Miscellanea : Insects in Southern Rhodesian tobacco culture. Part II, III, IV, Insects occurring in the fields : Hymenoptera ; Diptera ; Tenebrionidae and Elateridae

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Insects in Southern Rhodesian Tobacco Culture.[1]

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Part II: Insects occurring in the fields.

HYMENOPTERA

Inspections made of fields of Virginia Tobacco during the seasons 1949-1952 offered an opportunity of recording most of the insects which visit or dwell inside such tobacco fields. Insects, injurious or benevolent, which also occur in seed beds are listed in a precedent publication (see BÜNZLI and BÜTTIKER 1956), where all notes on Formicidae are included.

The list of entomophagous insects, actually observed, collected and/or bred in the insectary, includes a selection of allied species which prey or are parasitic on insects (Orthoptera, Scarabaeidae, Tenebrionidae, Noctuidae and other Moths, Aphidae) which cause elsewhere pests similar to those common in Rhodesia.

Hyperparasites counteracting the beneficial effect of primary parasites also are noted.

HYMENOPTERA:

Parasites and Predators.

A. VESPOIDEA.

1. **Vespidae:** True Wasps.

Sinagris abyssinica Guer., var. *emarginata* Saussure, solitary wasp, predator of *Heliothis obsoleta* F. (American Bollworm), not frequent. Once in April observed pulling out of an immature capsule of cotton, the larvae of *Diparopsis castanea* Hampson (Sudan Bollworm).

S. spiniventris Illig., *S. calida* Serv., *S. cornuta* L., and *S. proserpina nyassae* Stadelman, are Eumeninae of tropical Africa, the latter preys upon *Glossina palpalis* R.-D. (BOUVIER 1936).

2. **Scoliidae:** Digger (Dagger) Wasps, notorious, solitary, external parasites of Scarabaeid-larvae (Whitegrubs).

Scolia fasciatipennis Sm., not frequent, mostly in same areas as

S. fasciatipennis ssp. *alaris* Saussure, wide range of distribution, host: larvae of *Anomala exitialis* Pér. and *Schizonycha profuga* Pér.; adult wasps abundant during Jan.-Febr., feeding on flowering plants.

S. (Myzine?) sp. indet., occasional in Whitegrub infested fields.

Myzine pinguis Turner was collected by DODDS (1901) in Rhodesia (TURNER 1916).

S. manilae Ashm. of the Philippine Islands, successfully was introduced into Hawaii in 1915/16, against the sugar cane Whitegrub *Anomala orientalis* Waterh., and *Adoretus sinicus* Burm. (DAMMERMAN 1929).

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[1] Serial papers covering part of the activity during 1948-1952 of the Entomological Section of the Tobacco Pest Control Research Scheme sponsored by the Government of Southern Rhodesia and the Rhodesia Tobacco Association.

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S. procer Illig., develops in larvae of the Dinastid Palm beetle (*Oryctes rhinoceros* L.), *S. erratica* Smith in those of the Black Palm Weevil (*Rhynchophorus papuanus* Kirsch.); *S. quadripunctata* parasitizes *Anomala d. aenea* De G.

S. flavifrons F. and *S. haemorrhoidalis* F. proved of no economic value since they parasitize only larvae of *Oryctes nasicornis* L. which is not a pest (ADLERZ 1914, MACH 1940).

S. (Triscolia) rubiginosus F., is a larval parasite of *Xylotrupes gideon* L., a sugar-cane pest (Malay Peninsula).

S. dubia Say is a grub parasite of the green June-beetle *Cotinus (Allorhina) nitida* in the U.S.A. (DAVIS 1919).

S. umbrosus Christ (*argentatus* F.) has a wide area of distribution, being found from S. Africa to Australia and as far north as Japan (DAMMERMAN 1929).

Campsomeris madonensis du Buyss., not infrequent, adults December-March on flowers. Larval development especially on well grown larvae of *Anomala exitialis* Pér. One or two generations; *cocoons* reddish-brown spun considerably coarser than those of *Tiphia.*

C. annulata, in the Far East (Chosen) is parasitic on *Phyllophaga* and *Anomala* (CLAUSEN 1940).

C. (Elis)? thoracica Klug, a common species in India, attacks grubs of *Leucopholis, Holotrichia,* etc. (DAMMERMAN 1929).

C. dorsata F. is known from Barbados attacking grubs of *Liggrus tumulosus* Burm. (NOWELL 1915).

C. marginella modesta Sm. has been recorded from *Anomala orientalis* Waterh. (PEMBERTON 1939) in Hawaii in sugar cane fields.

C. javana and *C. pulchrivestita* are primary parasites of the cockcaffer beetle *Psilopholis grandis* in Java and Malay Peninsula, the grub destroying cover crops in Rubber plantations. The Bombyliid *Hyperalonia tantalus* is a hyperparasite (PENDELBURY 1932, quoted by CORBET 1935).

C. prismatica Sm. on *Melolontha hastata* Arr.: *C. quadrifasciata* var. *fimbriata* Burm., *C. leefmansi* Betr., *C. annulata* F. introduced from Java into Malaya (CORBET and PAGDEN 1940), the last named species also from China and Japan to America, against various Scarabaeid larvae including *Popillia japonica* Newm. (SWEETMAN 1936).

C. ciliata F. on *Rhizotrogus* ssp. on wheat in Algeria (MOUTIA 1940) 0.06% infestation.

Elis 5-cincta Fabr., *E. interrupta* Say and *E. atriventris* Gahan are parasites of Phyllophaga grubs (DAVIS 1919) attacking corn crops in the U.S.A. east of the Rocky Mountains and in Sugar cane in Porto Rico.

3. **Tiphiidae:** Black Digger-Wasps.

Five different species indet., looking very much alike, far spread and relatively frequent. Maximum infestation of Whitegrub population as per cocoons collected in September 1951 from a restricted area comparatively richer in organic matter than the bulk of the respective sandy Tobacco fields: 20 per cent, i.e. 3-4 per sq. yard. First adults end September, last ones March; most probably one or two generations per annum. Solitary ecto-parasites on 2nd to last instar larvae of *Anomala* and *Schizonycha* ssp., remaining in situ; beetles with one year life cycle. Cocoons of *Tiphia* egg shaped, tan-brown, consisting of woolly layers well differentiated. In the Philippine Islands *Tiphia lucida* Ashm. attacks grubs of *Adoretus* (DAMMERMAN 1929). In Hawaii *T. segregata* Crwf. is a parasite of *Anomala orientalis* Waterh.

(PEMBERTON 1939). In Kentucky (RICHTER 1940) several species of *Tiphia* (incl. *T. intermedia* Mall.) are parasites of Whitegrubs, population consisting of *Anomala innuba* F., *A. nigropicta* Csy., *A. flavipennis* Burm., *A. binotata* Gyll. and *Lachnosterna (Phyllophaga)*. In Illinois the principal hosts of *Tiphia punctata* Rob., *T. inornata* Say, *T. transversa* Say, *T. vulgaris* Rob. are grubs of *Phyllophaga, Anomala* and *Liggrus gibbosus* (DAVIS 1919). In Europe *T. femorata* Fabr. is parasitic on *Rhizotrogus ochraceus* Knoch (ADLERZ 1914).

Tiphia species tentatively have been used for biological control of Whitegrubs. *T. vernalis* Rohwer, for instance, which in its native habitat Chosen (Korea) parasitizes the Ruteline beetle *Popillia castanoptera* Hope and which experimentally could be bred on 3 other *Popillia* ssp. and on *Anomala orientalis* Waterh., was introduced (1926 onwards) into New Jersey and Pennsylvania against *Popillia japonica* Newm. (BALOCK 1934) an accidentally introduced pest.

4. **Bethylidae:** Fossorial Wasps.

One sp. indet., observed once only, mid-September, a female attacking in the subsurface a first year larva of the Tenebrionid *Psammodes similis* Pér.

Epyris extraneus Brid. is described by WILLIAMS (1919) as an external parasite of the Tenebrionid larvae *Gonocephalum seriatum* Bois.

Prorops nasuta Waterst. from Uganda has been used against the coffee-borer *Stephanoderes hampei* Ferr. in Java and Brazil (CLAUSEN 1940).

5. **Pompilidae** (Psammocharidae): Fossorial Predatory Wasps.

Paraclavelia marshalli Bingh., rare, October, prey or host not ascertained, probably cockroaches and spiders.

Cyphononyx aculipennis Bisch., and

C. aeneipennis Lucas, rare, July, prey doubtful, possibly young *Brachytrupes membranaceus* Drury and spiders.

C. priocnemoides Kohl is known from the Belgian Congo (KOHL 1913).

Hemipepsis tamesieri Guer., not frequent, December, breeding habit not ascertained, prey probably large spiders and/or caterpillars.

H. sinuosa Kohl, *H. aetiops* Kohl, *H. aperita* Kohl and *H. unguicularis* Kohl occur in the Belgian Congo (KOHL 1913).

Salius sp. in Asia is probably a hunter of the Giant Cricket *Brachytrupes portentosus* Licht. (DAMMERMAN 1929).

6. **Mutillidae:** "Velvet Ants".

Lophotilla comparanda Bischoff, rare, December, sandy soil. First recorded by NEAVE (1913) in Nyasaland and P.-E. Africa. The hosts of this species as well as of *Apterogyna rhodesia* Pér. and *A. bembesi* Pér., collected by ARNOLD in Bulawayo are unknown (BISCHOFF 1920).

Smycromyrme tettensis Gerst., occasional, light soils, strongly suspected to parasitize mature larvae and pupae of parasitic wasps (Sphegidae, Scoliidae, Tiphiidae).

ANDRÉ (quoted by MICHEL 1928) found *S. rufipes* Fabr. to breed in *Evagethes laboriosus* Fert. and *Tachysphex* sp., *S. viduata* Pallas in *Larra anathema* Rossi, *Dasypoda plumipes* Panz. and *Gortex* sp.; WILLIAMS (1919b) recorded in the Philippine Islands a *Mutilla* sp. parasitizing *Tiphia lucida* Ashm.

Dasylabris doriae Mayr., fairly frequent, October-February. Sandy and loamy substrata. In one instance females of very different sizes were found con-

gregated together with numerous apparently very juvenile adults of *Eccoptoptera cupricollis* Chaud., also of varying sizes, in a well built flat chamber under a boulder suggesting the wasp having parasitized some of the Carabid-larvae or pupae in situ. Coleopterous hosts of *Mutilla*, so far on record, are rare: *Cicindela* larvae host of *Methoca ichneumonides* Latr. (quoted by MICHEL 1928 and STEP 1932). *Clythra tristigma* Lacord. (Chrysomelidae) host of *Mutilla clythraea* Rosenh., *Clythra* sp. host of *M. thyone* Pér. (MICHEL 1928).

Dasylabris maura L.; hymenopterous hosts known: *Ammophila heydenii* Dahlbom, *Eumenes arbustorum* Panz. and *Sphex occidanica* Lepelet.

Dipterous hosts of importance: *Glossina morsitans* Westw. parasitised by *Mutilla glossinae* Turner (EMINSON 1915, North Rhodesia; LAMBORN 1915, Nyasaland), *M. benefactrix* Turner (1916) and *M. auxiliaris* Turner (1920).

B. SPHECOIDEA.

1. **Sphegidae:** Sand (Digger) Wasps. Predators.

Sphex (Psammophila) egregia Mocs. race *transvaalensis* Cameron., not very frequent, predator of *Brachytrupes membranaceus* Dr.;

S. lobatus, in tropical Asia, is hunting on *Brachytrupes portentosus* Licht. (HINGSTON 1925-26). *S. aurulentus* F., distributed from India to Australia, preys upon locusts, preferably *Gryllacris* (DAMMERMAN 1929).

S. ssp., indet., not frequent.

Chlorion xanthocerum Illig. var. *kigonserona* Strand., wide range of distribution, very common and most frequent of the Sphegides capturing *Brachytrupes membranaceus* Dr. in Southern Rhodesia. Active November to March. Recorded also in East Africa (ARNOLD 1922-1931).

Chlorion xanthocerum Illig., three varieties not identified, fairly frequent.

ARNOLD (1922-1931) records var. *apicalis* Guérin from Abyssinia and Uganda, var. *unicolor* Sauss. from Mozambique, var. *subcyaneum* Gerst. from E. Africa, var. *maxiliaris* Pal. from E. Africa, Congo and Natal, var. *instabilis* Smith from Guinea, Congo and Nigeria.

C. (Chlorion) xanthocerum Illig. occurring throughout the Ethiopian Region, attacks *Glossina palpalis* R.-D., in the Belgian Congo (BOUVIER 1936).

Other *Chlorion* recorded in S. Rhodesia are (ARNOLD 1922-1931):

C. (Isodontia) Simoni du Buysson, *C. ruficornis* Turner, *C. albisectum* race *marginatum* Smith, *C. (Proterosphex) haemorrhoidalis* Fab., *C. (Proterosphex) umbrosus* Christ, the latter discovered in the Belgian Congo (Luputa) by BOUVIER (1936) to prey upon *Glossina palpalis*, Rob. Desv.

2. **Larridae:** Burrowing Wasps.

Notogonidea bembesiana Bischoff, widespread, fairly frequent, preying upon young generation of *Brachytrupes membranaceus* Dr., April-June. ARNOLD (1922-1931) states October-January. Notogonid-Wasps are also rich in species in S. Rhodesia. ARNOLD records: *sepulchralis* Gerst., commonest throughout tropical and South Africa, *ciliata* Smith (November-February), *pompiliformis* Panzer race *intermedia* Arn., *felina* Arn. (March-July), *miscophoides* Arn. (July), *gracicollis* Arn. (April), *bidentata* Arn., *braunsi* Arn. and *cyphononyx* Kohl, collected by G. A. K. Marshall; *angustiventris* Arn. (Nov.-July), *solstitialis* Smith, the latter ascertained to prey upon Crickets.

N. luzonensis Rohw. and *N. subtesselata* Smith in the Philippine Islands collect immature mole- and field crickets respectively.

Larra spec. indet. apparently rare, January, strongly suspected to prey upon Crickets. *Larra* and *Sphex* use, according to DAMMERMAN (1929), "Crickets as food for their brood, the paralised insects being brought into their holes or the eggs being deposited in the hiding places of the Crickets themselves". *L. erythropyga* Turner and *L. bulawayoensis* Bischoff, are known from Nyasaland and Southern Rhodesia respectively.

ARNOLD (1922-1931) states: prey consists of Orthoptera, chiefly Grasshoppers. According to WILLIAMS (1928) Larrid-larvae are true parasites of Mole-Crickets, i.e. *L. scelesta* Turn. on *Gryllotalpa nitidula* Serv., *L. carbonaria* Sm. on *G. hirsuta* Burm. *L. anathema* preys upon *Gryllotalpa* (JMMS 1942). *L. americana* Sauss. was imported (1926-1928) from Brazil to Puerto Rico against the mole cricket *Scapteriscus vicinus* Scudd. (CLAUSEN 1940).

Palarus gen. (*Larra* group), not collected during 1949-52.

P. latifrons Kohl. and *P. pentheri* Brauns occur in Southern Rhodesia (ARNOLD 1922-1931), the latter said to prey on honey-bees. *P. saishiuensis* Okam is a predator of adult *Tiphia* in Korea (CLAUSEN 1940).

C. ICHNEUMONOIDEA.

1. **Ichneumonidae:** "Ichneumon-Flies".

Henicospilus antancarus Morl. and

H. euxoae Wilk., both fairly frequent August-June. Endoparasites of the Cutworm *Agrotis segetis* Schiff.

Ophion bifoveolatum Brullé has been recorded from scarabaeid grubs *Lachnosterna* (DAVIS 1919).

Macrophantes sp., common November-December. Host: *Agrotis segetis* Schiff. in Tobacco-seedbeds and lands.

Enicospilus capensis Thunb. (= *euxoae* Wilkn.), occasional October. Host: *Agrotis (Euxoa)* Schiff. in young Lucerne.

Diplazon laetatorius Fabr., fairly abundant, January-February. Host: Syrphid *Xanthogramma pfeifferi* Big., pupating on Tobacco infested with *Myzus persicae* Sulz. This species appears to be very common in the Union of S.A. (BRAIN 1929).

Horogenes (Angitia) sp., frequent, January. Host: *Gelechia (Phthorimae) operculella* Zell (Potato-tuber Moth = Tobacco Splitworm) and *Gelechia (Gnorimoschema) heliopa* Lowr. (Tobacco Stem-borer).

Angitia claripennis Thoms. is known from the Cape Province (MORLEY 1916); *A. punctoria* Rom. in continental Europe is a parasite of the pyraline moth *Pyrausta nubilialis* Hbn. (European Corn-borer).

Cremastus sp. and

Pristomerus sp. not as frequent as *Horogenes*. January-February. Host: *Gelechia operculella* Zell. on Tobacco.

Cremastus pestifer Morl., recorded in Natal, is breeding in Noctuid-larvae (MORLEY 1916).

2. **Braconidae:** Braconid Wasps.

Zele sp., not frequent, November-December. Host: *Agrotis segetis* Schiff. on Tobacco and Maize.

Microchelonus sp., fairly common, January-February. Host: *Gelechia operculella* Zell. and *G. heliopa* Lowr. on Tobacco.

Chelonus annulipes Wesm., in Europe, parasite of *Pyrausta nubilialis* Hubn.

Microbracon? gelechiae Ashm., abundant, observed feeding on foliar exudations of Peach trees. Host not ascertained. *M. brevicornis* Westw. recorded in S. Africa from *Heliothis armigera* Hbn. (TAYLOR 1932).

Aphidius matrichariae Haliday, most common, August-May, sporadic June-July. Host: *Myzus persicae* Sulz. on Tobacco (seed-bed, field and experimental out of season growth) and *Sesamum (orientale) indicum* L.

A. sp., not ident., common. Host: *Brevicoryne brassicae* L. and *Anuraphis persicae-niger* Smith. Also recorded by ULLYETT (1938) in the U. of S. A. but not named.

A. testaceipes Cresson was bred from the Green Wheat Aphis in S. Africa, the ♀ laying 300-400 eggs. BRAIN 1929 states: "This species has been found to parasitize a number of South African aphids including the black citrus aphis, black peach aphis, green cabbage aphis and the grain louse."

D. CHALCIDOIDEA.

1. **Encyrtidae.**

Gen. et sp. indet., probably an *Aphidencyrtus* sp., rare, collected once only in May. Host: *Myzus persicae* Sulz., profuse colonies on Tobacco severely parasitized by *Aphidius matrichariae* Hal. Most probably a secondary parasite. According to ULLYETT (1938) the Figitid *Chlorips (Allotria)* contributes in the U. of S.A. "by far the largest number of species which parasitize *Aphidius*".

Aphidencyrtus inquisitor Howard is known to be a hyperparasite on *Aphelinus jucundus* Gahan, developing in the primary host *Macrosiphum cornelli* Patch and *Myzus persicae* Sulz. (GRISWOLD 1929).

Gen. et sp. indet., rare, only once obtained from a Syrphid pupa on Tobacco, infested with *Myzus persicae* Sulz.

Gen. et sp. indet., not frequent, primary parasite of a Coccid (*Cribrolecanium?* preliminary identification LAING 1951), very often found in hypertrophic branches of the common Caesalpiniaceae *Burkea africana* Hook (Rhodesian Ash), inhabited by the Myrmicine-ant *Crematogaster (Acrocoelia) nigronitens* Santschi.

2. **Pteromalidae.**

Pachyneuron sp., rare, January, emerged from pupae of *Xanthogramma (Ichiodon) scutellare aegyptium* Wied., on Tobacco infested with *Myzus persicae* Sulz.

Pachyneuron sp., not frequent, August-September, on Tobacco grown experimentally, with *Myzus persicae* colonies parasitized by *Aphidius matrichariae* Haliday; most probably a hyperparasite. ULLYETT (1938) states: "The Pteromalid hyperparasites are ectoparasites upon the larvae of *Aphidius*."

Asaphes sp., not common, Febr.-March. Host: *Myzus persicae* Sulz. on Tobacco, parasitized by *Aphidius matrichariae* Hal. Strongly suspected to be an internal hyperparasite.

A. americana Girault has been found feeding not only on the primary parasite *Aphelinus jucundus* Gahan but also on the larvae and on the pupae of the secondary parasite *Aphidencyrtus inquisitor* Howard.

According to GRISWOLD (1929) several species of the genus *Asaphes* are known as hyperparasites of Aphididae through various Braconid, Aphelinid and Encyrtid primaries.

Amblymerus sp., fairly frequent, February-March. Host: Tobacco-Budworm *Heliothis obsoleta* F. (= *Chloridea armigera* Hbn.) on flowerheads of Tobacco.

3. Chalcididae.

Brachymeria sp.? *bottegi* Masi, rare, December-January. Host: *Heliothis obsoleta* F., on young Field-Tobacco.

4. Eurytomidae.

Eurytoma, two species, not frequent, March. Host: *Heliothis obsoleta* F., on flowerheads of Tobacco. One of the species may parasitize the other (KERRICH 1955).

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Part III. Insects occurring in the fields. Diptera.

DIPTERA:

Predatory and parasitic Flies.

Syrphidae: Hover-Flies.

Xanthogramma pfeifferi Big., and

X. (Ischiodon) scutellare aegyptium Wied., common, both very frequent December-June on Tobacco, larvae predators of *Myzus persicae* Sulz., pupate on the plant. Adults are pollen feeders. Many generations, dry season passed in pupal stage in soil. The two species are far spread in Africa.

Baccha sapphirina Wied., common parasite on Bagworms (Psychid) on *Brachystegia spiciformis* Benth. (Msasa).

B. picta Wied. occurs in the Belgian Congo, *B. claripennis* in Natal (HERVÉ-BAZIN 1913).

Asilidae: Robber-Flies.

Alcimus setifemoratus Hobby, and

A., sp. indet., fairly frequent, December-February. Larvae moving in the soil feed on various whitegrubs of *Anomala* and *Schizonycha* with medium and large adults, pupae hibernating in larval skins of victims in their earthen cell. Adults alert hunters of grasshoppers, moths, butterflies, dragonflies, lady-bird beetles. *A. biseriatus* Curr., *A. doris* Curr. and *A. fraternus* Curr. are known from the Belgian Congo (CURRAN 1927).

Philodicus javanus Wied. and *Emphysomera conopsoides* Wied. in Java, prey upon Rutelinae-grubs (DAMMERMAN 1929).

Promachus ssp., two species, indet., one on the wings from late October onwards, the other from December. Occurrence moderately frequent. Larvae predaceous habit, pupae, armed with rigid spines, found in Tobacco fields infested with Melolonthid and Rutelid Whitegrubs.

P. fulvipes Lw. and *Leophonotus setiventris* Lw. occur in the Kalahari desert (HERMANN 1908).

P. fasciatus Fabr. (BEZZI 1912), *P. roberti* Macq., *P. albicinctus* Rich., *P. bonensis* Curr. (CURRAN 1929) are known from the Belgian Congo. *P. Fitchii* O.S. is destructive to Whitegrubs in New York (FELT 1915, MALLOCH 1917). *P. vertebratus* Say is in the mid-west of the U.S.A. an important enemy of Whitegrubs of the genus *Phyllophaga* Harris (DAVIS 1919).

Neolophonotus (Lophopeltis), sp. indet., not frequent, December, larvae predator of small Whitegrubs in Tobacco fields.

Emphysomera conopsoides Wied. and *Philodicus javanus* Wied. are larval parasites of Indomalayan Whitegrubs of Rutelinae (DAMMERMAN 1929).

MAYET (1866 ex MELIN 1923) observed the emergence of *Asilus barbarus* from the Lamellicorn *Phyllognathus silenus* (Southern France).

Asilid-larvae, indet. spp., white to yellowish-white, threadlike, rather frequent, freely but slowly moving in the soil, often in humous pockets of sandy Tobacco soils.

a) S.-F. Asilinae? *Promachus*. Predators of Melolonthid and
b) S.-F. Leptogastrinae sp. Predators Rutelid Whitegrubs.
c) S.-F. Dasypogoninae sp. Predators Rutelid Whitegrubs.

XAMBREU (1901) in France records: larvae of *Asilus crabroniformis* Lin. feed on the Lamellicorn larvae of *Geotrupes hypocrita* Illig. RICHTER (1940) recorded the Asilid *Diogmites discolor* Lw. as pupal parasites of Whitegrubs in Kentucky.

Therevidae:

Larvae, gen. and sp. indet., vermiform, quick. locomotion sinuous. Rather frequent on medium-sandy tobacco soils. Suspected to be predaceous on young larvae of the Tenebrionidae: *Phanerotoma (Psammodes) simile* Pér., *Ph. scrobicolle* Fåhr., the Melolonthid *Schizonycha profuga* Pér. and the Rutelid *Anomala exitialis* Pér.

SWEETMAN (1936) states that Therevid-larvae are on record as predators of Wireworms.

SEGUY (1926) France, considers the larvae to be generally carnivorous and only exceptionally phytophagous or saprophagous.

ISAAC (1925) quoted by CLAUSEN (1940) found larvae of *Phycus brunneus* Wied., feeding upon Dermestid larvae.

Adult flies very active, observed on flowering Tobacco (March-April) infested with *Myzus persicae* which were preyed upon by the Coccinellid *Xanthogramma (Cydonia) lunata* F.

Adults are known to be predaceous upon other Diptera (CLAUSEN 1940) and soft-bodied insects (SÉGUY 1926).

Bombyliidae: Bee Flies.

Exoprosopa (Exoprosopa) major Richardo, frequent December.

BEZZI (1924) states "as yet met with only in Nyasaland, Fort Jameson and Mt. Mljanji 1901. Dec.".

Exoprosopa (Exoprosopa) albonigra Bezzi, fairly frequent December-January, recorded from N-W Rhodesia 4,000 ft. December, Nyasaland, Mt. Mljanji (November-December), Portuguese East Africa, Tanganyika, Kenya (BEZZI 1924). Other species belonging to the subgenus *Exoprosopa* and occurring in Rhodesia are: *E. nemesis* Fabricius, *E. elongata* Richardo and Bezzi's ssp: *E. stanusi, E. luteicosta, E. batrachoides, E. villaeformis, E. tabanoides, E. decipiens,* and *E. seniculus.*

Host relationships of the above as well as of all the fairly numerous Ethiopian species of the Exoprosopinae is not ascertained. From the study of the habitat of soil-borne insects in Rhodesian Tobacco fields it can be inferred that the maggots of *Exoprosopa* are either primary parasites of the larvae or pupae of the Melolonthids *Schizonycha* ssp. and Rutelids *Anomala* ssp. or, even more likely, hyperparasites of the beneficial Scoliidae *(Scolia, Tiphia),* Sphecidae and perhaps also of Asilidae of the same host range.

BEZZI (1924) states "All that is known with regard to the life history in the very extensive genus *Exoprosopa* is that two North American species, *E. fascipennis* Say. and *E. pueblensis* Jaenn., are hyperparasites of species of the Hymenopterous genus *Tiphia* which are parasitic on Coleoptera Lamellicornia *(Lachnosterna);* but it is very probable that the majority of Ethiopian species feed upon egg-cases of locusts".

From more recent literature we quote:

Exoprosopa (?Hyperalonia) tantalus Fabr. is a hyperparasite of the Scoliid *Elis (Campsomeris)* n. sp. in Java, which primarily attacks and feeds as an ecto-parasite, on the very destructive rootgrub of the Melolonthid *Leucopholis rorida* F. and *Holotrichia* ssp. (DAMMERMAN 1929).

Exoprosopa fasciata Macq., in Wisconsin attacks directly Phyllophaga larvae, the full grown parasitic larvae remaining in the old grub pupal cell. Field infestation up to ten per cent (RICHTER and FLUKE 1935).

WOLCOTT (1922), quoted by RICHTER and FLUKE, records rearing three species of Bombyliidae from *Tiphia* cocoons collected in Illinois, one was *E. fasciata* Macq.

Records from closely related subgenera of Exoprosopinae: *Hemipenthes* Loew, palearctic-nearctic, is a hyperparasite of parasitic Hymenoptera *(Ophion, Banchus)* and of parasitic Diptera *(Masicera)* living at the expense of Noctuids (BEZZI 1924).

Villa (flavescens) sexfasciata Wied. is, in South Africa, a parasite of the Army Worm *Laphygma exempta* Wlk. (HATTINGH 1941). Other species of the flava-groups are parasites of the genera *Mamestra, Panolis, Agrotis, Dichromia, Taeniocampa,* etc. (BEZZI 1924). *Villa ixion* Fabre—group are parasitic on the Tenebrionid *Podanta nigrata* (BEZZI 1924).

Anthrax (Villa) hottentotus L. of Europe and North Africa parasitizes the Cutworm *Agrotis porphyrea* and *A. segetum* (SÉGUY (1926). *A. lucifer* Fabr. attacks the larvae of *Laphygma frugiperda* S. & A., the Fall Armyworm (SWEETMAN 1936). *A. parvicornis* Coq. is a hyperparasite of Tiphia parasitic on Whitegrubs (DAVIS 1919). *Chrysanthrax* is a hyperparasite of a Scoliid Wasp of the genus *Elis,* parasitic on larvae of Lamellicorniae (BEZZI 1924). *Thyridanthrax abruptus* Loew, now known as a common South African species, first collected by R. W. JACK in Southern Rhodesia (WATERSTON 1915) and *Villa lloydi* Aust. (AUSTEN 1914) from N. Rhodesia are puparial parasites of the Tsetse Fly *Glossina morsitans* Westw.

Litorhynchus tollini Loew, rather frequent hyperparasite collected in diapause, and emerged from typical cocoons of the primary Scoliid-parasites *(Tiphia)* in the old pupal cell of *Anomala exitialis,* ascertained by the chitinous head and shrivelled integument of the larvae. From cocoons collected on the 24th and 26th November 1951 in Whitegrub infested tobacco fields, flies emerged on the 5th April and 27th March 1952 respectively. Numerous adults caught on the 1st April, between 10 a.m. and 3 p.m., hot, dry, full sunshine; swift flier, feeding on flowers (nectar) of annual, dicotyl. weeds in sandy Tobacco and Maize fields infested with Whitegrubs mainly *Anomala exitialis* Pér. and *Schizonycha profuga* Pér.

L. nyassae Richardo, adults fairly frequent, caught together with *L. tollini* under same environmental conditions. Considering that no *L. nyassae* flies emerged in the insectary from collected Tiphia cocoons this species is more likely a primary parasite of Whitegrubs.

BEZZI (1924) states: "The genus *Litorhynchus* Macquart characteristic element of the Ethiopian fauna; little known mode of life."

L. nyassae Ric. is known from Nyasaland and Portuguese East Africa; *L. tollini* Loew from Orange Free State and Cape Province; *L. maurus* Thunberg from North-Western Rhodesia (Chilanga) and Cape Province.

Gonarthrus cylindricus Bezzi, not numerous, shares the habitat of the Litorhynchi, i.e., fields where Whitegrubs occur in abundance. Flight of adults March-April, flies hovering over flowerheads of Tobacco, infested with *Myzus persicae* Sulz., settling down to feed on the excretions of the Aphids. Host-complex not ascertained.

Bombyliidae: Homoeophthalmae. Non collected 1949-52.

Sparnopolius Loew, a nearctic neotropical species, is parasitic on the larvae of the Lamellicorn *Lachnosterna* (BEZZI 1924). *Sp. fulvus* Wied. on *Phyllophaga grubs* (DAVIS 1919).

Systoechus albidus Loew is on record to parasitise, in South Africa, the egg-packets of the brown trek locust (*Locustana pardalina* Walk.) and maggots of *S. marshalli* Par., in the Western Cape province is parasitic in the egg-pods of the Acridiid locust *Acrotylus deustus* Thb. (HESSE 1938).

Systropus (Cephenus) roepkei de Meij, is a primary parasite of pupae of the Limacodid *Miresa albipuncta* H. Sch., a major pest of *Aleurites montana* in the Malay Peninsula (DAMMERMAN 1929). *S. bicuspis* Bezzi in S. Nigeria is parasitic on *Stenomutilla breve* Pér. (BEZZI 1924).

Tachinidae: Tachinid Flies.

Gonia bimaculata Wied., the most common parasite of the cutworm *Agrotis segetis* Schiff. through all seasons.

Recorded also in Uganda and Nyasaland (VILLENEUVE 1913).

Gonia ssp. occur from Europe to South Africa and Eastern Indies (TOWNSEND

1941) microtype eggs scattered over vegetation and the ground (CURRAN 1934).

Gonia (Musca) capitata De G. has been reared from pupae of many species belonging to 8 different noctuid genera (TOWNSEND 1936).

Chlorolydella metallica Vill., not frequent (October), bred from pupae of *Agrotis segetis* Schiff.

C. (Stomatomyia) metallica Vill., *C. caffrariae* Towns. and *Campylocheta pallidipes* Curran, occur from the Cape to Kenya (TOWNSEND 1941).

Tachinid, gen. et sp. indet., infrequent, November ex pupae of *Agrotis segetis*.

Tachina (?Prodotachina) sp.? n., most common parasite of Psychid sp. feeding on foliage of *Brachystegia randii*, emerging February-April.

Carcelia evolans W. is known from *Acanthopsyche*.

Prodotachina B.B. (Exoristini) are on record from Nyasaland and Congo only.

Nemoraea capensis Rob.-Desv. infrequent, June-July, breeding in Cutworms *Agrotis segetis* Schiff.

This species is also known from Nyasaland, Belgian Congo and Abyssinia (VILLENEUVE 1913).

N. vivina Macq., in North Africa, *N. rubellana* Vill. in Equatorial Africa (VILLENEUVE 1916). *N. (Tachina) pellucida* M. occurs in C. Europe, it has been reared from various noctuid, sphingid and allied caterpillars or pupae (TOWNSEND 1936).

Sturmia (Prosturmia) imberbis Wied., not common, December, microtype eggs bred from the Noctuid *Laphygma exigua* Hbn.

Phorocera blepharipa B.B. and *Exorista aethiopica* Rodh. parasitise in South Africa the Army Worm *Laphygma exempta* Wlk. (HATTINGH 1941).

Sturmia (rhodesiensis) halli Curran (1939) described by PARRY-JONES (1938) have been reared from the Cotton (Tobacco) Budworm *Heliothis armigera* Hubn. Also recorded in Rhodesia are *St. laxa* Curr. from the Maize Noctuid *Cyrphis loreyi* Dup. (JACK 1915) and *St. instabilis* Curr. from *Spodoptera mauritia* Boisd. (JACK 1942). *St. semitestacea* Vill.: Nyasaland; *St. angustifrons* Vill. and *St. dilabida* Vill.: Natal; *St. (Crassocosmia vix) aurifrons* Vill. is widely spread in Southern and Tropical Africa (VILLENEUVE 1916b). Various *Sturmia* species occur in South Africa (VILLENEUVE 1916).

St. (Tachina) bella M. is known from about 6 different genera of caterpillars (TOWNSEND 1936). *St. scutellata* R.-D. is dependent on *Porthetria dispar* L. only (SWEETMAN 1936).

Linnaemyia ssp., fairly frequent, March-May, parasitising *Heliothis armigera* Hubn., on flower heads of Tobacco.

L. agilis Curr. and *L. (Micropalpus) longirostris* Macq., are recorded from the same host in South Africa.

Parasitised juvenile adults of *Anomala exitialis* Pér., collected mainly in the early flight period (end October-November) attributed to Tachinid infestation.

Pexopsis pyrrhaspis Villen. is known from adults of one *Schizonycha* sp. and *Anomala plebeja* Oliv. in Zanzibar (MOUTIA 1940). This species also occurs in the Cape and Nyasaland (VILLENEUVE 1916b).

Records of Tachinidae parasites on larvae or adults of Lamellicornia beetles: *Masicera* sp. was bred from the Melolonthid beetle *Apogonia* sp. and other Tachinidae from *Holotrichia* (DAMMERMAN 1929).

Centeter cinerea Aldr., in North Japan, destroys 90% of the adult population of *Popillia japonica* Newm., in alternate years, within 6-10 days after emergence, the eggs of the Tachinid being laid when the beetles are in copula (CLAUSEN et al. 1927).

Centeter unicolor Aldr. in Chosen (Korea) often very considerably reduces

the beetle population of the Rutelid *Anomala sieversi* Heyd. and *Phyllopertha pubicollis* Waterh. (PARKER 1934).

Palpostomatini of the Oestridae family of Tachinids parasitizing adult beetles:

Hamaxia: *Anomala* and *Popillia; Eutrixa* Cocq.: *Phyllophaga; Eutrixopsis: Popillia; Opsophasiops: Anoplostethus; Palpostoma: Lepidoderma* and *Lepidiota; Pseudopalpostoma: Lepidiota* (TOWNSEND 1938).

Prosenini of the Prosenidae family:

Prosena siberita Fabr. attacks the larvae of Rutelidae *(Anomala, Adoretus)* in the East Indies (DAMMERMAN 1929).

The same species is a larvae parasite of *Anomala geniculata* Motch in Hokkaido (KUWAYAMA et coll. 1939).

Prosena nigripes Cur. parasitises the larvae of *Dermolepida albohirtum* Waterh. in Queensland (MUNGOMERI 1945).

Prosena have been reared from *Popillia; Ptilodexia harpasa* Walk. from Phyllophaga (DAVIS 1919); *Dinera* from *Phyllophaga* and *Serica; Phorostoma* from *Dorcus* (TOWNSEND 1936).

The Prosenini have been recorded only once from South Africa, i.e. *Africodexia* Town. (= *Dexia lugens* Wied.) from the Cape.

Dexillini: *Dexillia* Westw., occurs throughout Europe attacking the grubs of *Melolontha* and *Rhizotrogus.*

Microphthalma disjuncta Wied., parasitises *Phyllophaga* and other Scarabaeid grubs in America (DAVIS 1919).

Microphthalma europaea Egger parasitises *Anomala delagoa* Pér. in Zanzibar, 2.02 percent of larvae affected (MOUTIA 1940).

Eutrixoides jonesii Walton attacks adult *Phyllophaga* in Porto Rico (WALTON 1912).

Phoroceratini (Exoristidae Fam.).

Cryptomeigenia (Tachina) theutis Wlk. parasitizes the adults of *Phyllophaga* (DAVIS 1919).

Ochromeigenia ormioides Towns., a larviparous species has been reared in Japan and Java from *Popillia japonica* Newm. (DAMMERMAN 1929). It was introduced into the U.S.A. to aid in combating *Popillia japonica* Newm. (SWEETMAN 1936).

Afromeigenia pallens Cur., has been recorded from Transvaal (TOWNSEND 1936).

Meigeniella Cocq. ssp., *Pseudatractocera* Towns. ssp. and *Emphanopteryx* Town. ssp. are "important parasites of adult June Beetles" (TOWNSEND 1936).

Rutilia desvoidyi Men. and *Grapholostylum (Rutilia)* Macq. have been reared by JARVIS and DODD from the whitegrubs of *Lepidiota (Consobrina)* Gir., *frenchi* Blkl., *trichosterna (Lealea?)* and *Dermolepida albohirtum* Waterh. notorious sugar cane pests in Queensland.

Ortalidae (Acalyptera). Non-recorded 1949-52 in Southern Rhodesia. *Campylocera robusta* v. d. Wulp. is breeding in adult *Adoretus* ssp. (DAMMERMAN 1929). *Schizonycha* sp. parasitized 1-9.7 percent by *Adopsila* sp. (MOUTIA 1940). *Pyrgota undata* Wied. and *P. valida* Harris are parasites of *Phyllophaga* adults (DAVIS 1919).

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Part IV. Insects occurring in the fields.

TENEBRIONIDAE AND ELATERIDAE.

Tenebrionidae: Larvae are commonly called False Wireworms.

Phanerotoma (Psammodes) simile Pér., and
P. scrobicolle Fåhr., predominant species, populations often interspersed;

P. similis most abundant in light, sandy soils; *P. scrobicolle* frequent on sands with loamy pockets. Both species, larvae and/or imagines often major Tobacco pests but injury to Maize and Wheat are also on record. Adults November-beginning March; heavy rains may wash them to new breeding grounds; accumulations of drowned beetles also observed, locomotion otherwise slow, not far reaching.

P. vialis Burch., ssp.?, frequent only in the Bindura Distr. on belts of light, sandy soils, habitat of Crickets, adults abundant mid November-end December.

P. ventricosus Fåhr. not frequent, imagines December-February.

P. bierreri var. *tuberculifer* Am., fairly frequent, adults November-end January.

P. ssp(?) *mashunus* Pér., infrequent, adults November-end January.

P. sp. near *mulleri* Pér., sporadic, wooded borders of Tobacco fields.

P. sp. near *batesi* Haag, not very abundant, adults mid November-mid February.

In S. Africa the genus *Phanerotoma (Psammodes)* is very rich in species including the giant *sulcicolle* Pér. = *rehbocki* Kolb.) which measures 73 mm. *P. scrobicolle* occurs right across S. Africa (PÉRINGUEY 1908).

The remarkable nocturnal habit of the ♂ of these wingless beetles of knocking at intervals with the abdomen on the ground gave origin to the popular name "Tock-Tockies".

Trachynotus geniculatus Haag, rare on sandy soils but frequent on red sandy loams and loams, particularly in Cotton fields. JACK (1928) records damage to Tobacco, Maize, and Cotton, TAILOR (1924) to Tobacco in the U.S.Afr. Contrary to all other Tenebrionidae recorded from Southern Rhodesian tobacco fields, this species emerges above ground, on sandy soils mid February-March and on loams from March to April; it is also distinguished by fast diurnal locomotion, thus enhancing dispersal.

T. angulatus Fåhr., infrequent on loamy sand, adults above ground also comparatively late, i.e. February-March, often concentrated.

Dichtha inflata Gerst., wide-spread, frequent on medium sand.

Imagines October-end January, on red loam up to middle May.

D. cubica Pér., infrequent, adults December-January.

Micrantereus cestatus Gerst., very frequent, especially on arenaceous ground; beetles early October-end March.

M., sp. a, b, c: a) on medium sand only, occurring occasionally November-February, b), c) on loamy sand fairly frequent (November-January).

Distretus mashunus Pér., very common on light sands, old lands in bush-veld. Imagines November-beginning March. Adults feed on dead leaves; cannibalic in confinement. In November often congregated below root collars of stumped *Brachystegia (randii) spiciformis* Benth. and associated with *Anomalipus plebejus* Pér., *Psammodes* sp. near *batesi, P. scrobicollis, P. similis, Dichtha inflata* Gerst., and *Zophosis.*

D. amplipennis Fåhr., not frequent.

Renatiella (s. str.) *reticulata* Gerst., wide spread, common on all sandy substrata, adults present throughout the year, larvae and beetles feed in and upon the soil usually on dead and rotting plant material, such as field-stooped Maize and ploughed in grass sods, sunnhemp, tobacco stalks, only occasionally attacking sown Maize and young Tobacco. Distinguishes itself to be the only species to climb up to one foot, on stems of trees, stumps, etc. if danger of immersions is imminent.

R. (Macropoda) inaequalis ssp. *nigrogeminata* Fairm., not as frequent as the above sp. (September-November). *R. (Adesmia) marginipenis* B. occurs in S.-W. Africa (Péringuey 1908).

R. (Macropoda) ssp. (2), not frequent, dwell in leaf mould (December).

Ethmus s. str. *cinerosparsus* Geb., often met with in same areas and at the same time as *Trachynotus geniculatus*, on heavier types of soils, recorded from Cotton fields, but never in Tobacco lands. Adults April.

Anomalipus plebejus Pér., wide range of distribution but not very frequent, usually near or in humus pockets in sandy bush-veld (Virgin land Tobacco). Adults mid November-mid March.

Gonopus agrestis F., not frequent, imagines July, January-February.

G. ater Fhr., rare adults November-December.

Pogonobasis verrucosa Er., var. and *P.* sp. indet., seldom. Beetles October-February, sandy, shady Tobacco borderlands, does not breed in disturbed soil.

Eurychora sp. near *trichoptera* Haag, rare, medium sand. Imagines December-mid January.

Ossiporis terrena Pasc. ssp. *rhodesiana* Koch, sporadic on sandy soils, adults mid January.

Vieta crinita All., seldom, on loamy sand, imago mid January.

Himatismus (Curimosphena) patruelis Bert, wide-spread, locally very abundant, a fairly good nocturnal flier, attracted by light; adults mid October-mid January. Larvae single or aggregated up to 8, in contrast to the usual solitary habit of all the other Tenebrionids quoted, feeding on decaying roots, including those of old Tobacco, in all types of sandy soils, frequently in areas infested with *Phanerotoma simile* and *Ph. scrobicolle*.

H. (C.) buprestoides Gerst., a larger species, not frequent, seems to be confined to red loams. Imagines December-January. Larvae and adults of *Curimosphena* harmless to Tobacco. *H. fasciculosa* Geb. attack the fruit of apple and peach (CHORLEY 1943-44).

Gonocephalum simplex F. (*Opatrum aequale* Er.), very common.
"Gray-Surface Beetles" especially frequent on heavier types of soils, often reaching the level of a pest in Tobacco, Maize, Wheat and Barley. Adults most abundant beginning November-February, on irrigated soil present throughout the year. Larvae are most destructive to very early planted Tobacco.

G.(?) *arenarium* F., *G.*(?) *contractus* and *G.* various ssp., indet., also with wide range of distribution. Imagines September-June.
Gonocephalum Beetle pests are on the increase, in South Africa on Maize, Cotton, Chicory, in East Africa on seedlings of Cotton, beans and coffee.

Zophosis castelnaudi Deyr., wide-spread on all types of soil; beetles usually not numerous but individually more injurious than *Gonocephalum*, very agile, trend to congregate absent in contrast to *Gonocephalum*. Imagines present throughout the year.

Z. angusticostis Deyr., not very frequent.

Z. agaboides Gerst. and *Z.* ssp., indet., fairly frequent.

Z. punctatula Ol., infrequent, only occasionally numerous in December-January on red loams.
Z. orbicularis Deyr., *Z. rugatipennis* Pér., *Z. boei* etc. occur in S. Africa (CHATANAY 1916/17).
Distribution of *Zophosinae* in Africa is very wide (PÉRINGUEY 1908).
Zophosis, *Adesmia* and *Gonocephalum* usually exhibit on the back a pulverulent coating of the substrata in and on which they dwell and thus appear grey, yellow, brown, fulvous or red coloured the shades varying conform to moisture conditions.

Helopinus sp.(?) *caelatus* Gerst., usually dispersed on sandy soils but occasionally large Beetle populations concentrated on sandy loams and loams,

similar to *Gonocephalum,* with severe pest-character, beetles destroying young Tobacco transplants. Adults November-February.

H., sp. indet., infrequent, confined to loams, adults November-beginning March.

H. (Emyon) tristis Fhr., very similar to above species, recorded by JACK (1914) under the name "Slaty Surface Beetle" occurred during 1949-52 only sporadically.

Elateridae: Larvae commonly called "True Wireworms".

Adults.

Prosephus sp. near *puncticollis* Boh., frequent, red loam.
Maximum incidence (6-8 per sq.yd.) observed together with maxima populations (8-12 per sq.yd.) of *Helopinus caelatus* Gerst.

P. ssp., four species, two on loam, two fairly frequent on medium sand.

Cardiophorus sp. near *fulvicornis* Er., common on sandy soils.

C., ssp. indet., infrequent. *C. ventralis* Er. occurs in the Cape flats.

Dichronychus, sp. indet., very common.

Anisomerus bipectinatus Schwz., not frequent.

Drasterius, sp. indet., not frequent.

Tetralobus flabellicornis L., *T. rotundifrons* Guer., and *T. dufouri* Cand., large species not common, on loams only.

Alaus tortrix Cand., rare. *Aeolus* sp., sporadic.

Larvae.

Various unidentified. One species *(Cardiophorus?)* observed in loamy sand to bore into stem of young Tobacco transplants. Plants fall over, larvae one up to three remaining in the stump.

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