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MINOR RESEARCH TASK AT CADU NO. 7

An agrobotanical investigation of
leguminous species in the Chilallo
awraja, especially at higher
altitudes.

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I. INTRODUCTION

The investigation was carried out in October and November 1971 in the Chilalo awraja in the province of Arussi, Ethiopia, on behalf of CADU (Chilalo Agricultural Development Unit).

In the efforts to improve the fodder production and to solve the fodder problems of the dry season a large number of potential fodder crops or pasture plants have been experimentally cultivated by the Crop and Pasture Section at CADU. Besides to the grasses, much attention has also been paid to the legumes, which are important because of their usually high nutritive value and ability of nitrogen fixation from the atmosphere through root nodule bacteria. Almost all species observed have been exotics. In some cases seeds from other countries have been used of species also native to the Chilalo awraja.

The purpose of this study has been to investigate the legumes occurring wild in the Chilalo awraja, bring together relevant information about them and select the more promising ones for experimental cultivation.

II. MATERIAL AND METHODS

In order to collect and identify as many as possible of the different species of legumes in the Chilalo awraja, collecting trips were made by car to most parts of the area. Many excursions were made on foot or sometimes by horse. The plants were kept in polythene bags and were put in press in the evenings. During these trips notes were made of habitat, distribution, altitudinal range, seed production etc. of the different species. For the altitude measurements an altimeter of the aneroidbarometer type was used. As a fixed point was used the Administration building in the Project Centre in Asella (2400 m). These measurements were, however, not performed very systematically, and the altitudinal ranges given for the species must be considered only as rough estimates.

The species found were identified by myself partly in the field and partly at the herbarium of the Haile Selassie I University in Addis Abeba, the East African Herbarium in Nairobi and at the herbarium of the Royal Botanic Gardens in London. In the two last mentioned institutes many determinations were also checked by specialists.

The total number of leguminous taxa collected was about 90 and in addition to these some 300 species of other families were also collected from the area. Species already present in the CADU herbarium at Kulumsa were in general avoided to make the collections as good a complement as possible to the already existing ones. Five sets were originally collected of most species, but by accident some 200-250 specimens were lost during a trip from Asella to Kulumsa. As far as possible a set of each species will, after identification and labelling be distributed to the CADU herbarium at Kulumsa, to the three institutes mentioned above and to the Botanical Museum at the University of Uppsala. Collections of Ethiopian plants are of a special value as an Ethiopian Flora project is just about to start with participation from the above-mentioned institutes.

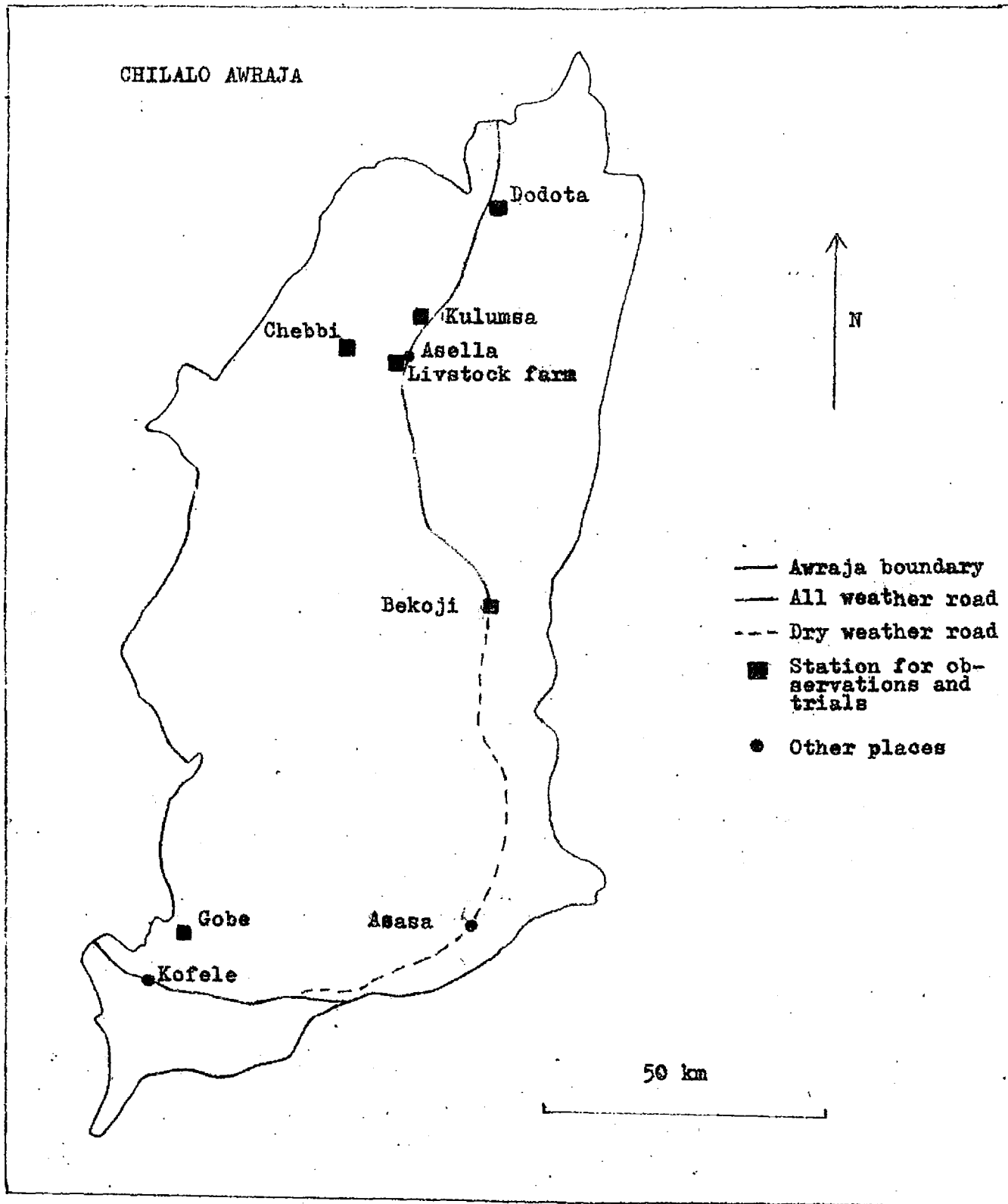
Species considered as promising for use as fodder crops or for sowing into natural grasslands were gradually selected and seeds were collected from them towards the end of my visit. No special measures were taken to protect plants for the seed-collecting, but untouched specimens could fairly easily be found anyway. The seed collecting was, however, sometimes rendered difficult as several species have pods with explosive dehiscence. Sometimes the pods were also to a large extent infected by larvae. The seed-setting was, however, in general very good. Some of the selected species did not produce ripe seeds during my visit, but seeds will be collected from them later on by the Crop and Pasture Section of the CADU.

III. LOCALITIES FOR OBSERVATIONS AND TRIALS OF FODDER CROPS

Each species naturally has its special demands on climatic and edaphic conditions. Within the species ecotypes have also been evolved, adapted to a certain environment. In each case the most suitable conditions should be looked for when choosing the locality for the observation. In the table below are given localities, altitudes and annual rainfall of the stations used for observations of fodder crops. From Kulumsa, Livestock farm (Asella Mission) and Gobe rainfall data are available for 3-4 years, while for Dodota and Bekoji data are only available for one and half a year respectively. No data exist from Chebbi. The figures given below are consequently in some cases only rough estimations or guesses.

Locality	Altitude	Annual rainfall
Bekoji	2700 m	c. 1100-1200 mm
Chebbi	1700 m	c. 600 mm
Dodota	1700 m	c. 500-600 mm
Gobe	2700 m	1200-1300 mm
Kulumsa	2100 m	800-900 mm
Livestock farm (Asella Mission)	2300 m	1300-1400 mm

Map showing the localities of stations used for observations and trials of fodder crops.



IV. SOME NOTES ON THE VEGETATION IN THE CHILALO AWRAJA

The altitudinal differences within the Chilalo awraja are considerable, which enables a wide variety of vegetation types to occur. From the Rift Valley bottom at an altitude of c. 1700 m, there are often steep slopes up to the large plateau at 2200-2700 m covering most of the awraja. From this plateau a number of high mountains rise, some of which reach 4000 m. Due to the good conditions for farming in the area, most parts have become arable land and only fragments of the natural vegetation are left.

The Rift Valley lowland was probably only some decades ago covered with Acacia woodland, which has decreased very rapidly owing mainly to charcoal burning, followed by heavy grazing and low grade farming. On ridges and steep slopes etc. some Acacia woodland is remaining and the more common species here are A. tortilis; A. seyal, A. etbaica and A. nilotica subsp. leiocarpa. Scattered Acacias often also remain in the fields, sometimes accompanied by Cordia abyssinica (Wansa), a tree with large white flowers. Especially along watercourses Ficus-trees are often common, as they have been left, because their wood is useless for firewood or charcoal. Trees and shrubs belonging to other mainly dry country genera like Euphorbia, Commiphora, Balanites and Terminalia are also common. Unpalatable shrubs like Calpurnia aurea and the spiny Pterolobium stellatum are favoured in the overgrazed areas. Among the grasses Cynodon dactylon, Hyparrhenia anthistirioides, Chloris pycnothrix and Cenchrus ciliaris are usually important, as are also unpalatable herbs like Hypoestes verticillaris and Blepharis ciliaris.

The fertile high plateau is to a very large extent under cultivation. The pastures are also rapidly decreasing to give room to the more profitable wheat-growing. The vegetation here, previously probably consisted of Acacia abyssinica dominated woodland or forest in the areas with lower rainfall like the Kulumsa terrace. Occasional trees of this species are still present. In areas with higher rainfall forests of Podocarpus gracilior (zigba) and Juniperus procera with contribution of Nuxia congesta, Schefflera volkensii, Bersama abyssinica etc. were presumably covering large areas. These species are still common in many places S. of Asella and of course in the Munessa forest in the SW (L. & B. Lundgren 1969). The botanical composition of the grasslands on the plateau has been thoroughly investigated by Håkansson (1968). With increasing altitude Hagenia abyssinica (kosso) becomes more and more common, often interspersed with the yellowflowered shrubs or small trees Hypericum revolutum and Gnidia glauca in the glades. The shrubby composite, Echinops ellenbeckii with large, round, redcoloured heads is common S. of Asella. It sometimes forms dense stands and can become a veritable pest in the pastures. Some areas in the SW. also have bamboo forests. The Hagenia has its upper limit at about 3200 m., and is replaced by heath scrub consisting of Erica arborea and Philippia spp., which form dense thickets on the upper part of the mountains. Grazing is of little importance here, but burning occurs. Large areas of heath scrub were burnt on Mt Chilalo in the dry season 1970-1971. The black persisting stems are cut and used as firewood.

V. LIST OF SPECIES COLLECTED OF LEGUMINOSAE

The number of the collection is given before, and the author of the name is given after each name.

Subfan. Papilionoideae

1506. *Alysicarpus ferrugineus* (Hochst. ex Steud.) A. Rich.
 1619. *Alysicarpus quartinianus* A. Rich.
 1620. *Alysicarpus rugosus* (Willd.) DC. subsp. *perennirufus*
 J. Léon
 1584. *Amphicarpa africana* (Hook. f.) Harms
 1499. *Antopetitia abyssinica* A. Rich.
 1463., 1509. *Argyrolobium confertum* Polhill
 1363., 1515. *Argyrolobium ramosissimum* Bak.
 1462. *Argyrolobium rupestre* (E. Mey.) Walp. subsp.
aberdaricum (Harms) Polhill
 1393. *Argyrolobium rupestre* (E. Mey.) Walp. subsp.
remotum (A. Rich.) Polhill
 1677. *Astragalus atropilosulus* (Hochst.) Bunge subsp.
atropilosulus var. *mooneyi*
 Gillett
 1573. *Astragalus atropilosulus* (Hochst.) Bunge subsp.
bequaertii (De Wild.)
 Gillett var. *bequaertii*
 1494. *Astragalus vogelii* (Webb) Hutch. & Dalz.
 1510. *Calpurnia aurea* (Ait.) Benth.
 1456. *Crotalaria agatiflora* Schweinf.
 1377. *Crotalaria brachycephala* Harms ex Bak.
 1312. *Crotalaria incana* L. subsp. *incana*
 1452. *Crotalaria incana* L. subsp. *purpurascens* (Lam.)
 Milne-Redh.
 1489. *Crotalaria laburnifolia* L.
 1389. *Crotalaria lachnocarpoides* Engl.
 1289. *Crotalaria pycnostachya* Benth.
 1453. *Crotalaria quartiniana* A. Rich.
 1435. *Crotalaria recta* A. Rich.
 1346. *Crotalaria spinosa* Benth.

1396. *Desmodium repandum* (Vahl) DC.
1428. *Dolichos sericeus* E. Mey. subsp. *formosus* (A. Rich.)
Verdc.
1448. *Eriosema longipedunculatum* (A. Rich.) Bak. var.
hirsutum Verdc.
1622. *Eriosema scioanum* Avetta subsp. *scioanum*
1337. *Glycine wightii* (Wight & Arn.) Verdc. subsp. *wightii*
var. *longicauda* (Schweinf.)
Verdc.
1406., 1431. *Glycine wightii* (Wight & Arn.) Verdc. subsp.
petitiana (A. Rich.)
Verdc. var. *petitiana*
1385. *Indigofera amorphoides* Jaub. & Spach.
1334., 1348. *Indigofera arrecta* A. Rich.
1330. *Indigofera brevicalyx* Bak. f.
1339. *Indigofera costata* Guill. & Perr. subsp. *goniodes*
(Bak.) Gillett
1504., 1533. *Indigofera spicata* Forsk.
1495. *Indigofera vicioides* Jaub. & Spach.
1508. *Lotononis laxa* Eckl. & Zeyh.
1575. *Lotus corniculatus* L. var. *eremanthus* Chiov.
1517., 1655. *Lotus goetzei* Harms
1329. *Macrotyloma africanum* (Wilczek) Verdc.
1380. *Medicago lupulina* L.
1507., 1540., 1576. *Medicago minima* L.
1379. *Medicago polymorpha* L.
1436. *Melilotus altissimus* Thuill.
1401. *Mucuna melanocarpa* A. Rich.
1468. *Parochetus communis* D. Don.
1514. *Rhynchosia elegans* A. Rich. (all material lost).
1328. *Rhynchosia minima* (L.) DC. var. *nuda* (DC) Kuntze
1505. *Rhynchosia minima* (L.) DC. var. *prostrata* (Harv.) Meikle
1600. *Rhynchosia resinosa* (A. Rich.) Bak.
1623. *Rhynchosia totta* (Thunb.) DC.

1616. *Scorpiurus muricatus* L.
1345. *Tephrosia emeroides* A. Rich.
1555. *Tephrosia interrupta* Engl.
1331. *Tephrosia pumila* (Lam.) Pers.
- 1332., 1621. *Teramnus labialis* (L.f.) Spreng. subsp.
labialis var. abyssinicus
(A. Rich.) Verdc.
1679. *Trifolium acaule* A. Rich.
- 1347., 1586. *Trifolium baccarinii* Chiov.
1360. *Trifolium burchellianum* Ser. subsp. johnstonii (Oliv.)
Gillett
1658. *Trifolium burchellianum* Ser. subsp. johnstonii (Oliv.)
Gillett var. oblongum Gillett
1469. *Trifolium calocephalum* Fresen.
1352. *Trifolium cryptopodium* A. Rich.
1646. *Trifolium lanceolatum* (Gillett) Gillett
1450. *Trifolium multinerve* A. Rich.
1556. *Trifolium polystachyum* Fresen.
- 1581., 1618. *Trifolium rueppellianum* Fresen.
1587. *Trifolium schimperii* (Hochst.) A. Rich.
1521. *Trifolium semipilosum* Fresen.
- 1358., 1585., 1612. *Trifolium simense* Fresen.
1568. *Trifolium tembense* Fresen.
- 1354., 1355., 1552. *Trifolium* sp. nov. A
1642. *Trifolium* sp. nov. B
- 1467., 1566., 1611. *Trifolium* sp. nov. C
1516. *Vicia hirsuta* (L.) S.F. Gray
1447. *Vicia paucifolia* Bak.
1382. *Vicia sativa* L. var. *angustifolia* L.
1601. *Vicia villosa* Roth
1326. *Vigna membranacea* A. Rich.
1327. *Vigna oblongifolia* A. Rich. var. *parviflora* (Bak.) Verdc.
1451. *Vigna vexillata* (L.) A. Rich.

the Acacias belong, have regular flowers, where the petals do not overlap. The stamens are often numerous. Caesalpinioideae is an intermediate group, usually considered as the most primitive, from which the two other subfamilies have evolved. It has lateral petals, which overlap the upper one. For example the genus Cassia belongs here.

27 genera of the Papilionoideae were found in the Chilalo awraja in the present study. To make an identification of these genera easier, I have prepared a key to them. The key has to be used with some caution, as still other genera and species certainly will turn up in the Chilalo awraja, especially during other parts of the year. Most of the genera and species occurring are surely included here, however. In order to make the key as simple as possible, its use is restricted to the species named in this report, and it can not be used on the genera in general. As far as possible, only easily observed characters have been used.

The Papilionoideae part of Flora of Tropical East Africa was published in December 1971, but as it is very comprehensive with about 1000 species, and consequently with very complicated keys, it was found useful to prepare these simple keys for local use. Besides, several species found in the Chilalo awraja do not occur in Tropical East Africa and are not included in F.T.E.A.

Key to genera of Papilionoideae

1. Shrub with yellow flowers. Leaves with many leaflets. Pods flat. Calpurnia
1. Characters not combined as above. 2
2. Leaves ending in a pair of leaflets (paripinnate). Sometimes only a pair of leaflets present. 3
3. Tendrils present. Pods not segmented. Vicia
3. Tendrils absent. Pods segmented. Zornia
2. Leaves ending in a leaflet (imparipinnate). Leaflets consequently in odd numbers, sometimes only one present. 4
4. Leaflets 3, toothed at the margin. 5
5. Petals persistent after flowering, usually enclosing the pod. Corolla purple, red or white (rarely yellow). Trifolium
5. Petals dropping after flowering, not enclosing the pod. 6
6. The middle leaflet without petiole. Flowers blue. Parochetus
6. The middle leaflet petiolate. Flowers usually yellow. 7

7. Pods spirally coiled. Inflorescence headlike.	<u>Medicago</u>
7. Pods straight. Inflorescence elongate.	<u>Melilotus</u>
4. Leaflets with entire margins.	8
8. Leaves always 1-foliolate.	9
9. Flowers red in manyflowered inflorescences.	<u>Alysicarpus</u>
9. Flowers yellow in fewflowered inflorescences.	<u>Scorpiurus</u>
8. Leaves 3-many-foliolate.	10
10. Pods consisting of joints that are falling separately.	11
11. Perennial subshrub with red flowers. Leaves 3-foliolate.	<u>Desmodium</u>
11. Annual herb with yellow flowers. Leaves at least 5-foliolate.	<u>Antopetitia</u>
10. Pods not jointed.	12
12. Leaves sessile or almost so. Leaflets usually 5.	<u>Lotus</u>
12. Leaves petiolate with various number of leaflets.	13
13. Leaves with 5-many leaflets.	14
14. Anthers apiculate. Biramous (T-shaped) hairs present (seen only in magnification).	<u>Indigofera</u>
14. Anthers not apiculate. Biramous hairs absent.	15
15. Flowers in dense, manyflowered racemes.	<u>Astragalus</u>
15. Flowers in lax, fewflowered inflorescences.	<u>Tephrosia</u>
13. Leaves with 3 leaflets.	16
16. Middle leaflet sessile. Erect plants.	17
17. Calyx 2-lipped; the lower lip 3-fid.	<u>Argyrolobium</u>
17. Calyx not 2-lipped.	18
18. Keel beaked; pod inflated.	<u>Crotalaria</u>
18. Keel obtuse; pod not inflated, flattened.	<u>Lotononis</u>
16. Middle leaflet petiolate. Usually climbers.	19

19. Undersides of leaflets, sepals and petals with yellow or orange gland-dots. 20
20. Pod broadened upwards, 3-4 times as long as broad. Rhynchosia
20. Pod abruptly contracted into the stipe, up to twice as long as broad. Eriosema
19. Undersides of leaflets, sepals and petals without yellow or orange gland-dots. 21
21. Pods covered with irritant hairs. Corolla very large, at least 4 cm long. Mucuna
21. Pods without irritant hairs. Corolla smaller. 22
22. Pods elongate, linear, distinctly turned up at the apex. Teramnus
22. Pods not as above. 23
23. Flowers in umbel-like inflorescences. Vigna
23. Flowers single, paired or in many-flowered racemes. 24
24. Pods at least 4 cm long, 1 cm wide. Dolichos
24. Pods smaller. 25
25. Bracteoles (small scales on the pedicel) absent. Pods glabrous with hairy margins only. Flowers violet. Amphicarpa
25. Bracteoles present. Other characters not as above. 26
26. Corolla yellowish. Pods glabrous. Macrotyloma
26. Corolla white or with blue markings. Pods hairy. Glycine

Key to species of Trifolium

1. Petiole of all leaves united with stipules throughout its length. 2
2. Flower heads elongated, often twice as long as broad. T. polystachyum
2. Flower heads round. 3
3. Leaves long and narrow. T. simense
3. Leaves shorter than 1 cm. T. cryptopodium

- | | | |
|-----|--|-------------------------|
| 1. | Petiole free from the stipules for much of its length at least in the lower leaves. | 4 |
| 4. | Calyx with fewer than 15 nerves. | 5 |
| 5. | Corolla white or pale pink. Pedicels reflexed after flowering. | 6 |
| 6. | Calyx, pedicels and lower sides of leaflets with soft hairs. | <u>T. semipilosum</u> |
| 6. | Calyx, pedicels and leaflets glabrous (not native to Ethiopia). | <u>T. repens</u> |
| 5. | Corolla purple or red (only occasionally white). Pods not reflexed after flowering. | 7 |
| 7. | Peduncle shorter than the inflorescence. | <u>T. acaule</u> |
| 7. | Peduncle longer than the inflorescence. | 8 |
| 8. | Calyx teeth at least 1 mm wide at the base. Inflorescence 1-15 flowered. | 9 |
| 9. | Leaflets less than 3 times as long as wide. | 10 |
| 10. | Inflorescence of 1-4 flowers. | <u>T. sp. A</u> |
| 10. | Inflorescence of 4-12 flowers. | <u>T. tembense</u> |
| 9. | Leaflets more than 3 times as long as wide. | <u>T. sp. B</u> |
| 8. | Calyx teeth less than 1 mm wide at the base. Inflorescence of more than 15 flowers. | 11 |
| 11. | Perennial, stem creeping, rooting at the nodes. | <u>T. burchellianum</u> |
| 11. | Annuals with ascending stems. | 12 |
| 12. | Pedicels as long as calyx tube. Leaflets with very small teeth (up to 0,2 mm long). | <u>T. baccarinii</u> |
| 12. | Pedicels shorter than calyx tube. Leaflets with teeth about 0,5 mm long. | 13 |
| 13. | Stipules entire. Leaflets oval, less than 3 times as long as wide. | <u>T. rueppellianum</u> |
| 13. | Stipules with a few teeth in the margin. Leaflets lanceolate, more than 3 times as long as wide. | <u>T. lanceolatum</u> |
| 4. | Calyx with more than 15 nerves. | 14 |

14. Standard more than 15 mm long. T. schimperi
14. Standard less than 10 mm long. T. multinerve

VII. DESCRIPTIONS AND QUALITIES OF THE SPECIES.

PAPILIONOIDEAE

Alysicarpus

A genus of annual or perennial herbs, characterized by the leaves, which have only one leaflet, and the pods that are breaking at maturity into a number of oneseeded joints. The inflorescence is a dense raceme. A. glumaceus, a related species is considered as a promising fodder plant by Bogdan (1949, p. 38).

Alysicarpus ferrugineus

Deeprooted perennial with rather hard ascending stems. Leaves broadly elliptic, thick and hairy. Calyx covered with long black hairs. Flowers small with dark purple wings and pale standard and keel. Pods about 15 mm long and break into 4-5 oneseeded joints.

The plant grows scattered in the grasslands of the Kulumsa terrace and seemed to be readily grazed, despite the rather hard stems and leaves. Droughtresistant but probably with low production.

Seeds collected. Should be planted at Kulumsa.

Alysicarpus rugosus subsp. perennirufus

Perennial herb with decumbent, hard stems, 20-50 cm long. Calyx sparsely hairy with brownish hairs. Pods 5-10 mm long, scarcely exerted from the calyx.

A variable species, widespread in Africa. The habitat and qualities about the same as in the previous species. Feeding tests with this species have been performed in Zambia with negative toxicological results (Watt & Breyer-Brandwijk 1962, p. 558).

Seeds collected. Should be planted at Kulumsa.

Alysicarpus quartinianus

Annual, erect herb, 20-40 cm tall, with lower leaves oblong and the upper ones more long and narrow in outline. The calyx is covered with long black hairs. The pods are short, scarcely from the calyx.

This species is like A. ferrugineus endemic to Ethiopia. It is often considered to be only a variety of A. ferrugineus, but after having observed the plants many times in the field I am convinced, that they should be treated as separate species. It was found as a weed in maizefields at Chebbi and also scattered in grasslands on the Kulumsa terrace. Due to its

annual habit it disappears rather rapidly in the dry season.

Seeds collected. Should be planted at Chebbi or Kulumsa.

Amphicarpa africana

Perennial climbing herb with stems often several meters long. Leaves 3-foliolate with leaflets up to 5 x 3 cm. Flowers purplish blue arranged in lax racemes. Pods 3 cm long, 6 mm wide, flat with glabrous faces, but densely hairy on the margins. This is the only African representative of the small genus Amphicarpa. It was found climbing in scrub in streamvalleys and in forest edges at 2300 - 2600 m S. of Asella.

No ripe seeds were found during my stay, but will be collected later. The species will probably do best mixed with a tall grass. Should be planted at the Livestock farm, Asella.

Antopetitia abyssinica

Spreading, to 75 cm tall annual with a small tap root. Leaves imparipinnate with 5-11 small leaflets. Inflorescence few-flowered with small yellow flowers. Pod composed of 2-5 one-seeded sphaerical segments.

Antopetitia is a genus with a single species, distributed in most parts of tropical Africa. It is common in the grasslands S. of Asella and was also found near Gobe. It is often stunted due to grazing, but can attain considerable size in more protected places. Because of the small leaflets the production is nevertheless probably low.

No ripe seeds were found during my stay but will be collected later. Should be planted in a place of higher altitude and precipitation.

Argyrolobium

A genus of usually shrubby, yellowflowered herbs with 3-foliolate leaves and the 3 lower calyx lobes united to a shortly 3-lobed lip.

The species found in Chilalo awraja are all perennials with a thick woody rootstock. The stems are fibrous and tough and the leaves are hairy and rather hard. The palatibility thus seems to be low. Seeds were not collected from any of them.

Argyrolobium confertum

A small, very densely silvery hairy herb. Its distribution is restricted to Ethiopia. It was found in several places in the Rift Valley at altitudes between 1700 and 1800 m. It is drought resistant and can maybe locally be of some importance as grazing in the dry season.

Argyrolobium ramosissimum

A shrubby perennial, up to 6 dm tall, with usually numerous spreading or ascending rather woody stems. Inflorescence a rather dense raceme with up to 12 flowers.

Found in grassland or forest margins at 2300 - 2700 m altitude.

Argyrolobium rupestre subsp. aberdaricum

A more weakstemmed, straggling and ascending herb, 15-30 cm tall with fewflowered racemes with up to 4 flowers. Pods to 3 cm long, with the valves continuous over the seeds. The flowers of this subspecies were often found to be cleistogamous with a much reduced corolla.

An often common but never very important constituent of upland grasslands at 2300 to 2900 m.

Argyrolobium rupestre subsp. remotum

This subspecies has longer, often 0,5 m long stems with shorter indumentum than the previous one. The petioles are also longer.

Found in grasslands around Gobe.

Astragalus atropilosulus subsp. atropilosulus var. mooneyi

Perennial herb with to 0,5 m long, prostrate or ascending, glabrous stems. Leaves imparipinnate, to 15 cm long with many small leaflets. Inflorescence a dense manyflowered, pedunculate raceme. Corolla purplish blue, c. 10 mm long. Pods glabrous, lanceolate, c. 3 m long, 6 mm wide.

This plant was found commonly on Mt Chilalo at altitudes above 3000 m and scattered specimens along streams down to about 2700 m. The species is very polymorphic and taxonomically it has been divided into a number of subspecies and varieties, each with its own distribution and ecological demands. The species mentioned by Edwards & Bogdan (1951, p. 90). A. abyssinicus and A. venosus, are now both included in the complex species A. atropilosulus. Edwards & Bogdan considered them to be "a palatable and valuable constituent of grassland". The seeds are said to be easy to collect, but the germination to be delayed and uneven. This variety was confined to very high altitudes, but it would be interesting to see how it behaves for example at Bekoji. No ripe seeds were found during my stay.

Astragalus atropilosulus subsp. bequaertii var. bequaertii

This variety has glabrous ovaries and pods, while at the previous one they are covered with appressed dark hairs. It was found at Asasa at about 2200 m altitude in the grassy and rocky slopes along Wabe Shebelle River. The habitat is thus rather different from the previous variety. It seemed to be a rather shortlived perennial and produced seeds abundantly.

Seeds were collected. Should be planted at Kulumsa.

Astragalus vogelii

Small perennial, silvery hairy herb with red flowers in dense racemes. Pods short and hairy. The species is very unlike the previous Astragalus. It is a dry country plant, in Ethiopia earlier known only from Eritrea. It was found once in the Rift Valley at about 1700 m. No seeds collected.

Calpurnia aurea

Shrub, 1-3 m. According to literature it can become a tree to 10 m tall. Leaves imparipinnate, 10-15 cm long with 10-25 leaflets, 3-4 cm long, c. 1.5 cm wide. The flowers are large, yellow, in manyflowered, long racemes. Pod flat, 10-15 cm long, 1-1.5 cm wide with a narrow wing along the upper margin.

The plant was never seen browsed by cattle, even if it is common in the Rift Valley, especially on the slopes of the escarpment. It is reported to contain 4.4 % tannin (Watt & Breyer-Brandwijk, 1962, p. 565) and is probably poisonous. It is clearly favoured by the overgrazing in the lowland.

Crotalaria

A large genus with about 400 species in tropical Africa. Some of them like Crotalaria brevidens (synonym: C. intermedia) have been considered to be promising fodder crops (Edwards Bogdan, 1951, p. 94). Several of them are also used as green manure or as cover crops. A large number are toxic, however, and some, like C. burkeana, are known to be the cause of the disease called crotalariosis or crotalism in cattle, sheep and horses. This condition is an inflammatory process in the horn forming membrane of the hoof and gives rise to an abnormal growth of the hoof. The animal suffers great pain and becomes unable to move around to search for food and may die of starvation (Watt & Breyer-Brandwijk, 1962, p. 578). None of the Crotalarias found in the Chilalo Awraja showed signs of being regularly grazed except in exceptional cases in very overgrazed areas, where not much else was to be found. Seeds were not collected from any of them.

Crotalaria agatiflora

A woody herb or a shrub 1-3 m tall. Leaves 3-foliolate with leaflets c. 5 x 2.5 cm. Flowers large, 3.5 - 4 cm long, yellow, mottled with purplish brown. Pods c. 8 x 1.5 cm, glabrous. A rather common plant in grassland, bushland or forest clearings at 2300 - 2600 m, especially around Asella.

The species has been used in Congo as a cover crop. "It can also serve as a hedge to prevent erosion and as a temporary shade for young coffee" (Whyte et al. 1953, p. 122).

Crotalaria brachycephala

Small annual herb with spreading branches. Leaves 3-foliolate with long, narrow leaflets. Flowers in short dense racemes, yellow with purplish mottling. Pods c. 1 cm long.

This is a very local species, hitherto only known from the central Ethiopian highlands. It was found in the grasslands N. of Asella at 2000 - 2400 m, and around Asasa.

Crotalaria incana subsp. incana

Erect, shrubby, annual herb to 1 m tall. Stems shortly pubescent. Leaves 3-foliolate. Racemes long and lax, manyflowered. Flowers c. 1 cm long, yellow with purplish veins. Pods c. 4 x 1 cm, with spreading hairs.

A plant native to tropical America and adventive in other parts of the tropics. Found on disturbed ground near Awash river at 1700 m.

Crotalaria incana subsp. purpurascens

Similar to the previous subspecies, but stems and calyx with long, spreading, yellow-brown hairs. It was found mostly in the highlands, often on waste places or as a weed. The plant is reported to have caused poisoning (Verdcourt & Trump, 1969, p. 84).

Crotalaria laburnifolia

Perennial, erect, shrubby herb to 1 m tall. Flowers c. 2.5 cm, yellow, mottled with red-brown, in long, lax racemes. Keel with a long, upwardly directed beak. Pods c. 6 cm long, 1 cm wide, glabrous, with long stipes.

The plant was seen in the Rift Valley at 1700-1800 m on roadsides and sometimes in cultivations.

Crotalaria lachnocarpoides

Small shrub, 0.5 - 1.5 m tall. Stems, leaves and pods covered with a grey, silky pubescence. Racemes fewflowered with flowers c. 1.5 cm long, yellow, with the standard reddish brown outside. Pods c. 2.5 x 1.2 cm.

Seen in grassland and bushland at 2200-2400 m around Asella. The plant is reported to have caused crotalism when eaten by stock (Verdcourt & Trump 1969, p. 84).

Crotalaria pycnostachya

Annual, usually erect herb, 20-40 cm tall. Flowers yellow, c. 5 mm long, in dense racemes, 4-6 cm long. Pods c. 13 mm long, 4 mm wide.

The species is common in the Rift Valley in grassland, bushland, along roads and in cultivations. It seems to be restricted to areas below 1900 m. It disappears rapidly in the dry season and does not seem to be grazed to any marked extent.

Crotalaria quartiniana

Erect or straggling annual (or shortlived perennial), to 1.5 m tall. Racemes very lax, to 15 cm long with 3-10 flowers. Calyx 10-12 mm long, almost enveloping the corolla. Corolla yellow, c. 10 mm long. Pods glabrous, c. 4 cm long, 1 cm wide.

The plant was seen in some streamvalleys around Asella at about 2200-2300 m altitude. Sometimes it was growing in protected sites in scrub and could then attain considerable height. Specimens seen in more open grassland were usually only 3-4 dm tall, however.

Perennial, erect, shrubby herb, usually about 1 m tall. Racemes long and dense with many yellow flowers, c. 1.5 cm long. The pods are c. 5 x 2 cm.

Seen in grassland or bushland 2300-2500 m. Occasionally also at Gobe at 2800 m.

Crotalaria spinosa

Annual or shortlived perennial, shrubby and spiny herb 2-3 dm tall. Inflorescences short with 1-3 yellow flowers. Pods c. 8 mm long, 4 mm wide.

The species is rather common in the grasslands and woodlands of the Rift Valley at 1700-1800 m, and by its spyness it seems to be favoured by grazing. The plant was also seen in the grasslands around Kulumsa and in the Asasa area at c. 2300 m.

Desmodium repandum

Perennial herb or slender shrub to 1.5 m tall. Leaves 3-foliolate with the terminal leaflets somewhat larger than the lateral ones. Inflorescence long and lax with brick-red flowers, c. 14 mm long. Pods breaking into up to 5 1-seeded segments, covered with hooked hairs.

The plant is common in scrub, forest margins or forest clearings especially just S. of Asella. It becomes very vigorous under shady conditions and where supported by dense vegetation and seems to be readily grazed by cattle and sheep. It is uncertain how it would behave in cultivation but probably it would do best mixed with a tall grass.

Seeds collected. Should be planted at the Livestock farm, Asella.

Dolichos sericeus subsp. formosus

Perennial, climbing herb, often several meters long. Leaflets 3, to 8 cm long, 7 cm wide. Flowers purplish blue, c. 1.5 cm long, in fewflowered axillary racemes. Pods oblong, pubescent to 7 cm long.

This beautiful species was seen climbing in dense scrub in streamvalleys or in forest margins at 2300-2700 m.

No ripe seeds found during my stay, but will be collected later. Should be planted at the Livestock farm, Asella, if possible mixed with a tall grass. The roots and seeds of the species (under the name Dolichos formosus) have been claimed to be toxic (Verdcourt & Trump, 1969, p. 94).

Eriosema longipedunculatum var. hirsutum

Perennial, erect subshrub from a woody rootstock, 2-4 dm tall. Stems with brown hairs, tough and fibrous. Leaf-lets 3, elliptic, hairy, hard. Flowers in short dense racemes, yellow, with the standard dark outside. Pods oval, c. 10 mm long, 6 mm wide, covered with long brown hairs.

In grassland, often on shallow soil or in rocky places, sometimes forming dense mats. Seen at 2300-2400 m. This species like the next one seems to be of low palatability due to the hard and hairy leaves and stems. No seeds collected from either of them.

Eriosema scioanum

Perennial, subshrubby herb to 1 m tall. Leaflets 3, broadly elliptic. Flowers in dense, narrow, rather long racemes, yellow, veined with purple-brown. Pods oval, 15 x 8 mm, covered with long, brown hairs.

Found only once in grass in a streamvalley at 2400 m. See previous species.

Glycine wightii

This species, often wrongly, named Glycine javanica, is very polymorphic and distributed from Ethiopia to South Africa and in large parts of southern Asia. It comprises a number of different subspecies and varieties, and two very distinct forms occur in Chilalo awraja. It is commonly cultivated as a fodder crop in the tropics.

Glycine wightii subsp. wightii var. longicauda

Perennial climber or trailer often several meters long. Leaflets 3, ovate or elliptic. Inflorescences long, manyflowered. Flowers c. 5 mm long, almost purely white. Pods 2-3 cm x 3 mm, covered with spreading hairs.

The plant is widespread and common, especially in the N. part of the Chilalo awraja. Its ecological amplitude seems to be very wide. It was climbing in scrub or forest margins up to c. 2500 m, but is also growing in the Rift Valley, for example at Chebbi at c. 1700 m. It was also often seen trailing on the ground among grasses. Seeds are produced abundantly and are easy to collect. The pods were, however, often found to be infected by larvae. It is already kept in cultivation at Kulumsa. Both introduced and indigenous forms have been grown according to CADU Publication No. 63, p. 101, 102. Only one plot was now seen however. The plants were growing well vegetatively, but did not flower during my visit, while all the wild populations were flowering and fruiting. Seeds were collected and should, if possible, be planted mixed with a grass both in the lowland and at higher altitudes.

Glycine wightii subsp. petitiana var. petitiana

Differs from the previous one in its larger, c. 10 mm long flowers, that are blue and white in colour. The leaves have a more dense and silvery indumentum of appressed hairs.

This subspecies has often been treated as a distinct species, G. petitiana, and in Ethiopia at least, they seem always to be easily distinguished. In Kenya and Tanzania, however, intermediate forms occur, and subspecific rank is perhaps the most adequate. Subsp. petitiana is generally restricted to higher altitudes 2300-2700 m, but there is much overlapping. Near the Livestock farm, Asella for example they grow side by side in scrub in a forest clearing.

No ripe seeds were found in this subspecies and will be collected later. Should be planted at one of the stations of higher altitude.

Indigofera

A widespread and large genus of some 700 species. A number of them are reported as more or less poisonous, but some are on the contrary of use as fodder crops.

Indigofera amorphoides

Erect, woody herb c. 0.5 m tall. Leaves imparipinnate with 7-15 leaflets. Racemes manyflowered, sessile. Pods c. 6 mm long, 3 mm wide, indehiscent.

Seen once at Dodota in bushland along a maizefield.

Indigofera arrecta

Erect, woody herb, 1-2 m tall, with manyflowered. sessile racemes. Pods c. 16 mm long, 2 mm wide.

A widespread species in almost all Africa, and also common in the Chilalo awraja at altitudes below 2500 m in bushland or on waste places. It is reported to be used as a cover crop or green manure in Asia (Whyte et al. 1953, p. 280).

Indigofera brevicalyx

Small perennial with prostrate branches from a woody taproot. Leaflets 5-13, peculiar in having a translucent blister at both sides. Racemes 2-3-flowered on short peduncles. Pods c. 20 x 2 mm.

Rather common but inconspicuous in grasslands at 1700-2300 m altitude. Usually it is much stunted by grazing, but due to its small size its production is probably very low.

Indigofera costata subsp. gonioides

Annual herb to 0,5 m. Racemes long, manyflowered on a short peduncle. Pods reflexed, slightly upturned towards the tip, c. 3 cm long, 2.5 mm wide. Found in grasslands at Chebbi.

Indigofera spicata

Perennial with prostrate or ascending stems to 0.5 m. Leaflets 5-11, alternate. Racemes dense, manyflowered on a short peduncle. Pods reflexed, c. 15 mm long, 2 mm wide.

A common species in grasslands, along roads or sometimes as a weed from 1700-2500 m. Is readily grazed by cattle and often becomes much stunted. Has been experimentally cultivated as a fodder crop in several countries in Africa, Asia and America according to Gillett (1958, p. 138). It was also, under the name I. endecaphylla, found to be palatable to cattle and sheep (Bogdan, 1949, p. 38). Despite this, cases of poisoning caused by this plant are mentioned by Verdcourt & Trump (1969, p. 95). None of these cases comes from Africa however, and there seems to be some evidences for the African form to be not poisonous. A small amount of seeds were collected and should be planted at Kulumsa. Would also be of interest in the lowland, as it seems to be rather drought resistant. The suspected poisonousness of the plant should be kept in mind, however.

Indigofera vicoides

Small annual (according to literature also perennial), with spreading branches. Racemes fewflowered, pedunculate with very small yellowish flowers. The genus is otherwise almost entirely redflowered. Pod 10-15 mm long, 2 mm wide, pubescent.

Found only once in grassland at 1700 m altitude.

Lotononis laxa

Perennial herb with a woody rootstock. Stems tough, decumbent to 2 dm long. Leaves 3-foliolate, with dense silvery indumentum. Flowers usually single, terminal, yellow, c. 8 mm long. Pods c. 20 x 4 mm with grey hairs.

Found on shallow soil in rocky grassland slopes at c. 2200 m N. of Asella. This species is most frequent in South Africa and has in Ethiopia only been collected once before in the southern part. The palatability of the plant seems to be low. According to Watt & Breyer-Brandwijk (1962, p. 625) the plant has proved to be responsible for hydrocyanic acid poisoning in stock in the Cape Province of South Africa.

Lotus corniculatus var. eremanthus

Perennial with procumbent or ascending stems to some dm. long. Leaflets 5. Flowers yellow with the back of the standard usually reddish, in 1-2 flowered pedunculate umbels. Pods to 3 cm long, 3 mm wide.

Found only once along Wabe Shebelle River in moist grassland at c. 2200 m altitude. This is the African form of the species widespread in Europe, Lotus corniculatus. It differs from the European plant by its smaller flowers in only 1-2 flowered umbels and in being almost glabrous.

Lotus goetzei

Perennial with woody rootstock and ascending stems to 0.5 m tall. Leaflets 5. Flowers c. 10 mm long, white with purplish markings in fewflowered, pedunculate umbels. Pods c. 2 cm long.

Common on Mt Chilalo and probably on all other mountains in the area. Most common in the heath zone at altitudes above 3000 m, but seen occasionally down to 2600 m. The species could be of interest as forage, but no seeds were collected.

Macrotyloma africanum

Annual or shortlived perennial, climbing herb to 2 m long. Leaflets 3, almost glabrous, to 4 x 2 cm. Flowers yellow, axillary, solitary or paired, c. 1 cm long. Pods glabrous, c. 4 cm long, 4 mm wide.

Found in the maizefields at Chebbi, where it locally is a common climber in the maize. The species has previously not been recorded from Ethiopia. It seems to be productive and palatable. Seeds are produced abundantly and were also collected. Should be planted at Chebbi.

Medicago lupulina

Annual herb with prostrate or ascending branches to some dm long. Leaflets 3, toothed. Flowers yellow, c. 2.5 mm long, in dense manyflowered racemes. Pods c. 3 x 2 mm, 1-seeded, curved, black when ripe.

This European and Asian plant is probably introduced to Ethiopia. It was found in grasslands on more or less disturbed ground at 2000-2400 m.

Seeds collected. Should be planted at Kulumsa.

Medicago minima

Annual with decumbent 5-30 cm long stems. Pods spiny like *M. polymorpha* from which it can be separated by being softly hairy on stems and leaves. The pods differ in having 4-5 dense turns.

Widespread in Chilalo at 2000-2300 m altitude in pastures, roadsides and on paths, usually on sandy places with little grass.

Medicago polymorpha

Annual herb with prostrate or ascending stems to some dm long. Leaflets 3, toothed. Racemes fewflowered. Pods c. 5-seeded of 3 turns, furnished with hooked spines.

The species is introduced to Ethiopia and many other parts of Africa. It is an often common constituent of pastures in Chilalo awraja and also occurs as a weed. Seen at altitudes up to 2700 m. It has been experimentally cultivated at Kulumsa, without much success, however.

A warning should be made against this plant as - according to Watt & Breyer-Brandwijk (1962, p. 626) - under the name Medicago hispida var. denticulata, it is reported to cause a disease called aphis disease in Australia. The disease, that is said to affect sheep, horse and cattle results from photosensitization and is described as follows: "Sufferers from aphis disease develop swelling of the unpigmented and unprotected parts of the skin, accompanied by reddening and exudation. The skin is itchy and so there are biting, scratching and rubbing of the affected areas with the formation of raw surfaces and finally scabbing. Similar effects have been produced experimentally in the guinea-pig after five days feeding on the plant. The disease has also been known as trefoil dermatitis." The same disease can also be caused by ingestion of *Trifolium* spp. (Watt & Breyer-Brandwijk 1962, p. 666). In South Africa Medicago denticulata var. glaucescens (another synonym of *M. polymorpha*), by the same authors is reported to be one of the plants involved in the production of a disease called dikkop without jaundice. It seems to be similar to aphis disease and is said to involve photosensitization of colourless or light-coloured parts of the skin.

Melilotus altissimus

Annual or shortlived perennial, often more than 1 m tall, fragrant herb. Leaves 3-foliolate with toothed leaflets. Flowers 6-7 mm, yellow, in axillary, long racemes. Pods 1-seeded, c. 5 x 3 mm, black when ripe.

The species is similar to M. officinalis but differs in the black pods without the strongly rugose transverse veins of the latter species. It is an European and Asian species, probably recently introduced to Ethiopia.

It was growing on somewhat disturbed ground in a grassland slope near the Livestock farm, Asella. No information has been found concerning its use as a fodder crop, but several similar, closely allied species like M. alba and M. officinalis are widely used. The strong smell from all Melilotus species comes from coumarin, a substance present in all parts of the plant. If the plant is damaged a decomposition product of coumarin called dicoumarin is formed which is toxic to animals. It causes delay in the coagulation time of the blood and the animal gets external and internal bleeding. The green plant itself or properly cured hay or silage is not toxic, however. The species has recently been taken into experimental cultivation at Kulumsa.

Mucuna melanocarpa

Large, climbing perennial with stems woody towards the base, probably to more than 10 m long. Leaflets 3, very large, to 15 x 10 cm, pubescent. Inflorescences pendulous, c. 20 cm long, with many flowers. Flowers 4-5 cm long, purplish black. Pods c. 10 cm long, 2 cm wide. Pods and calyces are densely covered with orange-brown very irritant hairs producing an extremely disagreeable itch.

The plant was found along Kulumsa river at c. 2100 m, where it is climbing in scrub, and in certain stretches almost covers the steep slopes along the river.

Several species of Mucuna (the genus is also often called Stizolobium) are cultivated as cover crops, for green manure or fodder. None of these, however, belongs to the group of species that can be characterized as large more or less woody lianes, where M. melanocarpa is included. No observations on its palatability were done, as it always was growing in places out of reach for the cattle. The irritating hairs on the pods makes the seedcollecting rather noxious and its habitat along the river indicates it is waterdemanding. Nevertheless it is a plant well worth trying in cultivation, owing to its vigorous growth and impressive size. No ripe seeds found, but will be collected later.

Parochaetus communis

Prostrate herb, rooting at the nodes. Leaves 3-foliolate with long petioles. Leaflets usually toothed in the outer part. Flowers blue, c. 15 mm long in fewflowered inflorescences with long peduncles. Pods to 25 mm long, 4 mm wide, glabrous.

Growing in shade in Hagenia forests or in scrub along streams, 2300-3000 m. It is also distributed in Asia, and on Ceylon it is considered to be a promising pasture plant and is said to grow well mixed with different grasses (Whyte et al., 1953, p. 302). No ripe seeds found and will be collected later. Should be planted at one of the stations of higher altitude.

Rhynchosia elegans

Perennial, climbing or trailing herb to more than 1 m long. Leaflets 3, pubescent and glanddotted. Inflorescences axillary, lax, with flowers c. 1.5 cm long, yellow with purplish venation. Pods c. 3.5 cm long, 7 mm wide, with glandular hairs.

Found only once on the W. slope of Mt Chilalo at 2700 m in scrub in a streamvalley. It has been used in feeding tests in Kenya and is reported to be palatable to cattle and sheep (Bogdan 1949, p. 38). No seeds collected.

Rhynchosia minima var. prostrata

Perennial, climbing or prostrate herb with stems to more than 1 m long, rather hard. Leaves 3-foliolate, pubescent and also glanddotted beneath, rather thick and hard. Inflorescences axillary, usually rather lax and manyflowered. Flowers c. 8 mm long, yellow, often with much red markings. Pods c. 15 x 5 mm, densely hairy.

Growing in grasslands N. of Asella. Tested in Kenya, where it was found to be eaten only unwillingly by sheep and cattle (Bogdan 1949, p. 38). Bogdan also mentions R. memnonia, now treated as a synonym to the polymorphic species R. minima. No seeds collected.

Rhynchosia minima var. nuda

Similar to the previous but differs in the laxer inflorescences with flowers only c. 5 mm long.

Found near Chebbi along a path. No seeds collected.

Rhynchosia resinosa

Shrub, about 1 m tall or more, often with scrambling stems. Leaflets 3, glanddotted. Inflorescences axillary and terminal, lax, glandular and sticky. Corolla yellow, veined with purple. Pods c. 1.5 cm long, 4 mm wide, hairy.

Seen in grassland and bushland near Chebbi.

Rhynchosia totta

Small, ascending, perennial herb with slender stems to some dm long, from a woody rootstock. Leaflets 3. Flowers solitary or a few in very lax inflorescences. Corolla c. 1 cm long, yellow with brown markings. Pods c. 2 cm long, 6 mm wide, pubescent.

This inconspicuous plant was seen in shallow soil in rocky grassland slopes N. of Asella at 2000-2200 m altitude. Seeds not collected.

Scorpiurus muricatus

Annual with decumbent or ascending stems to 40 cm long. Leaves simple, longpetiolate. Flowers c. 7 mm long, yellow, few together on long peduncles. Pods contorted, densely covered with bristles.

Not common but seen near Asella at 2100-2400 m as a weed or in grassland. Possibly recently introduced. Seeds not collected.

Tephrosia

Most species of this genus are unpalatable and poisonous. Many of them are much used in the native medicine in Africa and other continents and very important is also the use as fish-poison, insecticides or arrow-poison. Some species have proved to contain rotenone, but not in enough quantities to make extraction profitable. The species cannot be used as fodder but some are grown as green manure or for cover.

Tephrosia emeroides

Softly woody, erect perennial to 2 m tall. Leaflets 5-13. Flowers purple, c. 12 mm long in lax terminal inflorescences. Pods somewhat upcurved to 7 cm long, 5 mm wide, hairy.

Locally forming dense stands in Acacia woodland near Chebbi.

Tephrosia interrupta

Softly woody shrub. Specimens seen in Chilalo about 1.5 m tall, but it can attain several meters. Leaflets many, appressed pubescent beneath. Flowers purple 15-20 mm long in terminal, blackish tomentose inflorescences. Pods 5-7 cm long, 5 mm wide, densely tomentose.

Seen in bushland in the stopes of the escarpment above Siré at c. 2500 m.

Tephrosia pumila

Annual or shortlived perennial with procumbent stems to a few dm long. Leaflets 7-13, hairy, at least beneath. Flowers purple, c. 8 mm long, few, in short inflorescences. Pods upcurved at the tip, c. 4 cm long, 4 mm wide, hairy.

Rather common in heavily grazed grassland in the Rift Valley at 1700-2000 m.

Teramnus labialis subsp. labialis var. abyssinica

Perennial, climbing or creeping herb to more than 1 m long. Leaflets 3. Inflorescences slender and fewflowered. Flowers white, c. 5 mm long. Pods linear c. 4 cm long, 2 mm wide with a distinct right-angled hook at the apex, pubescent.

The species is widespread in Africa and also occurs in large parts of Asia. It is common in grassland and scrub N. of Asella at 1700-2300 m. Seemed to be drought-resistant and persisting in the dry season, but varies much in size according to the conditions. It is also a good seeder. The palatability has been tested in Kenya, where it is said to be of low palatability to sheep but is liked and well-eaten by cattle (Bogdan 1949, p. 38).

Seeds have been collected and should be tried at one, or some of the stations of low or medium altitude.

Trifolium acaule

Very small, perennial herb with prostrate branches from a taproot. Leaflets small, only slightly toothed. Inflorescences one- or fewflowered on a peduncle to 1 cm long. Flowers blue-violet, c. 8 mm long.

On mountains in the heath zone, above 3200 m.

Trifolium baccarinii

Annual herb with ascending stems to 2 dm tall. Leaflets with very small dense teeth. Inflorescences manyflowered with purple flowers. The plant is cleistogamous and produces seeds by self-fertilization (Bogdan 1966, p. 419).

Grasslands at 1700-2500 m, but apparently rather rare in the area. At Chebbi it was also seen as a weed in maizefields. If heavily grazed the plants often becomes very stunted. A small amount of seeds was collected. Should be planted at Kulumsa or Chebbi.

Trifolium burchellianum subsp. johnstonii

Perennial herb with a taproot. Stems creeping, rooting at the nodes. Leaves with long petioles. Inflorescences globular, manyflowered. Corolla purple.

Common in grasslands above 2300 m, preferring somewhat moist situations. The species seems to demand a fairly high rainfall. Seeds will be collected later and should be planted at one of the stations of higher altitude.

Trifolium burchellianum subsp. johnstonii var. oblongum

Differs from the previous variety by its much stouter habit with robust stems to almost one meter long. The leaves and flower-heads are larger and the corolla is more red in colour.

Common in grassland and heathscrub on Mt Chilalo above 3000 m, and probably occurs in similar conditions on the other mountains in the area. This variety has a very vigorous growth and would certainly be very useful if it is possible to cultivate it at lower altitudes. Seeds will be collected later. Should be planted at one of the stations of higher altitude.

Trifolium calocephalum

Perennial herb, rooting at the nodes. Stems to 0.5 m long. Leaves with long petioles. Inflorescence fewflowered with large flowers, 13-15 mm long, purple.

A beautiful species found at 2600-2900 m altitude in the S. part of Chilalo awraja. It seems to prefer very wet situations and the most vigorous populations were found around Gobe, where it was growing actually in the water of small streams.

Trifolium cryptopodium

Perennial herb with creeping or ascending stems to 2 dm. Leaflets small, to 9 mm long. Petioles united with stipules and never free. Inflorescences manyflowered with red-violet flowers.

Common in grasslands above 2300 m but never of much importance owing to the small size of the plant and its leaves.

Trifolium lanceolatum

Annual with ascending stems to 4 dm long. Leaves with narrow leaflets and a long petiole. Inflorescences manyflowered. Corolla c. 5 mm long, shorter than the calyx. Flowers cleistogamous and selffertile (Bogdan, 1966, p. 419).

In grasslands from 2100 to above 3000 m altitude. The species is already in experimental cultivation at Kulumsa.

Trifolium multinerve

Small, annual, erect herb. Leaves petiolate with narrow, acute leaflets. Inflorescences fewflowered. Corolla purple, 7-8 mm long.

Moist places in grassland at 2300 to above 3000 m. Seeds were collected from this species, that has probably a low production, however.

Trifolium polystachyum

Probably perennial herb with ascending stems to more than 1 m long, rooting at the lower nodes. Petioles united with stipules, never free. Inflorescences oblong, many-flowered. Flowers purple, c. 8 mm long.

Rarely seen in swamps or along streams at 2500-2700 m. Becomes very vigorous and forms dense stands in suitable situations.

A small amount of seeds collected.

Trifolium rueppellianum

Annual with erect or ascending or sometimes almost prostrate stems to 0.5 m long. Leaves with long petioles. Inflorescences manyflowered with purple flowers, 7-8 mm long.

Common in grasslands from 2000 to above 3000 m. The species is already in experimental cultivation at Kulumsa.

Some interest has been paid to this species in Kenya, where it has been studied by Bogdan. The palatability of the species is said to vary, even within the same population (Bogdan, 1966, p. 417). Experiments concerning breeding behaviour showed that the species needs tripping for seed formation, in nature performed by bees. Cross-pollination was proved to occur in nature, but self-fertilization is most common. This is in contrast to the conditions in *T. baccarinii* and *T. lanceolatum*. These have cleistogamous flowers, that needs no tripping for seed formation (Bogdan, 1966, p. 419).

Trifolium schimperi

Annual, erect herb to 2 dm tall. Leaves petiolate with long, very narrow leaflets. Inflorescences with few large flowers, more than 15 mm long, red.

Seen only once in the Chilalo awraja in short grass along a stream at c. 2300 m.

Trifolium semipilosum

Perennial herb with a taproot and prostrate stems, usually rooting at the nodes. Long hairy petioles and leaflets hairy beneath, but on one half only (this has given it its name). Inflorescences manyflowered with white or pale pink flowers, c. 9 mm long.

This species, that is similar to the European *T. repens*, is called Kenya white clover, and is very common in the area from 2000 to above 3000 m altitude. Has been kept in cultivation at Kulumsa, where it, however, gave no substantial yield according to CADU Publication No. 46, p. 118.

Seeds collected and should be planted also at a station of higher altitude.

Trifolium simense

Erect, perennial herb to 30 cm tall. Petioles united with stipules and never free. Leaflets long and narrow. Inflorescence manyflowered with red-violet flowers to 8 mm long.

Common in grasslands at 2200 to above 3000 m. The species seems to demand a fairly high rainfall, but prefers rather well-drained places. Some populations with much shorter leaf-length than normal were found and might indicate the presence of different races. Seeds were collected.

Trifolium tembense

Usually annual, ascending herb, but seems to be able to perennate if the conditions are wet enough, and when the stems also are rooting at the lower nodes. Leaves petiolate. Inflorescences usually c. 10-flowered, with purple or sometimes white flowers c. 9 mm long.

A common plant especially in moist situations in the grasslands at 2200 to above 3000 m. The species often shows a vigorous growth and could be especially useful for waterlogged areas. Seeds have been collected and should be planted for exemple at the Livestock farm, Asella.

Trifolium sp. nov. A

Small perennial herb, often forming dense mats. Leaves petiolate. Flowers single to a few together, purple. This most probably represents an undescribed species, that occurs in the area at 2300-2700 m. It grows in grasslands often in patches of more or less bare soil. It was also found in the margin of a wheat field, where it was more vigorous and to 20 cm tall. Trifolium sp. near elgonense in Håkansson (1968, p. 15) is this species.

Trifolium sp. nov. B

Small, annual, erect herb. Leaves petiolate with narrowly elliptic leaflets. Inflorescences many-flowered with red-violet flowers.

Also this species seems to be new to science. Its only known locality hitherto is in grassland-patches in Hagenia forests near Kersa at 2800-2900 m.

Trifolium sp. nov. C

Here are placed plants that look like a robust form of T. cryptopodium. The leaves are larger, as are the flowerheads, which also have a more blue-violet colour. It prefers moist places in grasslands at higher altitudes. The taxonomic rank of these plants is uncertain.

Vicia hirsuta

Climbing annual herb to 0.5 m long or more. Leaves with many leaflets, ending in a tendril. Inflorescences fewflowered. Corolla pale blue, c. 4 mm long. Pods c. 8 mm long, 3 mm wide, hairy.

Seen only once in grassland in forest margin at 2700 m.

Vicia paucifolia

Climbing, perennial herb to 1 m long. Leaves usually with only 2-4 narrow leaflets. Inflorescences fewflowered with flowers c. 10 mm long, blue. Pods flat, c. 3 cm long, 7 mm wide, glabrous.

Apparently rare, seen only in grasslands just S. of Asella at c. 2400 m. Stated by Bogdan (1951, p. 102) to be "a palatable legume valuable for grazing, although it contributes little bulk in natural pasture."

A small amount of seeds collected. Should be planted at the Livestock farm, Asella.

Vicia sativa var. angustifolia

Climbing, annual, weakstemmed herb to 1 m long. Leaves up to 12-foliolate ending in a tendril. Flowers solitary or paired, almost sessile, c. 12 mm long, violet. Pods c. 3 cm long, 5 mm wide.

The plant is the wild form of Vicia sativa. It is widely distributed in Europe, Africa and Asia. It was found in grasslands at 2000-3000 m. Very variable in size. Often heavily grazed and much stunted. It is mentioned by Whyte et al. (1953 p. 341) under the name Vicia angustifolia. It is said to be used for soil improvement and pasture in different parts of the world. "It succeeds as a cultivated plant only in mixtures with grasses." Seeds collected.

Vicia villosa

Climbing annual to more than 1 m long. Leaves with many leaflets, ending in a tendril. Inflorescences elongated, usually with many flowers. Corolla c. 1.5 cm long, blue-violet. Pods c. 3 x 0.6 cm.

Found around Kulumsa, probably as an escape, as it had been kept in cultivation some years. It is a widely grown fodder crop, called hairy or winter vetch, and has also been promising at Kulumsa.

Vigna membranacea

Annual, climbing or trailing herb to more than 2 m long. Leaflets 3, rather large, sparsely hairy. Inflorescences few-flowered on usually long peduncles. Flowers c. 1.5 cm long, pink. Pods 4-5 cm long, 2-3 mm wide, manyseeded.

Found in Rift Valley at 1700-1800 m usually in shady places, but also seen as a weed at Chebbi. The plant grows very well during the rains but disappears quickly in the dry season. Like the other Vigna species the pods have explosive dehiscence, which gives trouble for the seed collecting. The seed production is otherwise high.

A small amount of seeds was collected. Chebbi would probably be a suitable place for the plant.

Vigna oblongifolia var. parviflora

Annual, climbing or trailing herb to 2 m long. Leaflets 3, sparsely hairy. Inflorescences fewflowered, with flowers c. 7 mm long, greenish yellow. Pods c. 3 cm long, 4 mm wide.

Found as a weed at Chebbi. Mentioned by Bogdan (1951, p. 100) as an apparently palatable legume. No seeds collected.

Vigna vexillata

Perennial, climbing or trailing herb, with stems to 1 m long, densely ferruginous hairy. Leaflets 3, large, hairy. Inflorescences axillary, fewflowered with long peduncles. Flowers c. 2.5 cm long, purplish yellow. Pods 5-10 cm long, 3 mm wide, covered with brown hairs.

Found in grasslands at c. 2300 m. The species is very variable and widespread in most tropical areas. In Whyte et al. (1953, p. 344) it is said to have "possibilities as a pasture or fodder plant". The explosive dehiscence of the pods makes the seedcollecting rather troublesome.

Seeds were collected. Should be planted at Kulumsa.

Vigna sp.

Perennial, climbing or trailing, glabrous herb. Flowers yellow, few. Pods c. 3 cm long, 2 mm wide.

The plant was seen only in one spot near Kulumsa in grassland. It is related to Vigna triphylla, but the identification is uncertain.

No seeds collected.

Zornia pratensis

Perennial herb with decumbent stems to 2 dm long. Leaves 2-foliolate, with narrow, elliptic leaflets. Inflorescence spike-like with paired, comparatively large bracts to the flowers. Flowers yellow with red veins, to 10 mm long. Pods breaking up into one-seeded bristly segments.

Found in shallow soil in rocky grassland at 2100-2200 m. Seeds not collected.

Zornia setosa subsp. obovata

Perennial herb with prostrate stems to 2 dm long. Leaves 4-foliolate, with obovate leaflets. Flowers yellow c. 8 mm long. Pods breaking up into one-seeded bristly segments.

Found in same habitat as the previous species. Seeds not collected.

CAESALPINIOIDEAE

Caesalpinia decapetala

Shrub 2-5 m tall. Leaves bipinnate with hooked prickles on the rachis. Flowers large, yellow in long racemes. Pod 6-9 cm long, 2.5 cm wide.

An originally Asian plant commonly planted in hedges around huts and houses, especially in the lowland.

Cassia bicapsularis

Shrub to some meters tall, unarmed like all other Cassia species. Leaves paripinnate with 2-3 pairs of leaflets rounded at apex. Flowers large, yellow in racemes. Pods straight, cylindrical c. 10 x 1 cm.

A South American species, sometimes used as a hedgeplant and naturalized.

Cassia didymobotrya

Shrub to 2-3 m tall. Leaves paripinnate with leaflets in 8-12 pairs, obtuse at apex. Flowers large, yellow in rather dense and long racemes. Pods flat, c. 10 cm long, 2 cm wide.

In grassland and bushland and also often cultivated as an hedgeplant, especially in the lowland. It was never seen browsed by cattle. The plant has a strong smell and is very poisonous according to several authors cited by Watt & Breyer-Brandwijk (1962, p. 570).

Cassia floribunda

Shrub to some meters tall. Leaflets in 3-4 pairs, acute, glabrous. Flowers large, yellow. Pods almost cylindrical c. 8 x 1 cm.

The species, that probably is native to America is grown as a hedgeplant and sometimes naturalized.

Cassia hildebrandtii

Perennial herb with prostrate, hard stems to 0.3 m long, from a woody rootstock. Leaves with a stalked gland at top of petiole. Leaflets in 7-11 pairs. Inflorescences fewflowered with petals c. 5 mm long. Pods c. 4 cm long, 4 mm wide.

In grasslands N. of Asella at 2000-2200 m. Is grazed by cattle to some extent.

Cassia mimosoides

Similar to the previous species, but with a sessile gland at top of the petiole. Leaflets in more than 20 pairs, smaller.

Rather common in grasslands N. of Asella at 1700-2300 m. Grazed by cattle and often much stunted.

Cassia occidentalis

Erect, subshrubby herb to more than 1 m tall. Leaflets in 4-5 pairs, c. 7 x 3 cm, acute. Petals yellow c. 1 cm long. Pods slightly curved upwards, linear, compressed, c. 10 x 0.5 cm.

Common at roadsides and waste places in the lowland. It is known to be poisonous and was always avoided by cattle.

Pterolobium stellatum

Climbing or scandent shrub to more than 5 m tall. Stems armed with hooked prickles. Leaves bipinnate and also armed with prickles on the rachis.

Flowers small, yellowish-white in dense clustered racemes. Pods red-brown with a long wing, similar to maple-fruits.

The shrub is favoured in overgrazed areas in the lowland, where it is common in Acacia woodland, especially along streams, 1700-2300 m. Its very numerous prickles makes it a troublesome weed in pastures.

MIMOSOIDEAEAcacia

These are shrubs or trees, usually very drought resistant and important in arid areas. In Whyte et al. (1953, p. 249) it is stated about them: "Species of Acacia in the natural vegetation, especially in arid regions, are important as reserve fodder. The leaves and the nutritive pods are browsed or the trees are lopped." As the African species of Acacia all are more or less spiny they can encroach in overgrazed pastures and become noxious weeds. This is, however, not the case in the lowland of Chilalo Awraja, where they instead are rapidly diminishing due mainly to charcoal burning. The production of pods, which fall off during the dry season, is usually high and can be a good complement to the grazing. Acacias usually contain tannin and some are also potential sources of hydrocyanic acid and can cause poisoning.

Some of the more important Acacias in Chilalo awraja are listed below, but several others also occur.

Acacia abyssinica

Large flattopped tree with dark, rough bark. Spines straight, of variable length. Flowers in round heads, according to F.T.E.A. with red corolla and white stamens. Pods thick, straight, c. 10 x 2 cm.

A species of comparatively high altitudes. In wooded grasslands at 2000-2400 m.

Acacia dolichocephala

Small tree with short straight spines. Flowers in somewhat elongated heads. Pods straight c. 8 x 1.5 cm.

Found in Acacia woodland around Chebbi.

Acacia etbaica

Small or medium sized tree with dark, rough bark. Usually all spines very short. Flowers white in small round heads. Pods c. 5 x 1 cm.

Common in grassland and woodland in the lowland.

Acacia nilotica subsp. leiocarpa

Medium sized tree. Spines usually few, long. Flowers yellow in round heads. Pods glabrous, very thick with crenate margins, c. 10 x 1 cm.

In grassland and woodland in the lowland.

Acacia seyal var. seyal

Small tree with usually yellow-brown bark. Spines long, straight, white. Flowers yellow in round heads. Pods c. 10 x 0.6 cm, glabrous.

A common species at 1700-2200 m.

Acacia seyal var. fistula

Similar to the previous variety, but the bark is yellowish white and the spines have rounded, white "ant-galls" at the base.

Locally common in the Rift Valley, especially in seasonally wet places on dark soil.

Acacia tortilis subsp. spirocarpa

Medium sized tree with dark bark. Some spines short and hooked others long and straight. Flowers whitish in round heads. Pods c. 8 mm wide, spirally twisted, hairy.

Often the most common tree in the lowland.

Dicrostachys cinerea

Shrub with spines terminating short lateral branches. Inflorescences yellow in apical part, pink in the lower part, 3-4 cm long. Pods c. 6 x 1 cm, densely clustered, irregularly contorted.

Bushland and woodland in the Rift Valley where it can form dense thicket. However, "the pod and seed are nutritive and valuable as stock feed" (Watt & Breyer-Brandwijk, 1962, p. 595).

VIII. DISTRIBUTION OF INDIGENOUS LEGUMES IN THE CHILALO AWRAJA

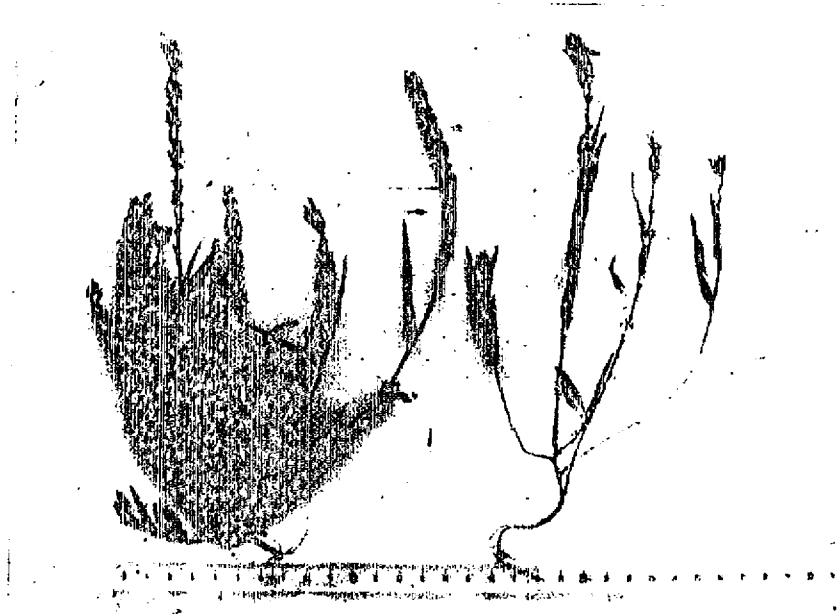
As is apparent from the altitudinal distributions of the species, many of them have their upper or lower limits at about 2300 m. A third group is more or less confined to the lowland. This is probably mainly due to influence by the rainfall that rapidly decreases at altitudes lower than about 2300 m, at least around Asella and further decreases in the Rift Valley. Of course, the higher temperature at lower altitudes strengthens this tendency by the increased evaporation.

To get some information about the altitudinal distribution of different lifeforms in the area, the number of perennial respective annual taxonomic units of Papilionoideae occurring above 2300 m, at 2000-2300 m or below 2000 m was counted. From this a very approximate picture of the conditions could be obtained.

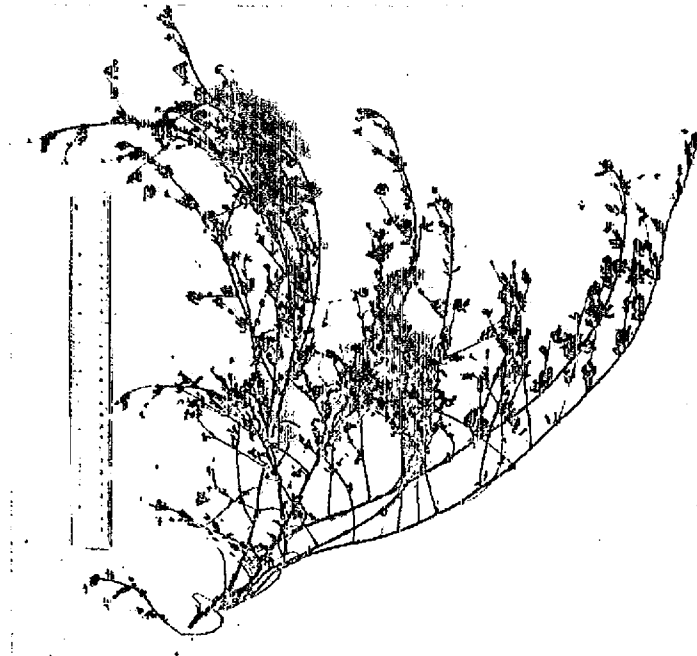
above 2300 m		2000-2300 m		below 2000 m	
annual	perennial	annual	perennial	annual	perennial
14	29	16	23	11	13
total number: 43		total number: 39		total number: 24	

Species not restricted to either of the groups were counted in two or three of them. There are also a number of less clearcut cases, and some, of course, can have been overlooked in one or the other situation. The table shows an increase in number of species at higher altitudes, where also the proportion of perennials is highest. One must remember, however, that the first group represents a much larger area in the Chilalo awraja. This has probably made the figure for total number of species too low in the two latter groups. But even if the total number of species in the groups would show no significant difference, the quantitative importance of legumes is higher in most of the highlands, as can be easily observed when travelling there.

X. PHOTOGRAPHS

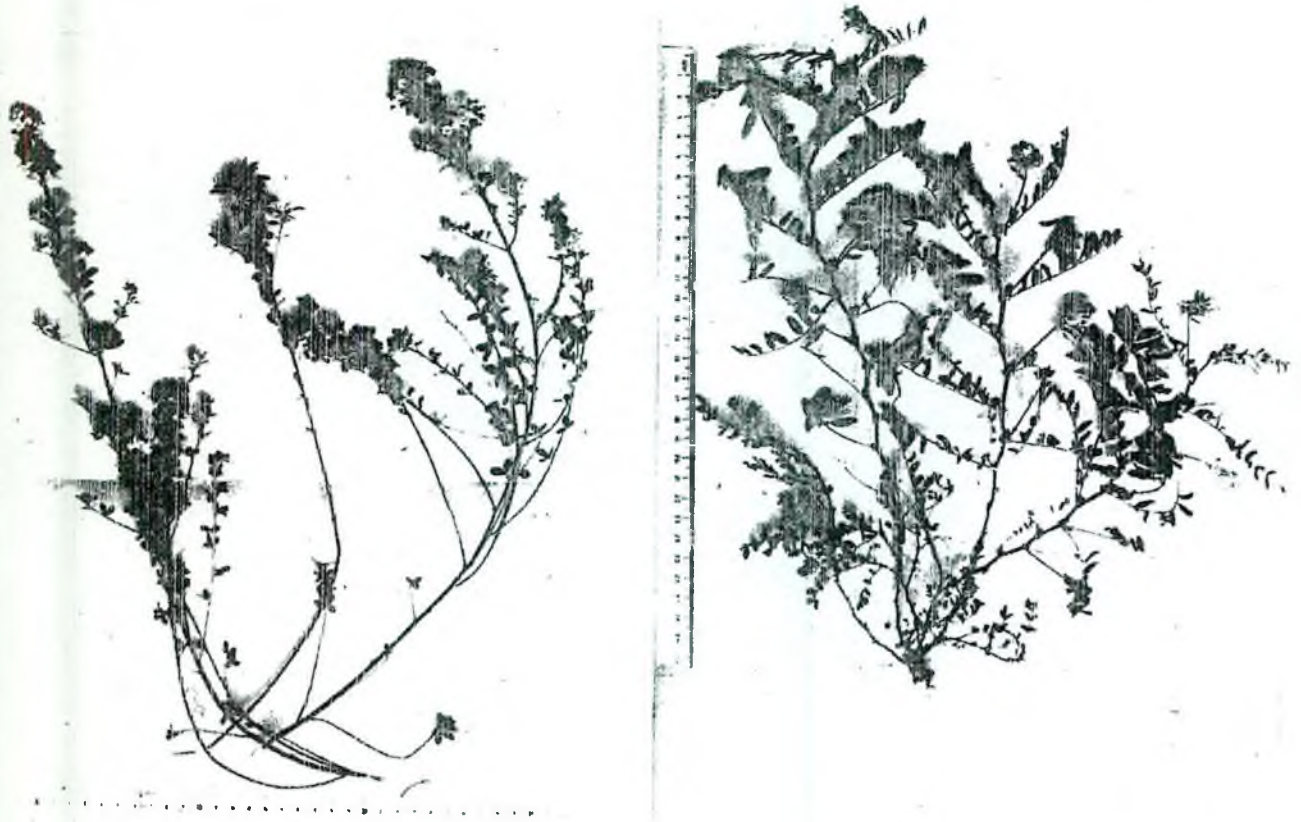


a.



b.

Fig. 2. - a. *Alysicarpus quartinianus*
b. *Antopetitia abyssinica*



a.

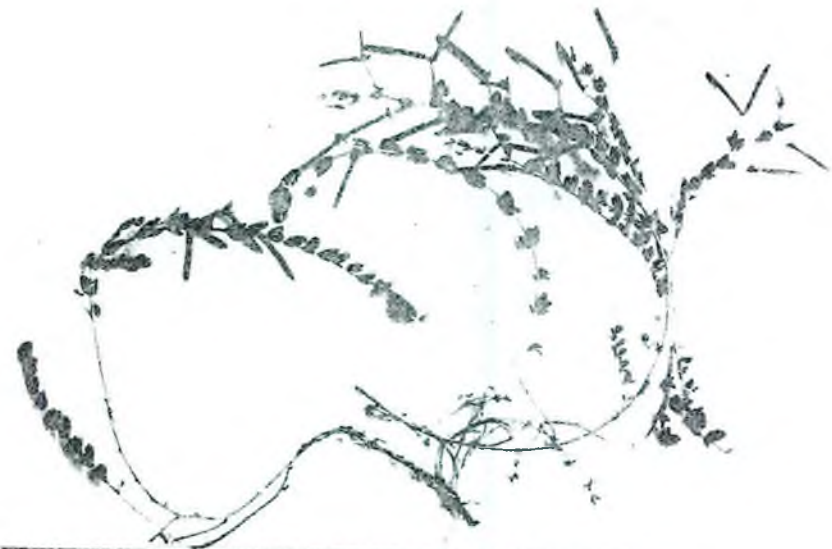


c.

FIG. 3. - a. *Ancyrolobium ramosissimum*
 b. *Astragalus atropilosulus* subsp. *bequaertii*
 var. *bequaertii*
 c. *Eriosema scioanum*



2.

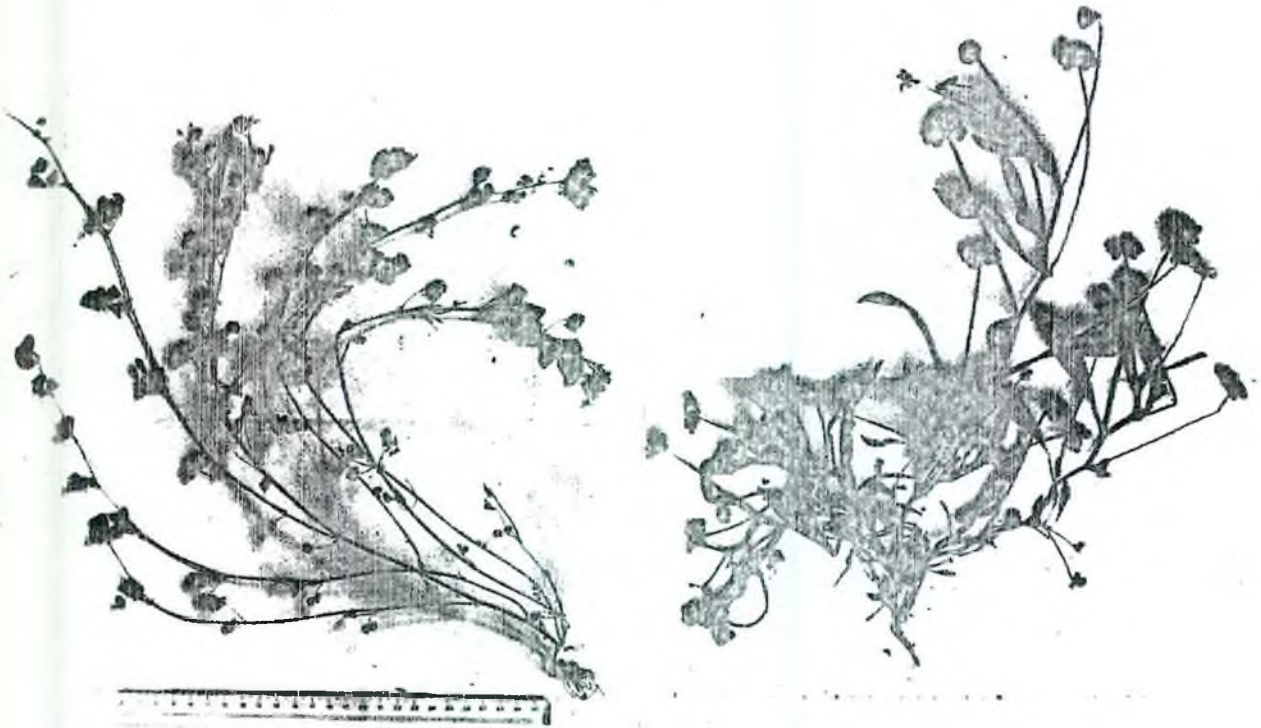


3.



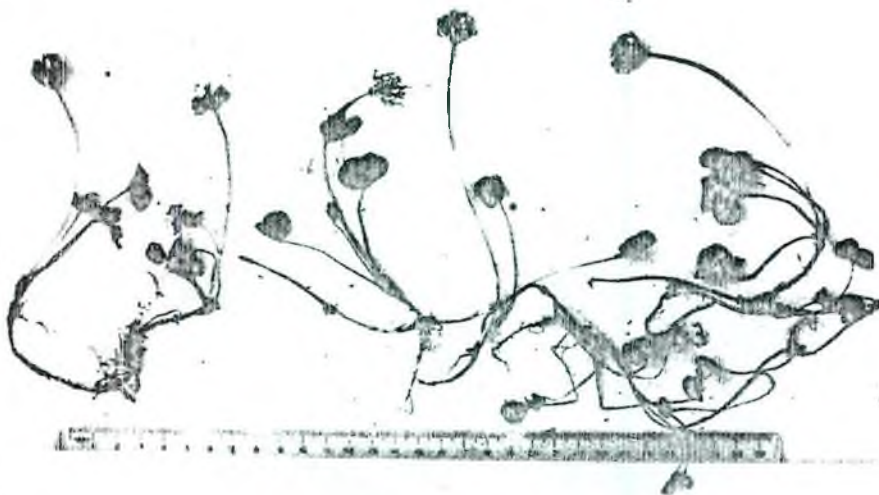
4.

Fig. 4. - a. *Indigofera spicata*
 b. *Lotus corniculatus* var. *ornamentalis*
 c. *Medicago minima*.



a.

b.

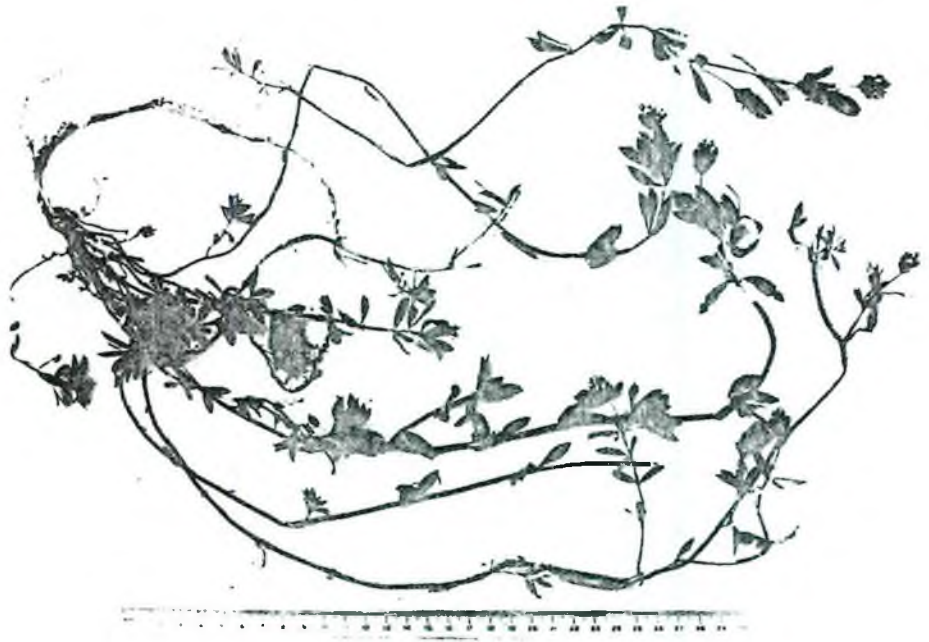


c.

FIG. 5. - a. *Medicago polymorpha*
b. *Scorpiurus muricatus*
c. *Trifolium burchellianum* subsp. *johnstonii*



a.



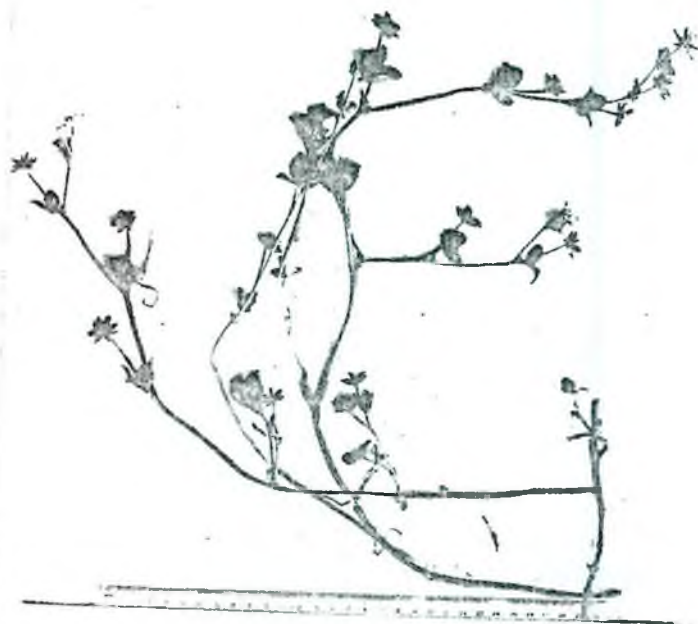
b.

FIG. 6. — a. *Trifolium calcephalum*
b. *Trifolium polystachyum*



a.

b.

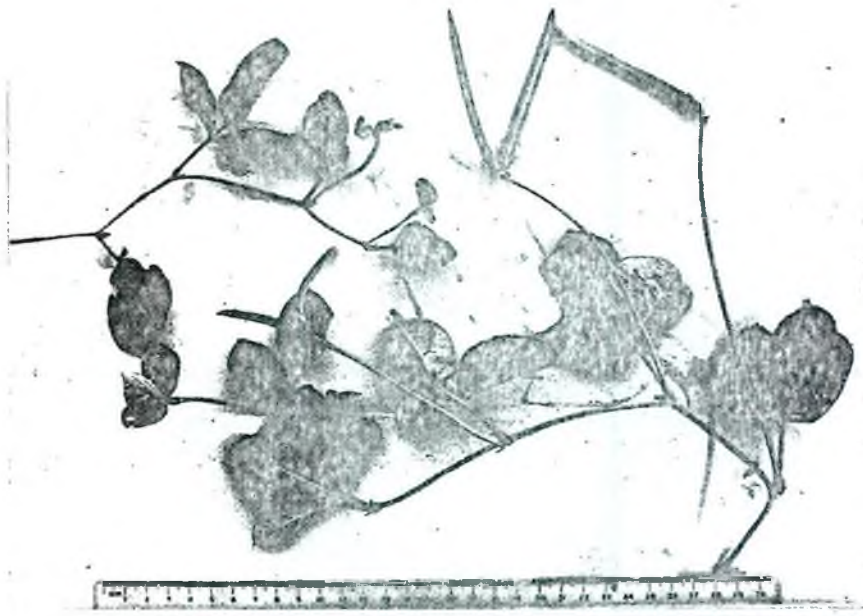


c.

Fig. 7. - a. *Trifolium rupeellianum*
 b. *Trifolium semipilosum*
 c. *Trifolium tembense*



a.



b.



c.

Fig. 6. - a. *Vicia villosa*
 b. *Vigna vexillata*
 c. *Caesalpinia decapetala*

X. SUMMARY AND RECOMMENDATIONS

About 90 taxa of the family Leguminosae were found in the Chilalo awraja. About 20 of these were considered to have qualitative properties good enough to make them suitable for experimental cultivation as fodder crops. Seeds have been or will be collected from these species. Most of them are suitable for areas with medium to high rainfall. All species have been described and keys to facilitate future identification of them have been prepared. Their ecological preferences and altitudinal distribution within the area have been given as far as known. Data about uses in other countries and also data about toxicity have been collected from the literature.

No analyses of the nutritive value have been made for any of the plants, but the species, which are promising in experimental cultivation, should be further studied in this and other respects, e.g. nodulation of the roots. An interesting paper on this subject, concerning 15 species of *Trifolium* from Africa, has been published (Norris & 't Marnetje, 1964). The study showed that these *Trifolium* spp. are highly specialized in their *Rhizobium* requirements. This, of course, presents a severe problem in the agronomic use of the species, as they probably cannot be removed from the areas they occupy in nature, without being inoculated with a very special *Rhizobium* strain. Without this they will probably either fail to nodulate or nodulate quite ineffectively (Norris & 't Marnetje, 1964, p. 230). When using indigenous species these problems will probably not come about to any greater extent, however.

The germination of the seeds should also be studied for species where enough amounts of seeds are available. The proportion of hard seeds seems to be high in many species, and scarification will probably be necessary for obtaining an even germination.

Establishing pastures has proved to be a difficult problem in CADU and more attention should be paid to it. The testing of different fodder crops cannot be really meaningful until this problem has been overcome.

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A. Project Preparation Period

1. Report No. I on the establishment of Regional Development project in Ethiopia, October, 1966
Part I General Background
Part II Project Outline
Part III Appendices
(A reprint of the Summary is also available)
2. Report No. II on the Establishment of Regional Development Programme in Ethiopia, May, 1967. (The building programme appears under separate cover)
3. Trials and Demonstration Plots at Kulumsa in 1966, July, 1966
4. Reconnoitering Survey of the Water Resources in Chilalo Awraja, March, 1967.
5. Creation of a Forestry Administration in Arussi Province, March, 1967
6. Crop Sampling in the Chilalo Awraja 1966, May 1967
7. Results of Trials and Observations Plots at Kulumsa 1966/67 May, 1967
8. Sagure, a Market Village, June 1967
9. Forest Nursery and Planning Techniques, June, 1967
10. Trials and Demonstration Plots at Kulumsa and Swedish Mission Asella in 1967, July, 1967
11. Grain Marketing Experiments 1967, August, 1967

B. Implementation Period

1. Government Agreement on Plan of Operation
2. Some Reflections on Water Erosion in Chilalo Awraja, October, 1967
3. The Taungya Afforestation Method, November, 1967
4. Grow better Bahr-Zaaf in Ethiopia, January, 1968
5. CADU Semi-annual Report 1967/68, January, 1968
6. Census in Sagure-Yeloma 1967, February, 1968
7. The Changing Rural Society in Arussi land: Some findings from a field study 1966-67, March, 1968
8. CADU (Pamphlet in English and Amharic)
9. CADU Plan of Work and Budget 1968/69 (with preliminary estimates for 1969/70)
10. Cultivation Practices and the Weed, Pest and Disease Situation in Some Parts of the Chilalo Awraja, March, 1968
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14. General Agricultural Survey, August, 1968
15. CADU Statistical Digest, May, 1968
16. Descriptions of Agricultural Demonstrations, 1968
17. Field Trials and Observations 1968/69
18. Feasibility Study on a Farm for Breeding of Grade Cattle at Gobe, Arussi Province, September, 1968
19. Feasibility Study on the Electrification of Sagure Town, September, 1968
20. CADU Annual Report 1967/68, September, 1968
21. Census in Dighelu Village, May, 1968
22. A Case Study of Peasant Farming in Dighelu and Yeloma Areas, Chilalo Awraja, Ethiopia, January, 1969.
23. CADU Semi-annual Report 1968/69, February, 1969
24. Results of Demonstrations 1968/69
25. CADU Plan of Work and Budget 1969/70
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27. Feasibility Study on Sunflower Protein Concentrate and Fafa Mizing Plant, May 1969
28. Results of Trials and Observations 1968/69 May, 1969
29. CADU Evaluation Studies, Health Education (Base-line study) May, 1969
30. CADU Evaluation Studies, Crop Sampling 1968, May, 1969
31. CADU Evaluation Studies, Training of Model Farmers (Base-line Study) May, 1969
32. Progress Report No. 1, Implement Research Section, June, 1969
33. Feasibility Study on Local Roads and Market Places in Chilalo Awraja, by Lars Leander August, 1969
34. CADU Annual Report 1968/69
35. Census in Sagure - Yeloma, by Gunnar Arhammar, February, 1968
36. Census in Golja (Ketar Genet), by Gunnar Arhammar, March, 1969
37. Sanitary Survey in Golja (Ketar Genet), by Gunnar Arhammar, April, 1969
38. Kap Study of Mothers in Golja (Ketar Genet), by Gunnar Arhammar April, 1969

39. Food Survey of Pre-school Children in Golja (Ketar Genet), by Gunnar Arhammar, April 1969
40. Health Survey of Pre-school Children in Golja (Ketar Genet) by Gunnar Arhammar, April 1969
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42. Census in Bekoji Village, Asella, by Gunnar Arhammar, September 1969
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44. CADU Semi-Annual Report 1969/70, February 1970
45. CADU Work Programme and Budget 1970/71 (With Preliminary Estimates for the Period 1971/72-1975/76)
46. Report on Surveys and Experiments, Crop Production Department, Asella, 1969
47. CADU Work Programme and Budget for the Period 8.7.70-31.12.70
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53. A Master Plan for Water Resources and Supplies within CADU's First Project Area, Nov. 1970
54. Report for the Period 8.7.70-15.11.70
55. CADU Work Programme and Budget for the Period 1.1.71-7.7.71
56. Animal Husbandry Activities 1968-1970, Research and Livestock Section, June 1970
57. Survey of Health Facilities of Arussi 1969-1970
58. CADU Evaluation Studies: Women's Extension, Sept. 1970
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69. Assessment of Status of Health in an Ethiopian Rural Community (Experience of Two Years' Public Health Work In Chilalo Awraja, Arussi), by Gunnar Arhammar, May 1970
70. Survey of the Consumption of Coffee, Tea, Tobacco and Alcohol in a Market (Sagure), Especially with Regard to cost, by Stig Lundin, September 1971
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72. Feasibility Study on the Establishment of a Rural General Store in Kentere, by Mehari Tesfaye, Planning and Evaluation September 1971
73. Feasibility Study on the Establishment of Saw-Mill in Asella and a Connected workshop for Wood Processing, Planning and Evaluation Section, November 1971
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78. Case Study on Farm Households In the Asella Area April, 1972
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80. Report on Surveys and Experiments Carried out in 1971 Crop & Pasture Section Asella April, 1972

MINOR RESEARCH TASKS AT CADU

1. Farm Management Studies of Model Farmers in the CADU Project Area, by S. Bergholtz, July, 1969
2. The Munessa Forest, a Plant Ecological Study, by Lill & B. Lundgren, June 1969
3. Credit Situation in Chilalo Awraja, by G. Bergman and H. Lindqvist, July, 1969
4. Local Varieties of Wheat in the Chilalo Awraja, by G. Widerstrom, November - December, 1968
5. An Inventory of Feeding System and Feed Stuff, Chilalo Awraja, Ethiopia, by Oscar Evaldsson
6. Comparative Study on the Possibilities for Different Farm Produce in the Chilalo Area in Ethiopia, by Bo Anselmsson, February, 1972
7. An agrobotanical investigation of leguminous species in Chilallo awraja, especially at higher attitudes, by Mats Thulin, May, 1972

Special Studies

- S.S.1 A Preliminary Survey of Soil Erosion in the Chilalo Awraja,
by Kebede Tato, September 1970
- S.S.2 Decision Making in the Family, by Pia Bergman, Asella,
July 1971
- S.S.3 The Innovation - Diffusion Process, by Johan Toborn,
Asella, March, 1971

