorsal margin of the sclerite of the coxopodite. *28:* harpago. *29* and *30:* dorsal and ventral branch of the latter.

at the boundary between 2a and 2b. (3) the dorsal VIII/IX muscles are inserted on the dorsal part of 2a. The tree pairs of muscles, no doubt, are homologous with those correspondingly numbered in *Lype* (p. 26). In *Tinodes* the muscle (1), also, has shifted its origin to that part of Segment IX which has fused with Segment X. The muscles

(1) and (3) possibly can give the upper lip a nodding movement. In the state of repose the muscle (2) is almost parallel to 2b. During a strong levation of the upper lip, however, it possibly may assist the muscle (3).

The inferior appendages (figs. 13A—C, *13* and *14;* 16) are large and two-jointed. Proximally the two coxopodites are united to a rather great extent, though chiefly by membrane. Quite proximally on the ventral side only, there is a narrow, but strong, sclerotic transverse bridge, which on either side of the membranous area continues as a thickened ridge along the ventral part of the proximal margin of the appendages. Hence, the sclerotic connection is effected chiefly by the large basal plate (figs. 14, *20;* 16A, *1*), which projects far forwards and further is protracted into a long, sagittally compressed and somewhat spoon-like apodeme (fig. 14, *11*). It is connected with the sclerotizations of the appendages themselves by two pairs of narrow bridges only (fig. 16A).

The basal plate is steeply descendent. It carries two unpaired processes. The distal (and ventral) one (fig. 16B, *4*) is short and clumsy and of a rather varying shape. It is provided with a pair of strong, yellow setae (which in fig. 16A are concealed by *3*). The proximal process (figs. 13B, C, *15*; 14, *22*; 16, *3*) takes the shape of a forwards directed, dorsally concave lip, from the anterior edge of which a very long and slender horn arises. Basally the latter is upwards directed, but it soon becomes curved backwards. It forms the ventral part of the phallus-guide. The proximal part of the horn is sagittally compressed. Its downwards curved apex, too, is much sagittally compressed, dagger-shaped, with a sharp anal (or dorsal) edge.

In transverse section the coxopodite is ovate with the broad end dorsally. Except for the bridges mentioned above its median side is membranous. Approximately in the middle of the dorsal margin of the lateral sclerite there is an inwards directed, flattened spine (figs. 16, *6;* 15B, C, *27*), which may be bifurcated or even have a more complicated shape. It may be opposed to the apex of the intermediate branch of the paraproctal process (figs. 14 and 15, *15*).

The harpago (figs. 13, *14;* 15B, C, *28;* 16, *7*) is much smaller than the coxopodite. Its median side is twice as long as the lateral side, but (except quite distally) it is sclerotized in its ventral half only. Distally the harpago is divided into a dorsal (fig. 15, B, C, *29*) and a ventral branch (*30*). The former is finger-like. The stronger ventral branch is claw-like and somewhat concave on the median side. The sclerotic connection between the two branches consists only of a rather narrow, laterodorsal bridge, so they may have some (passive) mutual movement. On the lateral side the sclerites of the coxopodite and the ventral branch of the harpago are continuous.

The anterior dorsal muscle is lacking. The anterior ventral muscle is very strong. It originates on the whole ventral part of the apodeme of Segment IX (fig. 14, *3a*), and also from the anterior end of the non-apodemal part (*1*). Some of the muscle-bands are inserted on the sclerotic part of the median sides of the coxopodites. The vast majority, however, are inserted on the basal plate, from its posterior edge to the base of the process *3* (fig. 16). The posterior dorsal muscle is much smaller, but still

rather strong. It originates from the ventral part of the sclerite (figs. 14 and 15, *6*) in the genital chamber, and is inserted on the oral end of the apodeme of the basal plate (fig. 14, *11*). The posterior ventral muscle originates from the proximal half of the ventral edge of the coxopodite and is inserted on the lateral margin of the basal

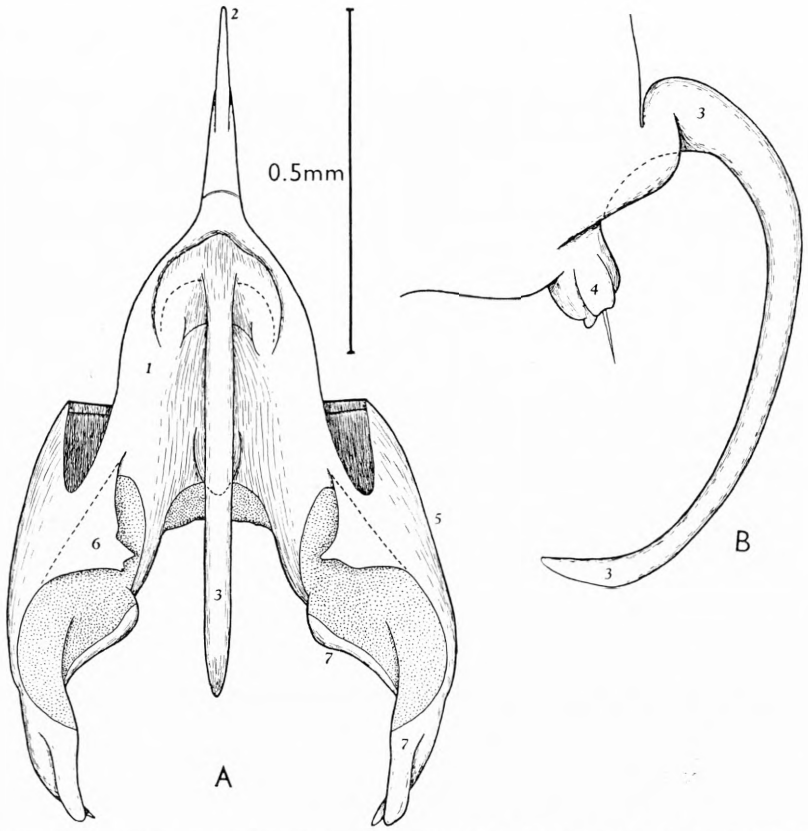

Fig. 16. *Tinodes waeneri*. A: inferior appendages in dorsal view. B: processes of the basal plate in lateral (left) view. *1:* basal plate. *2:* apodeme of the latter. *3* and *4:* proximal and distal process of the basal plate. *5:* coxopodite. *6:* spine on the latter. *7:* harpago.

plate; its fibres are descendent. The flexor of the harpago originates from almost the whole lateral side of the coxopodite and is inserted on the middle of the median side of the harpago, i. e. at the base of the ventral branch of the latter.

A contraction of the anterior ventral muscle must pull the basal plate forwards and thus adduce the two inferior appendages. Considering the small extent of the sclerotic connection between the basal plate and the appendages themselves, the former possibly may perform an independent movement, when the appendages are fixed by grasping the body of the ♀. This movement will be a depression of the oral part of the plate, which again causes a retraction of the base of the horn *3* (fig. 16B) and a

levation of its distal part. The posterior dorsal muscle is the antagonist of the anterior ventral one. Alternating contractions of the two posterior ventral muscles perhaps may give the horn *3* a rocking movement (from side to side).

The undivided phallus (figs. 13, *16;* 14, *21;* 17) is long and slender. From a

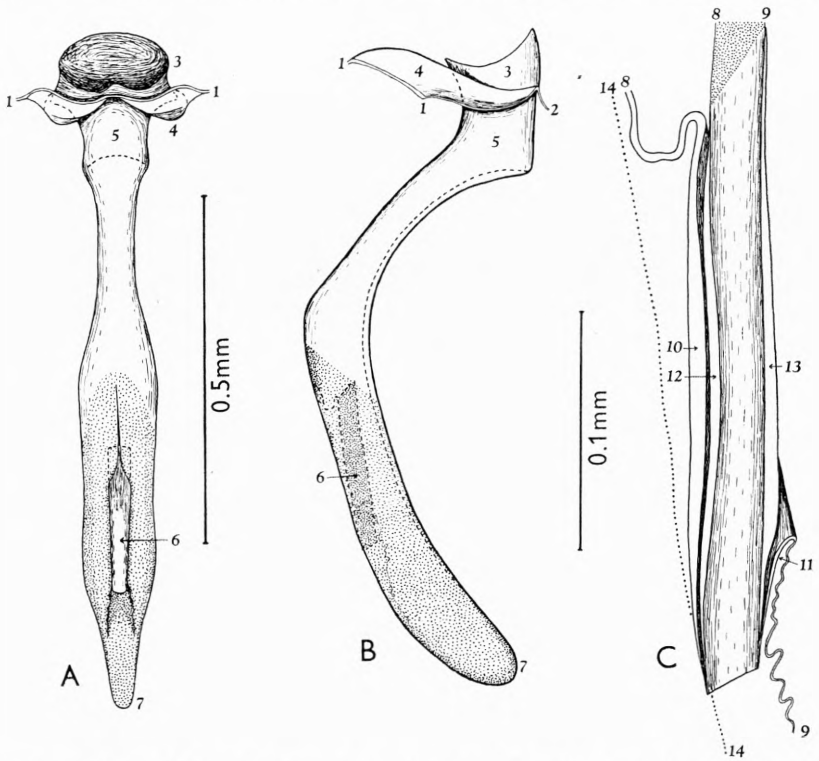

Fig. 17. *Tinodes waeneri.* A: phallus in dorsal view. B: the same in lateral (right) view. C: left half of the dorsal branch as seen from the inside (median view). *1—1:* cut edge along the line of connection between *4* and the sclerite of the genital chamber (figs. 14 and 15, *6*). *1—2:* cut edge through the line of connection between 4 and the membrane of the genital chamber (figs. 14 and 15, *12*). *3:* phallic apodeme. *4:* sclerite connecting the proximal end of the phallus with the sclerite of the genital chamber; in B as seen from the haemocoelic side. *5:* phallus. *6:* dorsal branch of phallus (in B shining through). *7:* ventral branch of phallus. *8—8* and *9—9*: cut edges. *10:* section through upper wall and *11:* section through lower wall of dorsal branch of phallus. *12:* section through upper wall and *13:* section through lower wall of the ejaculatory duct. *14—14* (coarsely dotted line) indicates the position of the upper side of the ventral branch.

purely topographical point of view it may be considered as composed of three parts: (1) A short and comparatively thick proximal part, pointing directly backwards. (2) A very slender, upwards and backwards directed middle part. (3) A thicker, backwards and a little downwards directed distal part, which apically is greatly sagittally compressed. The ventral sides of (2) and (3) form an even curve, congruent with the curve described by the horn of the inferior appendages (figs. 16, *3;* 13, *15;* 14, *22*), and have a concavity, which receives the dorsal side of this horn and proximally is bounded by a sharp edge. As mentioned above, the horn forms the ventral branch

of a tripartite phallus-guide. The dorsal part of the guide is formed by the superior branches (figs. 13, *9;* 14 and 15, *14*) of the paraproctal processes, the distal two thirds of which are applied laterodorsally to the distal part of the phallus.

The proximal and the middle part of the phallus is sclerotized, whereas the distal part chiefly is membranous. On the dorsal side of the distal part there is a longitudinal furrow, in which a sclerotic tube (fig. 17 A, B, *6*) is seen. A closer examination (fig. 17 C) shows that this tube has a double wall. The internal wall (*12, 13*) is the sclerotic distal part of the ejaculatory duct. On the external wall the dorsal side (*10*) is four times as long as and much thicker than the ventral side (*11*).

There is no phallocrypt and the phallic apodeme (figs. 14, *9;* 17, *3*) is very short, especially on the dorsal side. Laterally the base of the phallus is connected with the dorsal part of the sclerite *6* (figs. 14 and 15) by a pair of vertically placed sclerites (*8;* fig. 17, *4*). In transverse (horizontal) section the latter are curved, the convexities facing backwards. For their dorsal two thirds the two sclerites have fused, but are separated by a furrow corresponding to the their curvatures. Between the ventral third of the sclerites and the dorsal side of the phallus there is a triangular (or perhaps rather arrowhead-like) membranous area.

The phallus has no musculature, neither extrinsic, nor intrinsic. Its possible movements are entirely dependent on the musculature of the inferior appendages and Segment X. A levation of the horn of the inferior appendages also means a levation of the phallus. The inferior appendages being fixed by grasping the body of the ♀, the opposite movement may be performed with great power by elastic forces: the sclerites at the base of the phallus and the paraproctal processes.

The tube *6* (fig. 17) might be considered as the aedeagus. This, however, would imply an extraordinary dorsoventral asymmetry of the phallobase. I find it more probable that *6* is homologous with the dorsal branch of the aedagus in *Rhyacophila* (fig. 6, p. *19, 4*), and that part of the phallus (*7*) which projects beyond the base of *6* with the ventral branch in *Rhyacophila* (fig. 6, *5*). The undivided condition would then have arisen in a similar way as in *Rhyacophila:* by obliteration of the endotheca and subsequent fusion of the phallotheca and the aedeagus. In *Lype* the tube *4* (fig. 12, p. 29), no doubt, is homologous with *6* in *Tinodes*. *4* (perhaps together with 2 and *3*) then represents the dorsal branch of the aedeagus, whereas the "lower jaw of the beak" in the phallus of *Lype* represents the ventral branch. In *Lype* the aedeagal retractor is inserted on the proximal end of the tube *4*. In *Agapetus* (p. 23) it is inserted on the dorsal side of the aedeagus, i. e. at the base of the dorsal branch.

Psychomyia pusilla.

At a first glance this form is very different from the two other psychomyids. A closer examination, however, reveals the same principle: the reduced and entirely detached dorsal part of Segment IX is intimately associated with Segment X.

The most conspicuous structures are a dorsal pair of large, sclerotic rods (figs.

18, *8—10;* 19, *5—6*), proximally united by a short membranous area, which in situ is concealed by the overlapping posterior border of Segment VIII. The proximal half of the rods is directed backwards, sagittally compressed, and rather high. The distal half is directed upwards and backwards and somewhat flattened. In a lateral view

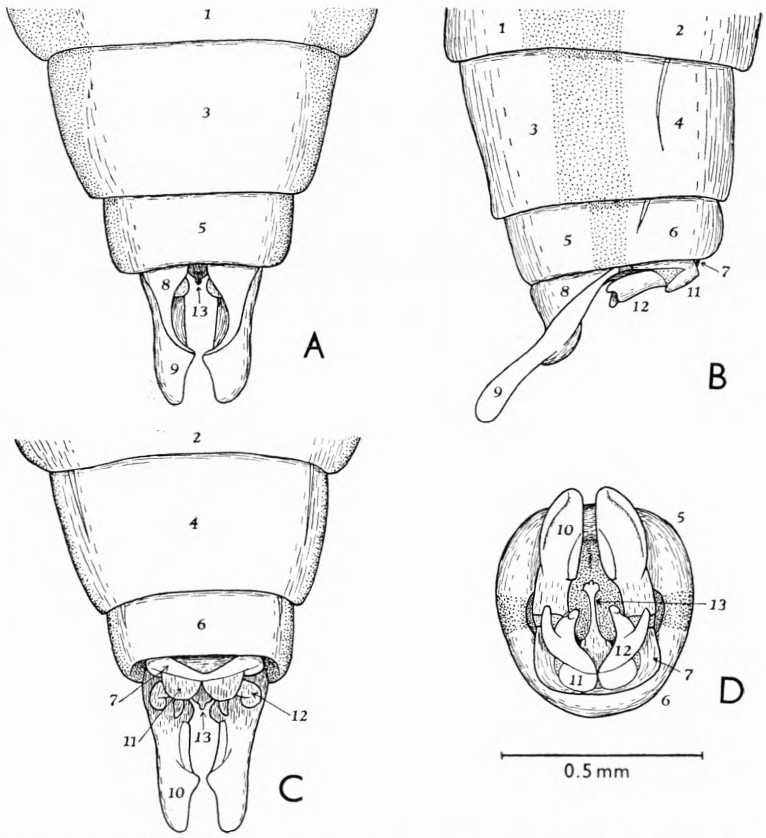

Fig. 18. *Psychomyia pusilla.* A—C: posterior end of abdomen in dorsal (A), lateral (right, B), and ventral view (C). D: Segments VIII—X in posterior view. *1:* anal part of Tergum VI. *2:* anal part of Sternum VI. *3:* Tergum VII. *4:* Sternum VII. *5:* Tergum VIII. *6:* Sternum VIII. *7:* Segment IX. *8:* proximal and *9:* distal part of "dorsal rod", separated by a suture (fig. 19A, *7*). *10:* ventral side of "dorsal rod". *11:* coxopodite. *12:* harpago. *13:* phallus.

a bulge (fig. 19, *8*) is seen in the middle of the rod. It is the brown ventral edge of an oblong, more thick-walled and more strongly sclerotized median area, which is concave; (the concavity faces mediodorsally). Proximally to this area there is, on the median side), a pad-like thickening, densely covered with setae and visible only in a dorsal or a ventral view. The distal end of the rod is spoon-like and more feebly sclerotized.

The sclerotization of the rod is separated from that of the ventral part of Segment IX (figs. 18, *7;* 19, *2*) by a rather broad membranous area. On the ventral side

a suture runs along the proximal margin of the sclerite of the rod. Laterally it makes a rectangular bend and runs, following a slightly sigmoid curve, obliquely backwards across the dorsal side of the rod (fig. 19, 7). It eventually ends on a small projection

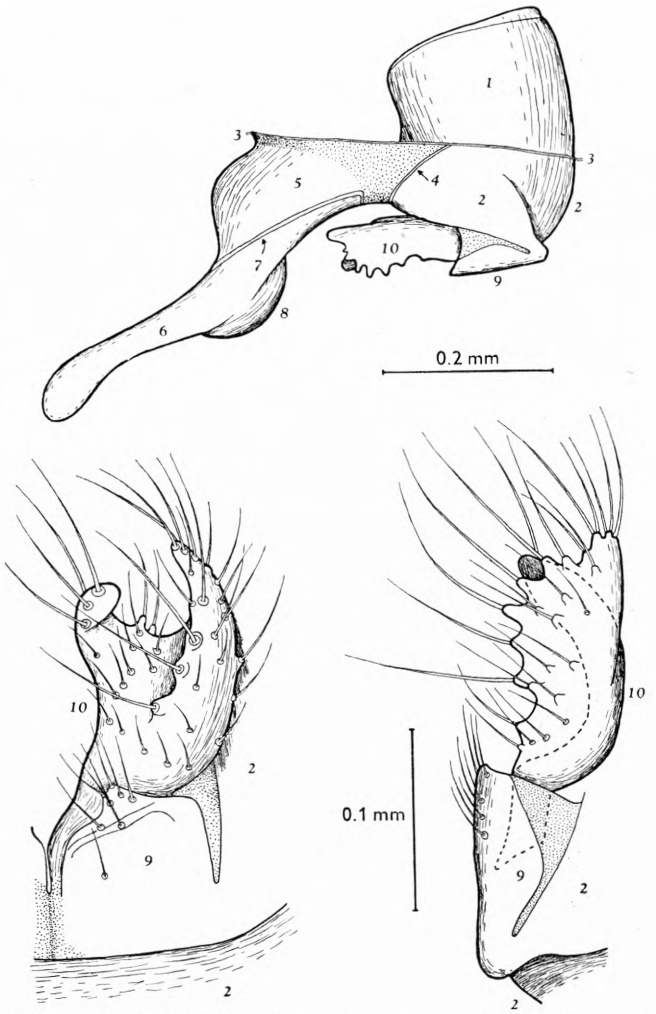

Fig. 19. *Psychomyia pusilla*. Above: Segments IX and X in lateral (right) view. Below: right inferior appendage in posterior and in lateral view; in the last figure the anterior direction is towards the right. *1:* apodemal and *2:* non-apodemal part of Segment IX, separated by *3—3:* cut edge through the intersegmental membrane between Segments VIII and IX. *4:* suture (see text). *5:* proximal and *6:* distal part of "dorsal rod", separated by the suture *7*. *8:* see p. 38. *9:* coxopodite. *10:* harpago.

of the median margin just distally to the cup-like depression described above. It might perhaps be supposed that this suture marks the boundary between Segment X and the dorsal part of Segment IX, the area (figs. 18, *8;* 19, 5) lying proximally (and medially) to the suture belonging to Segment IX, the area (figs. 18, *9;* 19, *6*) lying

distally (and laterally) to the suture to Segment X. The fact, however, that the anus (a vertical slit) is found between the bases of the rods shows that the proximal area contains parts of Segment X as well. The sutures, no doubt, is a secondary strengthening of the rods, and it is impossible to give the boundary between Segments IX and X. The homology of the rods is not entirely clear. They may represent the superior appendages, or they may represent paraproctal processes. I am most inclined to believe in the latter possibility. This view is supported by the fact that the medioventral edge of the rod projects into the phallocrypt and eventually joins the sclerotization of the latter; (cp. conditions in *Tinodes*, p. 37).

The ventral part of Segment IX (figs. 18, *7;* 19, *1—2*) is rather long, but more than its anterior half has an apodemal character (fig. 19, *1*). On the ventral side there is a strong, elevated area along the posterior margin. On the lateral side the sclerite also covers the broadly rounded posterior border of the segment, and at the posterior corner (i. e. quite dorsally) it is protracted as a rod-like sclerite into the phallocrypt. Along the dorsal margin of the non-apodemal part of the sclerite there runs a suture (fig. 19, *4*), which continues for at least some distance on the rod in the phallocrypt. From this suture rises the dorsal, strongly inwards bent part of the apodeme. This part of the apodeme, no doubt, is homologous with *3b* in *Tinodes* (fig. 14, p. 32), which shows that the sutures *4* in *Psychomyia* and *6a* in *Tinodes* (fig. 15) are homologous. In its course the suture *4* in *Psychomyia* shows so a high degree of conformity with the suture *10—11* in *Lype* (figs. 10—11, pp. 27 and 28) that a homology must be considered certain. It is very unlikely that these sutures are homologous with sutures in other families.

The dorsal VIII/IX musculature is divided into two portions. In one portion the bands converge fan-like and are inserted medially on *5* (fig. 19). This portion, which is very strong, must act as a levator and probably also as an adductor of the rods. The other, weaker, portion is inserted laterally and proximally in the rods and probably must act as an abductor. From the inwards bent part of the apodeme of Segment IX originates a strong muscle, which is inserted dorsally and proximally in the rods. It must be a depressor. According to its point of origin it is homologous with the muscle (2) in *Tinodes* (p. 33) and hence is a paraproctal muscle. The IX/X muscle is lacking in *Psychomyia*. Lateroventrally in the non-apodemal part of Segment IX (fig. 19, *2*) originates a muscle which is inserted on the posterior corner of the segment at the point where the latter bends into the phallocrypt. This muscle possibly influences the movements of the phallus and, no doubt, is the posterior ventral muscle of the inferior appendages, which has shifted its insertion.

The inferior appendages (figs. 18, *11—12;* 19, *9—10*) are very small and directed almost straight upwards. A comparison with *Tinodes*, as well as the musculature, seems to show that they have been subjected to a torsion of 90°, so that the backwards directed side represents the morphologically lateral side. (In the following purely topographical designations will be used). The appendage is divided into a shorter coxopodite (figs. 18, *11;* 19, *9*) and a longer harpago (*12*; *10*). The former is sclerotized

on the posterior side only. The two coxopodites are united for rather a long distance, though only by membrane. Proximally (= ventrally) their sclerites have fused with that of Segment IX. The line of union coincides with the elevated ridge along the posterior margin of Segment IX, mentioned above. There is no basal plate. The

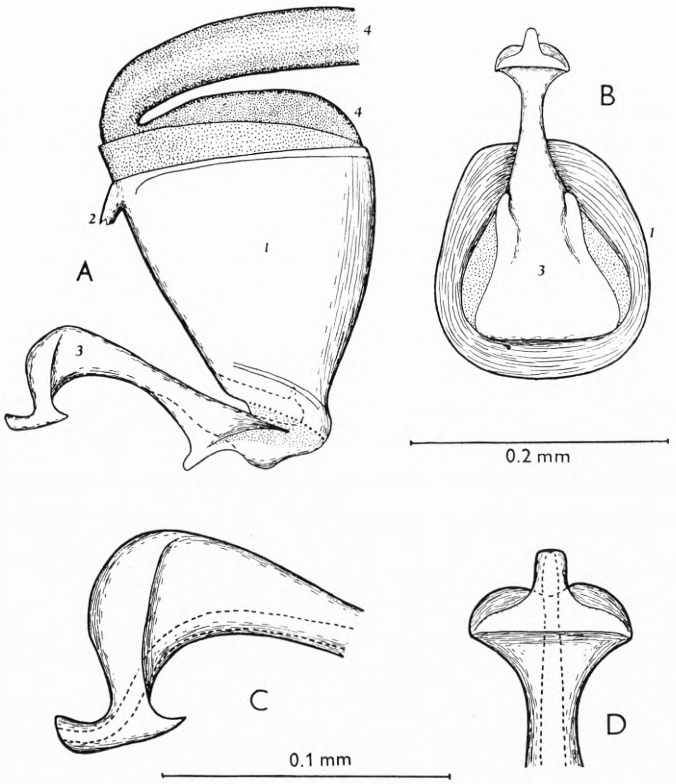

Fig. 20. *Psychomyia pusilla*. A: phallus in lateral (right) view. B: the same in posterior view. C: distal end of phallus in lateral (right) view. D: the same in posterior view. *1:* phallic apodeme. *2:* sclerite in the dorsal wall of the phallocrypt; its posterior part has been broken off. *3:* phallus. *4:* ejaculatory duct; in C and D its distal part is shown shining through. In A the coarsely dotted line indicates the boundary between the phallus and the phallic apodeme.

posterior side of the harpago is somewhat concave. Its distal end is divided into a thicker lateral and a slenderer median branch.

In conformity with the fusion between the coxopodite and Segment IX no muscles are inserted on the former. The two ventral muscles of the inferior appendages have acquired connections with the phallus, the two dorsal ones are lacking. The flexor of the harpago originates from the median margin of the sclerite of the coxopodite. Its bands pass orally and laterally to become inserted laterally and proximally on the anterior side of the harpago. Its function probably is to rotate the harpago, moving the lateral edge of the latter backwards and inwards.

The undivided phallus (figs. 18, *13;* 20) has a very unusual shape. Including the phallic apodeme it falls into two parts: a thick proximal part (fig. 20, *1*) and a slender, upwards directed, hook-like distal part (*3*). The shape of the latter will appear from the pictures better than from descriptions. The proximal part attains its greatest thickness anteriorly and tapers gradually in a posterior direction. In transverse section it is approximately trapezoid (though with much rounded corners) with a narrower dorsal side and a broader ventral side. For the greater part of its circumference the phallocrypt is obliterated, Part *1* being almost exclusively of an apodemal character. Dorsally, only, a pocket stretches forwards almost to the anterior margin of Part *1*. The floor of the pocket is the narrow dorsal side of Part *1*, the roof forms a longitudinal fold. As mentioned above, two pairs of rod-like sclerites (issuing from the dorsal rods and the posterior corners of Segment IX, respectively) stretch into this pocket. Anteriorly they fuse to an unpaired sclerite (*2*), which joins the dorsal wall of the phallus. If the dorsal rods (fig. 19, *6*) are considered as paraproctal processes, it will be seen that in *Psychomyia* there is the same sclerotic connection between the ventral part of Segment IX, the paraprocts, and the phallus as in *Tinodes* (pp. 31 and 37).

The slender, upwards directed distal part (fig. 20, *3*) is very heavily sclerotized. Its broader and flattened base, however, is membranous laterally, but here, also, the dorsal as well as the ventral side is sclerotic. The ejaculatory duct opens distally on the beak-like apex, which — apart from the lumen of the duct—is solid. A large, distal part of the ejaculatory duct is sclerotized. — The distal part (*3*) probably is homologous with the tubes *4* in *Lype* (fig. 12, p. 20) and *6* in *Tinodes* (fig. 17, p. 36), and thus is to be considered a dorsal branch of the aedeagus. This means that the ventral aedeagal branch is entirely reduced.

There are two anterior phallic muscles. One is the ordinary anterior muscle, which originates laterally from the antecosta of Segment IX and is inserted distally and laterodorsally on the phallic apodeme. The other, much stronger, muscle is the anterior ventral muscle of the inferior appendages. It originates from the ventral part of the antecosta and from the greater part of the ventral side of Segment IX and is inserted distally and ventrally on the apodeme. Since the sclerotic connections between the phallus on one side, and Segment IX and the dorsal rods (figs. 18, *8—9;* 19, *5—6*) on the other must exclude any higher degree of retraction, the two muscles probably act as levator and depressor, respectively. As mentioned above, the posterior ventral muscle of the inferior appendage has also been included in the muscular apparatus of the phallus. The posterior phallic muscle and the aedeagal retractor are lacking.

Wormaldia occipitalis.

The same principle is seen as in the Psychomyidae: the dorsal part (approximately the fourth) of Segment IX is much reduced and intimately associated with Segment X. It is still continuous with the ventral part of the segment, however, and appears as an anterior marginal thickening (fig. 22, *2*) of Segment X, forming a dorsal

continuation of the antecosta on the ventral part of Segment IX. *In situ* it is concealed by the overlapping posterior border of Segment VIII.

Lateroventrally Segment IX (figs. 21, *7;* 22, *1*) attains a considerable length and projects into the posterior part of Segment VII. The length of the ventral side is reduced by an oral an anal indentation. The latter, however, is shallow. Owing to the reduction of the dorsal part of the segment a rounded, laterodorsal posterior corner and an upper edge rise.

Segment X (figs. 21, *8;* 22, *3*) has the shape of a thin scale, much attenuated

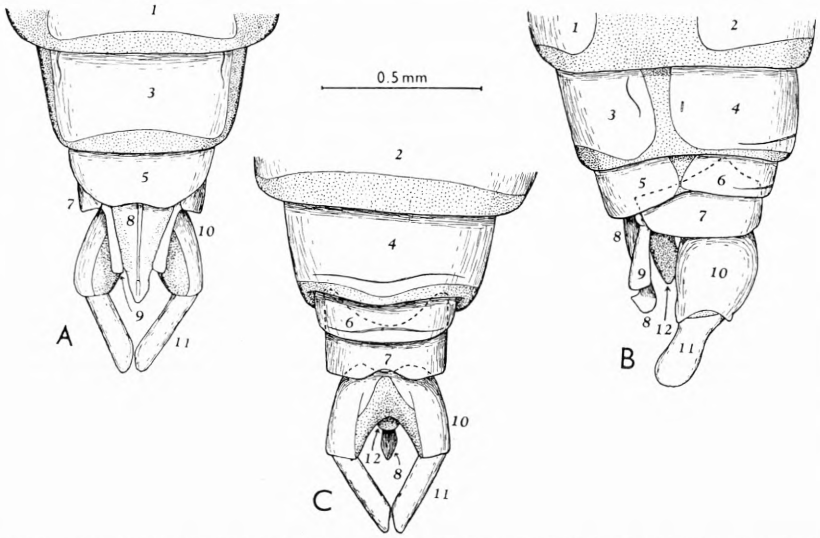

Fig. 21. *Wormaldia occipitalis.* Posterior end of abdomen in dorsal (A), lateral (right, B), and ventral view (C). *1:* anal end of Tergum VI. *2:* anal end of Sternum VI. *3:* Tergum VII. *4:* Sternum VII. *5:* Tergum VIII. *6:* Sternum VIII. *7:* Segment IX; in B and C the outline of its overlapped parts is shown by a broken line. *8:* Segment X. *9:* superior appendage. *10:* coxopodite; in C the ventral outline of its overlapped proximal end is shown by a broken line. *11:* harpago. *12:* phallus.

posteriorly, with a very convex dorsal side and a very concave ventral side. It encloses the phallus dorsally. Apart from the anterior and the posterior end a great, lateral part of the dorsal side is membranous. On the ventral side approximately the posterior half is sclerotized. On the dorsal side a little prominent longitudinal ridge (fig. 22, *4*) is seen. Posteriorly it grows narrower, and quite anally it is raised into a sagittally compressed process. It probably represents a reduced dorsal process.

The superior appendages (figs. 21, *9;* 22, *5*) are large and widened distally; in a lateral view the apex is obliquely cut off. The swollen proximal end medially is continuous with the sclerite of Segment X, so that the appendage is immovable in relation to the latter. On the dorsal side of the proximal end there is a short, broad, rounded longitudinal ridge. The upper edge of Segment IX overlaps the lateral side of this ridge, thus forming a sort of simple articulation.

The rather strong IX/X muscle originates laterally from the antecosta of Segment

IX and is inserted on Segment X at the angle between the segment itself and the superior appendage. The steeply ascendent (more than 45°) muscle must act as a depressor of Segment X (and the superior appendage). Its antagonist probably is the dorsal VIII/IX muscle, which as in *Psychomyia* (p. 40) is divided into two portions. The weaker lateral portion is inserted just anteriorly to the superior appendage. There is no paraproctal muscle.

The inferior appendages (figs. 21, *10—11;* 22 B) are very large, two-jointed and of a simple shape. The coxopodite (fig. 22, *7*) has a sclerotic lateral side and a membranous median side. The two coxopodites are united for approximately half of their length. The union, however, is largely membranous. It is only quite proximally that the common part of the two coxopodites is sclerotized, to the greatest extent dorsally. (The extreme proximal end of the two appendages thus forms an entire, sclerotic ring, the dorsal side of which is longer than the ventral side). The basal plate (*6*) is short and especially narrow. A narrow suture runs along the proximal margin of the appendages. At the posterior end of the basal plate it fuses with a broader, unpaired, longitudinal suture, and the suture thus formed covers the whole basal plate.

The harpago (*8*) is entirely sclerotized and somewhat sagittally compressed. Distally its median side is covered with close-set, short, but relatively very thick setae with rounded apices. Together, at a low magnification, they give the impression of a strong, dark brown thickening.

The anterior dorsal muscle originates lateroventrally from the antecosta (and partly from the surface) of Segment IX, and is inserted dorsally on the proximal margin of the appendage. It is ascendent and must act as a levator. The weaker posterior dorsal muscle acts as a depressor. The anterior ventral muscle, which also is a rather weak muscle, is inserted on the middle of the ventral membranous part of the coxopodites. Laterally to its insertion, but also on the membranous area, other muscle bands are inserted, which originate dorsally from the coxopodite, on the median margin of the sclerite, and which must represent the posterior ventral muscle. Their function—or rather the significance of their function—is obscure to me. The flexor of the harpago originates from the whole lateral side of the coxopodite as well as from the unpaired longitudinal suture of the basal plate and is inserted proximally on the median side of the harpago. It is the strongest muscle of the inferior appendage, and possibly it alone is responsible for their grasping function, since the coxopodites scarcely can be adduced (or abduced).

Including the phallic apodeme the phallus (figs. 21, *12;* 22 C) is composed of a proximal, very thick part (which may be called the bulb; fig. 22, *9*) and a distal, slender, and finger-like part (*10*). The phallocrypt is shallow except on the dorsal side (s. str.), where it is very deep, stretching as a pocket almost to the base of the bulb. (I have been unable to make out the boundaries with absolute certainty). The lateral and the ventral sides of the bulb thus have an apodemal character. In the bulb the ejaculatory duct has a very eccentric position, being shifted towards the dorsal side. It has a very strong musculature, comprising both circular and longitudinal

elements, which entirely fills up the bulb. The muscle layer of course is thickest on the ventral side. The weaker longitudinal muscles lie externally to the circular ones.

The distal, finger-like part of the phallus is membranous to its greatest extent, the extreme basal end, only, being sclerotized. In the state of repose more than the

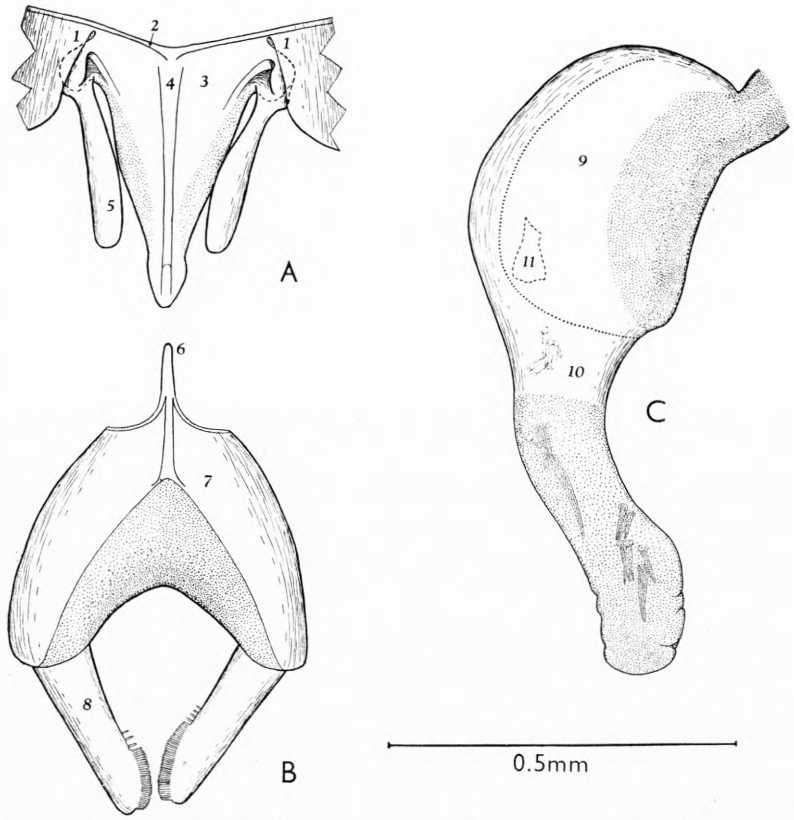

Fig. 22. *Wormaldia occipitalis*. A: Segment X and adjacent parts of Segment IX in dorsal view. B: inferior appendages in dorsal view. C: phallus in lateral (right) view. *1:* (ventral part of) Segment IX. *2:* antecosta, representing the dorsal part of Segment IX. *3:* Segment X and *4:* its dorsal ridge. *5:* superior appendage. *6:* basal plate of inferior appendages. *7:* coxopodite. *8:* harpago. *9:* phallic apodeme. *10:* phallus. The boundary between *9* and *10* is indicated by a coarsely dotted line. *11:* sclerite at the bottom of the endotheca (shining through).

distal half is invaginated into the more proximal part, and must be considered as an endotheca. In all specimens examined this was thrown into quite irregular folds, and hence its outline is not shown in the figure. The ejaculatory duct opens into the bottom of the endotheca, flanked by a pair of small sclerites (*11*), which may be rudiments of the aedeagus, and on which the aedeagal retractor is inserted. This muscle originates on the dorsal side of the bulb and causes an interruption of the circular musculature of the ejaculatory duct (which thus rather should be termed a horseshoe musculature). In (some) species of *Chimarrha* Steph. and *Thylakion* Barn. parameres

have been described (BARNARD 1934, pp. 382—84). The slerites (*11*) mentioned above may, therefore, represent rudimentary parameres (see also p. 12).

On the wall of the endotheca four groups of very strong setae are seen. The number of setae was counted on three specimens. (The group which is seen most anteriorly on the invaginated endotheca is mentioned first):

2—11	1, very large	3—6	1, large
4—10	ca. 6	3—6	1, large

KIMMINS (1953c) has called attention to these setae ("spines") as a means to distinguish the species and subspecies of *Wormaldia*. According to this the Cimbrian subspecies is *W. occipitalis occipitalis* Pict.

The anterior phallic muscle originates from the most dorsal part of the antecosta of Segment IX and on the lateral half of the "antecosta of Segment X" (fig. 22 A, 2). The posterior muscle originates from the rounded posterior corner of Segment IX. The chief function of the two muscles probably is to give the phallus a nodding movement.

Polycentropus flavomaculatus.

In this form, also, the same principle is found as in the Psychomyidae: the dorsal part of Segment IX is much reduced and intimately associated with Segment X.

The ventral part of Segment IX (fig. 23, *5;* in the following simply called Segment IX) is a rather long, sclerotic half-ring. It is longest on the lateral side. On the ventral side a deep, oral indentation reduces the length to less than half of that of the lateral side. Besides an anterior and a posterior edge an almost horizontal dorsal edge is seen. From a morphological point of view the latter is a part of the anterior edge: it is followed by the line of union between Segments VIII and IX, and the antecosta is continued upon it. The greater part of Segment IX is overlapped by Segment VIII, though the segment only to a small extent has an apodemal character.

The structure formed by the union of the dorsal part of Segment IX with Segment X (figs. 23, *6—8;* 24; in the following simply called Segment X) is trilobed. Its most oral part, however, is undivided, and membranous except for a pair of transverse, faintly defined sclerites lying in front of the dorsal (or median) half of the side-lobes (and in fig. 23 concealed by Segment VIII). The dorsal VIII/IX muscles are inserted on these sclerites, which thus, no doubt, represent part of the dorsal side of Segment IX. The muscle in question probably is homologous with the lateral portion of the VIII/IX muscle in *Psychomyia* (p. 40), whereas the median portion is lacking.

The middle lobe (fig. 23, *6*) of Segment X forms a large membranous tube, posteriorly carrying the anus (fig. 24, between the two *3—4*s), the upper lip of which projects much beyond the lower, which is slightly bilobed. On the ventral side of the tube there is a longitudinal pair of strong, rod-like sclerites (fig. 24, *3*). On each

sclerite there is a sharp, longitudinal ridge, which anally projects into a downwards, outwards, and forwards directed hook (figs. 23, *10;* 24, *4*). The sclerites, no doubt, are to be considered the paraprocts (cp. p. 7), and the hooks consequently as paraproctal processes. Accessory copulatory processes on the paraprocts possibly are an old heritage in the Trichoptera. In *Rhyacophila gregoryi* Ulm. Ulmer (1932—33, p. 41) describes "Appendices präanales" in the shape of "S-förmig geschwungene und gedrehte Chitinstäbe, die sich kreuzen." They should probably be interpreted in this way. Something similar is seen in *Rh. montana* Carp. (Ross 1944, p. 33), in *Agapetus cataractae* Ulm. (Ulmer 1951, p. 55), and in some species of *Synagapetus* (Kimmins

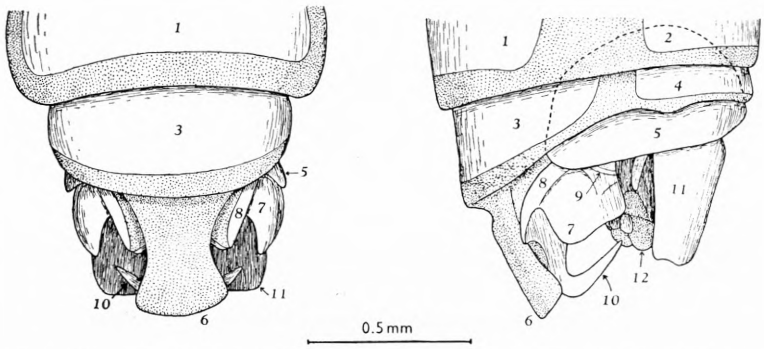

Fig. 23. *Polycentropus flavomaculatus.* Posterior end of abdomen in dorsal and in lateral (right) view. *1:* posterior part of Tergum VII. *2:* posterior part of Sternum VII. *3:* Tergum VIII. *4:* Sternum VIII. *5:* Segment IX. *6:* middle lobe of Segment X. *7:* superior appendage. *8* and *9:* see pp. 47–38. *10:* paraproctal process. *11:* inferior appendage. *12:* phallus.

1953b). In the two latter genera, however, the paraprocts have fused with the sclerite of Segment X (Cp. also p. 21 and pp. 146—47, 150—52). — Between the two sclerites the membranous ventral side is thrown into a longitudinal fold. Their ridges enclose the dorsal side of the phallus.

The side-lobes (figs. 23, 7; 24, *1*) are shorter than the middle lobe. Ventrally (= laterally) their bases are overlapped by the posterior edge of Segment IX. The convex lateral (= dorsal) side is sclerotized, except at the ventroproximal corner and along the dorsal edge, which latter has partly fused with the middle lobe. The strongly concave median side is entirely sclerotized and only by a narrow membranous stripe separated from the paraproctal sclerite (fig. 24, *3*). Proximally the ventral edge of the side-lobe projects below the narrow anterior end of the paraproctal sclerite, though a true articulation is not formed. By a distal notch, which is larger than the notch between the middle lobe and the side lobe, the latter is divided into a narrow dorsal branch and a several times as broad ventral branch. Along the dorsal half of the proximal margin of the side lobe there runs an external ridge (fig. 23, *8*), which continues on the dorsal branch and eventually forms a simple articulation with a process (fig. 24, 5) on the paraproctal sclerite. At the posterior corner Segment IX has an in-

wards directed point, which forms a simple articulation with the ridge *8*, lying anteriorly to the latter. Along the ventral half of the proximal margin there is a suture (figs. 23, *9;* 24, *2*) and a corresponding internal ridge.

The very strong IX/X muscle originates on the whole lateral part of the antecosta of Segment IX and is inserted on the side-lobe, partly—and especially—on the internal ridge corresponding to the suture *9* (fig. 23; fig. 24, 2), partly on the proximal end of the median side. Another, sagittally compressed muscle originates from the antecosta on the dorsal edge of Segment IX and is inserted on the median margin of the paraproctal sclerite. This muscle, no doubt, is an intersegmental muscle stretching between Segments IX and XI (the paraproct). In remote ancestors of the Insecta it probably had its anterior insertion on the antecosta of Sternum X. As a result of the reduction of the latter (p. 7), this insertion must have shifted to Segment IX. An undoubtedly homologous muscle, originating on the sternal region of Segment IX and inserted on the paraproct, is found in *Gryllus* (Snodgrass 1933, p. 69). Examples of intersegmental muscles passing over one or two segments are found also in the anterior end of the abdomen of insects in connection with reduction of terga and sterna.

The IX/X muscle possibly acts as a depressor of Segment X as a whole. Due to the articulation (fig. 24, *5*) between the side-lobe and the paraproct, part of the muscular power is transmitted to the paraprocts causing a rotation of the latter, by which the two hooks *4* (fig. 24) are adduced. This movement is accentuated by the paraproctal muscle. The antagonist to the IX/X muscle probably is the dorsal VIII/IX muscle, which—as mentioned above—has its insertion dorsally to the articulation between Segment IX and the side-lobe.

It seems an obvious conclusion that the side-lobes represent the superior appendages, and probably their ventral branch represents this appendages. A comparison between the origins of the posterior phallic muscle in *Polycentropus* (see below) and in *Holocentropus* (p. 53) indicates that the dorsal branch (fig. 23, *8*) belongs to Segment X itself. In one respect the superior appendage of the Polycentropidae differs very much from those of other Trichoptera: they carry the insertion of the IX/X muscle. An advance towards this condition perhaps is found in *Wormaldia*, in which the insertion of the IX/X muscle is in the angle between Segment X itself and the superior appendage (p. 43).

The inferior appendages (figs. 23, *11;* 24) are one-jointed. The median side is very concave. A distal notch divides the appendages into a dorsal (fig. 24, *7*) and an almost three times as long ventral branch. The dorsal branch has an obliquely cut off and somewhat concave distal edge. The median corner of the latter is protracted into a small, downwards bent tooth, which meets (or almost meets) the apex of another, transverse and lamella-like, tooth on the median side of the ventral branch. Proximally on the ventral side of the upper edge of the appendage there is a molar-like tooth (*8*), which can be opposed to the corresponding structure on the other appendage. Proximally to the "molar" the median side is not concave, but flat, and eventually united with that of the other appendage. The basal plate (*6*) takes the shape

of a small, forwards projecting pocket, on the anterior end of which there is a small, ridge-like, vertical apodeme.

The inferior appendages have only two pairs of extrinsic muscles. The anterior ventral muscle is inserted on the proximal part of the median side. The other is a slender muscle originating anally from Segment IX and inserted on the apodeme of the basal plate. The origin of this muscle is lateroventral, far removed from the origin of the posterior phallic muscle, and it thus might be concluded that it is the posterior ventral one. Since, however, the latter generally originates from the coxopodite, I find it most likely that the posterior muscle present in *Polycentropus* is the dorsal one. The two muscles probably are an adductor and an abductor, respectively, but the possibility also exists that they may act as a levator and a depressor. The flexor of the harpago is of course lacking.

The phallocrypt is very shallow, forming little more than a circular furrow. The phallic apodeme (fig. 25, 2) is large and thick. In a dorsal or ventral view it appears almost globular, in a lateral view it approaches the shape of a vertical cylinder, though with a pronounced, rounded bend on the anterior (morphologically: dorsal) side; for the greater part the phallic apodeme is membranous or at least very slightly sclerotized. It is only the (forwards directed) dorsal side which is (really) sclerotic. By an obtuse-angled bend the phallus is separated from the apodeme. (The bend, however, does not coincide exactly with, but is situated a little distally to, the boundary between apodeme and phallus).

The phallus (figs. 23, *12*; 25) is short and thick, straight, and straight backwards directed. It is formed chiefly by the phallobase (fig. 25, *3*), which is approximately cylindrical, though with a pair of laterodorsal impressions, leaving a proximally broader, distally narrower longitudinal keel, which fits into the interspace

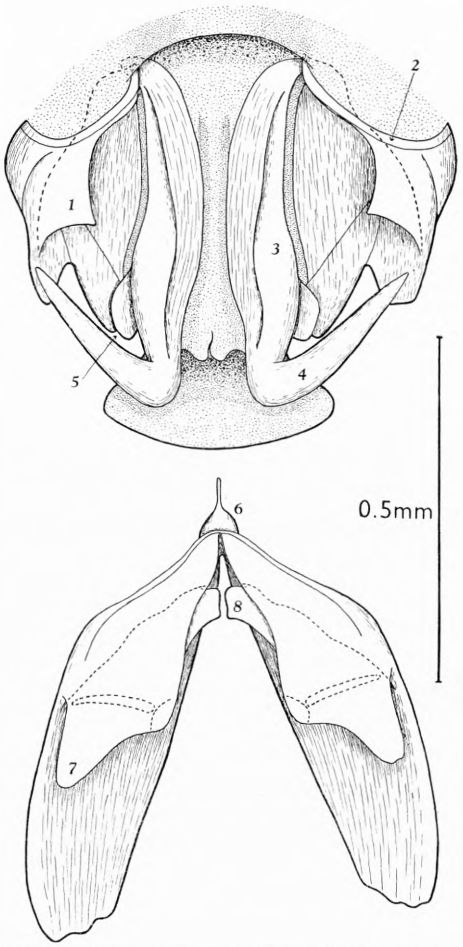

Fig. 24. *Polycentropus flavomaculatus*. Above: Segment X in ventral view. Below: inferior appendages in dorsal view. *1:* ventro-distal corner of superior appendage. *2:* proximal suture on superior appendage (= fig. 23, *9*). *3:* paraproctal sclerites; between their anterior ends the entrance to the phallocrypt, between their posterior ends the anus is seen. *4:* paraproctal process. *5:* articulation between the superior appendage and the paraproctal sclerite. *6:* basal plate of the inferior appendages. *7:* dorsal branch of the inferior appendage. The lamella-like tooth on the median side of this appendage is shown shining through by a broken line. *8:* molar-like tooth on upper edge of the inferior appendage.

between the paraproctal sclerites (fig. 24, *3*). The greater part of the phallotheca is sclerotized, but the sclerite has three distal, membranous indentations: an unpaired dorsal one (= the dorsal lobe described below) and a pair of lateroventral ones (on the ventral lobe described below). The distal end of the phallobase is divided into six lobes: two unpaired ones and two pairs. The unpaired ventral lobe (fig. 26 B, *4*) approximately covers the ventral half of the circumference and contains the lateroventral indentations described above. Dorsally it overlaps the base of the small lateral lobe (A, B, *3*), which is prominent and auricular, and which again overlaps the ventral edge of the laterodorsal lobe (*2*). This lobe in its turn overlaps the lateral edge of the unpaired dorsal lobe (*1*). The latter is entirely membranous (= the dorsal indentation) and has a slightly concave distal edge. The paired lobes are sclerotized on the inside, too.

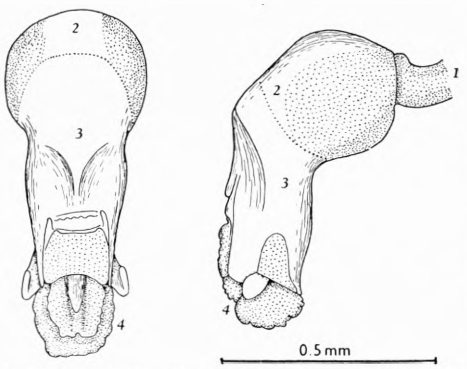

Fig. 25. *Polycentropus flavomaculatus*. Phallus in dorsal and in lateral (right) view. *1:* ejaculatory duct. *2:* phallic apodeme. *3:* phallobase. The boundary between *2* and *3* is indicated by a coarsely dotted line. *4:* aedeagus.

Ventrally the endotheca is very shallow. In a dorsal direction its depth increases rapidly, so that dorsally it is very deep.

The aedeagus (fig. 25, *4*) is much shorter than the phallobase. Those parts which in the state of repose are seen externally are chiefly membranous. By a deep slit the aedeagus is divided into an upper (fig. 26 A, B, *5*) and a lower lip (*6*). The latter is broader and projects farther backwards than the former. Proximally the lateral and the ventral sides of the upper lip (fig. 26 C—E) are sclerotized. The length of the sclerite increases in a ventral direction, and on the middle of the ventral side its posterior margin is produced into a narrow, tongue-like extension (*10*), which reaches the slightly bilobed distal end of the lip. On the ventral side the sclerite has a narrow, but very deep, unpaired, oral indentation. The wing-like parts of the sclerite (*9*) which flank this indentation, may be largely apodemal. Just behind the indentation there is a high and sharp transverse ridge. On the lateral side there runs along the distal margin of the sclerite a deep, descendent furrow, which in transverse section is approximately semicircular. On the ventral side the right and the left furrow are separated by a longitudinal ridge, which together with the transverse ridge mentioned above forms a stellate figure.

The ejaculatory duct opens proximally on the dorsal side of the upper lip. Its distal part has the shape of an elongate pitcher (*7*) and is sclerotized on the lateral and ventral sides as well as proximally on the dorsal side. Ventrally the sclerotization projects posteriorly as a tongue-like sclerite (*8*), which lies in a trough-like depression on the dorsal side of the upper lip. The anterior end of the sclerite *8* is continuous with the sclerite *9*. (This means that the proximal end of the upper lip is encircled by an annular sclerite). On the ventral side of the sclerotization of the

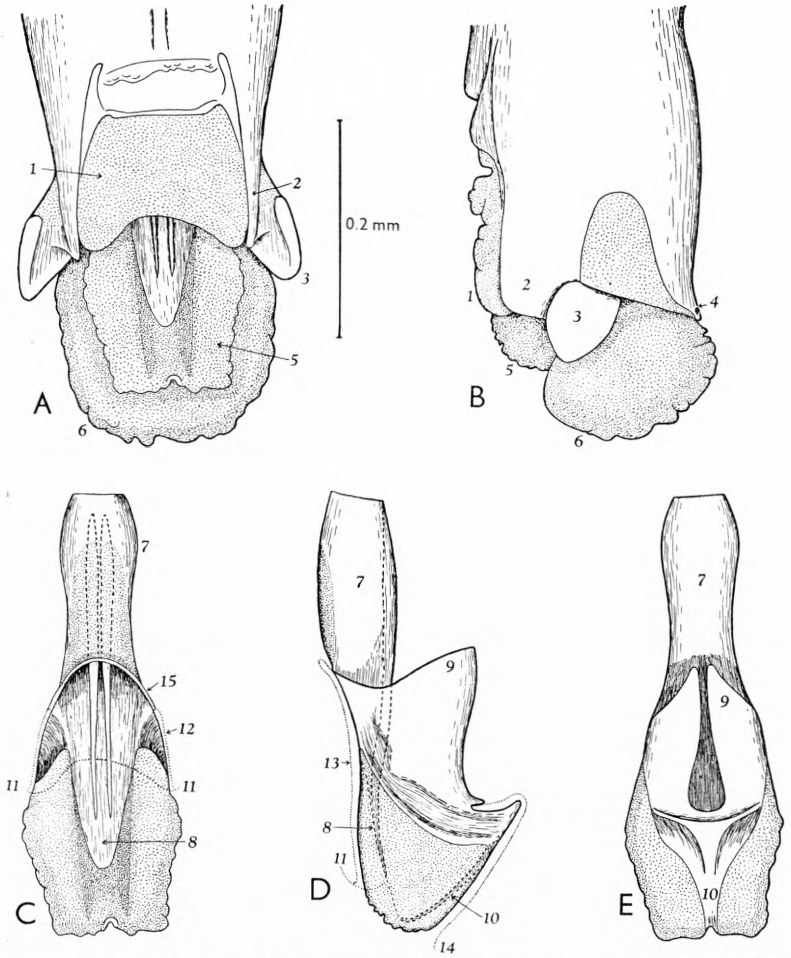

Fig. 26. *Polycentropus flavomaculatus;* phallus. A and B: distal end in dorsal (A) and in lateral (right, B) view. C—E: dorsal branch of the aedeagus in dorsal (C), lateral (right, D), and ventral view (E). *1—4:* distal lobes of phallobase; *1:* dorsal, *2:* latero-dorsal, *3:* lateral, *4:* ventral. *5:* dorsal, and *6:* ventral branch of the aedeagus. In A the aedeagus protrudes more than in B. *7:* distal part of the ejaculatory duct. *8:* distal, tongue-like extension of the sclerite of the ejaculatory duct; (in D shown shining through). *9:* proximal wing of aedeagal sclerite. *10:* ventro-distal end of same; (in D shown shining through). The coarsely dotted lines *11—14* indicate: *11:* distal edge of dorso-distal lobe of phallobase (fig. A, *1*); *12* and *13:* section through dorsal part of endotheca (= inside of dorso-distal lobe); *14:* section through dorsal side of ventral branch of the aedeagus. *15:* cut edge along the line of union between dorso-distal lobe of phallobase and dorsal branch of the aedeagus.

ejaculatory duct there is a pair of strong longitudinal ridges, which continue on the sclerite *8*.

The account of the ejaculatory duct given above perhaps is not quite correct. Within the "pitcher" (*7*) an extremely delicate tube is seen, at its entrance in the "pitcher" covered with long, very slender, backwards directed spinules, which form a sort of weel. Two explanations are possible: Either the delicate internal tube is the

true ejaculatory duct, and the "pitcher" is an apodeme issued from the sclerite of the upper lip. Or the delicate tube is an artefact, due to a delimination of the epicuticle. I am unable to decide between the two possibilities.

The lower lip is entirely membranous and partly encloses the ventral side of the upper lip.

The part of the phallic apodeme (fig. 25, *2*), which lies ventrally to a horizontal plane through the lower side of the phallus is filled up by a strong circular musculature belonging to the ejaculatory duct, whereas the part which lies dorsally to this plane is filled up by the strong aedeagal retractor. The latter muscle is inserted on the sclerite of the upper lip. The upper lip, no doubt, can be entirely everted by blood-pressure, the dorsal, membranous part of the endotheca as well as the cleft between the upper and the lower lip being stretched out.

To me there is little doubt that the upper and the lower lip are homologues of the dorsal and the ventral branch, respectively, of the aedeagus in *Rhyacophilidae* (pp. 19 and 24).

The posterior phallic muscle is very strong. Only a small number of its bands originate from the posterior corner of Segment IX; the vast majority originate from the ridge *8* (fig. 23) on the side-lobe of Segment X. It is inserted on the vertical part of the dorsal side of the phallic apodeme. The weak anterior muscle originates latero-ventrally from the antecosta of Segment IX and is inserted lateroventrally at the boundary between the phallic apodeme and the phallus. Since the shape of the phallic apodeme must prevent any higher degree of protraction, the chief function of the two muscles probably is to give the phallus a nodding movement.

Holocentropus dubius.

The relationship with *Polycentropus* is unmistakable, though there are considerable differences. The terms Segment IX and Segment X will be used in the same sense as in *Polycentropus flavomaculatus.*

The anterior edge of Segment IX (figs. 27, 3; 28, *1—2*) has not the bend seen in *Polycentropus*, but describes an even curve; in a lateral view Segment IX thus tapers gradually towards the rounded dorsal end. Along the whole anterior edge there is a large apodemal area (fig. 28, *1*). The posterior edge is bent inwards.

The membranous middle lobe (figs. 27, *4;* 28, *3*) of Segment X is very much reduced. At a first glance it appears only as small papilla carrying the anus. A closer examination, however, reveals that it stretches as a fine fold, *in situ* concealed by the overlapping posterior border of Segment VIII, to the base of the superior appendage (the side-lobe). The dorsal VIII/IX muscle is inserted on this fold. (Its most lateral bands, however, on Segment IX). Since the fold is very narrow, the muscle, no doubt, acts upon the sclerite in the genital chamber described below.

A very strong, unpaired sclerite lies in the dorsal part of the genital chamber (see fig. 27). It is rather concave, and its ventral edge projects as an elevated keel over

the ventral part of the genital chamber. Dorsally the sclerite has a deep, V-shaped indentation, the entrance to the phallocrypt, which dorsally is limited by the membranous middle lobe of Segment X. The edges of the indentation are bent much backwards, so that there arises a sort of trough (fig. 28, *4*), which—in a ventral view—has a distal V-shaped notch. The corners which flank the indentation are protracted into a pair of slender, entirely sclerotized horns (figs. 27, *7;* 28, *5*), which are backwards directed and downwards curved. The lateral corners of the sclerite are cut off vertically, as it were, leaving small membranous areas, in which the superior appendages are implanted.

The superior appendages (figs. 27, *5;* 28, 7). Almost the proximal half of the

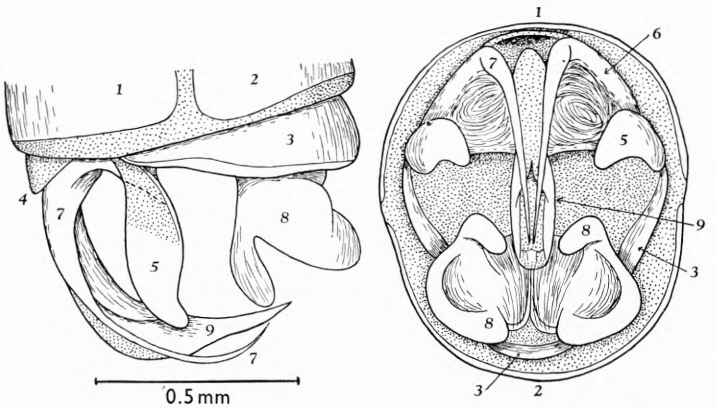

Fig. 27. *Holocentropus dubius*. Posterior end of abdomen in lateral (right) and in posterior view. *1:* posterior end of Tergum VIII. *2:* posterior end of Sternum VIII. *3:* Segment IX. *4:* middle lobe of Segment X. *5:* superior appendage. *6:* external ridge on the sclerite of the genital chamber. *7:* paraproctal process. *8:* inferior appendage. *9:* phallus.

lateral side is membranous. Quite proximally, however, there is a sclerotized stripe, which ventrally, but not dorsally, is continuous with the sclerotization of the median side. The distal part of the lateral side is sclerotic. The greater, distal part of the median side is membranous. Proximally there is a strong sclerotization, which is continuous with the sclerite of the genital chamber.

Between the base of the superior appendage and the horn 7 (fig. 27) the margin of the sclerite in the genital chamber is thickened to an external, rounded ridge (figs. 27 and 28, *6*). On the inside of the sclerite another short, but strong ridge is seen. It is placed lateroventrally at the base of the horn and runs in the direction from medially and dorsally to laterally and ventrally, almost perpendicularly to the entrance to the phallocrypt. From this internal ridge the posterior phallic muscle originates, and the paraproctal muscle is inserted on it (see below).

On the sclerite of the genital chamber the following, less important structures are seen: Lateroventrally on the base of the horn (between the numbers *4* and *5* in fig. 28) a backwards directed, conical, and very slender peg, ca. 60 μ long, distally

carrying a minute (13.5 μ), but relatively thick seta. Just medially to the superior appendages there is a low, ca. 45 μ broad node, which carries 3—5 yellow setae; (in the figs. concealed by the superior appendages).

A narrow suture runs along the posterior edge of Segment IX (see fig. 28, 2). The widened dorsal end of this suture joins the antecostal suture at the boundary of the apodemal part (*1*). (The two sutures enclose a small, triangular, membranous area between them). Eventually the antecosta bends medially and forms a simple

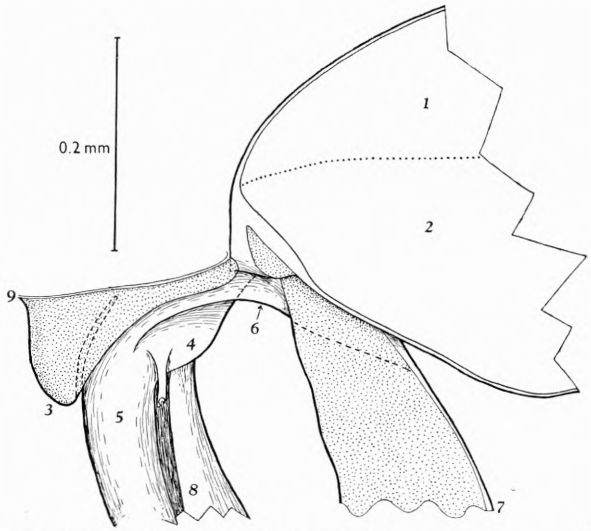

Fig. 28. *Holocentropus dubius*. The figure shows the relations between Segments IX and X; lateral (right) view. *1:* apodemal and *2:* non-apodemal part of Segment IX. *3:* middle lobe of Segment X. *4:* ventral, sclerotized lip of entrance to phallocrypt. *5:* paraproctal process; the greater, distal part has been broken off. *6:* external ridge on sclerite of genital chamber (= fig. 27, *6*). *7:* superior appendage; like *5*. *8:* phallus; like *5*. *9:* cut edge (the connection between Dorsum VIII and the middle lobe of Segment X).

articulation with the sclerite of the genital chamber. The line through the left and the right articulation is the axis of movement for this sclerite.

The very strong IX/X muscle originates from the lateral part of the antecosta of Segment IX and is inserted ventrally on the proximal margin of the superior appendage, partly by means of a leaf-like tendon, to the oral (or dorsal) side of which the muscle bands are attached. Another, weaker, fan-shaped muscle originates from the dorsal part of the antecosta of Segment IX and is inserted on the lateroventral end of the internal ridge on the sclerite of the genital chamber, described above. This muscle has the same position in relation to the IX/X muscle as has the paraproctal muscle in *Polycentropus* (p. 48) and thus, no doubt, is homologous with the latter.

The horns 7 (fig. 27) in *Holocentropus* obviously are homologous with the hooks *4* (fig. 24, p. 49) in *Polycentropus*, and thus are paraproctal processes. The relation between the horns and the sclerite in the genital chamber, as well as the insertion of the paraproctal muscle (see above) and the origin of the posterior phallic muscle (see

above and below), show that the sclerite in question in *Holocentropus* has arisen by fusion of the paraproctal sclerites and the rods *8* (fig. 23, p. 47) in *Polycentropus* into one unpaired sclerite.

The IX/X muscle moves the sclerite of the genital chamber and thus depresses the superior appendage and the horn. Its antagonists are the dorsal VIII/IX muscle and the paraproctal muscle.

As in *Polycentropus* the inferior appendages (fig. 27, *8*) are one-jointed and

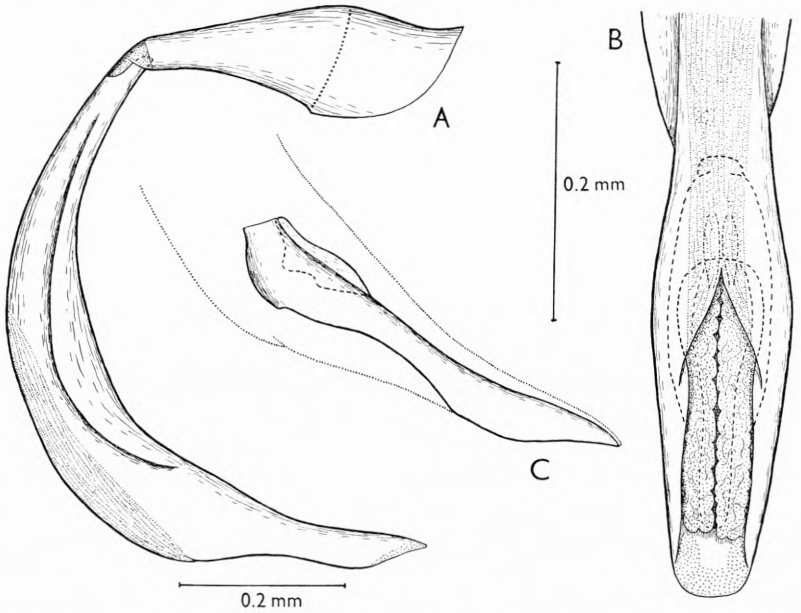

Fig. 29. *Holocentropus dubius*. A: phallus in lateral (right) view. B: distal end of phallus in dorsal view. C: sclerite of the ejaculatory duct and its distal extension in lateral (right) view. Coarsely dotted lines in A indicate the boundary between the phallic apodeme and the phallobase, in C the outline of the distal end of the phallus. Broken lines in B indicate the outline of the sclerite of the ejaculatory duct, in C the dorsal outline of the ventral thickening on this sclerite.

divided into a dorsal and a ventral branch. They have, however, a simpler shape than in *Polycentropus*. Their musculature is developed exactly as in this genus.

The phallus (figs. 27, *9;* 29) is divided into two parts, separated by a membranous articulation. The basal part is conical and very much attenuated towards the distal end. It is completely lowered into the deep phallocrypt, and in situ it has an almost vertical position. (Its longitudinal axis is parallel to the anterior edge of Segment IX). Proximally it continues as a strong phallic apodeme, which dorsally is two and a half times as long as ventrally. The slender distal part is club-shaped and curved rather much downwards. Its thin proximal end lies within the phallocrypt. On the lateral sides there is a pair of sclerotic wings, which together with the dorsal side form a pair of gutters receiving the horns 7 (fig. 27). These horns thus serve as a phallus-

guide. A large, distal part of the dorsal side is membranous with fine longitudinal wrinkles. The distal end itself is formed like a grocer's sugar spoon. The ejaculatory duct opens anteriorly at the bottom of the "spoon". As in *Polycentropus* the distal part of this duct is sclerotic, and as in *Polycentropus* there is a pair of longitudinal ridges on the ventral wall. The sclerite of the ejaculatory duct is produced into a pair of rods lying on the inside of the "spoon" and distally united with the main sclerite of the phallus. Distally the two rods are united also with each other and thus enclose a membranous area at the bottom of the "spoon". A pair of membranous, much wrinkled longitudinal folds rises from this area (in fig. 29 B they conceal the sclerotic rods). The space between these folds functionally continues the ejaculatory duct almost to the apex of the phallus. The extreme distal end of the phallus seems to be membranous or at least very feebly sclerotized, though rigid.

The same picture is seen as in *Polycentropus* (p. 51): Within the sclerotic part of the ejaculatory duct there is an extremely delicate tube, covered with fine, pale spinules. Anteriorly the latter attain their greatest length and form a sort of weel.

The rather weak aedeagal retractor originates from the dorsal side of the basal part and is inserted ventrally on the proximal end of the distal part. The insertion of this muscle shows that the distal part is the aedeagus, and the proximal part the phallobase. The endotheca has been obliterated. The similarity between the aedeagus in *Holocentropus* and the upper aedeagal lip in *Polycentropus* fig. 26 A, B, *5;* C) is so great that the two structures, no doubt, must be considered homologous. This means that the lower lip has been entirely reduced in *Holocentropus.*

As mentioned above, the posterior phallic muscle originates from the internal ridge of the sclerite in the genital chamber. It is inserted on the dorsal side of the phallic apodeme. The anterior muscle originates lateroventrally from the antecosta of Segment IX and is inserted ventrally on the proximal edge of the phallic apodeme. Owing to the shape of the phallobase and of the entrance to the phallocrypt, a protraction is impossible. The two muscles must have the same function, viz. a levation of the phallic apodeme, which will result in a slight protraction of the aedeagus.

Within the phallic apodeme the ejaculatory duct is provided with a strong circular musculature.

Ecnomus tenellus.

The length of Segment VIII is somewhat reduced, especially on the ventral side. In some of the preserved specimens the segment was withdrawn so much into Segment VII that the whole ventral side was concealed, and the dorsal side seen only as a narrow transverse area.

The structure which at a first glance might be supposed to represent Segment IX (figs. 30 and 31, *1—2*) in reality is of a composite nature and has arisen by fusion of Segments IX and X, or Segment IX and parts of Segment X. In the following it will for the sake of simplicity be called Segment IX. It is rather long and somewhat

sagittally compressed. By a pair of deep, longitudinal clefts, stretching anteriorly beyond the posterior margin of Segment VIII, it is divided into an upper (*1*) and a lower lip (*2*), both entirely sclerotized on the external side. Continuing the cleft there is a membranous area, so that the sclerotic connection between the two lips is restricted to a narrow bridge along the anterior margin of the segment. The antecosta continues without interruption from the upper to the lower lip. Orally as well as anally the lower lip projects much beyond the upper lip. There is an oral indentation both on the dorsal and the ventral side. The former is long and broad and evenly curved, the ventral indentation is shorter and narrower, V-shaped.

Anteriorly the ventral edge of the upper lip is very broad and has a broad, rounded longitudinal furrow (fig. 31 B, *8*). It might be supposed that this furrow was destined to receive the dorsal edge of the lower lip. The latter, however, is situated laterally to the former. From the furrow the posterior phallic muscle originates. On the lower lip there is a strong, unpaired longitudinal suture, which on a superficial view makes this lip look like a pair of basal joints of the inferior appendages.

The genital chamber is very deep, its anterior end being situated at the same level as the anterior end of the cleft mentioned above. Owing to the same cleft its wall is incomplete laterally. Quite dorsally in the genital chamber, just below the posterior edge of Segment IX, the anus is found, bounded ventrally by a membranous, bilobed lip. Beneath this, again, on the posterior part of the roof of the genital chamber, there is a pair of rodlike sclerites (figs. 31, *7;* 32 C), each bearing a slender, finger-like, sclerotic process, which points backwards, downwards, and a little outwards. Distally the process carries three short, but strong setae.

The superior appendages (figs. 30 and 31, *3*) are very large. In a lateral view they taper towards the rounded distal end. Dorsally and ventrally the posterior edge of Segment IX overlaps the base of the appendage a little; in the middle the lateral side of the latter is continuous with the upper lip of Segment IX. On the proximal part of the appendage a low keel is seen. Dorsally to this keel the lateral side is slightly concave. Otherwise the appendage forms approximately a quarter of a cylinder, the concavity of which faces downwards and inwards. This shape is especially pronounced distally, where the two superior appendages form a sort of an incomplete sheath for the inferior appendages (*4*). Proximally, however, the median side is somewhat swollen, and there it carries a large node near the ventral edge (fig. 31 B). Like the lateral side the median side of the appendage is sclerotized. The upper part of the proximal edge of the median sclerotization forms a simple articulation with the lateral edge of the sclerite *7* (fig. 31 B), dorsally to the finger-like process. — Distally on the edge of the appendage there is a group of very close-set, short, but extremely strong, medially directed setae. Along the dorsal edge there is a row of more scattered, strong, inwards directed setae, of which the distal ones are the shortest and strongest. On the basal node some few, rather short, but strong setae are seen. The other setae on the appendage are much smaller.

The inferior appendages (figs. 30 and 31, *4;* 32, *6*) are one-jointed. Proximally

the two appendages are connected, though by membrane only: On the ventral side membranous areas are seen both laterally and medially, and on the dorsal side the sclerite of the appendage is connected with the basal plate by a narrow lateral bridge only. (After all there thus is a sclerotic connection between the two appendages

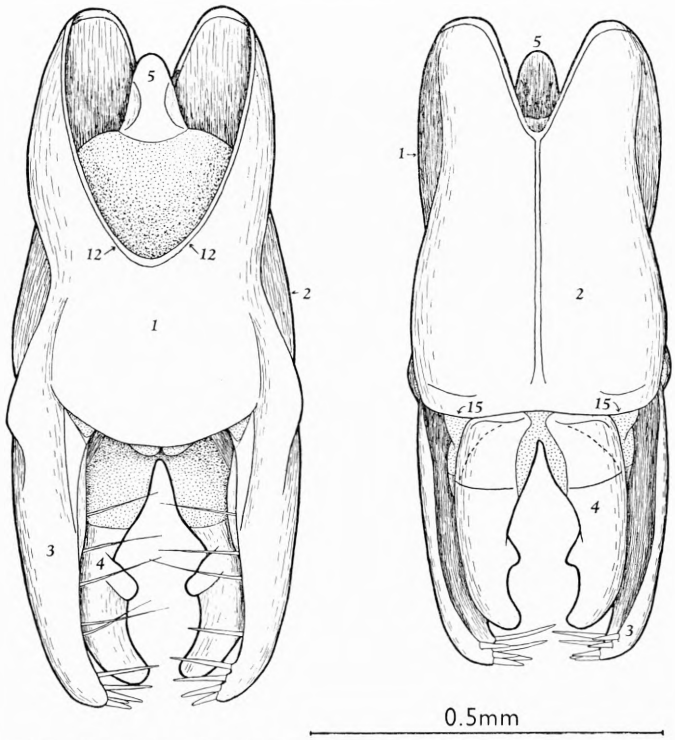

Fig. 30. *Ecnomus tenellus*. Segments IX and X in dorsal and in ventral view. *1:* dorsal lip of the genital segments; in the dorso-oral indentation the membranous roof of the genital chamber is seen from the haemocoelic side. *2:* ventral lip of genital segments. *3:* superior appendage. *4:* inferior appendage. *5:* phallic apodeme; in the figure on the right its proximal opening is seen. *12:* the arrow indicates the dorsal limit to the origin of the IX/X muscle. *15:* the arrow indicates the ventral limit to the origin of the posterior dorsal muscle of the inferior appendage.

via the basal plate). The greater, distal part of the appendage is entirely sclerotized.

The basal plate (fig. 32, 5) is very large. It stretches on the floor of the genital chamber to the anterior end of the latter. Its very strong oral end is continuous with the phallus (see below). In an oral direction the basal plate becomes a little narrower. Near the anterior end the lateral margin has an approximately triangular projection, carrying a strong apodeme, to which muscles are inserted. From the apodeme runs an internal ridge along the anterior part of the lateral margin to the root of the phallus. Anally the basal plate has a triangular indentation, an extension of the membranous area on the dorsal side of the inferior appendages. On the posterior part of

the basal plate, at the same level as the distal end of the phallus (see below) there is a paired group of short, but strong setae.

Each of the two appendages forms approximately a quarter of a cylinder. The concavity, which faces upwards and inwards, is continued on the posterior part of

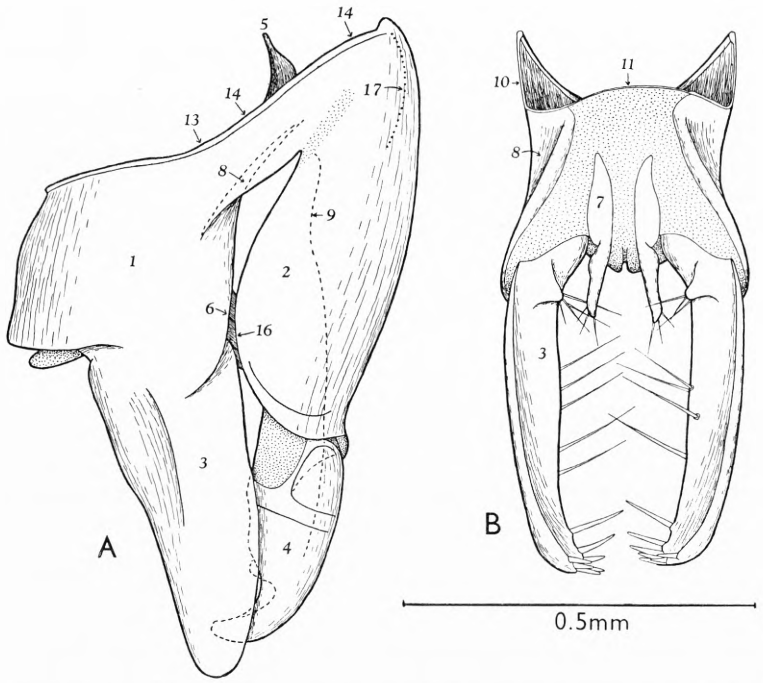

Fig. 31. *Ecnomus tenellus*. A: Segments IX and X in lateral (right) view. B: upper lip of the genital segments in ventral view. *6:* a small part of the phallus seen in the cleft between the upper and the lower lip of the genital segments. *7:* paraproctal sclerite. *8:* furrow on the ventral edge of the upper lip; in A shown by a broken line. *9:* (broken line): optical longitudinal section through the basal plate of the inferior appendages. *10:* cut edge through the sclerotic bridge between the upper and the lower lip. *11:* cut edge through the membranous roof of the genital chamber. *13:* the arrow indicates the ventral limit to the origin of the IX/X muscle. *14—14:* between the arrows the anterior dorsal muscle of the inferior appendages originates. *16:* the arrow indicates the dorsal limit to the origin of the posterior dorsal muscle of the inferior appendage. *17* (coarsely dotted line): origin of the anterior phallic muscle. Other numbers as in fig. 30.

the basal plate, whereas the anterior part of the latter is strongly convex in a transverse section.

On the median side of the appendage, near the dorsal edge, there is a short, finger-like, inwards and backwards directed process, which, no doubt, is homologous with the dorsal branch in *Polycentropus* (p. 48) and *Holocentropus* (p. 55). It is covered with long setae. (*In situ* this process lies far behind the node on the superior appendage). The inferior appendage forms a simple articulation with Segment IX: on the proximal edge of its sclerite there is a transverse furrow receiving a ridge on the posterior edge of Segment IX. On the outer side of the appendage, proximally to the middle, a strong transverse suture is seen. It is connected with a longitudinal suture

(see fig. 31 A), which runs in a proximal direction along the median margin of the lateral membranous area. At the base of the appendage the longitudinal suture is bent medially along the proximal edge. The longitudinal suture has an exceptionally high internal ridge, which unites the distal, more strongly sclerotized part of the appendage with the proximal articulation. The transverse suture might be supposed to

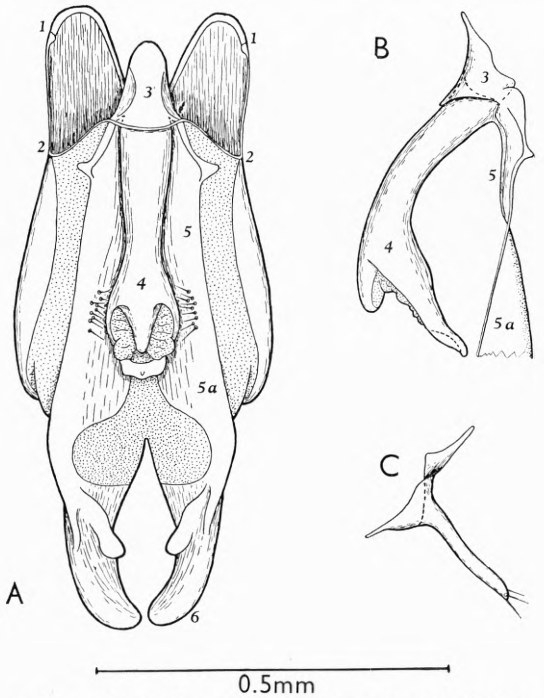

Fig. 32. *Ecnomus tenellus*. A: lower lip of the genital segments in dorsal view. B: phallus and basal plate of inferior appendages in lateral (right) view. C: right paraproct in lateral view. 1—2: cut edge through sclerotic bridge between upper and lower lip. *2—2:* cut edge through the bottom of the genital chamber. *3:* phallic apodeme. *4:* phallus. *5:* basal plate of inferior appendages. *5a:* concave part of basal plate. *6:* inferior appendage.

indicate a segmentation of the appendage. Possibly, however, it is a secondary structure.

The short, downwards curved phallus (figs. 32, *4;* 31 A, *6*) is undivided, formed by the strongly sclerotized phallobase. Its somewhat swollen distal end (fig. 33 A, B) is divided into an upper and a lower "beak", of which the latter is much larger than the former. In the state of repose the upper "beak" is flanked by the processes on the sclerites 7 (fig. 31 B). The distal end of the lower beak is flattened and a little concave on the dorsal side. Between the two lips there is a pair of membranous, much wrinkled longitudinal folds, marking the entrance of the short endotheca, on which the aedeagal retractor is inserted. This muscle originates from a strong apodeme (fig. 33 C, *4*) on the dorsal side of the proximal part of the phallus.

The phallocrypt (fig. 33C, *2*) is developed only dorsally and laterally. On the lateral side it is merely a furrow, and on the dorsal side as well it is very shallow. It is strongly sclerotized. The ventral side of the phallus is continuous with the basal plate of the inferior appendages. Like the phallocrypt the phallic apodeme (figs. 30 and 31, *5;* 32, *3;* 33C, *1*) is very short. It is beak-like, the dorsal side projecting anteriorly far beyond the ventral side.

The musculature of the genital segments is a little atypically developed, and in some instances it may be a bit difficult to decide the homologies of the muscles.

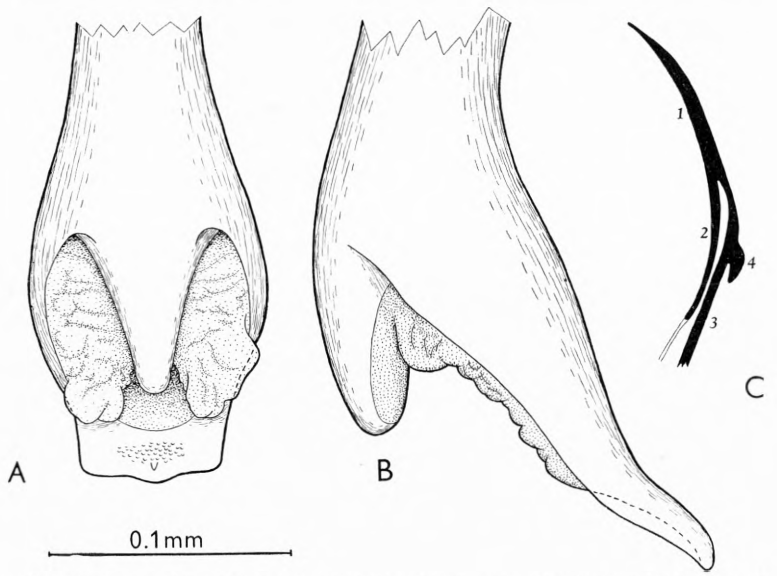

Fig. 33. *Ecnomus tenellus.* A and B: distal end of phallus in dorsal and lateral (right) view. C: optical sagittal section through dorsal side of phallic apodeme and proximal end of phallus. *1:* phallic apodeme. *2:* wall of phallocrypt. *3:* wall of phallus. *4:* transverse apodeme on which the aedeagal retractor originates.

The very strong IX/X muscle originates laterodorsally from the antecosta of Segment IX (figs. 30 and 31, *12—13*) and from the anterior half of the surface of the upper lip. Most of its bands are inserted proximally on the median side of the superior appendage (fig. 31B, *3*). Some of the most median bands, however, are inserted on the lateral margin of the sclerite 7, dorsally to the process. The function of the muscle probably is an adduction of the superior appendage, accompanied by an abduction of the process of the sclerite 7 causing the latter to meet the proximal node on the superior appendage.

The anterior ventral muscle of the inferior appendages is also very strong. It originates from the antecosta of Segment IX along the whole ventrooral indentation and is inserted on the concave part of the basal plate and on the bridges which connect this plate with the appendages themselves. It deviates from the usual picture, partly by being inserted on the basal plate and especially by having paired insertions. The

origin, however, shows that we are concerned with this muscle. It probably acts chiefly as a levator of the inferior appendages, but may be an adductor as well. In various preparations the distance between the apices of the two appendages differs.

The following muscles are weaker than the two already mentioned, but still rather strong. The anterior dorsal muscle of the inferior appendage originates from the antecosta of Segment IX at the lateral part of the dorsooral indentation (fig. 31 A, *14—14*) and is inserted on the anterior side of the apodeme orally on the lateral margin of the basal plate. It may be an accessory levator of the inferior appendages, but it probably also has some relation to the movements of the phallus (cp. the ridge from the apodeme to the root of the phallus). A muscle which originates from the rounded posterior corner of the lower lip (fig. 30, *15*—fig. 31 A, *16*) is inserted on the posterior side of the apodeme just mentioned. It is no doubt the antagonist of the former muscle. It is difficult to decide whether it is the posterior dorsal or the posterior ventral muscle of the inferior appendages. The same arguments which were advanced under *Polycentropus* (p. 49) make it probable that it is the posterior dorsal muscle. The posterior phallic muscle originates from the furrow (fig. 31 B, *8*) on the ventral edge of the upper lip and is inserted on the dorsal side of the phallic apodeme. The anterior muscle has an atypical origin, not from the antecosta, but from the lateral surface of the lower lip (fig. 31 A, *17*). Its bands run upwards and inwards and are inserted on the ventral edge of the phallic apodeme. The two last-mentioned muscles must give the phallus a nodding movement; the connection with the basal plate of the inferior appendages does not allow any independent protraction of the phallus.

At a first glance *Ecnomus* might be considered a more primitive form than the Polycentropinae, in so far as Segment IX forms a complete sclerotic annulus, and its dorsal side seems to be well developed. I find it more likely, however, that conditions in *Ecnomus* are a further specialization of those found in the Polycentropinae, viz. that the upper lip has arisen by sclerotization of a structure homologous with the middle lobe of Segment X in *Polycentropus* (fig. 23, *6*, p. 47), and that this structure secondarily has fused with Segment IX, which latter thus in *Ecnomus* is represented by the lower lip only. (The terms Segment IX and Segment X are used here in the same sense as in *Polycentropus;* p. 46. It is of course also possible—or perhaps likely—that the upper lip never was desclerotized in the ancestors of the Ecnominae). That the middle lobe at least has entered into the formation of the upper lip appears from the following facts: the anus is found immediately below the posterior edge of the upper lip; the superior appendages are sclerotically continuous with the upper lip; the sclerites 7 (fig. 31 B), which beyond any doubt are homologous with the paraproctal sclerites of *Polycentropus* (fig. 24, *3*, p. 49) are situated on the ventral side of the upper lip. A comparison between the origins of the posterior phallic muscle in *Polycentropus* (p. 52) and *Ecnomus* leads to the same conclusion. The origin of the IX/X muscle in *Ecnomus* might suggest that parts of Segment IX have entered into the formation of the upper lip, but it can be explained also by a shifting of the origin subsequently to the fusion

of the middle lobe and Segment IX. In the structure of the genital segments *Ecnomus* perhaps shows affinities to *Hydropsyche*.

As to the IX/X muscle, conditions in *Ecnomus* might be interpreted as an incipient division of this muscle into a IX/X muscle s. str. and a paraproctal muscle. I am more inclined, however, to think that we are concerned with an incipient fusion of the two muscles mentioned. Such a fusion may have taken place also in those (the majority of) Trichoptera in which no paraproctal muscle is seen.

Hydropsyche angustipennis.

The genital apparatus seems to be very simple. In all probability, however, it is a simplicity arisen by specialization.

Segment IX (fig. 34, *1*) forms, at least apparently, a complete, sclerotic annulus, which is shortest ventrally and longest laterally, the posterior edge of the segment having a lateral bulge. The latter is thick and tongue-like and sclerotized on the median side also. Ventrally to the bulge the posterior edge of the sclerite is not bent inwards. Dorsally the segment has a pair of large impressions, so that the middle of the dorsal side is raised as a broad keel (*2*) with a flat upper side.

Segment X (*3*) is a short and thick lobe, which is very feebly sclerotized and entirely membranous on the somewhat concave ventral side. In a lateral view the dorsal side of Segment X is separated from the longitudinal keel of Segment IX by a declivity. Laterally the limit between the two segments is poorly defined. On the oblique posterior end, above the anus, there is an unpaired impression bounded by a pair of rounded, seta-bearing longitudinal folds. In *H. instabilis* Curt. (fig. 35 A) these folds appear as a pair of sharp ridges. In this species the posterior end of Segment X carries a pair of small ventral processes with distal pencils of setae. They may remind of the cerci in the ♀. I find it more probable, however, that they represent rudimentary paraproctal processes. Structures which may be homologous with the paraprocts of the Polycentropidae have been described by Ulmer in some species of the genera *Hydropsyche* (1951, pp. 241 and 46) and *Diplectrona* Westw. (1932—33, pp. 49—52). In *H. angustipennis* there is, on the lateral side of the segment, a low, seta-bearing elevation, which perhaps is homologous with the process in *H. instabilis*. A suture with a corresponding internal ridge runs along somewhat more than the dorsal half of the anterior margin of Segment X. Ventrally (or laterally) it joins a short longitudinal suture, and the two sutures together form a Y-like figure. In *H. instabilis* a very weak muscle is inserted on the branching point of the Y. In *H. angustipennis* I was unable to find this muscle.

Superior appendages are lacking.

As to the morphology of the genital segments, I do not find it improbable that the greater part of the structure which above was termed the dorsal side of Segment IX, in reality is formed by Segment X. The dorsal keel (fig. 34, *2*) may be interpreted as a dorsal process of Segment X (cp. *Lype*, p. 24, and *Wormaldia*, p. 43). According

to this theory the condition in *Hydropsyche* has arisen from one like that in *Ecnomus* (p. 62) by a complete fusion of the upper and the lower lip. What here, in *Hydropsyche*, has been called Segment X may be in part homologous with the bilobed, membranous

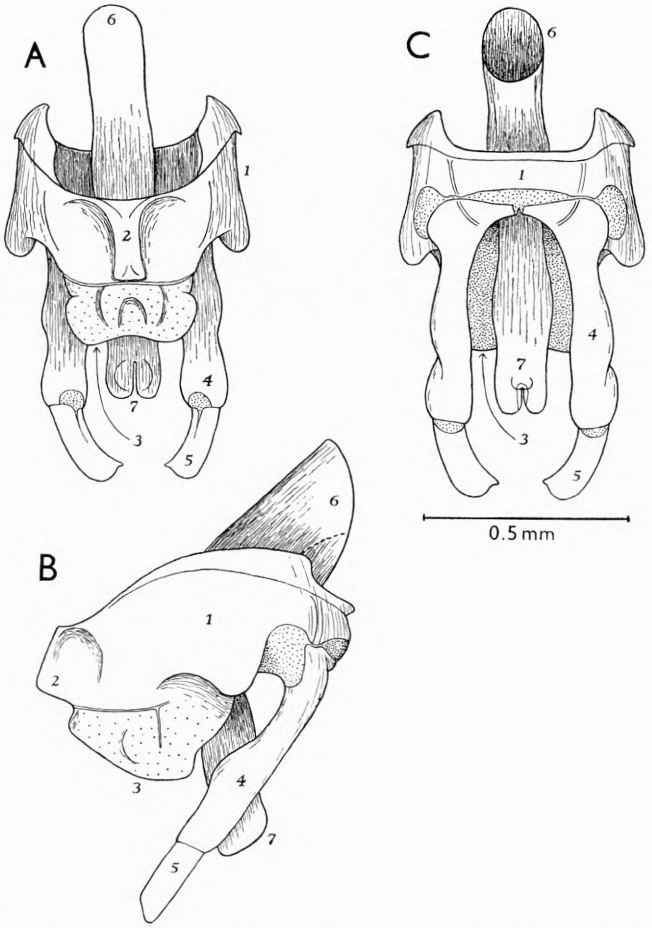

Fig. 34. *Hydropsyche angustipennis*. Segments IX and X in dorsal (A), lateral (right, B), and ventral view (C). *1:* Segment IX. *2:* dorsal keel on Segment IX; (cp., however, p. 63). *3:* Segment X. *4:* coxopodite. *5:* harpago. *6:* phallic apodeme. *7:* phallus.

process below the anus in *Ecnomus*. I am more inclined to interpret the weak muscle found in *H. instabilis* as a paraproctal muscle than as a IX/X muscle.

The inferior appendages (figs. 34, *4—5;* 35 B) are long, slender, and of a simple shape. They are two-jointed, and the coxopodite is about four times as long as the harpago. The coxopodites are united proximally, but for a very short stretch and by membrane only. The sclerites are separated by a narrow, membranous stripe. The latter continues on the middle of the basal plate (fig. 35, *3*), which thus is paired. An indirect sclerotic connection between the two appendages, however, is established

through the phallocrypt (see below). Lateroventrally the inferior appendage forms a simple articulation with the posterior edge of Segment IX. From the point of articulation a longitudinal suture runs to the antecosta of Segment IX. (It is possible that

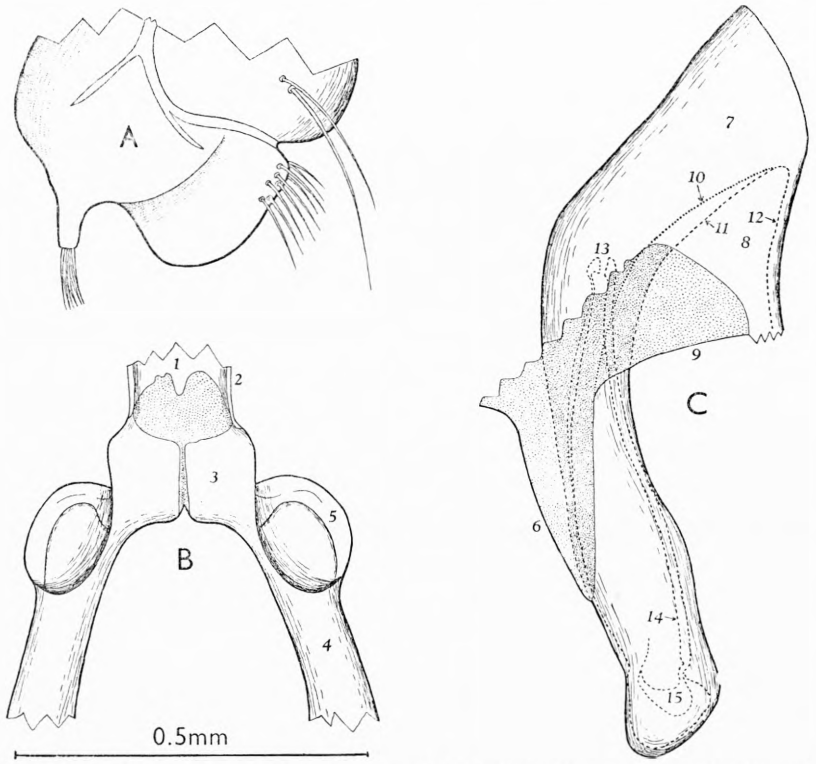

Fig. 35. *Hydropsyche instabilis* (A) and *H. angustipennis* (B, C). A: Segment X and adjacent parts of Segment IX (cp., however, p. 63) in lateral (left) view. B: proximal part of inferior appendages in dorsal view. C: phallus in lateral (right) view. *1:* part of the sclerite in the floor of the phallocrypt. *2:* cut edge through sclerotic wall of phallocrypt. *3:* basal plate of inferior appendages. *4:* coxopodite. *5:* thickening om ventroproximal margin of the latter. *6:* see p. 66. *7:* phallic apodeme. *8:* sclerotic and *9:* membranous wall of phallocrypt, both as seen from the haemocoelic side. *10* (coarsely dotted line): line of union of phallocrypt and phallus. *11—15:* the broken lines indicate: *11:* ventral outline of phallus; *12:* floor of phallocrypt; *13:* proximal end of dilated part of ejaculatory duct. *14:* ventral thickening of this part. *15:* lip at the opening of the ejaculatory duct.

this suture is homologous with the ventral suture in the Hydroptilidae). A corresponding suture runs across the ventral side of the appendage to its median side.

The anterior dorsal muscle originates lateroventrally from the antecosta of Segment IX and is inserted dorsally on the proximal edge of the appendage. It is much stronger than the anterior ventral muscle, which originates ventrally from the antecosta of Segment IX and is inserted proximally and ventrally on the median sides of the appendages. An examination of numerous preserved specimens seems to show that no mutual movement is possible between the two coxopodites, this probably being

prevented by the sclerotic connection with the phallocrypt. The two muscles then are a levator and a depressor, respectively. In the vertical plane the appendages have an exceedingly great motility. The two posterior muscles are lacking. The flexor of the harpago originates from the distal half of the lateral side of the coxopodite and is inserted medially on the proximal edge of the harpago.

The phallic apodeme (figs. 34, *6;* 35C, 7) and the undivided phallus (figs. 34, *7;* 35C) together form a strongly sclerotized tube, which proximally to the middle is bent at an obtuse angle. (The shape of this tube is different in the various species of the genus. In *H. instabilis* its proximal part is bent like the handle of a walking stick,

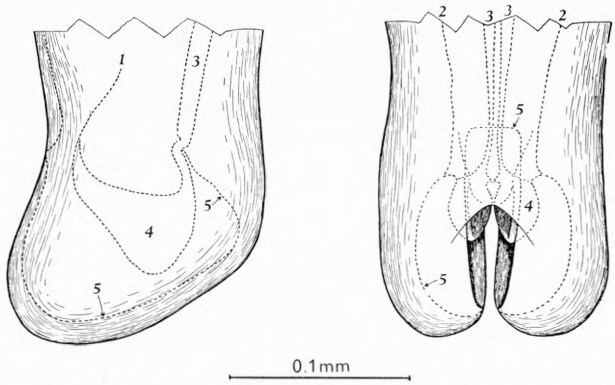

Fig. 36. *Hydropsyche angustipennis.* Apex of phallus in lateral (right) and in ventral view. The broken lines indicate: *1:* dorsal wall of ejaculatory duct. *2:* lateral wall of same. *3:* thickening on ventral wall of same. *4:* lip at the opening of the ejaculatory duct; (the distal ends of the two lips are seen freely exposed in the ventral cleft). *5:* wall of endotheca.

so that the extreme proximal end turns upside down). Ventrally the phallocrypt is very deep, so deep that no apodeme is developed. This part of the phallocrypt forms a spacious, wedge-shaped cavity, which is strongly sclerotized on the ventral side (fig. 35B, *1*) and the ventro-oral half of the lateral side (fig. 35C, *8*), whereas the roof is formed by the proximal part of the phallus. The lateral sclerotizations are connected with the basal plate of the inferior appendages by a pair of strong, sclerotic rods (B, 2). The ventral sclerotization is separated from the basal plate by a membranous area, the anterior margin of which was irregularly sinuous in all specimens examined. In a dorsal direction the depth of the phallocrypt decreases very much. On the dorsal side it even is, so to speak, negative: A tongue-like lobe (C, *6*), which has fused with the dorsal side of the phallus, is issued from the membranous wall of the genital chamber; (the boundary between the phallic apodeme and the phallus thus has an almost longitudinal course). This lobe encloses the anterior phallic muscle, which originates laterodorsally from the antecosta of Segment IX. The much stronger posterior muscle originates from the median side of the lateral, tongue-like bulging of the posterior edge of Segment IX described above. It is inserted proximally on the dorsal side of the phallic apodeme. Since the sclerotic connection with the inferior appendages

exclude any movements of protraction and retraction, the two muscles act as a levator and a depressor, respectively. Despite the sclerotic connection a considerable scissor-like movement is possible between the phallus and the inferior appendages. The chief agents in this movement are the anterior dorsal muscle of the inferior appendages and the posterior phallic muscle.

By a vertical cleft the sclerotic apex of the phallus (fig. 36) is divided into a pair of (external) lips. On the dorsal side the cleft is almost twice as long as, but also considerably narrower than on the ventral side. The lips, which like the rest of the phallus are strongly sclerotized, are very concave on the inside and thus enclose a subspherical cavity (*5*), in which the ejaculatory duct opens. The part of the latter which lies distally to the "knee" of the phallus is very spacious (fig. 35 C, *13—15*). The posterior half of this dilated part is very thin-walled. The anterior half is more thick-walled and sclerotized. Besides, a pair of sclerotic longitudinal ridges (figs. 35 C, *14;* 36, *3*) runs over the whole ventral side of the dilated part. The opening of the ejaculatory duct is narrowed by a pair of folds, the sclerotized distal ends of which project beyond the opening as a pair of internal lips (figs. 35 C, *15;* 36, *4*). Ventrally the two lips are continuous, and their sclerites are continuous with the ventral ridges mentioned above. In detail they have a rather complicated shape. Proximally on the median side there is an almost vertical furrow, semicircular in transverse section, shallower dorsally and deeper ventrally.

The strong aedeagal retractor originates dorsally in the phallic apodeme and runs descendent to the dorsal side of the sclerotic part of the ejaculatory duct, which is a little flattened. I cannot see other explanation of the function of this muscle than that the dilated part of the ejaculatory duct is a sperm pump. The internal lips perhaps may act as a valve, and the same may perhaps be the case with cuticular processes found proximally in the dilated part of the ejaculatory duct.

The morphology of the phallus is not quite clear. The two ventral ridges (figs. 35 C, *14;* 36, *3*) show that the distal, dilated part of the ejaculatory duct (fig. 35 C, *13—15*) is homologous with the distal, sclerotic part in *Polycentropus* (fig. 26, *7*, p. 51) and *Holocentropus* (fig. 29 C, p. 55). The sclerotized, subspherical cavity (fig. 36, *5*) possibly is a reduced, non-eversible endotheca. According to this the copulatory organ is formed by the phallobase.

Orthotrichia tetensii.

The genital structures of this minute form is extremely specialized and much complicated. It is not impossible that I have committed some minor errors in interpreting the structures, which of course had to be made out with the aid of an immersion lens, and the same is true as to the two other hydroptilids treated here. Especially the study of the inferior appendages proved to be a rather difficult task. I feel convinced, however, that the accounts are correct in the main.

Segment VIII, already, is much modified. The tergum (fig. 37, *5*) projects far

backwards and in a dorsal view largely conceals Segment IX. The sternum (*6*), on the other hand, is strongly indented anally, but the venter as a whole is not so much indented as the sternum. In a ventral view about the anterior half of Segment IX is covered by Venter VIII. Anally on Tergum VIII there is a pair of large, pit-like sensilla, probably s. campaniformia.

Segment IX (figs. 37, *7;* 38—41, *1*) is very asymmetrical. On the left side a large, horn-like, somewhat sagittally compressed, entirely sclerotized lateral process (figs. 37—39 and 41, *8*) is seen. On the right side a bipartite lateral process is just indicated (fig. 38). Sinistrally on the dorsal side there is a longitudinal suture, which anteriorly joins the antecosta and posteriorly goes to the base of the lateral process. On the right side but a rudiment of a longitudinal suture is seen quite orally (fig. 40). On this side (fig. 38) there might appear to be an anal transverse suture. This, however, is not the case. The picture is due to the fact that the posterior border of Segment IX, which here is very overlapping, is sclerotized on the lower side as well. Lateroventrally the posterior border of Segment IX to some extent overlaps the base of the inferior appendage, forming a simple articulation with the latter. Here the posterior border of Segment IX is strengthened. Medially to the articulation the strengthening bends forwards and eventually joins the antecosta, which means that Segment IX has a pair of ventral longitudinal sutures. Between these Segment IX and the inferior appendages are separated by a membranous area.

Segment X (figs. 37, *9;* 38—41, *4*) is large and asymmetrical to a still higher degree than Segment IX. The ventral side is very concave, so that the segment may be described as a rather thin lamella which forms more than half of a cylinder, and orally almost a complete cylinder. The ventral opening (fig. 41) is a little asymmetrical, shifted towards the right. In this way Segment X forms a very spacious sheath for the "base" of the phallus. The ventral side of the segment (the inside of the sheath) is membranous (cp., however, below), on the dorsal side there is a large, asymmetrical sclerite (*4a*). It covers the whole left side and a little more than the left half of the dorsal side. The rest of the dorsal side and the whole right side are membranous (*4b*). The dorsal side of the sclerite forms part of a cylinder, the radius of which is smaller than that of the cylinder formed by the segment as a whole. Since, moreover, the sclerite is narrower anteriorly than in the middle, the result is that the oral part of its right margin is steeply descendent. This descendent part of the margin has an internal ridge. On the left half of the dorsal side the sclerite of Segment X merges into that of Segment IX, no boundary between the two segments being visible, and on the left side it is is continuous with the median side of the lateral process of Segment IX through a sclerotization in the genital chamber above the base of the inferior appendage. Anally on the dorsal side the sclerite carries a pair of large spines. The left one (*2*) is very clumsy and bent upwards, the right one (*3*) is slenderer and bent laterally.

Orally on the ventral side of Segment X (the inside of the sheath) a semi-annular sclerite (figs. 38 and 40, *13—13*) is seen. In contrast to the dorsal sclerite, it has been shifted towards the right side. At its left end, i. e. dorsolaterally on the left side of the

segment, it carries two large processes. The left one (*19*) is thick and approximately semiglobular, the right one (*20*) has the shape of a long, slender spine, which almost, but not entirely, reaches the anal end of Segment X; it crosses the phallus, lying dorsally to the latter. A similar structure possibly has been described by ULMER (1951,

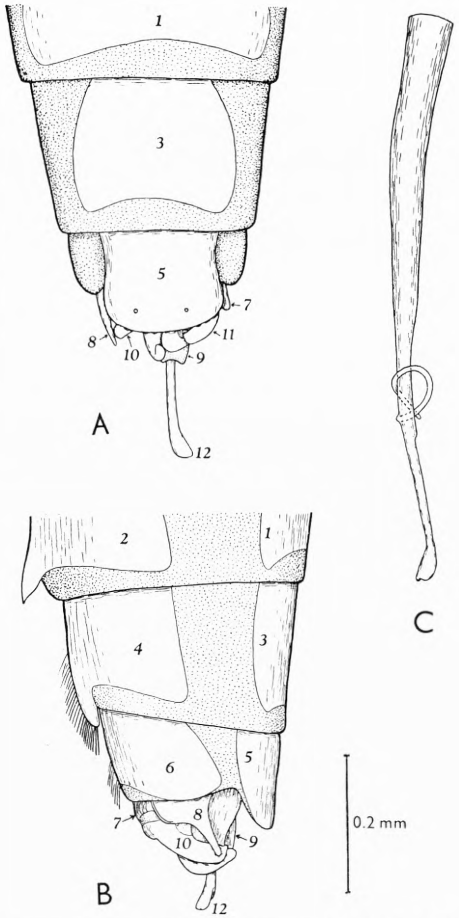

Fig. 37. *Orthotrichia tetensii*. A: posterior end of abdomen in dorsal view. B: the same in lateral (left) view. C: phallus seen from the left side (and a little from the ventral side, too). *1:* anal part of Tergum VI. *2:* anal part of Sternum VI. *3:* Tergum VII. *4:* Sternum VII. *5:* Tergum VIII. *6:* Sternum VIII. *7:* Segment IX. *8:* left lateral process of Segment IX. *9:* Segment X. *10:* left and *11:* right inferior appendage. *12:* phallus.

pp. 76 and 78) in *Javanotrichia* Ulm. as a "Chitingräte", which "überkreuzt in schräger Richtung den Penis", in *Orthotrichiella* Ulm. (l. c., p. 80), and in *Sumatranotrichia* Ulm. (l. c., p. 88); (see also p. 146).

The IX/X muscle is a very strong, unpaired muscle. It originates from the dorsal part of the antecosta of Segment IX. On the left side the origin continues along the longitudinal suture to the posterior end of the segment. Its very asymmetrical insertion

is on the oral, descendent part of the right margin of the sclerite of Segment X (fig. 40, *9*). This muscle perhaps may produce some depression of Segment X, perhaps some rotation towards the right as well.

Superior appendages are lacking.

The one-jointed inferior appendages are very porrect. The right appendage (figs. 37, *11;* 38, 40, 41, *7*) is rather slender, especially in its distal part, which is bent inwards and somewhat backwards above Segment X. The side which faces medially and anally is slightly concave. The left appendage (figs. 37, *10;* 38, 39, 41, *6*) is more robust. Its distal end is divided into two branches. One is directed upwards, the other inwards and touches the sclerite of Segment X (*4a*), which is thickened there. The lateral side of the left appendage is in close contact with the lateral process on Segment IX (*8*). The two appendages are sclerotically continuous on their rounded posterior edge.

On the membranous floor of the genital chamber, immediately in front of the common part of the two inferior appendages, there is a narrow and very deep, funnel-like depression (figs. 40 and 41, *14*). The stalk of the funnel (figs. 39—41, *15*) points forwards. The funnel is sclerotized and thus forms a long apodeme, which projects beyond the anterior margin of Segment IX. As is often the case with large apodemes, it contains a central cavity, at least in its posterior (proximal) part. The musculature associated with the apodeme shows that it must be included under the inferior appendages and represents the basal plate, or rather part of the basal plate. A sclerotic bridge (fig. 41, *12*) connects the left wall of the funnel with the left appendage. The right appendage, however, does not seem to have any direct sclerotic connection with the apodeme.

In front of, above, and a little to the right of the entrance to the apodemal funnel a large, thin-walled, though sclerotized, process (figs. 40 and 41, *5*) is seen. In a dorsal or ventral view it is somewhat clavate, in a lateral view it tapers gradually towards the distal end, which carries a pair of strong setae. The left side of the process is sclerotically continuous with the right wall of the apodemal funnel (*14*). The process is situated just below the anterior end of the ventral cleft in the sheath formed by Segment X. A sclerotic rib (figs. 39—41, *16*), lying in the bottom of the furrow between Segment X and the inferior appendage, is issued from each side of the base of the process. The right rib eventually is continuous with Segment IX (through the inwards bent posterior edge of the latter), the left one with the sclerotization in the genital chamber between Segments IX and X (see above). An approximately parabolic apodeme (*16a*) is issued from each rib. The muscles associated with the latter shows that the rib must be part of the basal plate of the inferior appendages.

The strong anterior dorsal muscle originates from the lateral part of the antecosta of Segment IX and is inserted laterally and dorsally on the proximal margin of the appendage, dorsally to the articulation with the posterior edge of Segment IX. Since there is hardly much mutual motility between the two appendages (the sclerotic connection being rather firm), this muscle possibly acts as a levator. The anterior

ventral muscle, too, is strong. It originates—as usually—from the ventral part of the antecosta of Segment IX. Laterally the origin passes beyond the ventral longitudinal

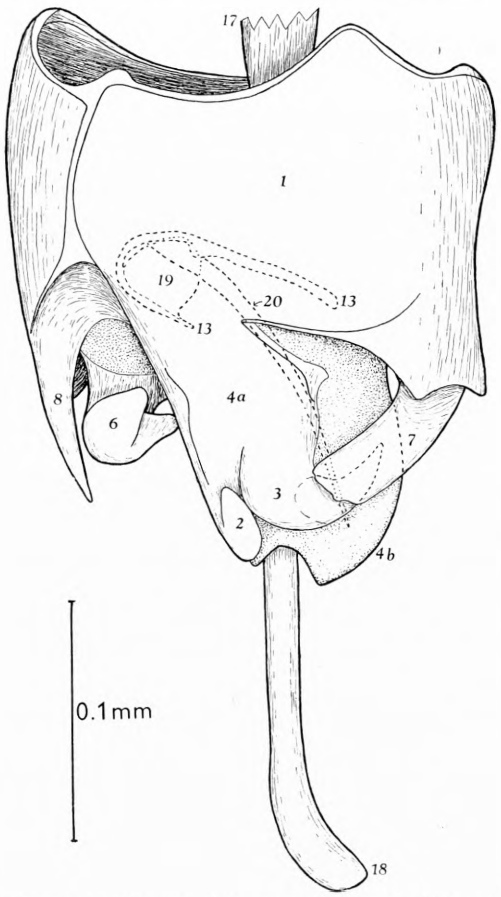

Fig. 38. *Orthotrichia tetensii*. Segments IX and X in dorsal view. In this and the three following figs. the numbers *4*, *5*, *8*, and *14—16* designate structures which probably are homologous with the correspondingly numbered structures in *Agraylea* (figs. 43 and 44) and *Hydroptila* (fig. 46). Legend common to figs. 38—41: *1:* Segment IX. *2:* left and *3:* right spine on Segment X. *4a:* sclerotic and *4b:* membranous part of Segment X. *4c* (fig. 40): membranous inner wall of left side of Segment X. *5:* seta-bearing process (see p. 70); in fig. 41 its distal end is seen freely projecting behind the common part of the two inferior appendages. *6:* left and *7:* right inferior appendage. *8:* left lateral process of Segment IX. *9* (broken line): descendent right margin of the sclerite of Segment X. *10* (broken line): ventral outline of Segment X. *11* (broken line): dorsal outline of proximal part of left inferior appendage. *12:* sclerotic bridge connecting left inferior appendage with funnel-like apodeme. *13:* semi-annular sclerite at the entrance to phallocrypt. *14—15:* funnel-like apodeme (see p. 70). *16:* sclerotic rib in the bottom of the furrow between Segment X and the inferior appendages. *16a:* apodeme issued from this rib. *17:* proximal part of phallus (broken off at different levels in the four figs.). *18:* distal end of phallus. *19:* left and *20:* right process on the semi-annular sclerite *13*.

sutures. It is inserted ventrally on the apodemal funnel *14* (figs. 40 and 41). It possibly —through the sclerotic bridge *12* (fig. 41)—acts as a depressor of the inferior appendages and, no doubt, also exercises some influence upon the process *5*. The strong

posterior ventral muscle originates lateroventrally from the proximal margin of the inferior edge of the appendage, ventrally to the articulation with the posterior edge of Segment IX. It spreads out fan-like and is inserted on the lateral side of the apodeme *16a* (figs. 39—41). Considering the sclerotic connection with the sclerite of Segment IX (and X), the apodeme probably must be the fixed point. The function then will be a depression of the inferior appendage. The posterior dorsal muscle is a weak one, inserted on the anterior end of the apodemal funnel *15* (figs. 39—41). I have been

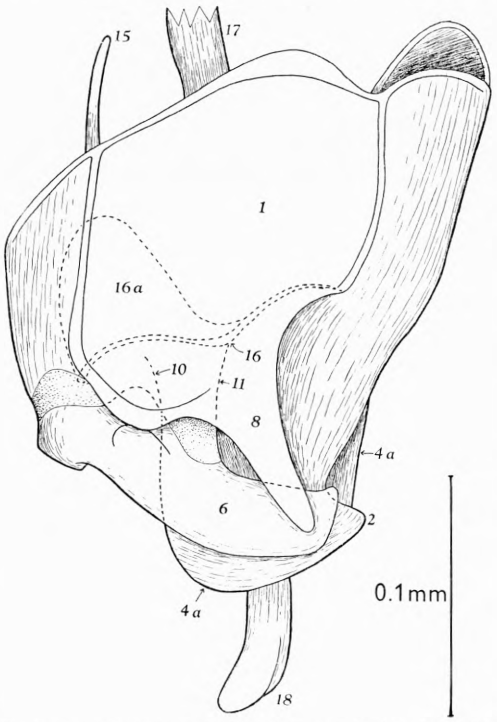

Fig. 39. *Orthotrichia tetensii.* Segments IX and X in lateral (left) view. For explanation see fig. 38.

unable to follow the few muscle bands to their origin, but their direction indicated that this must be in the vicinity of the origin of the posterior phallic muscle. The function possibly is restricted to movements of the process 5 (figs. 40 and 41).

It will be seen that the sclerite of Segment IX, the dorsal sclerite of Segment X, and the inferior appendages are united into a complicated sclerotic framework. Acting together the various muscles possibly can give this framework richly varied movements.

Including the possible apodeme the undivided phallus (fig. 37C) is very long and slender. In all specimens seen by me it seemed to be more or less protracted. In the specimen showing the least degree of protraction its anterior end reached the middle of Segment V. I have been unable to recognize the boundary between the phallus itself and the phallic apodeme, the wall of the phallocrypt being extremely delicate. In

the following the phallus and its apodeme are treated together and simply called the phallus. The phallus can be rotated. Hence it is difficult to say what is the dorsal and what the ventral side. The interpretation given below is that which I find most likely.

In its proximal half the phallus tapers gradually and slightly. The next fourth tapers more strongly. The two distal fourths are separated from one another by an

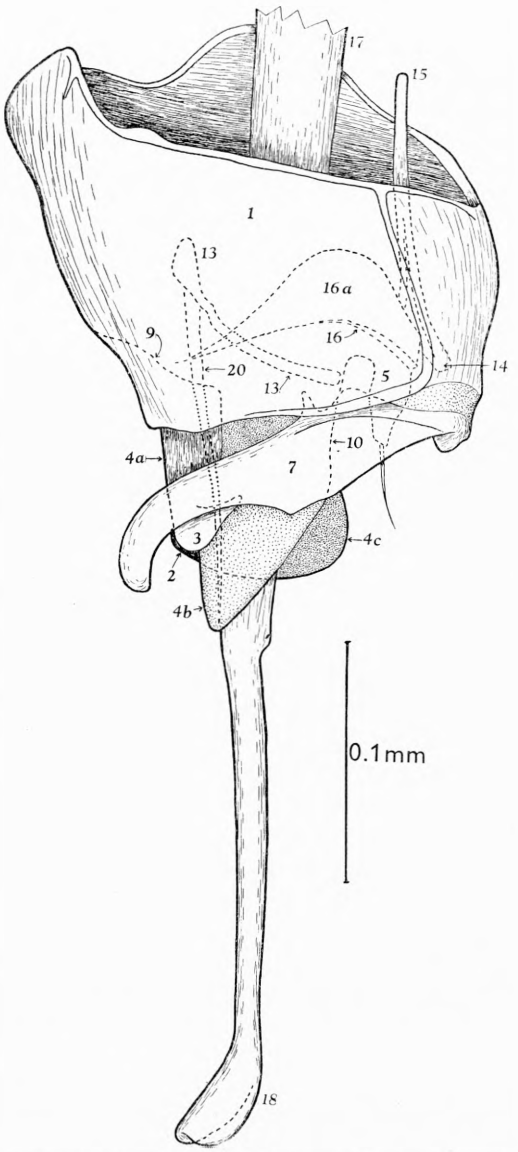

Fig. 40. *Orthotrichia tetensii*. Segments IX and X in lateral (right) view. That this fig. shows a dorsal outline different from that of fig. 39 is due to the fact that it is seen also a little from the ventral side. For explanation see fig. 38.

abrupt decrease in thickness. The distal fourth is extremely slender and almost cylindrical except for the swollen distal end, which is spoon-like excavated on the dorsal side. A little in front of the sudden decrease in thickness an unpaired, slender titillator

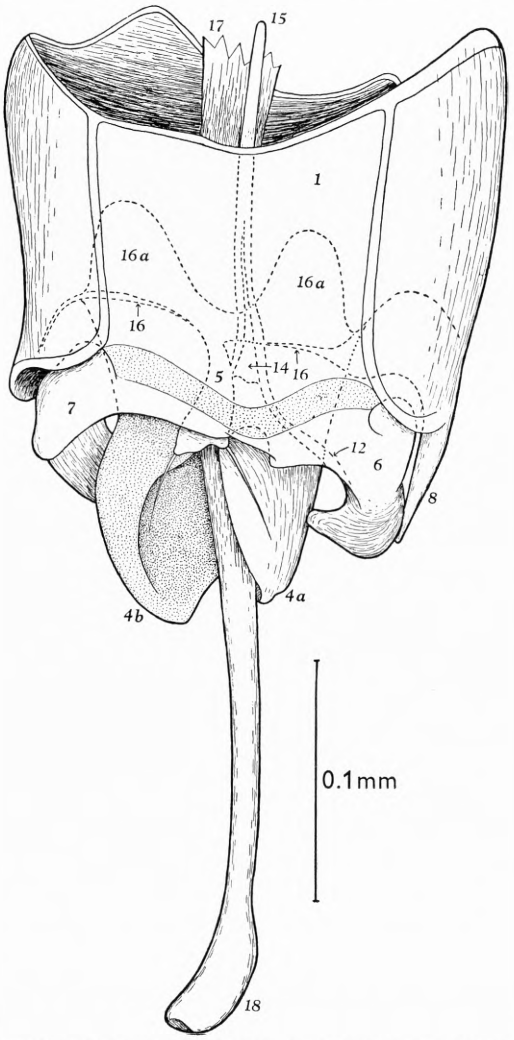

Fig. 41. *Orthotrichia tetensii*. Segments IX and X in ventral view. For explanation see fig. 38.

(fig. 42, 2) rises from the ventral side of the phallus. It is wound once round the phallus, towards the right and anteriorly.

In the greater, proximal part of the phallus the wall is very thin, ca. 1 μ thick, though rigid and thus probably sclerotized. Immediately in front of the abrupt decrease in thickness there is an oblique, annular area (fig. 42, 4), in which the thickness of the wall is somewhat greater, up to a little more than 2 μ. Distally to this area the wall is extremely thin, less than $^1/_2$ μ thick, and soft. The rigidity of the distal, slender part

of the phallus is due to the ejaculatory duct. (That this part of the phallus in fig. 42 is shown with a one-layered wall is due to the fact that it is impossible to distinguish between the two layers in a figure drawn on that scale). In the apical swelling the wall again is a little thicker and rigid.

In the proximal part of the phallus the cuticular wall of the ejaculatory duct (*1*) is particularly thin. A little proximally to the origin of the titillator the duct divides into two branches, one (*6*) entering the distal part of the phallus, the other (*3*) the titillator. In the former branch the thickness of the wall increases rapidly, and in the distal part of the phallus, as mentioned above, it is the ejaculatory duct which forms the skeleton. In the thick wall there are narrow, irregular, greyish annuli, separated by still narrower, yellowish annuli. The greyish colour possibly indicates a stronger sclerotization, and the annular structure allows for some flexibility. The branch entering the titillator has the same appearance, though the thickness of the wall is smaller and decreases again after the branch has entered the titillator. Otherwise the titillator is built in the same way as the distal part of the phallus. There is no indication of a distal opening on the titillator.

On so small an object it may of course be very difficult to make out structures as those described above with absolute certainty. In one of my slide-preparations, however, the ejaculatory duct had been filled with air, and the thread of air was seen very clearly to divide into two branches, one entering the distal part of the phallus, the other the titillator. It is interesting to note that the same branching of the ejaculatory duct occurs in the Lepidoptera (Beirne 1942; there is no titillator in this order), which probably means that this feature is an old heritage in the Trichoptera, though it has been lost in the vast majority of forms. The mechanical use made of it in *Orthotrichia* (see below) possibly is peculiar to this form.

The ejaculatory duct opens at the bottom of the distal spoon-like excavation. The extreme distal part of the duct is especially strongly sclerotized, blackish, and not annulated. Its roof seems to have fused with the bottom of the "spoon", and from this area more strongly sclerotized, brownish "wings" stretch out on the sides of the "spoon".

The anterior phallic muscle may be described as being unpaired and consisting of four portions. (1) originates from the costa corresponding to the left longitudinal suture on the dorsal side, below the IX/X muscle. Its bands, which have a trans-

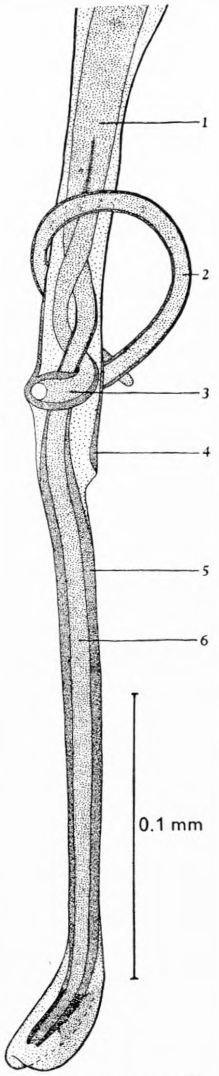

Fig. 42. *Orthotrichia tetensii*. Distal half of phallus as seen from the left and a little from the ventral side. In this fig. varying intensity of dotting indicates different degrees of transparency. *1:* ejaculatory duct just before its bifurcation. *2:* titillator. *3:* branch of ejaculatory duct entering the titillator. *4:* annular thickening of wall of phallus. *5:* thickened wall of ejaculatory duct. *6:* lumen of same.

verse course, cross below the phallus and are then wound round the latter before their insertion. (2) and (3) originate from the antecosta, below the IX/X muscle. (2) (left) crosses from the left side above the phallus and is wound round the latter before its insertion. (3) (right) spreads out rather much in a fan-like fashion, crosses from the right above the phallus, and is wound round the latter before its insertion. (4) also originates from the antecosta, but laterally to the left longitudinal suture. Its bands, which run in a very anterior direction, cross from the left above the phallus and are wound round the latter before their insertion. The insertions on the phallus agree with the numbers given. (1) is inserted most distally (posteriorly), (4) most proximally (anteriorly). The posterior phallic muscle is rather strong. On the left side it originates from the sclerotization in the genital chamber, just dorsomedially to the lateral process. On the right side on the posterior margin of Segment IX, above (and medially to) the rudimentary lateral process. It is inserted quite proximally on the phallus.

The posterior phallic muscle as usually acts as a protractor. The anterior muscle cannot be a retractor. If anything, the portion (4), and partly the the portion (3) as well, act as protractors. No doubt the function of the anterior muscle is to rotate the phallus. The portions (1) and (3) cause a rotation towards the right, (2) and (4) towards the left. In various preparations the phallus is seen at very different visual angles.

Both phallic muscles are inserted on the phallus (or on the ensheathing phallocrypt). As mentioned above, however, the skeleton of the distal part of the phallus is formed by the ejaculatory duct. The branch of the latter entering the titillator provides a means for transmitting the muscular power to the distal part of the duct.

The preserved specimens seen by me showed a very different degree of protraction of the phallus. At the highest degree the origin of the titillator was situated about midway between the anal end of Segment X and the distal end of the phallus. The lowest degree of protraction is shown in fig. 39. Even in this case, however, I think that we are concerned with some degree of protraction. In the living animal the phallus possibly does not project beyond Segment X, and perhaps not beyond the phallocrypt. The musculature indicates that the phallus, once protracted, cannot be retracted again. This means that only one copulation is possible for the ♂. In the genus *Hydroptila* I have made an observation (1948b, p. 127) which may suggest that the phallus is lost as a result of copulation.

The fact that the bands of the anterior muscle are wound round the phallus before their insertion might give an impression that a great part of the latter is surrounded by a circular musculature. Proximally this "circular" musculature almost reaches the basal end of the phallus. The distal limit is marked by the entrance to the phallocrypt, and this without regard to the degree of protraction, which shows that at least part of portion (1) must be inserted on the phallocrypt and not on an apodeme. It is worth noting that the rotations of the phallus exert little or no influence on the position of the semi-annular sclerite (figs. 38 and 40, *13—13*).

A discussion of the morphology of the phallus will be found under *Hydroptila occulta* (p. 84).

Agraylea multipunctata.

Segment VIII has a normal shape. As in *Orthotrichia* a pair of sensilla (possibly s. campaniformia) is seen anally on the tergum. They are, however, much smaller and more close-set than in *Orthotrichia*.

In its dorsal half, Segment IX (figs. 43 and 44) has a very deep anal indentation, so that the length in the middle of the dorsal side is only a small fraction of that of the lateral side. The short dorsal part is flanked by a pair of posteriorly diverging longitudinal sutures (shown as broken lines in fig. 43 A), which, no doubt, are homologous with the dorsal longitudinal suture in *Orthotrichia* (figs. 38 and 39; the homology i. a. appears from the origin of the IX/X muscle). The dorsal VIII/IX muscle is inserted on that part of the antecosta which lies between the two sutures. The areas laterally to the longitudinal sutures project into a pair of flat, tongue-like, sclerotic lobes (*1*), which stretch medially and almost touch each other in the middle line of the segment. The curvature of the outside of the lobes is a direct continuation of that of the lateral side of the segment. Laterally the posterior border of the segment is very bulging, and ventrally to the bulge a short, finger-like, membranous (or at least very slightly sclerotized) process is seen (*2;* in fig. 44 D almost entirely concealed by *13*). A pair of lateroventral longitudinal sutures join the posterior margin at these processes. They possibly are homologous with the ventral sutures in *Orthotrichia* (p. 68). Ventroposteriorly on Segment IX there is a deep, membranous indentation. The entrance to the membranous area, however, is restricted by a pair of medially directed points (*3*), the distal ends of which project as free processes forming articulations with the inferior appendages (*10*). In the middle of the ventral side the antecosta is interrupted.

Segment X has the shape of a broad, membranous lobe (*4*). The IX/X muscle is unpaired as in *Orthotrichia,* but much weaker. It originates partly on the antecosta between the two longitudinal sutures, partly on the anterior part of the latter. The insertion is anally on the dorsal side of Segment X, at the transverse depression seen in fig. 43 A. Whether this depression is the anus or merely a fold produced by the muscle insertion, I cannot tell.

Laterally to Segment X (*4*) the bottom of the genital chamber is sclerotized (*7*). This sclerotization is continuous with that of Segment IX. Ventrally *7* projects into a large, sclerotic process (*8*). This is sagittally compressed, but the distal end is bent inwards, so that in a dorsal or ventral view it is like a large, triangular plate. The two plates almost touch one another in front of the horn *6* (see below). On their ventral side there is a large, approximately semiglobular bulge. The dorsal longitudinal suture continues (fig. 44 D, *9*) along the median margin of *7* to the base of *8*. This relation to the longitudinal suture indicates that *8* is homologous with the lateral process in *Orthotrichia* (figs. 38, 39, 41, *8*).

Segment X (*4*) forms an upper lip for the entrance to the phallocrypt. The lower lip is formed by a lobe (*5*) approximately twice as long, which is membranous on the dorsal side and sclerotized on the lateral and ventral sides. Segment X (*4*) is very

concave ventrally and partly encloses the anterior end of the lower lip (*5*). The part of *5* which projects beyond *4* tapers much posteriorly. Its extreme posterior end projects into a finger-like, downwards and backwards directed, sagittally compressed horn

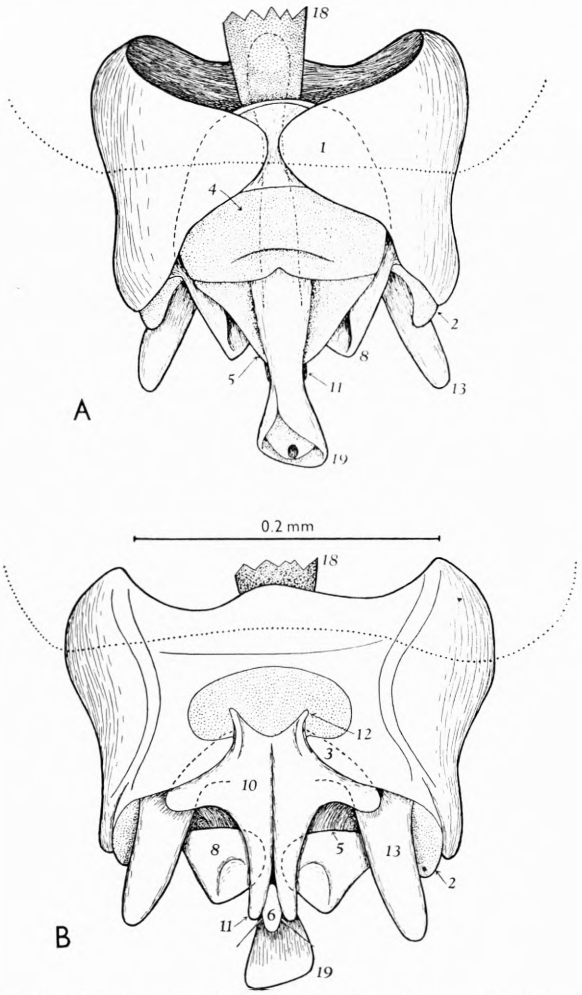

Fig. 43. *Agraylea multipunctata*. Segments IX and X in dorsal and in ventral view. In this and the following fig. the numbers *4*, *5*, *8*, and *14—16* designate structures which probably are homologous with the correspondingly numbered structures in *Orthotrichia* (figs. 38—41) and *Hydroptila* (fig. 46). The coarsely dotted line indicates the posterior border of Segment VIII. *18:* proximal part of phallus (broken off). *19:* distal part of phallus. For further explanation see text.

(*6*), on the base of which a pair of very strong setae is seen. On the ventral side the lower lip (*5*) has a pair of sharp, longitudinal ridges. The concave area between them is produced anteriorly as the sclerotic roof (*14*) of a narrow and deep pocket above the inferior appendages, and farther forwards as an apodeme (*15*), which almost reaches the anterior end of Segment IX.

The margin of the sclerite on the lower lip (*5*) is strengthened. Posteriorly this strengthened part (*16*) encloses the entrance to the phallocrypt like a U. It then runs forwards along the dorsal margin of the sclerite and bends downwards along the anterior margin. The lower end of the vertical part of *16* is interlocked (fig. 45 B)

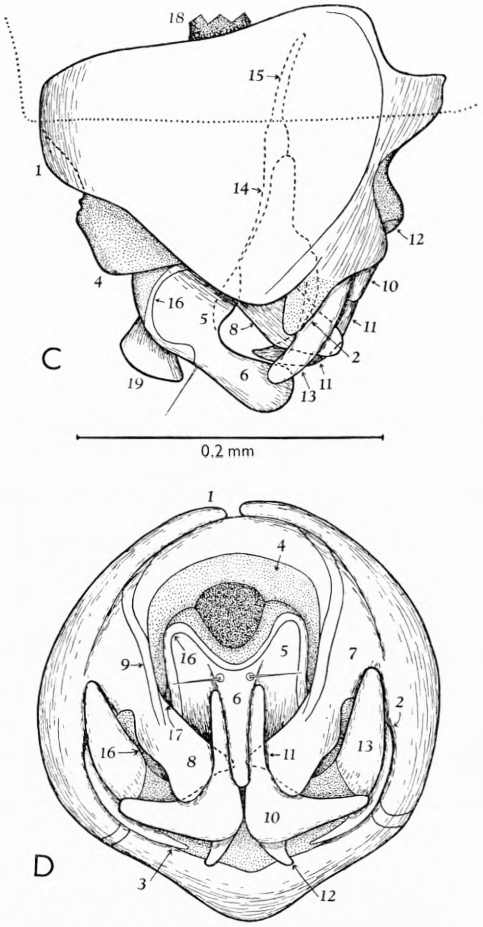

Fig. 44. *Agraylea multipunctata*. Segments IX and X in lateral (right) and in posterior view. In the lower fig. the phallus has been removed; the entrance to the phallocrypt is seen between the numbers *4* and *5*. For explanation see fig. 43.

with an upwards directed, rod-like extension (*17*) of *7*, issued at the base of *8* (fig. 44 D) and lying lateroventrally on the posterior end of Segment X (*4*). From this point *16* continues at the bottom of the genital chamber, running in a curve below the process *8*, and eventually joins the sclerite of Segment IX at the process *2*.

On *14* a pair of strong muscles is inserted, which originates ventrally from the antecosta of Segment IX. The origin covers only a rather small part of the antecosta just medially to the lateroventral longitudinal suture. A pair of weaker muscles origi-

nates on *7* and is inserted on the anterior end of *15*. The two muscles must be considered the anterior ventral and the posterior dorsal muscles, respectively, of the inferior appendages. (The former is unusual by being paired. The lack of the medioventral part of the antecosta of Segment IX has some connection with this fact). This shows that *14* and *15* must be included in the inferior appendages, though they have no sclerotic connection with the appendages themselves. No doubt the structures *5*, *14*, *15*, and *16* are homologous with those designated by the same numbers in *Orthotrichia* (figs. 38—41). The identity of *14* and *15* appears from their connection with the two muscles mentioned above. The identity of *5* partly from its connection with *14*, partly from the fact that as in *Orthotrichia* it carries a pair of strong setae. (*6* in *Agraylea* is a special part of *5*, projecting between these setae). As in *Orthotrichia* *16* forms a sclerotic connection between *5* and the sclerite of Segment IX. — The two muscles described probably act as a depressor and a levator, respectively, of *6*.

The inferior appendage itself (*10—12*) has a short, broad basal piece (*10*), which proximally projects into a small, downwards curved process (*12*), distally into a slender, backwards directed and upwards curved, somewhat sagittally compressed horn (*11*). The right and the left horn are rather closely approached. Quite proximally the two basal pieces (*10*) are sclerotically continuous on the ventral side. Proximally the dorsal side of *10* is membranous. From this area a large, finger-like, sclerotic process (*13*) rises. It possibly represents the harpago, though I have been unable to find any muscles associated with it.

The anterior dorsal muscle of the inferior appendage is very strong. It originates from the antecosta of Segment IX on the whole stretch between the laterodorsal and the lateroventral longitudinal suture, and is inserted laterally and proximally on *11*. The weaker posterior ventral muscle originates from the laterodorsal longitudinal suture of Segment IX and is inserted on *12*. Without knowledge of conditions in *Orthotrichia* (pp. 71—72) it would have been impossible to identify the latter muscle. In *Orthotrichia* it originates from the apodeme *16a* (figs. 39—41). Taking the sclerotic connection between Segment IX and *16* into account, it is not difficult to imagine that the origin may have shifted from *16a* to the dorsal side of Segment IX. — Since one muscle is inserted distally, the other proximally to the articulation with Segment IX (*3*), they act as a levator and a depressor, respectively. The two other muscles of the inferior appendage have already been mentioned.

The mutual position of the parts described above appears from figs. 43 and 44. It is somewhat different in the various preparations. It will be seen that a pair of tongs is formed by *6* and *8* on one side and *11* on the other side. Of those structures which enter into the composition of the tongs *8* is immovable. The process *13* probably has a tactile function.

The phallus (figs. 43 and 44, *18—19*; 45) is very like that of *Orthotrichia*, though it is considerably shorter and thicker. In a fully retracted state it reaches only to the posterior end of Segment VII. A deep constriction divides it into two parts, approximately equal in length. The elongately conical proximal part is considerably more

thin-walled than the slender distal part. A little distally to the constriction an unpaired, slender titillator rises on the ventral side. It is first wound one and a half times round the phallus, towards the right and forwards, and then is directed straight backwards. (Its exact position differs in the various preparations). As in *Orthotrichia* the ejaculatory duct is divided into two branches, one of which enters the titillator. Since this branch is quite thin-walled, the arrangement cannot have the same mechanical function as in *Orthotrichia* (p. 76). Perhaps it serves to prevent a torsion of the ejaculatory duct

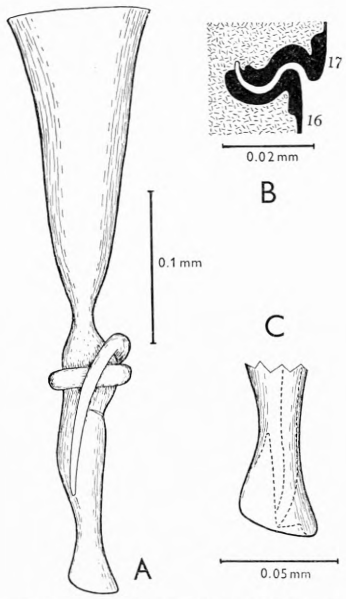

Fig. 45. *Agraylea multipunctata*. A: phallus in lateral (right) view. B shows the interlocking of *16* and *17* (see p. 79); semidiagrammatic horizontal section. C: distal end of phallus in lateral (right) view; the broken lines indicate the ejaculatory duct and the papilla carrying its opening shining through.

during the rotations of the phallus. A little distally to the origin of the titillator a narrow, approximately semicircular, internal ridge is seen on the ventral side of the phallus. (It is better developed on the left than on the right). It is probably homologous with the oblique, thickened annulus in *Orthotrichia* (fig. 42, *4*). The branch of the ejaculatory duct which enters the distal part of the phallus is strongly sclerotized, but its diameter is only a fraction of that of the phallus, and unlike conditions in *Orthotrichia* the skeleton is formed by the wall of the phallus. The somewhat swollen distal end of the phallus is spoon-like excavated on the dorsal side. At the bottom of the "spoon" the ejaculatory duct opens on a low, thick, membranous papilla (fig. 45 C).

The posterior phallic muscle originates from 7 (figs. 43 and 44) and is inserted proximally on the phallus. The anterior muscle originates from the lateral part of the antecosta of Segment IX and behaves in a similar way as in *Orthotrichia*. Two portions can be distinguished, a dorsal one running obliquely in an anal direction, and a ventral one running obliquely in an oral direction. On the left side the former crosses below,

the latter above the phallus, on the right side it is converse. As in *Orthotrichia* the anterior muscle may suggest that the phallus is surrounded by a circular musculature.

A discussion of the morphology of the phallus will be found under *Hydroptila occulta* (p. 84).

Hydroptila occulta.

In a previous paper (1951) I have described the genital segments of this species. Referring to this description, some supplementary information will be given here.

A pair of sensilla (possibly s. campaniformia) is seen posteriorly on Tergum VIII as in *Orthotrichia*. They are, however, much smaller than in this form.

Segment IX. Laterally the anterior margin projects into a long point reaching the middle of Segment VII or the posterior end of Segment VI, according to the state of contraction of the abdomen. (In other species, e. g. *H. cornuta* Mos. and *H. sparsa* Curt., the lateral side is not nearly so long. The anterior margin bulges much, it is true, but it forms an even curve. See Anker Nielsen 1948b, pp. 125—27). Laterodorsally there is a distinct longitudinal suture, which joins the antecosta at an angle of 45° halfway between the centre of the dorsal indentation and the lateral point of the anterior margin. Its relations to the IX/X muscle and the muscles of the inferior appendages indicate that it is homologous with the dorsal longitudinal sutures in *Orthotrichia* (p. 68) and *Agraylea* (p. 77). In *Hydroptila occulta* it extends only over the oral half of the segment, but it points towards the base of the dorsal branch of the lateral process (1951, fig. C). It is possible, therefore, that this branch (fig. 46, *8*) is homologous with the lateral process in *Orthotrichia* (figs. 38, 39, 41, *8*) and the process *8* in *Agraylea* (figs. 43 and 44). The hyaloid process (fig. 46, *2*) no doubt is homologous with the process *2* in *Agraylea*, though it has a more dorsal position than in the latter. The ventral branch of the dorsal process in *H. occulta* then possibly corresponds to the process *3* in *Agraylea;* as will be shown below, the two supposed homologues have similar relations to the inferior appendage.

Segment X. The dorsal side is scarcely entirely membranous, though it is pale and very thin-walled. The two more strongly sclerotized stripes in return are very strong, especially in their oral half. Their anterior ends are bent upwards and backwards like the handle of a walking stick and are continuous with the sclerite of Segment IX. The IX/X muscles are inserted on these rods, just anally to the bend. They originate from the antecosta of Segment IX between the two longitudinal sutures. Unlike conditions in *Orthotrichia* and *Agraylea* the IX/X muscle is paired, though the two origins almost touch each other in the middle of the dorsal side of the antecosta. The function of the muscle is possibly a depression of Segment X.

The inferior appendages. The two appendages not only touch one another medially, but they have also a common, large and thick, membranous part. Whether there is any sclerotic continuity, I do not venture to say; the two sclerites at least are separated by a fine furrow. The anterior dorsal muscle is very strong. It originates from the

antecosta from the longitudinal suture to a point about halfway between the latero-oral point and the middle of the ventral side. It is inserted laterodorsally on the proximal margin of the appendage (i. e. at the distal end of the dark stripe seen in fig. D, 1951). The posterior ventral muscle is weaker and is developed (almost) as in *Agraylea* (pp. 79—80). It originates on the antecosta of Segment IX somewhat dorsally to the longitudinal suture (and of course more distally on the antecosta than the IX/X muscle) and is inserted ventrally on the proximal end of the appendage. The two muscles are

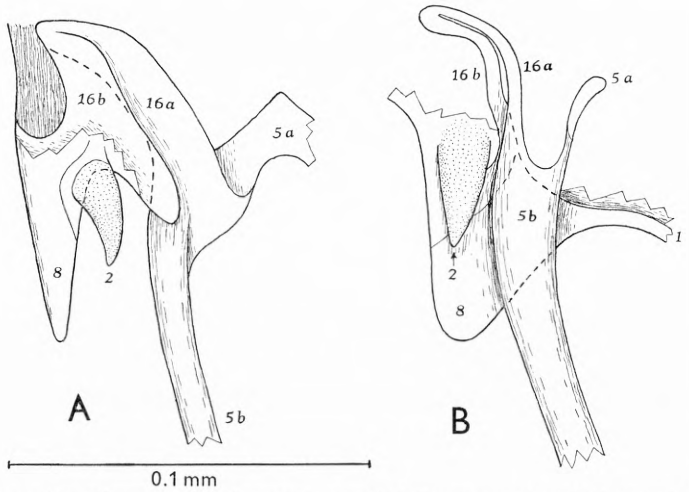

Fig. 46. *Hydroptila occulta*. Showing relations between left "paramere" and Segment IX. A: dorsal view. B: median view. The irregularly serrate lines are (supposed) lines of fracture after severance of sclerites. All membranes—with the exception of that of the process *2*—have been removed. The numbers *2*, *5*, *8*, and *16* designate structures which probably are homologous with the correspondingly numbered structures in *Agraylea* (figs. 43 and 44). *1:* inflected posterior margin of Segment IX. *2:* hyaloid process on the median side of the lateral process. *5a:* "cordate ventral plate" (in B as seen in optical sagittal section). *5b:* left "paramere". *8:* lateral process of Segment IX. *16a* and *16b:* see p. 84; in A *16b* is seen from the haemocoelic side, in B both are seen from the edge.

antagonists (levator and depressor, respectively), the inferior appendage forming a sort of articulation with the ventral branch of the lateral process of Segment IX.

In my previous paper (1951, p. 125) I described "a sheath of the aedeagus" carrying a pair of "parameres". "The sheath" projects rather far backwards (in 1951, fig. B, its distal end is seen between the two inferior appendages) and forms a lower lip for the entrance to the phallocrypt. (The several times longer dorsal lip is formed by Segment X). Proximally the "parameres" (fig. 46, *5b*) are much dilated in a median direction, and quite proximally their sclerites are continuous on the ventral side, thus forming the "cordate ventral plate" (*5a*). The strong seta on the "paramere", alone, indicates that the two "parameres" and their "ventral plate" are homologous with the process *5* in *Orthotrichia* (figs. 40 and 41) and *Agraylea* (figs. 43 and 44; the distal part of the "parameres", beyond the setae, then must be considered homologous with the horn *6* in *Agraylea*). This assumption is confirmed by the fact that the

anterior ventral muscle of the inferior appendage is inserted on the "cordate ventral plate". The "parameres" (and also the "sheath of the aedeagus") thus belong to the inferior appendages, though they are not sclerotically connected with the appendages themselves. The dorsal side of the "paramere" projects anteriorly and laterally into a plate (fig. 46, *16 a*), lying in the floor of a narrow pocket issued from the genital chamber medially to the dorsal branch of the lateral process of Segment IX. Another plate (*16* b), issued from the sclerotic median side of the branch mentioned, lies in the roof of this pocket. At the bottom of the pocket the two plates are continuous. These two plates, which form a sclerotic connection between *5* (the "parameres") and Segment IX, are to be considered homologous with those structures which in *Orthotrichia* (figs. 39—41) and *Agraylea* (figs. 43 and 44) have been marked by the number *16*. (It will be noted that the connection in *Agraylea* as well as in *Hydroptila* passes below the process *2*).

The anterior ventral muscle of the inferior appendages is very strong and approximately cylindrical. As in *Agraylea* it is paired and the origins of the two muscles even are widely separated, being from the very laterooral points of Segment IX (medially to the origin of the anterior dorsal muscle; see above). It is inserted on the proximal margin of the "cordate ventral plate". This muscle acts as a retractor, a depressor, and perhaps also an adductor of the "paramere". The antagonist must be the elastic connection (through *16 a—b*) with Segment IX. The posterior dorsal muscle is lacking.

The phallus is very delicate, but it is not correct to call it membranous. It has the same shape as in *Agraylea*, though it is longer and slenderer. In a fully retracted state (in which condition I have not seen it in any preparation) it will reach to the posterior end or to the middle of Segment V. The titillator rises on the ventral side. It is first directed backwards for a short distance, then it is wound one and a half times round the phallus towards the right and forwards, and eventually it is directed backwards. Distally to the origin of the titillator a fine and rather deep, circular furrow runs in the whole circumference of the phallus; no doubt it is homologous with the semiannular thickening in *Agraylea*. The papilla on which the ejaculatory duct opens is even more prominent than in *Agraylea*.

The lack of an aedeagal retractor makes it difficult to decide in which way the undivided phallus in the Hydroptilidae has arisen. It might be supposed that it was formed by the phallobase, and that the small papilla on which the ejaculatory duct opens in *Agraylea* and *Hydroptila* is the last remnant of the aedeagus. Or that the endotheca had been obliterated, and the phallobase and the aedeagus fused, as is probably the case in *Rhyacophila* (p. 20) and the Psychomyidae (p. 37), and that the boundary between the phallobase and the endotheca should be sought in the vicinity of the origin of the titillator. The exact boundary might be the constriction proximally to the titillator in *Agraylea* and *Hydroptila*, or the circular furrow distally to the titillator in *Hydroptila*.

The last explanation involves that the titillator is homologous with the parameres

in the Rhyacophilidae and the Limnophilidae. I find it likely, however, that the hydroptilid titillator is homologous neither with the paired parameres in *Rhyacophila* and the Limnophilidae nor with the unpaired paramere in the Glossosomatinae. None of these structures contains a branch of the ejaculatory duct. I am inclined to consider the hydroptilid titillator as a secondary structure, which has no homologue in other Trichoptera. In some Hydroptilidae the phallus bears, besides the titillator, various other processes, which have a greater or less resemblance to the titillator (DENNING 1947 a, b, c). In the genus *Oeceotrichia* Ulm., on the other hand, the phallus lacks every sort of processes (ULMER 1951, p. 86).

A third explanation is possible, and this I find the most probable: the copulatory organ represents the aedeagus alone; the phallotheca has been reduced, and the endotheca has been merged entirely in the phallocrypt. What leads me to this conclusion is the semi-annular sclerite at the entrance to the phallocrypt in *Orthotrichia* (figs. 38 and 40, *13—13*). The two processes on this sclerite may be homologous with the parameres in the Rhyacophilidae and the Limnophilidae. This explanation being true, it means that the probable phallic apodeme in the Hydroptilidae is not strictly homologous with that of the other forms, but is an aedeagal apodeme, otherwise not present in the Trichoptera. The "spoon" on the distal end of the phallus possibly represents the ventral branch of the aedeagus, the small papilla at the bottom of the spoon in *Agraylea* and *Hydroptila* the dorsal branch; (this may be true also if the second explanation is preferred).

It must be admitted, however, that the sclerite *13—13* and its processes may be interpreted also as (non-musculated) paraprocts.

Anyway, the hydroptilid phallus is highly specialized. In the genera *Plethus* Hag. (ULMER 1951, pp. 63—65), *Sclerotrichia* Ulm. (l. c., pp. 74—75) and *Protoptila* Bks. (MOSELY 1954), also, the phallus is very much specialized, but in quite another way than in the Danish Hydroptilidae. See also pp. 145—46.

Sericostoma pedemontanum.

Segment IX (fig. 47, *1*) has a deep oral indentation both dorsally and ventrally. Between the indentations the oral margin forms a strong bulge, from the summit of which a slightly descendent longitudinal suture runs backwards. The suture marks the boundary between the origins of the IX/X muscle and the anterior dorsal muscle of the inferior appendages. The anterior phallic muscle, however, has its origin on both sides of the suture. Hence it is uncertain whether the latter can be considered homologous with the dorsal longitudinal suture in the Hydroptilidae (though the posterior dorsal muscle of the inferior appendages originates laterally—or ventrally—to it as in this family). On the ventral side the posterior border of the segment is produced into a broad, triangular ventral process (*2*).

Segment X (*3—4*) is long, tapering posteriorly and bent somewhat downwards. The dorsal and the lateral sides are sclerotized. A deep longitudinal furrow on the

membranous ventral side serves to receive the dorsal side of the phallus. On the dorsal side the sclerite of Segment X is entirely continuous with that of Segment IX, so that it is difficult to state the boundary between the two segments with certainty. An obtusely-angled, rounded bend seen in a lateral view (C) may be considered as the

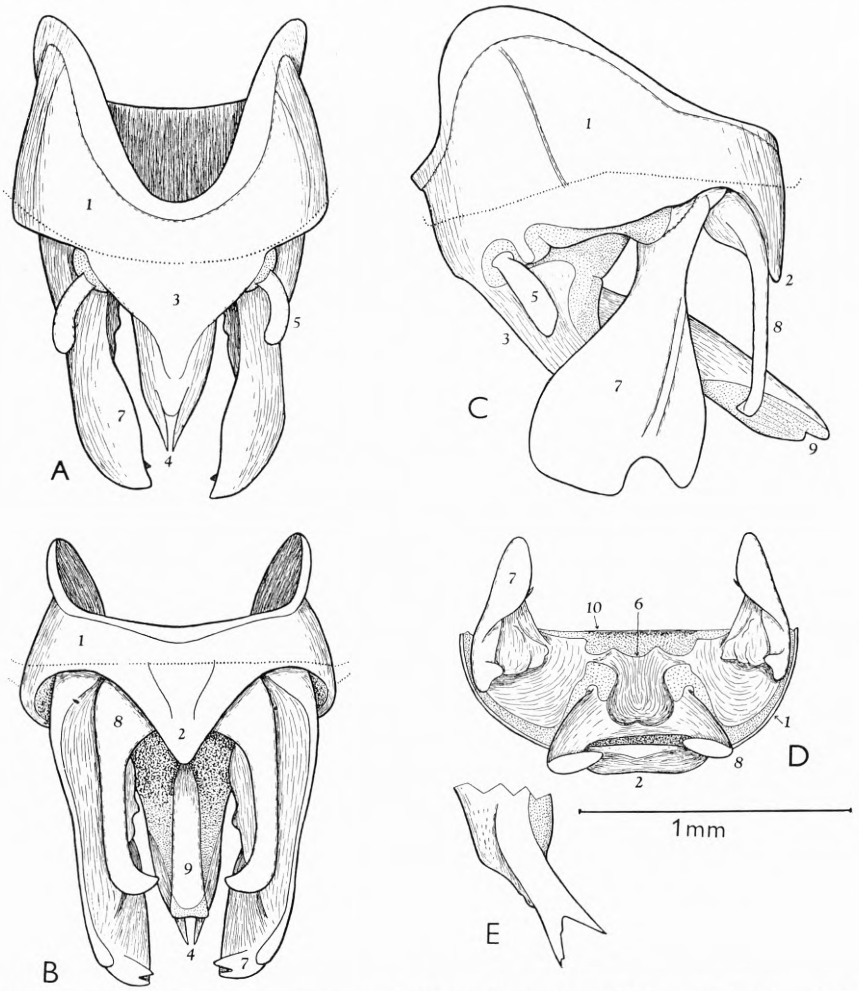

Fig. 47. *Sericostoma pedemontanum*. A—C: Segments IX and X in dorsal (A), ventral (B), and lateral (right, C) view; the coarsely dotted lines indicate the posterior border of Segment VIII. D: inferior appendages in posterior view. E: posterior end of Segment X in lateral (right) view. *1:* Segment IX. *2:* ventral process of Segment IX. *3—4:* Segment X. *5:* superior appendage. *6:* basal plate of inferior appendages. *7:* dorsal and *8:* ventral branch of inferior appendage. *9:* phallus. *10:* cut edge.

boundary, at least from a purely topographical point of view. On the lateral side the two segments are separated by a membranous area, at the dorsal end of which the small superior appendage (5) is implanted. Ventrally to the appendage the posterior margin of Segment IX has a narrow extension, the inwards bent distal end of which almost touches the anterior margin of the sclerite of Segment X. (The extension of Segment IX

lies at a more lateral level than the sclerite of Segment X, so that it does not prevent mutual movements of the two segments). The posterior end of Segment X is divided into three processes (*4*). The median, unpaired one is tongue-like with a strongly concave ventral side. Since it is bent rather much downwards, it in fig. 47 A appears less slender than it really is. The paired lateral processes (E) are sagittally compressed and their distal ends are divided into a dorsal and a ventral branch. (The shape varies a little). The ventral branches form a sort of phallus-guide. The well developed anus is found between the three processes, below the median one; (in B it is concealed by

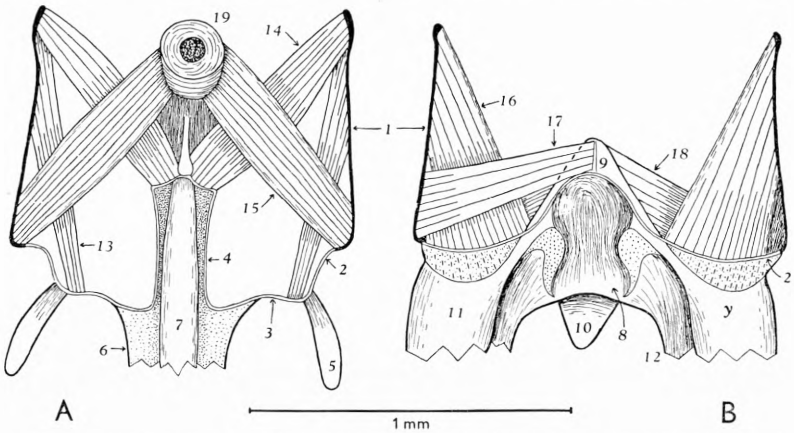

Fig. 48. *Sericostoma pedemontanum*. A shows the IX/X muscle and the phallic muscles in ventral view, B the muscles of the inferior appendages in dorsal view. *1—4:* cut edges, *1* through lateral side of Segment IX, *2* in A through membranous area between Segments IX and X, in B through membranous bottom of genital chamber (= *3* in A), *4* through wall of phallocrypt. *5:* superior appendage. *6:* Segment X (posterior part broken off). *7:* phallus (distal part broken off). *8:* basal plate of inferior appendages. *9:* apodeme on this plate. *10:* ventral process of Segment IX. *11:* dorsal and *12:* ventral branch of inferior appendage (distal parts broken off). *13:* IX/X muscle. *14:* anterior and *15:* posterior phallic muscle. *16—18:* muscles of the inferior appendages; *16:* anterior dorsal; *17:* posterior dorsal (removed on the right side); *18:* posterior ventral (possibly fused with anterior ventral). *19:* ejaculatory duct (cut through). In the pentagonal area between *19*, *14* and *15* the phallic apodeme (much shaded) is seen.

the phallus, *9*). The rather strong IX/X muscle is inserted on the anterior corner of the sclerite of Segment X.

The one-jointed inferior appendages (*7*, *8*) have a much complicated structure. Each appendage is divided into two branches: a smaller ventral (and median) one (figs. 47, *8;* 48 B, *12*) and a larger dorsal (and lateral) one (figs. 47, *7;* 48 B, *11*). The former is very thick-walled and devoid of setae. It is rod-like with an inwards curved and flattened distal end, so that it resembles a miniature golf club. Proximally the two ventral branches are continuous with each other and with the basal plate (figs. 47 D, *6;* 48 B; *8*), which is very concave. Proximally the dorsal branch has a somewhat flattened shaft. (It is flattened, however, in a plane which forms an angle of 45° with the horizontal plane; the median edge of the shaft lies at a more dorsal level than the lateral one). The larger distal part of the branch is much dilated, spoon-like, sagittally compressed and with an asymmetrical distal notch. The edges of the shaft continue as low keels on the median and the lateral side, resp., of the "spoon-

blade". The lateral keel is narrow and little prominent. The median keel soon becomes broad and cushion-like, but does not reach the distal end. Proximally the median side of the dorsal branch is connected with the basal plate by a narrow, sclerotic bridge (figs. 47 D and 48 B). In this way, only, a sclerotic connection is established between the two branches. Along the anterior margin of the bridge and of the basal plate there is a short apodeme (fig. 48 B, *9*), which is provided with a low, unpaired longitudinal ridge on the ventral side.

The very strong anterior dorsal muscle (fig. 48 B, *16*) originates from the oral two thirds of the lateral side of Segment IX (ventrally to the longitudinal suture) and

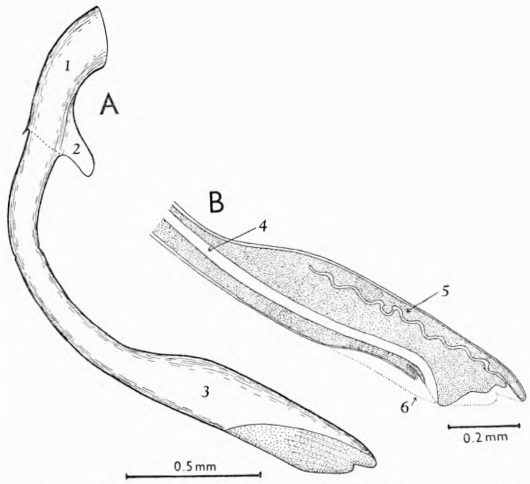

Fig. 49. *Sericostoma pedemontanum*. A: phallus in lateral (right) view. B: sagittal section through distal end of phallus. In B dotting indicates the haemocoele. *1:* phallic apodeme. *2:* ventral process on the latter. *3:* phallobase. The boundary between *1* and *3* is shown by a coarsely dotted line. *4:* ejaculatory duct. *5* (light, sinuous line): endotheca. *6* (dotted line): outline of dorsal longitudinal fold.

is inserted dorsally on the proximal margin of the dorsal branch. The posterior dorsal muscle (*17*) is inserted on the dorsal side of the apodeme *9*. The anterior and the posterior ventral muscles have fused into one very strong muscle (*18*), which originates from the whole ventral side of Segment IX and is inserted on the ventral side of the apodeme *9* and the anterior part of the ventral side of the basal plate. The two last mentioned muscles (*17* and *18*) act as a depressor and a levator, resp. Since *18* is the stronger of the two, the levation is more powerful than the depression. The anterior dorsal muscle is an adductor of the dorsal branches. (The ventral branches probably take no part in this movement). Its antagonist is—at least chiefly—elastic forces.

The phallus (figs. 47, *9;* 48 A, *7;* 49 A) is undivided, long, slender and curved much downwards. The membranous phallocrypt is deep, and there is also a long phallic apodeme (fig. 49 A, *1*). Distally on the ventral side of the latter there is a high, sagittally compressed process (*2*), the posterior side of which (as far as I can see) lies in the wall of the phallocrypt. The proximal half of the phallus is very slender. The

distal half (*3*) is thickened and sagittally much compressed, and distally its dorsal and lateral sides are membranous. In a lateral view the membranous part is slightly bilobed. The dorsal lip in its whole length (i. e. as far proximally as the membranous area reaches) is divided into two widely separated longitudinal folds, between which a membranous papilla is seen. This papilla is the distal end of an eversible, membranous and thin-walled structure. Or rather, it is that part of this structure which in an invaginated condition lies distally. The furrow which bounds the eversible part is quite low on the dorsal side, but very deep on the ventral side (fig. 49 B, 5). The strong aedeagal retractor, which originates in the phallic apodeme and fills up a great part of the "shaft" of the phallus, is inserted on the eversible structure. The latter probably represents the aedeagus. The phallus then is formed (almost exclusively) of the phallobase. The membranous aedeagus (in the invaginated state) is thrown into numerous folds. Hence I could not with certainty localize the opening of the ejaculatory duct (*4*), but it seems that it will come to lie proximally on the dorsal side of the aedeagus, when the latter is everted. — Proximally in the phallic apodeme the ejaculatory duct is provided with dilator muscles.

The phallic muscles (fig. 48 A), more especially the anterior one, are very strong. Their origins are at either end of the longitudinal suture of Segment IX. The two anterior muscles are inserted on the bottom of the phallocrypt on each side of the process (fig. 49 A, 2) of the phallic apodeme. The posterior muscle is inserted proximally and laterally on the apodeme.

Beraea maurus.

Segment VIII is slightly modified, the sternum being rather short.

Segment IX (fig. 50, *1*) is longest on the lateral side, whereas the length of the dorsal side is reduced by a deep oral indentation, and that of the ventral side by both oral and anal indentations.

Segment X (2) is scale-like, slightly tapering towards the posterior end and with a very concave ventral side. The greater, anterior part of the dorsal side is sclerotized, and this sclerite is continuous with that of Segment IX. The boundary may be stipulated in the same way as in *Sericostoma* (p. 86). The posterior part of the segment forms a hyaloid lamella, so delicate that in microscopic preparations it may be difficult to see its contour. The circular musculature of the rectum can be followed almost as far as the sclerite of the dorsal side goes. I have been unable to make out the exact position of the anus. It must be situated somewhere on the ventral side, and be very small and probably non-functional. On either side of Segment X there is a very deep, membranous indentation, which almost reaches the anterior margin of Segment IX.

Laterally to Segment X there is a pair of long, slender horns (figs. 50, *3;* 51, 2), which project beyond the posterior end of Segment X. Proximally the horn is directed outwards and backwards, but it soon becomes much inwards curved. It is sagittally compressed, and in its greater distal part the median side is slightly concave. In a

lateral view it is seen that the height of the horn proximally increases abruptly. The ventral side of this proximal, higher part is continuous with a triangular sclerite (fig. 51, *3*), which lies on the otherwise membranous ventral side of Segment X, and which —owing to the concavity of this side—is placed almost vertically. The IX/X muscle originates laterodorsally from the antecosta of Segment IX (laterally to the membranous indentation) and is inserted ventrally on the proximal, higher part of the horn. The horn possibly acts as a lever with the posterior border of Segment IX as a pivot, so that the function of the muscles will be to adduce—and perhaps also to some degree to depress—the horns.

The horns might be interpreted as the superior appendages. The fact, however, that they are musculated makes this assumption less probable. I find it most likely that they are homologous with the posterior, paired processes of Segment IX in *Sericostoma* (fig. 47, *4*). The superior appendage—which already in *Sericostoma* is much reduced —then is entirely lacking in *Beraea*, and what above simply has been called Segment X is the homologue of the unpaired median process in *Sericostoma*. (A small node orally on the lateral margin of the sclerite of Segment X may perhaps be considered as a rudiment of the superior appendage. It reminds also, however, of a paired, membranous process in *Molanna;* fig. 56, *4*, p. 100).

As in *Sericostoma* the inferior appendages, which are short and stout, are divided into a ventral (and median) branch (figs. 50, *5;* 51, *8*) and a dorsal (and lateral) branch (figs. 50, *4*; 51, *6*—*7*). The former approaches to the semiglobular shape, though it is longer than thick. On its distal end a small, backwards and inwards directed spine is seen. Quite proximally its sclerite is annular, but otherwise the greater part of the dorsal side is membranous. Distally from the membranous area a short, finger-like, upwards and backwards directed, sclerotic harpago (figs. 50, *6*; 51, *9*) arises. The harpago thus is situated subdistally on the coxopodite. The median side of the sclerite of the ventral branch is produced proximally and is continuous with the basal plate (fig. 51, *4*). Anteriorly the latter carries an unpaired ridge-like apodeme (*5*).

The proximal part of the dorsal branch forms a simple articulation with Segment IX, its lateral side resting in a shallow ginglymus (fig. 51, *10*) on a broad, inwards bent part of the posterior border of Segment IX. The distal part of the dorsal branch again is divided into two branches, of which the clumsy, finger-like dorsal one (*6*) is directed obliquely upwards, whereas the ventral branch (*7*) is bent inwards. The latter branch is much compressed, so that in a dorsal or ventral view it resembles an acute spine, and in a posterior view appears as a rounded plate situated behind the distal end of the ventral main branch of the appendage. (In fig. 50 D the number *6* and the companion arrow are placed on this plate). By a broad, sclerotic bridge the upper side of the dorsal branch is connected with the proximal, annular part of the sclerite of the ventral branch and through this with the basal plate. Besides there is an extensive membranous connection between the two branches.

In *Beraea* as in *Sericostoma* the inferior appendage is composed of two branches. A closer comparison, however, reveals that the position of the branches is the reverse

of that in *Sericostoma:* the dorsolateral branch in *Beraea* (fig. 51, *6—7*) corresponds to the ventromedian branch in *Sericostoma* (figs. 47, *8;* 48B, *12*), the ventromedian branch in *Beraea* (fig. 51, *8—9*) to the dorsolateral branch in *Sericostoma* (figs. 47,

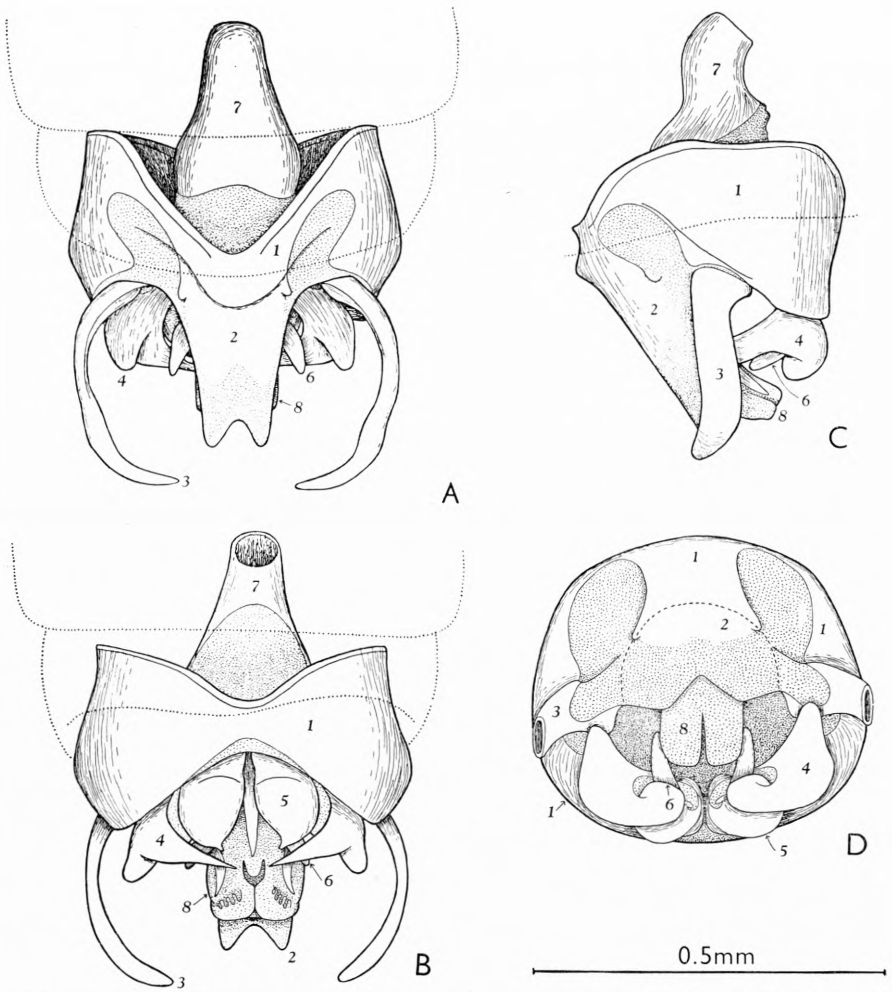

Fig. 50. *Beraea maurus.* Segments IX and X in dorsal (A), ventral (B), lateral (right, C), and posterior view (D). The coarsely dotted lines in A and B indicate the outlines of Segments VII and VIII, in C the posterior border of Segment VIII. The broken line in D indicates an optical transverse section through the ventral side of the anterior part of Segment X (corresponding to the sclerites *3* in fig. 51). *1:* Segment IX. *2:* median part of Segment X. *3:* lateral horn of Segment X (in D cut off near its base). *4:* dorsal branch of coxopodite. *5:* ventral branch of coxopodite. *6:* harpago. *7:* phallic apodeme. *8:* distal end of phallus.

7; 48, *11*). This appears from two facts. First: In *Beraea* it is the ventromedian branch which carries the harpago. In *Sericostoma* both branches are one-jointed, but the structure of the laterodorsal branch makes it probable that it was this branch

which was two-jointed in the ancestors of this genus, and nothing indicates that the medioventral branch has ever been two-jointed. Secondly (and this is more significant): The anterior dorsal muscle in *Sericostoma* is inserted on the dorsolateral branch, in *Beraea* on the ventromedian branch. A comparison with some other Integripalpia in which a more or less rudimentary dorsal branch is present, indicates that the condition in *Beraea* is the original one. The condition in *Sericostoma* may have arisen in

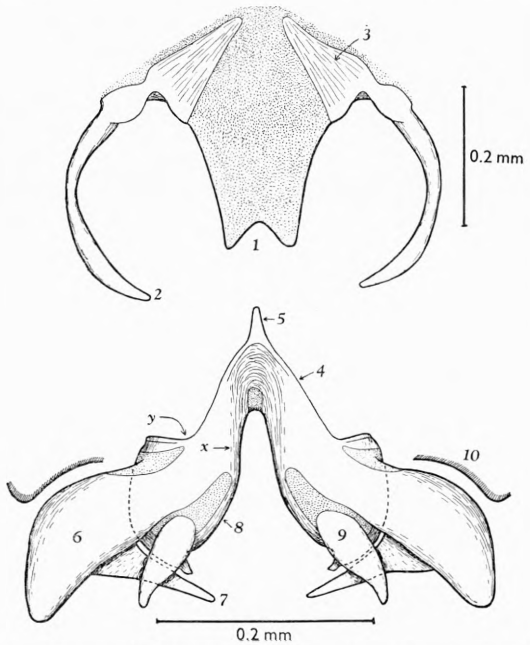

Fig. 51. *Beraea maurus*. Above: Segment X in ventral view. *1:* median part. *2:* lateral horn. *3:* sclerite supporting the latter. Below: Inferior appendages in dorsal view. *4:* basal plate. *5:* apodeme on basal plate. *6:* upper and *7:* lower secondary branch of dorsal branch of coxopodite. *8:* ventral branch of coxopodite. *9:* harpago. *10:* outline of ginglymus on posterior border of Segment IX.

the following way: The area labelled *x* in fig. 51 has been desclerotized, and the dorsal branch (*6*) has been shifted medially and ventrally, moving above the ventral branch. The bridges *y* in figs. 48B and 51 are homologous.

The musculature of the inferior appendages are normally developed. The strong anterior dorsal muscle is inserted laterally on the proximal margin of the ventral branch (laterally to the arrow *y* in fig. 51). Due to the articulation between the dorsal branch and Segment IX (*6/10*) it must act as an adductor. The same function has the rather feeble anterior ventral muscle, which is inserted proximally on the lower side of the ventral branch. The two posterior muscles are inserted on the apodeme (*5*) of the basal plate. The dorsal one originates on the posterior border of Segment IX at the ginglymus *10* (i.e. rather ventrally). The two posterior muscles are a depressor and a levator, respectively. Acting together they probably also may be antagonists to

the anterior muscles. The flexor of the harpago originates proximally from the lower side of the ventral branch (which there is devoid of setae) and is inserted medially and orally on the proximal margin of the harpago.

The phallus (fig. 50, *8*) together with the phallic apodeme (fig. 52) is composed of two parts separated by a membranous articulation. The proximal part (fig. 52, *1*—*2*) is rather pear-shaped with the thin end proximally. Its dorsal side is more than three times as long as the ventral side. The latter in its whole extent is apodemal, whereas the distal, broader part (*2*) of the dorsal side has the character of a sclerotization in

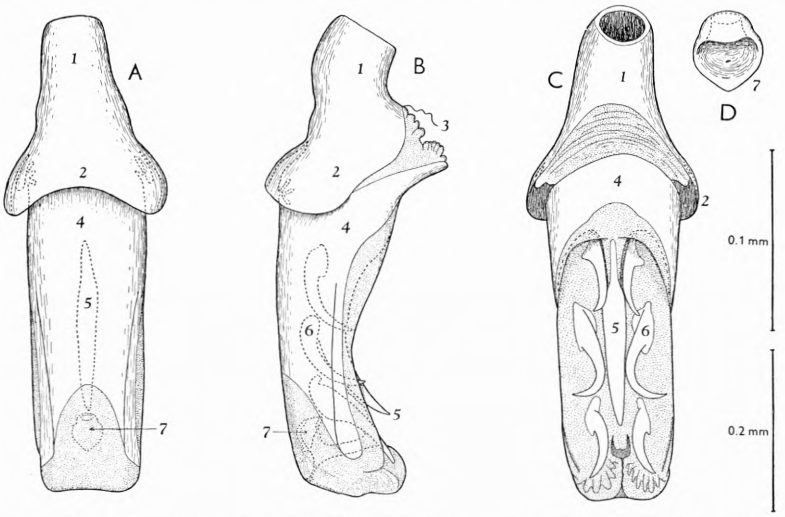

Fig. 52. *Beraea maurus*. A—C: phallus in dorsal (A), lateral (right, B), and ventral view (C). D: phallotremal sclerite (see p. 94) in ventral view. *1:* phallic apodeme. *2:* dorsal wall of phallocrypt (in A and B as seen from the haemocoelic side). *3:* part of ventral wall of same in optical section; in A and C this wall is removed. *4:* phallus. *5:* sclerotic longitudinal fold on ventral side of phallus; in A it is shown shining through (broken line), in B its freely projecting, spine-shaped distal end is seen. *6:* the middle one of the three paired spines. *7:* phallotremal sclerite.

the dorsal wall of the phallocrypt and like a roof projects above the base of the distal part. The distal part (*4*) is almost straight, only slightly downwards bent. Quite basally it is membranous and thrown into several wrinkles, which are much more numerous and more thin-walled on the ventral side than on the dorsal and lateral sides. On the lateral side one (the proximal) of these wrinkles is larger than the others and developed as a backwards directed fold, which is sclerotized (and sclerotically continuous with the proximal part) on the external side. The wrinkles must allow a considerable motility of the phallus, which, however, must be passive, since no muscles are inserted to the distal part. The wrinkles perhaps allow also protraction of the distal part by blood pressure. In this case the retraction also must be passive. After the membranous, wrinkled part there follows a short zone in which the phallus is entirely sclerotized. Ventrally the proximal edge of the sclerite is bent very much downwards. To its greatest extent, however, the distal part is sclerotized only on the dorsal side, which is enclosed

by the very concave lower side of Segment X. The sclerite moreover has a deep, distal indentation, and the extreme apex is entirely membranous. The lateral margin of the sclerite has an internal thickening. The membranous, but thick-walled ventral side is rather concave. Along its middle there runs a light brown, sclerotic longitudinal fold, the distal end of which projects freely as a large, backwards directed and somewhat downwards curved spine (*5*). This structure is flanked by three pairs of black spines (*6*). The proximal and the intermediate spine are curved downwards, the distal spine is curved backwards. The ventral side is much wrinkled, and the black spines to their greatest extent are lowered into membranous pockets (not shown in the figures).

The membranous apex, which is dilated in a ventral direction, is divided into three vertical lips, a pair of larger distal ones and a smaller proximal one. The three lips enclose a vertical U-shaped tube between them. The ventral end of this tube is the functional opening of the ejaculatory duct, which thus is subdistal on the ventral side of the phallus. The morphological opening is at the dorsal end of the U-shaped tube. It is surrounded by a strong, annular sclerite (*7*), the dorsal side of which is considerably longer than the ventral side. No muscles are inserted on this sclerite.

The posterior phallic muscle originates anally and lateroventrally from Segment IX (above the posterior dorsal muscle of the inferior appendage) and is inserted laterally on the proximal edge of the phallic apodeme (*1*). The anterior muscle originates laterally from the antecosta of Segment IX (ventrally to the IX/X muscle) and is inserted laterodorsally and distally on the sclerotic part of the phallocrypt (*2*). In the state of repose this muscle has an almost transverse course. There is no aedeagal retractor. In the phallic apodeme radial muscle bands go to the ejaculatory duct.

The lack of an aedeagal retractor renders it difficult to make out the comparative morphology of the phallus. Quite tentatively I shall suggest that the wrinkled basal portion of the distal part (*4*) is a reduced phallobase, and that the larger, partly sclerotized portion of the distal part represents the aedeagus. The distal, U-shaped tube then may be termed a phallotremal cavity, and the sclerite *7* (fig. 52) a phallotremal sclerite.

The shape of the genital segments is rather different in the Sericostomatinae and the Beraeinae; this is especially true as regards the phallus. The close relationship between the two subfamilies is revealed, however, in the structure of the inferior appendages.

Leptocerus cinereus.

Segment IX (fig. 53, *2—3*) is longest on the ventral side. On the dorsal side the acrotergite (fig. 54 A, *1*) is exceptionally large and very rich in possibly campaniform sensilla. Just behind the antecosta a pair of short, tongue-like, upwards and backwards directed dorsal processes (fig. 53, *6;* cut off in fig. 54 A) is seen. In a dorsal view they cover the posterior part of Segment IX and the anterior end of Segment X.

Segment X (figs. 53, *4;* 54 A, B) is long. Its posterior half is divided into a pair of

entirely sclerotized spines (*5*; *4*), which are a little flattened. In their whole length the two spines are curved slightly inwards, so that their upwards bent points almost touch each other. Although the bases of the two spines are contiguous above the anus (fig. 54 B), a comparison with *Molanna* (p. 99) and *Odontocerum* (pp. 101—02) indicates that they are homologous with the lateral processes in *Sericostoma* (fig. 47, *4*, p. 86). On the anterior half of the segment the dorsal side is much vaulted (transversally), whereas the ventral side is flat or (orally) slightly concave. The segment carries a pair of lateral sclerites, which are continuous with the two anal spines. In the middle of the ventral side the two sclerites almost reach each other (fig. 54 B, *3*), and on the dorsal side they are continuous for a short distance (fig. 54 A, *3*).

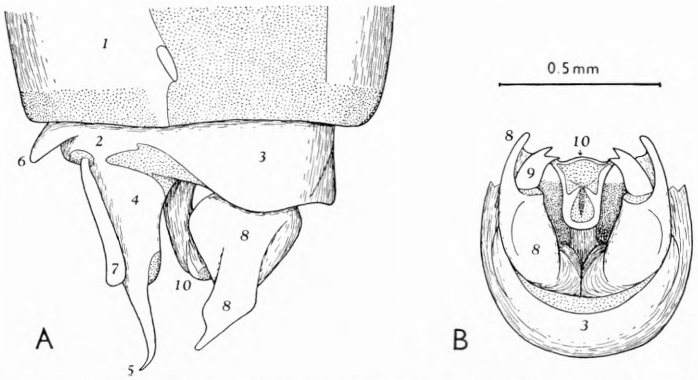

Fig. 53. *Leptocerus cinereus*. A: posterior end of abdomen in lateral (right) view. B: ventral part of Segment IX, inferior appendages and phallus as seen from behind and a little from the ventral side. *1:* Tergum VIII. *2:* dorsal and *3:* ventral part of Segment IX. *4:* Segment X. *5:* posterior spines ("intermediate appendages") of Segment X. *6:* dorsal process. *7:* superior appendage. *8:* coxopodite. *9:* harpago. *10:* phallus.

Laterodorsally the sclerites of Segments IX and X are continuous through a rather narrow bridge. Otherwise they are separated by three membranous areas, an unpaired dorsal one and a pair of laterals. Laterally in the dorsal area the long, slender and slightly clavate superior appendages (figs. 53, *7*; 54, *5*) are implanted. As in other Integripalpia it is difficult to state the boundary between Segments IX and X with certainty. From a purely topographical point of view the membranous areas may be considered as the boundary, but very likely the bases of the dorsal processes mark the true boundary.

The IX/X muscle is inserted on the proximal margin of the sclerite of Segment X ventrally to the bridge which connect this sclerite with that of Segment IX. Its function must be a depression of Segment X, and its antagonist the elasticity of the bridge mentioned; (the dorsal VIII/IX muscles probably move Segment IX + X as a whole).

The inferior appendages (figs. 53, *8—9*; 54 C) are rather long. They are two-jointed, though the harpago (*9*; *10*) is very short. In a lateral view the dorsal side of the coxopodite is strongly convex. The bulge appears as a narrow, sharp ridge, the edge of which is beset with strong, yellow setae. The ventral side, on the other hand,

is broadly rounded. The median side is slightly concave and proximally continuous with that of the other appendage, though a rather sharp furrow is seen between the two coxopodites. Dorsomedially and proximally on the appendage there is an area (fig. 54, 7) which is separated from the rest of the appendage by an approximately rectangular keel. The two areas 7 represent the basal plate which anteriorly is con-

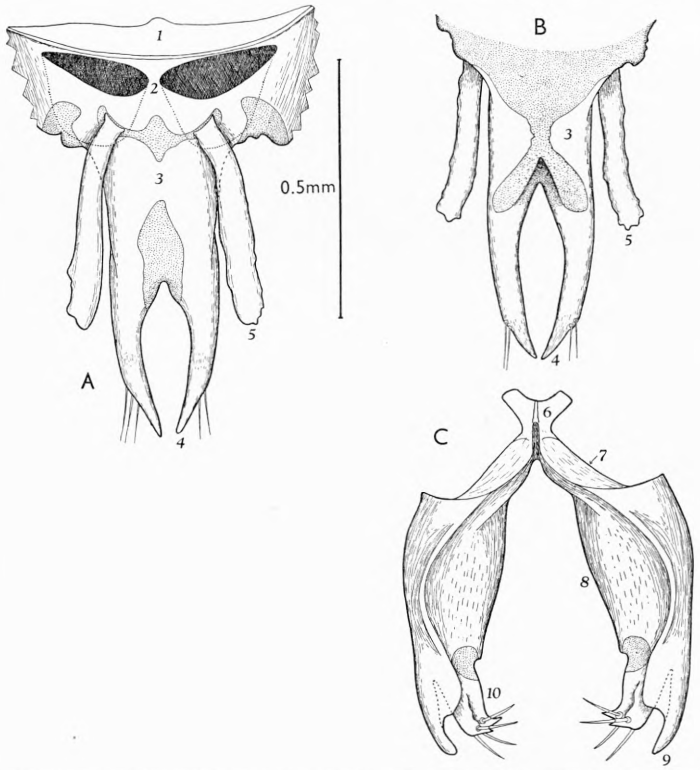

Fig. 54. *Leptocerus cinereus*. A: Segment X and dorsal part of Segment IX in dorsal view. B: Segment X in ventral view. C: inferior appendages in dorsal view. *1:* acrotergite of Segment IX. *2:* tergal region of Segment IX; the number is flanked by the cicatrices after the cut-off dorsal processes, the outlines of which are shown by coarsely dotted lines. *3:* sclerite of Segment X. *4:* posterior spine of Segment X. *5:* superior appendage. *6:* apodeme on *7:* basal plate of inferior appendages. *8:* coxopodite. *9:* distal process of coxopodite. *10:* harpago.

tinued as a Y-like apodeme (*6*), on the ventral side of which there is a longitudinal ridge, a continuation of the furrow separating the two appendages. The lateral side of the coxopodite is protracted into a sagittally compressed and medially concave process (*9*), which projects beyond and in a lateral view entirely conceals the small, claw-like, and bicuspid harpago (*10*). Laterodorsally the coxopodite and the harpago are sclerotically continuous, but the connection probably is flexible.

The anterior dorsal muscle is very strong. It originates from the whole lateral part of the antecosta of Segment IX and is inserted on the lateral half of the proximal margin of the coxopodite. The two ventral muscles are not so strong, but still they

are strong muscles. The anterior one is inserted medioventrally on the proximal margin of the coxopodite. The posterior ventral muscle originates ventrally from the proximal margin of the coxopodite. (The most median part of the origin distally to the insertion of the former muscle). It is inserted on the ventral side of the apodeme *6*. The anterior dorsal muscle and the anterior ventral muscle probably act as an abductor and an adductor, respectively. The posterior ventral muscle, also, may be an

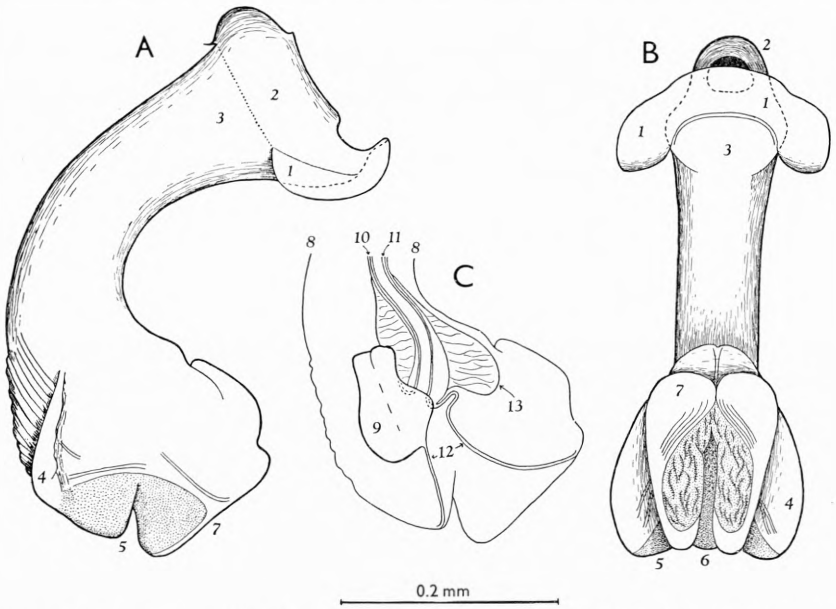

Fig. 55. *Leptocerus cinereus*. A and B: phallus in lateral (right) and ventral view. C: internal structures in distal end of phallus; lateral (right) view. *1:* rim-like sclerite in floor of genital chamber (in A seen from the haemocoelic side). *2:* phallic apodeme. *3:* proximal end of phallus (in A separated from *2* by a coarsely dotted line). *4:* sclerotic wing on distal end of phallus. *5:* lateral and *6:* median lobe of upper lip. *7:* right half of lower lip. *8—8:* outline of phallus. *9:* phallotremal sclerite (see p. 98). *10—13:* optical sagittal sections; *10:* epidermal and *11:* cuticular wall of ejaculatory duct; *12:* wall of phallotremal cavity (see p. 98); *13:* glandular mass.

adductor, but probably it has some relation to the movements of the phallus. The posterior dorsal muscle has been transformed into a phallic muscle (see below). The flexor of the harpago originates from the whole lateral side of the coxopodite and is inserted medially on the proximal margin of the harpago.

The undivided phallus (figs. 53, *10;* 55) is short and stout and sclerotized to its greatest extent. Basally it is directed obliquely upwards, but since it is very much curved its distal end comes to point almost straight downwards. The distal end is dilated and has a complicated structure. Laterodorsally there is a pair of sclerotized wings (fig. 55, *4*). In a lateral view a membranous area is seen below the posterior end of the wings. By a horizontal cleft this area is divided into two lips (*5*, *7*). A ventral view (B) reveals that the upper lip (*5*, *6*) is slightly trilobed, whereas the lower

lip (*7*) is strongly bilobed and sclerotized along the margin. The cleft between the two lips leads into a rather spacious cavity (C, *12*), at the bottom of which the ejaculatory duct (*10, 11*) opens. Above its opening, in the roof of the cavity, there lies a strong sclerite (*9*), a (proximal) part of which perhaps is apodemal. In a dorsal or ventral view the sclerite is broadest towards the proximal end of the phallus. The distal part of the ejaculatory duct is surrounded by a mass of (possibly unicellular) glands.

The phallocrypt is very feebly developed. Dorsally and laterally it appears only as a fine, membranous furrow, ventrally it is quite obliterated. There a crescent-shaped sclerite is developed in the floor of the genital chamber. This sclerite is continuous with that of the phallus and thus appears as a rim (*1*) on the proximal end of the latter (*3*). The greater, median part of the rim is bent forwards into a horizontal pocket between the phallus and the inferior appendages. The basal plate of the latter (fig. 54C, *7*) also is bent into the pocket and closely applied to the rim (*1*). The margins of the rim and of the basal plate are connected by quite a narrow, elastic membrane. The ventroproximal part of the phallus rests on the medioproximal part of the inferior appendages. The phallic apodeme (*2*) is very short.

The phallic musculature is highly specialized. The anterior muscle is lacking. The slender posterior muscle originates lateroventrally from the posterior border of Segment IX, approximately at the middle of the circumference of the inferior appendage. (Its origin thus has been shifted very much in a ventral direction). It is inserted laterodorsally on the phallic apodeme (*2*). Another and feebler muscle originates from the dorsal side of the apodeme of the basal plate of the inferior appendages (fig. 54C, *6*). Its bands spread fan-like and are inserted partly on the lateral side of the phallic apodeme (fig. 55, *2*), partly on the lateral part of the rim *1*. No doubt it is the posterior dorsal muscle of the inferior appendages, which has shifted its origin from the posterior border of Segment IX to the genital chamber (the rim *1*) and in part farther to the phallic apodeme. Initial stages of such a shifting are seen in *Tinodes* (pp. 34—35), *Agraylea* (pp. 79—80), and *Lasiocephala* (p. 109). In all these forms the muscle in question takes its origin from a sclerite in the genital chamber. At least as to the two first-mentioned forms it is a question of analogy only. The two muscles must act as a levator and a depressor, respectively. The depressor muscle is much weaker than the levator, but—owing to the close connection between the basal plate of the inferior appendages (fig. 54, *7*) and the rim *1* (fig. 55)—it probably is assisted by the posterior ventral muscle of the inferior appendage. The aedeagal retractor is lacking.

The latter makes it difficult to say anything with certainty about the comparative morphology of the phallus. I should consider it most likely that in *Leptocerus* we are concerned with a further development of the condition seen in *Lasiocephala* (p. 110), which means that the undivided phallus is formed by a fusion of the phallotheca and the aedeagus. The cavity (fig. 55, *12*) in the distal part of the phallus then is a phallotremal cavity, and the sclerite *7* a phallotremal sclerite. (See *Odontocerum*, p. 104, and *Oligoplectrum*, p. 114). The condition in *Leptocerus* might also be a further development of that in *Beraea* (p. 94), the phallobase having been entirely reduced.

Molanna angustata.

Segment IX (fig. 56, *3*) is short and more or less concealed by the overlapping posterior border of Segment VIII. Especially the dorsal and ventral sides are short, owing to oral indentations. The lateral side has an oral bulge and a lower anal bulge between the superior and the inferior appendage. Dorsally the posterior border projects like a roof above the oral end of Segment X.

Segment X (*5*) has a pair of lateral sclerites, which anally are protracted into a pair of sharply downwards bent processes (*6*), which are much sagittally compressed and sclerotized on both sides. They flank the distal end of the phallus. At the bases of the processes *6* the two sclerites almost touch each other on the dorsal side, being separated only by a narrow membranous stripe. Medio-orally the dorsal side of Segment X is membranous to a great extent. Anteriorly in this membranous area there is a pair of finger-like, membranous processes (*4*), which remind much of a pair of similar processes in the ♀, and which in this sex perhaps may represent cerci. In the ♂, at least, I am more inclined to think that they are homologous with the dorsal processes in *Leptocerus* (fig. 53 A, *6*). The membranous ventral side has in the middle a concavity, which receives the dorsal side of the phallus. The very distinct anus is between and below the bases of the processes *6*, ventrally bordered by a membranous lip, the upper (or inner) side of which in B is seen between the processes. A comparison with *Odontocerum* (pp. 101—02) strongly indicates that the processes *6* in *Molanna* are homologous with the lateral processes (fig. 57, *5*) in *Odontocerum*. This means that the processes mentioned in *Molanna* are homologous with the lateral processes in *Sericostoma* (fig. 47, *4*, p. 86), although they meet or almost meet above the anus. (Cp. also *Leptocerus*, p. 95).

The sclerites of Segment X are continuous with that of Segment IX through a pair of sclerotizations lying laterodorsally in the genital chamber. In these sclerotizations there is a pair of membranous "windows", ventrally in which the large, but rather feebly sclerotized superior appendages (*7*) are implanted. On the ventral edge the sclerite of the superior appendage is continuous with that of the genital chamber.

The IX/X muscle originates laterodorsally on the antecosta of Segment IX and is inserted medially on the ventral margin (at the arrow *9;* C) of the sclerite in the genital chamber. Its function probably is a depression and perhaps also an adduction of the processes *6*.

The large and much inwards curved inferior appendages (*12*) are one-jointed and of a very simple shape. The proximal half of the appendage is thicker than the distal half, sagittally compressed and with a concave median side. The distal half is approximately circular in a transverse section. Proximally and dorsally on the median side there is a spoon-like process (E, *11*), which is much flattened, has a slightly concave ventral side and is bent a little downwards. In all probability it is homologous with the dorsal branch in *Beraea* (and the ventral branch in *Sericostoma;* pp. 90—92). Proximally the two appendages are united, but chiefly by membrane. The

only sclerotic connection is through the basal plate (E, *10*), which lies in the floor of the phallocrypt; its anterior margin is separated from the phallus only by a quite narrow, membranous stripe.

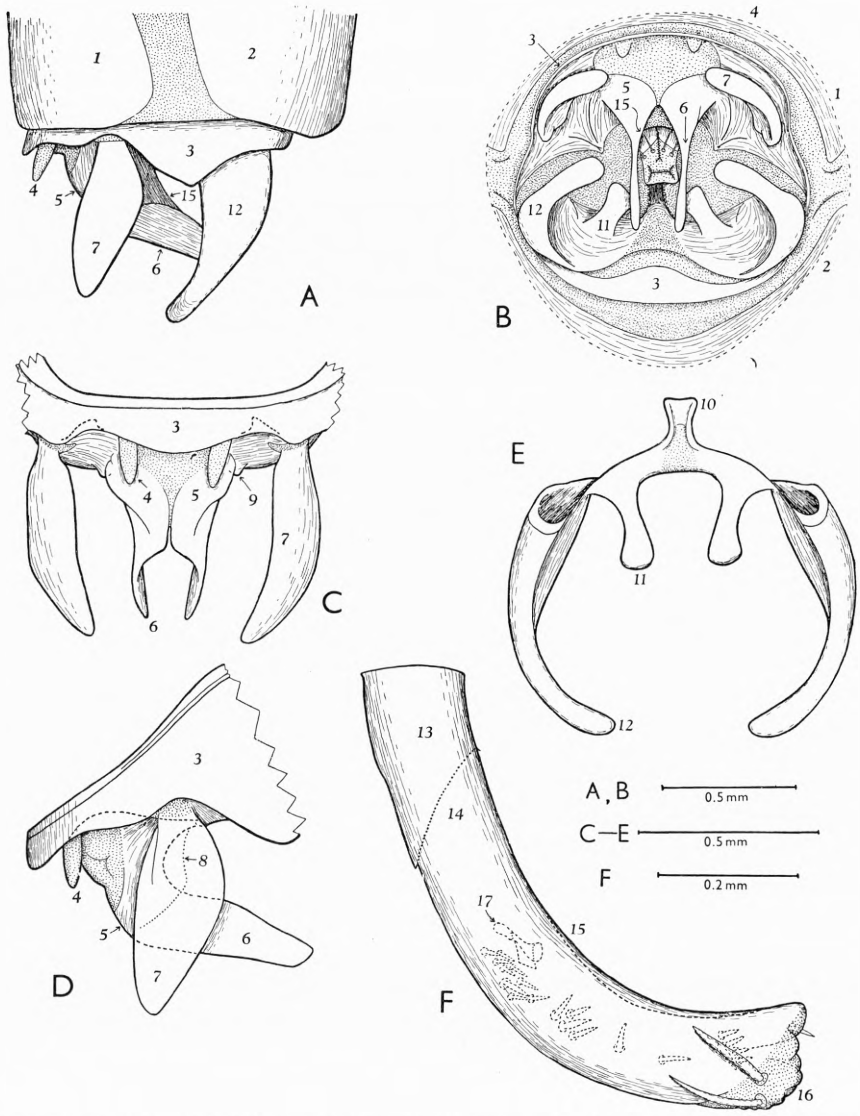

Fig. 56. *Molanna angustata*. A and B: posterior end of abdomen in lateral (right) and in posterior view. C and D: Segment X and dorsal part of Segment IX in dorsal and in lateral (right) view. E: inferior appendages in dorsal view. F: phallus in lateral (right) view. *1:* Tergum VIII. *2:* Sternum VIII. *3:* Segment IX. *4:* dorsal process (see p. 99; by a mistake an arrow pointing towards „S.W." has been omitted in B). *5:* sclerite of Segment X. *6:* posterior process of Segment X. *7:* superior appendage. *8:* (dotted line) outline of membranous ventral side of Segment X. *9:* point of insertion of the IX/X muscle. *10:* basal plate of inferior appendages. *11:* dorsal and *12:* ventral branch of inferior appendage. *13:* phallic apodeme. *14:* proximal, *15:* middle, and *16:* distal part of phallus; the setae of the endotheca are shown shining through. *17:* aedeagal sclerite (shining through; see p. 101).

The anterior dorsal muscle originates lateroventrally from the antecosta of Segment IX and is inserted laterally and dorsally on the proximal margin of the appendage. The anterior ventral muscle is inserted medially and ventrally on the proximal margin of the appendages. The two muscles probably act as a levator and a depressor, respectively. The two posterior muscles are lacking.

The slender and much downwards curved phallus (A, *15;* F) is formed by the phallobase. Except for the extreme distal end (*16*), which carries two pairs of very strong setae, it is sclerotized. Proximally the phallus is circular in a transverse section, more distally the ventral side is slightly concave; the concavity is bounded by a pair of broad, rounded longitudinal keels, which proximally are confluent. In the same region the dorsal side has a sharp and narrow longitudinal furrow. From the membranous distal end the (no doubt eversible) endotheca stretches approximately to the middle of the phallus (the phallic apodeme included). The endotheca is provided with short and thick setae, which are asymmetrically arranged (in fig. F the setae of both sides are shown shining through), and at the bottom of it there is an approximately saucer-like sclerite (*17*), on which the aedeagal retractor is inserted, and in the middle of which the ejaculatory duct opens on a high, tubular spout. It is difficult to say whether this sclerite represents a phallotremal sclerite as in *Odontocerum* (p. 104) and *Oligoplectrum* (p. 114), or it represents the whole aedeagus.

The phallocrypt is shallow, more especially so dorsally. Ventrally it is somewhat deeper, and as mentioned above, its floor is formed by the basal plate of the inferior appendages. There is a well-developed phallic apodeme (*13*).

The posterior phallic muscle originates from the posterior border of Segment IX, approximately in the middle of the lateral side, i. e. at the summit of the latero-anal bulge. It is inserted laterally and posteriorly on the phallic apodeme. The anterior muscle originates from the antecosta of Segment IX, approximately in the middle of the lateral side, i. e. at the summit of the latero-oral bulging. It is inserted laterodorsally on more than the distal half of the phallic apodeme.

Odontocerum albicorne.

Segment IX (fig. 57, *1*). The dorsal side is much reduced in length owing to an oral and an anal indentation. The former is rather evenly curved, the latter is approximately rectangular. At the boundary between the shorter dorsal part and the longer lateral part a distinct longitudinal suture is seen. The ventral side also is somewhat reduced in length by an oral indentation. Between the dorsooral and the ventrooral indentation the anterior margin makes a tongue-like bulge, on which the antecosta is very strongly developed. In the middle of the ventral side the posterior margin has a small, membranous indentation.

The rather large Segment X (figs. 57, *3—5;* 58 B) is sagittally compressed. The membranous ventral side is strongly concave, so that the segment forms a sort of bivalve sheath for the distal part of the phallus. The lateral sides of the segment are

sclerotized, and the sclerites (fig. 57, *3*) are produced posteriorly as a pair of much sagittally compressed processes (figs. 57, *5;* 58B, *2*), which are sclerotized on both sides. Dorsally, between these processes, there is an unpaired. finger-like, but much sagittally compressed process (*4; 1*), which is sclerotized on the dorsal side and distally on the ventral side, too. No doubt the three processes are homologous with the corresponding structures in *Sericostoma* (fig. 47, *4*, p. 86). The anus is found between the lateral processes and below the median one. Ventrally it is bounded by a membranous, slightly bilobed lip (fig. 58B). The sclerite on the median process (fig. 57, *4*) is connected with the lateral sclerites by narrow, sclerotic bridges (B). Furthermore, it is connected with the sclerite of Segment IX by a high and broad longitudinal keel (*2*), which probably represents a dorsal process homologous with the paired dorsal processes in *Leptocerus* (fig. 53A, *6*, p. 95) and the unpaired one in *Silo* (fig. 79, *7*, p. 139). The keel *2* and the narrow bridges mentioned form the only sclerotic connection between the sclerites of Segments IX and X. Otherwise they are separated by membranous areas, laterally in which the large superior appendages (figs. 57, *7, 8;* 58B, *6*) are implanted. The latter are leaf-like with a slightly convex lateral side and a slightly concave median side.

On the external side of the lateral processes (*5; 2*) a high and narrow longitudinal ridge is seen. It is highest orally, where it is protracted into a small, forwards directed spine (fig. 58, *3*). Another, backwards directed spine (*4*) is seen orally, near the ventral margin of the sclerite of Segment X. (The two spines thus are not situated at the same level, but the oral one considerably more ventrally than the anal one). Anteriorly to the last-mentioned spine the sclerite of Segment X is bent outwards as a "wing" (figs. 57, *6;* 58B, *5*), which lies at the bottom of the genital chamber, and the somewhat pointed lateral end of which is contiguous—but not continuous—with an inwards bent extension of the posterior margin of the sclerite of Segment IX. This extension flanks the dorsoanal indentation of the sclerite. The base of the superior appendage is, so to speak, wedged in between the dorsal margin of the "wing" and the posterior margin of Segment IX.

The strong IX/X muscle originates laterodorsally from the antecosta of Segment IX on the stretch between the summit of the laterooral bulge and the laterodorsal longitudinal suture. It is inserted on the ventral margin of the sclerite of Segment X at the median end of the "wing" (*6; 5*). The IX/X muscles must be able to depress and adduce the processes *5* (fig. 57) and probably at the same time cause some movement of the superior appendages.

The inferior appendages (fig. 57, *9—12*) have a large, slender coxopodite (*10*), which is almost circular in a transverse section. Basally it is directed much outwards, but since it is curved, the distal end comes to point almost straight backwards. The harpago (*12*) is small and finger-like. Together with a shorter, medioventral process (*11*) on the distal end of the coxopodite it forms a sort of chelicer. Proximally the median sides of the two appendages are continuous mutually and with the peculiar basal plate. The latter has the shape of a pot-like depression (*9*), the

length (= depth) of which is about twice the width. The "pot" is somewhat streamlined with the greatest width in the middle. On the dorsal side (which is an internal surface) there is a weak longitudinal ridge, on which muscles are inserted. Radiating

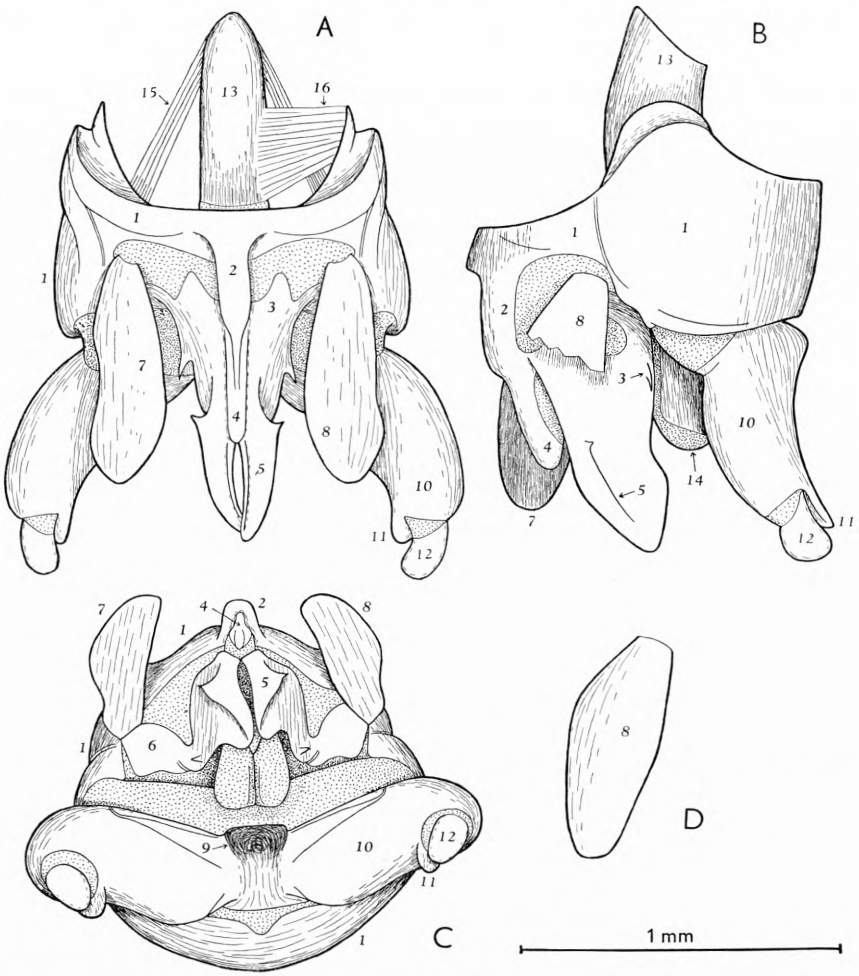

Fig. 57. *Odontocerum albicorne*. A—C: Segments IX and X in dorsal (A), lateral (right, B), and posterior view (C). D: right superior appendage in lateral view. *1:* Segment IX. *2:* dorsal process (see p. 102). *3:* oral part of sclerite of Segment X; in B the arrow points at the spine mentioned on p. 102 (= fig. 58 B, *4*). *4:* median and *5:* lateral process of Segment X; in B the arrow *5* points towards the longitudinal ridge mentioned on p. 102; in C the distal end of the phallus is seen below the two lateral processes. *6:* anterior "wing" of sclerite of Segment X (see p. 102). *7:* left and *8:* right superior appendage; in B the latter has been broken off near its base. *9:* basal plate of inferior appendages; the number is placed on the wedge-shaped area mentioned on p. 103. *10:* coxopodite and *11:* its distal process. *12:* harpago. *13:* phallic apodeme. *14:* distal end of phallus. *15:* posterior and *16:* anterior phallic muscle.

from the entrance to the "pot" there is dorsally on the median side of the coxopodite a wedge-shaped area, in which the cuticle is lighter and possibly also thinner; (in fig. 57 C the number *9* is placed in this wedge). The point of the wedge is bent dorsally

and continues as a narrow, irregularly winding stripe across the dorsal side of the appendage, approximately in the middle of the coxopodite.

The strong anterior dorsal muscle originates lateroventrally from the antecosta of Segment IX and is inserted dorsally on the proximal margin of the coxopodite. The likewise rather strong anterior ventral muscle is inserted on the median sides of the coxopodites ventrally to the entrance to the "pot" *9* (fig. 57 C). The posterior dorsal muscle is rather weak. It originates from the inwards bent extension of the posterior margin of Segment IX (at the lateral end of the "wing" *6:* fig. 57 C) and is inserted on the dorsal longitudinal ridge on the "pot" *9*. The posterior ventral muscle is stronger. It is inserted lateroventrally on the "pot". At least the majority of its bands originate from the proximal end of the ventral side of the coxopodite. An examination of the inferior appendages gives an impression that there is no motility between the two coxopodites. The movements then are levation (the anterior dorsal) and depression (the anterior ventral and the posterior dorsal). The function of the posterior ventral muscle is a puzzle to me, but perhaps the weaker area of the cuticle (the "wedge" described above) has something to do with it. The flexor of the harpago originates from almost the whole lateral side of the coxopodite.

Together with the phallic apodeme (fig. 57, *13*) the phallus (*14*) forms a rather regular, slightly downwards curved tube (fig. 58 A). The phallic apodeme (*7*) constitutes almost half of the length of this tube (when the aedeagus does not protrude). Since there is also a well-developed, though not very deep phallocrypt, the freely projecting part of the phallus is rather short. The phallus is divided into a phallobase (*9*) and an aedeagus (*10*). The latter is longer than the former, but that part of it which normally projects beyond the endotheca is shorter than the phallotheca. Proximally the phallotheca is entirely sclerotized, and the ventral side is sclerotized to the distal end, whereas the greater part of the dorsal side is membranous.

The aedeagus (fig. 58 C) has a sclerotic ventral side and a membranous dorsal side. That part of it which normally is withdrawn into the phallobase is almost semi-cylindrical. On the freely projecting part the membranous dorsal side is dilated so much that this part of the aedeagus is just as high as the phallobase. By a longitudinal furrow this cushion-like thickening is divided into two lips with almost contiguous edges. Proximally a much smaller, unpaired lip is wedged in between the two larger lips. These three lips enclose a cavity. On the floor of this cavity there lies a sclerite (fig. 58, *13*), in the middle of which the sclerotized distal end of the ejaculatory duct opens. From the proximal (anterior) end of the sclerite issues a pair of horn-like extensions, which are curved in semicircles so that their distal ends, lying on the lower side of the unpaired lip, come to point backwards. The strong aedeagal retractor, which originates from the proximal part of the phallic apodeme, is inserted on the sclerite. Since the latter is entirely separated from the sclerite on the external side of the aedeagus, I have decided to term it a phallotremal sclerite and the cavity which contains it a phallotremal cavity.

Proximally on the aedeagus two pairs of plate-like, strongly sclerotized para-

meres arise (*11*, *12*). Both pairs are short and normally do not project beyond the phallobase. The ventral pair (*12*) is the shorter and broader, triangular with acute points. The dorsal pair (*11*) is longer and narrower and has rounded points (fig. 58C;

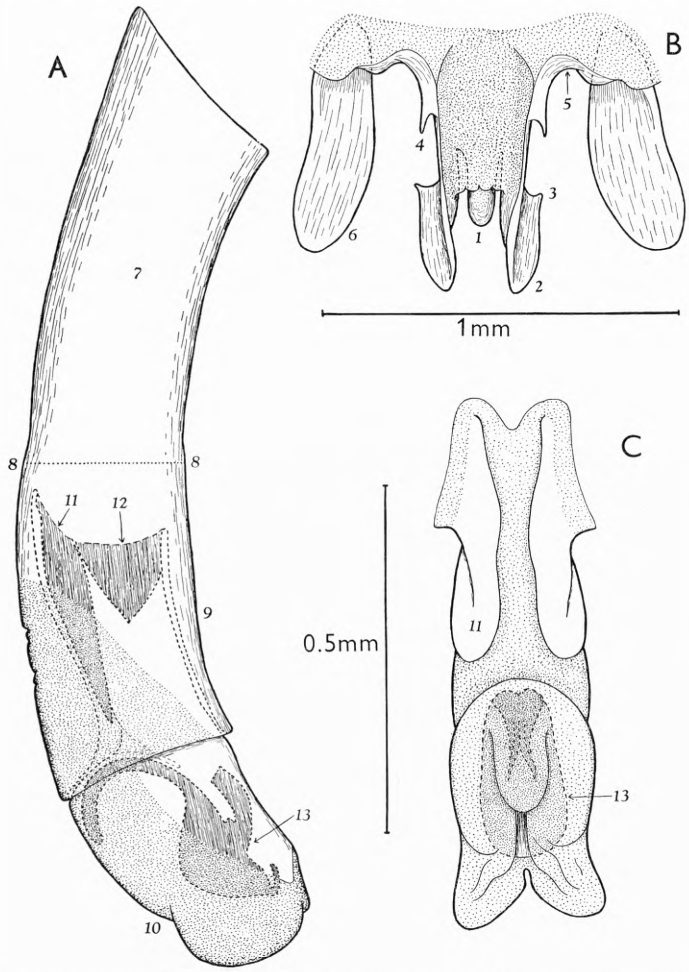

Fig. 58. *Odontocerum albicorne*. A: phallus in lateraï (right) view. B: Segment X in ventral view. C: aedeagus in dorsal view. *1:* median and *2:* lateral process of Segment X. *3* and *4:* the two spines mentioned on p. 102. *5:* the anterior "wing" of sclerite of Segment X (see p. 102). *6:* superior appendage. *7:* phallic apodeme. *8—8* (coarsely dotted line) indicates the boundary between *7* and *9:* phallobase; the broken lines are the outlines of the withdrawn part of the aedeagus and of the parameres. *10:* aedeagus. *11:* dorsal and *12:* ventral paramere (in A shining through). *13:* phallotremal sclerite (shining through).

in fig. B the dorsal paramere is seen from the edge and hence seems to be acutely pointed). Basally the two ventral parameres almost touch each other on the ventral side of the aedeagus, whereas the two dorsal ones are widely separated. Very likely the two pairs of parameres have arisen by division of one pair.

The anterior phallic muscle (fig. 57A, *16*) originates from the antecosta of Seg-

ment IX at the summit of the laterooral bulge, and is inserted laterally on more than the distal half of the phallic apodeme (*13*). In the state of repose this muscle has an almost tranversal course. The weaker posterior muscle (*15*) originates from the inwards bent extension of the posterior margin of the sclerite of Segment IX, just above the origin of the posterior dorsal muscle of the inferior appendage, and is inserted lateroventrally on the proximal end of the phallic apodeme.

Lasiocephala basalis.

Segment IX (fig. 59, *5*, *6*) is short, especially on the dorsal side, which is more or less completely concealed by the overlapping posterior border of Segment VIII. The length decreases gradually from the ventral side to the dorsal side, so that no distinct indentations are seen, except in the middle of the dorsal side, where there is a shallow anal indentation (fig. 60 B). Just in this place, however, it is difficult to state the boundary between Segments IX and X. On the ventral side there is a large, semicircular, membranous area, which almost reaches the anterior margin of the segment. Laterally to this area a pair of longitudinal sutures is seen. At the posterior end of the suture the edge of the sclerite has a slightly prominent, very much sclerotized node, which forms a simple articulation with the proximal margin of the inferior appendage.

Segment X (figs. 59, *8;* 60 B, *3*) is rather small. Its posterior half is divided into a pair of sagittally compressed processes, which are sclerotized on the lateral as well as on the slightly concave median side. The two processes, which probably are homologous with the lateral processes in *Odontocerum* (fig. 57, *5*), flank the subdistal part of the phallus. They are directed obliquely downwards and backwards; their pointed apices are bent upwards. In a posterior view (fig. 59 D, *8*) they converge dorsally. On the lateral side the sclerotization proceeds to the anterior margin of the segment and is continuous with that of Segment IX by a sclerotization lying in the genital chamber (fig. 59 D). On the dorsal side the sclerites of Segments IX and X are separated by a membranous—or at least very slightly sclerotized—area, which is raised into a pair of incompletely separated, cushion-like thickenings (figs. 59, *7;* 60 B, *2*). A comparison with *Oligoplectrum* (p. 111) indicates that we are concerned with a bipartite, much reduced dorsal process, homologous with the dorsal processes in *Leptocerus* (fig. 53 A, *6*, p. 95). Unlike (the rest of) Segment X the thickenings are covered with setae. Orally to the posterior processes the ventral side is membranous and concave. The small anus is found between the bases of the processes. Its ventral edge is deeply indented.

The IX/X muscle originates laterodorsally from the antecosta and adjoining parts of the surface of Segment IX, and is inserted on the ventral margin of the sclerite of Segment X, which there has a wedge-shaped, brown thickening. The muscle, which is not particularly strong, has almost parallel, steeply descendent bands. It can

adduce the posterior process. (In some preserved specimens the dorsomedian edges of the two processes touch each other).

Superior appendages are lacking.

The slender and apparently one-jointed inferior appendages (figs. 59, *10—11;* 60 A) are curved a little inwards and in their usual position directed somewhat up-

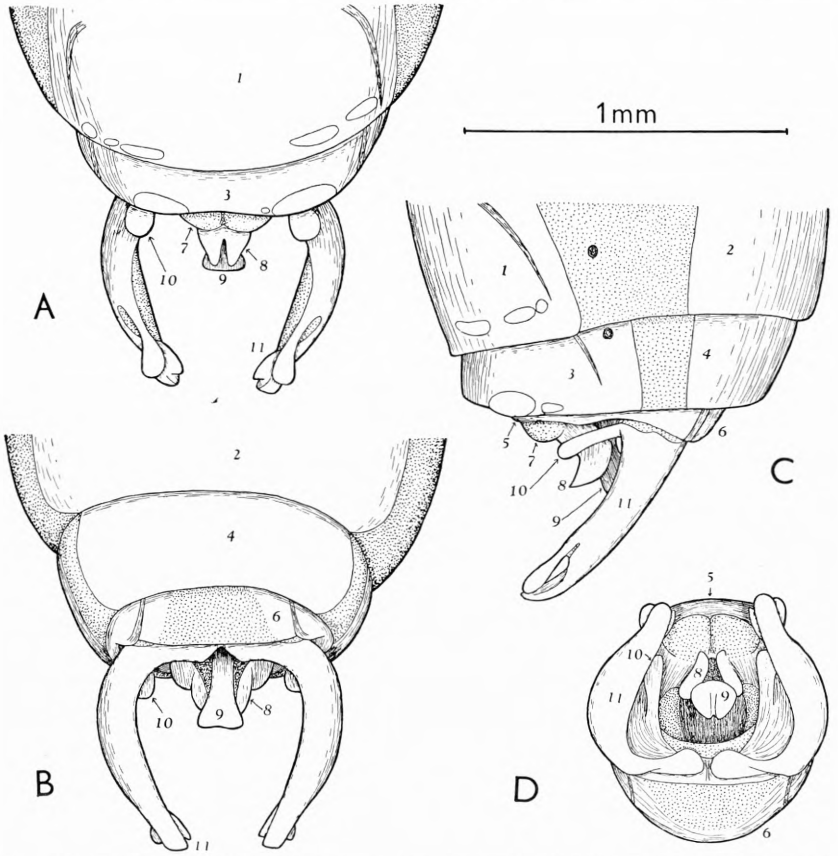

Fig. 59. *Lasiocephala basalis.* A—C: posterior end of abdomen in dorsal (A), ventral (B), and lateral (right) view (C). D: Segments IX and X in posterior view. *1:* Tergum VII. *2:* Sternum VII. *3:* Tergum VIII. *4:* Sternum VIII. *5:* dorsal and *6:* ventral part of Segment IX. *7:* dorsal process. *8:* lateral process of Segment X. *9:* distal end of phallus. In D the much shaded area below *8* and *9* is the proximal, broader part of the phallus. *10:* dorsal and *11:* ventral branch of inferior appendage.

wards. The apex is bifurcated. The dorsal prong (fig. 60 A, 7) is pear-shaped and much flattened. Proximally to it there is on the dorsal side a low, rounded keel, which is separated from the lateral side by a narrow, membranous area. The ventral prong is thicker and is again partly divided into two prongs. Except for the bifurcated apex the greater, distal part of the median side of the appendage is membranous. Dorsally from the proximal, sclerotized and slightly concave part of the median side issues an upwards and backwards directed branch (5), which is club-shaped and slightly

flattened. This structure, no doubt, is homologous with the dorsal branch in *Beraea* (fig. 51, *6*, p. 92). Proximally the median sides of the two appendages are united, though a vertical furrow is seen between them. The latter, however, is sclerotized and forms an internal ridge. The appendages moreover are connected with the basal plate (*4*), though this connection consists only of a pair of very narrow, but strong bridges issued from the bases of the dorsal branches (*5*). In continuation of these

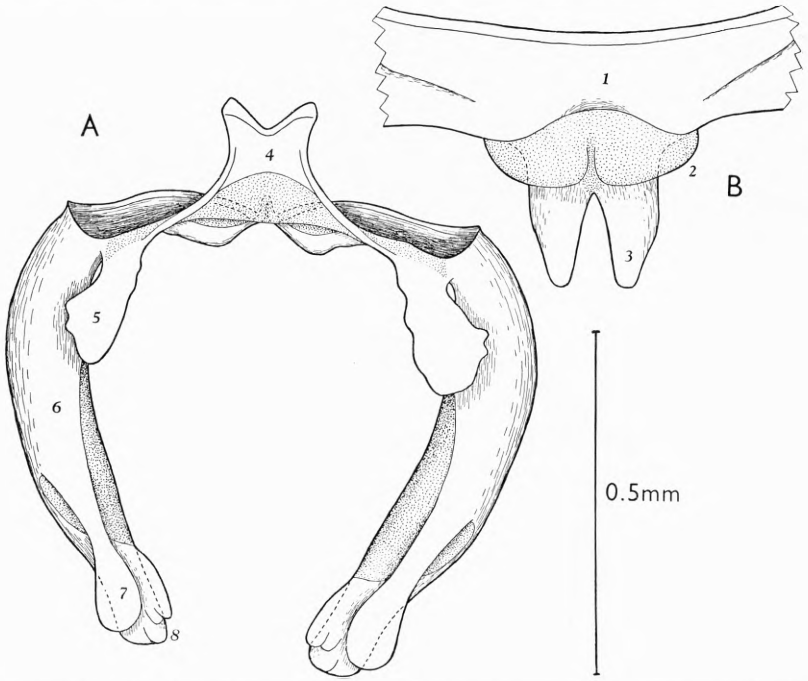

Fig. 60. *Lasiocephala basalis*. A: inferior appendages in dorsal view. B: Segment X and adjacent parts of Segment IX in dorsal view. *1:* dorsal part of Segment IX. *2:* dorsal process. *3:* lateral process of Segment X. *4:* basal plate of inferior appendages. *5:* dorsal and *6:* ventral branch of coxopodite. *7:* distal projection of same. *8:* harpago.

bridges the posterior half of the lateral margin of the basal plate is thickened internally. The concave anterior margin, also, is thickened. Between the posterior margin of the basal plate and the median sides of the inferior appendages a rather large membranous area is seen.

The strong anterior dorsal muscle originates lateroventrally from the antecosta of Segment IX and is inserted dorsally on the proximal margin of the appendage. The insertion stretches from the base of the branch 5 to the middle of the bridge connecting the latter with the basal plate. The anterior ventral muscle is still stronger. The majority of its bands are inserted ventrally on the median two thirds of the proximal margin, the rest on the vertical, internal ridge between the two appendages. The origins of the two anterior muscles are separated by the ventrolateral longitudinal

suture of Segment IX. The posterior dorsal muscle originates from the sclerite in the genital chamber (which connects the sclerites of Segments IX and X). Its converging bands are inserted on the anterior corner of the basal plate. The strong posterior ventral muscles stretch between the lower side of the basal plate and the appendage itself. From the basal plate its bands converge towards their insertion laterally on the proximal margin of the appendage. Possibly there are only a slight ab- and ad-

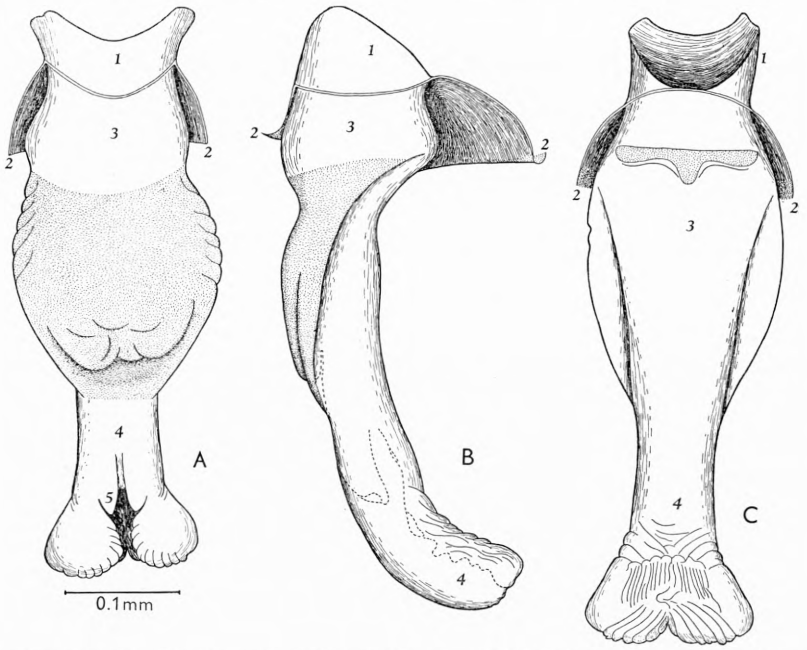

Fig. 61. *Lasiocephala basalis*. Phallus and phallocrypt in dorsal (A), lateral (right, B), and ventral view (C). In A the the dorsal, in B the right, and in C the ventral part of the phallocrypt is removed. *1:* phallic apodeme. *2—2:* cut edge through wall of phallocrypt. *3:* proximal and *4:* distal part of phallus. *5:* lip flanking the opening of the ejaculatory duct.

duction, if any at all. The anterior muscles then are a levator and a depressor, respectively. The posterior muscles perhaps may cause an independent movement of the branch *5* (provided that the connection with *6* is flexible), or they may be included in the mechanism of the phallus.

Although the appendage apparently is one-jointed, there is a well-developed and even very strong flexor of the harpago, which originates from more than the proximal half of the lateral side and is inserted medially on the proximal margin of the sclerotization of the ventral prong (*8*). This shows that the ventral prong represents the harpago, though not the slightest suggestion of an articulation is seen on the lateral side. (On the median side the harpago is bounded proximally by the membranous part of this side). The strong flexor indicates that the prong *8* must be capable of some movement.

The phallus (figs. 59, *9;* 61) is highly specialized. It is undivided; as will be

shown below, this condition has arisen by obliteration of the endotheca and subsequent fusion of the phallotheca and the aedeagus. From a purely topographical point of view the phallus may be described as consisting of two parts. The larger, proximal part (fig. 61, *3*) is—in a dorsal or ventral view—approximately ovoid and rather much flattened, being provided with large, thin, lateral wings. The ventral side of this part is sclerotized, though with a transverse, membranous area near the proximal end. The dorsal side is sclerotized proximally, but its larger part is membranous. The distal part of the phallus (*4*) is entirely sclerotized, and on the ventral side its sclerite is continuous with that of the proximal part. It consists of an approximately cylindrical shaft and a dilated, somewhat flattened, much downwards curved and slightly bilobed apex. The dorsal side of the latter is spoon-like excavated, but the edges of the "spoon" very much approach to each other. Anteriorly at the bottom of the "spoon" the ejaculatory duct opens, flanked by a pair of sclerotic, immovable lips (*5*). In the distal part of the ejaculatory duct (which is surrounded by a thick glandular mass) a small sclerite is seen on the ventral side. The strong aedeagal retractor originates proximally and dorsally in the phallus and is inserted dorsally on the proximal end of the shaft of *4*. It must be able to give some levation of the distal part. A transverse fold distally on the dorsal membranous area probably has some connection with this movement, the pivot of which perhaps is the proximal membranous area on the ventral side.

The insertion of the aedeagal retractor shows that at least the distal part (*4*) belongs to the aedeagus. Since this muscle generally is not inserted proximally in the aedeagus, the latter probably includes also part of *3*. The transverse membranous area on the ventral side perhaps mark the boundary between the phallobase and the aedeagus. The spoon-like depression on the distal end then is a phallotremal cavity (cp. *Odontocerum*, p. 104, and *Oligoplectrum*, p. 114), and very likely it is homologous also with the "spoon" in the Hydroptilidae (figs. 42, p. 75; 43 A, p. 78; 45, p. 81).

The phallocrypt (*2*—*2*) is sclerotized proximally. On the dorsal side the sclerite covers about the proximal half, on the ventral side, where the phallocrypt is deeper and very spacious, it reaches the entrance except in the very middle. Lateroventral extensions of the sclerite are bent downwards and forwards; they come to lie in the roof of a pocket, the floor of which is formed by the basal plate of the inferior appendages, and eventually they fuse with the anterior corners of the latter. The phallic apodeme (*1*) is short, especially so ventrally; in the middle of the ventral side its length is reduced to nil.

The posterior phallic muscle originates from the sclerotization in the genital chamber just above the posterior dorsal muscle of the inferior appendages; in its whole course it is rather closely applied to this muscle. It is inserted on the lateral side of the apodeme. The anterior muscle originates from the antecosta of Segment IX, a little ventrally to the middle of the lateral side, and is inserted dorsally, partly on the phallic apodeme, partly on the sclerotic part of the phallocrypt. The two muscles possibly act as a depressor and a levator, respectively.

Oligoplectrum maculatum.

Segment IX (fig. 62, *1*), which largely is withdrawn into Segment VIII, is short. Especially dorsally and lateroventrally the length is much reduced by deep oral indentations. Between the two lateroventral indentations the anterior margin makes a large ventral bulge. This would have given the ventral side a considerable length, if the posterior margin had not been deeply indented. Between the lateroventral and the dorsal indentation the anterior margin forms a broader and lower bulge. On the lateral side the posterior border of the segment has a broad and low bulge. This is sclerotized on the lateral as well as on the median side, and dorsally on the median side the sclerite is continuous with that of Segment X.

Segment X (figs. 62, *3;* 63) is short, very broad anteriorly and much attenuated towards the slightly bilobed posterior end. It is somewhat flattened and has a very concave ventral side. The dorsal and the ventral side are membranous. The lateral side is sclerotized, and this sclerite is continuous with that of Segment IX, partly—as mentioned above—through the latero-anal bulge of Segment IX, partly through a narrow bridge between this bulge and the dorsal process. The latter (figs. 62, *2;* 63, *3*), which arises between Segments IX and X, is large, broad, and much flattened (with a convex dorsal side); it has a deep anal notch, so that a pair of triangular lobes is formed. These lobes are sclerotized on the dorsal side, whereas the medio-oral area

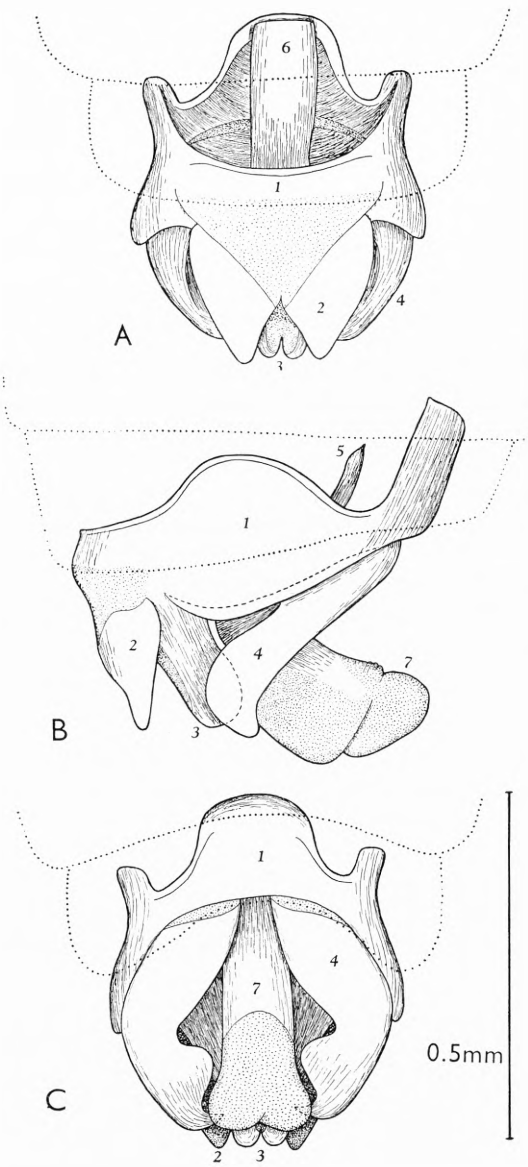

Fig. 62. *Oligoplectrum maculatum.* Segments IX and X in dorsal (A), lateral (right, B), and ventral view (C). The coarsely dotted lines indicate the outlines of Segment VIII and of the posterior end of Segment VII. *1:* Segment IX. *2:* dorsal process. *3:* Segment X. *4:* inferior appendage. *5:* basal plate of inferior appendages. *6:* phallic apodeme (not seen in B, since the phallus there is much protracted). *7:* phallus. The much shaded area which in B is seen between *1* and *4* is part of the phallus. In C the much shaded area between *4* and *7* is the broadly rounded ventral edge of Segment X.

of the dorsal side of the process as well as its whole ventral ventral side are membranous. The dorsal process in *Oligoplectrum*, no doubt, is homologous with the paired dorsal processes in *Leptocerus* (p. 94).

The small anus is situated in the furrow between the dorsal process and Segment X. This clearly shows that the processes *4* (fig. 63) are homologous with the lateral processes in *Sericostoma* (fig. 47, *4*, p. 86), since it is impossible that the median process in the latter form can shift its position in relation to the anus. They certainly are homologous also with the processes *3* in *Lasiocephala* (fig. 60 B).

The IX/X muscle originates laterodorsally from the antecosta of Segment IX, i. e. on the dorsal side of the lateral bulge of the anterior margin, and is inserted

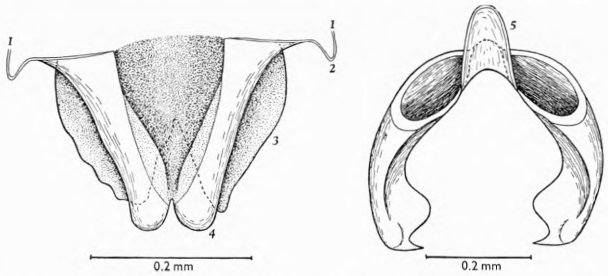

Fig. 63. *Oligoplectrum maculatum*. Segment X in ventral view and inferior appendages in dorsal view. *1:* cut edge through lateral part of Segment IX and through the sclerotic bridge connecting Segments IX and X (see p. 111). *2:* posterior edge of lateral part of Segment IX. *3:* dorsal process. *4:* Segment X. *5:* basal plate of inferior appendages.

orally on the ventral margin of the sclerite of Segment X. It has an almost horizontal course. I do not venture to make any statement on the function of this muscle.

Superior appendages are lacking.

The inferior appendages (figs. 62, *4;* 63) are short, strong and one-jointed. In their usual position they are much upwards directed. In a lateral view the apex again is bent downwards; it terminates in a strong, inwards directed spine. The median side of the appendage is very concave. The lower edge of the concavity on a whole is more prominent than the upper edge, and just proximally to the apex it moreover has an approximately semi-circular bulge. By movements of the inferior appendages (and of Segment X?) the anal end of Segment X may be brought to rest in the cavity between this bulge and the upper edge. Proximally the median sides of the two appendages are continuous mutually and with the basal plate (fig. 63, 5), which forms the floor of a pocket between the inferior appendages and the phallocrypt.

The strong anterior dorsal muscle originates lateroventrally from the antecosta of Segment IX, i. e. ventrally from the lateral bulge of the anterior margin. Its descendent bands are inserted dorsally on the proximal margin of the appendage. The still stronger anterior ventral muscle originates from the ventral part of the antecosta of Segment IX (the ventral bulge of the anterior margin) and is inserted ventrally on the proximal parts of the median sides of the appendages. The origins

of the two anterior muscles are separated by the lateroventral indentation of the anterior margin. The rather weak posterior dorsal muscle originates laterodorsally from the posterior border of Segment IX and is inserted on the anterior margin of the basal

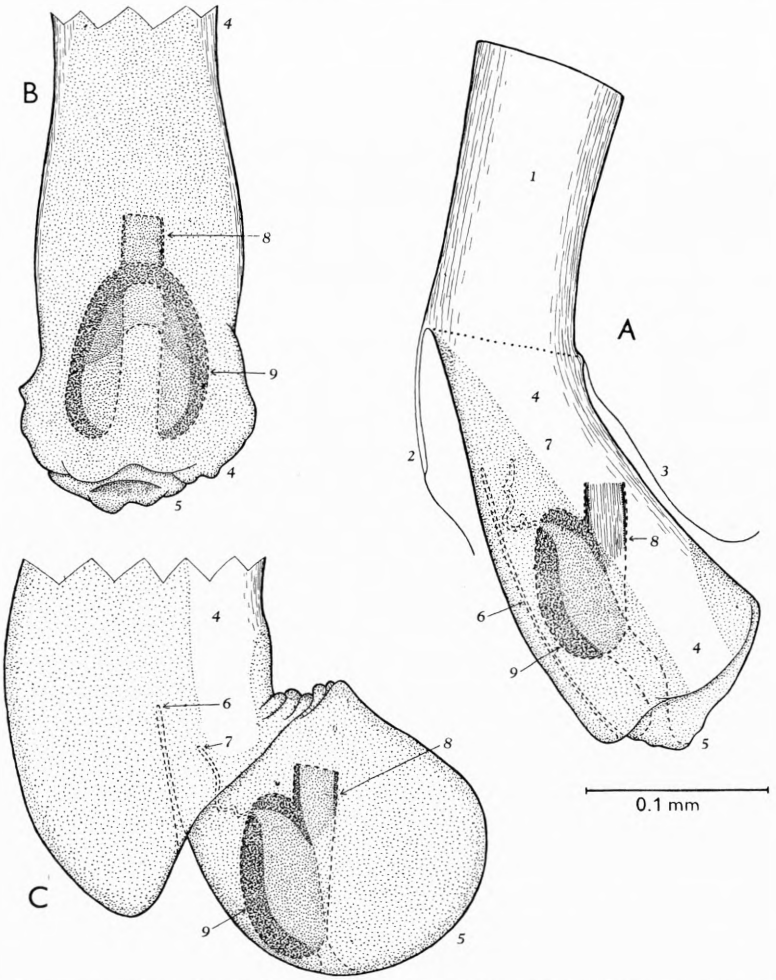

Fig. 64. *Oligoplectrum maculatum*. A: phallic apodeme and phallus in lateral (right) view. B and C: (distal part of) phallus in dorsal and in lateral (right) view. In A and B the aedeagus is retracted, in C it protrudes (but possibly not maximally). *1:* phallic apodeme. *2* and *3:* optical sagittal sections through dorsal and ventral wall of phallocrypt. *4:* phallobase. *5:* aedeagus. *6* (broken line): endotheca. *7* (broken line): blind end of phallotremal cavity. *8:* distal end of ejaculatory duct. *9:* phallotremal sclerite.

plate. The posterior ventral muscle stretches between the lateral margin of the basal plate and the lateral part of the proximal margin of the appendages. The most important movements of the inferior appendages possibly are levation and depression, though some abduction and adduction perhaps also may take place.

The phallocrypt (fig. 64 A, *2—3*) is deep. Its dorsal side is sclerotized proximally.

The cylindrical phallic apodeme (figs. 62, *6*; 64 A, *1*) also is of a considerable length. The phallus (*7*; *4*—*5*), on the other hand, is rather short. It is divided into a phallobase (fig. 64, *4*) and an aedeagus (*5*). At the extreme proximal end the phallotheca is entirely sclerotized. Otherwise the dorsal side is membranous, and the ventral side sclerotized. The latter, however, has a distal, membranous indentation, so that the sclerite reaches the distal end of the phallotheca on the lateral side only. The aedeagus is entirely membranous and in the state of repose completely, or almost completely, withdrawn into the endotheca. Dorsally the endotheca (*6*) is deep; in a ventral direction the depth decreases, and quite ventrally the endotheca is wholly obliterated. When the aedeagus is protruded by blood pressure, a strong bend therefore arises between it and the phallobase. The aedeagus contains a deep, eversible phallotremal cavity (cp. *Odontocerum*, p. 104). The latter to its greatest extent is membranous, but near (not at) the bottom it has a strong, annular sclerotization (*9*), a phallotremal sclerite, which has two distal indentations: a deep and narrow dorsal one and a broad and shallower ventral one. (The phallotremal sclerite has some resemblance to the gaping shells of a bivalve. Proximally it forms a pot-like cavity, though with a fine opening, through which the phallotremal cavity continues as a membranous cul de sac). The ejaculatory duct (*8*), the distal end of which is sclerotized, opens in the ventral indentation. The phallotremal sclerite of course delimits the degree of eversion of the phallotremal cavity. The aedeagal retractor originates proximally from the phallic apodeme. It is strong and fills up most of the lumen of the phallus. It is inserted—at least chiefly—on the phallotremal sclerite.

The posterior phallic muscle originates laterodorsally and anally from Segment IX and is inserted laterally and proximally on the phallic apodeme. The weaker anterior muscle originates from the antecosta of Segment IX at the summit of the lateral bulge and is inserted on the sclerotized part of the dorsal side of the phallocrypt.

Agrypnia pagetana.

Segment IX (fig. 65, *3*—*4*) is rather short. In the figure it is to a great extent concealed by the overlapping posterior border of Segment VIII (*1*—*2*). The segment is longest lateroventrally. The length of the ventral side is reduced by shallow oral and anal indentations, that of the dorsal side by a deep oral indentation. On the other hand, about the dorsal fourth of the posterior border is protracted into a short and very broad, tongue-like dorsal process (*3*), which is sclerotized on the upper as well as on the lower side, and the posterior edge of which is closely beset with long and strong, backwards directed, yellow setae. (The belt of setae is about three "rows" broad. In A the setae have been cut off near their bases, in B they have been omitted). The part of the segment which carries the dorsal process is separated from the lateral part by a longitudinal suture, which anteriorly joins the antecosta at an approximately right angle. The relation of this suture to the IX/X muscle (see below) makes it very unlikely that it is homologous with the dorsal longitudinal suture in the Hydroptilidae

(p. 82). Between the dorsal process and the point of greatest length (lateroventrally) the posterior border of the segment has a broad and deep indentation.

Segment X (figs. 65, *5;* 66 A, B) tapers much posteriorly. The very concave ventral side is membranous to its greatest extent, whereas the roof-like dorsal side is sclerotized. The sclerite continues around the lateral edge of the segment for some distance into the ventral side (fig. 66, *1;* broken line). The ventral part of the sclerite projects forwards (*2*), and on this extension the IX/X muscle is inserted. It originates from the antecosta of Segment IX laterally to the longitudinal suture. It is somewhat descendent, and possibly acts as a depressor. A comparison between various preserved specimens gives the impression that it may be able also to alter the slope of the "roof". Anteriorly the sclerite of Segment X widens into a plate, which covers the dorsal part of the genital chamber, and in which the small superior appendages (figs. 65, *6;* 66, *4*) are implanted in a pair of membranous "windows". The margin of the plate almost touches that of the sclerite of Segment IX, but it is continuous with the latter only for a very short distance at the lateral end of the dorsal process. The connection has the character of a strong sclerotization (fig. 66, *3*), which lies at the bottom of the furrow between the dorsal process and Segment X and continues on the surface of Segment IX as the longitudinal suture mentioned above.

The posterior end of Segment X is cleft into a pair of flat, laterally sloping processes, below the bases of which the anus is found. The latter is bounded ventrally by a thick, membranous lip, which does not project so far backwards that it is seen in the notch between the two processes. I am unable to decide whether the processes are homologous with the paired, lateral process in *Sericostoma* (fig. 47, *4*, p. 86) or with the median unpaired process in this form. I am most inclined, however, to believe in the latter possibility. In *Beraea*, also, the median process (fig. 50 A, *2*) is slightly bilobed. (Cp. also the Limnophilidae, p. 138).

For most of their length the inferior appendages (figs. 65, *7—9;* 66 C) are divided into an upper (*9*) and a lower branch (*8*). The latter in its greater, proximal part is somewhat sagittally compressed, with a rounded ventral and a sharp dorsal edge. The longer and slenderer upper branch is a little club-shaped and in its distal half slightly flattened. The appendages are curved inwards, so that their apices almost—or on the lower branches entirely—touch each other. A closer examination reveals that the upper branch is connected with the basal part (*7*) by a membranous articulation. A small muscle originates lateroventrally from the basal part and is inserted medially to the proximal end of the upper branch. This muscle is the flexor of the harpago. The upper branch thus represents the harpago and not—as might have been supposed—a dorsal branch as seen in *Beraea*. Proximally the median sides of the two appendages are continuous mutually and with the approximately triangular basal plate (fig. 66 C, *5*). Between the two appendages there is, however, a deep, vertical, sclerotized furrow, the origin of a plate-like apodeme (*6*), which is connected with the basal plate also.

The anterior dorsal muscle originates lateroventrally from the antecosta of

Segment IX and is inserted dorsally on the proximal margin of the appendage. The anterior ventral muscle is inserted on the furrow between the two appendages. Both of these muscles are strong. The weaker posterior ventral muscle stretches between the anterior end of the basal plate and the proximal end of the ventral side of the

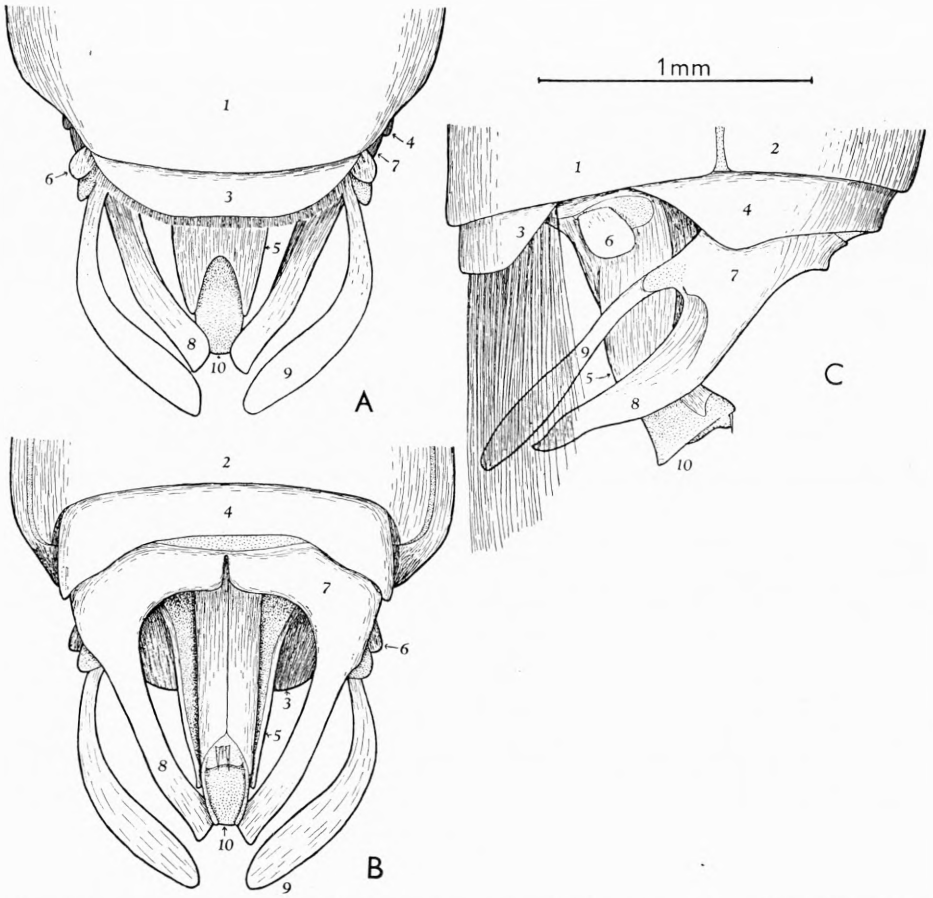

Fig. 65. *Agrypnia pagetana*. Posterior end of abdomen in dorsal (A), ventral (B), and lateral (right) view (C). *1:* Tergum VIII. *2:* Sternum VIII. *3:* dorsal process; (its setae are shown in their full length only in C). *4:* ventral part of Segment IX. *5:* Segment X. *6:* superior appendage. *7:* coxopodite. *8:* distal projection of coxopodite. *9:* harpago. *10:* phallus.

appendage. (The latter insertion is proximal to the origin of the flexor of the harpago). The posterior dorsal muscle is lacking. The positions in which the inferior appendages are seen in various preserved specimens show that the movements are both levation and depression and—at least some—abduction and adduction.

The undivided phallus (fig. 65, *10;* 67) is formed by the phallobase (fig. 67, *4—4*). It is almost straight, only slightly downwards curved, and almost entirely

sclerotized. The dorsal side is rounded, whereas the ventral side has a rather sharp longitudinal keel. Distally the sclerite is indented both dorsally and ventrally; the dorsal indentation is the deeper. The sagittally compressed, slightly axe-shaped distal end therefore is chiefly membranous. The entrance to the endotheca, which in the

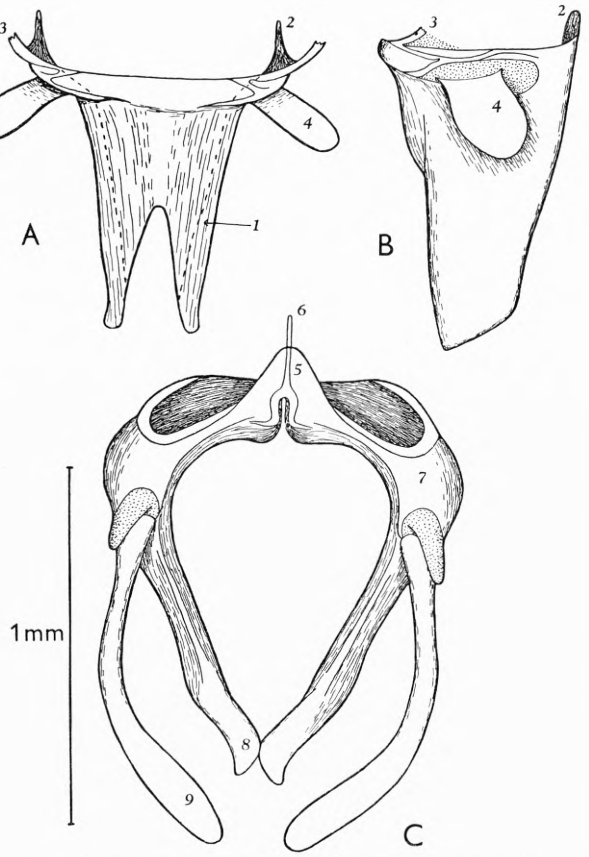

Fig. 66. *Agrypnia pagetana*. A and B: Segment X in dorsal and in lateral (right) view. C: inferior appendages in dorsal view. *1* and *2:* see p. 115. *3:* sclerotic bar connecting the sclerites of Segments IX and X. *4:* superior appendage. *5:* basal plate of inferior appendages and *6:* its apodeme. *7:* coxopodite and *8:* its distal projection. *9:* harpago.

inverted state almost reaches the proximal end of the phallobase, is ventrally at the distal end. When the endotheca is entirely inverted, the distal end of the phallus is slightly bilobed (fig. 67 A. B shows an initial stage of eversion). At the bottom of the endotheca there is a small sclerite (*6*), carrying a rather high process, on the apex of which the ejaculatory duct (*5*) opens. The strong aedeagal retractor originates proximally in the phallic apodeme (*1*), and is inserted on the sclerite *6*. It is difficult —or rather impossible—to decide whether this sclerite represents the whole aedeagus or is only a phallotremal sclerite. The distal part of the ejaculatory duct (*5*) is

sclerotized and surrounded by glandular tissue. In the endotheca three groups of spines (not setae) are seen. The group nearest to the entrance (*9*) contains the fewest spines. In most preparations seen by me they were freely exposed as shown in fig. 67 B; (in A they are concealed by the spines *8*). The next group (*8*) forms a dense pencil near the entrance to the inverted endotheca. On the everted endotheca it must form

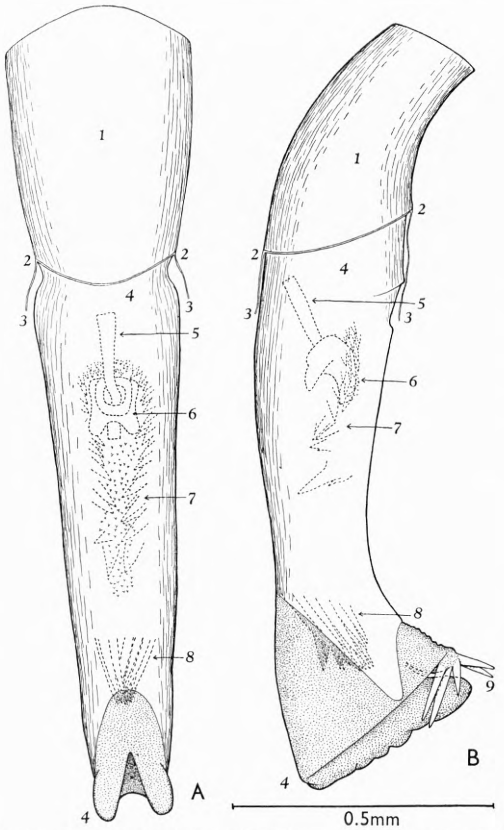

Fig. 67. *Agrypnia pagetana*. Phallus in dorsal (A) and in lateral (right) view (B). *1:* phallic apodeme. *2—2:* cut edge (boundary between phallic apodeme and phallus). *2—3:* optical section through wall of proximal part of phallocrypt. *4:* phallobase. *5:* distal part of ejaculatory duct (shining through). *6:* aedeagal sclerite (shining through; see p. 117). *6—8:* the three groups of spines on the endotheca (see p. 118).

a subproximal ring of spines. In the last group (*7*; in B the spines of the right side only are shown), the spines are more scattered and restricted to the ventral side, whereas the dorsal side is covered with pointed nodules. The spines gives the endotheca a certain resemblance to that of *Molanna* (fig. 56 F, p. 100). This similarity, however, is quite superficial, since in *Molanna* we are concerned with setae and in *Agrypnia* with cuticular processes, two entirely different sorts of structures.

The phallocrypt is deep and entirely membranous. The phallic apodeme (*1*) also is large. It is somewhat flattened and downwards curved. The anterior phallic

muscle originates from the antecosta of Segment IX in the middle of the lateral side and is inserted distally and laterodorsally on the phallic apodeme (and in part on the phallocrypt also). The posterior muscle originates laterally on the posterior border of segment IX and is inserted proximally and lateroventrally on the apodeme. Both muscles have an almost horizontal course. They certainly act as a retractor and a protractor, respectively.

Limnophilus flavicornis.

Segment IX (figs. 68 and 69, *4*) like the preceding segments is rather much sagittally compressed. It is longest dorsolaterally. The length of the ventral side is reduced by broad oral and anal indentations. The former is quite shallow, the latter very deep. For approximately the dorsal fourth the segment—or at least its sclerite—is reduced to an extremely narrow, sclerotic bridge, which in the middle does not comprise much more than the antecostal suture. (This part of Segment IX is entirely concealed by the overlapping, membranous posterior border of Segment VIII). The reduction is due chiefly to a very deep anal indentation, which is bounded by distinct, rounded posterior corners. Continuing the dorsal edge of the posterior corner a short longitudinal suture runs forwards and eventually joins the antecostal suture. It is probably homologous with the laterodorsal longitudinal suture in *Agrypnia* (p. 114). Immediately below the corner mentioned the posterior margin of Segment IX is bent inwards, forming an approximately rectangular, though rounded point. In this way the dorsal edge of the long, laterodorsal part of Segment IX embraces the base of the "superior appendage" (*8*).

Dorsally at the bottom of the genital chamber there is an unpaired, approximately vertical sclerotization (*5*), which is continuous with the dorsal, transverse bridge of Segment IX. Laterally this sclerotization has a pair of deep indentations, in which the "superior appendages" are implanted. The indentations are much larger than the bases of the appendages. Between the indentations the sclerotization, which here almost touches the sclerites of Segment X, is strongly convex in a horizontal section. This bulge perhaps represents a rudimentary dorsal process.

Segment X is so short that it can scarcely be regarded as an independent structure. It forms the steeply descendent floor of a depression, the anterior wall of which is formed by the sclerotization (*5*) described above, whereas overlapping parts of Segment VIII form the roof and the lateral walls. Segment X is provided with a pair of small sclerites (*6*), which are approximately triangular with an oral (or dorsal), a lateroanal (or -ventral) and a medioanal (or -ventral) margin. Anteriorly (dorsally) the two sclerites almost touch each other, posteriorly (ventrally) they are more widely separated. Along their medioanal margin two pairs of processes arise. The anterior processes (*7;* "intermediate appendages") are very strong. They are divergent, directed backwards and upwards, sagittally compressed and tapering greatly towards the almost black apex. The posterior processes (*12*) are much smaller, short and

finger-like. From the furrow between the anterior and the posterior process a suture runs to the lateral corner of the sclerite. The anus is a longitudinal slit in the membranous area between the two anterior processes. Below it there is an unpaired, tongue-like lobe (*13*), which is chiefly membranous, though the lateral sides are very slightly sclerotized.

The backwards and somewhat upwards directed "superior appendage" is very

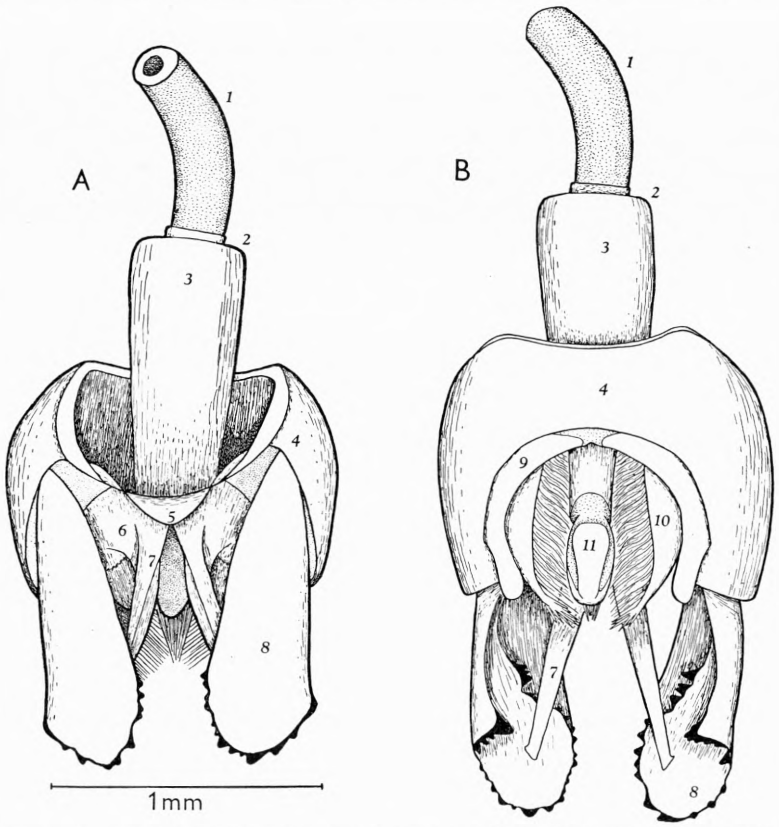

Fig. 68. *Limnophilus flavicornis*. Segments IX and X in dorsal (A) and in ventral view (B). *1:* ejaculatory duct. *2:* phallic apodeme. *3:* phallocrypt (as seen from the haemocoelic side). *4:* Segment IX. *5:* dorsal sclerotization in the genital chamber. *6:* sclerite of Segment X. *7:* anterior process ("intermediate appendage") on this sclerite. Between the two anterior processes in A the subanal lobe of Segment X (dotted) is seen anteriorly, the cuticular processes of the parameres posteriorly. *8:* laterol process ("superior appendage") of segment X. *9:* inferior appendage. *10:* paramere. *11:* distal end of aedeagus.

large. As mentioned above, its base is laterally embraced by the dorsal edge of the lateral part of Segment IX; medially it touches the lateral corner of the sclerite (*6*) of Segment X. In a lateral view the appendage has almost parallel sides and a concave distal edge. Distally the median side is strongly excavated, and the concavity thus formed is encircled by a row of black teeth, which, however, is incomplete ventrally. The greater, proximal part of the median side is flat (though the concavity proceeds

proximally through the gap in the row of teeth as a gutter along the ventral edge). Quite proximally the median side even is bulging and overlaps the lateral corner of the sclerite (*6*) of Segment X to a great extent.

The strong IX/X muscle originates on the lateral part of the antecosta of Segment IX; the longitudinal suture marks the dorsal boundary of the origin. It is inserted on the lateral corner of the sclerite (*6*) of Segment X. Its action is probably as follows: By the contraction of the muscle the sclerite *6* turns on an axis along its medioanal margin, and thus the "intermediate appendage" is moved outwards and upwards. At the same time the "superior appendage" is moved inwards and downwards. In this way the two appendages form a pair of pincers, the chief—and probably only—clasping device of the genital apparatus.

A discussion of the morphology of Segment X will be found under *Silo nigricornis* (p. 138).

The inferior appendage (*9*) has a very broad base, but is extremely short, appearing only as a rounded keel along the posterior margin of Segment IX. Quite dorsally, only, it projects as a small, sagittally compressed process. The latter is entirely sclerotized; otherwise the median side of the appendage is membranous. The two appendages are mutually united, but only by membrane. There is no basal plate. Quite ventrally the sclerite of the inferior appendage is separated from that of Segment IX by a very narrow, membranous stripe. Otherwise the sharp posterior edge of Segment IX overlaps the base of the appendage a little. The posterior ventral muscle is attached to the phallus, and the other muscles are lacking. The inferior appendage thus is not musculated.

The approximately cylindrical phallocrypt (figs. 68 and 69, *3;* 70, *2*) is very deep and projects far into Segment VIII. The phallic apodeme (*2; 1*), in return, is very short. It is shaped like a bowl with an asymmetrically placed foot. The "foot" is only slightly sclerotized. The anterior three fourths of the phallocrypt is faintly sclerotized, and on this part of the phallocrypt the phallic muscles are inserted. The latter are developed almost as in *Stenophylax* (p. 127), though the dorsal one of the two posterior muscles is lacking in *Limnophilus*.

The phallus (figs. 68 and 69, *11;* 70) is divided into a membranous phallobase (fig. 70, *3*) and a slender, almost entirely sclerotized aedeagus (*4*—*7*). The latter again is divided into two parts, separated by a membranous articulation and constituting three fourths and one fourth, respectively, of the aedeagus. The proximal part (*4*—*6*) is straight, the distal part (*7*) is bent slightly upwards. There is a pair of complicated parameres (figs. 68 and 69, *10;* 70, *9*—*11*), which originate laterodorsally at the bottom of the endotheca and are of the same length as the aedeagus. On the dorsal side of the proximal half of the latter there is a pair of longitudinal impressions, which partly receive the basal part of the parameres. The central keel (fig. 70, *4*) thus formed has a sharp longitudinal furrow in the middle. Proximally it is raised into a hump, which projects between the bases of the parameres. On the ventral side of the proximal part of the aedeagus there is a pair of sharp longitudinal furrows, which divide this

side into three rounded keels (*5*, *6*). Distally to the middle the central keel is much dilated.

The distal part of the aedeagus (*7*) is somewhat flattened. On the ventral side of this part also there is a pair of longitudinal furrows separating three folds. The lateral

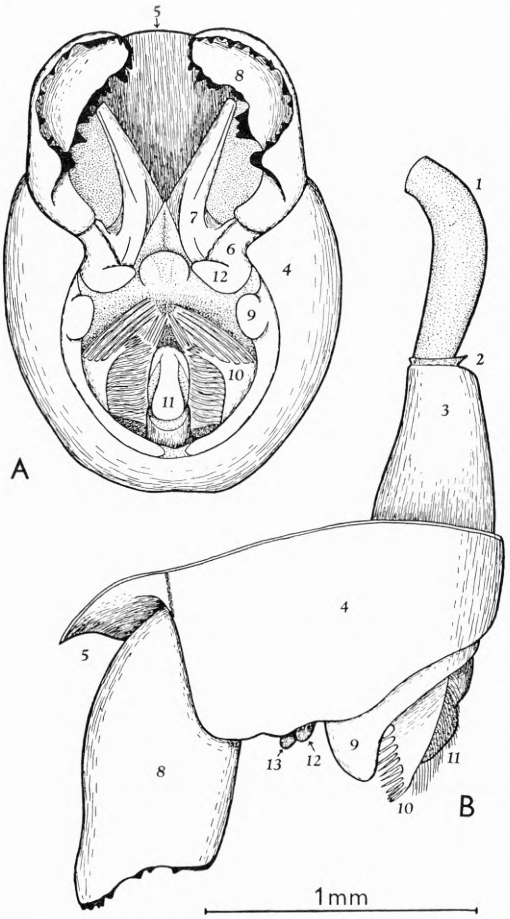

Fig. 69. *Limnophilus flavicornis*. Segments IX and X in posterior (A) and in lateral (right) view (B). *12:* posterior process on sclerite of Segment X. *13:* subanal lobe of Segment X; (in A it is seen between the two posterior processes. Other numbers as in fig. 68.

folds have sharp edges and are membranous on their median sides. The median fold is much broader than the lateral ones; its sole-like proximal end is especially strongly sclerotized and raised above the surroundings. Apically the sclerite of the median fold is continuous with that of the rest of the distal part of the aedeagus. For more than its posterior half the distal part of the aedeagus is spoon-like excavated on the dorsal side. Laterally the cavity is bounded by sharp edges. At its bottom the trumpet-like opening of the ejaculatory duct (*8*) is seen. The "spoon" can probably be re-

garded as a phallotremal cavity homologous with those of *Odontocerum* (p. 104) and *Oligoplectrum* (p. 114). The distal part of the ejaculatory duct is sclerotized and surrounded by a thin layer of glandular tissue.

The parameres have a sagittally compressed shaft (*9*) and a much dilated

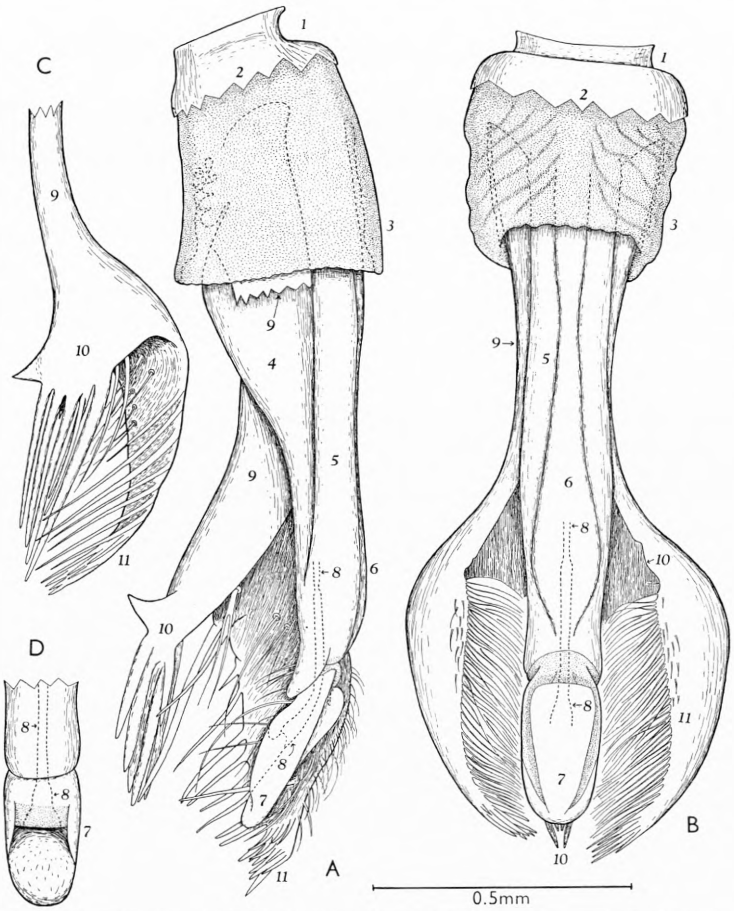

Fig. 70. *Limnophilus flavicornis*. A and B: phallus in lateral (right) and in ventral view; in A the right paramere has been broken off near the edge of the phallocrypt. C: distal end of right paramere in dorsal view; the cuticular processes of the ventral edge have been omitted. D: distal end of aedeagus in dorsal view. *1:* phallic apodeme. *2:* phallocrypt as seen from the haemocoelic side (the greater, distal part broken off). *3:* phallobase. *4:* dorsal, *5:* lateral, and *6:* ventral keel on proximal part of aedeagus. *7:* distal part of aedeagus. *8* (broken line): outline of ejaculatory duct. *9:* shaft, *10:* dorsal, *11:* ventral branch of paramere.

terminal part, which is divided into a smaller and stronger dorsal branch (*10*) and a larger and more delicate ventral (or lateral) branch (*11*). The former is flattened and directed somewhat medially. It terminates in a strong, inwards and upwards directed tooth and carries on its distal edge a row of long, strong, backwards directed spines. The teeth of the two dorsal branches are in contact with each other. The

ventral branch is placed vertically, convex on the lateral side and concave on the median side. On the dorsal edge there is a row of medially and distally directed spines, which are slenderer than those on the dorsal branch. (Such spines may be found singly on the median side, too). Distally—on the pointed distal end of the branch—the spines are shorter and close-set, forming a tuft. The spines of the two branches together form a grating above the distal part of the aedeagus. On the lower edge of the ventral branch there is a dense belt of hair-like spines, which fill in the interval between this edge and the aedeagus. Finally there is a varying—but always small—number of setae on the median side of the ventral branch. These setae, which especially are found proximally, are often bifurcated.

The aedeagal retractor is not particularly strong and fills only a rather small part of the lumen of the phallus. It originates laterally in the phallic apodeme and is inserted laterally in the phallus, proximally to the middle.

Stenophylax stellatus.

The genital segments are largely built as in *Limnophilus*, though distinct differences are seen.

Segment VIII is slightly modified. The tergum (fig. 71, 3) is a little broader than the preceding terga. At a short distance from the anterior corner the antecostal suture is bent backwards and runs subparallel to the lateral margin. (The same is the case on the preceding terga). At its anal end the posterior margin has a tongue-like extension. The large, anal, membranous area of Dorsum VIII is densely covered with minute, but comparatively thick, brown setae. Sternum VIII (*4*) is more feebly sclerotized than the preceding sterna.

Segment IX (figs. 71 and 72, *5*) is longest laterally. The length of the ventral side is reduced by an oral as well as by an anal indentation, and the dorsal side is reduced to a very narrow, transverse bridge, which comprises little more than the antecostal suture, and which is entirely concealed by the much overlapping posterior border of Segment VIII. Unlike conditions in *Limnophilus* the reduction of the dorsal side is due almost exclusively to a deep oral indentation. Quite laterally on the transverse bridge a pair of low, tongue-like, entirely sclerotized processes (fig. 72, *7*) are seen. These processes, on which the strong dorsal VIII/IX muscles are inserted, must be considered bulgings of the acrotergite and thus cannot be homologized with dorsal processes in other forms. In a lateral view the middle of the posterior margin of the segment is protracted into a sharp, backwards directed point, from which a suture runs forwards and downwards. This suture, which is far from reaching the antecostal suture, is possibly homologous with the laterodorsal longitudinal suture in *Limnophilus* (p. 119). In a posterior view it is seen that the point is bent inwards at a right angle and—placed at the bottom of the genital chamber—forms an efficient articulation with the sclerite of Segment X.

Segment X (figs. 71, *6—7;* 72, *8—12*) is not clearly defined as an independent structure. On the other hand it is much larger than in *Limnophilus*, but it is chiefly membranous and can be withdrawn very much. Maximally protruding, as shown in figs. 71 and 72 A, it has a horizontal dorsal side and a vertical posterior side, whereas it has no ventral side, or—perhaps more correctly—the ventral side forms part of the roof of the phallocrypt. The sclerites (fig. 72, *8*) of Segment X, which have almost the same shape as in *Limnophilus*, are situated on the posterior side of the segment, and are widely separated. The rounded ventral corner does not carry any process like that in *Limnophilus* (fig. 69, *12*). This corner is bent a little into the entrance of the

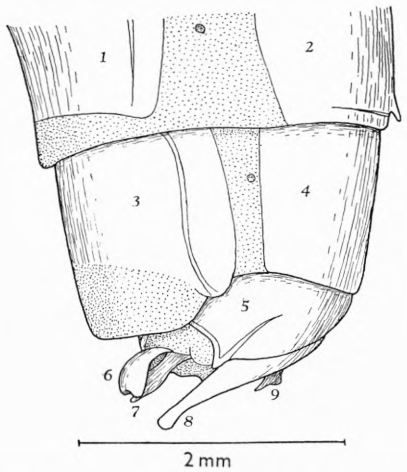

Fig. 71. *Stenophylax stellatus*. Posterior end of abdomen in lateral (right) view. *1:* Tergum VII. *2:* Sternum VII. *3:* Tergum VIII. *4:* Sternum VIII. *5:* Segment IX. *6:* lateral and *7:* median process of Segment X. *8:* inferior appendage. *9:* distal end of aedeagus.

phallocrypt. In the middle the lateroventral edge of the sclerite to a great extent overlaps the inwards directed point on the posterior margin of Segment IX described above. This is the pivot for the movements of the sclerite of Segment X. Along the margin this sclerite has a strong internal thickening, so that a small rounded "window" arises in the middle.

The "intermediate appendage" (figs. 71, *7;* 72, *9*) is directed upwards and backwards. It is much compressed sagittally. The ventral edge is almost twice as long as the dorsal edge. The base of the latter is connected with an elevated, sclerotic rib (fig. 72, *11*), which runs in a laterally concave curve on the dorsal side of Segment X towards the posterior margin of Segment IX. The rib is at a lower level than the dorso-posterior margin of Segment IX, so we are not concerned with a true articulation.

The "superior appendages" (figs. 71, *6;* 72, *10*) are much smaller than in *Limnophilus flavicornis*, directed much upwards and so placed that the homologue of the median side in *Limnophilus* faces backwards. The medioproximal corner of the appendage is in close contact (but not fused) with the base of the dorsal edge of

the "intermediate appendage". Otherwise the superior appendage is widely separated from the sclerite of Segment X. The posterior side is very concave, and the distal edge is deeply indented. The dark-coloured median one is the stronger of the two lobes

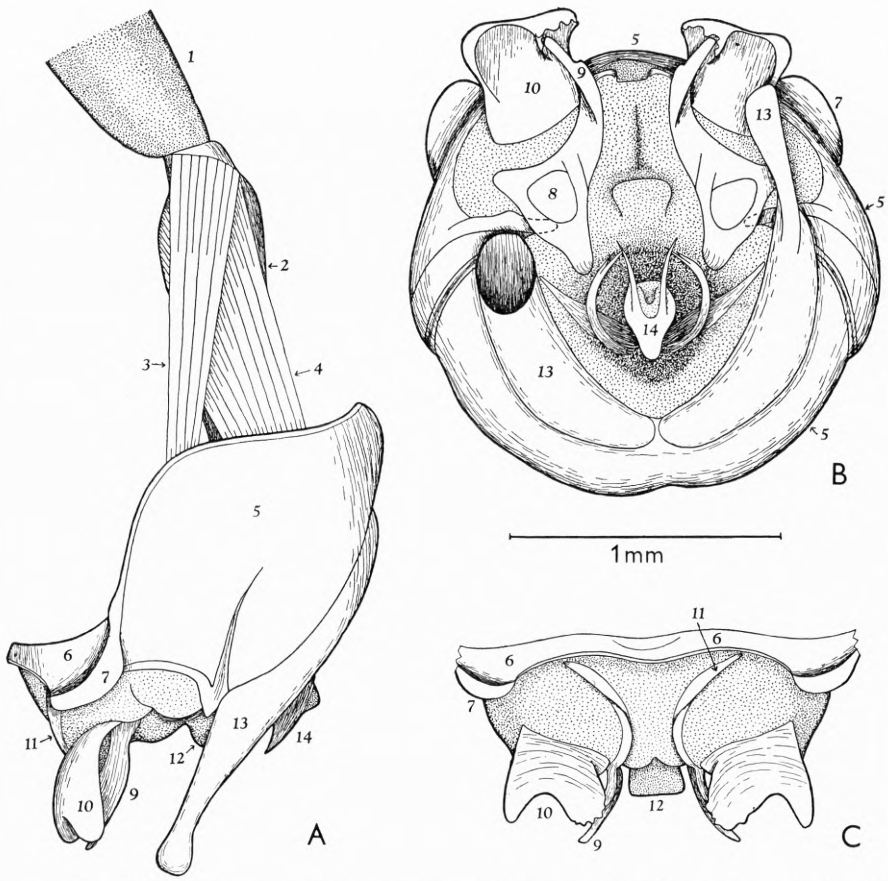

Fig. 72. *Stenophylax stellatus*. A and B: Segments IX and X in lateral (right) and in posterior view. C: Segment X and dorsal part of Segment IX in dorsal view. *1:* ejaculatory duct. *2:* phallocrypt as seen from the haemocoelic side. *3:* posterior phallic muscle. *4:* posterior ventral muscle of inferior appendage (transformed into a phallic muscle). *5:* Segment IX. *6:* dorsal part of antecosta of Segment IX. *7:* tongue-like process on which the VIII/IX muscle is inserted. *8:* sclerite of Segment X. *9:* median process ("intermediate appendage") and *10:* lateral process ("superior appendage") of Segment X. *11:* sclerotic rib on dorsal side of Segment X (seen—but not labelled—also in B). *12:* subanal lobe of Segment X. *13:* inferior appendage; in B the freely projecting part of the left appendage has been cut off. *14:* distal end of aedeagus. (In B *14* is seen projecting from the phallocrypt, flanked by the parameres. The extensions of the sclerotization of the phallocrypt are also seen. Above the phallocrypt the subanal lobe of Segment X, and above this again the anus).

thus formed. It has a concavity of its own, the edges of which are toothed, and which serves to receive the apex of the "intermediate appendage" (see below).

The very strong IX/X muscle originates on almost the whole lateral part of the antecosta of Segment IX, and is inserted on the lateral corner of the sclerite of Seg-

ment X (fig. 72 B, *8*). By the contraction of the muscle this sclerite turns on the inwards directed point of Segment IX and assumes a horizontal position. This implies a shortening of the dorsal side of Segment X and an increase of the curvature of the rib *11*. (The ribs *11* thus are the antagonists of the IX/X muscles). The "superior appendage" becomes adpressed to the bottom of the genital chamber (so that it can be seen only in a posterior view). The apex of the "intermediate appendage" is moved forwards and together with the median lobe of the "superior appendage" acts as a pair of pincers. — Pinned specimens will often be preserved with the IX/X muscles in a state of contraction, so that the "superior appendages" are not seen in a lateral view, and the same may be the case with specimens preserved in fluid.

The anus is a vertical slit between the two sclerites of Segment X. As in *Limnophilus* an unpaired, membranous lobe (12) is seen below the anus.

A discussion of Segment X will be found under *Silo nigricornis* (p. 138).

The inferior appendages (figs. 71, *8;* 72, *13*) have a similar shape as in *Limnophilus flavicornis*. Their dorsal processes, however, are considerably longer, much upwards directed, slender, conical with a knob-like thickened distal end. The rest of the appendage takes the shape of a rather thick, rounded fold along the posterior margin of Segment IX. This fold is sclerotized on the outside as well as on the inside, and—likewise opposite conditions in *Limnophilus flavicornis*—the two appendages are sclerotically continuous. For almost its whole extent the base of the inferior appendage has fused with the sclerite of Segment IX. Ventrally the fusion has left only slight traces; otherwise a distinct separating suture is seen. As in *Limnophilus* the posterior ventral muscle is attached to the phallus, but unlike conditions in *Limnophilus* the inferior appendages have also a musculature of their own. It is composed, however, only of the anterior ventral muscle, which is not particularly strong. It may possibly cause some depression of the processes of the appendages.

The phallocrypt (fig. 72, *2*) is rather spacious, especially so posteriorly, where it is somewhat funnel-shaped. Its greater, anterior part is sclerotized. Laterodorsally the margin of the sclerotization is protracted into a pair of long, rod-like, tapering extensions, the pointed distal ends of which almost touch the margin of the inferior appendages. The phallic apodeme (fig. 73, *1*) is considerably longer than in *Limnophilus flavicornis*.

The phallus has two pairs of posterior muscles. The dorsal pair (fig. 72 A, *3*), which is the weaker, originates on the posterior border of Segment IX just laterally (or ventrally) to the process *7* and is inserted proximally on the lateral side of the phallic apodeme. The stronger ventral pair (*4*) originates lateroventrally on the posterior border of Segment IX and partly also on the inferior appendages. It has a more diffuse insertion than the former pair, laterally and dorsally on the phallic apodeme and especially on the phallocrypt. It represents the posterior ventral muscle of the inferior appendages. The anterior phallic muscle, too, is strong. Like the IX/X muscle it originates on almost the whole lateral part of the antecosta of Segment IX. Its origin is more distally (medially) on the antecosta than that of the former muscle,

which in a median view is almost entirely concealed by the phallic muscle. It is inserted on the posterior extension of the sclerite of the phallocrypt mentioned above.

The phallus (figs. 71, *9;* 72, *14;* 73) is divided into a phallobase (fig. 73, *3*) and an aedeagus (*4*). That part of the latter which in the state of repose is withdrawn into the endotheca is comparatively thick; dorsally it is entirely membranous, laterally

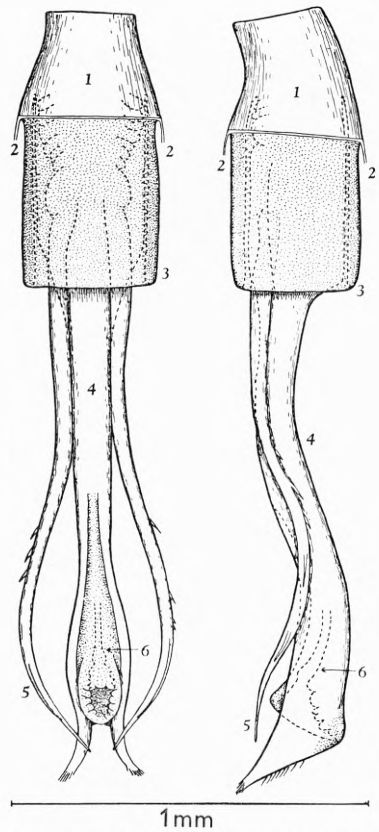

Fig. 73. *Stenophylax stellatus.* Phallus in dorsal and in lateral (right) view. *1:* phallic apodeme. *2—2:* cut edge (boundary between phallic apodeme and phallobase). *3:* phallobase. *4:* aedeagus. *5:* paramere. *6:* (broken line): outline of ejaculatory duct.

and ventrally it is only feebly sclerotized and thrown into numerous, irregular longitudinal folds. The part of the aedeagus which is free of the phallobase is very slender and slightly sigmoid. About the distal third of the dorsal side is membranous. The membranous area is bounded laterally by a pair of sharp, sclerotic ridges, which distally are protracted into a pair of triangular, vertical lamellae. Apically the lamellae carry a tuft of fine spinules and on their ventroposterior edge a row of minute setae. Still smaller setae are found scattered over the rest of the aedeagus. Distally on the ventral side there is a shallow membranous indentation. The ejaculatory duct (*6*),

the distal part of which is sclerotized, opens in a funnel-like depression (a phallotremal cavity) on the membranous part between the two sclerotic lamellae.

The parameres (*5*) are almost as long as the aedeagus. They are extremely slender and slightly sigmoid. Their proximal ends are implanted in pocket-like longitudinal furrows latero-dorsally on the thick basal part of the aedeagus. They are sparsely covered with fine spines.

The aedeagal retractor muscle is strong and fills more than the ventral half of the thick basal part of the aedeagus. The majority of the bands is inserted at the boundary between the thick and the slender part of the aedeagus, but some bands proceed rather far distally, where they are inserted ventrally.

Slide preparations were made of three phalli. On one of these a large (300 μ long) seta was seen on the edge of the left paramere-pocket.

Ecclisopteryx guttulata.

Segment VIII is slightly modified. The tergum (fig. 74, *3*) is broader than the preceding terga. In the middle it is protracted into an unpaired, anal extension (*5*), which is bent downwards on the exceptionally thick and otherwise membranous posterior border of the segment, and which is very densely covered by very short, but also very thick, black setae. In a lateral view (B) it is seen that this extension has a broad, rectangular transverse furrow, so that the posterior border of the segment descends, as it were, by two stages.

Segment IX (*6*) is short. It is longest laterally, where both the oral and the anal margin are bulging. Ventrally there are an oral and an anal indentation, so that the ventral side is very short. In the very middle this side is membranous. The dorsal side is reduced to a sclerotic transverse bridge, which comprises only the antecostal suture (fig. 75, *2*) and the acrotergite (*1;* which latter here, in return, is comparatively long). In the middle of the dorsal side the antecosta is interrupted. Dorsally to the inferior appendages the bottom of the genital chamber is provided with a pair of crescent-shaped, strong, lateral sclerotizations (*4*), which are continuous with the sclerite of Segment IX, though separated from it by a sharp edge. Medially the sclerite *4* is continuous with that of Segment X. The sclerotic bridge thus formed between Segments IX and X is strengthened by two high external ridges, between which a deep furrow (*5*) is seen.

Segment X (figs. 74 and 75, *7—9*) is somewhat better developed than in the Limnophilinae. It takes the shape of quite a short process, the anal end of which is cut off obliquely, descendent and lying in a plane almost parallel to the dorsolateral parts of the posterior margin of Segment IX. In a transverse section the process is coarsely triangular; the ventral base is smaller than the height. The sclerite of Segment X (figs. 74, *8;* 75, *8—9*) is annular. On the very short ventral side (fig. 75, *9*) a longtudinal furrow is seen. Lateroventrally the sclerite of Segment X is continuous with the sclerite in the genital chamber and through this with that of Segment IX.

Each half of the sclerite of Segment X is homologous with the triangular sclerite in the Limnophilinae (figs. 69A, *6;* 72B, *8*). Unlike conditions in this subfamily it does not carry processes of any kind. The rather small, but strong, rounded "superior appendage" (figs. 74 and 75, *7*) is continuous with the lateral side of the sclerite of Segment X. Between these two structures there is a deep, sclerotic concavity. The anus

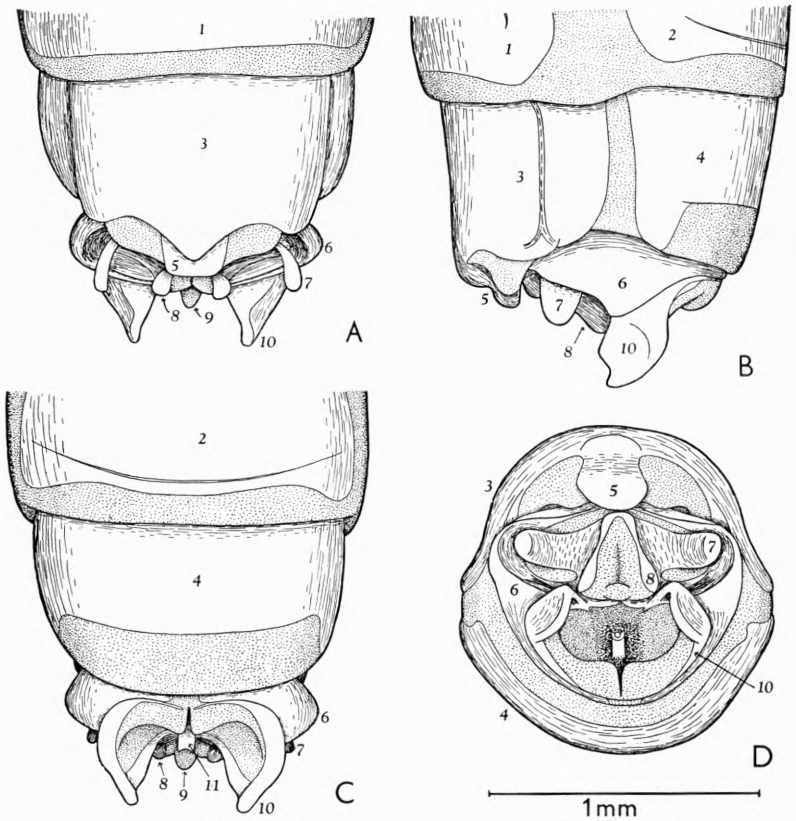

Fig. 74. *Ecclisopteryx guttulata*. Posterior end of abdomen in dorsal (A), lateral (right, B), ventral (C), and posterior view (D). *1:* anal part of Tergum VII. *2:* anal part of Sternum VII. *3:* Tergum VIII. *4:* Sternum VIII. *5:* anal extension of Tergum VIII. *6:* Segment IX. *7:* lateral process ("superior appendage"), *8:* median part, *9:* subanal lobe of Segment X. *10:* inferior appendage. *11:* distal end of aedeagus (in D seen projecting from the phallocrypt between the two inferior appendages).

is situated on the membranous posterior side of the segment. It is a vertical slit, below which a small, membranous process (fig. 74, *9*) is seen.

The very strong IX/X muscle originates on the laterodorsal part of the antecosta of Segment IX and is inserted on the sclerite in the genital chamber at the very point where the latter joins the sclerite of Segment X (at the median number *6* in fig. 75).

A discussion of Segment X will be found under *Silo nigricornis* (p. 138).

The inferior appendages (fig. 74, *10*) are very like those of the Limnophilinae. They have very broad bases, but are extremely short except dorsally, where they are

protracted into processes (fig. 76, *9*). In a transverse section the latter are approximately triangular with a slightly convex dorsal side, a slightly concave lateral side and a flat medioventral side. The process is entirely sclerotized, and its apex is rough with short, strong spinules. Otherwise the sclerotization of the inferior appendage is restricted to a narrow stripe (fig. 76, *8*) proximally on the external side. In a ventral direction the width of this stripe decreases, and quite ventrally the appendage is entirely membranous. The two appendages are continuous with each other, though there is a deep and narrow notch in the part common to them, so that the ventral ends of the appendages form a bilobed lower lip of the entrance to the phallocrypt (fig. 74C—D). The sclerite of the appendage is continuous with that of Segment IX, though separated from it by a distinct suture. The dorsal side of the process is like-

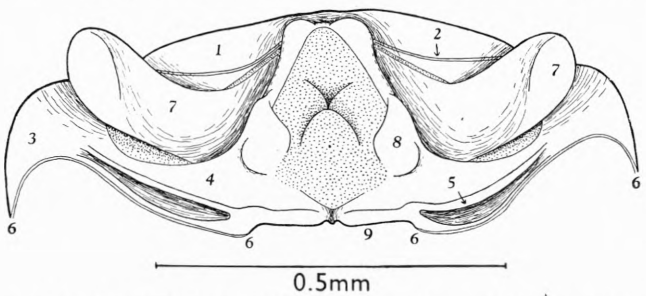

Fig. 75. *Ecclisopteryx guttulata*. Segment X and adjacent area of Segment IX as seen from behind and partly from below. *1:* dorsal side of Segment IX (the number is placed on the acrotergite). *2:* antecostal suture of Segment IX. *3:* lateral part of Segment IX. *4:* sclerite in the genital chamber. 5: see p. 129. *6—6:* cut edge through Segment IX and the sclerite of the genital chamber near the union of the latter with the inferior appendage; the insertion of the IX/X muscle is at the median number *6*. *7:* lateral, *8:* median, *9:* ventral part of Segment X.

wise continuous with the sclerite in the genital chamber (fig. 76, *6*). This union also is marked by a distinct suture. As in the Limnophilinae the posterior ventral muscle has been transformed into a phallic muscle, and the other muscles of the inferior appendages are lacking.

The clasping apparatus is very highly specialized. Its only muscle is the IX/X muscle. It acts on a lever, the sclerite in the genital chamber, which—as mentioned above—is strengthened by external ridges. The median end of the lever is pulled forwards, and owing to the continuity of the various sclerites the result is that both the "superior appendage" and the inferior appendage are bent inwards. Together the two pairs of appendages thus form a pair of tongs with bifurcated jaws. The movement involves a deformation of Segments IX and X. This is facilitated by the following structures: The dorsal transverse bridge of Segment IX is placed in a vertical plane, and the antecosta is interrupted in the middle. The middle of the ventral side is membranous. The longitudinal furrow on the ventral side of Segment X. (It is worth noting that in the Limnophilinae also the IX/X muscle is the only muscle of the clasping apparatus; see pp. 121 and 126—27). In preserved—and especially in pinned —specimens the IX/X muscle will often be fixed in different degrees of contraction.

This explains the difference which is seen in various pictures of the genital segments of *Ecclisopteryx guttulata*. In a fully relaxed condition the processes of the inferior appendages point almost straight backwards.

The phallus (figs. 74, *11;* 76) is largely built like that of the Limnophilinae.

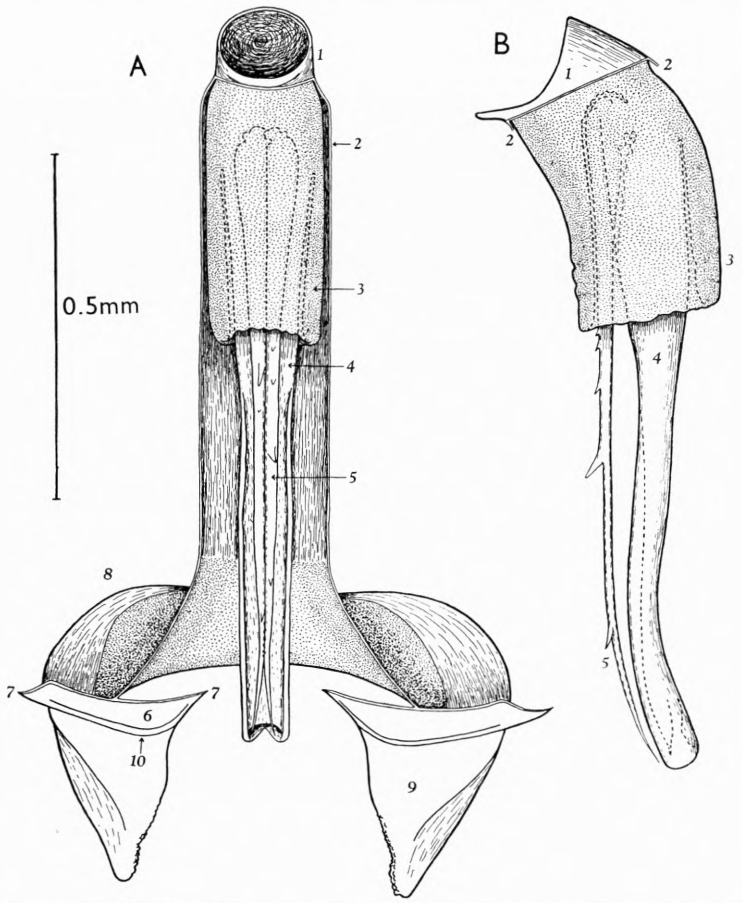

Fig. 76. *Ecclisopteryx guttulata*. A: inferior appendages, phallocrypt, and phallus in dorsal view; the dorsal wall of the phallocrypt has been removed. B: phallus in lateral (right) view. *1:* phallic apodeme. *2:* phallocrypt. *3:* phallobase. *4:* aedeagus. *5:* paramere. *6:* sclerite of the genital chamber. *7—7:* cut edge through this sclerite and Segment IX. *8:* sclerite of inferior appendage as seen from the haemocoelic side. *9:* freely projecting part of inferior appendage. *10:* suture separating this part from the sclerite of the genital chamber.

The phallocrypt (fig. 76, *2*) is sclerotized to its greatest extent. The phallic apodeme (*1*) is short. The phallic muscles are slender. As in *Stenophylax* two pairs of posterior muscles are present. The dorsal one originates laterodorsally on the posterior border of Segment IX and is inserted on the dorsal side of the phallocrypt somewhat anteriorly to the middle of the latter. The ventral posterior muscle originates in the inferior appendage, just ventrally to the process of the latter, and is inserted laterodorsally

on the middle of the phallocrypt. (As mentioned above, it represents the posterior ventral muscle of the inferior appendage). The anterior phallic muscle originates approximately in the middle of the lateral side of the antecosta of Segment IX and is inserted latero dorsally and posteriorly on the sclerotic part of the phallocrypt. The phallus being retracted, the anterior muscle takes an almost transverse course. It acts as a retractor, the posterior muscles as protractors.

The aedeagus (fig. 76, *4*) is extremely slender. The part which in the state of repose is enclosed by the phallobase (*3*) is a little thicker and has a membranous dorsal side. The aedeagus is almost straight, the distal end only is bent a little downwards. On the part which projects from the phallobase, the dorsal side is concave for most of its length. The apex is slightly bilobed. The ejaculatory duct opens apically. Its distal part is sclerotized almost as far as the thicker, basal region of the aedeagus. The very slender and sharply pointed parameres (*5*) carry some few spines on their dorsal sides. Their thicker proximal ends lie close against each other, lowered a little into a depression proximally on the dorsal side of the aedeagus. A peculiar asymmetry is noted: near its base the ventral side of the left paramere carries a strong seta ($55\times 4\ \mu$) on a process ($15\times 9\ \mu$). The aedeagal retractor muscle originates in the phallic apodeme. It almost entirely fills up the thick part of the aedeagus.

Apatania arctica.

In a previous paper (1943a, pp. 22—24; cp. 1950a, p. 400) I have given a description of the genital segments of this species. Here some supplementary information, especially concerning the musculature, will be given.

Segment IX. The length of the dorsal side is reduced to one fourth of that of the ventral side by an oral and an anal indentation. The former is trapezoidal. As in *Silo* (p. 137) the anterior part of the lateral side is apodemal. In *Apatania*, however, the length of the apodemal part is only one fifth of that of the whole lateral side. On the dorsal and the lateral sides, between the bases of the inferior appendages, a suture runs along the posterior margin of the segment. On the dorsal side it is connected with the antecostal suture by a pair of strong longitudinal sutures. The distance between the two latter is a little smaller than that between the two superior appendages, and is like the width of the bottom of the oral, trapezoidal indentation. (The longitudinal sutures probably are homologous with those of *Limnophilus;* p. 119). In the middle of the dorsal side there is thus an approximately rectangular area embraced by sutures (the antecostal suture, the posterior suture and the longitudinal sutures). This area is a little bulging and protracted backwards, so that a rudimentary dorsal process (fig. 77, *3*) is formed. In a dorsal view the latter conceals the median part of the posterior suture. In the middle of the ventral side of the segment there is a small, anal, membranous indentation.

Segment X to its greatest extent is strongly sclerotized, only the ventral side of the oral, undivided part being membranous. There the anus is found, ventrally

bounded by a slightly bilobed, membranous lip. Between the bases of the laterodorsal horns (*5*) the dorsal side is very concave. On the vertical lateral side the anterior margin of the sclerite is bent outwards as a narrow rim. The anterior corners of the sclerite are produced forwards as rod-like extensions (*7*), which, lying horizontally in the roof of the posterior part of the phallocrypt, converge anteriorly. Laterally on the dorsal side (in front of the superior appendages) the sclerites of Segments X and IX are continuous. The boundary between the two segments, however, appears distinctly, partly by Segment X having a considerably lighter brown colour than Seg-

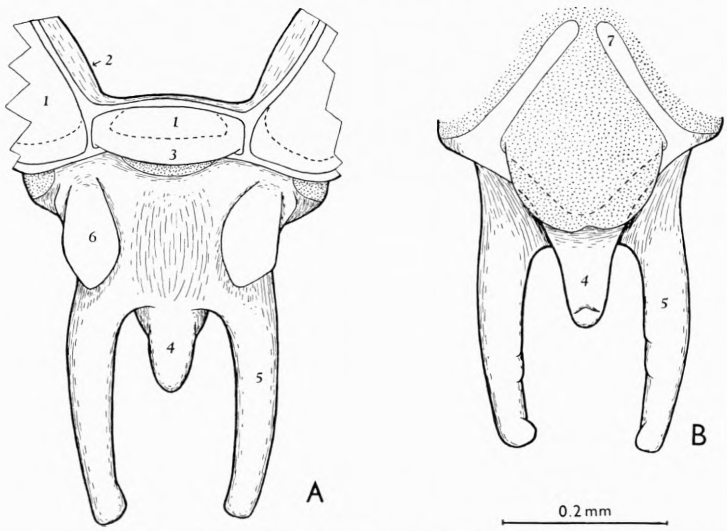

Fig. 77. *Apatania arctica*. Segment X in dorsal (A) and in ventral view (B); in A the adjacent parts of Segment IX is seen. Broken lines indicate in A edges of internal ridges shining through, in B sclerotic parts covered by the subanal lobe of Segment X. *1:* Segment IX. *2:* antecosta of Segment IX. *3:* dorsal process. *4:* median and *5:* lateral process of Segment X. *6:* superior appendage. *7:* anterior extension of ventroanterior corner of Segment X.

ment IX, partly by Segment X being at a lower level than Segment IX, and finally by the posterior suture of Segment IX mentioned above. On the greater median part of the dorsal side as well as on the lateral sides the two segments are separated by membrane.

The small superior appendages (*6*) are sclerotically continuous with the sclerite of Segment X.

The IX/X muscle is very strong and originates on the whole lateral part of the antecosta of Segment IX. Dorsally the origin is bounded by the longitudinal suture. It is inserted on the proximal margin of the sclerite of Segment X on the ventral half of the lateral side, and on the posterior half of the rod *7* (fig. 77 B). It must act as a depressor of Segment X.

A discussion of Segment X will be found under *Silo nigricornis* (p. 138).

The inferior appendages (fig. 78 A). The median side of the coxopodite (*9*)

is slightly concave. Ventrally the concavity is bounded by a broadly rounded edge, dorsally by a sharp edge which continues the dorsal edge of the distal projection (*10*). Proximally the median sides of the two coxopodites merge evenly into each other. In this way a sclerotic semitube (*8*) is formed, which proceeds forwards for some distance on the floor of the phallocrypt, and which represents the basal plate of the appendages. In the middle the posterior edge of the semitube is broadly rounded, but is not seen in a ventral view, since the posterior border of Segment IX overlaps the bases of the inferior appendages rather much. On the ventral side of the appendages there is an unpaired, lenticular, membranous indentation, corresponding to the membranous indentation in the posterior margin of the sclerite of Segment IX. The tongue-like distal processes (*10*) of the two coxopodites are situated in planes which converge posteriorly and dorsally. The harpago is implanted in a small, membranous area, and laterally it is lowered rather much into the coxopodite. It is divided into a larger upper (*11*) and a smaller lower lip (*12*).

The inferior appendages have only one extrinsic muscle, the anterior ventral muscle, which originates on the ventral part of the antecosta of Segment IX. Its bands converge posteriorly and are inserted on the ventral side of the part common to the two appendages. This muscle possibly acts as a depressor. The posterior ventral muscle is developed as a phallic muscle, and the two other muscles are entirely lacking, or perhaps the anterior dorsal has fused with the anterior phallic muscle. The flexor of the harpago is very strong. It originates from more than half of the lateral side of the coxopodite and is inserted medio ventrally on the proximal margin of the harpago. By its contraction it must rotate the latter in such a way that the apex of its upper lip (*11*) meets the apex of the distal process (*10*) of the coxopodite, a pair of pincers thus being formed.

The spacious phallocrypt (*2—4*) stretches into the posterior part of Segment VII. Its dorsal half is entirely membranous except for the rods (fig. 77 B, *7*) issued from the anterior corners of Segment X. Ventrally about the anterior half is sclerotized (fig. 78 A, *2*), and the posterior part of the floor is formed by the above-mentioned semitube (*8*), which is continuous with the inferior appendages. These two sclerotizations are separated by a large membranous area. Their dorsal margins, however, are connected by a pair of rod-like, somewhat ascendent sclerotizations (*3—4*), the posterior part of which (*4*) is colourless and hyaloid (though distinctly defined) and no doubt flexible and elastic. The ventral, membranous area between the two rods bulges into the lumen of the phallocrypt as a valve, which both orally and anally overlaps the sclerotized areas to a great extent. The phallic apodeme (fig. 78 B, *1*) is short and thin.

There are two pairs of posterior phallic muscles. The dorsal muscle, which is very strong, originates dorsally in Segment IX, just laterally to the longitudinal suture and on the whole area between the antecostal suture and the posterior suture. It is inserted on the phallic apodeme in the entire circumference of the latter: both dorsally and ventrally the insertions of the two muscles meet. The ventral muscle is

considerably weaker. It originates lateroventrally on the proximal margin of the coxopodite, and the insertion extends over the oral sclerotized part (*2*) of the floor of the phallocrypt. The two pairs of posterior muscles are protractors. Their antagonist is probably the elasticity of the hyaloid part (*4*) of the rod *3*—*4*. The membranous valve in the floor of the phallocrypt is a feature which allows the movements of protraction and retraction. The rather weak anterior phallic muscle originates lateroventrally on the antecosta of Segment IX and is inserted on the dorsal margin of the anal sclerotization (*8*) in the floor of the phallocrypt. Perhaps it has an antagonistic relation to the anterior ventral muscle of the inferior appendage. In a

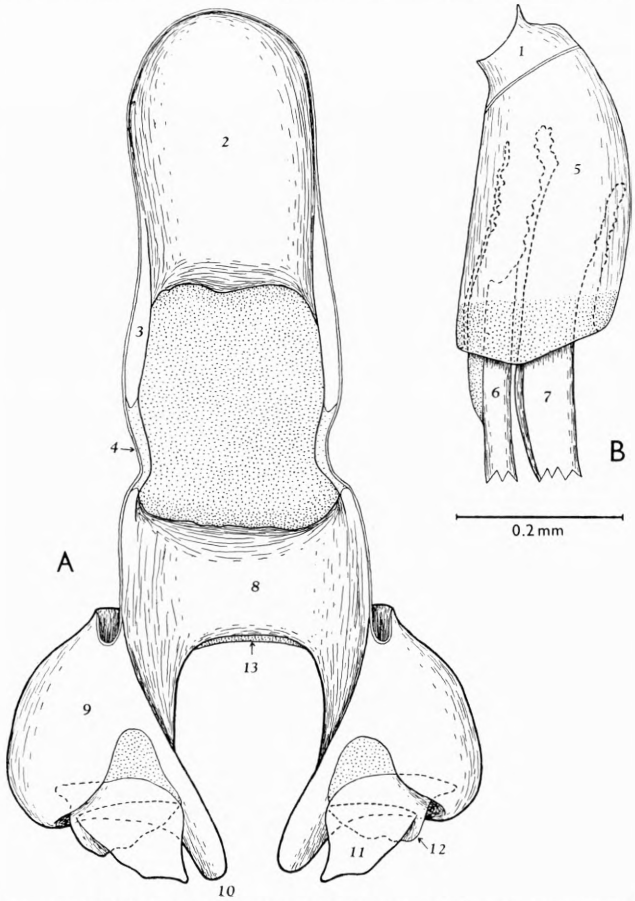

Fig. 78. *Apatania arctica*. A: inferior appendages and phallocrypt in dorsal view; the dorsal wall of the phallocrypt has been removed together with the phallus. B: proximal part of the phallus in lateral (right) view. *1:* phallic apodeme. *2:* sclerotic part of ventral wall of phallocrypt. *3:* rod-like sclerite connecting this part with the basal plate of the inferior appendages. *4:* flexible part of this rod. *5:* phallobase. *6:* paramere (distal part broken off). *7:* aedeagus (distal part broken off). *8:* basal plate of inferior appendages. *9:* coxopodite and *10:* its distal projection. *11:* upper and *12:* lower lip of harpago. *13:* membranous posterior border of Segment IX.

median view the anterior phallic muscle conceals the ventral part of the IX/X muscle.

The phallobase (fig. 78 B, *5*) is well developed. It tapers proximally, so that the short phallic apodeme (*1*) is considerably thinner than the phallobase. The phallotheca is slightly sclerotized except quite distally. The aedeagus (*7*) is somewhat flattened. On its proximal, broader part the dorsal side is flat, though with a pair of shallow longitudinal furrows, impressions after the parameres (*6*), whereas the ventral side forms a feebly defined, rounded longitudinal keel. In the distal half of the aedeagus the ejaculatory duct is sclerotized, and just proximally to this part it is surrounded by glandular tissue. The "spurs" on the distal end of the aedeagus are not setae, but spines, i. e. simple cuticular processes. The parameres, which proximally are united by membrane, are thin-walled. The aedeagal retractor originates proximally on the ventral side of the phallotheca and is inserted distally and laterally on the broad part of the aedeagus.

Silo nigricornis.

Segment IX (figs. 79 and 80, *6*) is very short and entirely concealed by the overlapping posterior border of Segment VIII. It is longest on the lateral side, where there is a large oral bulge, which to a great extent has the character of an apodeme (*6 a*). The dorsal as well as the ventral side are much reduced in length. In the middle the former is developed only as quite a narrow transverse bridge. Ventrally on the lateral side there is a longitudinal suture, which anteriorly joins the antecosta. The relation between this suture and the IX/X muscle makes it doubtful that it should be homologous with the longitudinal suture in *Apatania* (p. 133) and the Limnophilinae (p. 119), whereas it may be homologous with the lateroventral suture in various other forms; (see pp. 5—6). In the middle of the ventral side the antecosta of Segment IX is interrupted.

Segment X is broad anteriorly and tapers much posteriorly. The dorsal and the lateral sides are sclerotized, whereas the greater, median part of the ventral side is membranous. For more than the posterior half Segment X is cleft into a pair of strongly and entirely sclerotized processes (figs. 79—81, *9*). Basally the latter are sagittally compressed, but their dorsal edges are twisted inwards, so that the distal part of the processes becomes dorsoventrally flattened. This part is applied to the dorsal side of the aedeagus. The anus is between the two processes. Orally and laterally Segment X carries a pair of ear-shaped "superior appendages" (*8*), which are sclerotically continuous with the segment itself. Anteriorly on Segment X there is an unpaired, elongate, tongue-like, and entirely sclerotized dorsal process (*7*). The dorsal sides of this process and of Segment IX are connected by a narrow, sclerotic longitudinal bridge. The latter, the width of which is only a small fraction of that of the process, constitutes the only sclerotic connection between Segments IX and X. The unpaired dorsal process in *Silo* is probably homologous with the paired dorsal pro-

cesses in *Leptocerus* (fig. 53, *6*, p. 95) and *Oligoplectrum* (fig. 62, *2*, p. 111) a. o. The IX/X muscle is very strong. It originates from the whole apodemal part of Segment IX (*6a*) and is inserted on the prominent ventro-anterior corner of Segment X (see fig. 81).

A comparison between *Ecclisopteryx*, *Apatania*, and *Silo* gives strong evidence that the "superior appendages" in *Ecclisopteryx* (figs. 74 and 75, *7*) and *Silo* (figs. 79 and 80, *8*) are homologous with the lateral horns in *Apatania* (fig. 77, *5*). In *Apatania* these structures certainly are not superior appendages, since such (fig. 77, *6*) are present at the same time. The inference is that the "superior appendages" in *Ecclisopteryx* and *Silo* do not justly bear this name, but are structures homologous with the lateral processes in *Sericostoma* (fig. 47, *4*, p. 86) and *Beraea* (fig. 50, *3*, p. 91). The same of course is the case with the lateral horns in *Apatania*. The median horn in this genus (fig. 77, *4*) then is homologous with the median, unpaired process in *Sericostoma*, and the processes *9* in *Silo* (figs. 79 and 80) no doubt are homologous with the median horn in *Apatania*. In *Silo* the median process of Segment X thus is bifurcated, a condition which possibly finds its parallel in *Agrypnia* (p. 115) and to some extent in *Beraea* (fig. 50, *2*, p. 91) also. A comparison between the Limnophilinae and the Ecclisopteryginae strongly indicates that the "superior appendages" in these two subfamilies are homologous. The "superior appendages" of the Limnophilinae then are lateral processes of Segment X and not true superior appendages. The latter are lacking in all the Limnophilidae studied here with the exception of *Apatania*, in which they are present in a rudimentary state. The "intermediate appendages" in the Limnophilinae (figs. 68 and 69, *7*) is the median process of Segment X, bifurcated as in *Silo* (fig. 79, *9*). In *Ecclisopteryx* this process is lacking. It is a feature peculiar to the Limnophilinae that the sclerite of Segment X is divided into a right and a left half. An analogy is found i. a. in *Molanna* (p. 99). It is a much higher degree of specialization, however, that the lateral and the median processes are separated by an articulation and movable against each other. The lobes *13* in *Limnophilus* (fig. 69), *12* in *Stenophylax* (fig. 72), and *9* in *Ecclisopteryx* (fig. 74) are obviously homologous with each other and with the membranous lower lip of the anus in *Apatania* (Anker Nielsen 1943a, p. 25, fig. 4A). Such a lower lip is found more or less distinctly developed also in other Integripalpia.

Schmid (1955, p. 10) also considers the "superior appendages" of the Limnophilinae and the Eccolisopteryginae as parts ("branches externes") of Segment X itself. He calls the median process(es) "branches internes". He further recognizes a pair of "branches inferieures". In *Limnophilus* the latter are represented by the processes *12* (fig. 69). In my opinion, however, they are structures of only secondary importance and may in some cases have arisen by a subdivision of the median processes, in others perhaps by a subdivision of the lateral processes; in many Apataniinae the latter are bifurcated (Schmid 1953, 1954). Schmid calls the membranous parts of Segment X "corps de Xme segment". Expecially in some Apataniinae it may be produced into rather complicated lobes. I think, however, that secondary importance only can be attributed to these lobes.

The two-jointed inferior appendages are large and directed almost straight backwards. The coxopodite (figs. 79, 80 and 82 A, *10*) is semicircular in a transverse section; the dorsal side is membranous. Proximally the two coxopodites are contiguous and quite proximally the median sides of their sclerites are continuous, but a basal plate is not developed. From the proximal half of the laterodorsal margin of the sclerite a strong and rather broad, sclerotic rod (fig. 82 A, *6*) is issued, which proceeds

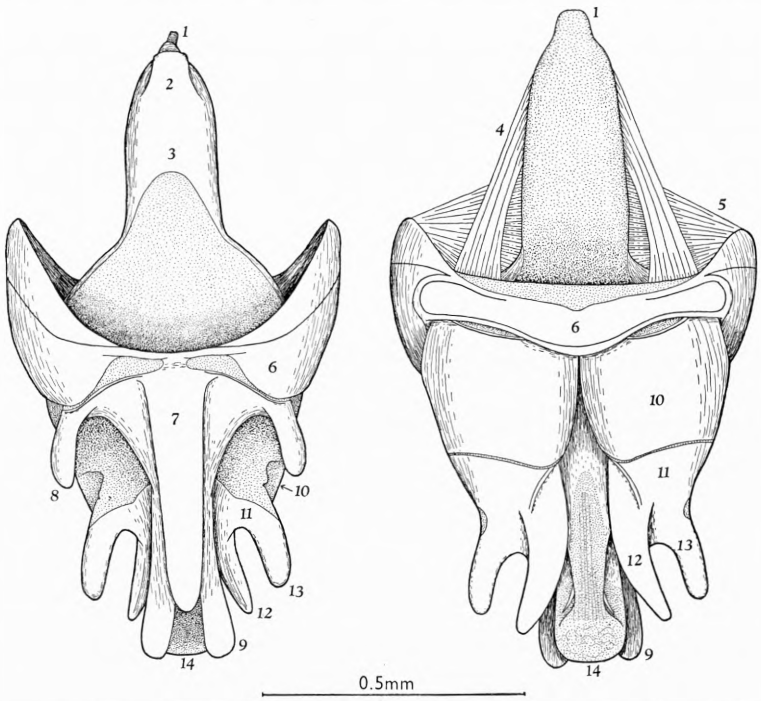

Fig. 79. *Silo nigricornis*. Segments IX and X in dorsal and in ventral view. *1* = *1* in fig. 80. *2:* phallic apodeme. *3:* sclerotic part of dorsal wall of phallocrypt as seen from the haemocoelic side. *4:* posterior ventral muscle of inferior appendage, transformed into a phallic muscle. *5:* anterior phallic muscle. *6:* Segment IX. *7:* dorsal process. *8:* lateral process ("superior appendage") and *9:* median process of Segment X. *10:* coxopodite. *11:* harpago. *12:* median and *13:* lateral branch of the latter. *14:* distal end of aedeagus.

into the phallocrypt, where it—being subjected to a torsion—comes to lie on the lateral wall of the latter; eventually it joins the sclerotization of the phallocrypt. The ventral side of the harpago (*11*) is much longer than the dorsal side. Distally the harpago is divided into two branches: one median (and a little ventral; *12*), the other lateral (and a little dorsal; *13*). The latter is finger-like. The former is flattened, and its dorsal side faces a little medially; proximally on its ventral side a sharp, elevated keel is seen. The dorsal sides (of the median branches) are more or less closely applied to the aedeagus and thus completes the aedeagus-guide, the rest of which is formed by the median processes of Segment X. The inferior appendages and Segment X together enclose the middle part of the aedeagus in such a way that only the distal end of the latter (fig. 80, *14*) is seen in a lateral view.

The rather weak anterior ventral muscle is inserted on the sclerotized furrow between the two coxopodites. The posterior ventral muscle is developed as a phallic muscle. The posterior dorsal muscle is lacking, whereas it is possible that the anterior dorsal muscle has fused with the anterior phallic muscle. The flexor of the harpago is divided into two portions. One is very strong. It originates on the ventral side of the coxopodite and is inserted proximally on the dorsal side of the harpago. The other

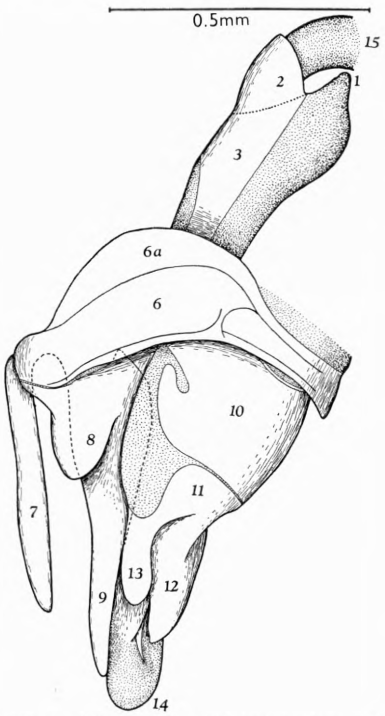

Fig. 80. *Silo nigricornis*. Segments IX and X in lateral (right) view. *6a:* apodemal part of lateral side of Segment IX. *15:* ejaculatory duct. Other numbers as in fig. 79.

portion is weaker, but still rather strong. It originates on the median side of the coxopodite and is inserted on the ventral side of the harpago, rather distally, between the bases of the two branches. It can hardly act as an antagonist to the former portion, but perhaps plays a role in the rather complicated movements of the harpago: By the contraction of the flexor the harpago is bent upwards, and the ventroproximal, undivided part of its sclerite comes to be placed as a lid on the distal end of the coxopodite. The distal branches, however, are bent downwards in relation to the rest of the harpago and hence continue to point obliquely backwards. During this movement the the median branch is removed from the aedeagus and together with the "superior appendage" forms a pair of tongs.

The phallocrypt (figs. 79, 80 and 82·A, *1* and *3*) is very deep. In a lateral view its anterior end is bilobed. The upper, beak-like lobe (2) is sclerotized, and through

its open ventral side the ejaculatory duct (*15*) enters the phallus. This "beak"alone represents the phallic apodeme. The inferior lobe (*1*) is membranous. The ventral side and the distal part of the dorsal side of the phallocrypt are membranous. Proximally the dorsal side is sclerotized (*3*), and the posterior corners of the sclerite are protracted backwards into the above-mentioned rods (fig. 82 A, *6*), which unite it with the inferior appendages.

The phallus consists of a short phallobase (fig. 82, 5) and a long, slender aedeagus (figs. 79 and 80, *14;* 82, 7). The distal end of the phallobase is cut off very obliquely; the ventral side is longer than the dorsal side, but nevertheless the latter

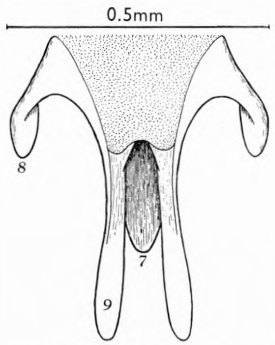

Fig. 81. *Silo nigricornis.* Segment X in ventral view. For explanation see fig. 79.

projects farther backwards than the former. Proximally the lateral and the ventral sides of the phallotheca are sclerotized, but the phallobase is membranous to its greatest extent.

The proximal half of the aedeagus is somewhat flattened, whereas the distal half approaches the cylindrical shape and hence, in a lateral view, appears swollen. The part of the aedeagus which in the state of repose is concealed in the endotheca, is membranous, and on the dorsal side the membrane stretches over the proximal two fifths of the organ. The apex is membranous, too; on the dorsal and especially on the ventral side the membrane proceeds farther proximally than on the lateral side. Distally a great part of the dorsal side is excavated spoon-like. The anterior part of the bottom of the "spoon" is sclerotized and very thick-walled, and there, rather far removed from the distal end of the aedeagus, the opening of the ejaculatory duct is found. The "spoon" may be considered as a phallotremal cavity (see pp. 12—13). Lateroventrally on the aedeagus there is a pair of deep and narrow depressions, which serve to receive the parameres (fig. 82, *8—9*). The latter are very slender and slightly sigmoid. They arise close together at the bottom of the endotheca, ventrally to the aedeagus.

The phallus has no posterior muscle of its own, but as mentioned above, the posterior ventral muscle of the inferior appendage is associated with the phallus. It originates on the lateroventral part of the proximal margin of the coxopodite and is

inserted on the phallic apodeme (2). The anterior muscle is very strong, stronger than the posterior one. It originates on the lateral side of Segment IX in front of the origin of the IX/X muscle. Its insertion extends in a horizontal, or rather slightly descendent, plane. The posterior half is on the rod (fig. 82A, *6*a) connecting the inferior appendage with the sclerite of the phallocrypt (*3*), the anterior half on this

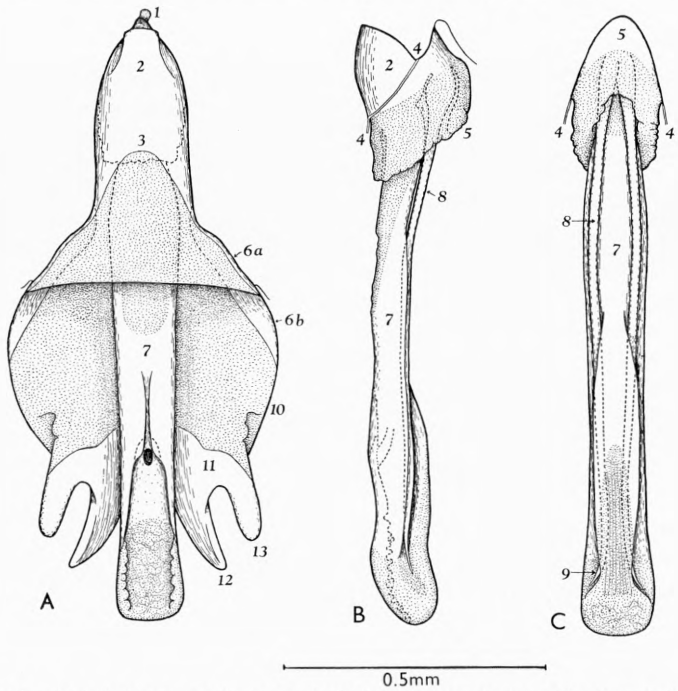

Fig. 82. *Silo nigricornis*. A: inferior appendages and phallus in dorsal view; the dorsal side of the phallocrypt is seen from the haemocoelic side. B and C: phallus in lateral (right) and in ventral view. *1* = *1* in fig. 80. *2:* phallic apodeme. *3:* sclerotic part of dorsal side of phallocrypt. *4—4:* cut edge through wall of phallocrypt (boundary between phallic apodeme and phallobase). *5:* phallobase. *6:* rod-like sclerite connecting inferior appendage with sclerite of phallocrypt; *6a* is seen partly from the haemocoelic side, partly shining through (broken line). *7:* aedeagus; in A the opening of the ejaculatory duct is seen in the middle of the freely projecting part. *8:* paramere. *9:* distal end of the latter. *10:* coxopodite. *11:* harpago. *12:* median and *13:* lateral branch of the latter.

sclerite. In the state of repose the most posterior muscle bands go a little backwards, the most anterior ones much forwards. The relation to the inferior appendage does not exclude the possibility that the muscle has arisen by a fusion of the anterior dorsal muscle of this appendage and the anterior phallic muscle, but nothing can be said with certainty about this. The function of the two muscles is not clear to me. If the posterior muscle acts as protractor, the elasticity of the rod *6* must be a very powerful antagonist. The strong development of the retractor (the anterior muscle) then is difficult to understand. Possibly the two muscles perform some other functions than protraction and retraction. The aedeagal retractor is rather weak.

The structure of the genital segments of *Silo* shows that the Goërinae are true

members of the family of Limnophilidae, and especially closely related to the Apataniinae. There is a great similarity between the two subfamilies as regards the stucture of Segment X, and the similarity becomes still greater if other forms of the Apataniinae are included in the comparison. In species of the genera *Radema* Hag. and *Thamastes* Hag., and also in some species referred to the genus *Apatania* Kol., there is a dorsal process of the same shape as that in *Silo*, and the median process of Segment X is bifurcated as in the latter (SCHMID 1953, 1954). In the development of the inferior appendages there are important points of resemblance between the Apataniinae and the Goërinae. It is especially noted that the harpago is bifurcated and that a sclerotic bridge connects the coxopodite with a sclerotization in the anterior part of the phallocrypt. (The rod-like extension of the sclerite of the phallocrypt which in *Stenophylax* —p. 127—almost reaches the inferior appendage may perhaps be homologous with the bridge mentioned. This being the case, it means that conditions in the Apataniinae are the original ones within the Limnophilidae, and those in Limnophilinae and Ecclisopteryginae due to a reduction). In the development of the musculature of the inferior appendages the Goërinae show affinities not only to the Apataniinae, but also to the Limnophilinae and the Ecclisopteryginae: The only extrinsic muscle associated with the appendages is the anterior ventral one; the posterior ventral muscle is developed as a phallic muscle, and the two other muscles are lacking. In the Apataniinae and the Goërinae, however, there is some evidence that the anterior dorsal muscle has fused with the anterior phallic muscle, and the same of course may be the case in the Limnophilinae and the Ecclisopteryginae. Finally, the phallus in *Silo* is decidedly of a limnophilid type.

In a previous paper (1943b, pp. 106—16) I have discussed the phylogeny of the Limnophilidae. In this paper I advanced the theory that within this family two main lines of evolution may be distinguished, one comprising the Apataniinae, the Goërinae and the Ecclisopteryginae, the other the Limnophilinae. The chief arguments were the facts that the Ecclisoptryginae like the Apataniinae, but unlike the Limnophilinae, lay their eggs below water, and that the mouth-parts of the Ecclisopteryginae larvae show similar adaptations to torrential life as do those of the Apataniinae and the Goërinae. Based upon a study of the imagines this theory has been criticized by SCHMID (1955, p. 116), who considers the Ecclisopteryginae more closely related to the Limnophilinae than to the Apataniinae. The structure of the genital segments, and more particularly of the inferior appendages and the phallocrypt, may indicate that SCHMID is right. This being the case, however, the two above-mentioned and several other points of similarity in the morphology and biology of the developmental stages of the Ecclisopteryginae on the one hand and the Apataniinae and the Goërinae on the other must be explained as convergencies. The aquatic egg-deposition of the Ecclisopteryginae undoubtedly is more primitive than the terrestrial egg-deposition of the Limnophilinae. The safest which at present can be said on the question of the systematic position of the Ecclisopteryginae is perhaps that it still is open to discussion.

Concluding Remarks.

An important purpose of the present study has been to throw some light upon the phylogeny of the Trichoptera. Before entering this subject it will not, perhaps, be superfluous to say some few words on phylogenetic considerations in general, though very likely others have expressed similar thoughts.

It goes without saying that no recent systematic group can be the ancestors of any other recent systematic group. Nor is it to be expected that any group has a very great similarity to the hypothetical, common ancestral form. Since the very beginning of Life on Earth the organisms have been subjected to the pressure of natural selection. Those, only, which in one or another direction became specialized were able to survive. Hence truly primitive animals (or plants) do not exist. The specializations have followed many different paths, which is the cause of the variety of Life. It seems that the specialization generally has comprised the vast majority of features. But it also seems that various features may be specialized to very different degrees: whereas some are highly specialized, others have remained comparatively primitive. And, finally, it seems that in various groups it is not the same features which have remained primitive. Comparative studies therefore give us a possibility of judging what condition is to be considered the original one. It is that which recurs in several forms which for other reasons must be considered distantly related. It then turns out that in some forms the specialization has comprised only comparatively few features (which in return more often are very highly specialized), whereas most features have remained comparatively primitive. Such forms are called generalized, primitive or "low"—though in some respects they may be very highly specialized. The more features the specialization comprises, the more specialized or "higher" the form is said to be.

From the above it will appear that when in the following mention is made of primitive forms, intermediate forms, etc., these terms must be taken *cum grano salis*. Their meaning is just that the forms in question are suited to give us some idea of what the true primitive or intermediate forms were like.

In a previous paper (1948a, pp. 177—91) I have advanced the theory that the Glossosomatinae are intermediate between the Rhyacophilinae and the Hydroptilidae, and that the latter again are intermediate between the Glossosomatinae and the Integripalpia. In a paper not yet published I am going to advance another theory, viz.

that the Psychomyidae are intermediate between the Rhyacophilinae and the families with net-spinning larvae (Philopotamidae, Polycentropidae and Hydropsychidae). The last-mentioned theory has already been published in popular form (ANKER NIELSEN 1950b; in Danish). It is now interesting to see whether the two theories are compatible with the facts about the structure of the male genital segments.

Both theories imply that the genus *Rhyacophila* Pict. is the most primitive among recent Trichoptera. This point of view (on which most trichopterologists agree) is supported by the fact that *Rhyacophila* is the only one among the forms studied here in which a distinct Segment XI comprising both an epiproct and a pair of paraprocts is found (pp. 16—17). The dorsal processes on Segments IX and X probably also represent a primitive condition (p. 7). In the stucture of the inferior appendages and the phallus the two Danish species of *Rhyacophila* are rather specialized. As to the former we are to some degree concerned with a specialization by reduction. (Cp. also p. 47: *Rh. gregoryi*).

In its original shape the first mentioned theory, that of the evolution of the Integripalpia, involved that the recent (Danish) Hydroptilidae had a diphyletic origin, the Orthotrichiinae and the Hydroptilinae representing two independent side-branches on the main stem between the Glossosomatinae and the Integripalpia. This cannot be upheld. The two subfamilies have too many features in common for that. Some of these, especially the structure of the inferior appendages, might perhaps be explained as very original features, but the phallus very obviously is highly specialized and that in the same direction in the two subfamilies. The Orthotrichiinae and the Hydroptilinae thus, no doubt, represent one line of evolution which later on has bifurcated. With this modification I think that the theory can be upheld.

Three things might seem to speak against the theory: 1. Superior appendages are lacking in *Rhyacophila*, *Agapetus fuscipes* and most Hydroptilidae, whereas they are present in the Psychomyidae and the Polycentropidae as well as in most Integripalpia. 2. The inferior appendages are two-jointed in *Rhyacophila* and most Integripalpia, but one-jointed in *Agapetus* and most Hydroptilidae. 3. Provided that the titillator of the Hydroptilidae is homologous with the parameres of other Trichoptera, *Agapetus* and the Hydroptilidae agree in having an unpaired paramere, but differ in this respect from both *Rhyacophila* and the Integripalpia.

Much weight cannot be attributed to the two first points. Both the reduction of the superior appendages and the establishment of a one-jointed condition in the inferior appendages no doubt have taken place independently in various systematic groups (pp. 6—7 and 8). Moreover, structures which probably are superior appendages have been described in many *Agapetus* species (ULMER 1930a, p. 375, 1951, pp. 53 and 55; DENNING 1941, p. 201, 1950, p. 117; ROSS 1944, p. 40; KIMMINS & DENNING 1951; KIMMINS 1953b), in *Synagapetus* MacL. (ULMER & KRAWANY 1938, pp. 307—08; KIMMINS 1953b) and in *Pseudagapetus moselyi* ULM. (ULMER & KRAWANY 1938, p. 310). The hydroptilid *Paduniella semarangensis* Ulm. also seems to have superior appendages (ULMER 1912, pp. 81—82. The procss 2 in Agraylea and Hydroptila—fig. 43, 44

and 46, pp. 78, 79 and 83—perhaps may be interpreted as a superior appandage; cp. pp. 146—47). Among the Hydroptilidae the inferior appendages probably are two-jointed in *Agraylea* and in *Baliotrichia* Ulm. In the latter genus ULMER (1951, pp. 89—90) besides the inferior appendages describes three pairs of cylindrical rods. I interpret the three rods, one of which carries a strong seta, as the dorsal branch of the inferior appendage (see below), the harpago and a paired paramere (see below).

The third objection might seem more serious. I find it unlikely, however, that the hydroptilid titillator is homologous with the paramere of *Agapetus* (pp. 84—85), and the unpaired condition of the paramere may very well be a development special to the Glossosomatinae. Paired parameres are found in *Glossosoma confluens* Kimm. (KIMMINS 1953b, pp. 169—70) and probably also in *Myspoleo murinus* Barn. (Glossosomatinae; BARNARD 1934, p. 390). In the genus *Himalopsyche* Bks. (Rhyacophilinae) some species have two, others only one paramere (KIMMINS 1952). Furthermore, structures which are homologous with the paired parameres in other Trichoptera are possibly found in *Orthotrichia* (p. 85), and similar structures seem to be present in the hydroptilid genera *Protoptila* Bks. (Ross 1944, pp. 41—44), *Baliotrichia* (see above), a. o. (see p. 69).

In several other respects features which support the theory, may be pointed out.

In Integripalpia the posterior part of Segment X is divided into three processes: a pair of lateral ones and an unpaired median one, which latter may be bifurcated. This feature is particularly typically developed in *Beraea* (p. 89) and the Limnophilidae (p. 138), but can also be traced in the other Integripalpia, though the median process often is suppressed. (In some few cases—*Agrypnia*, p. 115—it is perhaps the lateral processes which are suppressed). The processes *8* in *Agraylea* (figs. 43, p. 78; 44, p. 79) remind very much of the lateral processes in the Integripalpia. As mentioned above (pp. 77 and 82), the processes *8* in *Agraylea* possibly are homologous with the processes *8* in *Orthotrichia* (figs. 38, p. 71; 39, p. 72; 41, p. 74) and *Hydroptila* (fig. 46, p. 83), which implies that the lateral processes of Segment IX in the last-mentioned genera are homologous with the lateral processes of Segment X in the Integripalpia. This theory is not so improbable as it might seem at a first glance. In a great number of Integripalpia Segments IX and X have fused to such a degree that the boundary cannot be given with any degree of certainty; (e. g. *Sericostoma*, p. 86; *Beraea*, p. 89; *Leptocerus*, p. 95). And in those cases in which the boundary seems distinct, it may very well be secondary and not the true boundary between the two segments. The same applies to the Hydroptilidae (cp. *Orthotrichia*, p. 68). The inference is that Segment IX in *Orthotrichia* and *Hydroptila* is a composite structure, which includes parts of Segment X—or perhaps rather of Segment XI (see below). A condition like that in *Agraylea* seems to occur in the hydroptilid *Microptila bejela* Mos. (MOSELY 1948, p. 85): Segment X is tripartite, and its median process is membranous.

To me the two following assumptions seem reasonable: 1: That the lateral processes of Segment X in the Integripalpia, the processes *8* in the Hydroptilidae and the posterior parts of the sclerites of Segment X in *Agapetus* (p. 21) are homologous and

represent the paraprocts, which have fused with the sclerite of Segment X. On p. 47 it was pointed out that accessory copulatory processes on the paraprocts possibly are an old heritage in the Trichoptera. The fact that structures which seem to represent such processes are present in some Glossosomatinae supports this assumption. *Beraea* (pp. 89—90) might be supposed to represent an original stage, the paraprocts having not yet fused with the sclerite of Segment X. I am more inclined, however, to think that in *Beraea* this condition is secondary. 2. That the median process of Segment X in the Integripalpia represents the epiproct, which like the paraprocts has fused with the sclerite of Segment X. In *Agapetus* and the Hydroptilidae the epiproct has either been suppressed or been subjected to a desclerotization, though in *Orthotrichia* (p. 68) it may be represented by the spines 2 and 3. It is worth noting that the median process of Segment X in some Integripalpia is bifurcated like the epiproct in *Rhyacophila* (p. 16).

Another common feature of the Integripalpia is that the coxopodite is divided into a dorsal and a ventral branch, the latter carrying the harpago. This is seen particularly distinctly in the Beraeidae (pp. 87 and 90—92), but in a somewhat rudimentary condition the dorsal branch is present also in *Molanna* (p. 99) and *Lasiocephala* (p. 107), and it seems that it is found also in some limnophilid genera, viz. *Halesochila* Bks., *Chianophylax* Schmid, *Ecclisomyia* Bks. and *Farula* Milne (Schmid 1950, p. 59; 1951, pp. 58 and 60; 1955, pp. 57—58, fig. 33 and pp. 71—72, fig. 46). The dorsal branches are present also in the Hydroptilidae, though it seems in a rather specialized condition, represented by the structures labelled *5* in figs. 39, p. 72; 40, p. 73; 41, p. 74; 43, p. 78; 44, p. 79; 46, p. 83; (and *6* in figs. 43 and 44). Especially the "parameres" in *Hydroptila occulta* (p. 83) remind very much of the dorsal branches in *Beraea*. Structures of the same sort as the "parameres" in *H. occulta* are found also in some other species of the genus (Betten 1934, p. 513; Schmid 1947; Mosely 1948). They further occur in the following genera, though being much shorter (and with the setae placed distally), and thus having a still greater resemblance to the dorsal branches in *Beraea: Javanotrichia* Ulm. (Ulmer 1951, pp. 76 and 78), *Orthotrichiella* Ulm. (l. c., p. 81) and *Baliotrichia* Ulm. (l. c., pp. 89—90). The similarity to the dorsal branches in *Beraea*, however, is particularly great in the genera *Stactobia* MacL. (Ulmer 1950, p. 296; described as "obere Anhänge"; in this genus Vaillant—1951—seems to have confused these structures with the phallus), *Plethus* Hag. (Ulmer 1951, pp. 63—65; described as "Appendices präanales") and *Oeceotrichia* Ulm. (l. c., p. 86; each provided with a seta). In *Pasirotrichia* Ulm. they have the shape of a pair of hook-like rods (l. c., p. 91).—In *Sumatranotrichia* Ulm. there is an unpaired structure, which has some resemblance to the process *5* in *Orthotrichia*, though it is much longer (l. c., p. 88).

In this connection it should be mentioned that there also is some likeness between the structures mentioned in the Hydroptilidae and the processes on the basal plate in *Tinodes* (fig. 16, p. 35). Especially the process *5* in the Hydroptilidae reminds of the process *4* in *Tinodes*, both being provided with a pair of strong setae,

In species of the genera *Psychomyia* Pict. and *Psychomyiella* Ulm. ULMER (1951, pp. 163, 165, 166 and 168) describes "3 starke Chitingräten" which perhaps may be homologous with the processes of the basal plate in *Tinodes*. This indicates that the two-branched condition of the coxopodite is a very original feature in the Trichoptera, which now has been lost in most Annulipalpia.

In most Integripalpia with two-jointed inferior appendages the harpago arises subdistally on the coxopodite, so that the latter has a distal projection beyond the base of the former. This condition is seen most distinctly in *Agrypnia* (fig. 66, p. 117), but among the forms treated here it is only in *Silo* that the harpago arises distally, and in the closely related *Goëra pilosa* Fabr. it has a subdistal origin. In the Hydroptilidae the inferior appendages generally are one-jointed, but if the process *13* in *Agraylea* (figs. 43, p. 78 and 44, p. 79) really is a harpago—which seems very likely—it means that this joint in the Hydroptilidae also has a subdistal position; (cp. also *Baliotrichia*, p. 146). (In *Rhyacophila gregoryi* Ulm.—ULMER 1932—33, p. 42—the harpago is likewise placed subdistally. This, however, is possibly a development particular to this species and arisen in connection with a strong reduction of the harpago).

The hydroptilid phallus is very much specialized. Nevertheless, the shape of its distal end foreshadows conditions in the Integripalpia (cp. pp. 12—13).

As to the second theory, the evolution of the families with net-spinning larvae, some features may be pointed out in which these families resemble each other and the Psychomyidae, but differ from other systematic groups of Trichoptera. As the morphology and the biology of the developmental stages show, the families Psychomyidae, Philopotamidae, Polycentropidae, and Hydropsychidae are natural units. Hence, features which are common to these families must have evolved before their ways parted, and if such a feature is lacking in a member of one of the families, this lack must be due to a reduction. This means that the apparent simplicity in the structure of the genital segments in *Lype* and probably also in *Wormaldia* (see below) has arisen by reduction.

In the Psychomyidae (pp. 24—26, 30—31 and 37—40) and the Polycentropinae (pp. 46—48 and 52—55) the reduced dorsal part of Segment IX is detached from the ventral part and intimately associated with Segment X. In *Wormaldia* (pp. 42—44) conditions are very similar, though the two parts of Segment IX are sclerotically continuous; this latter, however, is possibly secondary. *Tinodes* and *Psychomyia* resemble the Polycentropinae in that Segment X is (at least chiefly) membranous. This, however, is probably due to parallel evolution in the two groups. In *Lype* Segment X is sclerotized like that of *Wormaldia* and provided with a dorsal process. The latter, no doubt, is a primitive feature, and since it is difficult to imagine a dorsal process in connection with a membranous Segment X, the sclerotic condition must be considered the original one in the family Psychomyidae.

The Polycentropidae are exceptional in that the IX/X muscle is inserted on the superior appendage (pp. 48, 54, 61). This condition may have evolved from that

in *Wormaldia*, in which the superior appendage is sclerotically continuous with Segment X, and the muscle inserted in the angle between the segment itself and the appendage (pp. 43—44).

As mentioned above (pp. 46—47), paraprocts with accessory copulatory processes are possibly an old heritage in the Trichoptera. Well developed, musculated paraprocts are found in the Polycentropidae (pp. 46—47, 54—55, and 62). The processes *14—16* in *Tinodes* (figs. 14 and 15), no doubt, belong to the paraprocts (p. 32), and the same is possibly the case with the rods *5—6* in *Psychomyia* (fig. 19; cp. p. 40). In both of these genera the paraproctal muscle is present (pp. 33 and 40), though in *Tinodes* it has shifted its insertion to a part of Segment X which, strictly speaking, belongs to Segment IX. In *Lype* (pp. 24—26) the paraprocts are reduced, but the paraproctal muscle is still found and has a similar insertion as in *Tinodes*.

In *Wormaldia* (pp. 43—44) the paraprocts are likewise reduced, and the paraproctal muscle either is lacking or has fused with the IX/X muscle. It seems, however, that the typical genital equipment of the Philopotamidae comprises paraproctal processes. Structures which may be interpreted as such are found in *Philopotamus* Leach. (Since I had only dried material of this genus at my disposal, I was unable to decide the question with certainty). Similar structures have been described in other philopotamids, viz. many species of the genus *Chimarrha* Steph. (Ulmer 1916; 1930b, p. 481. Barnard 1941, p. 106. Denning 1952), in *Vigarrha tibialis* Nav. (Ulmer 1930a, p. 377) and in *Thylakion* Barn. (Barnard 1934, p. 384).

On pp. 62—63 and 63—64 it has been accounted for how the genital segments of *Ecnomus* and *Hydropsyche* may have evolved from a polycentropine type.

Judging from MacFarlane's descriptions (1951) the rhyacophilid subfamily Hydrobiosinae approaches the family group in question: The dorsal part of Segment IX is much reduced. Both "superior" and "intermediate appendages" are described. The latter quite obviously are the true superior appendages; the former may be paraproctal processes.

Due to the intimate association of the dorsal part of Segment IX with Segment X the dorsal VIII/IX muscle is incorporated in the genital system. In *Psychomyia* (p. 40) and *Wormaldia* (p. 44) this muscle is divided into two portions, one the bands of which converge towards an unpaired median insertion, and another inserted laterally. In *Lype* and *Tinodes* the lateral, in the Polycentropidae and the Hydropsychidae the median portion is lacking.

In *Tinodes* (p. 34) and *Psychomyia* (pp. 40—41) the harpago is bifurcated, and the same is the case in *Philopotamus* Leach. The simple shape exhibited by *Lype* (p. 27) and *Wormaldia* (p. 44) therefore must be considered secondary. In the Polycentropidae (pp. 48, 55 and 59) the distal end of the inferior appendage is divided into two branches (the dorsal one much smaller than the ventral one). If the one-jointed appendage in this family has arisen by fusion of the coxopodite and the harpago—which is most probable—this indicates that the harpago was bifurcated. In *Ecnomus furcatus* Ulm. (Ulmer 1930a, p. 430) the bifurcation is very strongly pronounced, so

that the appendage has no small resemblance to that of *Tinodes pallidula* (p. 8). As in *Lype* and *Wormaldia* the simple shape of the harpago in *Hydropsyche* is possibly secondary.

A bifurcation of the harpago also occurs in some Integripalpia. It is especially distinct in the Apataniinae (p. 135) and the Goërinae (p. 139), but traces of this condition are found also in *Leptocerus* (p. 96) and *Lasiocephala* (pp. 107—09). The dorsal branch of the inferior appendage in *Sericostoma* (p. 87) probably includes the harpago (pp. 90—92). Its distal notch indicates that the harpago was bifurcated. A bifurcation of the harpago thus seems to be a very old feature in the Trichoptera. It is also seen in many species of *Rhyacophila* (Betten 1934, p. 506; Ross 1944, p. 33; Banks 1947, fig. 10; Schmid 1952, pp. 636 and 46; Kimmins 1953a).

The shape of the phallus varies much within the four families in question. Still, its proximal part (including the apodeme) shows a striking resemblance in *Lype* (pp. 27—28), *Psychomyia* (p. 42), *Wormaldia* (p. 44), *Polycentropus* (p. 49) and *Holocentropus* (p. 55).

Below a table is given of the development of the musculature of the inferior appendages and the phallus:

	Inferior appendage				Phallus	
	anterior dorsal	anterior ventral	posterior dorsal	posterior ventral	anterior	posterior
Lype	−	+	+	+	+	−
Tinodes	−	+	+	+	−	−
Psychomyia	−	+	−	+	+	−
Wormaldia	+	+	+	+	+	+
Polycentropus	−	+	+	−	+	+
Holocentropus	−	+	+	−	+	+
Ecnomus	+	+	+	−	+	+
Hydropsyche	+	+	−	−	+	+

The posterior ventral muscle of the inferior appendage has a similar and unusual development in *Lype* (p. 27), *Tinodes* (p. 35) and *Wormaldia* (p. 44). In *Psychomyia* (p. 40) this muscle is very highly specialized; in the Polycentropidae (pp. 49, 55 and 62) it probably and in *Hydropsyche* (pp. 65—66) it certainly is lacking. Since there can be no doubt that the Polycentropinae are more closely related to *Ecnomus* than to the Psychomyidae, the lack of the anterior dorsal muscle in both the Psychomyidae and the Polycentropinae must be due to parallel evolution. On the other hand, it is possible that the lack of the posterior ventral muscle in both the Polycentropidae and the Hydropsychidae is a sign of closer affinities.

It should now be possible to give an outline of the male genital segments of the hypothetical primeval Trichopteron: Segment IX was synscleritous; its posterior border was protracted into an unpaired dorsal process, and perhaps a similar ventral

process was found. The dorsal side of Segment X was sclerotized and anteriorly carried an unpaired dorsal process and a pair of passively movable superior appendages. Very likely the dorsal processes of Segments IX and X were united by membrane as is seen in *Rhyacophila* (p. 15). On the ventral side of Segment X (cp. p. 7) there was a pair of paraprocts, each carrying an accessory copulatory process, and above the anus an epiproct, perhaps divided into a right and a left prong, occurred. The epiproct was movable by a pair of muscles originating on the antecosta of Segment X (p. 16), the paraprocts by another pair originating in Segment IX (p. 48). The inferior appendage was two-jointed; the coxopodite was divided into a dorsal and a ventral branch, the latter carrying the harpago, which again was bifurcated; proximally the two coxopodites were sclerotically continuous with each other and with an unpaired basal plate. The phallus, the proximal end of which was lowered into a phallocrypt, was divided into a phallobase and an aedeagus; the distal part of the latter was cleft into a dorsal and a ventral branch; the opening of the ejaculatory duct, the phallotreme, was on the dorsal branch; at the bottom of the endotheca, beside the aedeagus, a pair of parameres took their origin. Finally, it must be mentioned that the ejaculatory duct probably was bifurcated as in the Lepidoptera (Beirne 1942); in recent Trichoptera this condition seems to be preserved only in the Hydroptilidae (p. 75). The specializations within the order have to a varying degree been accompanied by simplifications of the ground-plan described above.

Two main lines of evolution can be traced; (cp. pp. 144—45). 1: Rhyacophilinae — Glossosomatinae — Hydroptilidae — Integripalpia. 2: Rhyacophilinae — Psychomyidae — Philopotamidae, Polycentropidae, Hydropsychidae.

In Group 1 the dorsal processes of Segments IX and X have united into a single structure, which may be paired. It is rarely, however, well developed (*Leptocerus*, p. 94; *Oligoplectrum*, p. 111; *Silo*, p. 137). More frequently it is rudimentary to a greater or less degree, and in about half of the forms treated here it is entirely reduced. In Group 2 the dorsal process of Segment IX is lacking, but that of Segment X may be retained (*Lype*, p. 24; partly in *Wormaldialdia*, p. 43; possibly in *Hydropsyche*, p. 63). A most striking feature in this group is the fact that the sclerite of Segment IX is secondarily divided into a dorsal and ventral part, the former being intimately associated with Segment X.

In Group 1 the epiproct and the paraprocts have united with the sclerite of Segment X; in this way the tripartite structure of Segment X typical of the Integripalpia has arisen. The median process may be considered the epiproct, the lateral ones the (somewhat reduced) copulatory processes of the paraprocts. In Group 2 the epiproct is entirely reduced, whereas the paraprocts are often retained in a primitive condition.

Originally Segments IX and X were connected by two pairs of muscles, the IX/X muscle and the paraproctal muscle. This condition is preserved in *Lype* (p. 26), *Tinodes* (pp. 32—34) and the Polycentropidae (pp. 48, 54, 59 and 61), but in the vast majority of Trichoptera there is only one pair of muscles between the two segments.

The question then is whether it is the IX/X muscle or the paraproctal muscle which is preserved. In *Psychomyia* (p. 40) there is evidence that it is the paraproctal muscle, and it is perhaps also this muscle which is found in *Hydropsyche instabilis* (pp. 63 and 64). In *Rhyacophila* (p. 15), on the other hand, the paraproctal muscle seems to be reduced. In most cases, however, I am inclined to think that the single muscle has arisen by a fusion of the IX/X muscle and the paraproctal muscle. Among recent Trichoptera an epiproctal (dorsal X/XI) muscle is found only in *Rhyacophila*.

The dorsal branch of the coxopodite is retained in a rather primitive shape in the Beraeidae, and in a more or less rudimentary state in some other Integripalpia. It is retained also in the Hydroptilidae, but in this family it is oftener highly specialized. In Group 2 it is found (in a specialized condition) only in some Psychomyidae.

The phallus is perhaps that part of the genital structures which shows the richest variation. It may be very different even in forms which for other reasons must be considered closely related. In general, however, it may be pointed out that in Group 1 there is a tendency towards reduction of the dorsal branch of the aedeagus, whereas in Group 2 there is a tendency towards reduction of the ventral branch (pp. 12—13).

To sum up, it can be said that nothing in the structure of the male genital segments speaks definitely against the two theories, whereas some things speak in their favour. It will probably be better not to enter further into a phylogenetic discussion until more facts (i. a. a study of the female genital segments) are available.

Summary.

Segment VIII is the last typical abdominal segment with a separate tergum and sternum, though even this segment may be slightly modified. Its posterior border to a greater or less degree overlaps Segment IX, sometimes so much that the latter is partly or entirely concealed. Segment IX is typically synscleritous, forming a strong annulus. More often the dorsal part of the annulus is shorter than the other parts, and in extreme cases it is reduced to a narrow transverse bridge. Sometimes the sclerite has an anal membranous indentation on the ventral side, and rarely the ventral side is entirely interrupted by a membrane. The posterior end of Segment IX is a mainly membranous depression, the genital chamber. From this depression the following structures arise: Segment X dorsally, the inferior appendages ventrally, and between Segment X and the inferior appendages the copulatory organ, the phallus.

Except for the paraprocts, mentioned below, Segment X may be entirely membranous or very slightly sclerotized. Oftener, however, it is provided with a dorsal, sometimes paired sclerite. The latter varies greatly, and the shape of the segment as a whole is also extremely variable. In extreme cases (Ecclisopteryginae and especially Limnophilinae) its length is reduced so much that the sclerites of the segment appear as situated at the bottom of the genital chamber. The ventral side of Segment X is generally more or less concave, and part of the dorsal side of the phallus lies in this concavity. In some cases the edges of the concavity approach each other so much that the base of the phallus becomes enclosed in a functional tube. The segment typically carries a pair of superior appendages, which vary greatly in size and very often are lacking.

Segment X is a composite structure. It also comprises Segment XI. A distinct Segment XI, however, is developed only in the Rhyacophilinae, but in most other forms traces of it can be found. In nearly all forms there is some sort of sclerotic connection between Segments IX and X, and in many Hydroptilidae and Integripalpia the boundary between the two segments cannot be stated with any degree of certainty. In those forms in which there seems to be a distinct boundary it is most likely a secondary one. In the Psychomyidae and the Polycentropinae the reduced dorsal part of Segment IX is secondarily detached from the rest of the segment and intimately associated with Segment X. In *Wormaldia* conditions are very similar, though the two

parts of Segment IX are sclerotically continuous; this latter, however, is possibly secondary. The apparently more primitive condition in the Ecnominae and the Hydropsychidae probably has arisen by fusion of the secondary Segments IX and X of the Polycentropinae.

In *Hydropsyche instabilis* Curt. (p. 63) and *Molanna* (p. 99) structures which perhaps might be interpreted as cerci are found, though I find other interpretations more likely.

The inferior appendages, the gonopods, typically are divided into a proximal and a distal joint, coxopodite and harpago, respectively. In very many forms, however, they are one-jointed. This condition may have arisen in three ways: 1. By reduction of the harpago. 2. By fusion of the two joints. 3. By fusion of the coxopodite with Segment IX. In most cases the two coxopodites are sclerotically united with each other and with an unpaired basal plate situated at the bottom of the genital chamber between and above the two appendages. In some few forms they are connected by membrane only. This is, no doubt, a secondary condition, and the same is true in *Rhyacophila*, in which there is no connection between the appendages. The inferior appendages generally form the chief clasping apparatus. In some few forms, however, they are much reduced. This is especially the case in the Limnophilinae, in which subfamily they may be non-musculated. In the Ecclisopteryginae also the inferior appendages are much reduced, but still play an important rôle in the clasping apparatus.

The base of the phallus is lowered into a tubular depression, the phallocrypt, which generally is very deep, but may be almost entirely obliterated. In practically all forms a phallic apodeme is formed by fusion of the proximal end of the phallus with the anterior part of the phallocrypt. The length of this apodeme is extremely variable. The relation between the phallocrypt and the basal plate of the inferior appendages varies. In some cases the basal plate is situated on the floor of a small pocket, the entrance of which is separated from that of the phallocrypt. In other cases it is situated on the floor of the phallocrypt. In still other cases, in which the basal plate is very small, it simply lies on the floor of the genital chamber outside the entrance to the phallocrypt. In a rather large number of forms there is a sclerotic connection between the basal plate and the root of the phallus.

The phallus is probably that part of the genital apparatus which is most varying. In its original shape it was divided into a (probably membranous) phallobase and a mainly sclerotized aedeagus, which latter arises from an eversible depression, the endotheca, on the apex of the phallobase. In the majority of the Trichoptera, however, the phallus is undivided. This condition may have arisen in three ways: 1. By a strong development of the phallobase accompanied by a sclerotization of its external wall, the phallotheca, and a reduction of the aedeagus. The final result is that the copulatory organ is formed of the phallobase, which contains an eversible sac, the endotheca, at the bottom of which the ejaculatory duct opens. 2. By obliteration of the endotheca and subsequent fusion of the sclerotized phallotheca with the

aedeagus, or 3. By reduction of the whole phallobase, a direct continuation being established between the phallic apodeme and the aedeagus. The highly specialized phallus of the (Danish) Hydroptilidae possibly represents the final result of this process, though in a modified form. In detail the variations of the shape of the phallus are so numerous that they cannot be enumerated here.

By comparison of recent forms it is possible to give an outline of the male genital segments of the hypothetical primeval Trichopteron.

The posterior border of the synscleritous Segment IX was protracted backwards into an unpaired dorsal process. The sclerotized dorsal side of Segment X anteriorly carried a similar dorsal process. In *Rhyacophila* both processes are present, connected by membrane. In some Integripalpia a dorsal process is found, which may be paired, and which probably has arisen by fusion of the processes of Segments IX and X, and in some Annulipalpia the dorsal process of Segment X is retained. In most Trichoptera, however, dorsal processes are lacking. Segment IX perhaps was provided also with a ventral process. Such a process is found in *Sericostoma* and *Mystacides.*

Segment XI had the structure typical of primitive Pterygota: On the ventral side of Segment X, below the anus, there was a pair of paraprocts, each carrying an accessory copulatory process, and above the anus there was an unpaired, but perhaps bifurcated epiproct. Among recent forms a distinct Segment XI is found in *Rhyacophila* only (though in the Danish species the paraprocts lack copulatory processes), but well-developed paraprocts with copulatory processes are found in the Polycentropidae, no doubt in *Tinodes* also, and possibly in *Psychomyia.* In the Integripalpia the epiproct and the paraprocts have united with the sclerite of Segment X; in this way the tripartite structure of Segment X typical of the Integripalpia (and especially clearly shown by the Apataniinae and the Goërinae) has arisen. The median process may be considered the epiproct, the lateral ones as the (somewhat reduced) copulatory processes of the paraprocts. Very often the median process, more rarely the lateral ones are reduced; or all the three processes may be reduced in size (e.g. *Sericostoma*). In the Hydroptilidae Segment X has a similar structure. Owing to the intimate association between Segments IX and X the lateral processes in some hydroptilid genera appear as processes of the former segment. Segment X of the Glossosomatinae seems to be of the Integripalpia type with reduced median process.

In the Limnophilinae Segment X is highly specialized. In this subfamily the segment has no sclerotic connection with Segment IX, and its sclerite is paired. Moreover, the ear-like lateral process and the paired median process are detached from each other and together form a pair of pincers, which is the chief (or only) clasping apparatus. The lateral process has wrongly been termed "superior appendage". In *Ecclisopteryx* another specilization is found: the right and the left half of Segment IX can be moved in relation to each other, by which movement the lateral processes of Segment X (the "superior appendages") and the one-jointed inferior appendages together act as a pair to tongs with bifurcated jaws.

The coxopodite was divided into a dorsal and a ventral branch. The former is retained in a rather primitive shape in the Beraeidae, and in a more or less rudimentary state in some other Integripalpia. Furthermore, it is retained in *Hydroptila occulta* Eat. It is found also in other hydroptilids, but there the right and the left dorsal branch have fused into an unpaired, highly specialized structure. A similar condition is seen in some Psychomyidae. The ventral branch carried the harpago subdistally, which position it still has in most Integripalpia. Probably the harpago was bifurcated like the coxopodite.

The aedeagus was divided into a dorsal and a ventral branch, the former with the opening of the ejaculatory duct distally. This condition is found in the Rhyacophilidae, and more or less distinct traces of it are left in the Psychomyidae and in *Polycentropus*. In most recent Trichoptera, however, the aedeagus (when present) is undivided. In the Hydroptilidae and in the Integripalpia it seems that it is the dorsal branch which is reduced. The result of this is that the ejaculatory duct opens at the bottom of a spoon-like depression on the dorsal side of the undivided aedeagus. This spoon may develop into a distinct phallotremal cavity, at the bottom of which the opening of the ejaculatory duct is found surrounded by a phallotremal sclerite. In the Annulipalpia, on the other hand, there seems to be a tendency towards reduction of the ventral branch.

At the bottom of the endotheca, beside the aedeagus, a pair of parameres took their origin. In most recent Trichoptera they are lacking. The unpaired titillator, which in the Hydroptilidae arises distally to the middle of the undivided phallus, is scarcely homologous with the parameres of other forms.

It is interesting to note that in the Hydroptilidae the distal part of the ejaculatory duct is bifurcated, which is the case also in the Lepidoptera.

The specializations within the order have to a varying degree been accompanied by simplifications of the ground-plan described above.

The copulatory apparatus is provided with the following muscles: A dorsal IX/X muscle connects Segments IX and X. Another muscle originates in Segment IX and is inserted in the paraproct. Both of these muscles are well developed in *Lype*, *Tinodes*, and the Polycentropidae. In most Trichoptera, however, there is only one pair of muscles between Segments IX and X. In *Psychomyia* and perhaps in *Hydropsyche instabilis* Curt. there is evidence that it is the paraproctal muscle, in *Rhyacophila* that it is the IX/X muscle. In most cases I think that the single muscle has arisen by fusion of the IX/X muscle and the paraproctal muscle. A dorsal X/XI muscle, inserted in the epiproct, among recent Trichoptera is found only in *Rhyacophila*. The inferior appendages have four pairs of extrinsic muscles: anterior and posterior dorsal ones, and anterior and posterior ventral ones. Except in some Hydroptilidae the two anterior ventral muscles have fused to an unpaired muscle. Furthermore, there is an intrinsic flexor of the harpago; in *Silo* it is divided into two. The superior appendages have no musculature of their own, but in the Polycentropidae the IX/X muscle is attached to the superior appendage. The phallus has two pairs of extrinsic muscles, an anterior

and a posterior one, and an intrinsic retractor of the aedeagus. The latter originates in the phallic apodeme or in the phallotheca and is inserted in the aedeagus; in *Rhyacophila*, however, it is inserted on the bases of the parameres. All the muscles mentioned above are not present in all forms, and in many forms the genital musculature becomes very highly specialized. In the Psychomyidae, Philopotamidae, and Polycentropinae the dorsal VIII/IX muscles have been incorporated into the genital system.

The author has previously advanced the theory that within the order Trichoptera two main lines of evolution may be traced, viz. Rhyacophilinae-Glossosomatinae-Hydroptilidae-Integripalpia and Rhyacophilinae-Psychomyidae-Philopotamidae, Polycentropidae, Hydropsychidae. It seems to me that nothing in the structure of the male genital segments speaks definitely against the theory, whereas some things speak in its favour.

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