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THE

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VOL. III. JUNE, 1921 No. 1

REPORT OF THE COUNCIL FOR 1920.

Your Council in presenting its Report to Members this year does so with more confidence than was possible in the past.

The Membership Roll now includes 219 Members, all of whom have paid their subscriptions up to date. During the year we have lost one member through death, 6 members have resigned as from the end of this year, and your Council has been reluctantly compelled to remove 20 Members from the roll owing to non-payment of subscriptions. The pleasing feature is the number of new members who have joined during the year, viz. 71, which shows that the Society is appealing to a large section of the public. If this steady increase of new members can be maintained we may look with every confidence to the future of our Society.

Perhaps one of the most important events in the history of the Society is the formation of a Branch at Cape Town with a Membership of 24. Prof. H. R. Compton, Director of National Botanic Gardens, is the first President of the Branch and Mr. V. A. Putterill, M.A., the Hon. Secretary and Treasurer. There is no reason to doubt that the Cape Town Branch will become, a most flourishing section of the Society.

A new departure in the activities of the Pretoria Branch was the holding of a series of four Public Lantern Lectures in the Town Hall on various scientific subjects. Your Council feels that this is a step in the right direction and expresses the hope that the Pretoria Branch will continue holding a similar series of lectures in future years.

During the year the Society has published two parts of Vol. 11. of the " Journal ". While on the subject of the " Journal " your Council is pleased to state that the Society possesses sufficient funds to publish at least twice a year, but at the same time must again appeal to Members to support the Editorial Committee by sending in MS. for the Journal. The delay in the publication of the number now in press is solely due to lack of MS. from Members.

A glance at the balance sheet prepared by your Hon. Treasurer will show that the Society is financially sound. An amount of £100 has been placed on fixed deposit for 6 months, and there is a cash balance in hand of £81 19s. 7½d.

The Public Service Commission of Enquiry invited the Society to give evidence and your Council elected Dr. Green and Dr. van Hoepen, as its representatives. Dr. Green prepared a memorandum which was presented to the Commission and in the opinion of your Council this was the most excellent presentation of the case which had been placed before the Commission. A copy of this Memorandum has been published in the Journal.

The 1920 award of the Senior Capt. Scott Memorial Medal was made to Mr. Claude Fuller of the Division of Entomology for his research work on the South African Termitidae. The Junior Medal was presented to Mr. J. Sandground, B. Sc., as the best Candidate in Zoology in the Bachelor of Science examination. Next year the Junior Medal will go to the best candidate in Botany.

An account of Mr. Fuller's work and of the presentation of the medal is published in this volume.

CAPE TOWN BRANCH.

Report for period May — October, 1920.

As a result of a meeting held on January the 20th 1920, under the chairmanship of the Mayor of Cape Town (Mr. W. J. Thorne), for those of the Cape Town public interested in Natural History, it was decided to form a branch of the S. African Biological Society in Cape Town. At a subsequent meeting the following committee was elected by those who had signified their intention of joining the Society.

President.
Prof. R. H. Compton.

Vice Presidents.
Dr. Marloth, Prof. D. H. Thoday.

Hon. Secretary and Treasurer.
Mr. V. A. Putterill, M.A.

Assistant Hon. Secretary and Treasurer.
Mr. C. van Bonde, M.A.,

Committee Members.
Messrs. H. H. Crowther, B.A., A. H. Reid, H. G. Eaton.

A series of regulations applicable to the Cape Town Branch was drawn up by the Committee and passed at one of the general meetings. These regulations make provision for Associate Membership. All persons who are either (a) under the age of 21, (b) students or (c) members of the immediate family of a full member of the Society, may become local associates, on payment of an annual subscription of 5s., after having been duly elected by the local branch. The Annual Subscription of Local Associates go to the local fund.

Local Associates have the privilege of taking part in the activities of the Local Branch and of buying the Society's publications at cost price, but have no voice in the management of the Society or of the Local Branch.

The Local Branch has furthermore entered into an agreement with the Parent Society, whereby it retains 5s. out of each local branch member's subscription, in lieu of the £5 mentioned in Article 44 of the Constitution.

The first Monthly Meeting was held on the 17th of May, and at this meeting the President delivered his inaugural address. Mr. C. W. Mally, M.Sc., and Mr. A. H. Reid also made interesting contributions to the programme of this meeting. Since then monthly meetings for the reading of communications and discussions thereon have been held regularly.

Owing to the delay from various reasons in the preparation and the final acceptance by the local branch of the draft regulations, the activities and development of the branch have been somewhat hampered, but with the New Year it is hoped to be able to carry out an active membership campaign, to arrange public lectures, and to hold regular monthly excursions to places of biological interest, besides the ordinary monthly meetings.

Up to the present only one excursion has been held, viz. to the S.A. Museum.

The following papers were given during the period at the monthly meetings:—

Notes on the Mandibles of the Witte Visch: Mr. A. H. Reid

Talk on Insect Life: Mr. C. W. Mally, M.Sc.

Bees: A. J. Attridge.

Mud: H. G. Eaton.

Some Curious Fishes from S.A. waters: C. van Bonde, M.A.

Trout: A. H. Reid.

Talk on Leaf Pigments: Prof. D. Thoday.

Camouflage amongst some of the lower animals of the Cape Peninsula: C. J. French.

In conclusion this first report of the Cape Town Branch would be incomplete were it not to place on record the appreciation of the members of the Branch, of the very active interest taken in its promotion by Dr. E. P. Phillips.

PRETORIA BRANCH.

The interest taken in the Pretoria Branch by local members has been more encouraging this year, but there is still much room for improvement in this direction.

As was arranged last year, four public lectures have been given. The first was given by Prof. H. B. Fanthan on " Darwin, Before and After ", the second by Mr. H. E. Wood on " The Distances of the Stars ", and the third by Dr. I. B. Pole-Evans on " The Distribution of Plants in South Africa ". The fourth and last lecture was given in December, by Mr. A. J. T. Janse on the subject of " The Moths of South Africa ".

These lectures have taken the place of the usual meeting in the month in which they were held—March, June, September and December.

Ordinary meetings were held in January, April, July, August, and October.

During May, the Director of Veterinary Research and his staff gave an " At Home " to members of the Society.

The following papers were read at ordinary meetings:—

Transmission of Diseases by Insects: G. A. H. Bedford.

Trypanosomes: D. T. Mitchell.

Notes on the Vegetation of South West Africa: Dr. I. B. Pole-Evans.

The Haustoria of the Genus Melioa: Dr. E. M. Doidge.

An Exhibit of the Principal Cotton Pests of South Africa.: G. C. Haines.

On the Advisability of having ample Material for Entomological Study: A. J. T. Janse.

Snotziekte in Cattle: R. W. M. Mettam.

The possibility of destroying Jackals by any biological methods based on the Life History of the Animal, introduced by Sir A. Theiler.

An account of the Veld Burning Experiments at Groenkloof Illustrated by Lantern Slides. Dr. E. P. Phillips.

An Exhibit of some new South African Microlepidoptera by A. J. T. Janse.

An Exhibition of the Amonites of Pondoland by Dr. E. C. van Hoepen.

Exhibition of Microscopic Slides, forwarded by Dr. G. E Purvis, Grahamstown.

Veld Estimation: A. O. D. Mogg.

CAPT. SCOTT: SENIOR MEDAL, 1920.

The Capt. Scott Senior Medal was presented at the July meeting of the Pretoria Local Branch, by the President of the Society Mr. A. J. .T. Janse, who spoke as follows:—

Mr. Fuller,

It is an exceedingly great honour and pleasure to me to present the Capt. Scott Memorial Medal to you to-night. In presenting this third medal I may begin by pointing out to you and to the members of the S.A.B.S. that this is the first time the medal is given under somewhat different conditions from those under which the two previous awards were made. For the first time a *Medal Committee* has been appointed by the Council so as to secure a still higher efficiency in the nomination, and as this Committee consisted of our most distinguished scientists this method of election is in itself a token of the outstanding merit of the recipient.

A second alteration was that the Council recommended to this Committee that the decision should be made on *scientific grounds* only, omitting any recognition for work done for the Society. By this means the Council rightly attempted to raise the standard of the award, as made to a man of science.

May I point out however, that if this clause had stood you should have been the first to get the medal on such grounds alone, for there are few of our members who have done for the Society what you have done for it in the past and it is greatly to be regretted that circumstances prevent you from taking

the active position in the Society which you so ably held up to about a year ago. I hope you will, when looking at the medal, think of our gratitude for the vast amount of work you have done for the Society during the first three years of its existence and I hope you will also reflect on the friendly feelings of the one who was its President during two years of that period. Without your support and active work we would have been helpless.

At the same time, however, I beg to remind you that this award was made only in recognition of the *scientific work* done by you in S. Africa, and as an entomologist, it gives me great pleasure indeed that this award was made to you, as this honour reflects on us as well who are your fellow-workers.

At the time when you started your entomological career most people looked upon an entomologist as a sort of crank, who, though of a harmless nature, was certainly not a scientist in the true sense of the word. His study was a hobby, fascinating perhaps, but hardly scientific. It is true, that even then the general public regarded the economic entomologist as a worker of some importance, but he was looked upon as several ranks lower than the botanist. How this state of affairs for instance is changed is proved by the fact that this third award follows immediately upon one made to a botanist.

The Medal Committee has sent us the following report, showing the grounds on which they recommended the award of the third medal "On the unanimous recommendation of the Medal Committee of the S.A.B.S. the Capt. Scott Senior Medal has been awarded to Mr. Claude Fuller, of the Division of Entomology, more especially for his researches on S. African Termitidae. A brief outline of the wide scope of his work is here indicated."

Mr. Fuller's investigations in economic entomology are well known from his numerous publications in the official Reports of the Departments of Agriculture, not only in the Union, Cape Colony and Natal, but also of New South Wales and Western Australia. The contents of the seven Annual Reports (1899-1910) issued by him when Government Entomologist of Natal are of considerable interest, economic value and importance. In

these Natal Reports Mr. Fuller described the life history of the maize stalk-borer, *Calamistis fusca.*

The credit for the system of destroying locusts under State control, as practised at the present time, must be given to Mr. Fuller, who put forward he fundamental principles of this very successful scheme.

Mr. Fuller also worked on problems of distinct importance to horticulturists, such as those connected with citrus fruit and pineapples.

In addition to the numerous official publications mentioned previously, Mr. Fuller has published valuable memoirs on the *Coccidae* and *Termitidae.* Among these may be mentioned:—

(1) "The Coccidae of West Australia." Trans. Ent. Soc. Lond. (1899).

(2) "White Ants in Natal." Bulletin 54, Union of S.A. Dept. of Agriculture.

(3) "Observations on some S.A. Termites." Annals Natal Museum, Vol. 111. Pt. 2. 1915.

(4) "The Wing Venation and Respiratory System of certain S.A. Termites." Annals Natal Museum. Vol. IV. 1919.

(5) "The development of the Termite Antenna." Annals Natal Museum. (In the Press.)

As an entomologist who has had the good fortune of watching Mr. Fuller at his work I cannot refrain from making a few additional remarks, which, though not adding much to the above strictly scientific considerations, certainly will throw additional light on some of his methods of work.

We have in Mr. Fuller not only a scientist, but also a great artist, a combination only too rarely found among entomologists. All articles published by him were most ably illustrated by himself with rare skill, accuracy and taste. How much work of a painstaking nature the illustrations of his "The wing-venation and respiratory system of certain S.A. termites" involved, will only be realised by those who watched him during

the preparation of this volume and by those who attempt to follow in his footsteps. Not only his own papers, but many of those of other workers were illustrated by his able brush and pen, for instance some of Dr. Peringuéy's papers on S. African Coleoptera.

Last but not least I may mention Mr. Fuller's rare enthusiasm and devotion to his studies; I am sure he loves his Termites! Rarely did I come to his room when he was Secretary, to discuss matters concerning the Society, but we would not soon be conversing about possible wing-development, revolutionising views about structure of stigmata, or the arrangement of termites according to the joints of the antennae. It showed how deeply and how often he thought about the problems that presented themselves and how well the observations were digested before they were sent to the press.

While presenting this medal to you, Mr. Fuller, we add the sincere wish that for many years to come you will be able to continue your fascinating studies with as much success as you have done in the past.

THE TERMITES OF SOUTH AFRICA;

Being a Preliminary Notice.

By CLAUDE FULLER.

The present paper, whilst dealing mainly with the termites of the Union of South Africa also embraces species occurring or reported to occur in Africa south of lat. 22 deg.

It is not proposed to give descriptions of any of the known species, but preliminary statements are made for those regarded as, at present, undescribed.

The keys given are to be regarded as for the everyday use of the field naturalist, and are not designed for the systematist to whom the literature is available.

Some apology is required for the length at which the synonomy of some species is dealt with. I have, however, been unable to offer solutions to the puzzles presented in fewer words.

My species are species in the commonly accepted taxonomic sense. I take the type as having, or in the future being given, a sufficiently elastic description to include the many variations to be met in the asexual castes and also in the antennae and wing venation of the imagos.

The term "variety" has been avoided as a systematic distinction and "form" or "subspecies" used in its place. "Forms" are such as cannot be brought into an elastic description without destroying the biological situation. They would be treated as species by some, but appear to me more in the nature of topographical races.

The term "subspecies" is employed to preserve what also appears to me to be a biological situation. Such as are given might have been ranked as species were it not that by so treating them the distinct relationship they bear to the type would be obscured.

It is not to be inferred that I have any proof that the subspecies recorded are fertile with the type. It is quite possible they are not. On the other hand, the possibilities of "forms" interbreeding among themselves and with the type are so great that such may reasonably be inferred.

As I find no two authorities in agreement upon the fundamental points of a classification, all differing more or less in their view of family relationships, and even the status of genera and subgenera, I have adopted a group system. This may seem to be a retrograde step, but it is the only alternative. The arrangement followed permits of any reshuffling subsequently found desirable, and will be found workable and non-contentious. Moreover, the grouping as here proposed has these immediate, if but local, advantages:—

(a) The characters of the soldiers will, almost always, give a direct clue to the group to which they belong.

(b) The group gives a key to the biology of the species included in it; or, *vice versa*, the natural habit, when known, will indicate what group the species belongs to.

Although the termites of the African continent are estimated to represent at least sixteen groups, it would serve no useful purpose to notice all here and, for this reason, I have confined myself to those of which we have representatives. On this basis there are ten groups and twenty-one genera. These are:

1. CALOTERMES Group.
   - Calotermes.
   - Neotermes.
   - Cryptotermes.
   - Porotermes.
2. HODOTERMES Group
   - Hodotermes.
3. PSAMMOTERMES Group
   - Psammotermes.
4. RHINOTERMES Group
   - Schedorhinotermes.

5. TERMES Group
    - Allodontermes.
    - Macrotermes.
    - Termes.
    - Microtermes.
6. APICOTERMES Group
    - Apicotermes.
    - Hoplognathotermes.
7. NASUTITERMES Group
    - Trinervitermes.
    - Subulitermes.
    - Coactatotermes.
8. HAMITERMES Group
    - Hamitermes.
9. MIROTERMES Group
    - Mirotermes.
    - Cubitermes.
    - Procubitermes.
10. EUTERMES Group
    - Eutermes.
    - (syn. Microcerotermes.)

With regard to the genera enumerated, the following remarks are offered upon the synonomy and status thereof:—

Calotermes: In a preliminary note Hagen (1853) created the genus *Kalotermes*. The elaboration of this note was delayed for the publication of Peter's "Reise nach Mossambique" (1862). In this the same spelling is adopted and *Termes flavicollis* Fabr. is cited as the type for living species, as opposed to fossil species. However, in the interim, Hagen (1858) revised the spelling to *Calotermes*, and in this form it is now thoroughly engrafted upon the literature of termites. It is one of those cases that will, so I think, prove an exception to the rules of nomenclature Except *Porotermes*, the other genera included in this group (and some more not mentioned) are ranked as subgenera of *Calotermes* sens. lat. by Holmgren (1911). Admittedly most of Holmgren's subgenera of *Calotermes* sens. lat. are good independent genera.

Porotermes is included in the *Calotermes* group because the biology of our one species, *P. planiceps* (Sjöst), appears somewhat similar to that of the remaining genera. It is a genus with only four known representatives, one African, two Australian and one South American. The local species was originally described as a *Calotermes*. It was transferred to *Porotermes* by Holmgren (1911) who created a special subgenus, *Planitermes*, for its reception. This is a distinction that seems to me to be superfluous as the genus is so poor in species. *Calotermes amabilis* Sjöstedt is probably the winged form of *P. planiceps*.

Schedorhinotermes was created as an independent genus by Silvestri (1908) and subsequently reduced to a subgenus of *Rhinotermes* sens. lat. by Holmgren (1911). There is much to be said in favour of Holmgren's arrangement but, as the typical *Rhinotermes* are South American, a certain amount of prolixity is avoided by following Silvestri.

Allodontermes was created by Silvestri (1912). In Holmgren's classification (1912) it will be found as a subgenus of *Protermes* s.lat. If *Protermes* stands, it may only do so as a subgenus of *Allodontermes*, the last having admitted priority.

Macrotermes is the name given by Holmgren (1912) for a section or subgenus of his genus *Termes*. I propose to ignore the sub-division made by Holmgren, as it appears unnecessary, and call the genus *Macrotermes*. In creating a genus with *Termes bellicosus* Smeathman as the type, Holmgren (1912) deliberately gave to it the name *Termes*. As I interpret him he says: " I will no doubt be reproached for disregarding the rules of nomenclature in naming the species of this genus *Termes* because the type of *Termes* is *T.capensis* or *T.fatalis*, both of which have been placed by me in the genus *Odontotermes*." On both pages 32 and 40, " Termitenstudien III " he is at pains to point out that he has wittingly suspended the rules of nomenclature and to recommend that his *Odontotermes* should be called *Termes*, and a new name given to *Termes* sensu Holmgren. On this point Banks (1920) makes the following remarks: " *Termes* was used by Linneus in the tenth edition of his Systema Naturae

(p. 609, 1758) for three insects, one termite, and two psocids. The latter have been removed. The one termite was *T. fatale* of India; this then is the type of the genus. Several have credited the genus to Hagen, and Holmgren puts Smeathman as authority for the genus, and several have considered *T. bellicosus* as type." The Linnean type, as types go, is unquestionably *T. fatale* Linn. (1758) since this name is accompanied by both a description and a figure in the Systema Naturae. But *Termes fatale* can only be regarded as a legendary species seeing that it seems to have been based upon an account and drawings supplied to Linneus by Rolander of a termite seen by that traveller in Surinam, not India. On these grounds, coupled with the practical impossibility of connecting *fatale* with a South American termite, Hagen (1858) recommended the suppression of *fatale;* from then onward it has been treated as a *nom. negl.* The Indian insect is *T. fatalis* Köenig (1779) doubtless so named because Köenig, when describing it, thought he was dealing with the Linnean species. There is no evidence to show that Linneus ever saw this insect of Köenig, but we have Sparrman's word (1783) that *Termes capensis* De Geer (1778) was both seen and recognised as a termite by Linneus. *T. capensis* should therefore be regarded as the type or leucotype of the genus. Whilst *Odontotermes* sensu Holmgren falls away, it may be employed for a subgeneric section of Termes, covering species of the *monodon-badius-transvaalensis* group.

Microtermes is a genus to which, subsequently, *Ancistrotermes* will be found attached as a subgenus. *Ancistrotermes* was erected by Silvestri as an independent genus and subsequently Holmgren (1912) reduced it to a synonym of *Microtermes.* Silvestri has objected very strongly to this and maintains the separateness of his genus. Certainly *Ancistrotermes* is sufficiently distinct from *Microtermes* to hold subgeneric rank, but, biologically, it is too closely allied to be treated as an independent genus.

Nasutitermes is the group name for a series of genera or subgenera that were placed by Holmgren (1912) in his *Eutermes* sens. lat. Banks (1920) substituted *Nasutitermes* for Holm-

gren's *Eutermes* s.lat. and s.str. He gives ample evidence to prove that *Eutermes* has long been wrongly applied to those species with nasuti. Banks shows very clearly that the type of the genus *Eutermes*, as erected by Heer (1849), is a termite known as *Microcerotermes debilis*. Consequently *Microcerotermes* disappears and is replaced by *Eutermes*. The three South African sections of this group are herein accorded generic rank tentatively. *Trinervitermes* and *Subulitermes* probably represent subgenera of *Nasutitermes*, but *Coarctotermes* is without doubt independent.

Hamitermes is the spelling adopted by European authorities. The genus was erected by Silvestri (1901) under the name *Amitermes*. Subsequently Silvestri altered the spelling to *Hamitermes*. As the change may be authorised under Article 19 of the Rules of Nomenclature, Silvestri's revised spelling has been followed.

Mirotermes s.lat. is a genus in which Holmgren (1912) included those here given (and a number of others) as subgenera. So far as the South African kinds are concerned I find it convenient to accept the distinctions as generic.

SYNOPSIS OF GENERA.

I.—*WINGED IMAGOS.**

I. STUMP OF FOREWING PLAINLY DIFFERENT FROM AND DECIDEDLY LARGER THAN THAT OF HINDWING.

A. Radius well separated from Costa with a number of oblique offsets to Costa; Radius without strong sector-like branches to inner margin of wing.

(1) Media reaching to wing-tip; (yellowish insects).

a. Media faintly chitinised; half way between R. and Cu. or nearer to Cu. than R.

(i) With Ocelli, these touching eyes. *Calotermes*

(ii) Ocelli missing. *Porotermes*.

b. Media densely chitinised, close to and parallel with Radius. With ocelli touching eyes. *Neotermes*

(2) Media not reaching wing tip. Small brownish insects. M. joined to R. at half wing-length so forming an elongated cell between R. and M. *Cryptotermes*.

*In this synopsis Radius is equivalent to Sub-costa of Hagen and Sjöstedt, Radial Sector of Holmgren and Comstock and Radius of Desneux.

B. Radius quite close to and parallel with Costa; simple; reaching to wing-tip; both Costa and Radius of equal development. *Schedorhinotermes.*

II. STUMP OF FOREWING PLAINLY LIKE THAT OF HIND-WING, ABOUT THE SAME SIZE OR BUT SLIGHTLY LARGER.

A. Radius well separated from Costa, with a number of oblique offsets to Costa, and WITH SEVERAL STRONG SECTOR-LIKE BRANCHES TO INNER MARGIN OF WING. *Hodotermes.*

B. Radius quite close to and parallel with Costa; both C. and R. of equal development. R. simple, reaching to wing-tip.

(1) Media missing as a rule; weakly developed when present. Cubitus highly developed. Small brownish insects; span 15 mm. *Psammotermes.*

(2) Media always present; well developed but not strongly chitinised, reaching to apex of wing.

a. Head parallel sided, somewhat elongate. Small black insects; males decidedly smaller than females. *Eutermes.*

b. Head never parallel sided; (rounded or broadly oval.)

(i) Costa and Radius, yellow or orange coloured; colour contrasting with more or less smoky membrane of wing. Fontanelle plainly triangular. Antennæ XV to XVII jointed. Insects medium sized; body 10 mm. Span 38 to 45 mm. *Trinervitermes.*

(ii) Costa and Radius concolorous with wing, or, if contrasting, wings clear hyaline, not smoky or brownish.

aa. Antennæ XIX jointed.

1. Largest kinds; Body 16 to 20 mm. Span 54 to 88 mm. Body brown and relatively smooth. Wings hyaline, never smoky. *Macrotermes.*

2. Large kinds: Body 12 to 15 mm. Span 38 to 56 mm. Body usually hairy (exception *T. caffrariae*). Bodies brown or black; wings hyaline, brown, smoky or black. *Termes.*

3. Medium sized: Body 10 mm. Span about 40 mm. Bodies smooth, yellowish brown. Wings hyaline *Allodontermes.*

bb. Antennæ XV to XVIII jointed. Medium sized. Body 10 mm. Span about 30 mm. Bodies smooth, pale yellow to yellowish brown. Wings hyaline. (Compare with *Allodontermes*, which it much resembles.) *Microtermes.*

cc. Antennæ XV to XVII jointed.
Relatively small insects with dark bodies and dark wings.
1. Larger kinds: Body 6 to 8 mm. Span 23 to 27 mm. Wings usually smoky or blackish. Antennæ XV, XVI, XVII. *Cubitermes* and *Mirotermes*.
2. Smaller kinds: Body 5 to 6 mm. Span 19 to 24 mm. Wings usually brownish. Antennæ XV. *Hamitermes*.

II. *SOLDIERS.*

I. NASUTI WITH MANDIBLES REDUCED TO MICROSCOPIC PLATES. HEADS, SEEN FROM ABOVE, PEAR-SHAPED WITH A LONG TUBULAR SNOUT.

A. Head regularly pear-shaped. Body brownish.
(1) Head yellowish or reddish; snout usually darker. *Trinervitermes*.
(2) Head brownish. *Subulitermes*.
B. Head irregularly pear-shaped; sides plainly constricted; wine-coloured. Body black. *Coaretotermes*.

II. HEADS ABNORMAL: MANDIBLES AS LONG OR LONGER THAN HEAD, BLADE-LIKE OR ROD-LIKE. HEADS SHORT AND THICK; SEEN FROM THE SIDE DISTINCTLY TRUNCATE OR DECIDEDLY SLOPING IN FRONT AND ALWAYS WITH A LARGE FRINGED PORE (Fontanelle) ON FRONT.

A. Head not plainly longer than wide, four sided; mandibles blade-like.
(1) Labrum deeply forked; basal joint of antenna smooth. *Cubitermes*.
(2) Labrum with sinuate indented tip but not deeply forked; basal joint of antenna rough. *Procubitermes*.
B. Head longer than wide, four-sided, frontal ridge with a pinched up, pointed protuberance; mandibles rod-like. *Mirotermes*.

III. HEADS NORMAL: CYLINDRICAL SUBCYLINDRICAL OR LENTICULAR.

A. Head long cylindrical (roller-like) about twice as long as wide; eyes missing. Mandibles fairly strong; inbent at tips; cutting margin finely serrate. Small insects. *Eutermes*.
B. Head sub-cylindrical; somewhat flattened; facetted eyes present; mandibles toothed; pronotum flat or introse never plainly sellate.
(1) Mandibles plainly down bent, short, massive; eyes distinct. *Porotermes*.

(2) Tips of mandibles plainly up bent.

a. Head shorter than body; mandibles prominent, teeth large; labrum short, wide, appears rounded; eyes large, concolorous with head. *Calotermes.*

b. Head almost as long as body, very characteristic; in front decidedly truncate and with a distinct frontal cavity; cavity overhung by a sculptured ridge; mandibles short, triangular with small teeth; labrum triangular; eyes small, usually indistinct. *Cryptotermes.*

C. Heads lenticular, flatly arched, oval or sub-oval in dorsal outline; without facetted eyes.

(1) Labrum characteristic.

a. Labrum with a deep median groove and fimbrinate tip; fontanelle large; mandibles short and with acute teeth. *Schedorhinotermes.*

b. Labrum not grooved, triangular, with a distinct cordate, fleshy tip. *Macrotermes.*
[Labrum forked like prongs of catapult; head abnormal. *Cubitermes*, et ante.]

(2) Labrum excluded, except as a secondary character.

a. Mandibles sickle-shaped (characteristic); both alike; both furnished with one strong tooth, the point of which is directed backwards. *Hamitermes.*

b. Mandibles without teeth on cutting margin. Mandibles strong, sword-shaped, tips inbent and upcurved.

(i) Large insects: soldiers of two sizes; labrum with cordate fleshy tip. Smallest soldiers as large or larger than largest workers. *Macrotermes* (et ante).

(ii) Small insects: soldiers about one size; labrum triangular, tip not fleshy. Soldiers not larger than largest workers. *Microtermes.*
[Small insects: head abnormal; mandibles blade-like. *Cubitermes* and *Procubitermes.*]
[Mandibles rod-like. *Mirotermes.*]

c. Left mandible only with one strong tooth (like a step) on cutting margin. Tooth placed at half length. Right mandible may exhibit a faint tooth opposite that on left. In most species, soldiers only a little larger than largest workers. *Termes* (*Termes*).

d. Both mandibles dentate.

(i) Soldiers with facetted eyes.

aa. Head broadly oval or round, slightly arched; mandibles massive, with large sharp triangular teeth; eyes black and conspicuous. Pronotum distinctly sellate. *Hodotermes.*

bb. Head elongate; pronotum not sellate.
1. Mandibles up bent. *Calotermes* (et ante).
2. Mandibles down bent. *Porotermes* (et ante).
3. Mandibles triangular, teeth small. *Cryptotermes* (et ante).

(ii) Soldiers without facetted eyes.
aa. Pronotum flat, semi-lunar, deeply incurvate in front. Head longer than wide, with a large pore in middle, sides parallel. Antennæ stiff, joints with apex swollen. Legs short and stout. *Psammotermes.*
bb. Pronotum not flat, somewhat sellate.
1. Left mandible with several small broad teeth; right with one. Labrum pointed, on the tip a boss. *Apicotermes.*
2. Both mandibles with a decided tooth.
a. Tooth on left step-like, on right triangular. Head oval. Labrum tongue-shaped. *Termes* (*Odontotermes*).
b. On both step-like. Head short rectangular. Labrum as wide as long, sub-trapezoid in front. *Hoplognathotermes.*
3. Left mandible with a wide apical point, below this a distinct notch. Right mandible with a decided tooth (step-like) at half its length. Labrum roundly triangular with a small hyaline tip. *Allodontermes.*
4. Both mandibles alike, both finely serrate. Heads cylindrical. *Eutermes* (et ante).

SYNOPSIS OF HABITS AND FIELD KEY.

I. Living and nesting in trees.
A. Nests in form of simple cells and galleries gnawed out for food and accommodation; almost always located in dead stubs where limbs have broken away. Seldom any external evidence. Abdomen of queens elongated not greatly distended; queens moving freely in nest. No workers present; relatively few soldiers; colony composed of many nymphæ in all stages of development. No earth in nest.
(1) Soldiers fairly large; mandibles large and strongly toothed. Distribution: Natal, Cape, (East and S.E. Coasts). *Calotermes* (2 spp). *Neotermes* (1 sp).

(2) Soldiers small, very few in colony; mandibles short; head hardly longer than body. Distribution: Natal, Cape (East Coast). *Cryptotermes* (2 spp).

B. Living in dead wood; so far only found in mountainous parts of southern Cape Province. Soldiers with strong toothed mandibles; mandibles plainly downbent; facetted eyes large; accompanied by workers. Biology not well understood. *Porotermes* (1 sp).

C. Making nests of carton in hollows, that are due to decay, in trunks and limbs of standing trees. Soldiers and workers found below long individual galleries of carton extending up and down trunk and branches. Workers boring for food in dead limbs. Soldiers of two very distinct castes, both castes exhibiting a very distinct labrum which is deeply grooved and possesses a fimbrinate tip. Distribution: Coast of Natal and Zululand. *Schedorhinotermes* (1 sp.)

II. Nesting in soil.

A. Nests independent; capable of being lifted out bodily, unless, as sometimes happens, attached to dead roots or stumps. Nests made of a black or black-brown carton like substance. Nests ranging in size from that of the egg of a goose to that of an ostrich, rarely larger. Soldiers small; heads cylindrical, both mandibles alike, both finely serrate. Distribution: General. *Eutermes* spp.

B. Nests never independent.

(1) With little or no surface indication of nest-site.

a. Harvesters. Workers large with brown or black heads and large facetted eyes; to be seen dragging or carrying short grass-lengths into openings in soil. Soldiers large, yellow headed with black eyes and strongly toothed mandibles. Workers may often be found making loose piles of earth like mole-hills, each pile with a clay, tubular core. Nests are large globular cavities in soil; cavities filled with closely set shelving made of a very fragile carton. (Exception, *H. Thomseni*. This species builds a large, hard, clay cone over nest in De Ghoup of the Karroo.) Distribution: General. *Hodotermes*, spp.

b. Fungus growers. Workers feeding on dead grass, wood, and dung, always constructing a canopy of clay. Sometimes found feeding on dead bark and fencing poles.

(i) Nests as large globular cavities with clay brackets and a large fungus garden. Soldiers about as large as largest workers, with one large tooth on left mandible.

aa. Only known from Humansdorp, Cape, S.E. *Termes capensis*.

bb. Distribution: General, except Karroo and Cape, S.W. (Exceptions: making a small mound in the district of George; making a bare patch more or less circular in outline over nest-site in Transkei). *Termes angustatus*, s. lat.

(ii) Nests as very fine tunnels, diameter 2 mm., ramifying in soil; with small adjacent cavities, each containing a small fungus garden.

aa. Fungus gardens like the kernel of a walnut, from one to three inches in diameter. Soldiers not larger than workers with short, toothless, sword-shaped mandibles. Distribution: General, except Karroo and Cape S.W. *Microtermes* spp.

bb. Fungus gardens from 3 to 5 inches in diameter; sub-circular; flat below, arched above, plainly rosette shaped; laminæ radiating from centre. Soldiers but faintly larger than workers; mandibles toothed, left with a decided notch one-third from the apex. Distribution: Northern half of Transvaal and Kalahari. *Allodontermes* (1 sp).

c. Biology unknown.

(i) Reported from Zululand. *Apicotermes* (1 sp.)

(ii) Found at Vryburg. *Hoplognathotermes* (1 sp.)

(2) With marked and often characteristic indications of nest-site.

SECTION I. FUNGUS GROWERS.

a. Nest below a broad flattish and characterless mound or below an assembly of moundlets, each moundlet about 4 inches high and made of firmly cemented earth; nests usually associated with trees or shrubs. Nest cavity large, quite filled with sponge-like fungus garden. Queens largest found; imprisoned in large shapeless cell of clay. Workers often found in great numbers feeding on bark or trees and on posts under sheet-like canopy of clay; commonly found attacking wood work of houses; often found destroying lawns under wide canopies of clay. Soldiers larger than workers with a very distinct step-like tooth on left mandible. Distribution: Natal, Transvaal, Orange Free State and Transkei. *Termes badius* s. lat.

b. Nest-site always indicated by several pits in soil, flat or covered by a raised mound; mouths of pits surrounded with clay pipes; queens large, imprisoned in cells.

(i) Pipes thin walled, tenuous and tapering, sometimes 6 feet high.
Distribution: Transvaal Bush Veld, Kalahari and Vaal River Valley (West).
Termes transvaalensis.

(ii) Pipes thick walled, turret-like, three inches to two feet high.
Distribution: General for Natal and Transvaal. *Termes latericius* s. lat.

c. Nest site covered by mound of loose soil, not unlike that of new grave; usually amongst trees; infrequently becoming compact and hard by weathering; usually with mole-hill like moundlets on or next to main mound. Soldiers large and aggressive with sword-shaped mandibles; queens imprisoned in clay cells.
Distribution: Transvaal, Waterberg area.
Macrotermes waterbergi.

d. Nests in or below hard mounds of cemented earth.

(i) Nests as large cavities, down to 4 feet below soil level. Queens large, imprisoned in clay cells. Mounds fairly characteristic when not grass-grown.

aa. Mound roughly dome-shaped, covered with large knobs or moundlets of hard texture shaped like warts. Soldiers large; aggressive; with sword-shaped mandibles. A destructive species. Distribution: Foothills of Drakensberg in Eastern low veld of Transvaal and Swaziland. *Macrotermes swaziae.*

bb. Mounds conical.

1. Tall mounds, 10 feet and upwards; may be very large and grass-grown, then often with a clay column at apex. Soldiers with sword-shaped mandibles.

a. Very destructive, found in Damaraland; Ovomboland; Valley of Limpopo; Portuguese East Africa; west of Lebombo Mountains.
Macrotermes bellicosus s. lat.

b. Very destructive, found in Transvaal Eastern low veld.
Macrotermes natalensis f. intermedius.

2. Mounds not tall; 3 to 4 feet or, rarely, 6 feet high.

a. Soldiers with sword-shaped mandibles. Very destructive, found in Natal, Transvaal, Griqualand West, Kalahari.
Macrotermes natalensis s. str. and s. lat.

b. Soldiers with large step-like tooth on left mandible. Mounds low and more often grass covered than bare. Distribution: Natal.
Termes vulgaris.

SECTION II. NOT FUNGUS GROWERS.

(ii) Nests within cellular mounds; nest superficial, never penetrating soil to any great depth.

aa. Mounds usually hemispherical (like a Zulu hut) or roughly conical. In Kalahari sometimes columnar and 6 feet high; elsewhere, seldom more than 2 high and 3 feet in diameter. Surface of mound hard; interior relatively soft and very cellular; cells intercommunicating openly and forming a labyrinth, always more or less filled with short grass lengths. Cellular part never carried down into soil more than 18 to 20 inches.

1. Soldiers nasute. Soldiers with yellow or reddish heads. Distribution: General for Union.
Trinervitermes spp.

2. Soldiers with brown heads. Distribution: Bushmanland.
Subulitermes sp.

bb. Mounds sometimes hemispherical, more often flatly dome-shaped; of hard texture; cells small and cell-walls thick. No provisions stored in nest. Cellular part not carried deep into soil. Soldiers with barbed and sickle-shaped mandibles. Distribution: General, except Natal. *Hamitermes* spp.

cc. Mounds quite small; very hard, usually like a piece of sandstone set in soil; never more than a few inches high and 12 inches in diameter. Soldiers with short thick heads. Often built amongst stones.

1. Soldiers with a forked labrum. Distribution: General. *Cubitermes* spp.

2. Soldiers with basal joint of antenna roughened. Distribution: Transvaal.
Procubitermes sp.

1.—CALOTERMES GROUP.

Genus CALOTERMES Hagen.

Calotermes durbanensis Haviland.
= *Calotermes madagascarensis* Wasmann, Sjöstedt (in part, 1900).

This species belongs to the *C.flavicollis* group. No complete description of the imago has been given, the species being erected by Haviland on the soldier caste only. The imago is well known to me, and I believe the species to be distinct from the insular *madagascarensis*. There appears to be much in which the two are alike, and it is to be remembered that Sjöstedt reduced *durbanensis* to a synonym of Wasmann's species on a comparison of soldiers only. Unfortunately Wasmann's description does not go far enough. However, he describes the pronotum of the winged *madagascarensis* as short, broad and semilunar, a description that does not fit the pronotum of *durbanesis*, which is sub-quadrangular. Similarly, Wasmann's description of the pronotum of the soldier does not apply.

The soldiers of *durbanensis* differ from those of *flavicollis* in not having the prominent third tooth (not counting the apical) shown in Hagen's figure of the left mandible. Judging by the same figure, the soldier pronotum of *durbanensis* appears more like that of *flavicollis* than *madagascarensis* except that the hind margin is rounded, not incurvate in the middle as appears to be the case with both *flavicollis* and *madagascarensis*.

Calotermes braunsi n.sp.

Through the kindness of Dr. Hans Brauns, I have from " The Wilderness " on the Cape South Coast soldiers and nymphs of a *Calotermes*. These I regard as representing an undescribed species. The soldier is readily distinguished from that of *durbanensis* by having three distinct teeth below the apical, as figured for *flavicollis* by Hagen. It differs from both *flavicollis* and

durbanensis in having the front margin of the pronotum angularly indented in the middle. The labrum is longer than that of *durbanensis*, always covering more of the base of the mandibles.

Genus NEOTERMES Holmgren (1911).

Neotermes zuluensis Holmgren.

Holmgren has described a species under this name from material collected by Ivor Trägardh at Lake Sibayi, Zululand. The species is founded on the soldier form, the imago being unknown. The published description is very imperfect, and as far as it goes might relate to *durbanensis*. The imagos of *Neotermes* differ strikingly from those of *Calotermes* inasmuch as the Media runs close to and parallel with the Radius whilst in *Calotermes* it lies about half way between the Radius and Cubitus. I have not met with any imagos or soldiers of *Neotermes* up to the present.

Genus CRYPTOTERMES Banks.

Cryptotermes merwei sp.n.

This termite is to be found at a number of points along the Natal coast. The nests are always in the dead stubs left where limbs have broken away from living trees. Although intermingling with *Calotermes durbanensis* it favours more the flora of the sand dunes behind the sea beaches. However, I have received imagos that cannot be separated from the Natal form from the Albany Museum. These were obtained from the Brak Valley, Grahamstown.

The imago of *merwei* answers well to the description given by Sjöstedt for *C.Havilandi* from Senegal, etc. It is, however, a little smaller and may differ in features not touched upon in Sjöstedt's description. The soldiers are very different from those of *havilandi* as described by Silvestri. The frontal ridge of the head is very slightly incurvate, almost straight. In this it differs from *havilandi*, *senegalensis* and *pseudobrevis*. The clypeo-apical is short, wide, and the front margin distinctly incurvate. The labrum is wide, somewhat heart-shaped in outline; the tip

finely pointed. I have much pleasure in naming this insect after my colleague, Mr. C. P. van der Merwe, as a small return for the many observations he has made for me.

Cryptotermes pseudobrevis sp.n.

Colonies of this species are known to have inhabited the woodwork of certain compositors' desks in the printing works of the "Natal Mercury," at Durban, for a number of years past. Because it has not been found elsewhere and is localised in the centre of that part of the town which has longest been the most closely built over, one is inclined to look upon it as an exotic species.

The heads of the soldiers, in a lateral inspection, agree wholly with the excellent figure of the West Indian *Cryptotermes brevis* Walker published by Nathan Banks (1920). Unfortunately, there appears to be no description of this caste of *brevis*, the species having been erected on the imago. The head of *pseudobrevis* is, as with that of *brevis*, tuberculate in front and smooth behind. There is also a deep cavity in front. Viewed from above *pseudobrevis* exhibits a strikingly bilobed frontal ridge; this is more deeply indented than is the case with *havilandi* and *senegalensis*. Behind the frontal ridge there is a median groove extending back to nearly half the length of the head. From this aspect the sides of the head are so sinuate that the outline resembles that of a squat ewer. The pronotum is cream coloured except for the erected, front corners and thereabouts, where it is brown.

The front corners are well within the boundaries of the sides so that the pronotum may be said to narrow strikingly; they are triangular and flap-like, and so erected that each is marked off from the rest of the pronotum by a distinct groove. The sides and hind margin merge roundlv into one another The figure of *brevis* given by Banks does not indicate any striking peculiarity of the pronotum such as that here described for *pseudobrevis*..

The winged imagos before me were killed in the nest before they had become chitinised. They are pale yellow with black

eyes. With them are two breeding males and one female; these are brown. None of the specimens have antennæ.

Hagen's description of the imago of *brevis* might be applied to these except they are larger.

The measurements of the imagos of the several *Cryptotermes* discussed are contrasted below in millimetres.

	merwei	havi-landi	brevis	pseudo-brevis
Body with wings	8·5	9.0	9.0	11.0
Body without wings . .	5 to 5.9	5.0	4.0	5 to 5.5
F.Wing with stumps . .	7.0	—	—	9.5
F.Wing without stumps	6.2	7.3	—	8.5
Span	15.0	17.0	16·0	20.0

Genus POROTERMES Hagen (1858).

Porotermes planiceps (Sjöstedt.)

= *Calotermes planiceps* Sjöstedt (1904).

= *Porotermes* (*Planitermes*) *planiceps* (Sjöst.) Holmgren 1911).

? = *Calotermes amabilis* Sjöstedt (1911).

This species was described from soldiers and workers found in a dead stick by Dr. L. Perinquey, at Ceres, Cape Province. I understand from Dr. Perinquey that he has also seen the species at Stellenbosch and on Table Mountain. Part of the original type series is in the South African Museum at Cape Town. These specimens I have examined.

I have also a good series of soldiers and workers found by Dr. Hans Brauns in the Montagu Pass, where he kindly made a special search for the species on my behalf. They were found in a fallen piece of dead wood.

The imago of *planiceps* is as yet unknown. Sjöstedt has, however, described and named a winged termite from "Kapland" under the name *Calotermes amabilis*. This exhibits no ocelli, and the absence of these organs coupled with other features leads one to infer that *amabilis* is a *Porotermes* and, probably, the winged form of *planiceps*.

GROUP II.—HODOTERMES.

Genus HODOTERMES Hagen.

Sub-genus *Hodotermes* s.str.
Type *Termes viator* Latrielle (1805) a worker.
Sub-genus *Macrohodotermes* sg. nov.
Type *Hodotermes mossambicus* Hagen.
Sub-genus *Anacanthotermes* Jac.
Type *Hodotermes ochraceus Hagen* (from Persia.)

Hodotermes was created by Hagen (1853) with *T. viator* Latr. as the type. Later (1858) the genus was subdivided by him into two sections; one containing *ochraceus* and *vagans*, the other *mossambicus* and *viator*. Neither section was given subgeneric rank. Jacobson (1904) erected the subgenus *Anacanthotermes* for *H. ochraceus* Burm. This sub-genus was suppressed by Desneux and reconstituted by Holmgren.
The revision here submitted is:

A. Tibiae of imagos without lateral spurs *Anacanthotermes* Jac.

B. Tibiae of imagos with lateral spurs.

a. Styli elongate cylindrical, first wing rib without branchlets to costa. Basal half of gula noticeably chitinized, brown or yellow; left mandible of soldier somewhat straight with first and second teeth short, wide and blunt, not triangular; gula of worker as with imago. *Hodotermes* s. str.

b. Styli atrophied or missing; first wing rib with one or more short oblique branchlets to costa.
Basal half of gula not noticeably chitinised, pallid or mottled with grey or black; left mandible of soldier arcuate, with first and second teeth pointed and triangular; gula of worker as with imago.
Macrohodotermes, sg.n.

Sub-genus HODOTERMES, s.str.

Hodotermes viator (Latr.)
= *H. aurivillii* Sjöstedt (1900).

The synonomy of *Hodotermes viator* (Latr.) is somewhat involved; but from an examination of the type, I have been able to decide that the form hitherto known as *H. aurivillii* Sjöstedt (1900) represents Latrielle's species. In a previous paper of the writer's (1915), wherein a description of the soldier and worker caste of *viator* was set out, the announcement was made that *aurivillii* was quite a distinct species.

It is only recently, however, that I have had the opportunity of inspecting Latrielle's type, this being submitted to me, from the Brussels Museum, through the kindly offices of Dr. L. Peringuey, Director of the South African Museum. It is especially interesting that after a period of over 115 years this specimen should again return, if but temporarily, to South Africa and be sufficiently unique to set at rest what might otherwise have remained debatable.

The type has a recorded headwidth of 4 mm. (Hagen,, Sjöstedt) but a careful measurement shows it to be 3.8 mm. The head is a clear red brown in colour with the pseudo ocelli very distinct, quite sharply defined and bright yellow. The flagelli of both antennae are missing so that only the two basal joints of each organ remain. The mandibles are closely clenched and cannot be examined. The frons exhibits a shallow but distinct transverse depression almost oblong in outline, the hind margin being broken in the middle by a short keel, a projection of the vertex into the depression. The body, as a whole, is an opaque, orange yellow, there being a noticeable and dark band in the transverse furrow of the pronotum. The legs are a pale sordid yellow, but two are present, and from one, a tarsus is missing. Apart from the labels showing it to be Latrielle's type, there are two older labels which I have failed to decipher.

The type is characterized mainly by its unusually large head and it is mainly upon this feature I have connected *aurivillii* with *viator*.

Widely distributed as *Hodotermes* s.s. is throughout the Union south of the Orange River and ample as are my series from certain points, those points are comparatively few and widely separated as may be seen from the accompanying list:

N. W. area: Springbok, Steinkopf, Prieska (Sodium) Van Rhynsdorp.

S.W. area: Malmesbury, Stellenbosch, Elsenberg, Simondium, Groot Drakenstein.

Middle area: Victoria West, Nobelsfontein, Three Sisters, Beaufort West, Krantsvogelkuil, Montagu, Willowmore.

S.E. area: Peddie, Alicedale, Coeney.

Upon the whole each series is fairly representative of the average condition of the particular community each illustrates. This being so it is remarkable that in the Malmesbury series only are there workers that attain the full dimensions given by Sjöstedt for *H. aurivillii*. Quite a number of these workers have a head width of 3.8 mm. In only a few of the remaining series is there an occasional worker with a head width of 3.5 mm. Apart from their wide heads the workers from the Malmesbury district are also more in agreement with Latrielle's type as regards the colour of the head and the striking distinctness of the pseudo ocelli. So much is this the case that one feels sure the type locality of *viator* must be that neighbourhood or somewhere in the country intervening between there and Cape Town of a similar, sandy treeless, nature.

The points upon which Sjöstedt distinguished *aurivillii* from *viator* may be tabulated as follows:

viator.	*aurivillii.*
(a) Mandibles somewhat straight.	somewhat curved.
(b) Left mandible of soldier with third tooth small.	with third tooth very distinct.
(c) Front and hind lobe about equally long in the middle	Front lobe more strongly out-curved than *viator*, front angles more broadly rounded.
(d) Hind margin of pronotum circular (kreisformig).	not so strongly curved. Broad incurved (eingebuchtet) in the middle.
(e) Workers: The workers stand between the larger and the smaller of *aurivillii*, otherwise hardly distinguished.	
Headwidth of worker 4.0 mm. Length 8 mm.	Headwidth 2 to 3.8 mm. Length 7 to 11 mm.

There are three differences here which, taken together, go to show the strong possibility that the soldier, in the Schoenherr collection, identified as *viator* by Hagen was not *viator*. Upon the several points I would like to offer the following remarks.

(a) The mandibles of the largest soldiers in the Malmesbury series are plainly more incurved than are those of the medium sized and smallest. The mandibles of the smaller are as straight as of soldiers of equal size found elsewhere in the Cape S.W.

(b) By comparing camera lucida drawings of the mandibles of the soldiers of this sub-genus, one is able to detect differences in the prominence and orientation of the third tooth of the left mandible as between soldiers of the same series and as between species. Thus the third tooth is more prominent in some soldiers of the Malmesbury series than in others. As between species, so far as my examination goes this tooth is least produced and blunter in *viator* (e.g. *aurivillii*) than in others, especially *H. peringueyi* and *H. thomseni*.

(c) The difference cited for the anterior lobes and angles of the pronotum furnishes my principal reason for thinking the insect in the Schoenherr collection was wrongly determined as *viator* by Hagen.

(d) The hind margin of the pronotum of all soldiers of *Hodotermes* s. lat. is incurved in the middle. There are differences in the degree of incurvature, but with the exception of one abnormal specimen, I have seen no soldier of which the hind margin of the pronotum could be described as " kreisformig ". This abnormal specimen is one of the Malmesbury series!

(e) The only dimension of any value in comparing the variation of size of workers of *Hodotermes* s. lat. is the headwidth. On this Sjöstedt's statement that the workers of *viator* stand " between " the larger and smaller of *aurivillii* collapses.

Latrielle's description (1805) is quite brief and may be quoted in full:

TERMES VOYAGEURS — *Termes viator.**

> Je n'en connais que la larve qui est d'un brun clair, avec la tête grosse, brune; les yeux noirs, a facettes trés distinctes, placés sur les côtes, a peu de distance des mandibles; deux points jaunatres á la place des petits yeux lisse. Du Cap. d. Bon. Esp.

Burmeister (1839) described certain imagos from South Africa (vorbirge du G. Hoff.) as those of *viator*. How much guesswork there was about this determination cannot now be told, but it

*It is evident from the title here bestowed that Latrielle was to some extent acquainted with the characteristic habit of this species; that of moving freely over the surface of the ground.

must have been a conjecture. Burmeister speaks of the head being dark coloured, mouth, antennae and legs paler. He adds that the species inhabits sandy treeless parts where the cone-shaped mounds appear from a distance like the huts of the inhabitants.*

Hagen (1858) furnished a more elaborate description of *viator* comparing it with *H. mossambicus.* That part of the description which applies to the imagos was drawn up from several dried males and females, the types of Burmeister. The account of the worker clearly relates to Latrielle's type, but mention is made of five " younger " forms of paler colour. The description of the soldier was based upon two specimens, both of which Hagen for some reason regarded as dwarfed—(nicht ganz ausgewachsens).

One of these two soldiers belonged to Schoenherr's collection in the Stockholm Museum (e.g. that used by Sjöstedt for his diagnosis); the imagos were collected by Krebs and Mund. Hagen says that the relationship of imago with worker and soldier is based only upon a conjecture although confirmed by the specimens in the Berlin Museum belonging to one collection. From this it may be gathered that a soldier and five workers accompanied Krebes' and Mund's imagos. Unfortunately, here, as with the type, it is not nowadays possible to place precisely the locality where the specimens were obtained.

In his description of the imago Hagen says: " Dark brown, head and thorax black brown; the mouth, the antennae, the front margin of the pronotum, the tips of the tibiae and tarsi yellowish". It can only be inferred that the unmentioned parts of the limbs were dark brown; although this is not supported by either the older description of Burmeister (1839) or the newer of Sjöstedt (1900). However that the rest of the legs are dark may be gathered from the fact that Sjöstedt found an imago from Hex River to agree with the types; this could only have had dark legs

*The mounds referred to could only have been those of *Trinervitermes sp.* At Malmesbury Mr. W. R. Birch, of the Division of Entomology, has found a colony of *H. viator* nesting in a deserted mound of *Trinervitermes.* The interior of the mound being converted into a typical *Hodotermes* nest. The description of the country applies to the environment of *aurivillii.*

of which part of each tibia and the whole of each tarsus was yellowish.*

Silvestri (1908) with specimens before him from Namaqualand (Luderitzbucht and Steinkopf) reduced *aurivillii* to a synonym of *viator* stating that it was clear from the description and the analytical table of Sjöstedt, that the difference was one of size only. The writer has not seen any repudiation by Silvestri of his determination. But, as a footnote by no means germane to the discussion it appends, Sjöstedt (1911) briefly states that in a private letter to him Silvestri admits that he was wrong in reducing *aurivillii* to a synonym of *viator*. However, the Namaqualand form which Silvestri had before him is distinct from *viator*. It is referred to later as *H. silvestrii*.

The description of *viator* given by the writer (1915) applies to the form usually met with in the neighbourhood of Paarl and Stellenbosch. The soldiers and workers from this district seem to be regularly smaller in stature than those found at Malmesbury but the mandibles of the soldiers are not relatively straighter. The imagos from the two centres do not differ.

As relatively large soldiers and workers have been collected at Groot Drakenstein which intergrade between this smaller (Stellenbosch, Paarl) and the larger (Malmesbury) it is not wise to separate the smaller although it might be considered, tentatively, as *H. viator* f. *hageni*.

In conclusion, I take as *Hodotermes viator* (Latr.) that species found in the S.W. Cape to which the descriptions cited all apply fairly well. It is a species that can only be satisfactorily recognised by the following characters of the imago.

Males often decidedly smaller than females.

Above dark red-brown; below abdomen pallid, often a sordid brownish yellow, always sharply contrasting with the dark coloured legs. Pronotum not quite so dark as

*Hagen states that nothing is known of the habits of *viator* and questions the remarks of Burmeister. He presumes *viator* to be the species referred to by Lichtenstein as working underground in the vicinity of the Seacow River, a southern tributary of the Orange River. The insect seen by Lichtenstein was no doubt a *Macrohodotermes*.

the head, the anterior lobe often mottled with yellow, often with a dark median line. (In dried material the anterior lobe noticeably pale yellow).

Abdomen above brown or yellow brown, always less dark than the head or the thorax, always dark in contrast with the underside. Legs brown or red brown except that the tarsi, the tips of the tibiae and the tips of the femora are yellow. (The apical half of the tibia or less may be yellow). The outline of the pronotum is characteristic in that the margin of the front lobe bends into the front margin of the anterior lateral corners without being there angularly indented and in that the curve of the margin of the front lobe is somewhat acute.

The range of this termite is not defined but it may be described as a S.W. species common to the districts of the Cape, Stellenbosch, Paarl and Malmesbury.

Hodotermes peringueyi sp.n.

The imago of this species is readily distinguished from that of *H. viator* by the uniform pale yellow colour of the legs, only the sides of the coxae being brown; by the wide, short pronotum in which the margin of the front lobe meets the anterior corners at a sharp angle and by the golden yellow colour of the tergites of the abdomen. The third tooth of the left mandible of the soldier is more produced and acute than in viator.

This is essentially a S.E. termite of indefinite range but known to inhabit the districts of Albany. Peddie and Alexandria.

Hodotermes thomseni sp.n.

The imagos of this species differ from any others in their small size, the largest females attaining the dimensions of the smallest males of *viator*, *peringueyi* and *silvestrii*. The pronotum is somewhat like that of *H. peringueyi*, but relatively longer. The legs and abdomen are coloured as are those parts of *viator*, but are uniformly paler. The third tooth of the left mandible of the soldier is as in *peringueyi;* the dentation of the mandibles

and the sculpture is more sharply defined in this caste than in other species; this difference is plainly discernible when the soldiers of *thomseni* are compared with those of other species.

This termite inhabits that portion of the Great Karroo known as De Ghoup where it builds, over its nest sites, extremely hard conical mounds, remarkable for their symmetry. Many of these mounds attain a height of between three and four feet. It is the only *Hodotermes* building a mound over its nest site. Similar mounds have been seen in the Karroo in the northern part of the Ceres district where the environment is like that of De Ghoup.

Hodotermes silvestrii sp.n.
= *H. viator* sens. Silvestri (1908).

The imagos of this species are much in agreement with *H. viator.* They differ in having the tergites of the abdomen golden yellow like *H. peringueyi*, except that first tergite has a wide, brown band extending across the anterior half and that the pronotum is parti-coloured; it may be described as being somewhat cream-coloured with a wide transverse brown band. The outline of the pronotum closely approaches that of *viator*, but the margin of the front lobe bends into that of the anterior lateral corners at a more definite angle.

The mandibles of the soldiers agree closely with those of *viator* as regards the third tooth of the left.

This is essentially the Namaqualand-Bushmanland *Hodotermes* s.s. and ranges from van Rhynsdorp to the Orange River. Imagos have also been taken at Victoria West.

Hodotermes faurei sp.n.

The imagos of this species are structurally in agreement with *H. silvestrii.* Otherwise they approximate those of *H. viator* but are darker, especially below, the abdominal sternites being brown except that the first two or three may be yellowish in the middle. The mandibles are brown, not yellow and only the tips of the tibiae and the tarsi are pale, being pale brown. Only dealate imagos known. This may prove to be a dark form of *H. silvestrii.* Locality Victoria West.

Sub-genus MACROHODOTERMES sg.n.

The definition of species in this sub-genus is fraught with many difficulties, and it seems to me that the wide variety of forms scattered over Southern Africa represent but very few species. Having examined soldiers, workers and imagos from many parts I have decided to recognise only three species. These are *Macrohodotermes mossambicus* (Hagen) sensu latus, *Macrohodotermes karrooensis* mihi and *Macrohodotermes pallidus* sp.n. Each different terrain seems to give rise to its own peculiar " form " or topographical race. Especially is this the case in the *mossambicus* series, wherein from the largest (*transvaalensis* mihi) to the smallest (*pulcher* Sjöstedt) I have a series of intergrading imagos.

Here I may say that the published measurements of *pulcher* are somewhat conflicting; this is especially noticeable when comparing the " wing-lengths " and the " span ", seeing that in the latter no allowance is made by Sjöstedt for the width of the pronotum between the wing roots. According to Sjöstedt's basis of measurements, in his Monograph, the length of the wing does not include the stump. In the case of *pulcher* he gives the wings as 21 to 23 mm., and the span 42 to 46 mm. or just twice the length of the wing. The body length is given as 10 to 13 mm. and I can only think these measurements refer to shrunken insects with the heads in a vertical position. A type of *pulcher* in the British Museum has, with the head bent down, a length of 13 mm.; this with the head outstretched would be about 15 mm. The wings of two types in the British Museum, including the stump, measure respectively 20 and 23 mm., and the span of these should be 41.5 and 47.5 respectively.

In the subjoined table are given certain measurements in millimetres of six series of imagos. The range of each includes males and females, the larger dimension is that of the largest female the smaller that of the smallest male. All the material is preserved in alcohol. The body is measured with the head outstretched. The wing-length is that of the forewing without the stump.

	P.	P.R.	J.	L.	K.	pulcher *a*	pulcher *b*
Body & wings	34-31.5	32-27	31-30	30.5-29	29-25	—	25-23
Body	18-17	18-15.5	17-15	17-16.5	16-13	14	13-10
Fore-wing	28-25.5	25.5-20	24.5-22	24-23	22-19.7	23-20	23-21
Span	62-57	56-45	55-49	52-51	51-42	47.5-41.5	46-42
Head-width	3.5-3.1	3.3-3.0	3.3-3.0	3.4-3.2	3.1-2.7	—	—

P = Pretoria; P.R. = Pienaars River: J = Johannesburg; L = Lovat; K = Knapdaar; pulcher *a* = measurements of types in British Museum; pulcher *b* = Sjöstedt's published measurements.

Macrohodotermes mossambicus (Hagen) sens. str. (1853, 1862)
= *Hodotermes mossambicus* Hagen (1853, 1862).
= *Hodotermes mossambicus* Hagen (1858 in part, nec. soldier).

In the strict sense *mossambicus* is a species only known, even today, by the imagos and workers. No soldiers have ever been obtained from the type locality.

There are no less than five records of the occurrence of the species in South Africa, but no one of these can be regarded as technically valid.

Hagen (1858) gave the first record and this calls for some explanation. In 1853 he published a preliminary note on the Termites of Mossambique in which he named certain imagos *Hodotermes mossambicus*. The amplification of this note had a delayed publication and appeared in Peter's "Reise nach Mossambique" published in 1862. The amplification refers only to imagos and workers.

In the interim, Hagen (1858) published his Monograph and into the description of *H. mossambicus*, therein given, he inserted a description of the soldier caste. This description was based upon a single, dry and imperfect specimen collected by Dorhn at Pniel Mission Station in Griqualand West. The type locality of this soldier is, therefore, the valley of the Orange River between Kimberley and Barkly West.

Although it is not known with any degree of certainty whereabouts in Portuguese East Africa Peters obtained his imagos, the probability is that it was in the valley of the Zambesi River, or quite a thousand miles away from where the soldier came from.

Sjöstedt (1900) recorded the species from the Cape, the specimens being collected by Meyer at "Orlog River." This probably refers to the Oorlog Kloof Rivier in Calvinia, but may refer to the Oorlog Poort Rivier in Aliwal North. The imagos exhibited much larger measurements than the type, and these, being included in the description, have led to some misconceptions. Sjöstedt (1900) is also responsible for reducing *havilandi* to a synonym of *mossambicus*. Silvestri (1908) recorded *mossambicus* from the Kalahari and Damaraland. His determination seems to have been based on Sjöstedt's "hold all" description.

Holmgren (1913) determined specimens of soldiers from Zululand as *mossambicus*. He follows Sjöstedt; the record relates more properly to *havilandi*.

The writer (1915) recorded *mossambicus* from Marico (Transvaal), Kimberley (Griqualand West) and Somkele (Zululand). The last record relates to *havilandi*, the two former to *transvaalensis*.

Macrohodotermes mossambicus sub sp. *havilandi*.
= *Hodotermes havilandi*. Sharp and Haviland.

It is customary to credit Sharp with the description of *havilandi*. He appears to have selected the name for it, but it was described by Haviland. It is regarded by Sjöstedt and Holmgren as *mossambicus*. The species is only known by the soldier caste; the imagos await discovery. In the biological sense it is distinct from any in the rest of the Union and occupies a separate terrain. The soldiers differ from any others I have examined in having the pronotum narrower than the meso- and metanota and the labrum less acute.

Localities: Zululand; Swaziland; Natal, in the valley of the Tugela River only.

Macrohodotermes mossambicus sub.sp. *pulcher.*
= *Hodotermes pulcher* Sjost. (1905).

Although, as I have shown, *pulcher* imagos intergrade with those of other forms, here linked up under the subspecific name *transvaalensis*, it is sufficiently removed therefrom and from *mossambicus* s.str., to hold subspecific rank. According to Sjöstedt the types were obtained in the Orange Free State. I place with *pulcher* a series of imagos captured at Knapdaar in the Cape Province. The following are measurements from the Knapdaar series:

	males.	females.
Body, with wings	25 to 26 mm.	28 to 29 mm.
Body, without wings	13 to 14	15 to 26
Forewing, with stumps	21	23 to 24
Forewing, without stumps	19.7	21.5 to 22
Span	42	48 to 51
Head-width	3.1	2.7

Macrohodotermes mossambicus sub.sp. *transvaalensis.*
= *Hodotermes transvaalensis* Fuller (1915).
= ,, *pretoriensis* ,, ,,
= ,, *warreni* ,, ,,
= ,, *braini* ,, ,,
= ,, *mossambicus* Hagen, Silvestri (1908).
= ,, ,, Hagen (1858) (in part, soldier nec imago).

Under the one subspecific name *transvaalensis* I propose to bring together a number of series which, in the broad characters of the imagos so far found, agree with *mossambicus* s.str. but vary in their size and wing measurements so that their dimensions are both greater and smaller than those of *mossambicus* s.str.

As with the imagos so with the soldiers there is much variation, but the more this is studied the more the soldiers from one locality merge into those from another. However, all seem to agree as regards the general nature of the thorax and in the features of this to differ from the sub-species *havilandi* and from *karrooensis* mihi.

The pronotum is as wide or wider than the meso- and metanotum, as it is with *karrooensis* soldiers, but it is relatively longer and not so deeply incurvate. The hind margin of the mesonotum is broadly curvate, not produced as in *karrooensis* but agreeing with this feature in *havilandi*. The hind margin of the metanotum is produced as is the case with both *havilandi* and *karrooensis*.

Judging from specimens of soldiers from Kimberley and Barkly West, the soldier described by Hagen (1858) belongs here.

H. pretoriensis mihi, founded on soldiers, should rank as a *form* of the subspecies.

H. warreni mihi, of which the measurements of the imago are given under L in the foregoing table, should also rank as a *form*.

H. braini mihi is given as a synonym in the belief that the soldiers on which the species was based were members of an immature colony of *transvaalensis*, the peculiar character of their mandibles being due to nanism.

Macrohodotermes karrooensis (Fuller).
= *Hodotermes karrooensis* Fuller (1915).

This species is readily recognised by its imagos which differ from all others in their uniform yellow colour, only the wing-stumps being brown. The wings are a pale brown and exhibit a more generalized scheme of venation than do those of any others I have examined. Including the stumps, the forewings measure 31 to 32 mm. and the span is, approximately, 66 to 67 mm.

The largest soldiers are characterised by a distinct mound in the frons depression. The pronotum is short, decidedly incurvate behind and always as wide or wider than the meso- and metanotum. Both meso- and metanotum are produced behind and the margin of the produced part is slightly incurved.

Localities: Middelburg (Cape); Victoria West; Montagu.

Macrohodotermes pallidus sp.n.

The imagos of this species may be recognised by their pallid legs and the presence of two yellow patches on the frons. These patches rest on the clypeo-frontal suture and extend back to the ocellus spots (pseudo ocelli). In size the species approximates *pulcher*.

	Females.	Males.
Body with wings	28-30	24-26
Body	16	13.5-14
Forewing and stump	22.5	19-21.5
Forewing, without stump	21.5	20-20.5
Span	48-50	42-45
Head-width	3.1	2.6-2.7

The soldiers of *pallidus* have not been obtained, but there is much possibility that this is the termite referred to by Lichenstein.

Locality: Olivewood, Cape Province.

III. PSAMMOTERMES GROUP.

Psammotermes allocerus Silvestri (1908).

This is probably synonymous with *P.hyberstoma* Desneux (1902) in which case *P.fuscofemoralis* Sjöstedt (1904) and *P.assuanensis* Sjöstedt (1912) will almost certainly fall to *P.hybostoma.* I can, however, only indicate a possible synonomy arising out of my examination of lengthy series of imagos, soldiers and workers from Namaqualand and Ovomboland.

The following is a synopsis of the examinations referred to:—

(*a*) The imagos from Namaqualand and Ovomboland agree entirely with the description given by Sjöstedt for *fuscofemoralis* (1904). The antennæ of all examined are composed of XVI joints except one of XV joints. The type *fuscofemoralis* is stated to have antennæ of XVII joints but, subsequently (1912), Sjöstedt announced that the majority had XVI-jointed organs. I find the fontanelle larger and brighter in the females than in the males, turbinate in outline, the narrowed apex directed forward. The wing venation I have already dealt with (1920).

(b) The soldiers intergrade very regularly from very small to very large; the majority being of medium size. A series of measurements specially taken for this paper show the ranges to be as follows:*

*In my "Studies upon the Post-embryonic Development of the Antennæ of Termites," Annals, Natal Mus. IX, 2, 1920, p. 291, I have recorded a series of head widths for *P. allocerus.* In error only half the width of the heads measured is given so that it is necessary to double the figures to get the correct range. Thus treated the measurements will not be found to be at variance with the present statement.

Total length	4.1	to	11	mm.
Head width	0.88	to	1.9	mm.
Head and mandibles . .	2.2	to	3.7	mm.

There is a regular increase of about 0.10 mm. in the head width as from 0.88 to 1.4 mm.; there is then a break of 0.20 mm., the largest ranging in head width from 1.6 to 1.9 mm. It is only these few odd large soldiers of 9 to 11 mm. long that could possibly be regarded as majors. I have found the right mandible to be regularly as long as the head is wide, but the head length is variable as may be seen by the following contrasts:

	mm.	mm.	mm.	mm.
H.W. . .	1.0	1.2	1.3	1.4
H.+M. . .	2.0—2.5	2.2—2.7	2.3—3.0	2.7—3.1

It is readily seen from this that some heads are visibly more elongate-rectangular than others. To this it may be added that the largest soldiers have the heads more regularly rectangular than the lesser, and the sides straighter, some even faintly incurved.

(c) An examination of many soldier mandibles shows considerable differences. In the larger soldiers these organs are broader and coarser than in the smaller. Apart from this all mandibles differ extremely, both left and right, as regards the dental armature. Generally speaking, the teeth of the mandibles of the smaller soldiers are more acute and more antrose than those of the larger soldiers, but this does not hold good for all. The right mandible always exhibits a large step-like tooth below its arcuate, apical point; below this tooth there may be 2 or 3 quite distinct subtriangular teeth, or there may be an irregular series of knob-like teeth; any one of these may have a simple rounded apex or a notched apex. In one mandible I have noted three pointed teeth, and below these two knobbed teeth, giving six teeth to the right mandible. A suggestion of an extra tooth is often to be found on the cutting edge of the apical point. Scarcely two right mandibles are to be found that are quite alike.

There is more superficial regularity with the left mandible, but here also an extra tooth often occurs at half the length of the apical point. Leaving this out of consideration, left mandibles that are more or less regularly serrate usually exhibit 7, 8 or 9 teeth; the more inferior of the series may be rounded knobs and not triangular. Exceptional left mandibles are also to be met with which exhibit only 3 or 4 teeth.

(d) Throughout the series the pro-, meso- and metanota of the soldier are subject to slight variations of contour. With the pronotum the sides of some tend to be more oblique than of others, and to vary from being straight to faintly curvate or incurvate. The front margin is always decidedly, angularly indented, but in the larger soldiers the two margins meeting at the median notch are more arcuate than in the case with smaller soldiers. The hind margin is always faintly incurvate. The mesonotum is relatively large and usually rounded behind, the metanotum is usually shorter and has a more or less roundly truncate hind margin.

The head of every soldier exhibits a dorsal fuscous band extending forward to and widest at the clypeal suture, where it terminates. This has the appearance of being the visible sign of a duct below the cuticle. However, there is never a superficial groove upon the frontal area.

(e) The clypeus of the soldier is short and incrassate, the anterior margin broadly curvate; it can be described as a weal-like elevation with distinct hollows on each side.

(f) With the largest soldiers the labrum is decidedly inflated and darker than the head (somewhat alizarine) except that the pointed extension is white, and that this colour narrowly margins the tapering edges of the inflated part. With large and small soldiers the labrum narrows toward its base.

(g) With all soldiers the fontanelle is more or less distinct and has fuscous edges

(h) The soldier antennae range from X to XVI joints; very rarely are those of the smallest soldiers clearly moniliform.

(i) With the largest soldiers the head is plainly depressed in the middle.

Silvestri in his remarks upon *allocerus* states that it is quite distinct from *P.hybostoma* Desneux inasmuch as the major soldiers are smaller and have antennae with a maximum of XIII joints. The second contention falls away. The difference in size appears considerable, e.g. maximum length 11 against 10 to 15 mm., head-width 1.9 against 2.5 mm. It is, however, quite possible for *hybostoma* to be a large locality form or race just as is the worker type of *Hodotermes viator* Latr.

Sjöstedt's soldier of *P.fuscofemoralis* must be, from the description, quite agreeable with the small soldiers of *allocerus*. As between his *fuscofemoralis* and *assuanensis* the only differences are size, the number of teeth to the left mandible and the hollows on either side of the clypeus (epistome). All these are features of the soldiers of *allocerus*. It is true that for both these insects Sjöstedt describes a channel (Rinne) running forward from the fontanelle, but this reference is conceivably to the duct which is exhibited by the soldiers of *allocerus*.

To these remarks it may be added that Silvestri (1914) has determined the *Psammotermes* found by him in Senegal as *fuscofemoralis* and Holmgren (1913) determined as this species that from Zululand.

If future studies show the synonomy to be as here set out, then we have a variable and remarkable species almost encircling the African continent. That this should be the case is all the more interesting because it is contrary to my experience with South African species in general, most of which have a limited range, and then tend to vary more or less decidedly according to one environmental factor or another.

The insect now under reference as *P.allocerus* certainly extends from van Rhynsdorp, on the south, to Angololand, and may be classed as one peculiar to the Namib veld. It is, however, known to exist in the valley of the Orange River to at least one hundred miles from the sea. The part of Zululand from which Holmgren reported *fuscofemoralis* I have never visited, but I know it to be of a sandy nature. There the conditions are tropical and peculiar.

Sjöstedt has thrown out the suggestion that, since he found a preserved soldier with a piece of grass stem in its jaws, *Psammotermes* harvests as does *Hodotermes*. This is not so and, further, one never sees a soldier of the sub-genus *Macrohodotermes* outside of a burrow.

Although I have never had the opportunity of studying the biology of *Psammotermes* my correspondents on the Orange River have been very good in trying to clear up this matter for me and my colleague, Mr. F. Thomsen, endeavoured to locate the nest definitely when in Little Namaqualand. The species feeds upon dry grass haulms and upon wood. On the grass it feeds under a canopy of clay and attacks wood just as do fungus growers. It fills up the parts removed with sand-particles firmly cemented together. It has been taken injuring the wood of houses, vineyards, and fencing posts, being particularly destructive to the last mentioned. Pieces of damaged posts are before me, and it is clear that in the parts replaced by termite cement nest conditions obtain, the cells in the cement being found crowded with imagos, soldiers, workers and half-grown forms.

IV. RHINOTERMES GROUP.

Schedorhinotermes putorius (Sjöst.) sub species *australis* subsp.n.

I have hitherto regarded as *Rhinotermes putorius* Sjöst. those representatives of the genus coming under my notice at Beira (Portuguese East Africa) and Durban (Natal). These determinations (1915, 1919 and 1920) related to soldiers, workers and dealate imagos. I have since obtained one winged imago from Durban.

Sjöstedt has described two other species, *lamanianus* (1911) and *bequertianus* (1913) both from Congo; from this region he has also reported *putorius*. However, *putorius* has been recorded from quite a number of places. Sjöstedt gives the following localities; Cameron, Fernando Po; Gabun, Congo (1900); Sierre Leone (1904); Congo (1905); Usambara (1906). Holmgren (1913) determined material from several parts of Zululand as *putorius*, and Silvestri (1914) reports the species from French Guinea, Cameroon, and Gold Coast. Wasmann (1911) treats his material from the Upper and Lower Congo as *putorius*.

The imago of *bequertianus* is unknown.

According to Sjöstedt, *lamanianus* differs from *putorius* in the following features:

(a) The imago is distinctly larger; joint III of its antennae is clavate and much larger than joint II; the wings are much longer, 12 mm. as against 9 to 10 mm.

(b) The major soldier has a more rectangular head, less narrowed in front; the hind margins of the pronotum and mesonotum are distinctly incurvate; the abdomen is almost quite smooth.

As to whether these features are sufficient to establish the biological independence of *lamanianus* from *putorius* I am not able to say. Our South African insect is certainly more agreeable with the description of *lamanianus* than with that of *putorius*. However, I prefer to treat it as a sub-species of *putorius*. The imagos

are not longer in the body than *putorius*, but the wings are longer and agreeable with the measurements of those of *lamanianus*. The soldiers have the hind margins of the pronotum and mesonotum incurvate as with *lamanianus*, but the heads are not at all rectangular. The following is a table of comparisons:

	putorius.	*lamanianus.*	*putorius-australis.*
IMAGO			
Antennæ	XX joints	—	XX (or, rarely, XXI) joints.
Joint III	distinctly longer than II.	clavate, longer than adjoining	clavate, as long as IV + V.
Span	21-22 mm.	29 mm.	29.2 mm.
Forewing, length	9-10 mm.	12 mm.	with stumps 14.1 mm. without 12.7 mm.
Forewing, width	3 mm.	3.3 mm.	4 mm.
Total length	8-9 mm.	9 mm.	8 to 9 mm.
Body & wings	12-13 mm.	16 mm.	15.7-16.7 mm.
Head length	—	—	1.5-1.6 mm.
Head width	—	—	1.7-1.8 mm.
MAJOR SOLDIER			
Antennæ	XVI	XVII	XVI-XVIII
Total length	5-5.5 mm.	6 mm.	7-8.5 mm.
Head & Mands.	2.2 mm.	2.7-2.9 mm.	2.5-2.6 mm.
Head width	—	1.7 mm.	1.7-2 mm.
WORKER			
Total length	5-6 mm.	—	4.8-6.6 mm.
Head width	1.3 mm.	—	1.2-1.6 mm.
Antennæ	XVI, XVII	—	XVI-XVIII.

To be continued.

MARINE ALGAE OF THE CAPE PENINSULA;

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Marine Algae are only revealed to the curious for part of each day. This may perhaps account for the relatively slight knowledge which has been gained in the past with regard to the habits and life histories of these plants. Until perhaps the last ten or twenty years, the work of algologists was principally confined to describing the appearance and occurrence of those seaweeds which could be collected by dredging or by exploring the seashore at low tides. Of late years, however, efforts have been made to trace something more of the life histories of seaweeds, and to understand their mode of life. These efforts have mostly been made in the northern hemisphere, in England, America, and Japan. Very little work of this kind has been done on South African seaweeds; collectors have been numerous, and the work of the late Mr. Tyson has greatly aided in drawing attention to the large numbers of seaweeds found on these coasts.

When the tide recedes we may find seaweeds on the short belt in three characteristic habitats, in rock pools, exposed on rock faces or ledges, or submerged in the deep water, only partly visible and often wholly inaccessible to the collector. For the most part these plants are attached at their base to the solid rock, or to some sandy surface, by holdfasts or hapterons which reach out finger-like processes in the case of the larger algae or minute threads in the smaller forms, and firmly clasp the substratum. Since marine algae live in water which is constantly subject to agitation, success in attaching themselves is an important factor in the struggle for existence. Other Algae, however, fasten themselves to their neighbours. Plants of the green Alga, *Ulva lactuca* (the socalled sea

lettuce) are frequently found growing on larger Algae, and the delicate threads which are woven together to form the little attaching disk of this plant, are able to pierce the cells of its host and probably to absorb food from it, although this last point is a very difficult one to determine experimentally. In many cases no such penetration of the host plant can be detected, and we must suppose that any advantage derived from the epiphytic habits of these plants depends upon the protection from exposure, or possibly in the more crowded habitats, from a greater access to light.

On any rocky shore at low tide, it is at once easy to distinguish three varying types amongst seaweeds, green, brown, and red, the last varying from rose red in the more sheltered habitats, to deep brown or brownish red in the more exposed positions. On these shores the dark brown-red forms are very characteristic. These colours cannot always be observed in the drift weed cast up after rough weather, as the fronds are apt to become bleached in the sun, as they die.

These pigments have a real significance in the life of the plant, and play their part in determining the position in which a particular kind may be found. All these pigments undergo decomposition in bright daylight, but during life they are also being constantly re-formed. On the whole it seems probable that the red and brown pigments are more sensitive to light than the green which often accompany them; at any rate, the more delicate pink seaweeds are always found in deep water or else in deep shade; whilst when any red or brown Alga undergoes bleaching in sunlight, the red or brown fades first and finally the underlying green colour is also destroyed. This may sometimes be seen in pools at low water during spring tides, when exposed tips of red seaweeds (such as *Hypnea spicifera* or *Suhria pristioides* at Kalk Bay for example) may be seen, bright green in colour, projecting from the water whilst the rest of the shoots are submerged and are red or purplish red in colour.

When the pigments are extracted from the plant and examined spectroscopically it is found that whereas the green pigment chlorophyll absorbs light principally from the red end of the spectrum,

the brown, and still more the red pigments absorb the light at the blue end. This is significant when we remember that as light passes through water it is refracted unequally, the red end of the spectrum being first cut off, so that the light which penetrates to the deeper layers of water is bluish in tint. The red pigment is

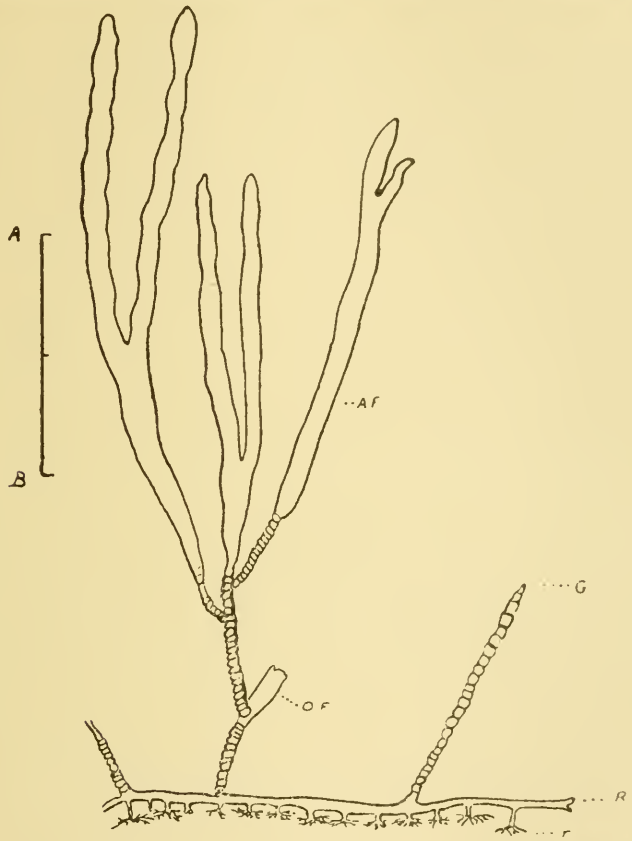

Fig. 1.—Reduced from a life size drawing of *Caulerpa ligulata*, showing rhizome-like base (R) bearing rhizoids (r) as hapterons, a young frond with growing tip (G), and an old frond (OF) proliferating and bearing new assimilating fronds (AF). The wrinkled basal part of the fronds is characteristic.
The line AB represents 2 inches.
(Drawing by M. G. THODAY)

especially able to absorb this bluish light. I am not aware that any definite experiments have been made to determine exactly what limits of light intensity are characteristic of the different seaweeds. but a simple observation was kindly made for me by Prof. Thoday with an exposure metre at Camps Bay, on a rock pool about ten

or twelve inches deep, high up on the shore near Camps Bay. The pool was sheltered from all direct light by the deeply overhanging rock, at one side of which was a narrow vertical cleft. Near the base of the cleft was a plant of *Gelidium cartilagineum* well grown and just submerged. This is a characteristic deep water red Alga, and is rarely, if ever, exposed at low water. It occurs usually at Camp's Bay in deep pools near low water mark, partly hidden by larger thalloid Algae (*Gigartina radula* and others). Prof. Thoday succeeded in lowering an exposure metre to the depth of the cleft and found that the light intensity just above the level of the *Gelidium* was not more than one thirtieth of the full daylight. This was probably as great an intensity of light as the plant would ever receive, and that only for a short time daily. Another deep water rose red Alga, *Plocamium corallorhiza*, is characteristic of rock faces on the shores of False Bay where it is sometimes visible at low spring tides. By dredging, this has also been found growing at a depth of 36 feet, in the fertile condition. Red seaweeds of this type are then truly shade plants in their capacity for utilising light of such feeble intensity. In England a typical shade flowering plant receives from about one half to about one third of the full daylight, in localities where it flowers, though a deeper shade often suffices for the survival of the vegetative organs.

Other factors besides light intensity determine the distribution of Algae on the coast. One of these is their power of resistance to dessication whilst the tide recedes. In an atmosphere as dry as that of this country, this factor may be of considerable importance. Two of the most resistant forms from this point of view are the blue-green Alga, *Lyngbya majuscula* and the purplish red Alga, *Porphyra laciniata*. Both are fairly common forms found at or near high tide levels. *Lyngbya* has a blackish appearance and is found in shallow pools or sometimes nearly dried, forming a dense covering on the surface of rocks. In the

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1. This information was received from Miss E. L. Stephens of the Cape Town University (Botanical Laboratory).

latter position it is one of the most slippery of all the South African Algae that I have as yet met. *Porphyra*, which is of almost world-wide distribution, grows hanging from the bare rock or amongst a tangle of other fronds; it is generally abundant in the neighbourhood of drain pipes or around the bathing pools of these coasts. It varies in colour from a deep purplish red to a pale yellow. The pale yellow fronds are generally smaller, about ½ inch to 3 inches long, and when examined microscopically may be seen to be giving off solitary spores which from analogy with their nearest allied seaweeds we must call monospores. The large purple fronds, often 12 inches or more in length, on the other hand often have brownish red edges, and these are the regions where reproductive organs known as carpospores are formed in little packets. As these packets are shed into the water the frond loses its colour and appears with a whitish edge. The two kinds of plants probably alternate with each other, the red spores producing the small plants which in their turn produce the solitary spores and presumably these grow into the large fronds. This sequence has never been observed for any species of *Porphyra*, but with a marine aquarium there is little doubt that something of the kind could be observed. The large carposporic fronds of *Porphyra* are the most resistant to drought and to exposure to light.

The distribution of Algae on a coast may often be found to give a more or less definite zonation. On the whole the green or blue green forms are found near the higher tide levels. On the shore at Sea Point, for instance, there are many pools filled with the bright green fronds of *Ulva* and of species of the socalled Sea grass, or *Enteromorpha*. These, like *Porphyra*, can endure bright sunlight for some hours at a time. They also flourish best within reach of sewage or other organic contamination of the water. Some years ago at Southampton *Ulva* increased in the harbour to such an extent that it became a nuisance to the inhabitants, owing to its liberation of sulphuretted hydrogen when decaying. An investigation was made to find a practicable method of exterminating the plants, but the only suggestion made was that of cutting the fronds at intervals and removing them. There

are, however, certain genera of green seaweeds which are found only in deep water or in pools near low water, during low spring tides. On the west coast of the Cape Peninsula, *Codium tomentosum* and *C. Lindenbergi* are specially frequent in this position. On the east coast, *Caulerpa ligulata* is also constantly submerged in deep water in sheltered positions. The genus *Cladophora* has representatives in both positions. It consists of a number of branched green threads attached below to some substratum. Several species are found in mid-tide pools, for example, *C. flagelliformis, hospita* and *Ecklonii;* but two appear only in deep water, *C. rupestris*, which forms dense green tufts in low tide pools, and *C. catenifera*, which inhabits even deeper water, often far beyond the tidal zone. It is not known how these plants find sufficient light to carry on the work of assimilation with only a green pigment: there is no definite evidence, however, to show whether their green pigment is identical with the chlorophyll of the higher plants, or of the other green Algae.

Below the pools which contain a predominance of the green Algae, there are others where one may find a variety of red or red-brown forms. Amongst the commonest on these coasts are certain species of *Gigartina*. These are often accompanied by the whip-like threads of the brown Alga, *Chordaria;* the large species is *C. capensis*, the smaller *C. flagelliformis*. In the deeper water we find the larger red seaweeds, and also the larger brown forms such as the bamboo seaweed, *Ecklonia buccinalis*, and the stringy fronds of *Macrocystis pirifera*. The last two are often quite inaccessible, but at Camps Bay at certain spots they may be reached at low tides. *Ecklonia* is characteristic of deep water below tidal limits, and is often found extending towards the open sea. *Macrocystis* on the other hand is found in much more sheltered positions, often protected from the force of the waves by a belt of *Ecklonia* beyond it.

Both these plants are of some interest to the botanist. *Ecklonia buccinalis* (named after Ecklon, one of the earliest collectors of seaweeds on these shores) is a giant seaweed with a perennial habit of growth. Its great stems reach a length of twenty feet

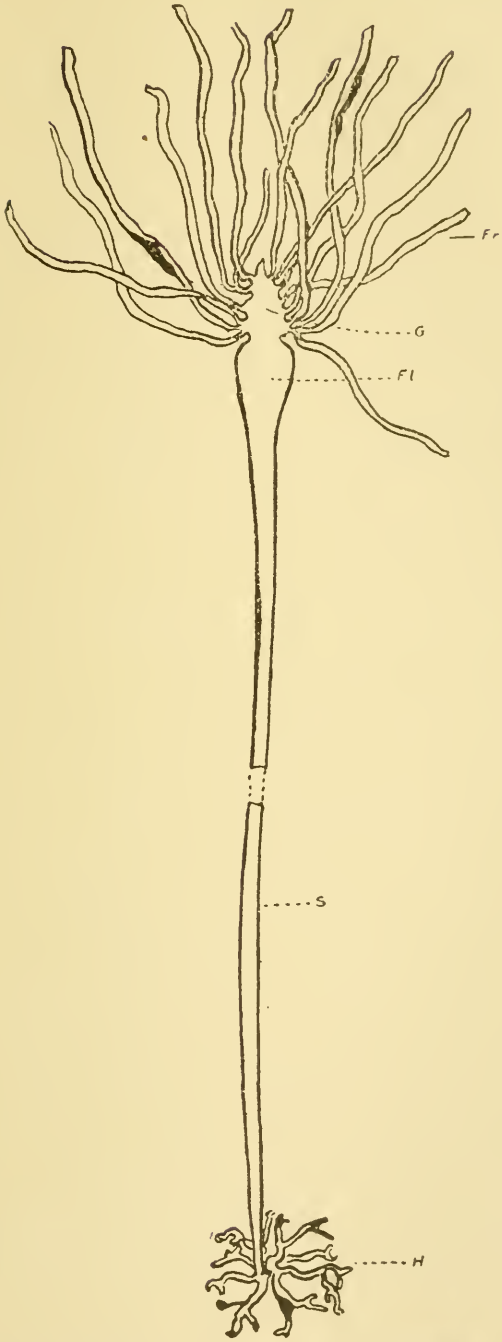

Fig. 2.—Outline sketch of *Ecklonia buccinalis* (the "bamboo" seaweed). H = Hapteron; S = stipe; Fl = Float; G = Growing region. Fr = Fronds.
(*Much reduced*)

or more. They are held at the base by a much branched hapteron. The stem is hollow when adult, and is swollen at the end to form a float. In this region it bears a large number of flat fronds which trail freely at or near the surface of the water. The fronds are therefore comparatively well illuminated like those of plants in shallow pools at low or mid-tide levels. The fronds like the stems are long lived, but ultimately become fertile, bearing a large number of sporangia. The dehiscence of these and the behaviour of the spores when liberated has not yet been followed.

Macrocystis is a large kelp which is also known from the deep water off the coasts of South America. On the shores of the Cape it possesses a creeping rhizome-like base bearing many long slender branches. These bear a series of distant leaflike appendages which have a wrinkled lamina, and generally a pyriform float at the base. A fair sized plant here reaches the length of 12-15 feet, and has a diameter of about ¼ inch; the South American form is said to reach much larger dimensions. At the apex of each branch is the region of differentiation of new fronds which gradually split off from one another as they lengthen. At the base of stem or " stipe," a leaf like frond may usually be seen without a float, and it is possible that this may depend on the depth of the water in which they are differentiated. At or near the base of the older stems, a short branch may occasionally be seen bearing two or three flat fronds without a float; these are thin at first and not wrinkled, but they become thicker and slimy in irregular patches, where a large number of sporangia may be found. So far as I am aware there are no previous records of the fertile fronds of this plant. Occasionally, the fertile fronds are borne on short stipes arising directly from the basal rhizome-like branches.

The deep water red seaweeds of these shores are sufficiently obvious when cast up after storms; they are often rose red when fresh, turning dark red when dried. The large leathery red fronds found in deep water near the Rogge Bay pier are *Nemastoma lanceolata*. The long more delicate fronds of *Schizymenia undulata* are found in deep pools such as are uncovered at low spring tides. Another deep water red seaweed characteristic of the warm

water of the East coast (False Bay) is *Plocamium corallorhiza.* It may be found on rock faces at low water of spring tides growing equally well on a sandstone substratum as at Kalk Bay, or on granite rocks, as at Oatlands. In both these places the fern-

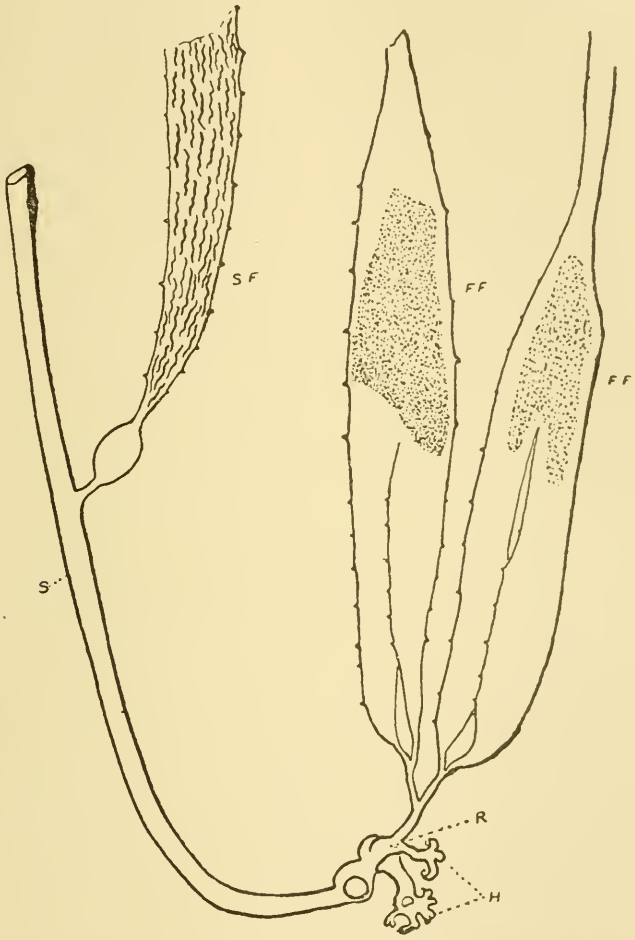

Fig. 3.—Outline sketch of base of plant of *Macrocystis pirifera.* S = Stipe; R = Rhizome-like base; H = Hapterons; SF = Lower part of sterile frond; FF = Fertile fronds, with broken apex, and with fertile region stippled: at the base, the fertile fronds are gradually splitting, and thus multiplying. (*Much reduced*)

like fronds may be found with little clusters of reproductive organs bodies at their crenated margins.

There are also a number of filamentous or thread-like red Algae, but these are usually found in the more sheltered pools

or epiphytic on the larger Algae. Various species of *Polysiphonia* may be found as delicate soft red tufts in the deeper creeks and sheltered pools of St. James and Kalk Bay. Various species of *Ceramium* may also be recognised by the beaded appearance of their regularly branched threads. These and many other seaweeds may be seen by the collector on application at the Bolus Herbarium, Cape Town.

In addition to this zonation which extends over the whole tidal area of the shore, there is a vertical zonation which is sometimes very clearly to be seen amongst the algae which line the steep rock faces of the deeper pools. At the top, well out of the water may be seen the half dry fronds of *Porphyra laciniata;* lower come the smaller and more delicate monosporic fronds of the same plant. Within the pools there are often green feathery tufts of *Cladophora* or of *Chaetomorpha*, sometimes called "mermaids' hair," while beneath there are plants of *Gigartina* or of *Polysiphonia*, and the smaller kinds of a stiff looking pink jointed seaweed known as *Corallina*. At a depth of about two feet, one frequently finds small fanlike fronds of a red Alga, *Gymnogongrus vermicularis*. The fronds are always extended so as to be placed at right angles to the direction of the brightest light. The bifurcated tips are so placed that they interlace, offering the maximum surface to the dim light which reaches them. This is the most striking case which I have seen of a definite orientation of fronds of seaweeds to light, comparable to the well known cases of leaf mosaic among the higher plants.

Another point of interest in connection with marine Algae is their common habit of becoming epiphytic or parasitic upon each other. The smaller red Algae sometimes have their own specific host plant. For instance, on these shores, *Ceramium cancellatum* is commonly found on *Codium tomentosum; Actinococcus aggregatus* on *Gymnogongrus repandus;* and *Callithamnion purpuriferum*, on *Gigartina stiriata*. On the other hand, certain Algae serve as hosts to a variety of other Algae. The various species of *Cladophora* are often coated with epiphytes, their rough walls serving as an excellent support. *Ecklonia buccinalis* in spite of

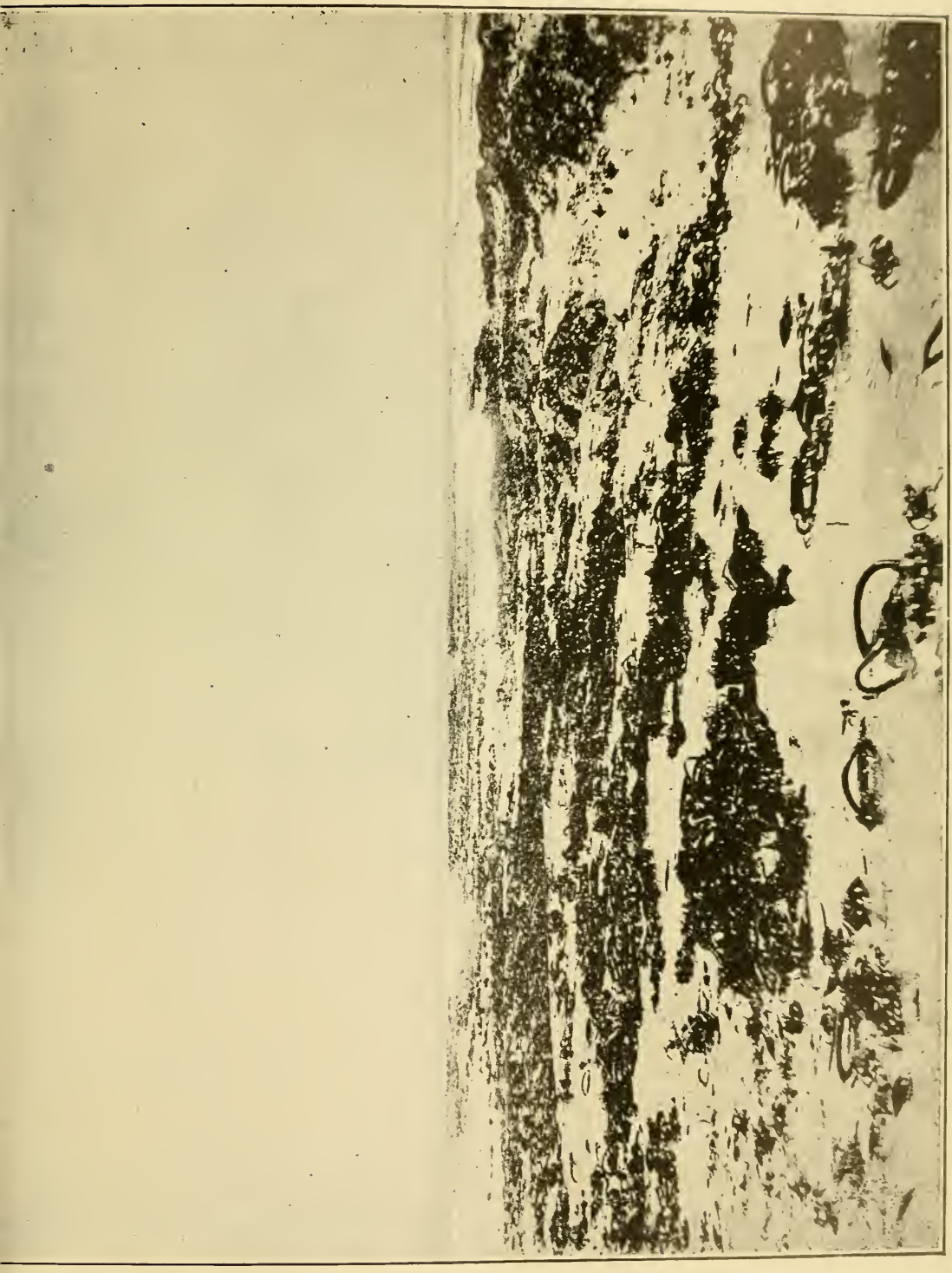

Fig. 4.—Foreshore at Onrust; low tide showing *Ecklonia buccinalis* partly exposed.
Photographed by PROF. THODAY.

its mucilage has also a characteristic number of epiphytic or sometimes parasitic plants. Among the commonest are *Suhria vittata*, *Carpoblepharis flaccida*, and *Polysiphonia virgata*. The first of these has narrow bright red ribbon like fronds fringed with minute reproductive bodies when fertile. This always frequents the base of the stipes of *Ecklonia*, so that it is submerged in deep water. When the stipes are cast up on the shore, these fronds quickly bleach white, and are then gathered by the poor and eaten as a vegetable. According to Mr. Tyson, this is the same plant as is mentioned in the "Swiss Family Robinson" as being edible. Other red Algae found at the base of *Ecklonia* stipes are *Epimenya obtusa* and *Trematocarpus flabellatus*. Higher up the stipes are found the ragged looking *Carpoblepharis flaccida* and *Polysiphonia virgata*. Of these, *Suhria vittata* and probably also *Polysiphonia virgata* send rhizoids into the substance of the host plant and may therefore be regarded as probably parasitic.

Much more might be said about the distribution of the Algae on these shores. One thing which has never received attention from workers in this country is the comparison of the flora of the East coast with its warmer seas with that of the west with its much colder water. Provisionally one may say that there is a predominance of the larger more leathery forms on the cold side; *Ecklonia*, *Macrocystis*, and *Laminaria pallida* are found on the west and hardly at all on the east coast. On the other hand it is easy to find plants which are characteristic of the warmer water, such are *Plocamium corallorhiza*, *Caulerpa ligulata*, *Dictyota*, and several species of *Ectocarpus*, whilst a large number can tolerate both habitats. That this difference is primarily due to the temperature seems to be shown from the fact that on both the east and west coast similar substrata may be found. Sandstone is characteristic of much of False Bay, but at Simon's Bay and Oatlands there is an outcrop of granite. Granite is characteristic of the west coast, but at Kommetje there is a sandstone formation, very similar in disposition to the granite boulders of certain coves near Camps Bay. On the whole, a comparison of these places gives the impression that sandstone offers the better substratum as

evidenced by greater numbers of Algae as well as by the greater variety of forms. Further information must be obtained, however, before any more definite conclusions can be reached, on this point.

In conclusion it may be well to mention some of the possible economic uses of seaweeds. It is well known that the larger brown Algae may be used as a source of iodine and also in some cases of potash. The fronds and stipes of *Ecklonia* would be well worth examining from this point of view. Before however any kelp industry on a large scale should arise, it would be well to remember that at present we know but little of the lives of the fishes of these seas, and any considerable interference with the algal flora would probably affect the supply of certain fish sooner or later. Many and probably all seaweeds form good manure for soil, either burnt for their ash or simply dug in as green manure. If any one is inclined to utilise the cast up seaweeds for this purpose they ought to receive facilities and encouragement from the municipality, for many are the problems both for the scientist and for the practical man in the study of seaweeds and the attempt to utilise them.

I have to thank Prof. Thoday of Cape Town University for the photograph showing the habit of *Ecklonia buccinalis*, and Mrs. Thoday for the original (drawn from life) of Fig. 1.

LIST OF FOODPLANTS OF SOME SOUTH AFRICAN LEPIDOPTEROUS LARVÆ.

By E. E. Platt, F.E.S.

The following list has been compiled in the hope that it may be of assistance to entomologists interested in the early stages of lepidoptera, either in supplying the name of a known foodplant for a given species, or in suggesting a substitute.

Unfortunately little is known of the larvae of our South African species, so the list is necessarily incomplete, but now that a start has been made I am hopeful that entomologists will kindly assist me with their information, which can be published in supplementary lists, from time to time, if sufficient interest is manifested. On page 98 the information is repeated in a form which will enable the foodplant of a particular species of butterfly or moth to be readily found.

The Roman numerals denote the months in which full-fed larvæ have been noted, whilst the initials indicate the observers and localities as follows:—

C.F.M.S.—Mr. C. F. M. Swynnerton, Melsetter, Rhodesia.
J.O'N.—Rev. Father J. O'Neil, S.J., Salisbury, Rhodesia.
C.B.H.—Mr. C. B. Hardenberg, Greytown, Natal.
G.F.L.—Mr. G. F. Leigh, Durban, Natal.
H.A.G.—Mr. H. A. Green, Durban.
H.M.M.—Mr. H. M. Millar, Durban.
H.W.B.-M.—Mr. H. W. Bell-Marley, Durban.
E.L.C.—Mr. E. L. Clark, Durban.
W.J.H.—Mr. W. J. Haygarth, Krantzkloof, Natal.

Where my own initials occur the observations were made in the Durban district, except where otherwise stated.

Many of these occurrences have been the discoveries of the late Mr. A. D. Millar (whose family have been the local

pioneers in so many branches of natural history) as well as of other entomologists of the past.

I have embodied the information contained in Miss Fountaine's paper in Trans. Ent. Soc., 1911, p. 48, and Lt.-Col. J. M. Fawcett's contribution to Trans. Zool. Soc., vols. xv, xvii.

The foodplants were identified at the Natal Herbarium by the late director, Dr. Medley Wood, and his assistants Miss Franks and Miss Lansdell: Dr. P. van der Bijl, who assumed charge after Dr. Wood's death, extended to me the same courtesy and assistance as his predecessor, and very kindly revised the botanical portion of the paper and verified the plant names.

To the above, I am much indebted for their kind assistance, also to Sir G. F. Hampson, of the British Museum, for determining many moths and describing new species, and to Mr. A. J. T. Janse, Pretoria, for similar help and encouragement.

Abutilon indicum *G. Don.* (Malvaceae).
    Pyrgus elma *Trimen.* G.F.L., E.E.P., i.
    Tarache antica *Wlk.* E.E.P., i.
    Anomis flava *Fabr.* E.E.P., i.
    Anomis luperca *Moschl.* E.E.P., i.
Aberia macrocalyx *Oliv.* (Bixineae).
    Atella phalantha *Drury*, C.F.M.S.
Acacia sp. (Leguminosae).
    Cyligramma latona *Cram.* J.O'N.
    Pericyma umbrina *Guen.* J.O'N.
Acacia sp.
    Azanus natalensis *Trimen.* E.E.P., x.
Acacia Gerrardi *Bth.*
    Megasoma accuminata *Wlk.* E.L.C.
Acacia hirtella, *E. Mey.*
    Laelia clarki *Janse.* E.E.P. i, iii, iv, xi.
    Dasychira georgiana *Fawcett.* E.E.P. iv.
    Eublemma nigrivitta *Hmpsn.* E.E.P.

Pericyma mendax *Wlk.* E.E.P., iv.
Ulothrichopus glaucescens *Hmpsn.* E.E.P., iv.
Ulothrichopus primulina *Hmpsn.* E.E.P., iv.
Ulothrichopus catocala *Feld.* E.E.P., iii, iv, v.
Sphingomorpha chlorea *Cram.* E.E.P., i, iv.
Sarmatia interitalis *Guen.* E.E.P., iii.
Tephrina deeraria *Wlk.* E.E.P., iii.
Macaria brongusaria *Wlk.* E.E.P.
Lophostola atridisca *Warr.* E.E.P.
Odontocheilopteryx myxa *Wllgrn.* E.E.P., iv.
Anadiasa punctifascia *Wlk.* E.E.P.

Acacia molissima *Willd.* (Wattle).
Pericyma mendax *Wlk.* E.E.P.
Polydesma inangulata *Guen.* E.E.P. i.
Dasychira georgiana *Fawcett.* E.E.P., i, ii, v, ix, xi.
Euproctis fasciata *Wlk.* Fawcett, E.E.P. iii.
Porthesia natalensis *Janse.* E.E.P., i.
Chogada acaciaria *Boisd.* E.E.P., viii.
Cleora proximaria *Wlk.* E.E.P.
Gonimbrasia tyrrhea *Cram.*
Gynanisa maia *Klug.* E.E.P., xii.
Heniocha dyops *Maas* & *Weym.* C.B.H.
Heniocha appolonia *Cram.* G.F.L.
Anadiasa punctifascia *Wlk.* E.E.P., iv.
Taragama polydora *Druce.* E.E.P.
Taragama carinata *Wllgrn.* E.E.P.
Pachypasa truncata *Wlk.* E.E.P., iii.
Pachypasa capensis *Aur.* E.E.P., xii.
Gonometa postica *Wlk.* E.E.P., xii.
Odontocheilopteryx myxa *Wllgrn.* G.F.L., E.E.P.
Coenobasis amoena *Feld.* E.L.C., E.E.P., iii.

Acacia Natalitia *E.M.*
Charaxes zoolina *Westw.* E.E.P., iii.

Acacia caffra *Willd.*
Ulothrichopus glaucescens *Hmpsn.* E.E.P., iv.
Hypotacha retracta *Hmpsn.* E.E.P., iii, vi.

Pericyma mendax *Wlk*. E.E.P., iii.
Odontocheilopteryx myxa *Wllgrn*. E.E.P., iv.
Acalypha sp. (Euphorbiaceae).
Neptis goochi *Trim*. E.L.C.
Acalypha glabrata *Thb*.
Neptis marpessa *Hopff*.
Cryptothripa polyhymnia *Hmpsn*. E.E.P., iv, ix.
Euproctis punctifera *Wlk*. E.E.P., iv.
Parallelia properans *Wlk*. E.E.P., ii, xii.
Omocena systis *Schaus*. E.E.P., xi.
Acokanthera spectabilis *Hooker*. (Apocynaceae).
Digama aganais *Feld*. E.E.P., ix.
Digama sinuosa *Hmpsn*. E.E.P., x.
Acridocarpus natalitius *Juss*. (Malpighiaceae).
Hesperia keithloa *Wllgrn*. E.E.P., iii, v, xi, xii.
Acridocarpus pruriens *A. Juss*.
Hesperia pisistratus *Fab*. H.W.B.M. Zululand, x.
Albizzia fastigiata *Oliv*. Flat-crown Acacia. (Leguminosae).
Charaxes ethalion *Boisd*. G.F.L., E.E.P., ii, v, vi.
Charaxes cithaeron *Feld*. Trimen.
Audea bipunctata *Wlk*. H.W.B.M., E.E.P., iii, ix.
Enmonodia capensis *Herr-Schäff*. E.E.P., iii.
Pericyma mendax *Wlk*. E.E.P., iii.
Polydesma marmorifera *Wlk*. G.F.L., E.E.P., i, v.
Eublemmistis chlorozonea *Hmpsn*. E.L.C.
Cleora proximaria *Wlk*. E.L.C.
Nudaurelia arata *Westw*. E.L.C., E.E.P., iv.
Taragama polydora *Druce*. E.E.P., iii.
Albizzia fastigiata *Oliv*., var. chirindensis *Swynnerton*.
Charaxes ethalion *Boisd*. C.F.M.S.
Althaea rosea *Cav*. (Hollyhock).
Phytometra limbirena *Guen*. E.E.P., x.
Anomis luperca *Möschl*. E.E.P., i.
Sylepta derogata *Fabr*. E.E.P., ii.
Ampelopsis sp. Virginia Creeper. (Ampelideae).
Hippotion eson *Cram*. E.E.P., v.

Anona senegalensis *Pers.* (Anonaceae).
Papilio angolanus *Goeze.* C.F.M.S.
Papilio corinneus *Bert.* H.W.B.M. (Zululand).
Ansellia africana *Lindl.* (Orchideae).
Theretra orpheus *Herr-Schäff.* Fawcett, E.E.P., iii.
Antidesma venosum *E.M.* (Euphorbiaceae).
Catephia dulcistriga *Wlk.* E.E.P., i, iv, xii.
Parallelia proxima *Hmpsn.* E.E.P., iii.
Apodytes dimidiata *E. Mey.* White Pear. (Olacineae).
Temnora murina *Wlk.* E.E.P., ii, x.
Temnora plagiata *Wlk.* E.E.P., iii, iv.
Diptychis geometrina *Feld.* E.E.P., x.
Veniliodes pantheraria *Feld.* E.E.P., x.
Zerenopsis leopardina *Feld.* E.E.P., xi.
Bunaea angasana *Westw.* H.M.M.
Arctotis grandis *Thunb.* (Compositae).
Pyrameis cardui *Linn.* E.E.P., x.
Asclepias fulva *N.E.B.* (Asclepiadaceae).
,, lineolata *Schl.*
,, Swynnertonii *S. Moore.*
,, coarctata *S. Moore.*
,, scabrifolia *S. Moore.*
,, reflexa *Britt & Rend.*
Danaida chrysippus *Linn.* C.F.M.S.
Asystasia coromandeliana *Nees.* (Acanthaceae).
Precis clelia *Cram.* Fawcett. E.E.P., ii, xii.
,, oenone *Hubn.* E.E.P.
,, natalica *Feld.* E.E.P.
,, elgiva *Hew.* E.E.P.
Salamis parhassus *Dru.* E.E.P., ii, iii, ix.
Hypolimnas misippus *Linn.* H.M.M.
Bombycopsis ? ochroleuca *Feld* E.E.P., xii, Eshowe.
Baphia racemosa *Hochst* (Leguminosae).
Charaxes cithaeron *Feld.* E.E.P., iv, xi.
Deudorix diocles *Hew.* (in seed pods). H.M.M.
Polyptychus mutata *Wlk.* E.E.P., i, x.

Bauhinia sp. (Leguminosae).
    Achaea catella *Guen.* J.O'N.
    Anomoetes levis *Feld.* H.W.B.M., E.E.P., v.
Bauhinia Galpini *N.E.B.*
    Deudorix diocles *Hew.* H.M.M., E.E.P., vi.
Becium angustifolium *N.E.B.*
    Cetola pulchra *B.-Baker.* E.E.P., iv, xii.
    Phytometra limbirena *Guen.* E.E.P., v.
Boehmeria nivea *Gaudich.* (Imported " Ramie "). Urticaceae.
    Pyrameis cardui *Linn.* C.F.M.S.
    Antanartia schoeneia *Trim.* C.F.M.S.
Bidens pilosa *Linn.* (Black Jack). Compositae.
    Zethes caffra *Guen.*
    Lebeda bipars *Wlk.* G.F.L., E.E.P., ii, iv.
Boscia caffra *Sond.* Capparideae.
    Pieris severina *Cram.* H.A.G.
        epaphia *Cram.* H.A.G.
Brachystegia appendiculata *Benth.* Leguminosae.
    Charaxes guderiana *Dew.* Miss Fountaine, Macequece.
Brachystegia globiflora *Benth.*
    Olapa nuda *Holl.* J.O'N.
    Olapa flabellaria *Fabr.* J.O'N.
    Epanaphe clarilla *Aur.* J.O'N.
    Nudaurelia carnegiei *Janse.* J.O'N.
    Athletes semialba *Sonth.* J.O'N.
    Taragama polydora *Druce.* J.O'N.
    Gonometa postica *Wlk.* J.O'N.
    Gastroplakaeis meridionalis *Aur.* J.O'N.
    Ceratopacha gemmata *Dist.* J.O'N.
    Bombycopsis *sp.* J.O'N.
Brachystegia Randii *Baker.*
    Eutelia polychorda *Hmpsn.* J.O'N.
    Olapa flabellaria *Fabr.* J.O'N.
    Polyptychus compar *Roths.* & *Jord.* J.O'N.
    Scalmicauda o'neili *Janse.* J.O'N.
    Scalmicauda albicostata *Hmpsn.* J.O'N.

Epanaphe clarilla *Aur.* J.O'N.
Stauropus thalassina *Hmpsn.* J.O'N.
Prionocentrum o'neili *Janse.* J.O'N.
Imbrasia epimethea-ertli *Rebel.* J.O'N.
Bunaea heroum *Oberth.* J.O'N.
Lobobunaea natalensis *Aur.* J.O'N.
Lobobunaea epithyrena *Maas.* & *Weym.* J.O'N.
Athletes semialba *Sonth.* J.O'N.
Goodia Kuntzei *Dew.* J.O'N.
Cinabra hyperbius *Westw.* J.O'N.
Taragama polydora *Druce.* J.O'N.
Gonometa postica *Wlk.* J.O'N.
Lenodora nigrolineata *Aur.* J.O'N.
Gastroplakaeis meridionalis *Aur.* J.O'N.
Bombycopsis *sp.* J.O'N.
Ceratopacha gemmata *Dist.* J.O'N.
Burchellia capensis *R.Br.* Rubiaceae.
Cephonodes hylas *Wllgrn.* E.E.P.
Temnora zantus *Herr-Schäff.* E.E.P.
Callistephus hortensis *Cass.* "Aster."
Phytometra transfixa *Wlk.* E.E.P., xii.
Calodendron capense *Thb.* (Rutaceae).
Papilio nireus *Cram.* E.E.P.
Papilio demodocus *Esp.* E.E.P., ix.
Chogada acaciaria *Boisd.* E.E.P.
Calpurnia lasiogyne *E.M.* (Leguminosae).
Achaea indeterminata *Wlk.* Fawcett, E.E.P., i, iii, x.
Achaea sordida *Wlk.* E.L.C.
Canthium obovatum *Kl.* (Rubiaceae).
Taviodes subjecta *Wlk.* E.E.P., ii.
Jana eurymas *Herr Schäff.* E.E.P., xii.
Capparis citrifolia *Lam.* (Capparideae).
Pieris gidica *Godt.* Fawcett, E.E.P., iv.
Capparis corymbifera *E.M.*
Pieris pigea *Boisd.* H.A.G.
,, gidica *Godt.* Fawcett, E.L.C.
,, severina *Cram.* Fawcett.

Capparis Zeyheri *Turcz.*
    Pieris gidica *Godt.* Fawcett.
Capparis Gueinzii, *Sond.*
    Pieris gidica *Godt.* Fawcett.
Carissa grandiflora *A.D.C.* "Amatungulu." (Apocynaceae).
    Euchromia amoena *Möschl.* E.E.P., xi.
    Digama aganais *Feld.* E.E.P., i, vii, xi.
    Deilephila nerii *Linn.* E.L.C.
    Nephele comma *Hopff.* G.F.L., E.E.P., i, ii.
    Nephele argentifera *Wlk.* H.W.B.M., G.F.L., E.E.P., iii.
    Zerenopsis leopardina *Feld.* E.E.P., ii.
    Chogada acaciaria *Boisd.*
    Gonimbrasia belina *Westw.* E.E.P., xi.
    Cirina forda *Westw.* E.E.P., x.
Cassia occidentalis *Linn.* (Leguminosae).
    Catopsilia florella *Fabr.*
    Diacrisia flava *Wllgrn.* E.E.P., xi.
Cassia Petersiana *Bolle.*
    Nychitona medusa *Cram.* C.F.M.S.
    Catopsilia florella *Fabr.* C.F.M.S.
Cassia *sp.*
    Athletes semialba *Sonth.* J.O'N.
    Pachypasa sp. J. O'N.
Cassia tomentosa *Linn.*
    Diacrisia flava *Wllgrn.* E.E.P., v.
        ,, lutescens *Wlk.* E.E.P., x.
        ,, scita *Wlk.* E.E.P., xii.
    Dionychopus amasis *Cram.* E.E.P.
    Euproctis fasciata *Wlk.* E.E.P., xii.
Cassipourea verticillata *N.E.B.* (Rhizophoreae).
    Achaea praestans *Guen.* E.E.P., xii.
    Redoa melanocraspis *Hmpsn.* E.E.P., xii.
Celastrus undatus *Thb.* (Celastrineae).
    Boarmia ectropodes *Prout.* E.E.P., vi.
Celastrus verucosus *E.M.*
    Sicyodes cambogiaria *Guen.* E.E.P., x.

Euexia percnopis *Prout.* E.E.P., x.
Metarbela tuckeri *Butl.* E.E.P.
Crothaema decorata *Dist.* E.E.P., xi.
Parasa latistriga *Wlk.* E.E.P., xi.
Omocena systis *Schaus.* E.E.P., xi.
Celtis Kraussiana *Bernh.* (Urticaceae).
Libythea laius *Trim.* E.E.P., x.
Exophila multistriata *Hmpsn.* E.E.P., iii, ix. x.
Dasychira georgiana *Fawcett.* E.E.P., iii.
Pseudoclanis postica *Wlk.* E.E.P., xii.
Lobobunaea tyrrhena *Westw.* Fawcett.
Pachypasa pithyocampa *Cram.* E.E.P., xii.
Celtis Soyauxii *Engl.*
Charaxes cithaeron *Feld.* E.E.P., iii.
Libythea laius *Trim.* E.E.P., x.
Cestrum aurantiacum *Ldl.* "Inkberry."
Dionychopus amasis *Cram.* E.E.P., x.
Phytometra acuta *Wlk.* E.E.P.
Metarbela tuckeri *Butl.* E.E.P., ix.
Chaetachme aristata *Planch.* "Umkavoti." (Urticaceae.)
Charaxes cithaeron *Feld.* E.E.P., iii.
Pseudoclanis postica *Wlk.* Fawcett, E.E.P., ii, xii.
Chadisra curvilinea *Swinh.* E.E.P., ii.
Chrysophyllum argyrophyllum *Hiern.* (Sapotaceae.)
Pseudacraea lucretia expansa. C.F.M.S.
Chrysophyllum fulvum *S. Moore.*
Pseudacraea lucretia expansa. C.F.M.S.
Chrysophyllum natalense *Sond.*
Pseudacraea eurytus imitator *Trim.* G.F.L., E.E.P., vi., vii.
,, lucretia tarquinia *Trim.* G.F.L., E.E.P., vii.
,, ,, expansa, C.F.M.S.
Desmeocraera atriguttata *Hmpsn.* E.E.P., x.
Chrysophyllum viridifolium *Wood* & *Franks.*
Pseudacraea eurytus imitator *Trim.* G.F.L., E.E.P., iii., vii.
,, lucretia tarquinia *Trim.* G.F.L., E.E.P., iii, vi.

Achaea mercatoria *Fabr.* E.E.P.
Dasychira greeni *Janse.* H.A.G., E.E.P.
Desmeocraera atriguttata *Hmpsn.* E.E.P., ii, x.
,, calliope *Hmpsn.* H.A.G., E.E.P.
Gastropacha sp. H.A.G.
Cissampelos torulosa *E.M.* (Menispermaceae.)
Calpe provocans *Wlk.* E.E.P., x.
,, emarginata *Fabr.* E.E.P.
Cissus capensis *Willd.* (Ampelideae.)
Theretra capensis *Linn.* Fawcett.
Cissus cirrhosa *Thb.*
Xanthospilopteryx africana *Butl.* E.E.P., i, xi.
,, superba *Butl.* E.E.P., i, ii, x.
Tuerta trimeni *Feld.* E.E.P., i.
Hippotion celerio *Linn.* E.E.P., xi.
Citrus aurantium, f. near vulgaris *Rino.* (Rutaceae.)
Papilio dardanus *Brown.* C.F.M.S.
,, demodocus *Esp.* C.F.M.S.
,, nireus *Cram.* C.F.M.S.
Clausena inaequalis *Bth.* (Rutaceae.)
Papilio demodocus *Esp.*
,, menestheus ophidicephalus *Oberth.* Miss Fountaine, Eshowe, i. E.E.P., Karkloof, i.
,, dardanus *Brown.* C.F.M.S.
,, echerioides *Trim.* Miss Fountaine, Donnybrook.
,, nireus *Cram.* C.F.M.S.
Procris subdiaphana *Feld.* E.E.P., Karkloof, i.
Clerodendron glabrum *E.M.* (Verbenaceae.)
Hypolycaena philippus *Fab.* E.E.P., iv.
Diacrisia diplosticta *Hmpsn.* E.E.P., xii.
Dionychopus amasis *Cram.* E.E.P., xi.
Porthesia natalensis *Janse.* E.E.P., i.
Acherontia atropos *Linn.* E.E.P., iii.
Ischnurges lancinalis *Guen.* E.E.P., i.
Clerodendron myricoides *R. Br.*
Phytometra euchroa *Hmpsn.* E.E.P., ii.

Cluytia pulchella *Linn.* (Euphorbiaceae.)
Hypoplexia mictochroa *Hmpsn.* E.E.P., ix.
Daseochaeta verbenata *Dist.* E.E.P., ix, xi.
Prasinocyma vermicularia *Guen.* E.E.P., ix, xi.
Cola natalensis *Oliv.* (Sterculiaceae.)
Abantis paradisea *Butl.* E.E.P., iv, viii.
Coleus sp. (Labiatae.)
Precis octavia *Cram.* W.J.H., ix.
Phytometra acuta *Wlk.* E.E.P.
Combretum apiculatum *Sond.* (Combretaceae.)
Hesperia forestan *Cram.* E.E.P., ii.
Bombotelia ethiopica *Hmpsn.* E.E.P., xi, xii.
Goniocalpe heteromorpha *Hmpsn.* E.E.P., iii.
Ornithopsyche difficilis *Wlk.* E.E.P., i, iv, xi.
Desmeocraera vernalis *Dist.* G.F.L., E.E.P., ii, xi.
Leipaxais peraffinis *Holl.* E.E.P., ii, ix.
Coryphodema tristis *Drury.* E.E.P., viii, ix.
Combretum bracteosum *Brandis.*
Neptis saclava *Bdv.* E.E.P., vi, vii.
Hesperia forestan *Cram.* E.E.P., v.
Ornithopsyche difficilis *Wlk.* E.E.P., v.
Combretum Gueinzii *Sond.*
Hamanumida daedalus *Fab.* H.M.M., E.E.P., iv
Pamphila morantii *Trim.* E.E.P., v.
Nola hardenbergi *Janse.* E.E.P.
Bombotelia ethiopica *Hmpsn.* E.E.P., v, ix, xii.
Maurilia arcuata *Wlk.* E.E.P., iii, v, xi.
Goniocalpe heteromorpha *Hmpsn.* E.E.P., iv, ix.
Negeta ruficeps *Hmpsn.* E.E.P., iii, iv.
Negeta luminosa *Wlk.* E.E.P.
Arcyophora longivalvis *Guen.* E.E.P., v, xi.
Dermaleipa rubricata *Holl.* E.E.P., v.
Hypanua roseitincta *Hmpsn.* E.E.P., iv, v.
Anua tirhaca *Cram.* E.E.P., iv.
Dasychira rocana *Swinh.* E.E.P.
Ornithopsyche difficilis *Wlk.* E.E.P., xi.

Homochira rendalli *Dist.* E.E.P., v.
Euproctis rufopunctata *Wlk.* E.E.P., xi.
Desmeocraera pergrisea *Hmpsn.* E.E.P., iv, xii.
Ochrostigma mediata *Wlk.* E.E.P., iv.
Hoplitis phyllocampa *Trim.* H.M.M., E.E.P., iv, v.
Celidomphax rubrimaculata *Warr.* E.E.P., iv, vi.
Haggardia grisea *Warr.* E.E.P., iii.
Omphalucha maturnaria *Möschl.* E.E.P., iii.
Cleora divisaria *Wlk.* E.E.P., iv, xi.
Boarmia octomaculata *Wllgrn.* E.E.P., iv.
Pachypasa pithyocampa *Cram.* E.E.P., xii
Commelina nudiflora *Linn.* (Commelinaceae.)
Acraea encedon *Linn.* E.E.P., iv, vi.
Commiphora caryæfolia *Oliv.* (Burseraceae.)
Usta terpsichore *Maas.* & *Weym.* Fawcett.
Convolvulus sp. (Convolvulaceae.)
Herse convolvuli *Linn* J.O'N.
Coelonia fulvinotata *Butl.* J.O'N.
Cordia caffra *Sond.* (Boragineae.)
Callyna decora *Wlk.* G.F.L., E,E.P., ii, vi, xi, xii.
,, figurans *Wlk.* G.F.L., E.E.P., ii, xii.
,, unicolor *Hmpsn.* E.E.P., x.
Cyclopera galactiplaga *Hmpsn.* E.E.P., ix.
Catephia striata *Hmpsn.* G.F.L., E.E.P., ii, iii, xii.
Polydesma basilinea *Hmpsn.* E.E.P.
Coelonia fulvinotata *Butl.* E.E.P., i.
Polyptychus grayi *Wlk.* Fawcett, E.L.C., E.E.P., ii, xii.
Striphnopteryx edulis *Boisd.* E.L.C
Jana tantalus *Herr.-Schaff.* E.L.C.
Lebedodes durbanica *Hmpsn.* G.F.L., E.E.P., ix.
Crotalaria capensis *Jacq.* (Leguminosae.)
Lycaena boetica *Linn.*
Alytarchia bellatrix *Dalman.* Fawcett, E.E.P., ii, vii, xi.
Croton sylvaticus *Hochst.* (Euphorbiaceae.)
Charaxes candiope *Godt.* Fawcett, E.E.P., iv, x, xii.
Amyna punctum *Fabr.* E.E.P., iv, v, x.
Epiphora mythimnia *Westw.* H.M.M., E.E.P., xii.

Cryptocarya Woodii *Engl.* (Laurineae.)
Metarbela tuckeri *Butl.* E.E.P., x.
Cryptocarya Woodii acuminata *Schinz.*
Charaxes xiphares *Cram.* Miss Fountaine, Dargle, Natal.
Cussonia spicata *Thb.* (Araliaceae.)
Bunaea alcinoe *Stoll.* J.O'N.
Holocera Rhodesiensis *Janse.* J.O'N.
Cyanotis nodiflora *Kth.* (Commelinaceae.)
Estigmene atropunctata *Fawcett.* Fawcett.
,, dissimilis *Dist.* Fawcett.
Cynanchum chirindense *S. Moore.* (Asclepiadaceae.)
Amauris lobengula *E. Sharpe.* C.F.M.S.
,, albimaculata *Butl.* C.F.M.S.
,, ochlea *Boisd.* C.F.M.S.
Cyperus albostriatus *Schrad.* "Sedge." (Cyperaceae.)
Phiala dasypoda *Wllgrn.* H.W.B.M., E.E.P., ii. (Dargle)
Dahlia variabilis *Desf.* (Compositae).
Coelonia fulvinotata *Butl.* Fawcett.
Dalbergia obovata *E.M.* (Leguminosae).
Pristanepa platti *Hmpsn.* E.E.P., x.
Thermesia atriplaga *Wlk.* E.E.P., iii.
Catalebeda cuneilinea *Wlk.* E.E.P., i.
Datura stramonium *Linn.* (Solanaceae).
Acherontia atropos *Linn.* E.E.P., xii.
Desmonema caffrum *Meirs* (Menispermeae.)
Ophideres materna *Linn.* E.E.P., iii, iv, xii.
Desmodium incanum *D.C.* (Leguminosae).
Antheua simplex *Wlk.* E.E.P., iii, xi.
Monda delicatissima *Wlk.* E.E.P.
Dichrostachys nutans *Bth.* (Leguminosae).
Zamarada secutaria *Guen.* E.E.P.
Pachymeta clarki *Aur.* E.L.C.
Dioscorea malifolia *Baker.* (Dioscoraceae).
Pterygospidea flesus *Fab.* E.E.P., i, v.
Dimorphotheca aurantiaca *D.C.* (Compositae).
Cucullia terrensis *Feld.* E.E.P., ii, xi.

Dipcadi umbonatum *Baker.* (Liliaceae).
Diaphone eumela *Stoll.* E.E.P., x.
Eublemma rubripuncta *Hmpsn.* E.E.P., xii.
Dombeya cymosa *Harv.* (Sterculiaceae).
Caprona canopus *Trim.* E.E.P., i, xi.
Pterygospidea nottoana *Wllgrn.* E.E.P., iii, v, xi.
Olapa flabellaria *Fab.* E.E.P., xi.
Pteredoa monosticta *Butl.* E.E.P., ii, iv, v.
Tarache nubilata *Hmpsn.* E.E.P., i.
Anomis leona *Schaus.* E.E.P., i, iii, iv.
Lophostethus dumolinii *Angas.* E.E.P., xii.
Chadisra uncifera *Hmpsn.* E.E.P., iv.
Dombeya rotundifolia *Harv.*
Hoplitis concolor *Janse.* J.O'N., E.E.P., iii, vi.
Anaphe reticulata *Wlk.* J.O'N.
Lophostethus dumolinii *Angas.* J.O'N.
Dovyalis rotundifolia *Thb.* (Bixineae).
Atella phalantha *Drury.* E.E.P., v, viii.
Dracaena Hookeriana *K. Koch.* (Liliaceae).
Pamphila erinnys *Trim.* E.E.P., ii, iii, x.
Duranta plumieri *Jacq.* (Verbenaceae).
Coelonia fulvinotata *Butl.* Fawcett.
Eclipta erecta *Linn.* (Compositae).
Deilemera leuconoe *Hopff.* E.E.P.
Ekebergia Meyeri *Presl.* (Meliaceae).
Charaxes brutus *Cram.* E.E.P., xi.
Ochrostigma mediata *Wlk.* E.E.P., iv.
Bunaea alcinoe *Stoll.* E.E.P., xi.
Lobobunaea tyrrhena *Westw.* H.A.G.
Holocera smilax *Westw.* E.E.P., iv.
Entada natalensis *Bth.* (Leguminosae).
Nyctipao Walkeri *Butl.* E.E.P., xii.
Erigeron canadense *Linn.* (Compositae).
Acraea rahira *Boisd.* Fawcett, E.E.P.
Eriobotrya japonica *Lindl.* (Loquat).
Euproctis rufopunctata *Wlk.* E.E.P., x.

Eriosema sp. (Vaal Bosch). (Leguminosae).
Precis sesamus *Trim.* J.O'N.
Antheua croceipuncta *Hmpsn.* J. O'N.
Leptoclanis pulchra *R.* & *J.* J.O'N.
Trabala rennei *Dew.* J.O'N.
Erythrina caffra *Thb.* Kaffir Boom. (Leguminosae).
Urota sinope *Westw.* Fawcett, E.E.P., i, x.
Agathodes musivalis *Guen.* E.E.P., ii, xi.
Terastia margaritis *Feld.* E.E.P., ii, xi.
Eugenia capensis *Harv.* (Myrtaceae).
Selagena obsolescens *Hmpsn.* E.E.P., x, xii.
Eugenia cordata *Laws.* Waterboom.
Charaxes druceanus *Butl.* J.H.D. Millar, W.J.H., vii, ix.
Rhodogastria bauri *Moschl.* Fawcett.
Rhodogastria astreas *Drury.*
Achaea echo *Wlk.* E.E.P., ix.
Catephia amplificans *Wlk.* E.L.C., G.F.L.
Euproctis rufopunctata *Wlk.* W.J.H.
Desmeocraera tripuncta *Janse.* E.E.P., vi, ix, xi.
Selagena obsolescens *Hmpsn.* E.E.P.
Bunaea angasana *Westw.* H.M.M.
Pingasa abyssinaria *Guen.* E.E.P., ii.
Excoecaria reticulata *Muell. Arg.* (Euphorbiaceae).
Crenis boisduvali *Wllgrn.* Fawcett, E.E.P., iii, xi.
Crenis natalensis *Boisd.* Fawcett, E.E.P., i, xii.
Achaea echo *Wlk.* G.F.L.
Faurea saligna *Harv.* (Proteaceae).
Dasychira pyrosoma *Hmpsn.* E.E.P., v.
Cerura esmeralda *Hmpsn.* E.E.P., v.
Ichthyura violacearia *Janse.* E.E.P., v.
Pseudometa basalis *Wlk.* E.E.P., vi.
Ficus capensis *Thb.* (Urticaceae).
Myrina ficedula *Trim.* E.E.P., iv.
Eutelia leighi *Hmpsn.* E.E.P., iv, vi.
Dasychira extorta *Dist.* E.E.P.
Euproctis rufopunctata *Wlk.* E.E.P., xi.

Ficus cordata *Thb.*
- Myrina ficedula *Trim.*
- Melanocera menippe *Westw.* C.B.H.

Ficus Petersii *Warb.*
- Myrina dermaptera *Wllgrn.* E.E.P., vii, x.
- Rhodogastria astreas *Drury.* E.E.P., iii.
- Bareia incidens *Wlk.* E.E.P., ii, vi, ix.
- Dasychira extorta *Dist.* E.E.P., vi.
- Naroma signifera *Wlk.* E.E.P., viii, x, xii.
- Hypsa subretracta *Wlk.* E.E.P., i, ii, xi.
- Pseudoclanis postica *Wlk.* E.E.P., iii.
- Nephele accentifera *Beauv.* E.E.P., ii, iv, v.
- Trilocha ficicolor *Westw.* & *Orm.* E.E.P., v, ix.

Ficus sp.
- Gonimbrasia belina *Westw.* E.E.P.

Ficus sp.
- Dasychira extorta *Dist.* J.O'N.

Fleurya capensis *Wedd.* (Urticaceae).
- Acraea esebria *Hew.* E.E.P., ii, iv, vi.
- Antanartia schoeneia *Trim.* E.E.P., vi.
- Hypolimnas mima *Trim.* E.E.P., i. iv.

Fuchsia sp. (Onagrarieae).
- Hippotion osiris *Dalman.*
- Hippotion eson *Cram.* E.E.P., ii, viii.

Gardenia jasminoides *Ellis.* (Rubiaceae).
- Cephonodes hylas *Wllgrn.*
- Deilephila nerii *Linn.* E.E.P., iii.
- Glyphodes sericea *Drury.* E.E.P., vi.

Gardenia globosa *Hochst.*
- Diacrisia diplosticta *Hmpsn.* E.E.P., iii.
- Hemerophila serrataria *Wlk.* E.E.P., xi.
- Omizodes ocellata *Warr.* E.E.P., ii, xi.
- Anomoetes levis *Feld.* E.E.P., xi.

Geranium sp. (Geraniaceae).
- Lycaena palemon *Cram.* E.E.P., v.

Gerbera Jamesoni *Bolus.* (Compositae).
- Polia speyeri *Feld.* E.E.P., x.

Gnaphalium purpureum *Linn.* (Compositae).
Pyrameis cardui *Linn.* E.E.P., i, vi.
Gomphocarpus fruticosus *R.Br.* (Asclepiadaceae).
Danaida chrysippus *Linn.* Fawcett, E.E.P., i, iv.
Gramineae (Grasses).
Mycalesis safitza *Hew.* E.E.P.
Leptoneura dingana *Trim.* Miss Fountaine, Barberton.
Pamphila hottentota *Latr.* E.E.P., x.
Cyclopides metis *Cram.* E.E.P.
Micragrotis interstriata *Hmpsn.* J.O'N.
Laphygma exempta *Wlk.* E.E.P., ii.
Cropera testacea *Wlk.* E.E.P.
Psalis securis *Hubn.* E.E.P., xii.
Janomima westwoodi *Aur.* J.O'N.
Phyllalia patens *Boisd.* Fawcett.
Phyllalia flavicostata *Fawcett.*
Rigema woerdeni *Snell.* E.E.P., iv.
Rigema ornata *Wlk.* J.O'N., E.E.P., i.
Nudaurelia arabella *Aur.* J.O'N.
Nudaurelia oubié *Guen.* J.O'N.
Anadiasa distincta *Dist.* E.E.P., iv.
Olyra reducta *Wlk.* E.E.P., xi.
Grewia lasiocarpa *E.M.* (Tiliaceae).
Chadisra curvilinea *Swinh.* E.L.C.
Rethona albicans *Wlk.* E.L.C.
Grewia occidentalis *L.*
Caprona canopus *Trim.* E.E.P., x.
Pterygospidea nottoana *Wllgrn.* E.E.P., ii, xi.
Chasmina tibialis *Fabr.* E.E.P., iv.
Acripia chloropera *Hmpsn.* E.E.P., iii., iv.
Cosmophila sabulifera *Guen.* E.E.P., iii.
Olapa flabellaria *Fab.* E.E.P.
Chadisra uncifera *Hmpsn.* E.E.P., iv.
Lophostethus dumolinii *Angas.* E.E.P., v.
Lebedodes rufithorax *Hmpsn.* E.E.P., ix.
Metarbela tuckeri *Butl.* E.E.P., x.

Gymnandropsis sp. (Capparideae).
    Crocidolomia binotalis *Zell.*
Helinus ovatus *E. Meyer.* (Rhamneae).
    Epiphora mythimnia *Westw.* H.M.M.
Heliotrope sp. (Boragineae).
    Diacrisia eugraphica *Wlk.* E.E.P., xii.
Heliotropium peruvianum *Linn.* (Lettuce).
    Syngrapha circumflexa *Linn.* E.E.P., x.
    Phytometra orichalcea *Fabr.* E.E.P., vii, ix.
    Xanthorhoe poseata *Guen.* E.E.P., ix.
Hibiscus gossypinus *Thb.* (Malvaceae).
    Pyrgus vindex *Cram.* E.E.P., iv, vi.
    Leocyma appollinis *Guen.* E.E.P., iii.
    Creaga dealbata *Herr.-Schaff.* E.E.P., iii.
    Anomis flava *Fabr.* E.E.P., iii.
Hibiscus panduraeformis *Burm.*
    Lophostethus dumolinii *Angas.* J. O'N.
Hibiscus pedunculatus *Cav.*
    Leocyma appollinis *Guen.* E.E.P., iii.
    Tarache tetragonisa *Hmpsn.* E.E.P., iii.
    Anomis luperca *Möschl.* E.E.P., iii.
Hibiscus tiliaceus *Linn.*
    Abantis paradisea *Butl.* H.M.M., E.E.P., iii, x.
    Chasmina tibialis *Fabr.* H.M.M., E.E.P., iii.
    Lophostethus dumolinii *Angas.* Fawcett, H.A.G.
Hypericum aethiopicum *Thb.* (Hypericineae).
    Terias brigitta *Cram.* C.F.M.S.
    Terias senegalensis *Boisd.* C.F.M.S.
Hyphaene crinata *Gaertn.* (Palmae).
    Nudaurelia anna *Maas.* & *Weym.* H.W.B.M., xi. (Zululand).
Impatiens sp. Balsam. (Geraniaceae).
    Hippotion osiris *Dalman.* E.E.P., ii.
    Hippotion eson *Cram.* E.E.P.
    Hippotion celerio *Linn.* E.E.P., iv.
Iboza riparia *N.E.B.*
    Phytometra obtusisigna *Wlk.* E.E.P., iii, v.

Ipomœa batatas *Poir.* Sweet Potato. (Convolvulaceae.)
Herse convolvuli *Linn.* J.O'N. E.E.P., i, iii.
Ipomœa ficifolia *Ldl.*
Catephia iridicosma *B.-Baker.* E.E.P., iii, xi.
Herse convolvuli *Linn.* E.E.P., i, iii.
Ipomœa sp. (flowers).
Eublemma apicemacula *Mab.* E.E.P., ii.
Ipomœa sp.
Euchromia formosa *Guen.* E.E.P., iv, xi.
Isoglossa mossambicensis *Lindau.* (Acanthaceae).
Salamis parhassus aethiops *Pal.* C.F.M.S.
Isoglossa Woodii *C. B. Clarke.*
Pterygospidea mokeezi *Wllgrn.* H.A.G., i.
Jasminium pubigerum *D. Don.* (Oleaceae).
Acherontia atropos *Linn.* Fawcett, E.E.P., iv, xi.
Holocera smilax *Westw.* Fawcett, E.E.P., ii, iv, xii.
Jasminium streptopus *E.M.*
Jana tantalus *H.-S.* E.E.P., xi.
Jussiaea repens *Linn.* (Onagrarieae).
Hippotion balsaminae *Wlk.* Fawcett, H.M.M., iii.
Justicia natalensis *T. Anders.* (Acanthaceae).
Precis oenone *Hubn.* Fawcett.
Justicia pulegioides *E.M.*
Catacroptera cloantha *Cram.* Miss Fountaine, Dargle.
Kiggelaria africana *Linn.* (Bixineae).
Acraea horta *Linn.* E.E.P., xii.
Cymothoe alcimeda *Godt.* E.E.P., i, xii.
Kraussia floribunda *Harv.* (Rubiaceae).
Cephonodes hylas *Wllgrn.*
Lantana camara *L.* (Verbenaceae).
Acherontia atropos *Linn.* E.E.P., ii.
Coelonia fulvinotata *Butl.* E.E.P., vi, xii.
Lasiosiphon kraussii *Meisn.*
Hadena bulgeri *Feld.* E.E.P., xi.
Leucas milanjiana *Guerk.* (Labiatae).
Temnora pylas *Cram.* J.O'N.

Leucosidea sericea *E.* & *Z.* (Rosaceae).
Nola holoscota *Hmpsn.* E.E.P. (Karkloof), i.
Ortholitha horismodes *Prout.* E.E.P. (Karkloof), i.
Lichen.
Ilema bipuncta *Hubn.* E.E.P., xi.
Asura sagenaria *Wllgrn.* E.E.P.
Chionema pretoriae *Dist.* E.E.P.
Ilemodes heterogyna *Hmpsn.* E.E.P., xi, xii.
Dasychira octophora *Hmpsn.* E.E.P., ix.
Euproctis crocata *Boisd.* E.E.P., xi, xii.
Lonicera sempervirens *Linn.* (Caprifoliaceae).
Diacrisia eugraphica *Wlk.* E.L.C., E.E.P., v.
Liliaceae.
Brithys pancratii *Cyr.* J.O'N., E.E.P., i, xi.
Loranthus Dregei *E.* & *Z.* (Loranthaceae).
Iolaus silas *Westw.* H.A.G., E.E.P., iii, vi, ix, xi.
Mylothris agathina *Cram.*
Achaea mabilli *Saalm.* E.E.P., iv.
Victoria mirabilis *Warr.* E.E.P., iv.
Chogada acaciaria *Boisd.* E.E.P.
Ocinaropsis obscura *Aur.* H.M.M., E.E.P., v, viii.
Loranthus Kraussiana *Meisn.*
Iolaus sidus *Trim.* E.E.P., iv, xii.
Mylothris trimenia *Butl.* E.E.P., ix.
Achaea mabilli *Saalm.* E.E.P., iv, xi.
Epigynopteryx deformis *Warr.* E.E.P., x.
Loranthus quinquenervius *Hochst.*
Iolaus sidus *Trim.* E.E.P., x.
Mylothris agathina *Cram.* E.E.P., ix.
Ocinaropsis obscura *Aur.* E.E.P., v, viii.
Maesa alnifolia *Harv.* (Myrsineae).
Pingasa abyssinaria *Guen.* H.W.B.M., E.E.P., iv.
Zerenopsis leopardina *Feld.* E.E.P., v.
Nudaurelia gueinzii *Staud.* H.W.B.M., E.E.P., xi.
Mangifera indica *Linn.* (Mango). (Anacardiaceae).
Lycaenesthes liodes *Hew.* (flowers) E.E.P., ix.

Deilephila nerii *Linn.* J.O'N.
Pachypasa pithyocampa *Cram.* E.E.P., ii.
Nudaurelia wahlbergi *Boisd.* E.E.P.
Medicago sativa *Linn.* (Lucerne). Leguminosae.
Colias electo *Linn.*
Phytometra angulum *Guen.* E.E.P., viii, x.
Melia azedarach *L.* (Syringa). Meliaceae.
Charaxes brutus *Cram.*
Microglossa mespiloides *Bth.* & *Hk.* Compositae.
Ludia delegorguei *Boisd.* Fawcett.
Millettia Sutherlandi *Harv.* Leguminosae.
Hesperia forestan *Cram.* E.E.P., iv.
Thermesia burrowsi *Butl.* E.E.P. (Eshowe), xii.
Platysphinx piabilis *Dist.* E.E.P. (Eshowe), i, ii, xii.
Scalmicauda heterogyna *Hmpsn.* E.E.P., vi.
Mimusops discolor *Sond.* Sapotaceae.
Pseudacraea boisduvali *Trim.* iii, vi.
Achaea mercatoria *Fabr.* E.E.P., iii, x, xi, xii.
Dasychira greeni *Janse.* H.A.G., E.E.P., i, v.
Euproctis punctifera *Wlk.*
Desmeocraera varia *Janse.* E.E.P., iii, vi, xi.
Desmeocraera platti *Janse.* E.E.P., vi, x.
Mimusops obovata *Sond.*
Pseudacraea boisduvali *Trim.* vi, xii.
Pseudacraea lucretia *Cram.*
Rhodogastria astreas *Drury.* E.E.P., ix.
Dasychira greeni *Janse.* H.A.G., E.E.P., v, vi.
Desmeocraera atriguttata *Hmpsn.* E.E.P., viii, xii.
Desmeocraera varia *Janse.* E.E.P., ii, ix.
Diptychis geometrina *Feld.* E.E.P., xi.
Morus sp. (Mulberry). Urticaceae.
Pseudoclanis postica *Wlk.* J.O'N.
Myrica aethiopica *Linn.* Myricaceae.
Lycaenesthes liodes *Hew.* (flowers). E.E.P., vi.
Eutelia leucographa *Hmpsn.* E.E.P., vi.
Maurilia arcuata *Wlk.* E.E.P., v.

Anua violascens *Hmpsn.* E.E.P., v.
Thalassodes digressa *Wlk.* E.E.P.,
Pantoctenia gemmans *Feld.* E.E.P., v.
Myrica sp.
Lycaenesthes liodes *Hew.* E.E.P., viii.
Eutelia leucographa *Hmpsn.* E.E.P., viii.
Nerium Oleander *Linn.* (Apocynaceae).
Deilephila nerii *Linn.* J.O'N., E.E.P., i, ii, iii.
Gonimbrasia zambesina *Wlk.* H.W.B.M., xi. (Zululand).
Nicotiana affinis *Hort.* Solanaceae.
Phytometra acuta *Wlk.* E.E.P.
Coelonia fulvinotata *Butl.* E.E.P.
Niebuhria pedunculosa *Hochst.* Capparideae.
Pieris severina *Cram.* E.E.P., iv, vii, ix.
Pieris zochalia *Boisd.* E.E.P., iv.
Pieris thysa *Hopff.* E.E.P., v, viii, xi.
Pieris epaphia *Cram.* E.E.P., i, iv, vi.
Teracolus erone *Angas.* E.E.P., iii, v, ix, xii.
Metarbela tuckeri *Butl.* E.E.P.
Ochna atropurpurea *D.C.* Ochnaceae.
Rhodogastria astreas *Drury.* E.E.P., ix.
Hemerophila contemptaria *Wlk.* E.E.P., x.
Hemerophila serrataria *Wlk.* E.E.P.
Melanocera menippe *Westw.* H.M.M., E.E.P., xii.
Oldenlandia amatymbica *Kuntze.* Rubiaceae.
Pais decora *Linn.* E.E.P., xi. (Zululand).
Oncoba Kraussiana *Planch.* Bixineae.
Acraea oncaea *Hopff.* E.E.P., iv, xii.
Acraea petraea *Boisd.* Fawcett, E.E.P., ii, viii, xi.
Ophiocaulon gummifera *Hk.F.* Passifloreae.
Acraea natalica *Boisd.* E.E.P., i, vi.
Planema aganice *Hew.* E.E.P., vi.
Calpe provocans *Wlk.* E.E.P.
Calpe emarginata *Fabr.* E.E.P., vi.
Ornithogalum Eckloni *Sch.* Liliaceae.
Diacrisia flava *Wllgrn.* Fawcett.

Diacrisia screabilis *Wllgrn.* Fawcett.
Diaphone eumela *Stoll.* Fawcett.
Orthosiphon sp. Labiatae.
Callyna nigerrima *Hmpsn.* J.O'N.
Oxalis corniculata *Linn.* Geraniaceae.
Zizura gaika *Trim.* W.J.H.
Parinarium Mobola *Oliv.* Rosaceae.
Dasychira pryosoma *Hmpsn.* J.O'N.
Polyptychus coryndoni *Roths.* & *J.* J.O'N.
Passiflora caerulea *Linn.* Passifloreae.
Acraea zetes *Trim.* E.E.P., i, iii, vii, xi.
Planema aganice *Hew.* E.E.P.
Acraea natalica *Boisd.* E.E.P., iii.
Passiflora edulis *Sims.* (Grenadilla).
Acraea neobule *Doubl.* C.F.M.S.
Acraea zetes *Trim.* Trimen, C.F.M.S.
Acraea aglaonice *Westw.* C.F.M.S.
Acraea horta *Linn.* Trimen.
Diacrisia lineata *Wlk.* Fawcett.
Passiflora incarnata *Linn.* (American "May Pop.")
Acraea neobule *Doubl.* C.F.M.S.
Acraea zetes *Trim.* C.F.M.S.
Acraea aglaonice *Westw.* C.F.M.S.
Pavetta lanceolata *Eck.* Rubiaceae.
Cephonodes hylas *Wllgrn.* Fawcett, E.E.P., iv, xii.
Parasa vivida *Wlk.* E.E.P., i.
Ctenogyna natalensis *Feld.* E.E.P.
Pavonia columella *Cav.* Malvaceae.
Duomitus capensis *Wlk.* E.E.P., vii.
Pavonia macrophylla *E.M.*
Pyrgus vindex *Cram.* E.E.P., i.
Caprona canopus *Trim.* E.E.P., ii.
Acontia malvae *Esp.* G.F.L., E.E.P., ii, xii.
Leocyma appollinis *Guen.* G.F.L., E.E.P., ii.
Pellaea hastata *Link.* (Fern).
Bombycopsis ?ochroleuca *Feld.* E.E.P., xi, xii. (Zululand)
Elaeodes acatharta *Hmpsn.* H.M.M., i.

Pentanisia variabilis *Harv.* Rubiaceae.
    Pais decora *Linn.* E.E.P., xi. (Zululand).
Petunia violacea *Lindl.* Solanaceae.
    Phytometra angulum *Guen.* E.E.P.
Phaseolus vulgaris *Linn.* Leguminosae.
    Phytometra angulum *Guen.* E.E.P., x.
    Phytometra acuta *Wlk.* E.E.P., iii.
Phoenix reclinata *Jacq.* Palmae.
    Pamphila dysmephila *Trim.* A. D. Millar, E.E.P., iv, x.
Pirus communis *L.* (Pear).
    Selagena tessellata *Dist.*
Plectranthus sp. Labiatae.
    Precis archesia *Cram.* Miss Fountaine, Jolivet, Natal.
Plectranthus floribundus *N.E.B.*
    Precis natalensis *Staud. C.F.M.S.*
Plectranthus calycinus *Bth.*
    Precis octavia *Cram.* Miss Fountaine, Dargle.
Plectronia ventosa *L.* Rubiaceae.
    Poloma angulata *Wlk.* E.E.P., v, xi.
Plumbago capensis *Thb.* Plumbagineae.
    Tarucus telicanus *Lang.* W.J.H.
Polygonum sp. Polygonaceae.
    Acraea rahira *Boisd.* H.M.M., E.E.P., iii.
Popowia caffra *H.* & *S.* Anonaceae.
    Papilio brasidas *Feld.* Fawcett, E.E.P., i, iii, xii.
    Saroba cyanescens *Hmpsn.* E.E.P., xii.
    Racotis zebrina *Warr.* E.E.P., ix.
    Mallocampa sp. E.E.P., vi.
Populus alba *Linn.* Salicinae.
    Atella phalantha *Drury.* C.F.M.S.
Portulaca foliosa *Ker-Gawl.* Portulaceae.
    Hypolimnas misippus *L.* C.F.M.S.
Portulaca sp.
    Hypolimnas misippus *L.* E.E.P., i, iii, v.
Protea hirta *Klotzsch.* Proteaceae.
    Capys disjunctus *Trim.* G.F.L., E.E.P., iv.
    Cerura esmeralda *Hmpsn.* E.E.P., i.

Protea multibracteata *Phillips.*
- Capys disjunctus, G.F.L., E.E.P., iv.
- Diacrisia flava *Wllgrn.* E.E.P., iv.
- Catephia natalensis *Hmpsn.* E.E.P., v.
- Dasychira pyrosoma *Hmpsn.* E.E.P., v, x.
- Ichthyura violacearia *Janse.* E.E.P., iv, v, x.
- Cerura esmeralda *Hmpsn.* E.E.P., v.
- Mauna filia *Cram.* E.E.P., iv, v.
- Pseudometa basalis *Wlk.* E.E.P., v.
- Clania moddermanni *Heyl.* E.E.P.

Protea sp.
- Achaea violescens *Hmpsn.* J.O'N.
- Callyna nigerrima *Hmpsn.* J.O'N.
- Cerura esmeralda *Hmpsn.* J.O'N.
- Cinabra hyperbius *Westw.* J.O'N.

Prunus Persica *Stokes.* Rosaceae.
- Pachypasa capensis *Aur.* H.W.B.M., xii.

Psidium sp. (Guava). Myrtaceae.
- Chlumetia polymorpha *Hmpsn.* E.E.P., i, xii.
- Euproctis rufopunctata *Wlk.* E.E.P.
- Nudaurelia wahlbergi *Boisd.* E.E.P.
- Holocera smilax *Westw.* Fawcett, E.E.P., ii.

Psychotria capensis *Vatke.* Rubiaceae.
- Prodenia litura *Fab.* E.L.C.
- Catephia bipuncta *Hmpsn.* E.E.P., iv, ix.
- Temnora marginata *Wlk.* E.L.C., E.E.P., i, iv, ix, xii.

Pycnostachys reticulata *Bth.* Labiatae.
- Precis octavia *Cram.* E.E.P., iv.

Pycnostachys urticifolia *Hook.*
- Precis octavia *Cram.* E.E.P., viii, ix.
- Coelonia fulvinotata *Butl.* E.E.P., x, xii.

Quercus pedunculata *Ehrh.* Cupuliferae.
- Dasychira georgiana *Fawcett.*
- Holocera smilax *Westw.*

Rauwolfia natalensis *Sond.* Apocynaceae.
- Deilephila nerii *Linn.* W.J.H., xii.

Rawsonia lucida *Harv.* Bixineae.
Acraea cerasa *Hew.* H.A.G., E.E.P., i, ix.
Lachnoptera ayresii *Trim.* H.A.G., E.E.P., i, x.
Rhoicissus cirrhiflora *Gilg.* & *Brandt.* Ampelideae.
Aegocera fervida *Wlk.* E.E.P., iv, xii.
Tuerta trimenii *Feld.* E.E.P., i.
Polia speyeri *Feld.* E.E.P., xi.
Theretra capensis *Linn.* E.E.P., i.
Saliuncella marshalli *Jord.* E.E.P., iv.
Rhus laevigata *L.* Anacardiaceae.
Anua tirhaca *Cram.* E.E.P., ii.
Dasychira georgiana *Fawcett.* E.E.P.
Holocera smilax *Westw.* E.E.P., i, xi.
Taragama polydora *Druce.* E.E.P., iii.
Rhus villosa *Lf.*
Eutelia amatrix *Wlk.* E.E.P., iv, xi.
Phlegetonia catephioides *Guen.* E.E.P., iii.
Anua tirhaca *Cram.* E.E.P., iv.
Lymantria modesta *Wlk.* E.E.P., iii, iv, xi.
Chadisra bicolor *Dist.* E.E.P., iv.
Omphalucha maturnaria *Moschl.* E.E.P., iii, xi.
Xylopteryx arcuata *Wlk.* E.E.P.
Holocera smilax *Westw.* E.E.P.
Bombycomorpha bifascia *Wlk.* E.E.P., xi, xii.
Beralade pygmula *Strand.* E.E.P., iii, iv.
Rhus longifolia *Sond.*
Pacidara venustissima *Wlk.* E.E.P., v.
Holocera smilax *Westw.* E.E.P., ii.
Gonimbrasia belina *Westw.* Fawcett.
Bunaea angasana *Westw.* H.M.M.
Cirina forda *Westw.* Fawcett, E.E.P., x.
Richardia africana *Kunth.* Aroideae.
Hippotion osiris *Dalman.* J.O'N.
,, eson *Cram.* J.O'N., E.E.P.
Richardia albomaculata *Hook.*
Theretra cajus *Cram.* E.E.P., i. (Karkloof).

Richardsonia pilosa *H.B.* & *K.* Rubiaceae.
Basiotha medea *Fabr.* E.E.P., iii, iv.

Ricinus communis *Linn.* (Castor Oil Plant). Euphorbiaceae.
Eurytela dryope *Cram.* E.E.P., v.
Euproctis punctifera *Wlk.*
Dasychira georgiana *Fawcett.*
Achaea catella *Guen.* J.O'N.
Achaea mormoides *Wlk.* G.F.L., E.E.P., ii.
Achaea finita *Guen.* E.E.P., iv.
Parallelia algira *Linn.* E.E.P., iv.
Thalassodes digressa *Wlk.* E.E.P., xii.
Chogada acaciaria *Boisd.* E.L.C.
Nudaurelia wahlbergi *Boisd.* E.E.P., v.
Duomitus capensis *Wlk.* E.E.P.

Royena pallens *Thb.* Ebenaceae.
Hypocala deflorata *Fabr.* E.E.P., ii, xi.
Taragama carinata *Wllgrn.* E.E.P., ii.

Royena villosa *Linn.*
Hypocala deflorata *Fabr.* E.E.P., xii.
Ornithopsyche difficilis *Wlk.* E.E.P., xi.
Cleora divisaria *Wlk.* E.E.P.
Metarbela tuckeri *Butl.* E.E.P., x.
Omocena systis *Schaus.* E.E.P., xii.

Rubia cordifolia *L.* Rubiaceae.
Macroglossum trochilus *Hubn.* H.M.M., E.E.P., ii, iv.

Salix sp. Salicinae.
Atella phalantha *Drury.* C.F.M.S.

Salvia splendens *Ker-Gawl.* Labiatae.
Phytometra limbirena *Guen.* E.E.P., vii.
Coelonia fulvinotata *Butl.* E.E.P., ii.

Sapindus oblongifolius *Sond.* Sapindaceae.
Egybolis vaillantina *Stoll.* Fawcett, E.E.P., ii, vii, xi.
Serrodes inara *Cram.* E.L.C.
Omocena systis *Schaus.* E.E.P., xii.
Argyroploce illepida *Butl.* E.E.P.

Schinus molle *Linn.* (Pepper Tree). Piperaceae
    Eutelia discistriga *Wlk.* E.E.P., iii, iv.
    Thalassodes digressa *Wlk.* E.E.P., iv.
Schmidelia africana *D.C.* Sapindaceae.
    Charaxes varanes *Cram.* E.E.P., i, iii, xii.
    Lycaenesthes liodes *Hew.* E.E.P., i.
    Dasychira lunensis *Hmpsn.* G.F.L., E.E.P., i, iii, xi.
    Tagoropsis flavinata *Wlk.* E.E.P., xii.
Schotia brachypetala *Sond.* Leguminosae.
    Pachymeta clarki *Aur.* E.L.C.
Sclerocarya caffra *Sond.* Anacardiaceae.
    Phlegetonia catephioides *Guen.* E.E.P., iv.
    Lymantria modesta *Wlk.* E.E.P., iv.
    Euproctis rufopunctata *Wlk.* E.E.P., iii.
    Argema mimosa *Boisd.* Fawcett, E.E.P., xi.
    Gonimbrasia belina *Westw.* E.E.P., xi.
    Usta terpsichore *Maas.* & *Weym.* H.M.M., E.E.P., i, xi.
    Lebeda kollikerii *Dew.* E.L.C., E.E.P., iv, v, xii.
    Trabala pallida *Fawcett.* Fawcett, E.L.C., E.E.P., iv.
Scolopia Gerrardi *Harv.* Bixineae.
    Ichthyura lentisignata *Hmpsn.* E.E.P., v.
    Pararethona hierax *Dist.* E.E.P., v, x.
Scutia Commersonii *Brogn.* Rhamneae.
    Pterygospidea nottoana *Wllgrn.* E.E.P., xi.
    Polydesma inangulata *Guen.* E.E.P., x.
    Lasiochlora bicolor *Th. Mieg.* E.E.P., x.
    Lasiochlora diducta *Wlk.* E.E.P., xii.
    Chloroclystis marmorata *Warr.* E.E.P., x.
Secamone Gerrardi *Harv.* Asclepiadaceae.
    Euchromia amoena *Moschl.* E.E.P., xi.
    Spiramiopsis comma *Hmpsn.* E.E.P., x.
Senecio bupleuroides *D.C.* Compositae.
    Diacrisia scita *Wlk.* E.E.P., xii.
    Phytometra exquisita *Feld.* E.E.P., i.
Senecio deltoideus *Less.*
    Ludia delegorguei *Boisd.* E.E.P., xi.

Lebeda bipars *Wlk.* H.A.G., E.E.P., v.
Senecio pellucidus *D.C.*
Deilemera leuconoe *Hopff.* E.E.P., v, vi.
Setaria sulcata *Raddi.* Gramineae.
Melanitis leda *Linn.* H.A.G., E.E.P., iii, v.
Sida rhombifolia *Linn.* Malvaceae.
Cosmophila erosa *Hubn.* E.E.P., iii.
Sideroxylon inerme *L.* Sapotaceae.
Dasychira metathermes *Hmpsn.* E.E.P., iii.
Smilax Kraussiana *Meisn.* Liliaceae.
Diacrisia scita *Wlk.* E.E.P., iv.
Heliophisma croceipennis *Wlk.* E.E.P., ii, iv, vi.
Dasychira whitei *Druce.* E.E.P., iii, vi, xi.
Solanum auriculatum *Ait.* Solanaceae.
Hesperia forestan *Cram.* E.E.P., xii. (Eshowe).
Solanum giganteum *Jacq.*
Euplexia amaranta *Feld.* E.E.P., xii. (Eshowe).
Solanum lycopersicum *Linn.* (Tomato).
Phytometra acuta *Wlk.* E.E.P.
Acherontia atropos *Linn.* E.E.P.
Coelonia fulvinotata *Butl.* E.E.P., ii, iv.
Solanum Seaforthianum *Andr.*
Diacrisia lutescens *Wlk.* E.E.P., ii.
Solanum sodomeum *Linn.*
Selepa docilis *Butl.* E.E.P., i.
Coelonia fulvinotata *Butl.* E.E.P., vi.
Solanum tuberosum *Linn.* (Potato).
Acherontia atropos *Linn.* J.O'N.
Spermacoce natalensis *Hochst.* Rubiaceae.
Basiotha medea *Fabr.* Fawcett, E.E.P., i. (Karkloof).
Sphedamnocarpus pruriens *Szyszyl.* Malpighiaceae.
Papilio angolanus *Goeze.* C.F.M.S.
Stephania discolor *Spreng.* Menispermaceae.
Calpe emarginata *Fabr.* E.E.P., i. (Karkloof).
Stoboea discolor *D.C.* (Thistle). Compositae.
Pyrameis cardui *Linn.*

Strelitzia augusta *Thb.* (Wild Banana). Scitamineae.
Pamphila fiara *Butl.* H.A.G., E.E.P., viii, x.

Strychnos Henningsii *Gilg.* Loganiaceae.
Temnora inornatum *Roths.* E.E.P., i, x, xi.
Temnora zantus *H.-S.* E.E.P., ii, iii, v, vi, vii, viii, xi.
Leucostrophus hirundo *Gerst.* H.M.M., E.E.P., ii.
Atemnora westermanni *Boisd.* E.E.P., vii.

Strychnos Gerrardi *N.E.B.*
Phasicnecus obtusus *Wlk.* E.E.P., xi.

Syncolostemon densiflorus *E.M.* Labiatae.
Phytometra transfixa *Wlk.* E.E.P., iv.
,, acuta *Wlk.* E.E.P., iv.
,, arachnoides *Dist.* E.E.P., iv.

Tagetes erecta *L.* (African Marigold). Compositae.
Diacrisia eugraphica *Wlk.* E.E.P., ii.
,, scita *Wlk.* E.E.P., xii.
,, flava *Wllgrn.* E.E.P.
,, lineata *Wlk.* E.E.P., ii.
Teracotona submacula *Wlk.* E.E.P., xi, xii.
Dionychopus amasis *Cram.* E.E.P., x.

Teclea Swynnertonii *Bak.* Rutaceae.
Papilio dardanus *Brown.* C.F.M.S.
,, demodocus *Esp.* C.F.M.S.
,, nireus *Cram.* C.F.M.S.

Tecomaria capensis *Spach.* Bignoniaceae.
Acherontia atropos *Linn.* E.E.P.
Coelonia fulvinotata *Butl.* E.E.P., xi.
Oligographa juniperi *Boisd.* E.E.P., iii, x, xii.
Striphnopteryx edulis *Wllgrn.*

Tephrosia elongata *E.M.* (Leguminosae).
Diacrisia scita *Wlk.* E.E.P., xii.

Tephrosia macropoda *E.M.*
Antheua dimorpha *Janse.* E.E.P., x, xi.

Thespesia Garckeana *F. Hoffm.* Malvaceae.
Eulymnia pulcherrima *Hmpsn.* J.O'N.

Thyatirina achatina *Weym.* J.O'N.
Likoma apicalis *Roths.* & *Jord.* J.O'N.
Thunbergia alata *Bojer.* Acanthaceae.
Rhanidophora phedonia *Stoll.* E.E.P., xi.
Thunbergia podoensis *Lindau.*
Rhanidophora cinctigutta *Wlk.* E.E.P., i, iii, xi.
,, phedonia *Stoll.* E.E.P., iii.
Thunbergia lancifolia *T. Anders.*
Rhanidophora cinctigutta *Wlk.* J.O'N.
Toddalia aculeata *Pers.* Rutaceae.
Papilio dardanus *Brown.* C.F.M.S.
,, demodocus *Esp.* C.F.M.S.
,, nireus *Cram.* C.F.M.S.
Toddalia lanceolata *Lam.*
Papilio echeroides *Trim.* E.E.P., ii. (Karkloof).
,, nireus *Cram.* E.E.P., ix.
Toddalia natalensis *Sond.*
Papilio dardanus *Brown.* C.F.M.S.
,, demodocus *Esp.* C.F.M.S.
,, nireus *Cram.* C.F.M.S.
Tragia durbanensis *Kuntze.* (Euphorbiaceae).
Byblia ilithyia *Drury.* E.E.P., i, ii.
Eurytela hiarbas *Drury.* E.E.P.
Rhaesena subcupralis *Wlk.* E.E.P., ii, vi.
Trema bracteolata *Blume.* Urticaceae.
Charaxes cithaeron *Feld.* E.E.P., vii.
Metarctia meteus *Stoll.* E.E.P., xii.
Plusiopalpa adrasta *Feld.* E.E.P., ii, iv, vi.
Phytometra acuta *Wlk.* E.E.P., iv.
Cosmophila erosa *Hubn.*
Dasychira georgiana *Fawcett.* E.E.P., iv.
Porthesia natalensis *Janse.* E.E.P., iii, iv.
Pseudoclanis postica *Wlk.* E.E.P., i.
Chadisra curvilinea *Swinh.* E.E.P., iv.
Gonimbrasia belina *Westw.* E.E.P.
Nudaurelia wahlbergi *Boisd.* E.E.P., xi.

Lobobunaea tyrrhena *Westw.* E.E.P., xi.
Trabala rosa *Druce.* E.E.P., xii.
Trichilia Dregeana *E.M.* Meliaceae.
Dendrolimus aculeata *Wlk.* Fawcett.
Trichilia emetica *Vahl.*
Charaxes brutus *Cram.* G.F.L., E.E.P., iv, vi.
Taragama distinguenda *Aur.* E.E.P., viii.
Tagoropsis dentifera *Maas.* & *Weym.* E.E.P., xi.
Eulophonotus myrmeleon *Feld.* H.M.M., ix.
Trimeria alnifolia *Planch.* Bixineae.
Atella phalantha *Drury.* E.E.P., iii.
Ichthyura lentisignata *Hmpsn.* E.E.P., x.
Rethona albicans *Wlk.* E.L.C., E.E.P., xi, xii.
Teragra guttifera *Hmpsn.* E.E.P., x.
Triumfetta annua *L.* Tiliaceae.
Acraea terpsichore *Linn.* C.F.M.S.
Triumfetta effusa *E. Meyer.*
Acraea terpsichore *Linn.* C.F.M.S.
Triumfetta pilosa *Roth.*
Acraea terpsichore *Linn.* C.F.M.S.
Triumfetta rhomboidea *Jacq.*
Acraea terpsichore *Linn.* Fawcett, C.F.M.S., E.E.P., ii.
Pyrgus dromus *Plotz.* E.E.P., ii.
Cosmophila sabulifera *Guen.* E.E.P., ii.
Triumfetta tomentosa *Boj.*
Acraea cabira *Hopff.* E.E.P., ii, iv, vi.
Pyrgus dromus *Plotz.* E.E.P., ii.
Tropaeolum sp. (Nasturtium). Crucifereae.
Crocidolomia binotalis *Zell.* E.E.P., ii.
Tryphostemma Sandersoni *Harv.* Passifloreae.
Acraea nohara *Boisd.* E.E.P., xi.
Turraea floribunda *Hochst.* Meliaceae.
Charaxes brutus *Cram.* G.F.L., E.E.P., vi.
Pseudaphelia apollinaris *Boisd.* Fawcett, E.E.P., i, xi.
Tylophora anomala *N.E.B.* Asclepiadaceae.
Amauris echeria *Stoll.* E.E.P., iv, v, ix.

Amauris albimaculata *Butl.* E.E.P., iv, vii, x, xii.
,, ochlea *Boisd.* E.E.P., i, x, xii.
Uapaca Kirkiana *Muell.* Euphorbiaceae.
Bunaea angasana *Westw.* J.O'N.
Urera Woodii *N. E. Br.* Urticaceae.
Acraea igola *Trim.* H.A.G.
,, esebria *Hew.* H.A.G., E.E.P., vii.
Uvaria caffra *E.M.* Anonaceae.
Papilio policenes *Cram.* Fawcett, E.E.P., i, xi, xii.
,, morania *Angas.* Fawcett, E.E.P., iii, x.
,, antheus *Cram.* G.F.L., E.E.P., ii, xii.
Verbascum sp. Scrophularineae.
Phytometra limbirena *Guen.* E.E.P., vii.
Vigna sp. (Cow Pea). Leguminosae.
Polia speyeri *Feld.* J.O'N.
Vernonia corymbosa *Less.* Compositae.
Ramesodes divisa *Hmpsn.* E.E.P., iv.
Vernonia Gerrardi *Harv.*
Estigmene atropunctata *Fawcett.* Fawcett.
,, dissimilis *Dist.* Fawcett.
Vernonia sp.
Basiotha schenki *Möschl.* J.O'N.
Vangueria infausta *Burch.* Rubiaceae.
Cephonodes hylas *Wllgrn.* E.E.P., xi.
Omphax subaspersa *Warr.* E.E.P., xi.
Petovia dichroaria *H.-S.* Fawcett, E.E.P., xi.
Heterorachis devocata *Wlk.* Fawcett.
Voacanga Dregei *E.M.* Apocynaceae.
Deilephila nerii *Linn.* E.E.P., xii. (Eshowe).
Vitis vinifera *Linn.* (Grape Vine). Ampelideae.
Rothia butleri *Wlk.* Fawcett.
Xanthospilopteryx superba *Butl.* E.E.P., xii.
Agrotis segetis *Schiff.* Fawcett.
Euchloron megaera *Linn.* E.E.P., ii, v.
Hippotion eson *Cram.* E.E.P.
,, celerio *Linn.* E.E.P., i.

Hippotion osiris *Dalman*. Fawcett.
Theretra capensis *Linn*. E.E.P., i.
Weihea Gerrardi *Schinz*. Rhizophoreae.
Ogoa simplex *Wlk*. E.E.P., vii.
Lepidopalpus hyalina *Janse*. E.E.P., vi, viii, x.
Wormskioldia longepedunculata *Mast*. Turneraceae.
Acraea asema *Hew*. C.F.M.S.
,, caldarena *Hew*. C.F.M.S.
,, oncaea *Hopff*. C.F.M.S.
,, natalica *Boisd*. C.F.M.S.
,, nohara *Boisd*. Miss Fountaine, Macequece.
Zizyphus mucronata *Willd*. Rhamneae.
Tolna sypnoides *Butl*. H.W.B.M.
Taeniopteryx cinerea *Janse*. E.E.P., i.
Petrodava subapicata *Warr*. E.E.P.
Epiphora vera *Janse*. J.O'N.
,, mythimnia *Westw*. H.M.M., E.E.P.

SOUTH AFRICAN LEPIDOPTERA WITH THE PLANTS UPON WHICH THEIR LARVÆ FEED.

DANAIDIDAE.

Danaida chrysippus *Linn*.
Gomphocarpus fruticosus *Linn*.
Asclepias fulva *N.E.B*.
,, lineolata *Schl*.
,, Swynnertonii *S. Moore*.
,, coarctata *S. Moore*.
,, scabrifolia *S. Moore*.
,, reflexa *Britt. & Rend*.
Amauris echeria *Stoll*.
Tylophora anomala *N.E.B*.
Amauris albimaculata *Butl*.
Tylophora anomala *N.E.B*.
Cynanchum chirindense *S. Moore*.

Amauris ochlea *Boisd.*
Tylophora anomala *N.E.B.*
Cynanchum chirindense *S. Moore*
Amauris lobengula *E. Sharpe.*
Cynanchum chirindense *S. Moore*

SATYRIDAE.

Mycalesis safitza *Hew.*
Grass.
Melanitis leda *Linn.*
Setaria sulcata *Raddi.*
Leptoneura dingana *Trim.*
Grass.

NYMPHALIDAE.

ACRAEINAE.

Acraea terpsichore *Linn.*
Triumfetta rhomboidea *Jacq.*
,, annua *L.*
,, effusa *E. Meyer.*
,, pilosa *Roth.*
Acraea cabira *Hopff.*
Triumfetta tomentosa *Boj.*
Acraea igola *Trim.*
Urera Woodii *N. E. Br.*
Acraea cerasa *Hew.*
Rawsonia lucida *Harv.*
Acraea zetes *Trim.*
Passiflora edulis *Sims.*
,, caerulea *Linn.*
,, incarnata *Linn.*
Acraea horta *Linn.*
Passiflora.
Kigellaria africana *Linn.*
Acraea aglaonice *Westw.*
Passiflora edulis *Sims.*
Passiflora incarnata *Linn.*

Acraea neobule *Doubl.*
Passiflora edulis *Sims.*
,, incarnata *Linn.*
Acraea asema *Hew.*
Wormskioldia longepedunculata *Mast.*
Acraea caldarena *Hew.*
Wormskioldia longepedunculata *Mast.*
Acraea oncaea *Hopff.*
Oncoba Kraussiana *Planch.*
Wormskioldia longepedunculata *Mast.*
Acraea natalica *Boisd.*
Ophiocaulon gummifera *Hk. f.*
Wormskioldia longepedunculata *Mast.*
Passiflora caerulea *Linn.*
Acraea petraea *Boisd.*
Oncoba Kraussiana *Planch.*
Acraea encedon *Linn.*
Commelina nudiflora *Linn.*
Acraea rahira *Boisd.*
Erigeron canadense *Linn.*
Polygonum sp.
Acraea nohara *Boisd.*
Tryphostemma Sandersoni *Harv.*
Wormskioldia longepedunculata *Mast.*
Planema aganice *Hew.*
Ophiocaulon gummifera *Hk. f.*
Passiflora caerulea *Linn.*

NYMPHALINAE.

Atella phalantha *Drury.*
Trimeria alnifolia *Planch.*
Dovyalis rotundifolia *Thb.*
Aberia macrocalyx *Oliv.*
Populus alba *Linn.*
Salix sp.
Lachnoptera ayresii *Trim.*
Rawsonia lucida *Harv.*

Pyrameis cardui *Linn.*
    Arctotis grandis *Thb.*
    Gnaphalium purpureum *Linn.*
    Stoboea discolor *D.C.* (Thistle).
    Boehmeria nivea *Gaudich.*
    Phaseolus vulgaris *Linn.*
Antanartia schoeneia *Trim.*
    Fleurya capensis *Wedd.*
    Boehmeria nivea *Gaudich.*
Precis oenone *Hubn.*
    Justicia natalensis *T. Anders.*
    Asystasia coromandeliana *Nees.*
Precis clelia *Cram.*
    Asystasia coromandeliana *Nees.*
Precis terea *Drury.*
    Asystasia coromandeliana *Nees.*
Precis natalica *Feld.*
    Asystasia coromandeliana *Nees.*
Precis archesia *Cram.*
    Plectranthus sp.
Precis octavia *Cram.*
    Coleus sp.
    Plectranthus floribundus *N.E.B.*
    ,, ,, var. longipes *N.E.B.*
    Plectranthus calycinus *Bth.*
    Pycnostachys reticulata *Bth.*
    Pycnostachys urticifolia *Hook.*
Catacroptera cloantha *Cram.*
    Justicia pulegioides *E.M.*
Salamis parhassus *Dru.*
    Asystasia coromandeliana *Nees.*
    Isoglossa mossambicensis *Lindau.*
Crenis boisduvali *Wllgrn.*
    Excoecaria reticulata *Muell. Arg.*
Crenis natalensis *Boisd.*
    Excoecaria reticulata *Muell. Arg.*

Eurytela hiarbas *Drury.*
Tragia durbanensis *Kuntze.*
Eurytela dryope *Cram.*
Tragia durbanensis *Kuntze.*
Ricinus communis *Linn.*
Byblia ilithyia *Drury.*
Tragia durbanensis *Kuntze.*
Neptis saclava *Bdv.*
Acalypha glabrata *Thb.*
Combretum bracteosum *Brandis.*
Neptis goochii *Trim.*
Acalypha sp.
Hypolimnas misippus *L.*
Portulaca sp.
Portulaca foliosa *Ker.-Gawl.*
Asystasia coromandeliana *Nees.*
Hypolimnas mima *Trim.*
Fleurya capensis *Wedd.*
Pseudacraea lucretia *Cram.*
Chrysophyllum natalense *Sond.*
,, viridifolium *Wood & Franks.*
,, fulvum *S. Moore.*
,, argyrophyllum *Hiern.*
Mimusops obovata *Sond.*
Pseudacraea eurytus *Clerck.*
Chrysophyllum natalense *Sond.*
,, viridifolium *Wood & Franks*
Pseudacraea boisduvali *Trim.*
Mimusops obovata *Sond.*
,, discolor *Sond.*
Hamanumida daedalus *Fab.*
Combretum Gueinzii *Sond.*
Cymothoe alcimeda *Godt.*
Kigellaria africana *Linn.*
Charaxes varanes *Cram.*
Schmidelia africana *D.C.*

Charaxes zoolina *Westw.*
Entada natalensis *Bth.*
Acacia Natalitia *Willd.*
Charaxes candiope *Godt.*
Croton sylvaticus *Hochst.*
Charaxes guderiana *Dew.*
Brachystegia appendiculata *Benth.*
Charaxes druceanus *Butl.*
Eugenia cordata *Laws.*
Charaxes brutus *Cram.*
Trichilea emetica *Vahl.*
Turraea floribunda *Hochst.*
Melia azedarach *L.*
Ekebergia meyeri *Presl.*
Charaxes ethalion *Boisd.*
Albizzia fastigiata *Oliv.*
" " var. chirindensis *Swynnerton.*
Charaxes cithaeron *Feld.*
Chaetachme aristata *Planch.*
Albizzia fastigiata *Oliv.*
Baphia racemosa *Hochst.*
Trema bracteolata *Blume.*
Celtis Soyauxii *Engl.*
Charaxes xiphares *Cram.*
Cryptocarya Woodii acuminata *Schinz.*

PIERIDAE.

Nychitona medusa *Cram.*
Cassia Petersiana *Bolle.*
Terias brigitta *Cram.*
Hypericum aethiopicum *Thb.*
Terias senegalensis *Bdv.*
Hypericum aethiopicum *Thb.*
Mylothris trimenia *Butl.*
Loranthus Kraussiana *Meisn.*

Mylothris agathina *Cram.*
Loranthus Dregei *E.* & *S.*
,, quinquenervius *Hochst.*
Pieris thysa *Hopff.*
Niebuhria pedunculosa *Hochst.*
Pieris gidica *Godt.*
Capparis corymbifera *E.M.*
,, citrifolia *Lam.*
,, Gueinzii *Sond.*
,, Zeyheri *Turcz.*
Pieris severina *Cram.*
Boscia caffra *Sond.*
Niebuhria pedunculosa *Hochst.*
Capparis corymbifera *E.M.*
Pieris zochalia *Bdv.*
Niebuhria pedunculosa *Hochst.*
Pieris pigea *Bdv.*
Capparis corymbifera *E.M.*
Pieris epaphia *Cram.*
Boscia caffra *Sond.*
Niebuhria pedunculosa *Hochst.*
Teracolus erone *Angas.*
Niebuhria pedunculosa *Hochst.*
Colias electo *Linn.*
Medicago sativa *Linn.* (Lucerne.)
Catopsilia florella *Fabr.*
Cassia occidentalis *Linn.*
,, Petersiana *Bolle.*

PAPILIONIDAE.

Papilio antheus *Cram.*
Uvaria caffra *E.M.*
Papilio demodocus *Esp.*
Clausena inaequalis *Bth.*

Toddalia aculeata *Pers.*
,, natalensis *Sond.*
Teclea Swynnertonii *Bak.*
Citrus aurantium, f. near vulgaris *Rino.*
Calodendron capense *Thb.*

Papilio angolanus *Goeze.*
Anona Senegalensis *Pers.*
Sphedamnocarpus pruriens *Szyszyl.*

Papilio dardanus *Brown.*
Toddalia aculeata *Pers.*
,, natalensis *Sond.*
Teclea Swynnertonii *Bak.*
Clausena inaequalis *Bth.*
Citrus aurantium, f, near vulgaris *Rino.*

Papilio nireus *Cram.*
Calodendron capense *Thb.*
Toddalia aculeata *Pers.*
,, natalensis *Sond.*
,, lanceolata *Lam.*
Teclea Swynnertonii *Bak.*
Clausena inaequalis *Bth.*
Citrus aurantium, f. near vulgaris *Rino.*

Papilio morania *Angas.*
Uvaria caffra *E.M.*

Papilio corinneus *Bert.*
Anona Senegalensis *Pers.*

Papilio policenes *Cram.*
Uvaria caffra *E.M.*

Papilio menestheus *Trim.*
Clausena inaequalis *Bth.*

Papilio brasidas *Feld.*
Popowia caffra *H & S.*

Papilio echerioides *Trim.*
Toddalia lanceolata *Lam.*
Clausena inaequalis *Bth.*

ERYCINIDAE.

Libythea laius *Trim.*
Celtis Kraussiana *Bernh.*
,, Soyauxii *Engl.*

LYCAENIDAE.

Lycaena baetica *Linn.*
Crotalaria capensis *Jacq.*
Lycaena palemon *Cram.*
Geranium sp.
Zizura gaika *Trim.*
Oxalis corniculata *Linn.*
Azanus natalensis *Trim.*
Acacia *sp.*
Tarucus telicanus *Lang.*
Plumbago capensis *Thb.*
Myrina ficedula *Trim.*
Ficus cordata *Thb.*
,, capensis *Thb.*
Myrina dermaptera *Wllgrn.*
Ficus Petersii, *Warb.*
Capys disjunctus *Trim.*
Protea hirta *Klotzsch.*
,, multibracteata *Phillips.*
Lycaenesthes liodes *Hew.*
Schmidelia africana *D.C.* (flowers)
Mangifera indica *Linn.* (flowers)
Myrica aethiopica *Linn.* (flowers)
Hypolycaena philippus *Fab.*
Clerodendron glabrum *E.M.*
Deudorix diocles *Hew.*
Bauhinia Galpini *N.E.B.* (seeds).
Iolaus silas *Westw.*
Loranthus Dregei *E.* & *S.*
Iolaus sidus *Trim.*
Loranthus quinquenervius *Hochst.*
,, Kraussiana *Meisn.*

HESPERIDAE.

Cyclopides metis *Cram.*
    Grass.
Pyrgus vindex *Cram.*
    Pavonia macrophylla *E.M.*
    Hibiscus gossypinus *Thb.*
Pyrgus dromus *Plotz.*
    Triumfetta tomentosa *Boj.*
    ,, rhomboidea *Jacq.*
Pyrgus elma *Trim.*
    Abutilon indicum *G. Don.*
Pamphila morantii *Trim.*
    Combretum Gueinzii *Sond.*
Pamphila hottentota *Latr.*
    Grass.
Pamphila erinnys *Trim.*
    Dracaena Hookeriana *K. Koch.*
Pamphila dysmephila *Trim.*
    Phoenix reclinata *Jacq.*
Pamphila fiara *Butl.*
    Strelitzia augusta *Thb.*
Abantis paradisea *Butl.*
    Hibiscus tiliaceus *Linn.*
    Cola natalensis *Oliv.*
Caprona canopus *Trim.*
    Grewia occidentalis *Linn.*
    Dombeya cymosa *Harv.*
    Pavonia macrophylla *E.M.*
Pterygospidea flesus *Fab.*
    Dioscorea malifolia *Baker.*
Pterygospidea mokeezi *Wllgrn.*
    Isoglossa Woodii *C. B. Clarke.*
Pterygospidea nottoana *Wllgrn.*
    Grewia occidentalis *Linn.*
    Dombeya cymosa *Harv.*
    Scutia commersonii *Brogn.*

Hesperia keithloa *Wllgrn.*
Acridocarpus natalitius *Juss.*
Hesperia forestan *Cram.*
Combretum apiculatum *Sond.*
,, bracteosum *Hochst.*
Solanum auriculatum *Ait.*
Millettia Sutherlandi *Harv.*
Hesperia pisistratus *Fab.*
Acridocarpus pruriens *A. Juss.*

AMATIDAE.

Euchromia amoena *Moschl.*
Secamone Gerrardi *Harv.*
Carissa grandiflora *A.D.C.*
Euchromia formosa *Guen.*
Ipomoea.
Metarctia meteus *Stoll.*
Trema bracteolata *Blume.*

ARCTIADAE.

Nolinae.

Nola holoscota *Hmpsn.*
Leucosidea sericea *E. & Z.*
Nola hardenbergi *Janse.*
Combretum Gueinzii *Sond.*

Lithosianae.

Ilema bipuncta *Hubn.*
Lichen.
Asura sagenaria *Wllgrn.*
Lichen.
Chionaema pretoriae *Dist.*
Lichen.

Arctianae.

Ilemodes heterogyna *Hmpsn.*
Lichen.

Diacrisia flava *Wllgrn.*
- Cassia tomentosa *Linn.*
- Cassia occidentalis *Linn.*
- Tagetes erecta *Linn.*
- Protea multibracteata *Phillips.*
- Ornithogalum Eckloni *Sch.*

Diacrisia scita *Wlk.*
- Cassia tomentosa *Linn.*
- Senecio bupleuroides *D.C.*
- Tephrosia elongata *E.M.*
- Tagetes erecta *Linn.*
- Smilax Kraussiana *Meisn.*

Diacrisia eugraphica *Wlk.*
- Lonicera sempervirens *Linn.*
- Heliotrope.
- Tagetes erecta *Linn.*

Diacrisia screabilis *Wllgrn.*
- Ornithogalum Eckloni *Sch.*

Diacrisia lutescens *Wlk.*
- Solanum Seaforthianum *Andr.*
- Cassia tomentosa *Linn.*

Diacrisia lineata *Wlk.*
- Tagetes erecta *Linn.*
- Passiflora edulis *Sims.*

Diacrisia diplosticta *Hmpsn.*
- Gardenia globosa *Hochst.*
- Clerodendron glabrum *E.M.*

Estigmene dissimilis *Dist.*
- Vernonia Gerrardi *Harv.*
- Cyanotis nodiflora *Kth.*

Estigmene atropunctata *Fawc.*
- Vernonia Gerrardi *Harv.*
- Cyanotis nodiflora *Kth.*

Dionychopus amasis *Cram.*
- Cestrum aurantiacum *Ldl.*
- Clerodendron glabrum *E.M.*

Tagetes erecta *Linn.*
Cassia tomentosa *Linn.*
Teracotona submacula *Wlk.*
Tagetes erecta *Linn.*
Rhodogastria astreas *Drury.*
Eugenia cordata *Laws.*
Ficus Petersii *Warb.*
Ochna atropurpurea *D.C.*
Mimusops obovata *Sond.*
Rhodogastria bauri *Moschl.*
Eugenia cordata *Laws.*

AGARISTIDAE.

Xanthospilopteryx superba *Butl.*
Cissus cirrhosa *Thb.*
Vitis vinifera *Linn.*
Xanthospilopteryx africana *Butl.*
Cissus cirrhosa *Thb.*
Rothia butleri *Wlk.*
Vitis vinifera *Linn.*
Tuerta trimenii *Feld.*
Cissus cirrhosa *Thb.*
Rhoicissus cirrhiflora *G. & B.*
Pais decora *Linn.*
Pentanisia variabilis *Harv.*
Oldenlandia amatymbica *Kuntze.*
Aegocera fervida *Wlk.*
Rhoicissus cirrhiflora *G. & B.*

NOCTUIDAE.

AGROTINAE.

Agrotis segetis *Schiff.*
Vitis vinifera *Linn.*
Micragrotis interstriata *Hmpsn.*
Grass.

HADENINAE.

Brithys pancratii *Cyr.*
    Liliacea.
Diaphone eumela *Stoll.*
    Dipcadi umbonatum *Baker.*
    Ornithogalum Eckloni *Sch.*
Polia speyeri *Feld.*
    Rhoicissus cirrhiflora *G. & B.*
    Vigna sp.
    Gerbera Jamesoni *Bolus.*
Hadena bulgeri *Feld.*
    Lasiosiphon Kraussii *Meisn.*

CUCULLIANAE.

Cucullia terrensis *Feld.*
    Dimorphotheca aurantiaca *D.C.*

ACRONYCTINAE.

Hypoplexia mictochroa *Hmpsn.*
    Cluytia pulchella *Linn.*
Euplexia amaranta *Feld.*
    Solanum giganteum *Jacq.*
Daseochaeta verbenata *Dist.*
    Cluytia pulchella *Linn.*
Cetola pulchra *B.-Baker.*
    Becium angustifolium *N.E.B.*
Prodenia litura *Fabr.*
    Psychotria capensis *Vatke.*
Laphygma exempta *Wlk.*
    Grass.
Eulymnia pulcherrima *Hmpsn.*
    Thespesia Garckeana *T. Hoffm.*
Ramesodes divisa *Hmpsn.*
    Vernonia corymbosa *Less.*
Calamistis fusca *Hmpsn.*
    Mealie stalks.

Chasmina tibialis *Fabr.*
    Grewia occidentalis *Linn.*
    Hibiscus tiliaceus *Linn.*
Callyna unicolor *Hmpsn.*
    Cordia caffra *Sond.*
Callyna nigerrima *Hmpsn.*
    Protea sp.
    Orthosiphon sp.
Callyna figurans *Wlk.*
    Cordia caffra *Sond.*
Callyna decora *Wlk.*
    Cordia caffra *Sond.*
Cyclopera galactiplaga *Hmpsn.*
    Cordia caffra *Sond.*

ERASTRIANAE.

Eublemmistis chlorozonea *Hmpsn.*
    Albizzia fastigiata *Oliv.*
Eublemma rubripuncta *Hmpsn.*
    Dipcadi umbonatum *Baker.*
Eublemma apicemacula *Mab.*
    Ipomoea (flowers).
Eublemma nigrivitta *Hmpsn.*
    Acacia hirtella *E. Mey.*
Amyna punctum *Fabr.*
    Croton sylvaticus *Hochst.*
Thyatirina achatina *Weym.*
    Thespesia Garckeana *T. Hoffm.*
Tarache nubilata *Hmpsn.*
    Dombeya cymosa *Harv.*
Tarache antica *Wlk.*
    Abutilon indicum *G. Don.*
Tarache tetragonisa *Hmpsn.*
    Hibiscus pedunculatus *Cav.*

EUTELIANAE.

Pacidara venustissima *Wlk.*
Protorhus longifolia *Engl.*
Eutelia leucographa *Hmpsn.*
Myrica aethiopica *Linn.*
Myrica sp.
Eutelia leighi *Hmpsn.*
Ficus capensis *Thb.*
Eutelia discistriga *Wlk.*
Schinus molle *Linn.*
Eutelia amatrix *Wlk.*
Rhus villosa *L.f.*
Eutelia polychorda *Hmpsn.*
Brachystegia Randii *Baker.*
Bombotelia ethiopica *Hmpsn.*
Combretum apiculatum *Sond.*
Combretum Gueinzii *Sond.*
Chlumetia polymorpha *Hmpsn.*
Psidium sp. (guava).
Phlegetonia catephioides *Guen.*
Sclerocarya caffra *Sond.*
Rhus villosa *L.f.*

SARROTHRIPINAE.

Cryptothripa polyhymnia *Hmpsn.*
Acalypha glabrata *Thb.*
Selepa docilis *Butl.*
Solanum sodomeum *Linn.*

ACONTIANAE.

Maurilia arcuata *Wlk.*
Combretum Gueinzii *Sond.*
Myrica aethiopica *Linn.*
Acripia chloropera *Hmpsn.*
Grewia occidentalis *Linn.*

Goniocalpe heteromorpha *Hmpsn.*
Combretum apiculatum *Sond.*
Combretum Gueinzii *Sond.*
Negeta ruficeps *Hmpsn.*
Combretum Gueinzii *Sond.*
Negeta luminosa *Wlk.*
Combretum gueinzii *Sond.*
Arcyophora longivalvis *Guen.*
Combretum Gueinzii *Sond.*
Acontia malvae *Esp.*
Pavonia macrophylla *E.M.*
Leocyma appollinis *Guen.*
Pavonia macrophylla *E.M.*
Hibiscus gossypinus *Thb.*
Hibiscus pedunculatus *Cav.*

CATOCALINAE.

Audea bipunctata *Wlk.*
Albizzia fastigiata *Oliv.*
Ulothrichopus catocala *Feld.*
Acacia hirtella *E. Mey.*
Ulothrichopus primulina *Hmpsn.*
Acacia hirtella *E. Mey.*
Ulothrichopus glaucescens *Hmpsn.*
Acacia caffra *Willd.*
Acacia hirtella *E. Mey.*
Hypotacha retracta *Hmpsn.*
Acacia caffra *Willd.*
Egybolis vaillantina *Stoll.*
Sapindus oblongifolius *Sond.*
Nyctipao walkeri *Butl.*
Entada natalensis *Bth.*
Cyligramma latona *Boisd.*
Acacia sp.
Enmonodia capensis *H.-S.*
Albizzia fastigiata *Oliv.*

Dermaleipa rubricata *Holl.*
    Combretum Gueinzii *Sond.*
Anua violascens *Hmpsn.*
    Myrica aethiopica *Linn.*
Anua tirhaca *Cram.*
    Rhus laevigata *Linn.*
    Rhus villosa *L.f.*
    Combretum Gueinzii *Sond.*
Heliophisma croceipennis *Wlk.*
    Smilax Kraussiana *Meisn.*
Tolna sypnoides *Butl.*
    Zizyphus mucronata *Willd.*
Achaea praestans *Guen.*
    Cassipourea verticillata *N.E.B.*
Achaea echo *Wlk.*
    Excoecaria reticulata *Muell. Arg.*
    Eugenia cordata *Laws.*
Achaea mormoides *Wlk.*
    Ricinus communis *Linn.*
Achaea indeterminata *Wlk.*
    Calpurnia lasiogyne *E.M.*
Achaea sordida Wlk.
    Calpurnia lasiogyne *E.M.*
Achaea mabilli *Saalm.*
    Loranthus Dregei *E.* & *Z.*
    Loranthus Kraussiana *Meisn.*
Achaea mercatoria *Fabr.*
    Mimusops discolor *Sond.*
    Chrysophyllum viridifolium *Wood* & *Franks.*
Achaea violescens *Hmpsn.*
    Protea *sp.*
Achaea catella *Guen.*
    Bauhinia sp.
    Ricinus communis *Linn.*
Achaea finita *Guen.*
    Ricinus communis *Linn.*

Parallelia proxima *Hmpsn.*
Antidesma venosum *E.M.*
Parallelia properans *Wlk.*
Acalypha glabrata *Thb.*
Parallelia algira *Linn.*
Ricinus communis *Linn.*
Pericyma umbrina *Guen.*
Acacia *sp.*
Pericyma mendax *Wlk.*
Acacia molissima *Willd.*
Albizzia fastigiata *Oliv.*
Acacia hirtella *E. Mey.*
Acacia caffra *Willd.*

MOMINAE.

Elaeodes acatharta *Hmpsn.*
Pellaea hastata *Link.* and other ferns.

PHYTOMETRINAE.

Syngrapha circumflexa *Linn.*
Heliotropium peruvianum *Linn.* (Lettuce).
Plusiopalpa adrasta *Feld.*
Trema bracteolata *Blume.*
Phytometra exquisita *Feld.*
Senecio bupleuroides *D.C.*
Phytometra limbirena *Guen.*
Salvia sp.
Verbascum sp.
Becium angustifolium *N.E.B.*
Althaea rosea *Cav.* (Hollyhock).
Phytometra orichalcea *Fabr.*
Heliotropium peruvianum *Linn.* (Lettuce).
Phytometra euchroa *Hmpsn.*
Clerodendron myricoides *R. Br.*
Phytometra angulum *Guen.*
Petunia violacea *Lindl.*

Medicago sativa *Linn.* (Lucerne).
Phaseolus vulgaris *Linn.* (Kidney Bean).
Phytometra acuta *Wlk.*
Solanum lycopersicum *Linn.* (Tomato).
Nicotiana affinis *Hort.*
Trema bracteolata *Blume.*
Cestrum aurantiacum *Ldl.*
Lonicera sp.
Coleus sp.
Phaseolus vulgaris *Linn.* (Kidney Bean).
Synclostemon densiflorus *E.M.*
Phytometra transfixa *Wlk.*
Callistephus hortensis *Cass.* (Aster).
Synclostemon densiflorus *E.M.*
Phytometra arachnoides *Dist.*
Synclostemon densiflorus *E.M.*
Phytometra obtusisigna *Wlk.*
Iboza riparia *N.E.B.*

NOCTUINAE.

Serrodes inara *Cram.*
Sapindus oblongifolius, *Sond.*
Sphingomorpha chlorea *Cram.*
Acacia hirtella *E.M.*
Catephia bipuncta *Hmpsn.*
Psychotria capensis *Vatke.*
Catephia dulcistriga *Wlk.*
Antidesma venosum *E.M.*
Catephia striata *Hmpsn.*
Cordia caffra *Sond.*
Catephia amplificans *Wlk.*
Eugenia cordata *Laws.*
Catephia natalensis *Hmpsn.*
Protea multibracteata *Phillips.*
Catephia iridicosma *B.-Baker.*
Ipomoea ficifolia *Ldl.*

Polydesma inangulata *Guen.*
    Acacia molissima *Willd.*
    Scutia commersonii *Brogn.*
Polydesma marmorifera *Wlk.*
    Albizzia fastigiata *Oliv.*
Polydesma basilinea *Hmpsn.*
    Cordia caffra *Sond.*
Taviodes subjecta *Wlk.*
    Canthium obovatum *Kl.*
Saroba cyanescens *Hmpsn.*
    Popowia caffra *H.* & *S.*
Pristanepa platti *Hmpsn.*
    Dalbergia obovata *E.M.*
Thermesia burrowsi *Butl.*
    Millettia Sutherlandi *Harv.*
Thermesia atriplaga *Wlk.*
    Dalbergia obovata *E.M.*
Anomis luperca, *Moschl.*
    Abutilon indicum G. *Don.*
    Althaea rosea *Cav.*
    Hibiscus pedunculatus *Cav.*
Anomis flava *Fabr.*
    Abutilon indicum G. *Don.*
    Hibiscus gossypinus *Thb.*
Anomis leona *Schaus.*
    Dombeya cymosa *Harv.*
Cosmophila erosa *Hubn.*
    Trema bracteolata *Blume.*
    Sida rhombifolia *Linn.*
Cosmophila sabulifera *Guen.*
    Triumfetta rhomboidea *Jacq.*
    Grewia occidentalis *Linn.*
Bareia incidens *Wlk.*
    Ficus Petersii *Warb.*

Rhanidophora cinctigutta *Wlk.*
Thunbergia podoensis *L.*
Thunbergia lancifolia *T. Anders.*
Rhanidophora phedonia *Stoll.*
Thunbergia alata *Bojer.*
Thunbergia podoensis *L.*
Hypocala deflorata *Fabr.*
Royena villosa *Linn.*
Royena pallens *Thb.*
Ophideres materna *Linn.*
Desmonema caffrum *Meirs.*
Calpe emarginata *Fabr.*
Cissampelos torulosa *E.M.*
Ophiocaulon gummifera *Hkf.*
Stephania discolor *Spreng.*
Calpe provocans *Wlk.*
Cissampelos torulosa *E.M.*
Ophiocaulon gummifera *Hkf.*
Exophila multistriata *Hmpsn.*
Celtis Kraussiana *Bernh.*
Sarmartia interitalis *Guen.*
Acacia hirtella *E.M.*

HYPENINAE.

Zethes caffra *Guen.*
Bidens pilosa *Linn.*
Rhaesena subcupralis *Wlk.*
Tragia durbanensis *O. Kuntze.*

LYMANTRIADÆ.

Ogoa simplex *Wlk.*
Weihea Gerrardi *Schinz.*
Lepidopalpus hyalina, *Janse.*
Weihea Gerrardi *Schinz.*
Olapa nuda *Holl.*
Brachystegia globiflora *Benth.*

Olapa flabellaria *Fabr.*
    Grewia occidentalis *Linn.*
    Dombeya cymosa *Harv.*
    Brachystegia Randii *Baker.*
    Brachystegia globiflora *Benth.*
Redoa melanocraspis, *Hmpsn.*
    Cassipourea verticillata *N.E.B.*
Creaga dealbata *H.-S.*
    Hibiscus gossypinus *Thb.*
Cropera testacea *Wlk.*
    Grass.
Dasychira octophora *Hmpsn.*
    Lichen.
Dasychira rocana *Swinh.*
    Combretum Gueinzii *Sond.*
Dasychira georgiana *Fawcett.*
    Trema bracteolata *Blume.*
    Ricinus communis *Linn.*
    Celtis Kraussiana *Bernh.*
    Acacia molissima *Willd.*
    Quercus pedunculata *Ehrh.*
    Rhus laevigata *Linn.*
    Acacia hirtella *E. Mey.*
Dasychira metathermes *Hmpsn.*
    Sideroxylon inerme *L.*
Dasychira lunensis *Hmpsn.*
    Schmidelia africana *D.C.*
Dasychira extorta *Dist.*
    Ficus Petersii *Warb.*
    Ficus capensis *Thb.*
    Ficus sp.
Dasychira pyrosoma *Hmpsn.*
    Protea multibracteata *Phillips.*
    Faurea saligna *Harv.*
    Parinarium Mobola *Oliv.*

Dasychira whitei *Druce.*
    Smilax kraussiana *Meisn.*
Dasychira greeni *Janse.*
    Chrysophyllum viridifolium *Wood* & *Franks.*
    Mimusops discolor *Sond.*
    Mimusops obovata *Sond.*
Laelia clarki *Janse.*
    Acacia hirtella *E. Mey.*
Psalis securis *Hubn.*
    Grass.
Lymantria modesta *Wlk.*
    Sclerocarya caffra *Sond.*
    Rhus villosa *L.f.*
Ornithopsyche difficilis *Wlk.*
    Royena villosa *Linn.*
    Combretum Gueinzii *Sond.*
        ,, apiculatum *Sond.*
        ,, bracteosum *Hochst.*
Homochira rendalli *Dist.*
    Combretum Gueinzii *Sond.*
Euproctis fasciata *Wlk.*
    Acacia molissima *Willd.*
    Protea multibracteata *Phillips.*
    Cassia tomentosa *Linn.*
Euproctis punctifera *Wlk.*
    Ricinus communis *Linn.*
    Acalypha glabrata *Thb.*
    Mimusops discolor *Sond.*
Euproctis rufopunctata *Wlk.*
    Sclerocarya caffra *Sond.*
    Ficus capensis *Thb.*
    Eriobotrya japonica *Lindl.*
    Combretum Gueinzii *Sond.*
    Psidium sp.
    Eugenia cordata *Laws.*

Euproctis crocata *Boisd.*
Lichen.
Porthesia natalensis *Janse.*
Trema bracteolata *Blume.*
Clerodendron glabrum *E.M.*
Acacia molissima *Willd.*
Naroma signifera *Wlk.*
Ficus Petersii *Warb.*
Pteredoa monosticta *Butl.*
Dombeya cymosa *Harv.*

HYPSIDAE.

Hypsa subretracta *Wlk.*
Ficus Petersii *Warb.*
Digama sinuosa *Hmpsn.*
Acokanthera spectabilis *Hooker.*
Digama aganais *Feld.*
Carissa grandiflora *A. D.C.*
Acokanthera spectabilis *Hooker.*
Deilemera leuconoe *Hopff.*
Senecio pellucidus *D.C.*
Alytarchia bellatrix *Dalm.*
Crotalaria capensis *Jacq.*

SPHINGIDAE.

Herse convolvuli *Linn.*
Ipomoea ficifolia *Ldl.*
,, batatas *Poir* (Sweet Potato).
Convolvulus sp.
Acherontia atropos *Linn.*
Datura stramonium *Linn.*
Jasminium pubigerum *D. Don.*
Solanum lycopersicum *Linn.*
Lantana camara *Linn.*
Tecomaria capensis *Spach.*
Clerodendron glabrum *E.M.*
Solanum tuberosum *Linn.*

Coelonia fulvinotata *Butl.*
    Cordia caffra *Sond.*
    Tecomaria capensis *Spach.*
    Solanum lycopersicum *Linn.*
    Solanum sodomeum *Linn.*
    Duranta plumieri *Jacq.*
    Dahlia variabilis *Desf.*
    Lantana camara *Linn.*
    Nicotiana affinis *Hort.*
    Convolvulus sp.
    Pycnostachys urticifolia *Hook.*
    Salvia sp.
Oligographa juniperi *Boisd.*
    Tecomaria capensis *Spach.*
Pseudoclanis postica *Wlk.*
    Chaetachme aristata *Planch.*
    Trema bracteolata *Blume.*
    Celtis Kraussiana *Bernh.*
    Morus sp.
    Ficus Petersii *Warb.*
Leptoclanis pulchra *R.* & *J.*
    Eriosema sp. (Vaalbosch)
Platysphinx piabilis *Dist.*
    Millettia Sutherlandi *Harv.*
Polyptychus grayi *Wlk.*
    Cordia caffra *Sond.*
Polyptychus mutata *Wlk.*
    Baphia racemosa *Hochst.*
Polyptychus compar *R.* & *J.*
    Brachystegia Randii *Baker.*
Polyptychus coryndoni *Roth.* & *Jord.*
    Parinarium Mobola *Oliv.*
Lophostethus dumolini *Angas.*
    Grewia occidentalis *Linn.*
    Hibiscus tiliaceus *Linn.*
    Dombeya cymosa *Harv.*

Dombeya rotundifolia *Harv.*
Hibiscus panduraeformis *Burm.*
Likoma apicalis *R.* & *J.*
Thespesia Garckeana *T. Hoffm.*
Cephonodes hylas *Linn.*
Pavetta lanceolata *Sond.*
Gardenia jasminoides *Ellis.*
Burchellia capensis *R. Br.*
Kraussia floribunda *Harv.*
Vangueria infausta *Burch.*
Deilephila nerii *Linn.*
Carissa grandiflora *A.D.C.*
Gardenia jasminoides *Ellis.*
Rauwolfia natalensis *Sond.*
Voacanga Dregei *E.M.*
Nerium Oleander *Linn.*
Mangifera indica *Linn.* (Mango).
Nephele argentifera *Wlk.*
Carissa grandiflora *A.D.C.*
Nephele comma *Hopff.*
Carissa grandiflora *A.D.C.*
Nephele accentifera *Beauv.*
Ficus Petersii *Warb.*
Temnora pylas *Cram.*
Leucas milanjiana *Guerk.*
Temnora zantus *H.-S.*
Burchellia capensis *R. Br.*
Strychnos Henningsii *Gilg.*
Temnora murina *Wlk.*
Apodytes dimidiata *E. Mey.*
Temnora marginata *Wlk.*
Psychotria capensis *Vatke.*
Temnora inornatum *R.* & *J.*
Strychnos Henningsii *Gilg.*
Temnora plagiata *Wlk.*
Apodytes dimidiata *E. Mey.*

Atemnora westermanni *Boisd.*
    Strychnos Henningsii *Gilg.*
Macroglossum trochilus *Hubn.*
    Rubia cordifolia *L.*
Leucostrophus hirundo *Gerst.*
    Strychnos Henningsii *Gilg.*
Euchloron megaera *Linn.*
    Vitis vinifera *Linn.*
Basiotha medla *Fabr.*
    Spermacoce natalensis *Hochst.*
    Richardsonia pilosa *H.B.* & *K.*
Basiotha schencki *Moschl.*
    Vernonia sp.
Hippotion osiris *Dalman.*
    Fuchsia sp.
    Impatiens sp. (Balsam).
    Richardia africana *Kunth.*
    Vitis vinifera *Linn.*
Hippotion celerio *Linn.*
    Cissus cirrhosa *Thb.*
    Vitis vinifera *Linn.*
    Impatiens sp.
Hippotion eson *Cram.*
    Fuchsia *sp.*
    Ampelopsis sp. (Virginia Creeper).
    Vitis vinifera *Linn.*
    Richardia africana *Kunth.*
Hippotion balsaminae *Wlk.*
    Jussiaea repens *Linn.*
Theretra capensis *Linn.*
    Vitis vinifera *Linn.*
    Rhoicissus cirrhiflora *G.* & *B.*
    Cissus capensis *L.*
Theretra orpheus *H.S.*
    Ansellia africana *Lindl.*
Theretra cajus *Cram.*
    Richardia albomaculata *H.K.*

EUPTEROTIDAE.

Striphnopteryx edulis *Boisd.*
Tecomaria capensis *Spach.*
Cordia caffra *Sond.*
Janomima westwoodi *Aur.*
Grass.
Poloma angulata *Wlk.*
Plectronia ventosa *L.*
Spiramiopsis comma *Hmpsn.*
Secamone Gerrardi *Harv.*
Phyllalia patens *Boisd.*
Grass.
Phyllalia flavicostata *Fawcett.*
Grass.
Phiala dasypoda *Wllgrn.*
Cyperus albostriatus *Schrad.*
Jana tantalus *H.-S.*
Jasminium streptopus *E.M.*
Cordia caffra *Sond.*
Jana eurymas *H.-S.*
Canthium obovatum *Kl.*
Phasicnecus obtusus *Wlk.*
Strychnos Gerrardi *N.E.B.*

NOTODONTIDAE.

Ichthyura lentisignata *Hmpsn.*
Trimeria alnifolia *Planch.*
Scolopia Gerrardi *Harv.*
Ichthyura violacearia *Janse.*
Protea multibracteata *Phillips.*
Faurea saligna *Harv.*
Scalmicauda heterogyna *Hmpsn.*
Millettia Sutherlandi *Harv.*
Scalmicaudo o'neili *Janse.*
Brachystegia Randii *Baker.*

Prionocentrum o'neili *Janse.*
    Brachystegia Randii *Baker.*
Pararethona hierax *Dist.*
    Scolopia Gerrardi *Harv.*
Rethona albicans *Wlk.*
    Grewia lasiocarpa *E.M.*
    Trimeria alnifolia *Planch.*
Desmeocraera vernalis *Dist.*
    Combretum apiculatum *Sond.*
Desmeocraera varia *Janse.*
    Mimusops obovata *Sond.*
    ,, discolor *Sond.*
Desmeocraera platti *Janse.*
    Mimusops discolor *Sond.*
Desmeocraera tripuncta *Janse.*
    Eugenia cordata *Laws.*
Desmeocraera pergrisea *Hmpsn.*
    Combretum Gueinzii *Sond.*
Desmeocraera calliope *Hmpsn.*
    Chrysophyllum viridifolium *Wood* & *Franks.*
Desmeocraera atriguttata *Hmpsn.*
    Chrysophyllum viridifolium *Wood* & *Franks.*
    ,, natalense *Sond.*
    Mimusops obovata *Sond.*
Desmeocraera thalassina *Hmpsn.*
    Brachystegia Randii *Baker.*
Anaphe reticulata *Wlk.*
    Dombeya rotundifolia *Harv.*
Epanaphe clarilla *Aur.*
    Brachystegia Randii *Baker.*
    ,, globiflora *Benth.*
Rigema woerdeni *Snell.*
  Grass.
Rigema ornata *Wlk.*
    Grass.

Chadisra bicolor *Dist.*
Rhus villosa *Lf.*
Chadisra curvilinea *Swinh.*
Trema bracteolata *Blume.*
Chaetachme aristata *Planch.*
Grewia lasiocarpa *E.M.*
Croton sylvaticus *Hochst.*
Chadisra uncifera *Hmpsn.*
Dombeya cymosa *Harv.*
Grewia occidentalis *Linn.*
Cerura esmeralda *Hmpsn.*
Protea hirta *Klotzsch.*
,, multibracteata *Phillips.*
,, sp.
Faurea saligna *Harv.*
Tæniopteryx cinerea *Janse.*
Zizyphus mucronata *Willd.*
Ochrostigma mediata *Wlk.*
Ekebergia Meyeri *Presl.*
Combretum Gueinzii *Sond.*
Hoplitis phyllocampa *Trim.*
Combretum Gueinzii *Sond.*
Hoplitis concolor *Janse.*
Dombeya rotundifolia *Harv.*
Antheua croceipuncta *Hmpsn.*
Eriosema sp. (Vaalbosch).
Antheua simplex *Wlk.*
Desmonodium incanum *D.C.*
Antheua dimorpha *Janse.*
Tephrosia macropoda *E.M.*

GEOMETRIDAE.

Petovia dichroaria *H.-S.*
Vangueria infausta *Burch.*

Pingasa abyssinaria *Guen.*
    Maesa alnifolia *Harv.*
    Eugenia cordata *Laws.*
Victoria mirabilis *Warr.*
    Loranthus Dregei *E. & Z.*
Thalassodes digressa *Wlk.*
    Ricinus communis *Linn.*
    Schinus molle *Linn.*
    Myrica aethiopica *Linn.*
Heterorachis devocata *Wlk.*
    Vangueria infausta *Burch.*
Prasinocyma vermicularia *Guen.*
    Cluytia pulchella *Linn.*
Celidomphax rubrimaculata *Warr.*
    Combretum Gueinzii *Sond.*
Omphax subaspersa *Warr.*
    Vangueria infausta *Burch.*
Lasiochlora bicolor *Th. Mieg.*
    Scutia commersonii *Brog.*
Lasiochlora diducta *Wlk.*
    Scutia commersonii *Brog.*
Lophostela atridisca *Warr.*
    Acacia hirtella *E. Mey.*
Xanthorhoe poseata *Guen.*
    Heliotropium peruvianum *Linn.* (Lettuce).
Ortholitha horismodes, *Prout.*
    Leucosidea sericea *E. & Z.*
Chloroclystis marmorata *Warr.*
    Scutia commersonii *Brogn.*
Diptychis geometrina *Feld.*
    Mimusops obovata *Sond.*
    Apodytes dimidiata *E.M.*
Mauna filia *Cram.*
    Protea multibracteata *Phillips.*
Sicyodes cambogiaria *Guen.*
    Celastrus verucosus *E.M.*

Haggardia grisea *Warr.*
    Combretum Gueinzii *Sond.*
Omphalucha maturnaria *Moschl.*
    Rhus villosa *Lf.*
    Combretum Gueinzii *Sond.*
Hemerophila serrataria *Wlk.*
    Ochna atropurpurea *D.C.*
    Gardenia globosa *Hochst.*
Hemerophila contemptaria *Steph.*
    Ochna atropurpurea *D.C.*
Xylopteryx arcuata *Wlk.*
    Rhus villosa *Lf.*
Racotis zebrina *Warr.*
    Popowia caffra *H. & S.*
Chogada acaciaria *Boisd.*
    Calodendron capense *Thb.*
    Tagetes erecta *Linn.*
    Loranthus Dregei *E. & Z.*
    Acacia molissima *Willd.*
    Carissa grandiflora *A.D.C.*
    Ricinus communis *Linn.*
Cleora divisaria *Wlk.*
    Royena villosa *Linn.*
    Combretum Gueinzii *Sond.*
Cleora proximaria *Wlk.*
    Albizzia fastigiata *Oliv.*
    Acacia molissima *Willd.*
Boarmia ectropodes *Prout.*
    Celastrus undatus *Thb.*
Boarmia octomaculata *Prout.*
    Combretum Gueinzii *Sond.*
Tephrina deeraria *Wlk.*
    Acacia hirtella *E. Mey.*
Macaria brongusaria *Wlk.*
    Acacia hirtella *E. Mey.*

Euexia percnopis *Prout.*
    Celastrus verucosus *E.M.*
Petrodava subapicata *Warr.*
    Zizyphus mucronata *Willd.*
Omizodes ocellata *Warr.*
    Gardenia globosa *Hochst.*
Veniliodes pantheraria *Feld.*
    Apodytes dimidiata *E.M.*
Zerenopsis leopardina *Feld.*
    Maesa alnifolia *Harv.*
    Apodytes dimidiata *E.M.*
    Carissa grandiflora *A.D.C.*
Epigynopteryx deformis *Warr.*
    Loranthus Kraussiana *Meisn.*
Zamarada secutaria *Guen.*
    Dichrostachys nutans *Bth.*

SATURNIDAE.

Epiphora mythimnia *Westw.*
    Croton sylvaticus *Hochst.*
    Helinus ovatus *E. Meyer.*
    Zizyphus mucronata *Willd.*
Epiphora vera *Janse.*
    Zizyphus mucronata *Willd.*
Argema mimosae *Boisd.*
    Sclerocarya caffra *Sond.*
Gonimbrasia zambesina *Wlk.*
    Nerium Oleander *Linn.*
Gonimbrasia tyrrhea *Cram.*
    Acacia molissima *Willd.*
Gonimbrasia belina *Westw.*
    Carissa grandiflora *A.D.C.*
    Trema bracteolata *Blume.*
    Rhus longifolia *Engl.*
    Ficus sp.
    Sclerocarya caffra *Sond.*

Imbrasia epimethea ertli *Rebel.*
Brachystegia Randii *Baker.*
Bunaea alcinoe *Stoll.*
Ekebergia Meyeri *Presl.*
Cussonia spicata *Thb.*
Bunaea angasana *Westw.*
Apodytes dimidiata *E.M.*
Eugenia cordata *Laws.*
Protorhus (Rhus) longifolius *Engl.*
Uapaca Kirkiana *Muell.*
Bunaea heroum, *Oberth.*
Brachystegia Randii *Baker.*
Nudaurelia arata *Westw.*
Albizzia fastigiata *Oliv.*
Nudaurelia gueinzii *Staud.*
Maesa alnifolia *Harv.*
Nudaurelia wahlbergi *Boisd.*
Trema bracteolata *Blume.*
Ricinus communis *Linn.*
Psidium sp. (Guava).
Mangifera indica *Linn.* (Mango).
Nudaurelia oubié *Guen.*
Grasses.
Nudaurelia carnegiei *Janse.*
Brachystegia globiflora *Benth.*
Nudaurelia arabella *Aur.*
Reed-like grass.
Nudaurelia anna *Maas* & *Weym.*
Hyphaene crinata *Gaertn.*
Lobobunaea tyrrhena *Westw.*
Celtis Kraussiana *Bernh.*
Trema bracteolata *Blume.*
Ekebergia Meyeri *Presl.*
Lobobunaea natalensis *Aur.*
Brachystegia Randii *Baker.*

Lobobunaea epithyrena *Maas* & *Weym.*
    Brachystegia Randii *Baker.*
Cirina forda *Westw.*
    Rhus longifolia *Engl.*
    Carissa grandiflora *A.D.C.*
Melanocera menippe *Westw.*
    Ochna atropurpurea *D.C.*
    Ficus cordata *Thb.*
Gynanisa maia *Klug.*
    Acacia molissima *Willd.*
Athletes semialba *Sonth.*
    Brachystegia Randii *Baker.*
    Brachystegia globiflora *Benth.*
    Cassia sp.
Heniocha appolonia *Cram.*
    Acacia molissima *Willd.*
Heniocha dyops *Maas* & *Weym.*
    Acacia molissima *Willd.*
Pseudaphelia apollinaris *Boisd*
    Turraea floribunda *Hochst.*
LUDIINÆ.
Goodia kuntzei *Dew.*
    Brachystegia Randii *Baker.*
Ludia delegorguei *Boisd.*
    Microglossa mespiloides *Bth.* & *Hk.*
    Senecio deltoideus *Less.*
Urota sinope *Westw.*
    Erythrina caffra *Thb.*
Holocera smilax *Westw.*
    Jasminium pubigerum *D. Don.*
    Rhus laevigata *Linn.*
    Psidium sp.
    Rhus longifolia *Sond.*
    Rhus villosa *Lf.*
    Ekebergia Meyeri *Presl.*
    Quercus pendunculata *Ehrh.*

Holocera rhodesiensis *Janse.*
Cussonia spicata *Thb.*
Cinabra hyperbius *Westw.*
Brachystegia Randii *Baker.*
Protea sp.
Tagoropsis flavinata *Wlk.*
Schmidelia africana *D.C.*
Tagoropsis dentifera *Maas* & *Weym.*
Trichilea emetica *Vahl.*
Usta terpsichore *Westw.*
Sclerocarya caffra *Sond.*
Commiphora caryaefolia *Oliv.*

BOMBYCIDÆ.

Trilocha ficicolor *Westw.* & *Orm.*
Ficus Petersii *Warb.*

PSYCHIDÆ.

Clania moddermanni *Heyl.*
Protea multibracteata *Phillips.*
Monda delicatissima *Wlk.*
Desmonodium incanum *D.C.*

ARBELIDÆ.

Lebedodes rufithorax *Hmpsn.*
Grewia occidentalis *Linn.*
Lebedodes durbanica *Hmpsn.*
Cordia caffra *Sond.*
Selagena obsolescens *Hmpsn.*
Eugenia cordata *Laws.*
,, capensis *Harv.*
Selagena tessellata *Dist.*
Pirus communis *L.* (Pear.)
Metarbela tuckeri *Butl.*
Cryptocarya Woodii *Engl.*
Cestrum aurantiacum *Ldl.*

Celastrus verucosus *E.M.*
Niebuhria pedunculosa *Hochst.*
Royena villosa *Linn.*
Grewia occidentalis *Linn.*
Abutilon indicum *G. Don.*
Teragra guttifera *Hmpsn.*
Trimeria alnifolia *Planch.*

COSSIDÆ.

Coryphodema tristis *Drury.*
Combretum apiculatum *Sond.*
Duomitus capensis *Wlk.*
Ricinus communis *Linn.*
Pavonia columella *Cav.*

LASIOCAMPIDÆ.

Anadiasa punctifascia *Wlk.*
Acacia molissima *Willd.*
Acacia hirtella *E. Mey.*
Anadiasa distincta *Dist.*
Grass.
Taragama polydora *Druce.*
Albizzia fastigiata *Oliv.*
Rhus laevigata *Linn.*
Acacia molissima *Willd.*
Brachystegia Randii *Baker.*
,, globiflora *Benth.*
Taragama distinguenda *Aur.*
Trichilea emetica *Vahl.*
Taragama carinata *Wllgrn.*
Royena pallens *Thb.*
Acacia molissima *Willd.*
Pachypasa truncata *Wlk.*
Acacia molissima *Willd.*
Pachypasa capensis *Aur.*
Acacia molissima *Willd.*
Prunus persica *Stokes.* (Peach.)

Pachypasa pithyocampa *Cram.*
    Celtis Kraussiana *Bernh.*
    Mangifera indica *Linn.* (Mango.)
    Combretum Gueinzii *Sond.*
Pachymeta clarki *Aur.*
    Dichrostachys nutans *Bth.*
    Schotia brachypetala *Sond.*
Gonometa postica *Wlk.*
    Acacia molissima *Willd.*
    Brachystegia Randii *Baker.*
    Brachystegia globiflora *Benth.*
Pseudometa basalis *Wlk.*
    Protea multibracteata *Phillips.*
    Faurea saligna *Harv.*
Dendrolimus aculeata *Wlk.*
    Trichilea Dregeana *E.M.*
Catalebeda cuneilinea *Wlk.*
    Dalbergia obovata *E.M.*
Lebeda köllikerii *Dew.*
    Sclerocarya caffra *Sond.*
Lebeda bipars *Wlk.*
    Senecio deltoideus *Less.*
    Bidens pilosa *Linn.*
Trabala rennei *Dew.*
    Eriosema sp.
Trabala pallida *Fawcett.*
    Sclerocarya caffra *Sond.*
Trabala rosa *Druce.*
    Trema bracteolata *Blume.*
Lenodora nigrolineata *Aur.*
    Brachystegia Randii *Baker.*
    Leipaxais peraffinis *Holl.*
    Combretum apiculatum *Sond.*
Gastroplakaeis meridionalis *Aur.*
    Brachystegia Randii *Baker.*
    Brachystegia globiflora *Benth.*

Bombycomorpha bifascia *Wlk.*
Rhus villosa *Lf.*
Megasoma accuminata *Wlk.*
Acacia Gerrardi *Bth.*
Ceratopacha gemmata *Dist.*
Brachystegia Randii *Baker.*
Brachystegia globiflora *Benth.*
Odontocheilopteryx myxa *Wllgrn.*
Acacia molissima *Willd.*
,, hirtella *E.M.*
,, caffra *Willd.*
Beralade pygmula *Strand.*
Rhus villosa *Lf.*
Bombycopsis ?ochroleuca *Feld.*
Pellaea hastata *Link.*
Asystasia coromandeliana *Nees.*
Ocinaropsis obscura *Aur.*
Loranthus Dregei *E. & Z.*
,, quinquenervius *Hochst.*
Pachygastria reducta *Wlk.*
Grass.

LIMACODIDÆ.

Crothaema decorata *Dist.*
Celastrus verucosus *E.M,*
Coenobasis amoena *Feld.*
Acacia molissima *Willd.*
Parasa vivida *Wlk.*
Pavetta lanceolata *Sond.*
Parasa latistriga *Wlk.*
Celastrus verucosus *E.M.*
Pantoctenia gemmans *Feld.*
Myrica aethiopica *Linn.*
Omocena systis *Schaus.*
Sapindus oblongifolius *Sond.*

Royena villosa *Linn.*
Acalypha glabrata *Thb.*
Celastrus verucosus *E.M.*

ZYGÆNIDÆ.

Procris subdiaphana *Feld.*
Clausena inaequalis *Bth.*
Saliuncella marshalli *Jord.*
Rhoicissus cirrhiflora *Gilg.* & *Brandt.*
Anomoetes levis *Feld.*
Bauhinia sp.
Gardenia globosa *Hochst.*

DREPANULIDÆ.

Ctenogyna natalensis *Feld.*
Pavetta lanceolata *Sond.*

PYRALIDÆ.

Crocidolomia binotalis *Zell.*
Gymnandropsis sp.
Tropaeolum sp.
Sylepta derogata *Fabr.*
Althaea rosea *Cav.* (Hollyhock).
Agathodes musivalis *Guen.*
Erythrina caffra *Thb.*
Glyphodes sericea *Drury.*
Gardenia jasminoides *Ellis.*
Terastia margaritis *Feld.*
Erythrina caffra *Thb.*
Ischnurges lancinalis *Guen.*
Clerodendron glabrum *E.M.*

THE FUNGUS FOOD OF CERTAIN TERMITES.

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Almost since 1781 when Smeathman first commented upon the white globules " which evidently appeared to be a species of mushroom " found by him in the " nurseries " of *Macrotermes bellicosus* (Sm.), a profound interest has been attached to the cultivation of fungi by certain white ants. And it was Smeathman who observed that the white globules or " spheres " as they have come to be called, were " composed of an indefinite number of pellucid particles, approaching to oval forms and difficult to separate ".

The nature of these spheres, the combs on which they grow and the other fungi with which they are associated have all been ably set out by Petch (1906).

Although, following upon the observations of Döflein (1905), it is generally accepted that the young of certain termites subsist on the spheres, it is still held that the case is not definitely proved, however probable. According to Petch, the spheres were found by Döflein in the crops of all the larvae and nymphae investigated and the cells of the spheres were quite uninjured. Petch goes on to remark " It has yet to be decided whether the larvae feed themselves (p. 245)..... The non-occurrence of injured spheres on the comb suggests that each is devoured whole. If so, although the spheres are abundant, there does not appear to be at any time a sufficiently large number to supply food for the crowded hosts of larvae, unless the growth of the fungus is abnormally rapid ".

One of the writers (C.F., 1920) stated it could be readily demonstrated that the immature forms of *Macrotermes natalensis* (Hav.) fed regularly upon the cells composing the white spheres.

In this connection it may be added that whilst the immatures of all fungus growers can be seen browsing upon the spheres, the action is more in the nature of a caress and is not followed by any disturbance of the contour of the spheres. The insects swallow chains of cells. Thus no sphere has the appearance of being gnawed and none is removed bodily. As Petch suggests, there are relatively few spheres in comparison with the host of insects; consequently, one cannot avoid the conclusion that every removal is almost at once made good by abnormally rapid growth. There can be no oher explanation and it is quite essential and natural to the economy of the nest that such should be the case. There is not room for many spheres where there are so many insects to be accommodated.

Sjostedt (1913) described *Eutermes agricola* as a fungus grower. This termite belongs to Holmgren's genus *Trinervitermes* of which there are a number of species scattered over South Africa. The cellular, mound nests of one or another are noticeably abundant throughout our grassy areas, but no species is a fungus grower in our present acceptance of this term. Although, during the rainy season, either *Podaxon pistillaris* or *P. carcinomalis* — fungi belonging to the *Lycoperdaceae* or puff-ball family —may be found growing from out of these mounds there is, as yet, no direct evidence of a symbiotic relationship between termite and *Podaxon*. Certainly there is a very definite association of nest and fungus and as certainly the latter is tolerated by the insects. It is this toleration which leads one to suspect a more intimate relationship since some mycelial growth, not yet observed, may be consumed by the *Trinervitermes*. The mycelium of the *Podaxon* is, at times, observable in the intra-cellular matrix of the mound and one is led to suspect that it grows there upon the organic matter of the nest composition or on the matter voided and plastered on to the cell walls by the termites. These Podaxons originate within the cellular spaces of the mound, and here at a depth of one to four inches from the surface, the initial stages of the fruiting bodies develop. The *Podaxon* pushes through the crust of the mound, and after the spores

have dispersed, dries up, the stalk remaining for a long while like a short pointed stick of wood. Very often, immediately after this fungus has developed and before the spores have ripened, the termites construct a clay collar about the base of its stalk. This collar seems to give no practical protection and is seldom made; however, that it is made is indicative of a benign relationship. When the spores have dispersed, the greater part of the base of the *Podaxon* within the mound is eaten away by the termites. Sjostedt gave the name *agricola* to the *Trinervitermes* mentioned because he was misled by the account Bequaert (1913) gives of its nest and the fungus associated therewith. It is abundantly clear from this writer's illustration and remarks that he found growing over the surface and in the chimneys of the nest of a *Termes* (probably *T. latericius*) a small agaric, and in probing the soil shallowly below the agarics he found a *Trinervitermes* which simply had galleries in the clay thrown up by the *Termes* and was quite unconnected with the fungus except, perhaps, in a predatory sense.

The true fungus-growers, those making special combs composed of more or less digested matter upon which white spheres grow, all belong to the *Termes* Group as represented by the following African genera: *Acanthotermes* Sjost. *Allodontermes* Silv., *Macrotermes* (sensu Fuller), *Termes* Linn., (=*Odontotermes* sensu Holmgren), *Microtermes* Wasmann and *Ancistrotermes* Silv.

It has not fallen to either of us to find any large agaric associated in any definite way with the nests of the species belonging to these genera. In Ceylon, however, Petch (1906) made an elaborate study of an agaric frequently found growing from the old comb in the nests of certain fungus-growing termites of that island. Of it he says:

> "This agaric appears in two forms, one of which has been assigned by various mycologists to *Lentinus*, *Collybia*, *Pluteus*, *Pholiota*, and *Flammula*, and the other to *Armillaria*. It develops in a cartilaginous, almost gelatinous, universal veil and is a modified *Volvaria*.

The same author discusses at length the *Xylarias*, the mycelium of which he found to be always present in the comb. At the close of his paper Petch gives an account of a small agaric, *Entoloma microcarpum*. He speaks of this as having no connection with termite nests (p. 251) although he found it "in profusion on the side of a mound of earth, part of which was occupied by a termite nest". Still, a possible connection of this fungus with those cultivated by termites was strongly suspected by Petch and he discusses many points of similarity between the *Entoloma* and the white spheres of the fungus garden. From his summary we quote the two following sections:

> "17. A Ceylon agaric *Entoloma microcarpum*, possesses a mycelium composed of spheres of swollen cells: the details of these spheres resemble the parts of the termite spheres, but are not so highly developed."
>
> "19. The available evidence appears to show that the 'spheres' are part of the mycelium of the *Volvaria*, but it has not been possible to connect these forms experimentally."

Several years ago the remains of a bed of very small agarics was found overlying the nest of *Termes vulgaris* Hav. at Pietermaritzburg, Natal, by one of the writers (C.F.) Later two correspondents of the Department of Agriculture remarked upon the amount of earth-like material being brought up and placed upon the floors of their houses by white ants and upon the subsequent growth thereon of small mushrooms. One correspondent sent examples of the mushrooms and termites. The latter were identified as *Termes* (*Odontotermes*) *transvaalensis* Sjost., the former were very small dried agarics exactly resembling those figured by Bequaert (1913).

Quite recently when at Klerksdorp, Transvaal, one of the writers (C.F.) observed a flagged stoep being carpeted with more less finely triturated fungus comb from its nest below the stones by *Termes* (*Odontotermes*) *badius* Hav. This was brought up through very small openings and spread about evenly over the surface to form a canopy beneath which many workers and soldiers moved about. The pellets were loosely webbed

together with mycelium and in the course of a few hours longish white spheres or buttons, as the initial stages of agarics are usually termed, developed upon the upper surface of the carpet. These were about 2 mm. in diameter, flattened at the base and slightly pointed at the apex. A small quantity of the material was wrapped in paper and when opened out about thirty-six hours later, it was found that some of these spheres had developed into small white agarics, described as follows:—

Pileus — 4-8 mm. diameter, white, conical (expanded when kept in moist chamber) umbonate, splitting at the margin.

Gills — white, free, edge wavy towards stipe.

Spores — subglobose, slightly angular 3-4 μ diameter.

Stipe — solid, white, smooth, equal except at base where slightly bulbous, 1.5 - 2.5 cm. long, 1 - 1.5 mm. diam.

The plants occurred singly, and were apparently short-lived, soon shrivelling up and becoming a yellowish or dirty white colour, but reviving rapidly again in water.

On comparing the above description with that of Petch's *Entoloma microcarpum*, it will be found that the two fungi resemble each other in many points, but whether the two are identical will have to be decided when more material is available and further investigation undertaken. Our collection of fruiting bodies developed under rather abnormal conditions and it will be necessary to examine further specimens before the identity of the fungus can be established. The chief points in which the two agarics seem to differ are as follows:—In *E. microcarpum* the pileus is livid gray, darker towards the umbo, it varies in size from 1.75 to 5 cm. in diameter, and becomes expanded when mature, whereas that of our agaric is pure white when fresh, the maximum size of its diameter is only 8 mm. and it becomes expanded only when kept in a moist chamber. Again the spores of *E. microcarpum* differ from those of the other, being larger in size, 5-7 x 3-4 μ instead of 3-4 μ, and elliptic with a sub-lateral apiculus instead of subglobose and slightly angular. With regard to the colour of the spores on which the identity of the fungus depends a spore print was unfortunately not taken so that this point remains to be cleared up.

The pellets on being examined microscopically were found to be composed of vegetable matter and particles of soil closely interwoven with a hyaline, branched mycelium.

Sections cut through the spheres showed typical agaric formation and differentiation. No chains of swollen cells such as are described by Petch for the spheres of *E. microcarpum* were observed.

Although direct proof may still be wanting, the circumstances herein related point to a direct connection between the small agaric and the white spheres since both are " cultivated " by the termites. As the comb of the fungus garden is specially treated (chewed up) and, when removed from the nest, attended to by the insects, it is perfectly clear that special provision is made for the fruiting of the fungus with which the economy of the colony is so intimately involved.

To this it may be added that the deliberate removal of parts of the fungus garden and the placing of such under the influence of external conditions only takes place when circumstances are propitious. Thus, the incident at Klerksdorp took place after a week's rain succeeding upon a prolonged drought. The time also coincided with a general emergence in the country thereabouts of winged imagos. With some species the exodus had been long delayed. The moment was normal for *Termes* (*O.*) *badius* and *T.* (*O.*) *transvaalensis;* but, in addition to these species, the winged imagos of *Microtermes* and *Hodotermes* also emerged, species which ordinarily leave the nest in November and December.

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See Addendum, page 223.

SOME REMARKS ON THE ESTABLISHMENT AND TENDING OF TIMBER PLANTATIONS WITH SPECIAL REFERENCE TO THE CAPE PROVINCE.

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Introduction.

The profession of the Forest Officer is generally little understood in South Africa, and is usually taken to represent something relating to the planting of trees. While this has a modicum of truth in it the prevailing idea would be greatly modified if this were a country rich in natural forests, and it may come as a surprise to many to learn that for the successful practice of his profession the Forest Officer requires to be highly trained. In addition to a knowledge of the principles underlying the management of forests, called Forest Science, and the application of these principles to the treatment of forests (Practical Forestry), he must be acquainted with the many sciences auxiliary to forestry such as Botany, Zoology including Entomology, Chemistry, Physics including Meteorology, Geology, Surveying, etc. Moreover, the profession demands long views, and in this connection it may not be out of place to quote from a speech delivered by His Majesty the King on the 21st July, 1920, in reply to the address of the the delegates to the recent Empire Forestry Conference when they had the honour of being received by His Majesty in London. His Majesty said *inter alia*:

> " It is a peculiar difficulty of your work that it demands " perhaps more imagination, more patience and more fore- " sight than any other industry; and it is an immense advan- " tage that the experience of all parts of the Empire should " be brought into a common stock and made available for " all. I welcome the importance which is now attached to

" forestry, one of the most useful and healthful of human
" occupations. Directed as it is to checking reckless con-
" sumption of the world's supply of timber and to teaching
" and encouraging thrifty use and prudent replacement, it
" represents a great work for the common good."

The indirect utility of forests to mankind is not so readily patent as its direct benefits in the shape of timber, fuel, bark and other products, in the provision of a field for employment in their management and working, in supplying the raw material on which so many industries depend, and in the economic development of a country, nevertheless, without entering upon that much debated and controversial topic as to whether forests influence climate, it may be stated it is now generally recognised that they do, when in mass formation, reduce to some extent the temperature of the air and soil, thus rendering a climate more equable, that they increase the relative humidity of the air, assist in reducing evapor ation and tend to increase the precipitation of moisture, and there is no doubt that forest cover, particularly on watersheds and elevated situations, is of great value in regulating the run-off and the flow of water, in minimising erosion of soil and in preventng the silting of watercourses.

Forestry is closely connected with agriculture. The object of both is the same—to make the most profitable use of the soil. The part of agriculture is to supply the country with food; the part of forestry is to supply the country primarily with wood. And for civilised life wood is almost as necessary as food. Their interests do not, moreover, clash as neither of them covets the land which the other uses, the forester being satisfied with land which is of no use to the farmer or only suitable for grazing.

The production of timber for commercial purposes is a duty for which the State and, to a lesser extent, Corporate Bodies are peculiarly fitted to deal with. The practice of forestry involves a large outlay of capital from which the State and Public Bodies can afford to wait for returns. Another important consideration is that the State enjoys, to all intents and purposes, perpetual existence, and its forestry assets are thus handed down from gener-

ation to generation, provided of course they have been properly and scientifically managed.

The natural forests of the Union, even if fully developed, are never likely to be able to supply even five per cent. of the softwood requirements of the country. According to the latest Census Returns the percentage of forest land, i.e. land under natural forests as well as plantations, in the Union is only .5 per cent., in other words, the Union contains only 2,361 square miles under trees in comparison with its total area of 473,096 square miles. Of these 2,361 square miles, 1,446 belong to private individuals, including companies, 880 to the State, and 35 to Corporate Bodies.

The Government, realising the seriousness of the position, has embarked on a vigorous policy of afforestation, and the Forest Department now aims at making the Union in years to come largely independent of outside sources of softwood supplies. At the same time it continues to safeguard and husband as far as possible the resources of the country's existing natural forests. Apart from the fact that the creation of large forests in South Africa is a national necessity, it is not likely that afforestation will prove unprofitable from a financial point of view.

Though the chief responsibility for afforestation in this, as in most other countries, must be shouldered by the State, yet much can be done by private enterprise and by Public Bodies such as Municipalities, Divisional Councils and Corporations, provided they have funds and facilities after they have discharged the more special functions for which they exist.

Every tree successfully planted adds to the national wealth, and in times of stress and shortage, such as we have recently experienced, these trees may prove a useful store on which to draw. In illustration of this point it may be mentioned that for the past five years the match factories of the Union have been dependent solely on South African timber, the bulk of it Poplar, which was planted long ago in small lots by farmers all over the country, and the planters had no idea then how important economically their efforts would ultimately become.

With these introductory remarks we now pass on to consider the practical measures necessary for the establishment and tending of Plantations, and finally an endeavour will be made to indicate the class of trees most likely to succeed in various zones of the Cape Province.

PRELIMINARY CONSIDERATIONS.

Perhaps the most clear and concise account of these considerations in so far as South Africa, especially the Transvaal High Veld, is concerned, is given by Mr. Carlson in his recent Bulletin (No. 1 of 1920) on "*The Growing of Mine Props on the High Veld*," and this publication, as well as Mr. Robertson's Bulletin (No. 1 of 1911) entitled "*Farm Forestry in the Orange Free State*," have been freely drawn upon in the preparation of the following paragraphs.

(1) SITUATION.

General.

Although some classes of industrial timbers can be grown, within limitations, in parts of the Cape Province, a great deal of this area cannot compete in the production of high grade material of large dimensions with the true forest land on the well-watered mountains of the Cape Peninsula and adjoining Districts and along the seaward slopes and foothills of the mountain ranges of the south, south-east and east, where the climate is comparatively moist and equable. Nevertheless, in many parts further inland successful plantations have been established, and in most regions where the rainfall exceeds 20 inches plantations or trees of some kind or other can be grown.

Local.

Particular attention should be directed to studying the configuration of the area it is proposed to afforest as this materially affects the choice of species. Is the situation an open one exposed to all winds or is shelter obtained from kopjes. Is it low lying, and thus subject to severe frosts, or is it high and warm. Has it a northern or western aspect receiving the full force of the sun's rays or has it a cool southern or eastern slope.

(2) Soil.

A careful examination of soil conditions, especially where the rainfall is on the low side, is very important.

Generally the soils in forest areas and areas of high rainfall where afforestation is most feasible are poor in plant food, being especially lacking in lime and phosphoric acid. On account of the deficiency of lime, locally described as "sourness," these soils have to be very thoroughly worked before they can be planted successfully. Fortunately the chemical composition of a soil has little effect on tree growth, and there are few soils too poor in plant food to sustain trees. The physical properties of a soil, viz., its depth, porosity and a proper degree of moisture, especially depth, are, however, of paramount importance in afforestation. Depth of soil varies rapidly even within limited areas, and stretches of land which present a uniform appearance to the eye may show variation in depth from a few inches to several feet. On accoupnt of the long dry season depth of soil becomes a factor of prime importance, and is one of the cardinal points to be considered in deciding on the suitability of any area for planting. Hardpan, or impervious pot-clay subsoils occur over large tracts, and render many localities, otherwise suitable for tree growth, of little or no value for that purpose. The depth of the soil and nature of the subsoil should therefore be carefully ascertained by examining any railway cuttings, quarries, dongas or sluits that may happen to be situated in or in the vicinity of the area, and whenever in doubt test pits should be sunk. Trees often flourish for a number of favourable years even on shallow soil, and then go off suddenly, and the error of planting in such ground may therefore not be discovered for some years. Generally speaking a depth of 4 to 5 feet will be found sufficient, although a lesser depth may suffice in areas of high rainfall.

The soils most suitable for afforestation appear to be those derived from granites, Table Mountain Sandstone and dolerites, but it may be stated that some trees thrive equally well on soils of the most different geological origin.

(3) Climate.

Temperature.

In high-lying areas frosts, especially early frosts, are a serious factor to reckon with in the establishment of plantations of certain species, such as the Eucalyptus. In normal years, if the selection of species has been sound, losses are insignificant, but occasionally sudden severe frosts, accompanied by cold winds, following on a period of warm weather, will play havoc. In such circumstances the whole or a large percentage of the plantation may be destroyed, though, if the planting scheme be persevered in, and is favoured with a few good seasons, a wood may be established which will be proof against subsequent vicissitudes of a similar kind. It is generally in the first two years after planting that losses occur. After that the trees are usually strong enongh to hold their own.

Rainfall.

Perhaps no factor in South Africa influences afforestation so much as rainfall, and it is owing to the more abundant precipitation that the most suitable portions of the country for afforestation occur along the escarpment previously referred to and on the foohhills immediately below it.

Where the fall drops to below 20 inches the limit of successful commercial forestry may, speaking broadly, be said to have been reached. In the dry western and central interior portion of the Cape Province where the rainfall is about 5 to 15 inches, tree growth, except along river banks, is entirely absent, and it is impracticable, if not impossible, except under irrigation, to establish plantations in such localities.

Attention must be drawn to the variation that occurs in the Cape Province in respect of the time of the year during which the rain falls, for this variation has a marked influence in the selection of the species of trees suitable for a particular locality. A tree such as *Pinus longifolia* is peculiarly suited to a summer rainfall area, whereas *P.insignis*, although largely grown in summer rainfall areas, shows better and surer growth in winter or all-

the-year rainfall areas such as the western and south-western coastal districts.

(4) Natural Vegetation.

The nature of the surface vegetation is also an important factor to consider. Virgin veld, as a general rule, is by far the best, as very little cultivation after planting is then necessary. Weedy old lands, on the other hand, give much trouble in this respect, and they should be thoroughly cleared before planting.

(5) Object For Which The Plantation Is Desired.

The object of management is a very important consideration as the selection of the species to be grown, the distance from each other at which the trees are to be planted, the subsequent tending of the plantation, etc., are all governed by it. The object might be for shelter for stock, for crops or for orchards, for the prevention and arresting of erosion, or for the production of timber for various uses such as saw-timber, for poles, fuel, bark, etc.

(6) Selection Of Species.

The factors of the locality having thus been assessed, and the object of management having been clearly defined, the next step is the selection of the species of trees most likely to suit the conditions obtaining, and at the same time most likely to fulfil the purposes desired.

The selection of the best species is perhaps the most important and difficult matter of all, for on a correct choice depends to a large extent the success of the undertaking. It requires a good knowledge of the requirements and characteristics of different trees, and an intimate acquaintance with the locality where they are to be planted. In a paper of this nature it is not possible to state definitely which trees should be planted in specified localities as the local conditions vary so very much throughout the Province, and even in the same locality. At the end of this paper will be found a list giving some of the characteristics and require-

ments of a number of trees, and it must be left to planters to endeavour to fit the requirements of the trees to the conditions obtaining on the areas it is desired to afforest or to consult the nearest Forest Officer in order to obtain special advice. Trees growing in the vicinity are very useful in affording evidence as to which species have already found the factors of the locality to their liking, and their growth and general appearance will serve as an excellent guide.

Operations Necessary to the Formation of a Plantation.

1. *Preparation of a Planting Plan.*

If the planting scheme be of any extent it is very necessary that a clearly defined *modus operandi* be drawn up. Haphazard planting is of little avail, and usually leads to a great deal of trouble later on. A detailed examination of every part of the area to be planted, a rough survey and the construction of a map on which should be shown a complete system of compartments, roads, nurseries, buildings, etc., for the most convenient and economic future working of the scheme, the proposed protective measures to be adopted against fire or cold winds, the allocation of species to each compartment according to soil, aspect and elevation, the regulation of espacements, directions as to the order in which planting should proceed and numerous other details should all be included in the plan.

2. *Fencing.*

Planting unfenced areas avails little, and this protective measure against stock, etc., should be carried out before a single tree is put in.

3. *Preparation of the Ground.*

Experience in South Africa has demonstrated that an entire and thorough preparation of the soil is essential. In the summer rainfall areas new ground should be broken up by ploughing, or by picking where ploughing is not possible, in late summer before

it dries out altogether and allowed to lie fallow during the winter. Before planting in the following summer as soon as steady rains have set in, the ground must be cross-ploughed and harrowed to bring it to a proper tilth. In the winter rainfall areas the seasons are reserved and the first preparation should then take place towards the end of the rainy season, and the second just prior to planting at the commencement of the following winter.

4. *Raising the Young Crop.*

Trees may be established either by setting out plants raised in a nursery or else by sowing the seeds direct in the land. The latter method can, however, be used with certainty only in certain localities where the climatic conditions are favourable, where the seed of the species being sown is comparatively cheap, and when germination can be relied upon. The various kinds of wattles and some of the pines, e.g. *P.pinaster*, can be raised in this manner. The best time to sow *in situ* is when steady rains have commenced to fall. The seed coats of wattles are very hard, and such seeds should have boiling water poured on them and be left to soak for 24 hours till soft enough to be cut with the thumbnail. *In situ* sowings may be carried out either broadcast, in lines, or in spots, and wherever practised now the Department finds the latter method the most economical. In spot sowings a few seeds are placed in the same spot at the required espacement, care being taken to place each seed in the spot a few inches from the other. This facilitates weeding out later on and disturbs the root system of the seedling left to form part of the crop to a much lesser extent and allows of those uprooted to be utilised for filling blanks.

Raising plants in a nursery or purchasing transplants from the nearest Government Nursery will, however, be found the safest method. Transplants in trays containing about 25 plants each are sold from the Government Nurseries at a price of approximately 6s. per hundred, and the Department issues a Price List giving further information on the subject. For the guidance of those anxious to carry out the operation for themselves the Department issues two Bulletins on the subject, viz.: " The Propagation

of Trees from Seed," and "How to Raise Trees from Seed." The former refers mainly to summer rainfall, and the latter to winter rainfall areas, but as the former is the more useful of the two a copy of it should always be obtained even if the area affected be a winter rainfall one.

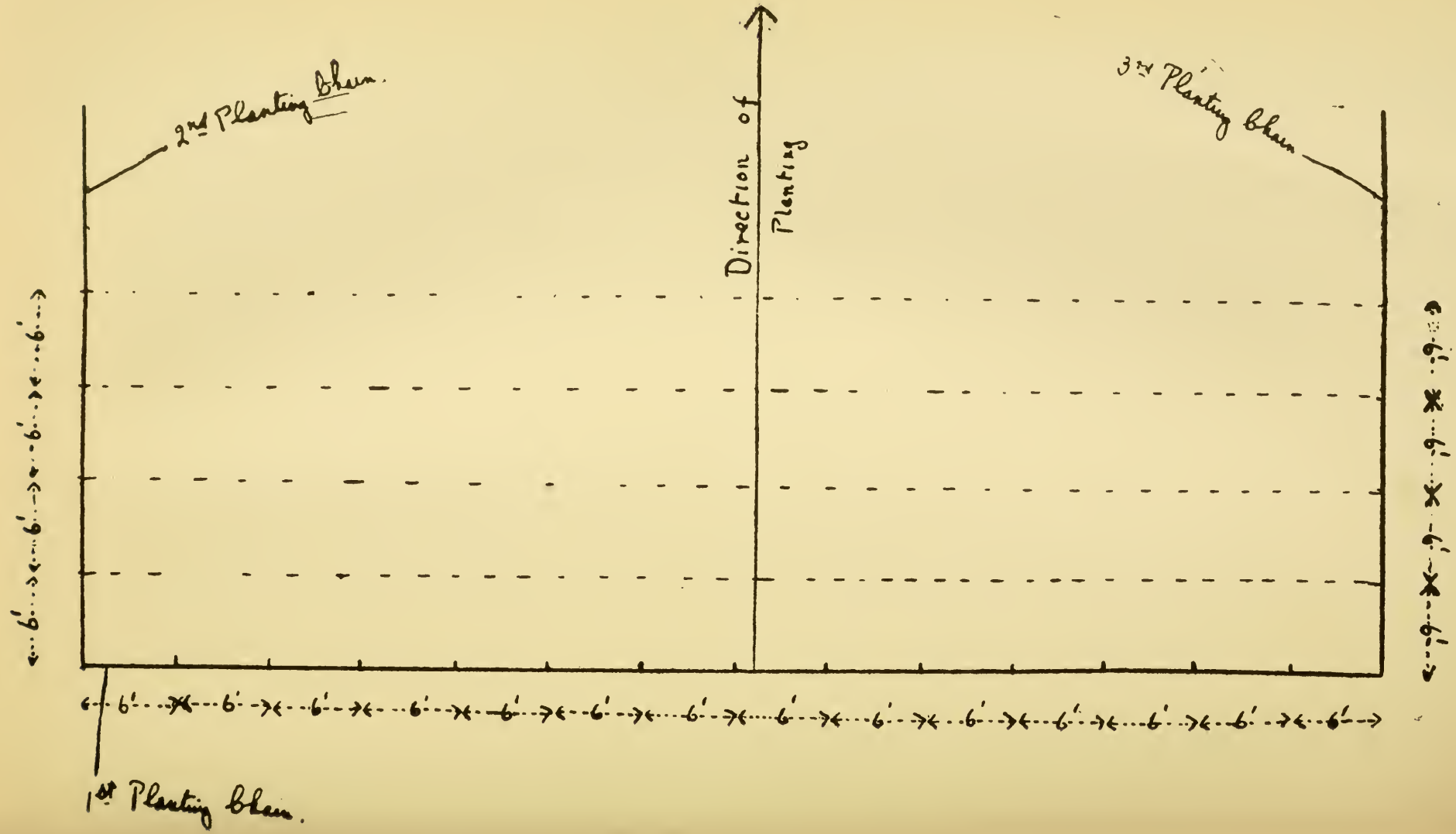
5. *Planting.*

In the case of deciduous trees planting out of transplants or rooted cuttings must be carried out in winter when they are leafless, and if the ground be very dry occasional waterings, especially at the time the plants commence to shoot, should be given.

Evergreen trees (Pines, Eucalypts, etc.) on the other hand can be planted at any time provided the ground is moist and good rains have set in. If possible the operation should be carried out on a cloudy day when more rain is expected or even while it is actually raining. Otherwise the trees should be well watered immediately after planting, and if hot, dry weather follows further watering may be necessary. Watering, however, is scarcely a practicable proposition when the area planted is a large one.

It is estimated that a gang of 20 men under a good overseer, if properly organised, should plant from 10,000 to 20,000 trees a day on easy ground. Care in planting should not, however, be sacrificed for speed.

The actual operation consists in removing the transplants carefully out of the tins or trays, each with a ball of earth adhering to the roots, and placing them in the little holes made with an ordinary garden trowel at the required distance. The position of this required distance or espacement (see next paragraph) on the ground is best ascertained by stretching along the row a planting chain or line which has the espacement desired marked on it. A good plan is to have three planting lines, all marked to the same espacement, in operation at the same time, the second and third being placed at right angles to and at each extremiy of the first to mark the distance between the rows. The first marks the position each plant is to be set out in the row. The following diagram showing an espacement of 6 feet by 6 feet makes this clear:—


2nd Planting Block.
3rd Planting Block
Direction of Planting
6'
1st Planting Block.

As each row is planted the first chain is moved on to the position of the next row as indicated by the second and third chains which are left on the ground until all the rows indicated by their lengths are planted when they are moved onwards and the same process repeated.

6. *Espacement.*

The espacement or distance at which the trees should be planted from one another has, to quote Mr. Carlson:* "an important bearing not only on the successful establishment of a stand of trees, but on its future development, the quality of wood produced, and the general economy of management. Too often those intending to go in for afforestation are under an impression that planting espacement is a common factor which can be applied to any species, situation or circumstances, and that some day they will harvest approximately the same number of trees that were originally planted Such is far from being the case. Nature's method is to regenerate in more or less dense mass formation which, when unassisted by man, has to undergo a slow process of survival of the fittest before final development is reached. The science of forestry, evolved by man, consists in hastening this process to secure his needs more quickly. We cannot, however, afford to discard nature's example entirely, and must base our sylvicultural methods on certain fundamental natural principles. One of these principles is to secure what is technically known as 'forest conditions' at an early stage. In a young stand this condition is reached when it is sufficiently dense to exclude weed-growth without necessity for further cultivation, and no stand on the high veld (and elsewhere for that matter) can be considered established, or safe against damage from frost, drought and fire until then. To attain this end most economically the planting espacement has to be varied according to differences in rate of growth and individual habits of species, such as natural erectness or otherwise of stem, density of lower bran-

*"The Growing of Mine Props on the High Veld"—Forest Dept. Bulletin 1 of 1920.

ches, etc.," and, Mr. Carlson might have added, according to the conditions obtaining on the area to be afforested.

From the above it will be evident that it is not possible to lay down certain fixed espacements—the espacement for each stand must be determined according to the various factors involved. As a general rule Eucalypts may be planted at wider espacements than conifers. For convenience in estimating the number of plants required per acre at different espacements the following table is appended:—

Distance in feet from plant to plant (in squares).	Number of Plants required per acre.
3 x 3	4,840
4 x 4	2,722
5 x 5	1,742
6 x 6	1,210
7 x 7	889
8 x 8	680
9 x 9	537
10 x 10	435

The number of plants required *per morgen* can be calculated from the above table by multiplying the number of trees per acre by 2.1165 or $2\frac{1}{9}$, i.e., by the number of acres in one morgen.

The question might be asked: Why are such close espacements necessary at all; why cannot the trees be planted wide apart in order to give them more room from the start for development and in order to do away with subsequent thinning operations? This question goes to the very root of sylviculture and requires brief explanation. The very marked contrast in the habit of growth between isolated trees and trees growing in plantation form is evident to all, but may be there are some who have not paused to think why this should be so. All trees require light for their proper development, some to a greater extent than others, but without it trees cannot grow. The object of commercial

forestry is to obtain clean or branchless stems of considerable length with as little taper and producing a timber with as close or as even a grain as possible. The isolated tree cannot produce this as it responds to the enjoyment of light from all sides by sending out lateral branches at the expense of height growth. When reared in close order, however, lateral light is shut out, and each tree vies with the other in an endeavour to outgrow its neighbours, and so flaunt its head in full enjoyment of the sunlight above. In other words, a keen struggle for existence sets in and the trees draw each other up so to speak. As very little light comes from a lateral direction after a wood has once closed canopy the side branches are starved and succumb when quite young, and each individual directs all its energy towards height growth. Thus it is we observe the marked change in habit between trees growing in the open and those in close formation. The forester takes advantage of this characteristic and makes his trees struggle to develop lengthy boles There is a limit to this struggle, however, and sooner or later the more vigorous and thrifty individuals outgrow and suppress their weaker neighbours, and it is the forester's object to assist those trees likely to form the final stand by giving them more room to develop, but at the same time he must maintain a more or less unbroken canopy so that the sun may not stream down upon the forest floor and endanger its fertility. We have now reached the stage known as " thinning," and further remarks will be deferred till we reach that stage in the tending or management of a plantation.

Another important consideration for a close espacement is that weed-growth should be killed as soon as possible and the soil be protected from the full force of the sun's rays. Weeds not only draw much moisture from the soil, but also may actually choke the trees—hence the necessity for cultivation until the trees close canopy and kill off the weeds by the dense shade they cast.

Operations Necessary to the Establishment and Subsequent Tending of a Plantation.

The planting completed it is too often supposed that all that remains to be done is to await the maturing of the crop. A

greater fallacy was never propounded. It is now that the forester has to commence the practice of his skill in earnest, and as the crop progresses on its long journey more and more skill is called into play for its efficient management. Broadly speaking these steps are as follows:—

1. *Cultivation.*

The amount of cultivation necessary after planting depends mainly on the surface condition of the soil and the rapidity of growth of the trees. Constant cultivation until the crowns of the trees unite and form " canopy," thereby killing off weeds and grass and creating " forest conditions," is essential, especially in the drier localities.

2. *Blanking.*

The failures that occur should be replaced immediately they are detected so that the new plants may catch up with the original ones. If this operation be not attended to serious gaps will occur in which grass and weeds will take possession and form dangerous fire traps. Moreover, these gaps spoil the uniformity of a stand and damage the quality of the trees in their immediate neighbourhood by causing them to bevelop lateral branches, and the capacity of the area is not being utilised to its fullest extent—the more gaps the less trees there are. Unless " blanking " or, as it is sometimes called, " beating up " be done at once it becomes very expensive and uncertain in its results later on.

3. *Pruning.*

Until the stand of young trees has formed canopy numerous lateral branches are developed, and these persist for some little time afterwards until gradually killed by the overhead shade. This vigorous development of side branches often alarms the inexperienced, and advice is sometimes sought as to whether pruning should be resorted to. Pruning, however, is seldom desirable, and nature should be left to do this in her own way. The lateral

branches of most of the cypresses are very persistent, even when planted at very close espacements, and experience so far gained in South Africa seems to indicate that in order to obtain good quality timber some pruning will be necessary in their case.

One form of pruning, however, is very necessary, and that is in the case of trees forming two leading shoots or " leaders.' The less vigorous leader should be removed as soon as detected. If this be left undone a tree with a forked stem will result. Such a tree is very apt to split at the fork, and it does not produce such good timber as a single straight stem. It invariably also, owing to its greater crown development, interferes with the growth of its neighbours.

On no account should the outside branches of the trees on the margin of a wood be pruned as this operation would let in winds, destructive both by their impetuosity and by their dessicating effects. When pruning of side branches is done at all clean cuts should be made flush with the stem so that the wounds may heal over quickly, thereby lessening the danger of the entrance of fungoid disease.

4 *Protection against Fire.*

Annually after the rainy season as wide a belt as possible should be burned round the perimeter of the plantation. In carrying out this operation two parallel lines, 60 or more feet apart, should be ploughed or scoffled, and all inflammable material in the intervening strip burnt, as well as the veld to the outside of the belt where this is possible. It is also important that any inflammable material under or near the edge trees be taken out and burnt or else raked back for several yards inside the plantation.

In addition to these external or perimeter fire traces internal belts, either unplanted and kept clear of vegetation, or planted with less inflammable species, e.g., belts of Eucalypts through blocks of pines, should be maintained. Where pines are to be grown in masses one or two rows of Eucalypts could be planted in the middle of the clean belts in order that they may act as spark arrestors. Litter should also be swept or raked up to a

distance of a few yards under the trees on either side of internal belts or roads to prevent ground fires crossing.

Burning operations should take place at the time of the day when the vegetation is in its least inflammable condition, usually after sunset or before sunrise, and when high winds are absent. Burning should always proceed against the direction of the wind.

Provided sufficient labour is available and there is an absence of high velocity winds, most grass fires can be extinguished with the aid of wet sacking or green branches of trees.

A comprehensive system of good roads and paths is necessary to facilitate rapid movement of men during an outbreak or when one is threatened, but there always remains the danger that the human element is liable to fail at the most critical moment.

5. *Thinning.*

Under the heading " Espacement " we saw how the struggle for existence set in soon after the canopy had closed and that thinning became necessary shortly thereafter. Mr. Carlson has treated this very important forestal operation in such a clear manner that I cannot do better than quote from him again. " Having secured 'forest conditions', the forester's attention is next concentrated on maintaining what is known as a ' normal stand ' throughout the remainder of the rotation. By 'normal stand'* is understood that particular density which, without sacrificing ' forest conditions ', will maintain normally vigorous growth in the best stems. Everything depends on maintaining this density. A too open stand is exposed to the dangers of understocking, and if too dense, loss of increment takes place. As the stand develops the correct density is maintained by a process of thinning whereby espacement is constantly increased and the number of stems to the acre reduced. This operation is of the utmost importance and demands great skill and experience. The lungs and

*The term is generally defined as a stand fully stocked for the particular treatment which is being given to it. Mr. Carlson here confines his definition to the subject he is dealing with viz., " The Growing of Mine Props on the High Veld ".

stomach of a tree lie in its crown, hence it must be seen to that the crowns of those individuals intended for the main crop are properly developed and not allowed to deteriorate. Every species has its own individuality of habit which must be taken into account when thinning. Furthermore its habit varies according to situation and age and whether it is growing pure or in mixture with other kinds. . . . . An error of judgment in the conducting of thinnings may not be eradicated throughout the rotation of a crop."

Further on in his Bulletin, again discussing thinning, he says: " It has been pointed out that after establishing 'forest conditions', the next consideration is to maintain a ' normal stand ' throughout the rotation of the crop by means of periodic thinnings. Also that the degree and frequency of these thinnings must be regulated according to the species, situation, variation of seasons, and the class of material it is desired to produce. The first thinning is usually called a cleaning when the material removed is too small or inferior to yield a monetary return. As a rule the cost of cleaning is very small. In the vicinity of markets the sale of material from subsequent thinnings should more than cover the cost of the operation to an ever increasing extent, thus bringing in a gradually growing interest on the capital outlay before the final crop is felled.

It is safer to thin lightly and frequently than too heavily at one time, but undue delay may result in serious loss of growth and injury to the final crop ".

A word or two may be added. In the case of plantations of conifers all that is required for a good many years is the removal of dead, suppressed, badly shaped or sickly trees. With Eucalypts, however, thinning at a comparatively early stage (after say 5 years) is often necessary as their rate of growth is in early youth so very much more rapid.

If the struggle for existence be not interfered with it will continue until height growth lasts. The trees become so drawn up and lanky that they are unable to stand upright if deprived of the support of their neighbours and are liable to whip and be laid low by wind. Moreover, all their vitality has gone into height

growth and the crowns have become unnaturally small and increment in diameter is slow. If, on the other hand, the wood be judiciously thinned the trees will remain in a healthy condition, and increase in diameter more rapidly, forming cylindrical stout stems.

A special word should be said about the treatment of the margin trees. In the case of conifers these should be heavily thinned from the commencement in order to induce lateral braches and the development of sturdy root systems. By this means a thick curtain of branches is formed on the outside to protect the interior from the impetuosity and dessicating effects of winds. Too often do we find the margin trees left unthinned in the mistaken idea that they will remain dense. On the contrary, they become drawn up and defeat the very object for which they were left dense. In the case of Eucalypts, owing to the natural tendency of the genus to form straight clean stems even when on the margins of plantations or in the open, no amount of heavy thinning in early youth appears to induce a strong protective screen. In their case it is best to keep the first two or three outside rows continually coppiced on a short rotation.

CHARACTERISTICS OF VARIOUS TREES.

We now pass on to consider the various classes of trees and their suitability for different purposes and localities.

There are two large natural groups into which forest trees fall, viz: the Conifers and the broad-leaved species.

CONIFERS.

In this group we find the Pines, the Cypresses, the Junipers, the Cedars, the Callistrises and the Cryptomeria of Japan. They all produce light, soft, yet strong, timber which usually present little difficulty in handling and seasoning.

PINES.

The *Pines* produce the deals of commerce which are in such great demand for building and constructional purposes. They

are not durable in the ground. Almost all pines prefer sandy or loamy soils and most of them are hardy to frost. All except *Pinus insignis* are rather slow growers.

Pinus insignis.—This large, handsome and quick growing tree has been very widely planted throughout South Africa, but it thrives best in the coastal districts from Cape Town to Storms River in the Humansdorp District. It is quite at home in these winter and all-the-year rainfall areas. Not to be recommended for summer rainfall areas except in certain moist mountain situations nor for localities where the rainfall is low. Likes a good well-drained soil and not affected by frost. Produces a greater volume of wood per acre in a shorter time than any other pine. From 12 to 15 years it is large enough to yield boxwood and at 30 years reaches a height of 100 feet with a diameter of 18 to 24 inches. Its timber is not strong, though tough, and is not durable in the ground. Practically free from resin and useful for any purposes where strength and durability are not required, such as for ceiling-boards, joinery, packing-cases, fruit boxes etc.

Pinus pinaster. (The Cluster Pine.)—Has become naturalised in the Cape Peninsula. Also prefers winter rainfall areas though grows well in summer rain areas as well. Hardier to drought than *Pinus insignis* and will thrive on poorer soils than the latter. It is the safest Pine to plant on poor, peaty or swampy soils. Very hardy to frost. Often raised by *in situ* sowings. When broad-casted 10-20 lbs. of seed per acre are required. Does best near the coast in localities with fairly good rainfall. Its timber is useful for flooring, rafters, joists and general carpentry.

Pinus halepensis (Aleppo Pine.)—A sweet-veld Pine. Hardy against both drought and frost and does not mind shaly or calcareous soils. Does well in both winter and summer rainfall areas. Has a bushy habit of growth for the first three or four years, but then shoots up.

Pinus longifolia (Chir Pine).—One of the best, if not *the* best, pines for eastern districts of the Cape Province. Hardy to drought, but tender to severe frosts. Should be preferred to Cluster and Insignis pine for up-country planting. Will grow on sandy and shaly soils. Produces a strong timber suitable for constructional purposes.

Pinus canariensis (Canary Pine).—Hardy to drought but tender to severe frost. Very similar to Chir Pine, but not quite so hardy. Thrives almost equally well in summer as in winter rainfall areas. Is fairly fire-resistant. Produces a strong and durable timber—excellent for general constructional purposes.

Cypresses.

These together with the Junipers, the Cedars, the Callitrises and Cryptomeria yield what are known as Cedar woods, famous for their durability when in contact with the ground. They are moreover soft woods, light, easily worked and of considerable strength for constructional purposes, especially the Cypresses. Also very suitable for furniture, framing, panelling, etc., The Cypresses are usually of more rapid growth at first than pines and retain their lower branches much longer and have denser foliage, thus very suitable for wind-breaks. Owing to the persistency of their lateral branches they require to be closely espaced when grown for timber and even then require a certain amount of pruning.

Cupressus macrocarpa (Macrocarpa or Monterey Cypress) and *Cupressus lusitanica* (Portuguese Cypress).—Require deep, moist soils for their best development. Both are hardy to frost but sometimes injured in the coldest situations. Both are rapid growers in suitable localities and seem to do equally well in winter or summer rainfall areas. The Monterey Cypress is, however, rather short lived when planted away from the Coast in summer rainfall areas.

Cupressus arizonica.—The hardiest of all the cypresses against both frost and drought and thus does well in very cold and dry regions. Does well with summer rains. Not quite so rapid in growth as the Monterey or Portuguese Cypress, but to be preferred to these two in the drier and colder areas.

Cupressus sempervirens (Common Cypress).—There are two varieties, the spreading (var. *horizontalis*) or the upright (var. *pyramidalis*). Both are hardy, being frequently seen in the Karoo. They prefer limestone and well-drained soils. Not quite so hardy to drought and frost as *Cup. arizonica*. The spreading variety is the best for plantation purposes.

Cupressus torulosa (Himalayan Cypress).—This cypress from India does not object to the severest cold nor to limestone soils. Stands some drought but is not very hardy in this respect. Will also grow on sour soils.

Junipers.

These are similar in appearance to the Cypresses, but are slow growing and do not reach such large dimensions.

Juniperus virginiana (Pencil Cedar).—Very hardy against both frost and drought, but slow-growing. Does well in very dry situations.

Juniperus bermudiana (Bermula Pencil Cedar).—Not nearly so hardy as the true Pencil Cedar and does well only near the coast. Prefers sub-tropical conditions.

Various.

Cedrus deodara (The Deodar).—Does best in high-lying situations preferably where snow occurs in winter. Is surprisingly drought resistant and produces a valuable wood. Seed very perishable and difficult to obtain.

The Callitrises.—Both *Callitris calcarata* (The Black Pine) and *Callitris robusta* (White Cypress Pine) are suited for dry areas, but the former is not so hardy as the latter against frost and drought. Both, especially the latter, resist the attacks of white ants and do well in sandy or gravelly soils.

Cryptomeria japonica is one of the most valuable timber trees of Japan. Suited to moist localities only, and likes granite soils.

BROAD-LEAVED SPECIES.

This is a very large class and contains the Eucalypts, the Wattles, the Oaks, the Poplars, etc. We can subdivide this class into deciduous and non-deciduous.

Deciduous.

The *Poplars* produce a light, yet comparatively strong, soft timber easily worked and seasoned and they yield light poles and sticks suitable for many purposes such as hut building. As a wood for matches it stands out pre-eminently as the one most suitable and for paper-pulp it has few rivals. In addition sawn poplar timber is very suitable for building construction and many other commercial purposes, such as for packing cases, fruit and other boxes, in fact, it is such a generally useful and valuable timber that it should be planted to the exclusion of all other trees wherever the factors of a locality suit it. These factors are rich bottom lands where the supply of permanent moisture is good, or a deep moisture-retentive soil. In the drier districts waste places along river banks in an open, gravelly or sandy soil, near vleis, etc., where a good deal of subsoil moisture is available, suit its growth very well, but it does not like stagnant moisture. They thrive equally well in summer and winter rainfall areas and endure a considerable amount of frost.

Populus canescens (the Grey or White Poplar), is the one most commonly seen. It should not be grown near orchards, gardens or other cultivated lands, as it spreads by means of root suckers, but is useful owing to this characteristic for planting in dongas to prevent erosion. Propagated by means of root-suckers.

Populus serotina (Black Italian Poplar) and *Populus deltoidea* var. *missouriensis* (True Carolina Poplar) are faster grow-

ing than the Grey Poplar and stand more frost. Do not sucker and propagated by means of cuttings.

Populus italica (Lombardy Poplar).—Is useful for shelter against wind and suckers freely, but its timber is not of much value and should therefore not be planted in preference to the other poplars mentioned.

The Willows (Salix sp.) are not so useful as the poplars, and should not be planted except along streams for ornament.

The Common Oak (Quercus pedunculata) likes a cool, wet winter but thrives also in the moist mountains of eastern South Africa. Is subject to pustular oak scale. Not recommended on a large scale for South African conditions.

Robinia pseudacacia (Robinia or the False Acacia) is a hardy tree, producing excellent fencing poles. Is very drought resistant but grows best in moist situations where there is some lime in the soil. Suckers freely and thus suitable for planting in dongas to stop erosion.

Non-Deciduous.

In this sub-division the Gums or *Eucalypts* take the first place. Owing to their rapid growth and the strong, durable timber and excellent firewood yielded by many they have been widely planted in South Africa and have become a very familiar landmark in South African scenery.

Contrary to the popular idea that all Eucalypts are Blue Gums, i.e., *Eucalyptus globulus*, there are about 150 or more species having very varied characteristics and demanding very diverse conditions for their successful growth.

They all produce hardwood timbers, some much more valuable than others. Unfortunately their efficient seasoning is a matter of great difficulty and they are probably the most refractory woods in the world to deal with in this respect. Appended are a few notes on the most important species in so far as the Cape Province is concerned.

(1) For Coastal Districts with a Moist Climate.

Eucalyptus diversicolor (Karri) grows well along the coast in the south and south-western districts, though at George and Knysna it appears somewhat susceptible to the effect of "berg" winds. It is a rapid grower but is not hardy to drought or frost. Produces a very strong timber which is not, however, durable in the ground. Thinnings can be used for the manufacture of pick-handles and as rough building poles. A winter or all-the-year rainfall tree.

Eucalyptus globulus (Blue Gum). For its successful growth this tree requires a moist climate or a deep moist soil and should not be planted in very cold or dry situations. Grows quite well on the poor soils of George and Knysna. A very rapid grower producing a large bulk of timber per acre. Yields a useful timber, hard and strong but difficult to work and season. Prefers winter rainfall but also does well in summer rains where soil and moisture conditions are good.

Euc. gomphocephala (Tuart) does best on light calcareous soils near the coast. Thrives on the Cape Downs in the neighbourhood of Bellville. It also does well on the drift sands at Port Elizabeth. Produces a valuable timber.

Euc. resinifera (Forest Mahogany). A valuable timber tree to grow where frosts and droughts are not severe and does well in the George and Knysna Districts. Has a fine erect growth and trees 80 to 100 feet with a corresponding diameter are growing in the Union. Better adapted, however, to summer than winter rainfall areas. Requires a rainfall of at least 30 inches.

Euc. pilularis (Blackbutt). Doing well in various parts of the coastal belt of the Union and making promising growth at Tokai, Elgin (Caledon), George, Knysna, Manubi and Bazeya (Transkei), and in parts of the midlands and coast of Natal. Susceptible to frost and drought and is probably best suited to the warmer coastal belt areas. Produces a hard, durable timber.

Euc. saligna (Saligna Gum). Suited to much the same country as *Euc. pilularis* and is being grown fairly extensively at all the Government Plantations along the coastal belt of the Union and also inland where the rainfall is good. A lofty, straight and very rapid grower producing a comparatively soft and light timber suitable, among other uses, for boxes and potato crates. Endures little frost.

Euc. botryoides. Doing well on the Port Elizabeth drift sands and at Bellville, near Cape Town. Also thriving in the coastal plantations of Zululand and in the Barberton and Pietersburg Districts of the Transvaal. Though not much is as yet known of its requirements in South Africa it is likely to give the best results along the coast where the rainfall is 30 inches or more or inland in sub-tropical localities where the rainfall is heavy. Does not stand severe frost and produces a fair eucalypt timber.

Euc. cornuta (The Yate). Thrives well on sand and other soils in the southern and south-western districts and its cultivation should be confined to the coast within the winter rainfall areas. Produces a heavy timber, probably one of the strongest in the world.

(2) For Districts further inland with moderate climatic conditions.

Euc. corynocalyx. One of the best Eucalypts for the drier Western districts. In the Western Province it is to be seen growing successfully at various Government plantations such as Tokai, Lebanon (Caledon), Cecilia (near Tokai), Robertson, Kluitjes Kraal and at George. In the Eastern Province it does only fairly well. It is more particularly a Western Province Eucalypt, where it grows best a little away from the coast and in localities where the rainfall is from 20 to 30 inches. Should de well in a district such as Malmesbury. Will stand moderate frost and considerable drought.

Euc. rostrata (Red Gum). This tree produces a valuable strong and durable timber suitable for many industrial purposes. For its best development it requires a good depth of soil and will stand drought, heat, brak and a good deal of frost. It thrives best in inland situations. Provided there be subsoil moisture it enjoys dry atmospheric conditions. Its crown is usually scanty and in an open stand its natural habit is branchy and crooked. To counteract these tendencies it should be planted at a fairly close espacement, say, 4 by 4 ft. to 5 by 5 ft. Rather slow in its growth in comparison with some of the other Eucalypts but its hardy nature and the excellent timber produced make up for this. Should not be planted in frost hollows. Grows in both winter and summer rainfall areas.

Euc. tereticornis (Forest Red Gum). Very closely related, both botanically and in its requirements, to Euc. rostrata. As it is inclined to be more scraggy in its growth the *rostrata* is to be preferred.

Euc. sideroxylon. Also produces a strong and durable commercial timber and stands more drought than *Euc. rostrata* and *Euc. tereticornis*, but like these two it also requires good conditions to reach its best development. Produces less wood per acre, conditions being equal, than *Euc. rostrata.* Does best in the summer rainfall areas.

(3) For Dry Inland Districts.

Euc. rostrata, Euc. tereticornis and *Euc. sideroxylon* are worth trying.

Euc. polyanthemos (Red Box), *Euc. melliodora* (Yellow Box) and *Euc. hemiphloia* (Grey Box). Where the conditions are too severe for *rostrata* or *sideroxylon* these Boxes often succeed, although Grey Box is rather tender to frost. They are comparatively of small size but yield very hard, tough, heavy woods, durable in the ground and excellent for fuel.

Euc. populifolia is a small dry-country tree similar to *Euc. polyanthemos* in appearance and somewhat more drought-enduring.

Wattles (*Acacia* spp.)

Foremost amongst the Wattles on account of its valuable tanning bark stands the Black Wattle (*Acacia decurrens* var. *mollis*). This tree was introduced from Australia some 50 years ago and to-day approximately 312,000 acres are under Black Wattle in the Union, of which approximately 240,000 acres are in Natal and during 1919, 56,538 long tons of bark and 6,143 long tons of wattle extract, to an aggregate value of £602,182, were exported. For its best development it requires a cool, misty climate such as is found in the mist belt of South Africa and a deep soil such as the extensive red or chocolate soils of Natal derived from the disintegration of dolerite. It also flourishes on any medium, well-drained loam with a rainfall of from 30 to 40 inches but is tender to frost and severe heat. Although the mist belt of the Natal midlands has been found the most suitable to the cultivation of the Black Wattle, there are many districts in the Cape Province where it also does well, such as in the neighbourhood of George, King William's Town, Stutterheim and in the Transkei and Griqualand East.

Wattle cultivation is very popular amongst private individuals and companies owing to the short rotation (7 to 12 years) on which it is possible to grow the crop, but sight must not be lost of the fact that in order to make it a profitable undertaking, besides a suitable soil and climate, proximity to rail and a port of export and a good supply of cheap labour are essential. In all these respects Natal is most favourably situated.

Acacia decurrens var. *dealbata* (Silver Wattle). This wattle yields a bark of much lower tanning value and is of little value on that account. It is hardier against frost than the Black Wattle and should be tried only where black wattle will not grow.

Acacia decurrens var. *normalis* (Green Wattle). Closely resembles the Black Wattle but is of a more erect habit and its bark is also not so valuable.

All these wattles, however, yield a good fuel and useful poles, are easily and quickly grown and afford good shelter.

Acacia melanoxylon (Blackwood). This tree is not usually classed as a wattle. It produces a very valuable timber closely resembling our native Stinkwood (Ocotea bullata) and grows to a height of 75 feet with a diameter of 2 feet or more. It is fast growing and prefers situations with deep moist soil, such as is found on bottom lands. Suitable only for the cooler, moister portions of the Province. The climate of George and of the natural forest belt generally seems to suit its best development.

There are many more trees which could be dealt with but the foregoing are perhaps the most important from a Cape Province afforestation point of view, and it would make this paper, already too lengthy, although merely a sketch, too cumbersome if further notes were given.

NOTES ON BIRDS OCCURRING IN THE CRADOCK AND TARKASTAD DISTRICTS, CAPE PROVINCE, WITH NESTING DATES.

By H. W. James.

The Districts of Cradock and Tarkastad are of very great interest to ornithologists as bird life is plentiful both in numbers and species.

The district of Cradock lies in the Eastern Province of Cape Colony. The town of Cradock is on the main line from Port Elizabeth to Johannesburg, the distance from Port Elizabeth being 187 miles. Its latitude is 32.10S and its longitude 25.50E.

The climate of the district is delightful being temperate and extremely salubrious, although the town itself is, at times, excessively hot during the summer months, due to the fact that it has been built in a hollow, its altitude being 2855 feet as compared with 2900 feet at Halesowen, eight miles to the south, 4000 feet on the extreme eastern boundary and about 5000 feet on the extreme western boundary.

Running through the district and right through the town we get the Great Fish River. This is fed from the western side by the Paul's River, which joins the Fish a few miles north of the town, and from the eastern side by the Tarka River, which enters the Fish about 16 miles south of the town. These three rivers are rivers in name only, being in reality nothing but huge sluits, dry, with the exception of pools here and there, for the best part of the year, but becoming raging torrents after heavy rains.

The land surface of the district is very varied. On the western side lies the Sneeuwberg range of mountains, and practically the whole of this part of the district is extremely rugged and mountainous, with frequent sparsely wooded kloofs. The sides of the mountains, especially those nearer Cradock, are steep and stony;

many of them are fairly thickly covered with Aloes, Speckboom and small bushes about a foot high; these gradually diminish as we go further westwards until the Swagershoek mountains are reached, their place there being taken by red and other grasses.

To the north-west the aspect of the country is somewhat different. There the mountains are lower with their sides fairly densely covered with an entirely different growth, chiefly Besom and Rhenoster bush and grass. This is the home of the Partridge, *Francolinus afer* (Latham) and some very excellent sport is to be had in those parts. Along the banks of the sluits the soil is deep alluvial in which grows a dense scrub consisting of Karreebosch and Blaauwbosch and a thick undergrowth of grass and smaller bushes. Bird life on this and the western side of the district is fairly plentiful but very limited as regards number of species.

On the northern and eastern sides of the district the country is totally different, consisting of miles and miles of treeless flats, broken here and here by low, dolorite kopjes and rands. The monotony of these flats is somewhat relieved by hills forming their boundaries. One can drive for miles on these flats without seeing a tree, beyond those planted round the homesteads. The vegetation consists of karroo bush and grass with a few stunted Karreebosches dotted about here and there and occasionally a few prickly pear bushes. At the foot of the hills bounding these flats we get a few stunted Mimosa trees growing on the banks of the ravines that carry the water down from the hills. In this part of the district bird life is very plentiful but confined chiefly to Alaudidae, Motacillidae, Limicolae, and Pteroclidae, and Otididae.

The Southern and south-eastern sides of the district are very similar to the western side, but less mountainous and more heavily wooded, especially along the banks of the Fish and Tarka Rivers. The soil on the banks of these rivers consists of a very rich, deep alluvial extending for many hundreds of yards on either bank and supporting a heavy growth of tall Mimosa and smaller bushes such as Karree and Ganna, the whole forming a thick scrub ideal for the support of bird life and it is in this part of the district that bird life is most plentiful, both in numbers and species.

In the last ten years farming along the banks of these two rivers has made rapid strides, especially with regard to irrigation; several large irrigation schemes have materialised, resulting in extensive areas being brought under cultivation. The effect of this has been that many species are steadily on the increase; others, formerly unknown have been attracted by the plentiful food supply and are gradually extending their range. Most noticeable of the new species *Sporopipes squamifrons* (A. Sm.) and *Pyromelana taha* (A. Sm.).

Formerly *S. squamifrons* did not extend further south than northern Cape Colony. It has gradually come southwards and now extends as far south as Witmoss, which lies 32 miles due south of Cradock. *P. taha* was not found in Cape Colony until a few years ago, but in the last six years has been fairly common in the Cradock district also extending as far south as Witmoss.

On the farm Halesowen, belonging to Mr. Hilton-Barber, and situated 8 miles south of Cradock I identified 134 species of birds and found the nests of 97.

For the last three years I have been living on a farm in the Tarkastad district. This farm lies almost due east of Cradock and is just over the boundary, our fence being the actual boundary of the two districts. As conditions prevailing there are exactly similar to those of the Cradock district I have included the observations made there in this paper. Running through the farm is an irrigation furrow, cut for practically the whole of its length, out of solid rock. The material excavated has been thrown out on either side of the furrow, forming two very substantial banks. Along the edge of the furrow, on either side, a path has been left and on this all kinds of small bushes and grass have sprung up. In this growth and amongst the stones of the banks I have found a good many nests of the following species, *Alario alario* (L), *Fringillaria impetuana* (A. Sm.), *Motacilla capensis* (L), *Emarginata sinuata* (Sund.), *Phoenicurus familiaris* (Steph.), *Saxicola monticola* (Vieill.), *Galerida crassirostris* (Vieill.), of these species *A. alario*, *F. impetuana*, *M. capensis*, *G. crassirostris* build open nests in exposed positions, the others nests

always well sheltered under stones. I made careful notes of all the nests I found along this furrow and on looking over these find, that 95% of the open, exposed nests were built in those parts of the furrow that ran from north to south and were placed on the bank facing the east. This was not the case with the sheltered nests, these were found on either bank and anywhere along the furrow. The placing of the exposed nests where they faced the east was evidently done with the purpose of protecting them from the fierce afternoon sun, which in the narrow confines of the furrow would be felt very intensely.

Near my house is a long narrow rand that runs almost due north to south so that its two sides face east and west. This rand is a favourite nesting place of *F. impetuana* and here again I have found every nest on the side facing the east and have not recorded a single nest taken on the other side although, if we eliminate the heat of the sun, conditions are just as favourable on one side as on the other.

An interesting example of the way a bird will endeavour to protect its young came under my observation last season. I was searching a low rand for nests of *Fringillaria capensis* (L) when, about three yards in front of me, up rose a Black-faced Lark, *Pyrrhulauda australis* (A. Sm.). I knew from the way it was behaving that it had a nest near by. After a short search I found it sheltered against a tuft of grass, but it was empty, and yet by the behaviour of the bird it was quite evident that it had chicks. Thinking that the chicks were old enough to leave the nest but not strong enough to fly I searched for them, and to my astonishment, when I did find them, found them to be two helpless, naked little chicks. They were lying on the ground about six feet from the nest and could only have got there by the bird carrying them. She must have spotted me walking about in the vicinity of the nest, and as I was there some time, had plenty of time to remove the chicks before I came too near.

In conclusion I would like to state that in submitting these few meagre notes, I do so with the hope that something of interest will be found in them.

The order followed and nomenclature is that of Dr. J. W. B. Gunning's check-list published in July, 1910.

Colymbus capensis (The Cape Dabchick).—The only place I have observed this little Grebe is in the pools in the Fish River in the Cradock district. It is very uncommon and undoubtedly nests in the district as I have seen young birds but I have no records.

Sterna macrura (The Arctic Tern).—A friend of mine, residing at Halesowen shot one of these terns on his dam on September 29th, 1917. It came there alone and was there two days before he shot it.

Nyroca capensis (South African Pochard).—This duck is fairly plentiful in the Tarkastad district. I found it nesting in the long grass growing at the edge of a spring on August 17th, 1919.

Anas undulata (Yellow-billed Duck).—I have several times come across this duck in both districts. It appears to be fairly plentiful.

Chenalopex aegyptiacus (The Egyptian Goose).—This goose is by no means rare in the Cradock district. It is usually found along the rivers. I have so far not observed it in the Tarkastad district. I have not come across the nest but have often seen and caught young ones feeding in the pools in the Fish River below Cradock.

Plectropterus gambensis (Spur-wing Goose).—This fine bird occurs in the Cradock district, but is very rare.

Cascarca cana (South African Sheldrake).—This species is found in good numbers in both districts and will often be seen with its young feeding on the dams. A pair nest on the farm I am now living on in the Tarkastad district, every year, but I have not been able to locate the spot.

Cursorius rufus (Rufous Courser).—This species is found in fair numbers in both districts inhabiting the open flats. In the winter it is usually found in small flocks of 4 to 5 individuals.

Cursorius temmincki (Lesser Courser).—The only record of this species being found in either district is a pair I came across on a farm near Tarkastad on February 28th, 1920. I was walking across a land that was being ploughed when I spotted one of these birds jump up. On investigating I found it had a nest containing two fresh eggs. They were laid on the bare ground with no attempt at nest building and were only one foot away from the furrow that had been pulled earlier in the day. The animals were constantly passing close to the nest as they came down the furrow, ploughing away from the nest of course, but the sitting bird took no notice of them.

Rhinoptilus africanus (Two-banded Courser).—This species is by far the commonest Courser in both districts, being found on all the open flats. Unlike the Rufous Courser it is never found in flocks. I have never seen more than two adult birds together. The single egg is laid on the bare ground. I have recorded it nesting in the months of Jan., March, August, Sept.. Nov., Dec.

Squatarola squatarola (Grey Plover).—This species visits both districts yearly in fair numbers.

Charadrius varius (Kittlitz Plover).—I have never observed this bird in the Cradock district, but find it fairly common in the Tarkastad district where it nests. I have taken eggs in Sept. in the Tarkastad district, but at the coast it apparently nests much earlier as I found several nests on Bird Island, Algoa Bay, in the month of July. On December 4th, 1919, I found a nest containing two young ones a few hours old. On leaving the nest the parent bird covered the chicks with sand as this species invariably does its eggs.

Charadrius tricollaris (Three-banded Plover).—This bird is common in both districts, being found wherever there is water. I have found a great number of nests in the bed of the Vlekpoort River, Tarkastad. The nest is a hollow amongst the shingle and is nearly always well lined with small stones. Some nests will be found on stony places on the river banks, but the greater majority I have found have

been in the river bed so that in the event of a flood a great many eggs must get destroyed. The number of eggs is invariably two. It nests in the months of August, Sept., October, November, December, and sometimes in February, April and June.

Stephanibyx coronatus (Crowned Lapwing).—This is a common species in both districts congregating in small flocks during the winter months. I have taken eggs in the months of October and December.

Oedicnemus capensis (Cape Thickknee).—A common bird in both districts. When out riding one day I noticed one of these birds jump up from a stony patch near a water furrow. I rode towards the place and when I was about 20 yds. away the other bird, which had been lying close by jumped up very erect and with wings outstretched charged straight at my horse running rapidly and hissing loudly. I could now see the eggs and on dismounting the birds repeated the manoeuvre several times as I knelt beside the nest. A couple of months later I came across another nest about 200 yards from this spot and as the birds behaved in the same manner I presume it was the same pair as this is the only instance I have come across of this species behaving in this way. I have recorded it nesting in Nov., Dec., Jan., Feb.

Totanus littoreus (The Greenshank).—A few of this species are found feeding on the dams or in the pools of rivers.

Tringa minuta (Little Stint).—This migrant visits both districts yearly in good numbers being found in flocks of 20 to 40 on the rivers and dams. I have obtained specimens in March and October.

Otis cafra (Stanley Bustard).—This handsome bird is plentiful in the least wooded parts of both districts. It is a very shy, wary bird. It nests out on the stony rands making no attempt at nest building, laying its eggs in a slight hollow amongst the stones. At Halesowen I took many nests in the months of October, Nov., Dec., Feb. In the Tarkastad district I took several nests in the months of March & April.

Otis caerulescens (Blue Bustard).—Common in both districts. As soon as the breeding season is over it congregates in small flocks of five to six individuals. I have recorded it nesting in October and December.

Otis afra (Black Bustard).—This is a common species in both districts. This bird does not congregate in flocks, but will always be found in pairs. The only record I have of its nest is February.

Anthropoides paradisea (Stanley Crane).—This beautiful bird is very common in both districts. It is found in flocks of anything from 20 to 300 and does a good deal of damage to ripening grain, particularly wheat, of which it seems to be very fond. I have seen a large field of wheat completely destroyed by these birds, every head of grain having been stripped off. It nests on the ground in the months of November and December.

Fulica cristata (Red-knobbed Coot).—I have only once come across this Coot; that was at Mortimer in the Cradock District. It was nesting on a dam there in the month of November.

Turnix lepurana (Kurrichane Button Quail).—This species occurs sparingly in the Cradock district where I have obtained several specimens in the month of September.

Turnix hottentotta (Hottentot Button Quail).—I have only observed this species in the Cradock district, but as far as my observations go it is nowhere common. I took a nest containing 4 eggs in a lucerne land at Halesowen, but unfortunately have no record of the date.

Pteroclurus namaquus (Namaqua Sandgrouse).—This species is very common in certain localities in both districts, being found in fairly large flocks. It lays two to three eggs in a slight hollow on the ground, sometimes lining the hollow with bits of stick and grass in the months of Sept., Oct., Nov. It is however an irregular nester as this year 1920 I took a good many clutches in May and July.

Scopus umbretta (Hammerhead).—This bird is found in both districts wherever there is water. Its huge nest is placed on a krantz or the river bank and is made use of for several years. It breeds in the months of August and September. In spite of the fact that it lays 6 to 7 eggs it never seems to increase in numbers and is nowhere plentiful. I watched one feeding in some liquid mud at the edge of a dam. It waded in to the mud and moved one foot rapidly which caused frogs and insects to jump out to be instantly snapped up by the waiting bird.

Ciconia ciconia (White Stork).—This migrant visits Cradock almost every year, but I have not yet observed it in the Tarkastad district. It comes in large flocks doing a great deal of good in the lucerne lands by devouring caterpillars and other harmful insects.

Ardea goliath (Goliath Heron).—I have seen one specimen only of this heron. It was feeding in the dam near our house, district Tarkastad. That was in January 1919. It remained here two days and then disappeared to reappear for one day in November of the same year.

Ardea cinerea (Grey Heron).—This bird is plentiful in both districts. At Halesowen it nests in prickly pear bushes growing high up on a krantz. In other parts of the district it nests in tall poplar trees. I have recorded it nesting in August and September.

Herodias brachyrhyncha (Yellow-billed Egret).—In November 1919 I came across a single specimen of this Egret feeding in the Vlekpoort River, Tarkastad district. It remained there for some weeks. This is the only specimen of this genus I have observed in either district.

Columba phaeonota (Rock Pigeon).—This pigeon is exceedingly common in both districts. I have recorded nests taken in September, January and April.

Turtur senegalensis (Laughing Dove).—This is another very common species in both districts. Nests have come under my observation in Sept., Oct., Nov., Dec. and April.

Turtur capicola (Cape Turtle Dove).—Exceedingly plentiful throughout both districts. I have taken nests in September and several times in June.

Oena capensis (Namaqua Dove).—This pretty little dove is very common in both districts. The eggs of this species are a departure from the usual white eggs of this family, being a pretty dark cream colour. On several occasions I have found nests built right on the ground, in one instance in a ploughed field. The nesting months are Sept., Oct., Nov., Dec. and January.

Numida coronata (Crowned Guinea Fowl).—This bird is found in great numbers in certain localities in both distrcts, chiefly where there is plenty of bush to afford it cover. The only nests that have come under my observation were found in the month of March.

Francolinus afer (Grey-winged Partridge).—This is the common partridge of both districts being found chiefly in the mountains. December is the usual nesting month.

Francolinus levaillanti (Red-wing Partridge).—In certain parts of the Tarkastad district this fine bird is fairly common.

Coturnix coturnix africana (African Quail).—In some seasons there is a great influx of this species to both districts. It is very fond of lucerne lands both as a feeding and nesting ground. I have found a great many nests in the months of Oct., Nov., Jan., March and April.

Serpentarius serpentarius (Secretary Bird).—This handsome bird can be found stalking about the veldt in pairs throughout both districts, but is nowhere common. It builds a huge flat nest on the top of a mimosa tree, generally choosing the thorniest tree in the locility. September is the usual nesting month in these districts.

Melierax canorus (Chanting Goshawk).—This very handsome bird is found in both districts but appears to be rare. I have found it nesting in a mimosa tree at Halesowen, but have no record of the date.

Buteo jakal (Jackal Buzzard).— I have observed this species in both districts, but it is rather a rare bird. A specimen I shot at Halesowen was found to have swallowed a Cobra snake, about fifteen inches long, whole.

Helotarsus ecaudatus (Bateleur Eagle).—I have observed this Eagle a few times in the Cradock District.

Elanus coeruleus (Black-shouldered Kite).—This species is found in both districts, but is nowhere very plentiful. The nest is built in a high tree, generally a mimosa, the birds keeping to one locality for many seasons if not disturbed. I have records of nests taken in October and January.

Falco biarmicus (South African Lanner).—I have only seen this bird in the Cradock district where it is rare. I secured a specimen at Halesowen.

Cerchneis rupicoloides (Larger African Kestrel).—This is fairly common in both districts. I took nests at Halesowen, but have no records of the dates. In the Tarkastad district I found a pair utilising a deserted Secretary Bird's nest. There was only one egg, fairly well incubated, so that it was certain that constituted the full clutch. This was unusual as the number of eggs is usually 4 to 5. The Tarkastad egg was found on the 17th September.

Cerchneis rupicola (South African Kestrel).—This is common in both districts. It is very fond of resting on the telegraph wires. The nesting site is in a hole in a krantz or a high river bank.

Cerchneis naumanni (Lesser Kestrel).—This bird is occasionally seen in Cradock in large flocks, roosting at night in the tall trees growing in the streets.

Bubo lacteus (Giant Eagle Owl).—This rare bird is found in the Cradock district but to what extent I have never been able to find out. I secured a fine specimen at Halesowen.

Bubo maculosus (Spotted Eagle Owl).—This is a fairly common species in both districts. I have taken the eggs, two in number, in the month of October. They were laid amongst stones on the river bank.

Bubo capensis (Cape Eagle Owl).—I have so far only come across this owl in the Tarkastad district. On October 6th, 1919, I found its eggs. They were laid on the edge of a water furrow under the shelter of a large stone.

Strix flammea maculata (Cape Barn Owl).—As far as I can ascertain this is an uncommon Owl in both districts. I have certainly seen very few specimens. I came across it nesting in a hollow in the banks of the Fish River at Halesowen, and in a deserted nest of Scopus umbretta on Aug. 25th in the Tarkastad district. The clutch of eggs in the last instance numbered 7.

Clamator serratus (Black Crested Cuckoo).—I have never seen this Cuckoo in the Tarkastad but have often observed it in the Cradock district. At Halesowen I have taken its egg from the nest of Lanius collaris, and Pycnonotus capensis nigricans. The egg is pure white.

Clamator glandarius (Great Spotted Cuckoo).—This cuckoo is common in both districts. It is usually found in company with Spreo bicolor, this bird being its only host in these parts. The egg is blue, spotted with dark brown chiefly on the larger end, where it tends to form a ring.

Chrysococcyx cupreus (Golden Cuckoo).—This species is found in both districts in good numbers. The usual host is Ploceus velatus and Passer melanurus. I have taken eggs in October, December and January. On skinning a female shot at Halesowen I found an egg just ready to lay. It was pale bluish in colour, spotted with fair sized irregular spots of brown and underlying markings of purplish grey. It corresponded exactly in colour and shape to an egg once taken from a nest of Anthus rufulus cinnamomeus. Another egg taken from the nest of P. melanurus resembled the Sparrow's eggs very closely. Several eggs from nests of Ploceus velatus resemble the Weaver's eggs closely being pale blue in colour, spotted with browns. The Cuckoo's egg can always be distinguished by the difference in texture of the shell and colour of the yolk.

Tricholaema leucomelan (Pied Barbet).—This is a fairly plentiful bird in both districts. It generally chooses a decayed tree trunk as a nesting site. In my orchard it nests yearly in an old apple tree. Nesting season in these districts is Dec., and sometimes February.

Geocolaptes olivaceus (Ground Woodpecker).—This weird, fantastic bird is common in both districts. All the nests that have come under my observation were in the months of August and September.

Dendropicos guineensis (Cardinal Woodpecker).—This species is well distributed over both districts but is nowhere common.

Colius striatus (Spreckled Mousebird).—This is found throughout both districts being more plentiful in the Cradock district. It nests in the month of October laying three dirty white eggs.

Colius colius (White-backed Mousebird) is another very common species found throughout both districts. It nests in October and November.

Colius indicus (Red-faced Mousebird).—This bird is also very plentiful in both districts. It nests in the months of October and November. The eggs differ from those of the other two species in being slightly streaked and spotted with dark red.

Halcyon albiventris (Brown-hooded Kingfisher).—This is the only species of Kingfisher common in the Cradock district . have not yet observed it in the Tarkastad district.

Corythornis cyanostigma (Malachite Kingfisher).—This beautiful little species occurs in the Cradock district, but is rare.

Ceryle maxima (Giant Kingfisher).—I have observed this species in the Cradock district only where it is a rare bird.

Merops apiaster (European Bee-eater).—This species visits both districts yearly in good numbers. I have not yet come across its nest, but it certainly does nest in these districts as I have often seen young birds.

Upupa africana (African Hoopoe).—This pretty bird is well distributed throughout both districts, confining itself to the more wooded parts. It nests in a hole in the ground, a roof

of an outbuilding or a hole in a stone wall laying 4 to 6 dark grey coloured eggs. The usual nesting season is Sept. and October.

Caprimulgus rufigena (Rufous-cheeked Nightjar).—This species is common in both districts.

Apus melba africanus (White-bellied Swift).—This fine Swift is found in good numbers in both districts during the summer months.

Apus caffer (African white-rumped Swift).—This is a common bird in both districts. It nests in December. It often uses the nest of the Rock Martin driving away the rightful owners. I find this bird invariably relines the nest with feathers before using it.

Riparia paludicola (South African Sandmartin).—This species is common in both districts.

Riparia fuligula (Rock Martin).—This bird is found throughout both districts remaining with us all the year round. It builds its cup-shaped nest of mud against a house, a krantz or in a hollow in the river bank. By way of experiment I took six clutches of eggs from one nest, but the birds never deserted it, within a fortnight of losing their eggs another clutch of three would be laid. Before using the nest again, the birds invariably added a fresh lining of feathers and a half inch rim of mud. The eighteen eggs were so much alike that had they been mixed up it would have been very difficult to sort them into clutches again. As soon as the next nesting season arrived the birds returned to the same nest which had become quite a formidable affair. I have records of nests in August, September, October, November and December.

Hirundo dimidiata (Pearl-breasted Swallow).—This little Swallow is found in both districts but is much more plentiful in the Cradock district. In the Tarkastad district it appears to be a rare bird. It builds a small cup-shaped nest of mud lined with feathers against a building or cliff,

often inside a room and lays three pure white eggs. The breeding season is October to December.

Hirundo albigularis (White-throated Swallow).—I do not think this Swallow ever visits Cradock. In the Tarkastad district it is a rare bird. A pair visit this farm every year, nesting against a beam in one of the outbuildings. I have taken nests in November, February and March.

Hirundo rustica (European Swallow).—This species visits both districts during the summer months.

Hirundo cucullata (Larger Striped-breasted Swallow).—This species is common throughout both districts. Its globular shaped nest with long entrance funnel will be found on most farm houses or in outbuildings. The eggs are three to four in number and pure white in colour. I have records of nests taken in the months of October, November, December and March.

Petrochelidon spilodera (South African Cliff Swallow).—In both districts this species is found in large colonies nesting against a cliff or house. In the Tarkastad district there is a colony that nests yearly against the high banks of the Vlekpoort River. The breeding season is in October and November.

Bradornis infuscatus (Brown Flycatcher).—This bird is found on all the open flats in both districts. It builds a cup-shaped nest of sticks and fine twigs, lined with woolly seeds. It is placed in a low bush rarely more than two feet above ground. The eggs, two to three in number are blue, sparingly spotted with dark brown and purplish grey. The breeding season is in October and November.

Sigelus silens (Fiskal Flycatcher).—This species is common in both districts wherever there is plenty of Mimosa scrub. The breeding season is October, November and December.

Batis molitor (White-flanked Flycatcher).—I have no records of this species from the Tarkastad district. It is by no means common in the Cradock district. Its principal haunts are the tall Mimosas growing along the river banks. I have recorded it nesting but have no dates.

Stenostira scita (Fairy Flycatcher).—This beautiful little bird is common throughout both districts. It is very partial to the bush found along all the river banks. The nest is a very difficult one to locate as it is always well hidden and harmonises wonderfully with its surroundings. It is a very small cup of fine twigs and soft material, lined with wool and a few feathers. The eggs, two to three in number are either a uniform olive brown or with a ring encircling the larger end of a darker shade of the same tint. I have taken nests in October and November.

Tchitrea perspicillata (Paradise Flycatcher).—This species I have never observed in the Tarkastad district. In the Cradock district it is fairly common in the parts of that district bordering on the Bedford district. In the town of Cradock it nests in the gardens but does not appear to extend its range North of Cradock. It nests in December.

Pomatorhynchus tschagra (Tschagra Bush Shrike).—I have records of this bird from the Cradock district only. There it is a rare bird. I have three times come across its nest. The nest is well hidden and is composed of twigs etc., lined with roots. The eggs, two in number are white with spots and short streaks and twisted lines of purple and bluish-grey or red and bluish-grey fairly evenly distributed over the whole surface.

Pelicinius zeylonus (Bakbakiri Bush Shrike).—The Kokivit is well distributed over both distrcts. It breeds in the months of October and November.

Laniarius major (Greater Puff-back Shrike).—This fine Shrike occurs in the Cradock district only and there in very limited numbers. I took its nest at Halesowen in the month of Nov.

Lanius collaris (Fiskal Shrike).—Jan Fiskal is a very common bird in both districts being found everywhere. I found a nest of this species on this farm built in the old skeleton of a sheep hanging on a fence. I have records of nests taken in Sept., Oct., Nov., Dec. and January.

Lanius collurio (Red-backed Shrike).—This species visits Cradock in the summer but is rare. I secured a specimen at Halesowen in March.

Heterocorax capensis (African Rook).—Common in the Cradock district, but local in its distribution. I have not yet observed it in the Tarkastad district. It breeds every year on the Cradock commonage and in the tall trees in the Cradock Park. The breeding season is in the months of September and October.

Corvultur albicollis (White-necked Raven).—I have once only come across this species. That was in Swager's Hoek in the Cradock district where it was nesting on an inaccessible krantz.

Dicrurus afer (Fork-tailed Drongo).—This species is found in both districts in the wooded parts in fair numbers. I have seen it nesting in the Cradock Park.

Creatophora carunculatus (Wattled Starling).—This bird is plentiful in both districts being usually found in company with Spreo bicolor. I found it nesting in Swager's Hoek, Cradock about fourteen years ago and have not come across it nesting in the district since. It nested on this farm I am told about 8 years ago. The remains of the nests can still be seen in a small clump of mimosas near the house. I have found several such nesting sites in both districts.

Spreo bicolor (Pied Starling).—This Starling is exceedingly common in both districts. It nests in burrows excavated in the river or sluit banks in the months of September and October.

Amydrus morio (Red-wing Starling).—This species is found throughout both districts.

Amydrus caffer (Pale-wing Starling).—This is also a common species in both districts.

Sporopipes squamifrons (Scaly-feathered Weaver).—This pretty little bird is common in the Cradock district and rare in the Tarkastad district. It breeds in September and October constructing a nest, resembling a Sparrow's, but built entirely of grass with feathers for a lining. The eggs are pale

bluish-grey much obscured by cloudings of pale ashy-brown. The number varies from three to five.

Ploceus velatus (Masked Weaver).—This is a very common bird in both districts. It nests every year in my orchard in some tall pear trees far away from water. I have records of its nesting in Sept., Oct., Nov., Dec., Jan. and March.

Quelea sanguinirostris lathami (Southern Pink-billed Weaver).—This species visits the Cradock district at irregular intervals. I have not observed it in the Tarkastad district. On April 5th, 1910 I came across a colony nesting in a small patch of Mimosa trees at Halesowen. Each tree contained many nests. The total number of nests must have been thousands. They were similar to the nests of Pyromelana orix but smaller and were woven on to the branches of the trees. They contained two to three pale blue eggs. As soon as the young were ready to fly the whole colony disappeared and I did not observe any birds of this species again until 1917, when here were a good many about at Mortimer about 8 miles from Halesowen. This year 1920 I have heard of two colonies nesting near Cradock in the same month. One colony was just South of Mortimer and the other about 8 miles North of Cradock. I was unable to visit the places, but from the description sent me of the birds there is no doubt about the species.

Pyromelana orix (Red-Bishop Bird).—This is a very common species in certain localities in both districts. It breeds in the months of Oct., Nov., and February.

Pryomelana taha (Golden Bird).—During the last few years this species has been common in the Cradock district. I never came across it nesting in the Cradock district, but I have records of its nesting for the last two years near Mortimer in the month of March. I did not observe this bird in the Tarkastad district until this year when it turned up in good numbers on this farm in the month of February and remaned to nest in the long weeds and teff grass. I found many nests in March and April. After nesting the

birds left these parts. The usual number of eggs is four, but I found one nest containing seven.

Diatropura procne (Long-tailed Widowbird).—In 1917 a few of these birds were seen near Mortimer in the Cradock district. As far as I can ascertain this is the only record of this species having been seen in either district.

Amadina erythrocephala (Red-headed Weaver Finch).—This species is common throughout both districts. I have kept this species under careful observation and I am quite convinced that in these parts it never builds its own nest, but uses the deserted nest of Passer melanurus and sometimes Sporopipes squamifrons. A friend of mine found it using old nests of Ploceus velatus. I have frequently followed up birds carrying nesting material, and have invariably found that this was to be used to renovate an old nest. The usual nesting months are May, June and August, but I have also records of eggs taken in November and December.

Estrilda astrild (Common Waxbill).—A common species in both districts chiefly in the winter months. I have not yet found it nesting in either district.

Lagonosticta rubricata (South African Ruddy Waxbill).—This species appears at irregular intervals in the Cradock district being plentiful some years.

Ortygospiza polyzona (Quail Finch).—This little bird is very common in both districts. I have taken nests in the months of November, April and August.

Neisna dufresnei (Swee Waxbill).—This bird is now rare in the Cradock district, although common a few years ago. I have not observed it in the Tarkastad district.

Vidua serena (Pin-tailed Widowbird).—Common throughout both districts.

Passer melanurus (Cape Sparrow).—This bird is very common in both districts. It nests practically all the year round.

Alaria alario (Mountain Canary).—This pretty little songster is very common in both districts. It is found in large flocks and does a lot of harm to ripening grain. The neat cup-

shaped nest is built in a low bush, for preference one growing on and overhanging the banks of a furrow or sluit. It is constructed of twigs and dead grass and is lined with pure white silky seeds. The eggs three in number are white, marked with fine spots, blotches and streaks of reddish-brown, chiefly on the larger end. I have records of nests taken in October, November, February, March and April. The chief nesting time is in March and April.

Poliospiza albogularis (White-throated Seed-eater).—This is another common species in both districts. It nests in the months of October, November and April.

Serinus canicollis (Cape Canary).—This species is common throughout both districts. In winter it is found in small flocks in company with Alario alario. I do not think this bird breeds here as I have never come across its nest in either district.

Emberiza flaviventris (Golden-breasted Bunting).—I have observed this beautiful species in the Cradock district only. It is a fairly rare bird there. I have several times found its nest at Halesowen in the month of October.

Serinus icterus (Icterine Seed-eater).—I have only one record of having seen this species in either district. In November 1919 a small flock turned up on this farm, Tarkastad district and remained here about a couple of months.

Fringillaria capensis (Cape Bunting).—This is a common species in the kopjes of both districts. It builds its nest in a low bush placing it about 6 inches from the ground. I have records of nests in November, March and April.

Fringillaria impetuana (Lark Bunting).—This Bunting is common in both districts in the least wooded parts. It is found on the kopjes and rands. It is somewhat local in its distribution. The nest is built on the ground and usually sheltered against a stone. It is composed of twigs, dead grass etc., and lined with fine roots. The eggs, two to three in number are white or very pale bluish, thickly spotted with fine spots of various shades of browns. My records

of nests are in the months of October, March, April and May.

Motacilla capensis (Cape Wagtail).—This is the only species of Wagail found in these districts. It is a common bird throughout both. I have recorded it nesting in August, September, October and April.

Anthus rufulus cinnamomeus (Tawny Pipit).—This is a common bird in both districts. It nests in the months of Sept., Oct., Nov., Dec., Jan., Feb. and March.

Anthus nicholsoni (Nicholson's Pipit).—I obtained a specimen of this Pipit at Halesowen, where it is a rare bird. This is the only locality in which I have observed it.

Anthus leucophrys (Plain-backed Pipit).—This is a common species throughout both districts. I have records of nests in January, February and March.

Macronyx capensis (Cape Longclaw).—I have observed this bird in the Cradock district only, where it is very uncommon.

Certhilauda albofasciata (Rufous Long-billed Lark).—This is a common species found on all the large open flats in both districts. Unlike the other species of Larks found in these districts, it rarely nests in the cultivated lands, preferring the open veldt. I have taken nests in Sept., Oct., Nov., Dec., Feb. and March.

Galerida crassirostris (Thick-billed Lark).—This is another common Lark in both districts. It lays two to three eggs in the months of Sept., Oct., Nov., Feb., March and April.

Pyrrhulauda verticalis (Grey-backed Lark).—This small Lark is found in great numbers throughout both districts. I have records of its nesting in the months of Sept., Oct., Nov., March and April.

Calandrella conirostris (Pink-billed Lark).—I have found this bird in the Tarkastad district only. It is a migrant visiting these parts about February and nesting in March, April and May. In June they disappear together with P. verticalis and do not reappear until the following year.

Calandrella cinerea (Red-capped Lark).—This is a resident and common in both districts. This bird very rarely lays more than two eggs in fact I have only taken one nest with three eggs. I have records of nests taken in Sept., Dec., Feb. and April.

Pycnonotus capensis nigricans (Red-eyed Bulbul).—This is the only member of the Pycononotidae found in these districts. It is fairly common in the wooded parts. I have taken nests in December and February.

Zosterops annulosa (Cape White-eye).—In the wooded parts of both districts this little bird is common.

Cinnyris chalybaeus (Lesser Double-collared Sunbird).—This is a common species in the Cradock district, but appears to be rare in the Tarkastad district. I have recorded it nesting in the months of October, November, July and August.

Nectarinia famosa (Malachite Sunbird).—This is a common species throughout both districts. I have records of nests taken in Sept, Oct., November.

Parus afer (Grey Tit).—This is the only member of the true Tits that inhabits both districts. It is fairly common in the least wooded parts. It nests in a hole in a heap of stones or in a stone kraal wall. The eggs vary a good deal in the density of markings. I have one clutch in which the eggs are completely covered with fine reddish spots. In another clutch the eggs are very sparingly marked with fairly large spots and blotches of pale reddish-brown. I have records of nests taken in the months of October and March.

Parisoma subcaeruleum (Titbabbler).—This is a common resident in both districts. It is very common in the Mimosa scrub found along the banks of the Fish River. I have records of nests in October, November and December.

Anthoscopus minutus (Penduline Tit).—This wonderful little nest builder is common in both districts. I was somewhat surprised to find it inhabiting the open flats of the Tarkastad District. There it builds its nest in any small bush often only a few feet from the ground. In this situation

it is very conspicuous and I am sorry to say often gets destroyed by native children. I have recorded it nesting in the months of Oct., Nov., Jan., Feb., March and April. The text books give the number of eggs laid by this species as seven. Personally I have never found more than five and this number in one instance only. I have examined numbers of nests and with the one exception mentioned, have never found more than four eggs or young birds.

Cisticola subruficapilla (Grey-backed Grass-Warbler).—This species is found in both districts but is rather uncommon.

Cisticola terrestris (Wren Grass-Warbler).—This is a common species in both districts. It is very partial to lucerne lands often nesting in the growing lucerne. I have recorded it nesting in November.

Prinia hypoxantha (Saffron-breasted Warbler).—This is a very common warbler in both districts especially Cradock. It builds its neat little oval-shaped nest in long grass or a low bush in the months of Sept., Oct. and sometimes in March, April and August.

Apalis ocularia (Rufous-eared Wren Warbler).—This is an exceedingly common Warbler in both districts. It is only found out on the treeless flats keeping right away from the bush. It builds a very neat oval-shaped nest of dead grass lining it with silky seeds and a few feathers. The nest is placed in a small bush and is rarely more than six inches above the ground. The eggs are four in number and plain, unspotted, pale blue in colour. I have records of nests found in the months of Oct., Nov., Dec., Jan., March and April.

Apalis thoracica (Bar-throated Wren-Warbler).—I have only observed this species in the Cradock district where it is nowhere common. I have found it nesting in that district in September and October.

Sylvietta rufescens (Crombec).—This Warbler is fairly common in both districts. It builds a beautiful, pendulant nest of cobwebs and a lining of fine roots. The outside of the

nest is always ornamented with white and yellow cocoons. It is by no means easy to find. The eggs are two in number. In colour they are white, spotted and blotched with dark brown and purple, the markings often forming a ring round the larger end. I have recorded it nesting in Sept. and October.

Eremomela flaviventris (Yellow-bellied Warbler).—This is another common species in both districts. It builds a tiny cup-shaped nest composed of wool and cobwebs securely woven to the branches of a small bush and rarely more than 2 ft. above ground. The eggs are two in number and white in colour with markings consisting of spots of greenish brown chiefly on the larger end. The nesting months are October and November.

Phylloscopus trochilus (Willow Warbler).—This little migrant visits Cradock yearly and is found in good numbers feeding in the tall Mimosa trees growing along the river banks. I have not yet observed it in the Tarkastad district.

Turdus olivaceus (Cape Thrush).—This species is found in both districts being commonest in the Cradock district. It nests in Oct.

Myrmecocichla formicivora (Ant-eating Chat).—This is a common species in both districts confining its haunts to the open flats. It nests in a rat or ant bear burrow, but I have no record of dates.

Emarginata sinuata (Sickle-winged Chat).—Another common species in both districts. It nests on the ground under a bush, clod of earth or a stone, laying three to four pretty blue eggs, sometimes spotted faintly with light brown and sometimes plain. I have records of nests taken in Sept., Oct., Nov., and March.

Saxicola monticola (Mountain Chat).—This species is very common in the mountains of both districts although it does not confine itself to the mountains being equally common on the tree-less flats. It nests in a stone wall or under a stone in the months of Oct., Nov., Dec. and April.

Saxicola pileata (Capped Wheatear).—This species is found in both districts, but is not common. I found it nesting in the Tarkastad district in a rat burrow, the nest being placed at the foot of the burrow. This was in September.

Pratincola torquatus (South African Stone Chat).—This bird is found in both districts, but is very uncommon.

Cossypha caffa (Cape Robin Chat).—A common resident in both districts. I have records of nests taken in Oct., Nov., December.

Erythropygia coryphaea (Cape Ground Robin).—This species is very common in both districts. It builds a large nest well hidden under a stone or bush, in a tin lying on the ground or in a heap of rubbish. Another favourite nesting site is an Agave hedge. The eggs are two to three in number. They are blue in colour, spotted and blotched with reddish-brown and purplish-grey. I have recorded it nesting in the months of September, October and November.

Phoenicurus familiaris (Familiar Chat).—This is a very common species in both districts. Its nest resembles that of Emarginata sinuata closely but differs in having invariably a foundation of stones and small pieces of earth. It is more often than not placed in a hole in a sluit bank or a stone wall. I have records of nests in Oct., Nov., Dec. and January.

Monticola explorator (Sentinel Rock Thrush).—I have on one or two occasions come across this species in both districts.

SOME SOUTH AFRICAN CERCARIAE.*

By F. G. Cawston, M.D., Cantab.

An examination of over 5,000 fresh-water snails which I have collected during the last two years from rivers along the East Coast reveals the presence of some twenty distinct species.

Most of the specimens have been obtained from the rivers and pools of water around Durban; others have been collected at Grahamstown and Port Elizabeth in the Cape Province.

Six different species were infested with various cercariae. *C.pigmentosa* has been isolated only from *Limnaea natalensis*. Specimens infested with this encysting cercaria which develops in very large rediae have been obtained from Sydenham in the Durban suburbs and from a fluke-infested farm at Lake Chrissie in the Transvaal. In guinea-pigs these cercariae have developed into *Fasciola gigantica.*

Cercariae closely resembling the Bilharzia have been obtained from *Physopsis africana* (nearly 30 per cent. of the mature specimens examined) : *Isidora tropica* (1 specimen) ; *Planorbis pfeifferi* (1 specimen)—Durban; *Limnaea natalensis* (5 specimens from the Umgeni river harboured rediae containing cercariae closely resembling the Bilharzia).

C. gladii from *Isidora schackoi Jickeli* at Potchefstroom somewhat resembles the Bilharzia, but is also redia-produced.

These cercariæ from *Physopsis africana* have been given to guinea-pigs and numerous *Schistosoma haematobium* and *Schisiosoma bovis* obtained from them post-mortem.

Styletted cercariae resembling *C. cawstoni* have been obtained from *Limnaea natalensis* (13) at Port Elizabeth, Umgeni, Umhlangana, Umbilo and Prospect Hall. *Physopsis africana* (2)

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*These researches have recently been assisted by a small grant from the Royal Society.

in the Umhlangana; *Isidora tropica* (1) at Prospect Hall; *Isidora natalensis*? at Merebank, and *Tiara tuberculata* at Prospect Hall. *Tiara tuberculata* has been suspected of being the intermediate host for *Bilharziella polonica* in Egypt. See R. T. Leiper on "Bilharziosis in Egypt" proc. of Royal Society of Medicine, 1916, Vol. ix. By means of its stout operculum even infested specimens can resist drying for several weeks.

Cercariae resembling C. *frondosa* have been found in *Isidora tropica*, *Isidora forskali* and *Tiara tuberculata*. This encysting amphistome was very common in *Isidora schackoi* at the Potchefstroom golf links in 1917-1918.

Eye-spotted schistosomes, C. *oculata*, have been found only in two *Physopsis africana* in the Durban suburbs. They are produced in bottle-shaped rediae and their eye-spots are readily visible through the walls of the rediae. Some that I measured were 7.7 m.ms in total length.

Chained cercariae were present in *Isidora tropica*, *Planorbis pfeifferi* and *Isidora natalensis* from Umgeni, Mayville, Merebank and *Limnaea natalensis* from Klerksdorp.

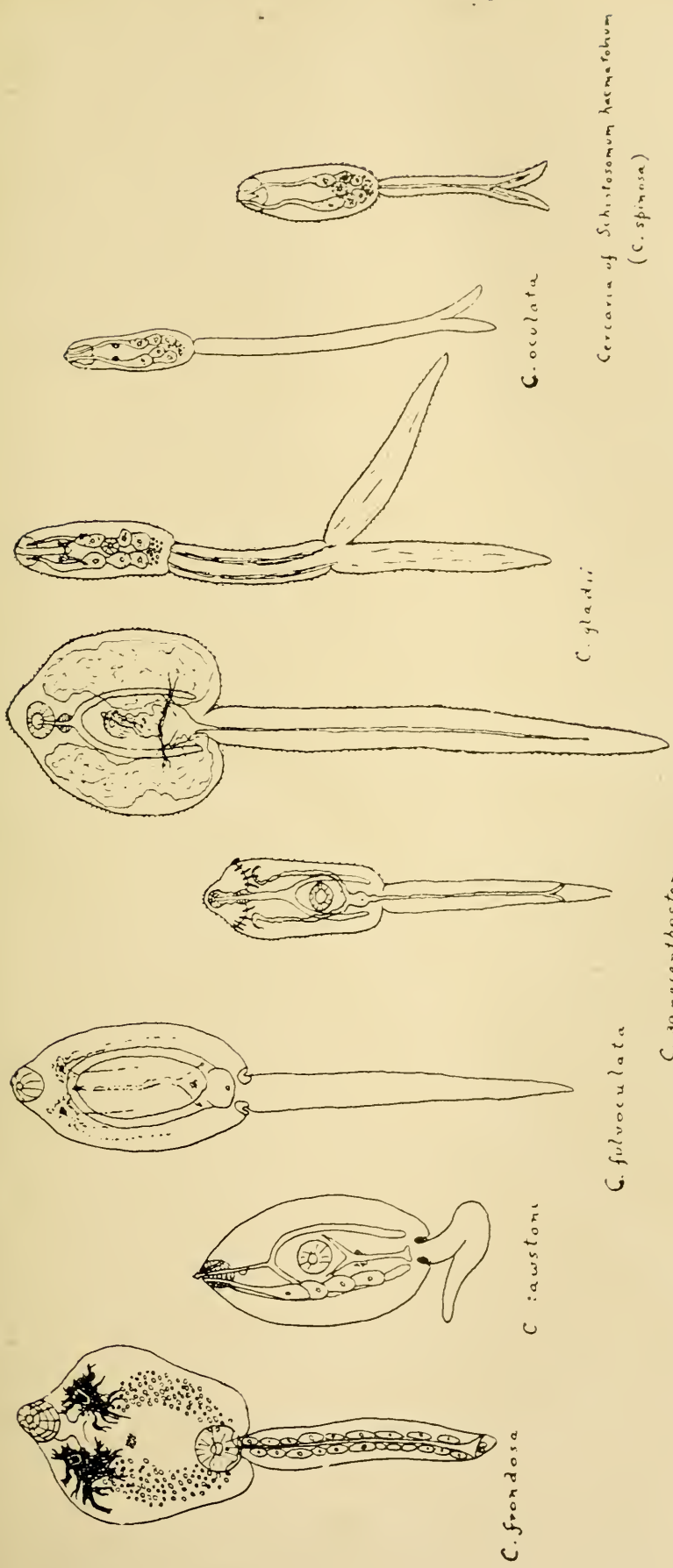
Cystophorous cercariae were obtained from 18 out of 22*Planorbis pfeifferi* at Merebank.

A large number of snails were examined microscopically and found to be free from cercariae; but in every instance those were set aside for microscopic examination which were considered most likely to be infested.

No cercariæ were observed in *Ancylus* or in brackish water inhabitants.

An eye-spotted monostome was found in *Tiara tuberculata* from Prospect Hall and another, C. *fulvoculata* in one *Limnaea natalensis* in the Durban suburbs.

In some instances those specimens which were suspected of harbouring cercariae were set aside in a test-tube for a few hours, and occasionally infestation was determined by the presence of free-swimming cercariae in the water surrounding them. These cercariae did not live as free-swimming organisms for more than 24 hours after their escape from the snail that produced them,



SOME COMMON SOUTH AFRICAN CERCARIAE.

Drawings by Dr. E. C. FAUST, reduced to a uniform magnification of 100, to show their relative size. For his description of South African cercariae see *Journal of Parasitology*, June, 1919, Vol. V, No. 4, and *Parasitology*, September, 1920, Vol. 12, No. 3.

and *C. pigmentosa*, *C. frondosa* and *C. cawstoni* were observed to encyst readily.

Several little fish called "millions" were observed to feed greedily on the fork-tailed cercariae escaping from *Physopsis africana* and on *C. pigmentosa* escaping from *Limnaea natalensis*. In this way the fish might be used to keep down the infection in semi-stagnant pools and in rivers.

Strong solutions of salt, fresh lime and tartar emetic have each been shown to destroy the free-swimming cercariae.

Tiara tuberculata (Müll.) is very prevalent amongst the water-cress at Prospect Hall along the Natal North Coast. The snail is provided with a stout oval operculum or lid, so that the animal is able to close itself inside its shell as a protection against injury or drought. *Limnaea natalensis*, *Planorbis pfeifferi* and *Isidora tropica*—all fresh-water snails, also occur in these water-cress beds, but *Tiara tuberculata* is the most prevalent. Some of the shells are as much as 30 m.ms in length; but it is common to find them eroded at their pointed extremity. *Tiara tuberculata* is closely related to *Blandfordia nosophora* Robson of Japan, the intermediary host of *Schistosomum japonicum*, and Dr. W. W. Cort has recently shown that infested specimens can resist drying for as much as 71 days—see Journal of Parasitology, vol. vi. pp. 84-88. I have found an interesting redia-produced cercaria in some *Tiara* which I have collected from Prospect Hall. It is an eye-spotted monostome with a long, slender tail armed with numerous long spikes. The total length of the cercaria is : 7 mms., the tail being slightly longer than the head. There is also a small styletted distome cercaria infesting *Tiara* at Prospect Hall, closely resembling *C. cawstoni Faust*. We do not know the life-history of either of these parasites; but crabs and birds abound in these water-cress beds. *Tiara tuberculata* also occurs close to the Umgeni mouth.

Cerithidea decollata L. is well-known to fishermen as a useful bait. It is commonly seen on the trunks of trees growing in the marshy surroundings of the lagoons near Durban. The shell is a stouter one than that of *Tiara tuberculata*, but the operculum is

more slender and round. I have not found any cercariae in this species of snail. The living animal is hard to remove from its shell, and no cercariae have been observed in the water in which numbers of the snail have been kept. *Cerithidea decollata L.* is a brackish-water inhabitant.

I have recently found eight specimens belonging to the genus *Septaria* in the Umbogintwini lagoon. *Septaria* have not previously been recorded in South Africa, though they are found in Mauritius. Mr. H. C. Burnup, who kindly examined them for me and has identified the other species, found the operculum attached to the animal between the foot and the viscera. All four snails were attached to floating sugar-cane, close to the mouth of the river.

I do not think that the presence of an operculum has been sufficiently recognised as a means whereby the life of a snail infested with cercariae can be materially prolonged. Though several species possess much stouter opercula than those I have described, it is interesting to note that, whilst the operculum of *Septaria* is a relatively inadequate one, and that of *Cerithidea* so slender as to be partly transparent, *Tiara tuberculata* is provided with a stout well-fitting operculum. Furthermore, at least two distinct cercariae are parasitic in *Tiara tuberculata* which, of the three species of snail mentioned here, is the one which possesses the stoutest operculum and is thus the best able to resist drought. On the other hand, in breeding *Limnaea natalensis*, a common fresh-water snail which does not possess an operculum, I have repeatedly observed specimens crawling up the sides of the tub or glass jar which contains them, and often escaping on to the table or floor. These specimens die if they are not put back into the water before they have had time to become quite dry; for they have no power of resisting dessication, so that the complete draining of a pool containing infested snails which do not possess opercula is a reliable means of preventing infection by killing the snails that harbour the cercariae.

TABLE SHOWING RESULTS OF EXAMINATION OF FRESH-WATER SNAILS FOR CERCARIAE.

	free from cercariae.	cystophorous	styletted	chained	cercariae resembling C. pigmentosa	cercariae resembling C. frondosa	cercariae resembling the Bilharzia	others.
Limnaea natalensis								
1487	81		39		30		5	13
Physopsis africana								
1073	311		2				152	7
Isidora tropica								
600	12		2	2		4	1	
Planorbis pfeifferi								
345	10	18		4				5
Isidora forskali Ehrub								
289	9					2	2	
Tiara tuberculata (Müll)								
422	18		1			3		3

Ancylus including *Ferrissia burnupi Walk.* and *Burnupia caffra* (*Krs.*) and *Ferrissia fontinalis Walker.*
414

Planorbis including *Segmentina planodiscus* and *Planorbis costulatus Krauss* and *Planorbis anderssoni Auc.*
273

Cerithidea decollata L. from Isipingo
59 *Assemania bifasciata Ner.* from Isipingo.

Littorina bifacciata Ner. from Isipingo
92

Septaria from Umbogintwini
4

Isidora diaphana Krauss from Umgeni, 11; and *Isidora natalensis* (*Krs.*) junr. from the North Coast of Natal.

REACTION OF BILHARZIA CERCARIAE TO LIME, SALT AND ANTIMONIUM TARTRATE.

Cercariæ from *Physopsis* added to Salt Solution (gr. 10 to 10 c.c. of water). Practically all cercariæ dead and shrivelled in five minutes.

Cercariae from *Physopsis* added to Salt Solution (gr. 10 to 40 c.c. of water). Practically all dead within half an hour.

Cercariae from *Physopsis* added to Solution of Lime (fresh) (gr. 10 of fresh slaked lime in 20 c.c. of water). All cercariæ killed in five minutes.

Cercariae from *Physopsis* added to solution of 10 grs. of fresh lime to 10 c.c. of water. All cercariæ killed instanteously and globules seen throughout them.

Cercariae from *Physopsis* added to a solution of 10 gr. of fresh lime in 40 c.c. of water. About 1 in 10 of the cercariæ still alive at the end of an hour.

Cercariae from *Physopsis* added to a solution of 10 grs. of old lime to 20 c.c. of water. All cercariæ still active after half an hour.

These experiments were made with typical Bilharzia cercariae on January 19th.

Head of cercaria, : 175 mm., tail, : 2625; prongs, : 0875. Total length, : 425 m.m.

On March 30th a solution of gr. 1 Antimonium Tartrate to 4 c.c. distilled water was added to some mature Bilharzia cercariae. Nearly every one was dead within a quarter of an hour.

These investigations have been carried out under the auspices of the Streatfield Research Trust.

ON THE HABITS OF THE CRAB DOTILLA FENESTRATA, HILGENDORF, WITH SPECIAL REFERENCE TO THE MODE OF FEEDING.

By R. Bigalke, M.A.

At low water a portion of the sandy beach at Polana, Lourenço Marques, may be seen to be strewed with what appear to be grains of gravel, but closer examination shows that these are really small balls of wet sand varying in size up to about ⅛ of an inch in diameter. A large number of apertures are also to be seen scattered among the globules of sand; these apertures vary in diameter from less than ¼ of an inch to about ½ of an inch, according to the size of the crab inhabiting the burrow.

If the observer remains perfectly still for a few minutes he will see a small crab pop out of each burrow and withdraw again immediately. After repeating this a few times, and having overcome its fright, there emerges from each burrow a small crab, and in casting one's eyes around many hundreds of such little creatures will be seen. The body of the largest of them measures about 11 mms. in greatest width and 10 mms. in greatest length. The crabs are found in what may be termed a zone of sand situated closer to the high water than to the low water mark, but this zone is almost level, and the sand remains very wet from the time it becomes uncovered until the tide again returns.

In order to observe the little creatures it is essential to remain quite still, for they are very wary and at the least movement on the part of the observer they disappear into their burrows. They are able to see well since the eyes are situated at the apices of movable stalks about 4 mms. long in the largest of them; these eye-stalks stand up prominently from the anterior border of the carapace and diverge slightly from one another. At the base of each eye-stalk is a transversely lengthened orbit into which each stalk can be folded down. The stalks are folded down into the orbits when

the animals withdraw into their burrows, but immediately on emerging from their burrows they are erected. It is evident then that the orbits are protective in function, and prevent the eyes from scraping the sides of the burrow when the animal withdraws into it.

When they have come out of their burrows the little animals move slowly sideways, and if an individual be observed closely it will be noted that the che lipeds are actively moving; the basal portions of the third maxillipedes, which, when the animal is at rest, lie flat against the body and meet in the middle line, are now seen to have a small gap between them in the middle line and to slope away at an angle from the body, a groove being thus formed between them. With he claws of the che lipeds wet sand is scraped on to the lower portion of this groove and passed forwards, and presently a little ball of sand appears at the mouth region, looking as though the animal were blowing sand bubbles. When this globule has reached a diameter of about 1/8 of an inch or less, according to the size of the animal, it is nipped off quickly with the claw of one of the che lipeds, passed under the second and third pereipods of the same side, and pushed away behind the animal with the fourth and fifth pereiopods of the same side. These globules of sand are produced at the rate of about 25 per minute. In scraping up the wet sand both che lipeds are used, and in nipping off the globule the same che liped may be used a number of times in succession and then the other one, or each may be used alternately for a number of times. While performing the process the crabs stand with the body raised off the ground, but every now and then they sit down with the posterior margin of the body resting on the ground just for a few seconds, as though to rest the body. It is the accumulation of these globules of sand prepared by thousands of the little animals that gives a portion of the beach the gravelly appearance mentioned above.

In performing the process it appears that the animal does not move more than about 6 inches from its burrow, and if a neighbour intrudes on its little pathway he is vigorously attacked, though in none of the cases observed was either of the pugilists harmed. Occasionally some of them lose themselves owing to the fact that

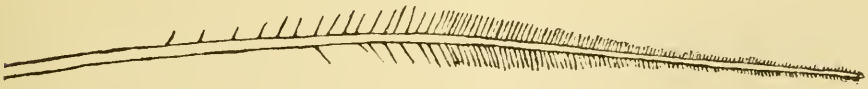
they proceed much further from their burrows than usual. If one endeavours to catch such a crab he either crouches quite close to the ground, or tries to evade capture by looking for a burrow sufficiently large to admit him.

Larger elongated bits of sand about ¼ of an inch long were observed gathered together in small heaps to a less extent, and it was noted that these were produced by the crabs making their way to the surface when the sand became uncovered by the receding water, and also by the crabs deepening their burrows at intervals.

Structural.

A microscopic examination of the second maxillipedes shows them to be bent upon themselves and to be fringed with hairs on the inside and outside borders, these hairs being more densely arranged on the former than on the latter. The hairs are of different kinds.

(1) The first kind, as shown in the diagram, consists of a central stem with small projections on each side, reminding one somewhat of the structure of a feather.



(2) The second kind is similar in structure to the first, but differs from it in being shorter and in having the free extremity shaped like the bowl of a spoon with notched borders.

These two kinds i.e. (1) and (2) occur together on the inside border of each second maxillipede and stand out almost perpendicularly to the edge. The spoon-shaped kind is however particularly abundant on that surface of the maxillipede which is applied to the body of the animal, i.e. the dorsal surface.

(3) A third kind of hair is found on the outer edge of the second maxillipedes and differs from the first kind in being longer and in having the side projections more uniformly arranged. This kind is curved strongly inwards. Hairs similar to those in the diagram and simpler ones without side projections are found also along the inner, and a few small ones along the outer borders of

the basal and other segments of the third maxillipedes. Since however the sand is passed forwards between the third and second maxillipedes it must be the latter which perform the straining process discussed below.

Interpretation of the Process.

The structure of these hairs together with the fact that wet sand is continually being passed forwards as long as the animal remains undisturbed, suggests that they act as a straining apparatus in which either,

(1) water is separated from the sand and passed backwards over the gills to be used for respiration, or

(2) food particles are strained off from the sand and passed into the mouth. This seems to be the more probable of the two explanations.

The process described must therefore be interpreted either

(1) as being a means of respiration, or

(2) as being a means of obtaining food.

Evidence against its being a mode of respiration is afforded by the following facts:—

(a) Gills are found to be present at the sides of the body under the branchiostegites. Now many species of crabs which breathe normally by gills are known to be able to live out of the sea water for considerable periods, and it seems but natural to infer that this particular species is able to do likewise during the periods of low water.

(b) When the tide comes in the burrows become closed up with sand, and as far as could be observed the little creatures remain in them until the water again goes out. Hence the only period during which they are able to take nourishment is during the period of low water, and unless the animals feed during this period it is not clear when they do so. Evidence in favour of its being a method of obtaining food is afforded thus:—

(a) The process takes place in the region of the mouth.

(b) A similar method of obtaining food is known in other tropical species of sand-burrowing crabs belonging to the

genus Gelasimus. Thus according to the observations of Prof. S. I. Smith, quoted by Stebbing (Recent Malacostraca pp. 89-90), the American species, Gelasimus pugilator Latreille, is a vegetarian and feeds upon the minute algae which grow upon the moist sand. The males of this species have one of the chelipeds enormously enlarged, and in feeding they use only the small cheliped, with the claw of which they pick up the bits of algae very daintily; the females use indifferently either of their small chelipeds for this purpose. Thus in Gelasimus pugilator bits of algae are picked out from the sand, whereas in the present species the food particles are strained off from the sand.

(c) Methods of taking food from sand are known also in other animals. Some Annelids, e.g., Arenicola, take quantities of sea-sand into their digestive tracts for the sake of the organic particles and small organisms which it contains, i.e. they literally eat the sand for the nourishment which it contains.

Hence there can be but little doubt that the process described above is an interesting method by means of which this little crab obtains its nourishment.

My thanks are due to Mr. K. H. Barnard, M.A. for kindly determining the species.

VOICES OF THE NIGHT.

By Ambrose L. Lane.

The utterances of the various animals, birds, and insects indigenous to any locality afford an interesting study to the nature lover whose knowledge of wood craft is enhanced by what we might describe as an educated sense of hearing, and distinguishing the varied sources from which such sounds proceed. From dawn to sunset it is a sterile portion of the country-side indeed where the sight of such a person is not gladdened by many visual observations, but as night falls and the mantle of darkness prevents visible observation, the sounds which often reach the practised ear make one aware of many continuous activities of the animal life around, though the world be involved in mystic gloom or almost impenetrable darkness.

When the arctic cold rules in death-like stillness over the snow laden northern forest, the almost overwhelming silence might convince one that all nature is entombed in a death-like trance, and such conditions prevail more or less during midwinter over all the temperate climes, although as one approaches the more clement latitudes, the ghostly silence of the winter's night is more prone to be interrupted by the occasional hoot of an owl, or call of some night feeding bird; but when the icy chill of frosty calm overspreads great northern wastes even those clamorous wild fowl most active at midnight become strangely silent; probably apprehensive of the freezing over of those open springs, and estuaries where they have been accustomed to adjourn with vociferous exuberance for nocturnal meals.

In Africa, except for the frosty cold of the winter night on the high veld which usually silences all but the dorp roosters,—how we wish it would silence those,—many notes attest the nightly activity of bird, beast or insects; the latter seldom heard during

the winter nights, but predominating as summer advances, when they are augmented or quite outdone in a moist locality by the chorus of the frogs. Who has not marvelled, where after the summer rains have flooded some vlei parched up during months of drought until one might have imagined all living tissue dessicated beyond even the last stage of suspended animation, to hear there the voices of innumerable batrachians, arising into a veritable continuous roar after darkness has fallen, whilst the harsh screeching of the "kivietjes" (lapwing plover) at the margin of the water may be echoed by the more flute-like quavering of the "dikkop" (thick knee plover) on the higher slopes. The note of the latter is more musical than the shrill clamour of the "hammerkops" so often heard, and which it resembles. The last does not need to advertise its presence by its loud voiced nocturnal conversations, as it rises sluggishly, or flops down tamely in the vicinity of the wayfarer along most water courses in broad daylight, with little attempt at concealment. The "dik-kop" on the other hand is comparatively seldom seen, and it is often only through its nocturnal utterances that its presence in a locality will be detected, for it is a nocturnal feeder, and an adept at running swiftly and elusively amongst scattered bush or lying flat and motionless in the open, and obliterating itself to even the most careful scrutiny, like birds of the rail tribe. Mentioning the latter, I have not had much experience of them in Africa, and their nocturnal cries seem less pronounced here than elsewhere, especially to one who has heard the persistent cracking of the restless corncrake during the short summer night in England, or the extraordinary volume of rumbling and squeaking variations emanating at night from a certain small, and seldom seen bird known as the water rail which is widely distributed in the northern parts of the old world, and a very similar species in the southern parts of the new world, and probably elsewhere.

That prince of sulkers the waterhen apparently is usually active at night in the reed beds as the subdued clucks or chuckles there indicate; but the coots (represented here by the "bleshoender") are more dismal in habit and the occasional grunt

emitted in the darkness may be the result of disturbed slumber rather than the wakeful activity of most other members of their kindred species in the rail family.

Sad to relate the snipe seems to be a vanishing species in many localities where its characteristic " drumming " was always heard about sunset in swampy localities, and after darkness had set in the " drumming " overhead, or piping call note in the sedges always drew attention to its presence. The harsh cry of the heron is often heard on a summer's night, and where ducks and other waterfowl are numerous, their call notes often indicate midnight activities.

The screech of the barn owl sounds weird when close by on a misty night, but familiarity with it has for most of us dispelled its reputed uncanny associations. More fearsome for the superstitious if heard, and not identified is the human like " hoo hoo " of the eagle owl issuing from the shadows of the trees on a still night. The " churring " of nightjar may be confused with the harsher strain of a cicala when heard at a distance, but this remarkable birdsong is smoother in its tenor, and often proceeded by very characteristic chuckling notes, after the bird has alighted from its moth-like flight on some bare piece of ground to take up its whirring ditty.

During fine moonlight nights a small feathered songster will sometimes surprise us by a sudden burst of melody, or an amorous dove commence cooing, and more surprising still come these midnight rehearsals occasionally during the stillness of a very dark night. There is a mystic romanticism for many individuals whose spirits may be said to be in accord with nature, in hearing these nocturnal sounds. Sometimes the cries are easily identified, and the hearer speculates from their locality or moving cadence as to the whereabouts and doings of the species indicated.

One can follow the courtship of the snipe; the duck busily feeding along the edge of the river or dam; the vigilant watch of the plover on the shore; the wanderings of a hungry jackal; and many details of the activity of the life around us proceeding under the pall of darkness. Then again one hears unfamiliar notes con-

veying a strange significance as of mysterious wanderers during the hours of darkness. Perchance a reader can recollect trekking across the soft sandy desert and the feeling conveyed by the appearance of a calvalcade issuing from the veiled moonlight, and noiselessly crossing his vision. The outline of the animals being blurred in the mystic glamour, and the muffled human figures barely recognizable, so that were it not for the subdued voice of a driver, or a rattle of equipment reaching the ear, the whole procession appearing for a few moments, and vanishing rapidly into the gloom, gives one the conception of some ghostlike apparition. So, at times, the vague shadows of birds or beasts momentarily seen at night by the nature lover, or unknown voices proceeding from creatures unseen though passing in proximity under cover of the darkness, cannot fail to fascinate his imagination, or excite his curiosity Not long ago I heard a strange croak at intervals uttered by some bird first approaching, and passing overhead which I could not identify, but upon its alighting at some distance, the croak which had so puzzled me lapsed into a higher key that at once identified the bird as an ordinary " Kwietje " (crowned lapwing), and this identity was established beyond doubt by the welcoming clamour of some more of his species further away.

Yet some of these night voices reach one with almost uncanny effect. I remember waking in the moonlight when outspanned with my waggon on the open veld, and distinctly hearing the rattle of the wheels of a buggy approaching along the track, for which I looked but could see nothing. Listening intently I became aware of the sound repeated in several directions as if ghostly vehicles were being driven about all round where I lay. I do not know what species of insect produced the sounds, but heard for the first time in the midnight stillness in that remote solitude, the effect was certainly weird. I have not heard the cry of the "aardwark" but am told by those who have, that heard close by on a still night the effect is about as appalling as could be produced by so harmless an animal.

In the Kalakari the mule " pauw " (great bustard) utters an intermittent boom, which coming at regular intervals, has been

likened to the fall of a steam hammer; as he proceeds in circular patrol during the night, round the spot where the female is brooding her clutch, and woe betide the intruding jackal who does not heed the warning. In the Northern Transvaal bush veld from November a finch-like lark (*Mirafra fringillaris*) becomes very plentiful. Its short song though somewhat monotonous is of pleasing cadence, and though continuously heard all through the day, is continued throughout the night at this season, by reason of which it is locally honoured with the name of " nightingale ", and in spite of its inferior performance, listening to a number of them brought back sweet memories of wondrous summer nights in the Weald of Kent, where the real nightingales form a wonderful natural orchestra accompanied by the whirring notes of the grasshopper warbler and other night congsters.

Each region has its distinguishing features in this respect, but there are few in which the voices of the night cannot fail to stimulate a romantic interest in the true lover of nature.

A NOTE ON THE GERMINATION OF THE SEED OF *ELEPHANTORRHIZA BURCHELLII*, Bth.

By JOAN HOFMEYR.

The following note on the germination of the seed of the "Eland's Boentje" (*Elephantorrhiza Burchellii*, Benth.) appears to be of sufficient interest to warrant being placed on record.

Several seeds were planted in damp sawdust on August 20th, 1920, after a previous soaking of 24 hours, in warm water. Five days after planting a structure resembling the radicle made its appearance and began to elongate, and on the 30th August measured 1½ inches long. On September 4th, *i.e.* two weeks after planting a distinct swelling was observed on the elongated structure and for about 13 days the swelling gradually increased in size. A shoot pierces through the tissues of the swelling and in about 10 days appears above the soil. This is the shoot which eventually develops the bipinnate leaves of the adult plant. Meanwhile rootlets are given off from the lower portion of the swelling which all the time has been increasing in size to form the huge underground rootstock so characteristic of the species.

The above observations show that a peculiar and rather unusual type of germination is found in the species.

A careful examination of the seed in various stages of germination brought the following points to light:—

(1) The seed has two large fleshy cotyledons enclosed in a leathery seed-coat.

(2) When germination has commenced it was found that no plumule was present between the cotyledons as was expected.

(3) The radicle-like structure is really a hollow cotyledonary tube which carries the plumule and radicle down into the soil.

(4) The plumule develops within this cotyledonary tube and eventually pierces the wall and the resulting shoot comes above the ground.

(5) Throughout germination the cotyledons remain below the ground and function as a store house upon which the developing seedling draws its nourishment.

A similar type of germination is seen in *Megarrhiza californica* a cucurbitaceous plant found in California (see Asa Gray " Structural Botany " 6th ed. p. 20. fig. 43, 44.), but here the cotyledons come above the ground and do not remain below as in the " Eland's Boentje ".

Dr. Schönland informs me that Lubbock in his work on " Seedlings " mentions a cotyledonary tube in *Berberidaceae*, some *Ranunculaceae* (Anemone) and in one of the *Cucurbitaceae*.. In the above examples the plumule disengages itself through a slit in the cotyledonary tube.

This type of germination should be compared with that of the Date Seed.

It is very probable that many other peculiar types of germination will be found among our native plants and the investigation opens out an interesting line of research.

THE NESTING HABITS OF THE TRUMPETER HORNBILL.

Bycanistes bucinator, (Temm.).

By A. Graham Millar.

Although this bird is common in the Karkloof District of Natal, especially in the vicinity of the Falls, and I was on the lookout for its nest, it was by mere chance that I came upon two separate birds making initial preparations towards nesting during October, 1913. In both instances, male birds had returned to the nesting sites of the previous year, and were busily engaged in breaking away the plaster, which had served to conceal the nest and prevent its occupation by other creatures during the interval. Having opened the nests in this manner, they proceeded to throw out the dried seeds of berries and other accumulated deposits which had formed the lining the year before.

A week later, I again visited the nests and carefully watched the birds' habits. The hen bird, in each instance, was then inside the nest, a natural hollow in a tall tree, some 20 or 30 ft. from the ground, and the male bird constantly plied to and from the nest bringing large pieces of mud or clay to form the foundations of the partition, which would, when completed, serve to enclose the hen bird while sitting on the eggs. The mud brought by the male bird was given to the hen who did most of the plastering from within with her bill. The partition was made to gradually taper in thickness towards the centre, where a long slit-like aperture was left—sufficiently large to enable the hen bird when sitting to project her bill through and receive food from her mate. The edge of the plaster surrounding the aperture, i.e. the thinnest part of the partition, was made entirely of the birds' excrement, which consisted very largely of the remains of black millipedes and beetles.

When I visited the nests on the third week, I found the partition in each case completed and the hen imprisoned, while the male bird was occupied in procuring food for her. He brought, at intervals of about an hour, a supply of berries which he had swallowed, and these he brought up one by one with a belching action and gave to the hen. The manner of the male bird in doing this is most ludicrous as it is so human. In one instance, I counted as many as twenty berries brought up in this way.

Allowing a week to pass from the date of the hen's confinement, and considering it ample time for her to have laid her full clutch, I was greatly astonished on climbing to one of the nests and releasing the bird that she had not laid a single egg! I therefore allowed another five days to elapse before visiting the other nest; but on examining it, I found that she also had failed in her duty, after being imprisoned for twelve days! However, in this latter case I had wisely not released the bird, and by means of small blocks of wood nailed into place and smeared with softened plaster, I hastily restored the partition to its natural appearance, with the result that the male bird continued feeding his mate.

Twelve days later, I returned to examine the latter nest, and on breaking away the partition was rewarded with two good eggs. I may mention, though it is sad to relate, that the hen of the first nest had entirely deserted it. My good fortune, however, did not cease, for whilst sitting having my lunch, I discovered that I chanced to be under a tree containing a nest with a hen sitting on two eggs. This gave me a second clutch.

The extraordinary caution and timidity of the male bird when approaching the nest, while building or feeding his mate is most marked. For instance, from a distance I had been watching a male bird who had just left the nest after delivering his store of food, and I approached to a position nearer the nest for the purpose of minutely watching his actions when he returned with his next supply. But the hen bird must have seen me, for during the next two hours he did not settle on the tree to deliver his food, owing to warnings from his imprisoned mate, which consisted of

a shrill squeaky note. Whenever I got near the nest, the male bird always settled on some other tree and would continually call for as long as five minutes. He would survey the entire surroundings, and on discerning the intruder would fly off immediately, uttering a note of warning to the hen which no doubt she understood.

The clutch appears to consist of two eggs, ovate in shape and of a pale cream colour. The lining of the nest during the early portion of incubation in each instance consisted of excrement, largely the remains of berries, and dry chips pecked off from the walls by the hen bird. The chips seemed to serve the purpose of keeping the eggs free from any water that might find its way into the nest.

At the time the eggs are hatched, the hen bird has moulted nearly all her feathers, and they now form the lining of the nest for the young birds. While tending her chicks she grows a fresh lot of feathers.

For the nest, a natural hole from 18 inches to 2 feet in diameter high above the ground in a big tree is chosen. In one case it happened to have previously been occupied by bees.

Immediately after the young birds leave the nest the hole is plastered up almost entirely. and so well concealed that detection is practically impossible. This is to preserve the nest for use the following season.

CORRESPONDENCE.

Mr. James A. G. Rehm, Assistant Curator, The Academy of Natural Sciences, Philadelphia, U.S.A., writes as follows:—

" At present being engaged upon the studies of the *Dermaptera* and *Orthoptera* belonging to the Transvaal Museum, as well as series possessed by this Academy from Mozambique and Natal, it occurred to me that you might have material belonging to these orders which you would care to have determined. My work on the Transvaal *Dermaptera* and the *Blattidae* is virtually completed and my report goes to England for publication in the " Annals of the Transvaal Museum " in about ten days. However, I should be extremely happy to see any additional *Blattidae* as I have many Transvaal problems which are far from solved. The work on the *Mantidae* is partially done and I intend to complete the whole series of studies as rapidly as possible. My African studies are by no means limited to southern Africa, as I have very large series from the Congo, Cameroons, East Africa and the Soudan, work on which is in various stages of completion.

Of any material sent, the Academy would ask a set for the collection here, in return for my identifications.

Mr. F. S. Townsend of Plumstead, writes as follows:—

Has the colour—greenish-blue—of the eggs of *Coccystes cafer* been recorded?

On the 6th Feb. 1918, on my farm " Copleston " 16 miles north of Bulawayo, I shot a female whose oviduct contained an egg, pure greenish-blue (and very many others undeveloped) exactly like in size, colour and shape to the eggs of Craterops pardinii and which egg I gave to the Rhodesian Museum.

On the 30th Dec. 1917, about 3 o'clock in the afternoon I found a nest of *C. pardinii* containing 3 eggs—it was not convenient to take them then, but next morning on visiting the nest I found it to contain 5 eggs. I thought it odd that two eggs should have been laid since the previous afternoon, but when I shot the *C. cafer* on the 6th Feb., felt sure it was one of these cuckoos had laid the extra egg.

On the 19th April, 1918, I shot another *C. cafer* female, whose oviduct contained 1 large fully developed egg, but with no shell, and many small others, but doubt if it would have been laid so late in the season as these birds usually have all left by the middle of May, though she might have found a host even so late as on the 19th June, 1915, I found a nest of *C. jardinii* with 3 eggs, very hard set.

These cuckoos in pairs are common on " Copleston " and very noisy from Nov. to the end of April, and seem to live almost entirely on large hairy caterpillars of *Nudawielia belina* (Arnold Bulawayo) principally.

Coccystes glandarius—on May 27th, 1918, I shot a female; it was very shy, but persisted in returning to an acacia full of hairy caterpillars (of a kind that live in huge companies and sleep in a mass against the sheltered side of the trunk) on which it was feeding. Each time I disturbed it it was chased some distance by a fork-tailed Drongo—it uttered no cry and is the only one I ever saw on the farm.

C. serratus visits us in Nov., but does not stay the summer.

C. Jacoinus and *C. hypopinarius* are both fairly common. I shot a female of the latter as late as 27th May, 1917.

Also have the nest and eggs of *Prionops talacoma* been described?

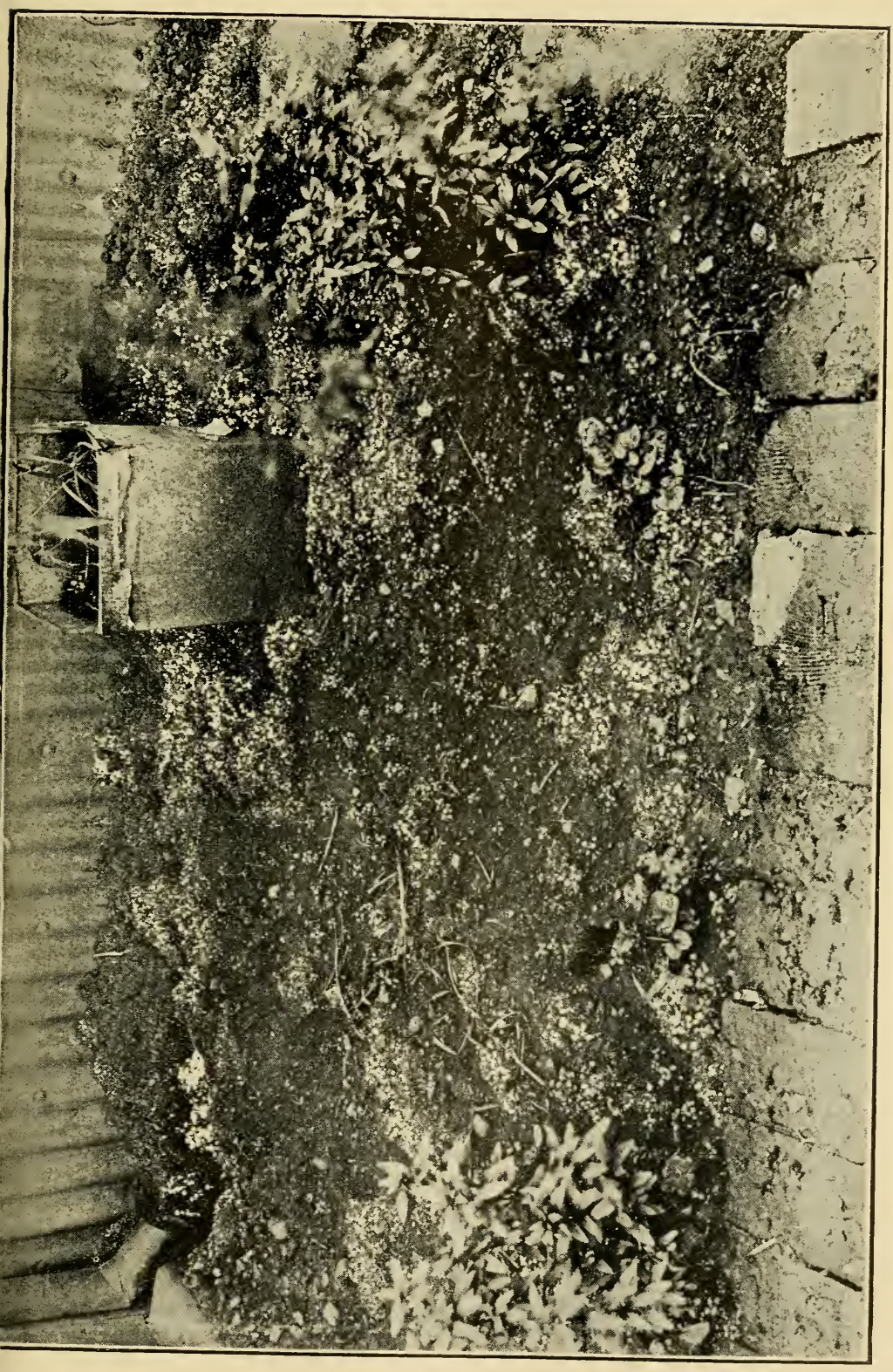
On 9th April, 1918, I found a nest built on the horizontal branch, about 10 ft. from the ground, of a Mangwe, a silvery-leaved tree something like a Cape Silver tree—it was one of the most beautiful nests I have even seen, cup-shaped, of grass entirely overlaid on the outside with white cobwebs, exactly similar to its surroundings and unless the parent bird had flown off, I could not

have distinguished it from any ordinary enlargement or knot of the branch, it contained 4 pale blue eggs, spotted and blotched with dull purple, and given to the Rhodesian Museum.

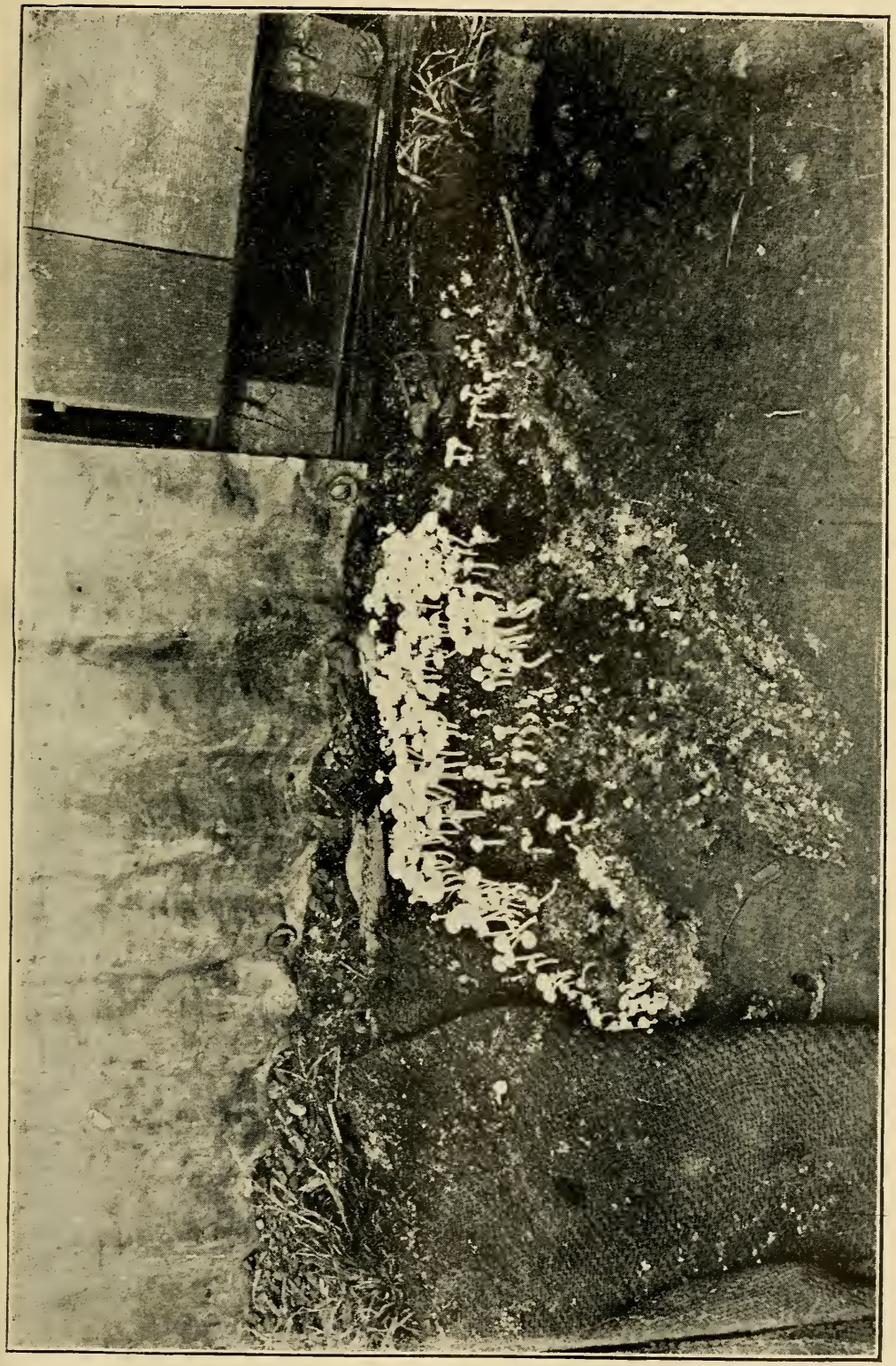
In the same connection the following note in contributed by Mr. A. Roberts.

The egg of *Clamator cafer* was described by Dr. Ansorge, and the nest and eggs of *Prionops talacoma* by S. A. Neave; there is also a clutch of four eggs of the latter in the Transvaal Museum collection, taken by F. Streeter at Hector Spruit.

The point which has interested me is your finding the egg in the nest of *Crateropus jardinei*, evidently a special choice of the cuckoo. Did you notice whether there was any difference in the texture of the cuckoo and babbler eggs? The other, smaller, black and white cuckoos seem always to lay pure white eggs and are not particular as to the host: I have found one of these white eggs in the tiny nest of *Parisoma subcaeruleum!*



A. *Entoloma microcarpum*: Surface of mound of *Termes* (*O*) *badius* Haw. covered with patches of the agaric. (Photo by I. B. Pole Evans).



B. *Entoloma microcarpum.* Natural growth of agaric on termite mound. (Photo by I. B. Pole Evans).

THE FUNGUS FOOD OF CERTAIN TERMITES.

By Averil M. Bottomley, B.A., and Claude Fuller,
Department of Agriculture, Pretoria, S. Africa.

ADDENDUM.

Since the foregoing was sent to press, a further occurrence of the agaric in question has been noted in Pretoria under conditions similar to those at Klerksdorp. As before, it appeared after a spell of rainy weather and developed from " spheres " present in the triturated fungus comb brought up by termites and deposited in patches on the surface of the soil. The agarics were produced in great abundance enabling us to make an examination of large numbers of fresh specimens, as a result of which it was found that the fungus is almost identical with that described by Petch as *Entoloma microcarpum* and this name is, therefore, adopted by us. It was also found that the fresh specimens differed somewhat from the dried material originally at our disposal and, in view of this, the description is amended as follows:—

Entoloma microcarpum. Caespitose, arising from small white " spheres " developed in triturated fungus comb deposited by termites, and forming dense white flower-like patches on the surface of soil, etc.; varying in size according to the humidity of the situation in which they occur.

Pileus. Fleshy but thin and delicate, pale buff or dirty white when young, pure white or white tinged with pale yellow at the umbo when mature; conico-campanulate becoming expanded and umbonate. Margin irregular, often splitting into several segments giving the pileus a characteristic flower-like appearance. Diameter 5 mm. to 1.7 cm. according to situation.

Gills. Pure white, becoming dirty white or pale buff with age, free, irregular, subdistant.

Stipe. White, smooth, except at base, where villose; solid or slightly stuffed; somewhat bulbous; 4 mm.-5 cm. in length, by 1-2 mm. diameter according to situation.

Spores. Subglobose to oval, obliquely apiculate, 5-7 x 4-5 μ; colour in mass, Vinaceous Buff to Avellaneous. (Ridgeway Plate XL).