

On the Terrestrial Planarians from Japanese Territories.

By

Tokio KABURAKI,

Zoological Institute, Science College, Imperial University, Tokyo.

With 1 plate and 23 text figures.

Since the appearance of STIMPSON's report (62), the terrestrial planarians of Japan have been largely neglected, though von GRAFF (25) recorded one more species later.

The material upon which the present report is based was collected chiefly by the late Professor ISAO IJIMA and by myself in several localities. Consignment of some specimens were received from Professor S. WATASE, Dr. S. HÔZWA, Mr. S. KINOSHITA, the late Mr. M. TAKESHITA and the late Mr. YASUDA. To the gentlemen named I desire to express my thanks for the opportunity of working at these forms.

Here I deem it my duty to acknowledge my indebtedness to the University of Cambridge for the use of their tables at the Zoological Laboratory, which made it possible for me to prosecute the present investigation. It should also be mentioned that some of the coloured illustrations given in the plate accompanying this paper were made by the late Professor IJIMA from living examples. To him are due my warmest thanks for his kindness in allowing me the use of those excellent figures as well as in placing at my disposal a series of notes and sketches taken by him.

The classification here adopted is that laid down by von GRAFF in his well-known monograph.

List of the species embodied in this paper.

Family Geoplanidæ STIMPSON.

1. *Geoplana bimaculata*, n. sp.
- 2.* : ,, *lapidicola* STIMPSON.
3. *Artioposthia japonica*, n. sp.

Family Bipaliidæ von GRAFF.

4. *Perocephalus fulvus*, n. sp.
5. *Bipalium venosum*, n. sp.
6. ,, *ruteofulvum*, n. sp.
7. ,, *ochroleucum*, n. sp.
8. ,, *kisoensis*, n. sp.
9. ,, *fuscolineatum*, n. sp.
10. ,, *hilgendorfi* (VON GRAFF).
11. ,, *fuscocephalum*, n. sp.
12. ,, *monolineatum*, n. sp.
- 13.* ,, *maculatum* STIMPSON.
14. ,, *trifuscostriatum*, n. p.
15. ,, *trilineatum* STIMPSON.
16. *Pläcocephalus fuscatus* (STIMPSON).
17. ,, *glaucus*, n. sp.
18. ,, *virgatus* (STIMPSON).

Family Rhynchodemidæ von GRAFF.

19. *Rhynchodemus ijimai*, n. sp.
20. *Microplana ruteocephala*, n. sp.

Family Geoplanidæ STIMPSON.

Genus **Geoplana** MÜLLER.

1. ***Geoplana bimaculata***, n. sp.

(Pl. I., Fig. 1.)

This new species is based on the late Professor IJIMA's notes and sketches taken from a single individual, which was obtained by himself in July, 1886, in Nikko.

*) The species indicated by asterisks are those which could not be brought under my direct examination.

The body, when the worm was living, was slender and had the lateral margins even and nearly parallel for a large part of their length, but was tapering at both the anterior and posterior ends, which were bluntly pointed. The ventral surface is made up of the slightly raised sole, extending over the whole surface. The specimen was 24 mm. in length and 1.5 mm. across the widest part of the body.

The ground colour of the dorsal surface is of a dark olive-like brown colour and medially marked with a slender dark stripe which loses itself in the anterior parts. There occur two pairs of colourless spots at the lateral sides of the body, a short distance behind the anterior extremity which is dark. Ventrally, the dark olive-brown colour is continued from the dorsal surface, except for the mid-ventral surface which is pale.

The eye-spots, numbering about twelve on either side, are arranged round the anterior tip in a single row interrupted by a gap in the middle.

2. *Geoplana lapidicola* STIMPSON.

Geoplana lapidicola, STIMPSON (62), pp. 23, 30.—DIESING (16), pp. 510.—VON GRAFF (25), pp. 370, 371.

This species was first recorded by STIMPSON from Loo Choo. No specimen came under my examination.

“Elongata, subconvex, post medium parum latior, lateribus fere parallelis, extremitatibus rotundatis; supra grisea, fascia mediana fulva, marginibus pallidis. Ocelli vix numerosi in lateribus extremitatis anterioris sparsi, majores utrinque 3-4 latero-frontales. Long. 1.2 (30.5 mm.); lat. 0.1 (2.5 mm.) poll’.

Genus *Artioposthia* VON GRAFF.

3. *Artioposthia japonica*, n. sp.

(Pl. I., Fig. 2.—Text Fig. 1.)

This new species is one of the commonest forms in Central Japan; it was procured in fair abundance in Nikko, at Itaya in Prov. Iwashiro and in the neighbourhoods of Tokyo and Kyoto.

The body in the living state is slender and nearly uniformly broad for the most part of its length, though it tapers off considerably in front. Both the anterior and posterior extremities are bluntly pointed or rounded. Extending almost throughout the whole length, in the mid-ventral line, is a slightly raised ridge, the sole, which is not less than one-fifth the width of the body. Well-grown specimens measure 40–60 mm. in length and 2–4 mm. in breadth.

The ground colour of the dorsal surface is uniformly yellow or yellowish brown with a fine black stripe, which medially extends over the whole surface. As it approaches the anterior tip it gradually assumes a darker tone. The ventral surface is a somewhat paler shade of the same colour as the dorsal, except for the surface of the sole which is nearly white.

The eye-spots are arranged in one or two rows round the anterior tip and continued, without any grouping, for a few mm. down the sides.

The mouth-opening which leads into the peripharyngeal pocket is situated near the middle of the body.

The common genital aperture is placed half-way between the mouth-opening and the posterior end of the body.

The epidermis consists of a single layer of columnar cells which are about equally high on the dorsal and the ventral surface. The sole possesses a ciliated epithelium, but the cilia appear to be confined to this part of the ventral surface. Except on the surface of the sole, the epidermis contains enormous quantities of minute spindle-like rhabdites, evidently wedged in between the cells. As is well known, the rhabdites arise from their mother-cells, scattered in fair abundance in the parenchyme beneath the epidermis, and sometimes are seen to be in connexion with the latter. Scattered in sparse numbers in the parenchyme are unicellular glands, which open out at various points of the body-surface. Besides this, there are enormous quantities of glands which occur deeply embedded in the parenchyme and make their way to the surface of the sole.

The musculature of the body is differentiated into two systems, superficial and deep. The superficial system, immediately

underneath the fine basement membrane, is made up of two layers of the outer circular and the inner longitudinal fibres. Separated from this by a zone of tissue is the deep muscular system which forms a layer thicker than the superficial and consists principally of two sets of fibres, longitudinal and circular; these fibres occurring intermingled in the same mass without being arranged in definite layers. Besides, dorso-ventral fibres are well developed, running between the intestinal branches.

The mouth-opening lies near the centre of the peripharyngeal cavity, in which the pharynx is horizontally disposed. The pharynx is of a short cylindrical shape, terminating conically at the free end. The three main trunks of the intestine are provided with numerous lateral branches which are sometimes bifurcated and sometimes trifurcated. Their direct wall is a single layer made up of high cylindrical cells, each of which contains a great number of coarse, highly refractive granules in the finely granular protoplasm. Sometimes the cells were observed to be vacuolated in their distal portion.

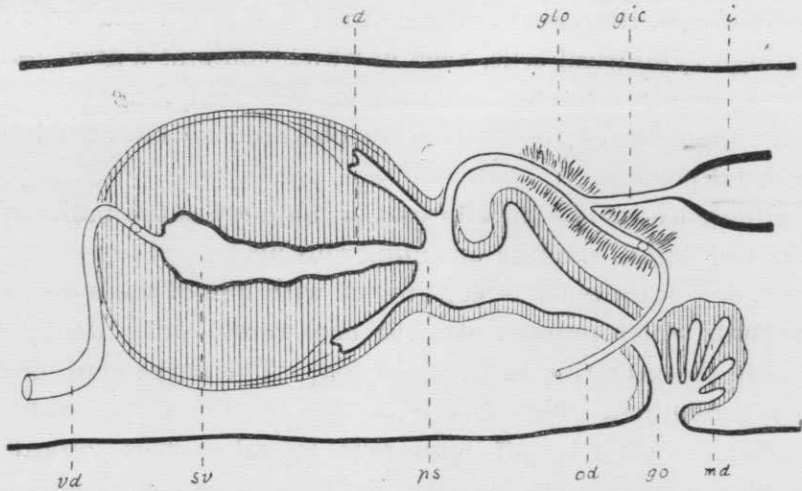
Situated near the anterior end of the body is the brain, which is a bilobed organ, sending out numerous nerves. Posteriorly each half of the brain-mass is continuous with one of the longitudinal nerve cords which proceed straight backwards, until finally they extend to the posterior end of the body. The nerve cords are connected throughout their entire course by numerous transverse commissures and give off numerous lateral nerves towards the nerve plexus, which lies beneath the outer longitudinal muscles of the body and extends completely round the body.

The genital opening leads anteriorly into the penis-sheath and posteriorly into the "muskulösen Drüsenorgan", provided with a wall which projects into the lumen in folds. Embedded in the parenchyme around the said organ are numerous glands which make their way into its lumen.

Numerous testes, ventral in position, are arranged in a single row just outside the longitudinal nerve cords, beginning from behind the ovary and ceasing altogether to exist at the level of the pharynx-insertion. The vasa deferentia, filled with spermatozoa,

proceed straight backwards just along the dorsal side of the longitudinal nerve cords, and in front of the penis make an inward bend, rising at the same time, to enter the penis-bulb and then to unite into a common duct, which communicates with the seminal vesicle, after receiving numerous glands.

The penis divided into two parts of the bulbous basal part of muscular nature and the free conical intromittent part lying horizontally in the penis-sheath, which opens to the exterior through a narrow passage. Enclosed in the penis-bulb is the relatively narrow and somewhat folded seminal vesicle, which passes behind into the ejaculatory duct terminating at the tip of the penis. The cavity is lined with a single layer of columnar cells.



Text fig. 1. Genital organs of *Artioposthia japonica*, n. sp. in sagittal section, diagrammatically shown.

ed ejaculatory duct, *gic* genito-intestinal canal, *glo* glandular organ, *go* genital opening, *i* intestine, *md* "muskulöse Drüsenorgan", *od* oviduct, *ps* penis-sheath *sv* seminal vesicle, *vd* vas deferens.

Behind the brain occurs the paired ovary, occupying a ventral position. At the postero-lateral aspect the oviduct springs from the ovary in the form of a funnel-like widening, which soon assumes the character of a narrow duct, pursuing a backward course just along the outer side of the longitudinal nerve cords and receiving in its course the vitelline glands at several points. The

vitelline glands are composed of closely packed, large cells, extensively filling up the interspaces between the branches of the intestine. The mode of their connexion with the oviduct is effected by means of the short branches of the latter. In the neighbourhood of the genital opening the oviduct nears the median line, rising upwards at the same time, to unite into a common canal, the glandular canal, which pursues a forward course, finally opening from behind into the penis-sheath. The wall of the oviduct is made up of a ciliated epithelium, external to which is a thin muscular coating.

In its course the glandular canal gives off a branch which stands in communication with the right posterior trunk of the intestine, so that there is, as in some land planarians,¹⁾ a genito-intestinal canal. The canal is constructed in the same manner as the glandular canal, and is lined with an epithelium made up of ciliated columnar cells, outside this is a muscular coating.

Family Bipaliidæ VON GRAFF.

Genus *Perocephalus* VON GRAFF.

4. *Perocephalus fulvus*, n. sp.

(Pl. I., Fig. 3.)

Only a single specimen representing this new species was procured by the late Professor IJIMA in July, 1886, on the stone wall covered with the moss in Nikko.

According to the late Professor IJIMA's notes and sketches taken from the living worm, the head presented a lunar shape and merged into the trunk, from which it was separated by a slight neck-like narrowing. In the preserved state, the head lobes make it very difficult to distinguish. The trunk is nearly oval in cross section and almost uniformly broad for the most part of its length, but is tapering in the hind parts down to the bluntly pointed extremity. Along the mid-ventral line runs the slender sole from

1) See the author's report "On the Terrestrial Planarians from the Islands of Mauritius and Rodrigues, with a Note upon the Canal connecting the Female Genital Organ with the Intestine." (32).

the neck to the posterior extremity, which is scarcely raised above the general level. When fully extended the worm measured 20 mm. in length and 0.75 mm. in breadth.

The animal is, dorsally, of a bright orange colour, except the head which is more or less reddish. Ventrally, the colour is much lighter than that of the dorsal surface.

Numerous eye-spots are present in a row or rows all round the margin of the head.

The mouth-opening is situated nearly at the hind end of the second third of the body, opening into the peripharyngeal cavity with the pharynx plicated.

The sexual organs were not yet developed in the specimen examined.

The epidermis consists of a layer of columnar cells, which are much higher on the dorsal side than on the ventral, and contains small spindle-like rhabdites in sparse numbers; wedged in between the cells. Deep below the epidermis, in the parenchyme, are found such rhabdites as are still contained in their mother-cells. There are numerous glands, situated in the parenchyme, opening to the exterior on the surface of the sole.

The superficial muscular system underlying the basement membrane is composed of two layers, outer circular and inner longitudinal. The deep muscular system is well developed all round in the parenchyme as a thick and continuous sheet, consisting of two principal sets of longitudinal and circular fibres.

The mouth-opening is situated near the centre of the peripharyngeal chamber, in which is hanging the plicated pharynx from above. The gut trunks are provided with numerous branches which are bifurcated.

The brain forms a meshwork, from which posteriorly start two longitudinal nerve cords, connected together by numerous transverse commissures and giving off numerous lateral branches.

Genus *Bipalium* STIMPSON.

5. *Bipalium venosum*, n. sp.

(Pl. I., Fig. 12.—Text Figs. 2, 3.)

Two specimens of this species were obtained by me in July, 1916, on the stone wall of the Mii Temple in Ôtsu.

The head, which is semi-lunar in shape, presents a somewhat recurrent lappet on either side and is not less than twice the breadth of the body, from which it is separated by a neck-like narrowing. The frontal margin of the head in the creeping state shows a serrated appearance. The trunk is almost uniformly broad for the most part, but gradually tapering in the hind parts to the bluntly pointed extremity. Dorsally it is slightly convex and ventrally nearly flat, the sole on the mid-ventral surface forms a slightly raised ridge, rather less than one-third the width of the body, and extending from the base of the head to the posterior end. The large specimen measures 90 mm. long by 5 mm. broad, while the small is 50 mm. long by 2.5 mm. broad; the head in both measures 7 mm. across.

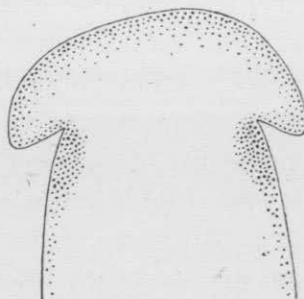
The dorsal surface is of a uniform dark brownish colour, which anteriorly gets more or less lighter. Ventrally, the colour is much lighter than that of the dorsal surface, except on the sole which presents a pale tone.

The eye-spots are thickly distributed all round the margin of the head and also occur sparingly scattered over the entire length of the body, submarginally on the ventral side. At the sides of the neck, they are especially densely packed.

The mouth-opening is placed slightly in front of the centre of the body, leading into the peripharyngeal chamber. In the preserved specimens the pharynx is protruded through the mouth-opening.

The common genital aperture is situated near the centre of the second fourth of the distance between the mouth-opening and the posterior extremity of the body.

The epidermis consists of a layer of columnar cells which are a great deal higher on the dorsal than on the ventral surface. Widely distributed almost over the entire surface of the body, except on the sole, are enormous quantities of vermiform rhabdites



Text fig. 2. Distribution of eye-spots in *Bipalium venosum*, n. sp.

situated between the epidermic cells. Directly below the superficial muscular system, there occur such rhabdites as are still contained in their mother-cells. There are enormous quantities of slime glands which are deeply situated in the parenchyme along the median zone of the body and open out on the surface of the sole.

The superficial muscular system is composed of the outer circular and the inner longitudinal layer. The deep muscular system, which chiefly consists of longitudinal fibres, is well developed all round in the parenchyme as a continuous sheet. In addition to these, dorso-ventral muscles are found, running between the branches of the intestine.

The mouth-opening is situated near the centre of the peripharyngeal chamber with the plicated pharynx hanging from above. The three main gut trunks are provided with numerous outwardly directed, lateral branches which are sometimes bifurcated and sometimes multifurcated. The lining epithelium of the intestine is made up of high cylindrical cells which contain a great number of coarse, highly refractive granules in the finely granular protoplasm. In some cases the cells were seen to be vacuolated in the distal portion of the cell.

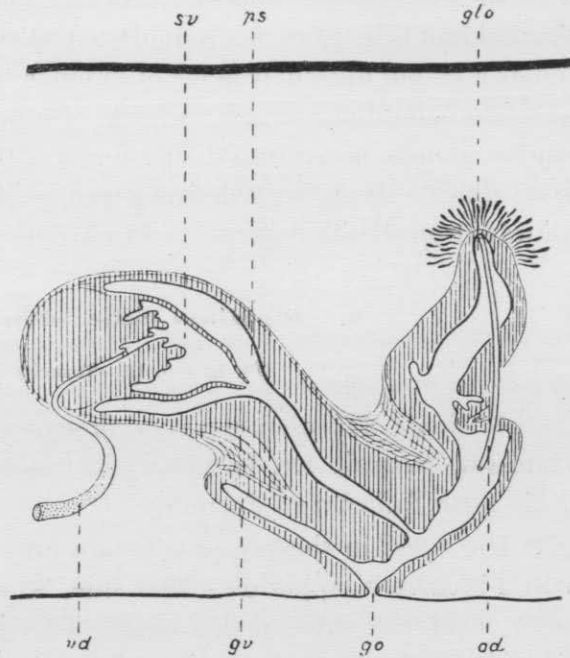
The cerebral nervous system has the appearance of meshwork which is continuous with two longitudinal nerve cords, running on either side of the median line. Throughout their entire course, the cords are connected by very numerous transverse commissures. Laterally they give off numerous branches towards the nerve plexus, lying beneath the outer longitudinal muscles of the body and extending completely round the body.

The common genital aperture leads into the vestibulum which forms an oblique, upwardly directed, annular outbulging; consequently there is formed in the cavity a downwardly directed, conical process surrounded by the said outbulging. The cavity is lined with a single epithelium, beneath which is a muscular coating composed of circular and longitudinal fibres.

Numerous small testes, each made up of sperm-mother-cells and spermatozoa in several stages of development, are arranged in

two lateral zones, which extend from somewhat behind the ovary to the insertion of the pharynx. The vasa deferentia, proceeding straight backwards, make an abrupt forward bend at the sides of the penis, to enter the base of the penis and then finally to unite into a common duct just before opening into the lumen of the penis.

In the penis there can be distinguished the bulbous part of muscular nature and the conical intromittent part, lying almost horizontally in the penis-sheath. Enclosed in the latter part is the wide seminal vesicle with an anterior wall which projects into the lumen in folds. The cavity directly opens into the penis-sheath at the tip of the intromittent part, without passing through the ejaculatory duct. Posteriorly the penis-sheath is



Text fig. 3. Copulatory organs of *B. v. nosum* in sagittal section, diagrammatically shown.
gv genital vestibulum.
 Other letters as in text fig. 1.

continuous with the narrow passage which opens into the posterior outbulging of the vestibulum, near the tip of the conical process. Its actual wall is formed by a single layer of columnar cells, beneath which comes a muscular coating.

At a short distance behind the meshwork of the brain is seen the paired ovary which is nearly oval in shape and consists of ova in several stages of development. The oviduct leaves the ovary in the form of a funnel-like widening, which soon assumes the character of a narrow duct, running outside the nerve cords and receiving

in its course the vitelline glands at numerous points. The vitelline glands are represented by branching cellular masses, which are distributed in the interspaces between the diverticulae of the intestine. The mode of their connexion of the glands with the oviduct is effected by means of the short branches of the latter. In the region of the genital opening the oviduct rises upwards and unites with its fellow of the opposite side, to form the glandular organ. The oviduct is lined with a nonciliated epithelium, external to which comes a feeble muscular layer of circular fibres.

The glandular organ, which is supplied with numerous unicellular glands, opens into the posterior outbulging of the vestibulum from above. It shows a definite wall consisting of a single layer of columnar epithelial cells and a thick muscular coating.

6. *Bipalium rufesulvum*, n. sp.

(Pl. I., Fig. 10.—Text fig. 4.)

A single representative of this new species was obtained by Professor WATASE, Dr. HÓZAWA and the late Mr. YASUDA in May, 1911, near Taihoku in Formosa.

The head in the preserved state presents a semi-lunar outline with a recurrent lappet on either side, which curves so far inwards as to meet the sides of the neck. The trunk is almost uniformly broad for the greater part of its length, though it gradually tapers off in the hind parts towards the bluntly pointed posterior extremity. From the base of the head to the posterior body end, in the mid-ventral line, is the sole, forming a slightly raised ridge and not a great deal wider than one-fifth the breadth of the body. The specimen measures about 45 mm. long by 6 mm. broad.

Dorsally, the body, in spirit, is of a uniform dark reddish brown colour, which on the head gets more or less light towards the frontal margin. Ventrally, the colour is nearly similar to that of the dorsal side, except for the surface of the sole which is pale.

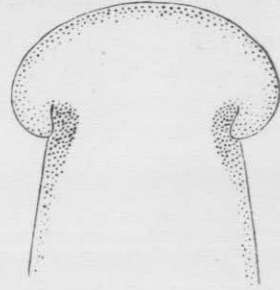
Numerous eye-spots surround the entire fringe of the head and are continued round to the sides of the neck where they are more ventral than dorsal, forming a crowded patch. Further, they

are present sparsely scattered over the whole length of the body, submarginally on the ventral surface.

The mouth-opening is situated near the middle of the body, leading into the peripharyngeal pocket.

The genital organs were not yet developed in the individual examined.

Note:— The present species seems to resemble *Bipalium venosum* previously described as well as *B. giganteum* WHITEHOUSE and *B. claparèdei* VON GRAFF, but may be distinguished from any of them by the differences in the appearance of the head and the colouration of the body.



Text fig. 4. Distribution of eye-spots in *Bipalium ru'eofulvum*, n. sp.

7. *Bipalium ochroleucum*, n. sp.

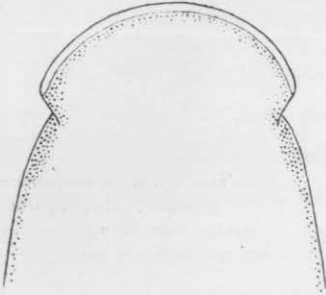
(Pl. I., Fig. 13.—Text figs. 5, 6.)

A single representative of this new species was captured by Mr. YERI in January, 1916, in Nara.

The head in the preserved state presents a very small, semi-lunar shape and is a great deal narrower than the width of the trunk, from which it is only separated by a slight constriction. The trunk, which is nearly oval in cross section, is almost uniformly broad for the most part of its length and gradually tapers in the hind parts to the rounded posterior extremity. Extending from the base of the head to the posterior extremity is the sole, which is raised into a prominent ridge and less than one-fourth the width of the body. The body measures 50 mm. in length and 3.5 mm. in breadth.

The dorsal surface, in spirit, is of a dirty yellowish colour with a fairly thick black stripe which medially extends almost throughout the whole length of the body. On the ventral surface the colour is much paler than on the dorsal, except for the creeping area which is nearly white.

Numerous eye-spots are distributed all round the margin of the head and continued round to the sides of the neck, where they are more ventral than dorsal and form a crowded cluster. Further, the eye-spots are arranged in sparse numbers almost throughout the whole length of the body along the sides.



Text fig. 5. Distribution of eye-spots in *Eipalium ochroleucum*, n. sp.

The mouth-opening is situated between the first and second thirds of the body, leading into the peripharyngeal chamber. The pharynx was protruded through the mouth-opening as a creamy frill.

The common genital aperture occurs at a short distance behind the centre of the body.

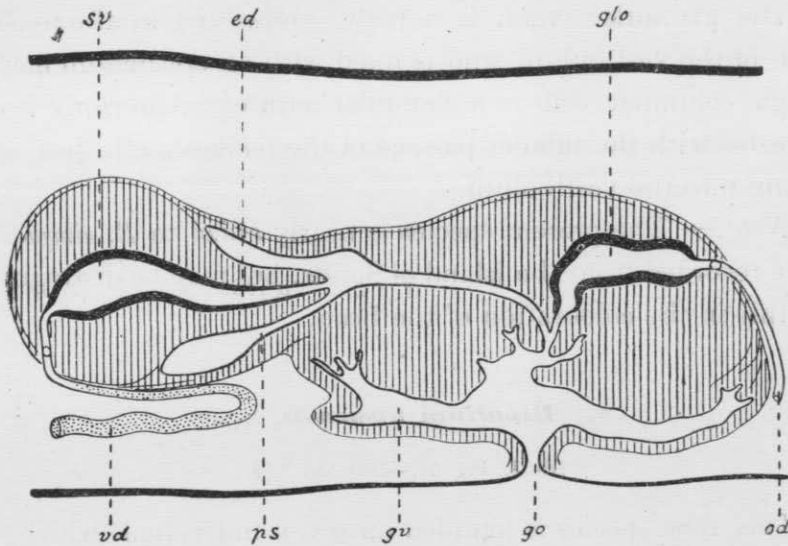
The epidermis consists of a layer of columnar cells, which are of a greater height on the dorsal than on the ventral side. The cilia are present on the surface of the sole only. Situated between these cells, except for the surface of the sole, are spindle-shaped rhabdites which are derived from their mother-cells, scattered in the parenchyme deep below the epidermis. In addition to the glands opening to the exterior on the surface of the sole, there are some glands which open in scattered distribution all over the surface of the body.

The superficial muscular system underlying the fine basement membrane is composed of the outer circular and the inner longitudinal layer. The deep muscular system, which consists of longitudinal and circular fibres; is well developed all round in the parenchyme as a thick and continuous sheet. Besides these, there are well-developed dorso-ventral muscles which run between the gut branches.

The mouth-opening is situated near the centre of the peripharyngeal chamber, in which is hanging the plicated pharynx from above. The gut trunks give off numerous lateral branches which are mostly bifurcated.

The common genital opening leads into the wide, annularly outbulged vestibulum which is provided with a wall composed of a ciliated epithelium and a muscular coating, thickest on the dorsal side.

The vas deferens, filled up with spermatozoa, proceeds backwards and at the sides of the penis makes an abrupt forward bend, to enter the base of the penis and to unite with its fellow of the opposite side into a short common duct which joins the seminal vesicle.



Text fig. 6. Diagrammatic genital organs of *B. ochroleucum* in sagittal section. Index letters as in text figs. 1 and 3.

The penis consists of the spherical bulbous part of muscular nature and the conical intromittent part lying horizontally in its sheath. The bulb encloses a relatively narrow seminal vesicle with its smooth wall, which posteriorly narrows gradually into the ejaculatory duct, opening at the tip of the penis. The penis-sheath opens, through the ciliated tubular passage, at the tip of a small conical and downwardly directed process projecting into the vestibulum.

The vitelline glands are represented by cellular cords with the cells closely packed; they extensively fill up the interspaces between the gut branches and are in connexion with the oviduct at numerous points by means of the short branches. Slightly behind the genital aperture, the oviduct nears the median line, rising upwards at the same time, and finally unites with its mate of the opposite side on the dorsal side of the vestibulum, to form a short common duct which soon communicates with the glandular organ from behind. The oviduct is lined with a ciliated epithelium, external to which comes a muscular layer of circular fibres,

The glandular organ is a body, embedded in the muscular sheath of the vestibulum, and is lined with an epithelium made up of high columnar cells of a glandular nature. Anteriorly it communicates with the tubular passage of the penis-sheath, just before opening into the vestibulum.

Note:— The present species is nearly allied to *B. simplex* von GRAFF recorded from the island of Sunda, but may be distinguished from this in the colouration of the head.

S. *Bipatium kisoensis*, n. sp.

(Pl. I., Fig. 11.—Text figs. 7, 8.)

This new species is founded on seven individuals which were procured by the late Professor IJIMA in 1889 in Kiso.

The head in the preserved state presents a small semi-lunar shape and is less than the width of the trunk, from which it is only marked off by a neck-like constriction. The trunk is nearly oval in cross section and has the lateral margins even and nearly parallel for a large part of the body-length, but is tapering in the hind parts to the rounded hind end of the body. The ventral surface is made up of a slightly raised sole, extending almost throughout the entire length of the body and rather less than one-third the breadth of the body. Well-grown specimens measure 30–35 mm. in length and 5 mm. in breadth.

The dorsal surface, in spirit, is of a dark colour with a touch of olive-like brown and marked with a black median stripe, extending over almost the whole length of the body. Ventrally, the colour is nearly similar to that of the dorsal surface, except for the surface of the sole which is nearly white.

The eye-spots are thickly set along all the margin of the head and also occur sparsely scattered over the whole length of the body. At the sides of the neck they are somewhat closely packed.

The mouth-opening which leads into the peripharyngeal chamber lies slightly behind the middle of the body. In some preserved specimens examined the pharynx was protruded through the mouth-opening as a frill.

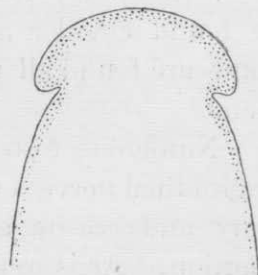
The common genital aperture is placed slightly in front of the middle of the distance between the mouth-opening and the posterior end of the body.

The epidermis is somewhat thicker on the dorsal surface than on the ventral and full of minute spindle-shaped rhabdites, evidently situated between the epidermic cells, except on the sole-surface. Deep below the epidermis, in the parenchyme, are found the rhabdites enclosed in their mother-cells. Numerous glands, deeply situated in the median plane of the body, make their way to the surface of the sole.

The superficial muscular system consists of the outer circular and the inner longitudinal layer. Separated from this by a zone of tissue is the deep muscular system which is composed of two sets of fibres, longitudinal and circular, these two sets occurring intermingled in the same sheet.

The mouth-opening lies near the centre of the peripharyngeal pocket with the plicated pharynx. The gut trunks are provided with numerous subdivided lateral branches, which consist, as usual, of high columnar cells.

In the region of the head the nervous system forms a mesh-work which passes behind into two longitudinal nerve cords, con-



Text fig. 7. Distribution of eye-spots in *Bipalium kisoensis*, n. sp.

nected in their course by numerous transverse commissures and giving off numerous lateral branches towards the marginal nerve plexus.

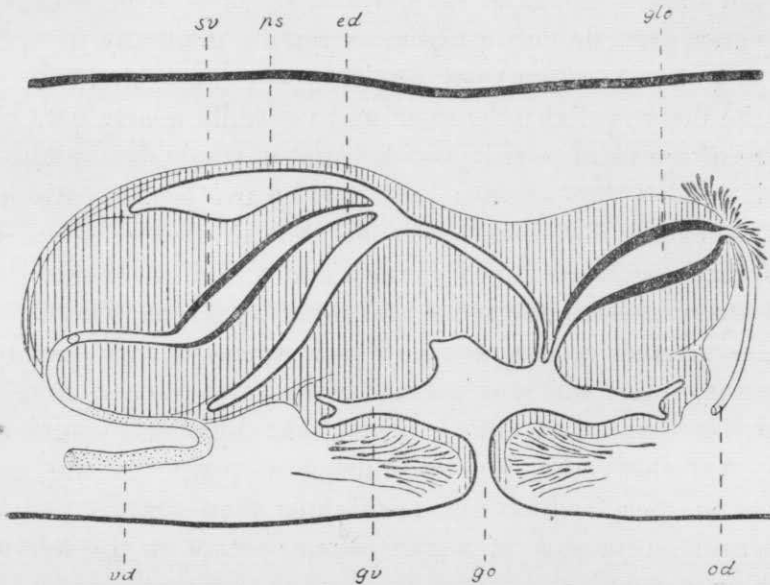
The copulatory organs are constructed in similar manner to those in *Bipalium ochroleucum* previously described, and embedded in the muscular sheath. The common genital opening leads into the wide vestibulum of an irregular contour, which receives the openings of the penis-sheath and the glandular organ from above. The vestibulum is lined with a single epithelium, beneath which are found circular and longitudinal muscular layers. Numerous glands are found all round the genital aperture, into which they open.

Numerous testes are arranged in a single row just outside the longitudinal nerve cords, beginning from some distance behind the ovary and ceasing altogether to exist at the level of the pharynx-insertion. As is well known, each testis is made up of sperm-mother-cells and spermatozoa in all stages of development. The vasa deferentia, which are filled with spermatozoa, pursue a backwardly directed, sinuous course along the outer side of the nerve cords, and at the sides of the penis make an abrupt turn upwards and forwards. After entering the penis-bulb, they fuse together to form a common duct which opens into the seminal vesicle.

The penis is composed of the bulbous basal part of strongly muscular nature and the free conical intromittent part, being almost horizontally disposed in the penis-sheath. The latter part encloses a relatively narrow seminal vesicle lined with a layer of high columnar cells of a glandular nature. The vesicle passes behind into the ejaculatory duct, opening into the penis-sheath at the tip of the penis. The sheath communicates with the vestibulum through the narrow passage.

The paired ovary, ventral in position, is situated at a short distance behind the meshwork of the brain, and at the posterolateral aspect gives rise to the oviduct in the form of a funnel-like widening which soon passes into the narrow duct, proceeding backwards just above the nerve cords and receiving the vitelline glands at numerous points. The vitelline glands are represented

by branching cellular masses, extensively filling up the interspaces between the branches of the intestine. Behind the genital opening the oviducts bend inwards, rising upwards at the same time, and finally enter, each separately, the glandular organ at the posterior end. The wall of the oviduct is, as usual, composed of a ciliated epithelium and a thin muscular layer.



Text fig. 8. Copulatory organs of *B. kisoensis* in sagittal section, diagrammatically shown.

Index letters as in text figs. 1 and 3.

The glandular organ, embedded in the muscular sheath, presents a fairly wide lumen lined with a thick ciliated epithelium of a glandular nature, and opens in front into the vestibulum close to the opening of the penis-sheath. At the opening point of the oviducts the organ is supplied with numerous glands.

9. *Bipalium fuscolineatum*, n. sp.

(Pl. I., Figs. 4, 5.—Text fig. 9.)

A few representatives of this new species were caught by the late Professor IJIMA in July, 1886, on the stone wall or under stones in Nikko.

According to the late Professor IJIMA's notes and sketches taken when the worms were living, the head, which was dorso-ventrally depressed, was semi-lunar or oval in shape, a great deal wider than the trunk, and marked off from the trunk by a neck-like narrowing. In the creeping state the frontal margin of the head gave rise to numerous serrated processes. The trunk in the preserved state is elongate, slender and of a uniform breadth for the greater part, though it tapers extremely gradually in the hind parts, to end with a blunt point at the posterior extremity. Dorsally, the body is slightly convex and ventrally nearly flat. From the base of the head to the posterior end of the body, in the mid-ventral line, is the slender sole, forming a prominently raised ridge, rather less than one-fourth the breadth of the body. Large worms may reach 50 mm. in length and 3 mm. in breadth, while one of the smallest measured 9 mm. long by 2 mm. broad.

The ground colour of the dorsal surface is very dark mixed with a slight olive tint and marked with a fine black mid-longitudinal line, extending almost throughout the whole length of the body. Anteriorly the line loses itself gradually in the general colour of the head, which is much lighter than that of the body. The ventral surface is of a gray colour, except on the sole where the colour is pale.

The eye-spots thickly surround the entire fringe of the head, continuing sparsely along the sides of the body. At the sides of the neck they form, as usual, a crowded cluster.

The mouth-opening which leads into the peripharyngeal chamber lies somewhat behind the middle of the body on the sole.

The common genital aperture is placed at the hind end of the first third of the distance between the mouth-opening and the posterior extremity of the body.

The epidermis consists of a single layer of columnar cells resting upon a fine basement membrane and contains numerous spindle-shaped rhabdites, evidently situated between the cells. The rhabdites enclosed in the subcutaneous cells occur in wide distribution over various parts of the body. In addition to the glands opening on the surface of the sole, there are some glands

which open in scattered distribution over the surface of the body.

The superficial muscular system consists of the outer circular and the inner longitudinal layer. The deep muscular system, which is composed of longitudinal and circular fibres, is well developed all round in the parenchyme as a thick and continuous sheet.

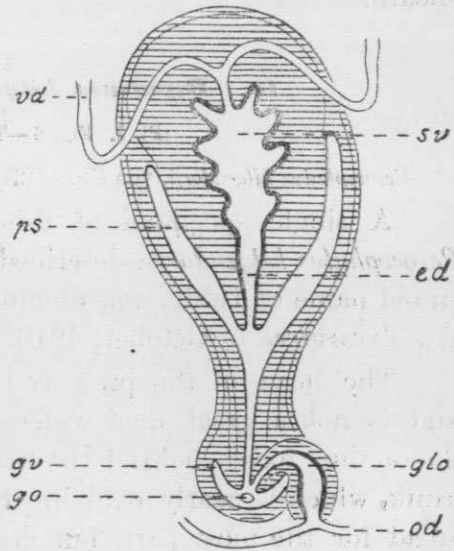
The mouth-opening lies near the centre of the peripharyngeal chamber, in which is laid the pharynx plicated. The gut trunks give off a large number of lateral branches, the walls of which are composed of single epithelium of high cylindrical cells.

The cerebral-nervous system exhibits an appearance of mesh-work which gives rise behind to two longitudinal nerve cords, connected throughout by very numerous transverse commissures and laterally giving off numerous nerves towards the nerve plexus.

The common genital opening leads into the vestibulum which makes an oblique, upwardly directed, annular outbulging; consequently there is formed in the cavity a small conical and downwardly directed process surrounded by the said outbulging.

Numerous testes are arranged in a single row just along the lateral side of the longitudinal nerve cords, extending from behind the ovary to about the level of the mouth. The vasa deferentia, proceeding straight backwards, turn abruptly upwards and forwards to enter the bulbous part of the penis, and unite into a short common duct, which soon opens into the seminal vesicle.

The penis consists of the small semi-spherical bulbous part of



Text fig. 9. Diagrammatic representation of the genital organs of *Bipalium fuscolineatum*, n. sp., as seen from the dorsal side.

Index letters as in text figs. 1 and 3.

muscular nature and the free, conical intromittent part lying almost horizontally in its sheath, which communicates with the vestibulum, through a narrow ciliated passage, at the tip of the conical process. Enclosed in the penis is the seminal vesicle, which is provided with a folded wall and continuous posteriorly with the ejaculatory duct, opening into the penis-sheath at the tip of the penis.

The paired ovary is situated somewhat behind the cerebral meshwork and gives rise to the oviduct on each side, which receives the vitelline glands at numerous points. Behind the genital aperture the oviduct bends mediad, at the same time rising upwards, to unite with its fellow of the opposite side into a fairly wide-common canal, the glandular organ, which gradually narrows and opens into the vestibulum close behind the opening of the penis-sheath.

10. *Bipalium hilgendorfi* (VON GRAFF).

(Pl. I, Fig. 6.—Text figs. 10, 11.)

Perocephalus hilgendorfi, VON GRAFF (25), p. 415.

A single specimen of this species, which I identify with *Perocephalus hilgendorfi*, described by von GRAFF from "Yeddo", an old name of Tokio, was obtained by Mr. KINOSHITA and the late Mr. TAKESHITA in October, 1916, at Takao near Tokyo.

The head in the preserved state presents a semi-lunar shape and is not a great deal wider than the breadth of the trunk. There thus exists behind the head a neck-like constriction. The trunk, which is nearly oval in cross section, is almost uniformly broad for the most part, but gradually tapering in the hind parts to the bluntly pointed extremity. From the neck to the extreme posterior is the sole, which forms a prominently raised ridge, about one-third the width of the body. The worm in the fully extended state measures 70 mm. in length and 2.5 mm. in breadth.

The dorsal surface is of a uniform umber brown colour with a fine black line which extends almost throughout the whole length of the body along the median line. Anteriorly the line merges

into the ground colour of the head, which is much darker than the rest of the dorsal surface. The ventral surface is much lighter than the dorsal, except on the sole, where the colour is nearly white.

The eye-sopts are arranged in one or two rows along the margin of the head, except on the lappets, where they occur in loosely scattered distribution. In addition there are present the eye-spots around the body, at the sides of the neck they are especially dense, extending over more ventral than dorsal.

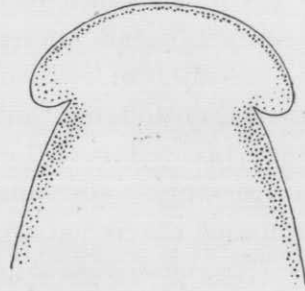
The mouth-opening lies somewhat behind the centre of the body, opening into the peripharyngeal chamber. In the preserved specimen the pharynx was protruded through the mouth-opening as a frill.

The common genital aperture is situated at the commencement of the second third of the distance between the mouth-opening and the hind end of the body.

The epidermis consists of a layer of columnar cells, which are a great deal higher on the dorsal than on the ventral side. The cilia are present on the surface of the sole only. Evidently wedged in between the cells, except on the sole, are spindle-shaped rhabdites, which arise from their mother-cells, embedded in the parenchyme below the superficial muscular system. Numerous glands, deeply situated in the body along the median line, make their way to the surface of the sole.

Directly below the fine basement membrane is the superficial muscular system composed of two layers, outer circular and inner longitudinal. The deep muscular system, separated from the superficial by a zone of tissue, forms a thick and continuous sheet, and consist of two distinct sets of fibres, longitudinal and circular, which occur intermingled in the same sheet, without being arranged in definite layers. The longitudinal fibres are more strongly developed than the circular.

The mouth-opening is situated near the centre of the peri-



Text fig. 10. Distribution of eye-spots in *Bipalium hilgendorfi* (von GRAFF).

pharyngeal chamber, in which is disposed the plicated pharynx. The gut trunks are provided with numerous bifurcated branches, the epithelium of which is made up, as usual, of higher columnar cells.

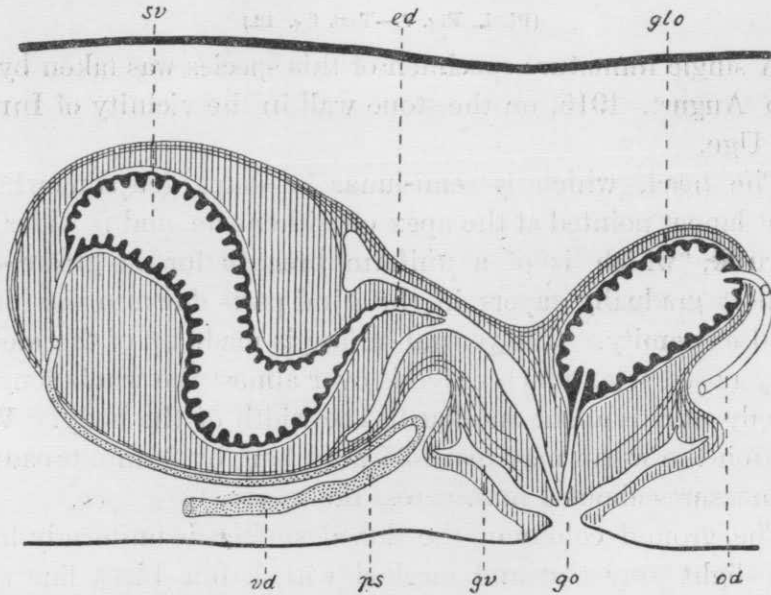
The structure of the genital apparatus is in accord with that described by von GRAFF. The common genital opening leads into the vestibulum, which forms a wide, annular, oblique, upwardly directed outbulging, and which receives the openings of the penis-sheath as well as of the glandular organ. The vestibulum is lined with a single epithelium, beneath which is a muscular coating composed of circular and longitudinal fibres.

Numerous testes are arranged on either side of the anterior gut trunk, extending from behind the ovary to the insertion of the pharynx. The vasa deferentia, proceeding backwards just along the upper side of the longitudinal nerve cords, turn abruptly round at the sides of the penis and then pursue a directly opposite course, to enter the penis-bulb at its anterior end. Within the bulbous part they unite into a common duct before opening into the seminal vesicle. The vas deferens, which is filled with spermatozoa, shows a definite wall consisting of a thin epithelium and a feeble muscular layer of circular fibres.

The penis is composed of the spherical bulbous part of muscular nature and the small, conical intromittent part which is nearly horizontally disposed in the penis-sheath. Enclosed in the former part is a wide cavity, the seminal vesicle, which is lined with an epithelium of a glandular nature, projecting to a considerable extent into its lumen in folds. Posteriorly the vesicle is continuous with the ejaculatory duct which opens into the penis-sheath at the tip of the penis. Externally the penis is covered with a thin epithelium. The muscular fibres of which the penis is composed are arranged in two principal sets, circular and longitudinal, the fibres of the two sets occurring intermingled with one another.

The penis-sheath leads into the vestibulum, through the tubular passage which is richly ciliated. The wall of the sheath consists of a non-ciliated epithelium and a thick muscular coating, much as observed in the vestibulum.

The paired ovary, situated behind the brain, gives rise to the oviduct on each side, which proceeds backwards just outside the longitudinal nerve cord receiving the vitelline glands at numerous points. The vitelline glands are represented by branching cellular



Text fig. 11. Genital organs of *B. hilgendorfi* in sagittal section, diagrammatically shown. Index letters as in text figs. 1 and 3.

cords, extensively distributed in the interstices between the gut diverticulae. Behind the genital opening the oviduct, supplied with numerous unicellular glands, nears the median line, rising obliquely upwards at the same time, and finally unites with its fellow of the opposite side, to form a short common duct, which soon enters the glandular organ at the posterior end. The duct shows a distinct lumen throughout its entire length. Its direct wall is formed by a richly ciliated epithelium, outside which is a muscular layer of circular fibres.

The glandular organ, situated dorsal to the vestibulum, is an oblong muscular organ, which anteriorly communicates with the vestibulum, through the ciliated narrow passage, at a point close to the opening of the penis-sheath. It is internally lined with a

ciliated epithelium of a glandular nature, which is thrown into many folds, projecting into its lumen. The formation of the cocoon takes place in this organ, as mentioned by VON GRAFF.

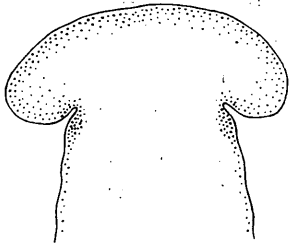
11. *Bipalium fuscocephalum*, n. sp.

(Pl. I, Fig. 7.—Text fig. 12.)

A single immature specimen of this species was taken by myself in August, 1915, on the stone wall in the vicinity of Innai in Prov. Ugo.

The head, which is semi-lunar in shape, has somewhat recurrent lappet pointed at the apex on either side, and is wider than the trunk, which is of a uniform breadth for the greater part, though it gradually tapers in the hind parts down to the bluntly pointed extremity. The ventral surface is made up of the median, slightly raised sole, which extends over almost the whole length of the body and is about one-fourth the width of the body. When in motion the worm may reach 35 mm. long by 3 mm. broad; the head measures about 4 mm. across the apices.

The ground colour of the dorsal surface is uniformly brown with a slight gray tint and marked with a fine black line which medially extends over nearly the entire length of the body. Anteriorly the line merges into the ground colour of the head, which is of a brownish black colour. The ventral surface is much lighter than the dorsal, except for the surface of the sole, which is somewhat paler.



Text fig. 12. Distribution of eye-spots in *Bipalium fuscocephalum*, n. sp.

The eye-spots are exceedingly numerous, and occur, not only surrounding the entire fringe of the head and lobes, but also continuing sparsely for a considerable distance along the sides of the body. At the sides of the neck, they are somewhat more ventral than dorsal, forming a crowded cluster.

The mouth-opening lies slightly behind the middle of the body, leading into the peripharyngeal cavity.

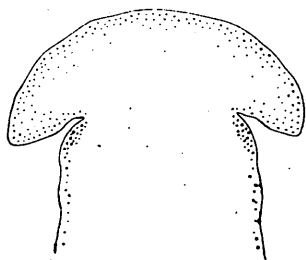
12. *Bipalium monolineatum*, n. sp.

(Pl. I., Fig. 14.—Text figs. 13, 14.)

This new species is represented by two specimens which were captured by me in July, 1916, on the stone wall of Chionin, a Buddhist temple, in Kyoto, and also at Mt. Hiyei. According to the late Professor IJIMA's notes he also obtained a specimen referable to this species in the former situation.

The head presents a semi-lunar shape and is more or less wider than the width of the trunk, from which it is distinctly separated by a neck-like constriction. The frontal margin of the head in the creeping state gives rise to numerous serrated processes. In the hind parts the sides of the trunk converge backwards to a pointed extremity. The ventral surface is marked with the slightly raised sole, which is rather less than one-third the width of the body and extends almost throughout the entire length of the body. When fully extended the body measures 35 mm. long by 2 mm. broad and the head may reach twice the width of the body, across the apices.

The colour of the dorsal surface is brownish orange mixed with a dark tone, leaving a light coloured, median zone which extends over almost the entire length of the body. Along the mid-dorsal line runs a fine black stripe from the head to the posterior extremity. Anteriorly the stripe merges into the general colour of the head, which is much darker than the rest of the dorsal surface. Ventrally, the colour is similar to that of the dorsal side, though usually paler; the surface of the sole is pale yellow, and on each side of it is a diffused black line.



Text fig. 13. Distribution of eye-spots in *Bipalium monolineatum*, n. sp.

The eye-spots are numerous and extend all round the head to the sides of the neck, where they are densely set. Further, the eye-spots are present sparingly scattered over the entire length of the body along the sides.

The mouth-opening which leads into the peripharyngeal chamber is situated near the centre of the body.

The genital aperture is placed at the hind end of the second third of the distance between the mouth-opening and the posterior end of the body.

The epidermis is composed of a layer of columnar cells, which are very much higher on the dorsal than on the ventral side. The cilia are confined to the surface of the sole only. Evidently situated between the cells are minute rhabdites which take place in the subcutaneous cells. Besides the glands opening medially on the surface of the sole, there are some unicellular glands which open in scattered distribution all over the surface of the body.

Directly below the basement membrane comes a muscular system which consists, as usual, of the outer circular and the inner longitudinal layer. Deep below these layers, in the parenchyme, is a thick and continuous sheet composed of two distinct sets of fibres, longitudinal and circular, which occur intermingled in the same sheet. In addition to these are found the dorso-ventral muscles which run between the gut diverticulae.

The mouth-opening is situated in the middle of the peripharyngeal pocket, from the dorsal wall of which arises the plicated pharynx. The intestinal trunks are provided with numerous branches which are sometimes bifurcated and sometimes trifurcated. Their walls are a single epithelium made up of high cylindrical cells which are placed very closely together and contain numerous coarse, highly-refractive granules in the finely granular protoplasm.

The brain has the appearance of meshwork, widely spread at the anterior end of the body. Posteriorly from the meshwork spring two longitudinal nerve cords which proceed backwards, running nearly parallel to each other, to the hind end of the body, and are connected by numerous transverse commissures. Laterally they give off numerous branches.

The eye consists simply of a pigment cup, filled with a cellular substance, which is a faintly staining, very slightly granular body and very little differentiated from the general cell-contents.

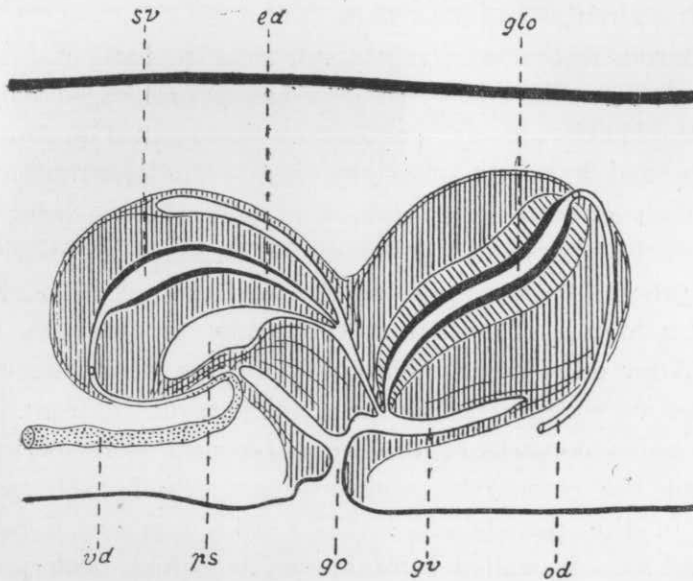
The common genital opening leads into the vestibulum which receives the openings of the penis-sheath and the glandular organ. The actual wall of the vestibulum is an epithelium made up of ciliated columnar cells, beneath which are a muscular coating composed of circular and longitudinal fibres.

Numerous testes, each nearly spherical in shape and made up of sperm-mother-cells and spermatozoa in several stages of development, are placed closely together in the ventral portion of the body, arranged in a single row just outside the longitudinal nerve-cords, which extend from somewhat behind the ovary to the insertion of the pharynx. The vasa deferentia, filled up with spermatozoa, proceed backwards along the outer side of the nerve cords and form a loop at the sides of the penis, to pursue a forward course. After entering the base of the penis, they unite into a single duct which joins the seminal vesicle from the front.

The penis consists of the semi-spherical bulb of muscular nature and the conical intromittent part which is horizontally disposed in the penis-sheath. The bulb contains a relatively narrow and smooth-walled seminal vesicle, which posteriorly narrows gradually into the ejaculatory duct, opening into the penis-sheath at the tip of the penis. The penis-sheath communicates with the vestibulum through the ciliated tubular passage.

The ovaries are nearly oval in shape and are present in a pair somewhat behind the brain, one on the lateral side of the nerve-cord. From the inner lateral aspect of the ovary starts the oviduct as an ampullaceous passage, which soon assumes the character of a narrow tube, proceeding straight backwards just along the inner side of the vas deferens and receiving the vitelline glands at several points of its course. The vitelline glands are represented by irregularly ramified, cellular cords, extensively distributed in the interstices between the gut branches. The mode of their connexion with the oviduct is effected by means of the short branches of the latter, which are situated at fairly regular intervals. Behind the common genital aperture the oviduct, supplied with numerous unicellular glands, bends inwards, at the same time rising upwards, to fuse with its fellow of the opposite side into a very short.

common duct, which soon joins the glandular organ from behind. The wall of the oviduct is composed of a ciliated epithelium and a muscular layer of circular fibres.



Text fig. 14. Reproductive organs of *B. monolineatum* in sagittal section, diagrammatically shown.

Index letters as in text figs. 1 and 3.

The glandular organ, situated dorsal to the vestibulum, is a nearly spherical body with a sheath of parenchyme including numerous muscular fibres, and anteriorly opens into the vestibulum at a point close behind the opening of the penis-sheath. Its direct wall is formed by an unfolded epithelium made up of non-ciliated columnar cells of a glandular nature, which are placed very closely together. Immediately external to the layer mentioned is a fairly thick layer of nearly homogeneous tissue.

Note :—The parasitic nematode has long been known to occur in the bodies of some land planarians. Embedded in the parenchyme of the specimen at present under examination are found a few individuals of a small nematode parasitic, which appear making their way through the body-wall.

13. *Bipalium maculatum* STIMPSON.

Bipalium maculatum, STIMPSON (62) pp. 25, 30—DIESING (16), p. 514.—MOSELEY (45), p. 108 and (46), p. 290.—Loman (40), p. 64.—VON GRAFF (25), p. 446.

This species was first described by STIMPSON from the island of Oshima. No specimen came under my observation.

“Subdepressum; capite auriculis sat brevibus, fronte arcuata. Corpus supra fulvum, maculis nigris confertis, fascia mediana pallida nigro-marginata; auricularum marginibus posterioribus nigris. Ocelli valde numerosi in acervum arcuatum frontalem submarginalem. Long. 3 poll. (76 mm.); corporis lat. 0.2 poll (5 mm.); capitis lat. 0.3 poll. (7.6 mm.)”

The present species seems to be nearly allied to *B. ceres* MOSELEY (45) from Ceylon, as described by von GRAFF.

14. *Bipalium trifuscostriatum*, n. sp.

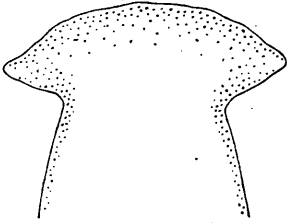
(Pl. I., Fig. 15.—Text fig. 15.)

This new species is represented by two individuals, one of which was secured by the late Professor IJIMA in 1890 at Sakata, Prov. Ohmi, and the other by myself in July, 1916, on the stone wall of the Mii Temple in Ôtsu.

The head in the living state is of a semi-lunar shape and a great deal wider than the trunk, from which it is distinctly marked off by a neck-like narrowing. The trunk is almost uniformly broad in the greater part of its length, but gradually tapering in the hind parts down to the bluntly pointed posterior extremity. Extending from the neck to the hind end of the body, in the mid-ventral surface, is the sole, which is scarcely raised above the general level and rather less than one-third the width of the trunk. The specimen is 50 mm. long, the greatest breadth, at about the middle of the trunk, is 2 mm., and the head measures 6 mm. across.

The ground colour of the dorsal surface is a bluish gray with a touch of black. Medially are three black stripes which run throughout the whole length of the body. Of those the median stripe extends over the head and loses itself gradually in the

general colour of the head, which is characterized by a touch of brown colour. The ventral surface is similar in colouring to the dorsal, but the surface of the sole is more or less pale than the rest of the ventral surface.



Text fig. 15. Distribution of eye-spots in *Bipalium trifuscostratum*, n. sp.

Except on the apex of the lappets the eye-spots are distributed all round the margin of the head, where they are exceedingly numerous, and also sparingly present over the entire length of the body to the posterior extremity.

The mouth-opening which leads into the peripharyngeal chamber is situated at nearly the centre of the body.

The genital aperture is placed at a distance behind the mouth-opening equal to about one-third that between the latter and the posterior end of the body.

The epidermis is much thicker on the dorsal side than on the ventral and contains numerous spindle-like rhabdites, evidently wedged in between the epidermic cells. Numerous glands, embedded in the parenchyme along the median plane of the body, open out on the surface of the sole.

The superficial muscular system is composed of the external circular and the internal longitudinal layer. Separated from this by a zone of tissue the deep muscular system is found, forming a thick and continuous sheet which consists of two sets of fibres, longitudinal and circular, occurring intermingled in the same mass.

The mouth-opening lies near the centre of the peripharyngeal pocket with the plicated pharynx. The gut trunks are provided with numerous subdivided lateral branches, which are lined with an epithelium of high cylindrical cells, each full of coarse, highly refractive granules.

The genital organs were, unfortunately, not yet well developed in the specimen examined. The genital opening leads into the tubular atrium, which divides into two parts, anterior and posterior. The former passes into a vesicle, the penis-sheath, which is wholly devoid of any intromittent part of the penis. The muscular fibres

of which the penis-bulb is composed are found occurring intermingled with one another. The latter leads into a muscular-walled blind vesicle, doubtless representing the glandular organ.

15. *Bipalium trilineatum* STIMPSON.

(Pl. I., Fig. 16.—Text fig. 16.)

Bipalium trilineatum, STIMPSON (62) pp. 25, 31.—DIESING (16) p. 516.—MOSELEY (45), p. 108 and (46), p. 290.—LOMAN (40), p. 64.—VON GRAFF (25), p. 443.

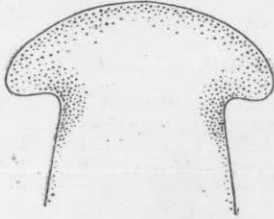
Two specimens, which I identify with STIMPSON'S *Bipalium trilineatum*, described by that author from Hokkaido, were collected by the late Professor IJIMA, 1889, at the foot of Mt. Hanaoka, near Kumamoto, in Prov. Higo.

This worm is possessed of a broadly spread semi-lunar head, which presents somewhat recurrent lobes and is distinctly separated from the trunk by a neck-like narrowing. The trunk gradually widens backwards to the pharyngeal region and then begins to taper gradually, to end with a point at the posterior end of the body. The dorsal surface is slightly convex and the ventral nearly flat; the sole forms a slightly raised ridge, rather less than one-fifth the width of the body, and extending from the base of the head to the posterior extremity. The large specimen was 54 mm. long by 4 mm. broad, at the pharyngeal region, while the small was 39 mm. long by 3 mm. broad; the head in both measured 5 mm. across.

The dorsal surface in the living state is of a dirty yellowish orange colour with three well-defined black stripes, which extend almost throughout the whole length of the body. The median stripe extends to a point on the head and loses itself gradually in the general colour of the head, which is much lighter than that of the trunk. Ventrally, the colour is similar to that of the dorsal side, though usually paler, except for the surface of the sole which is nearly white.

Exceedingly numerous eye-spots surround almost the entire fringe of the head and lappets, and are continued round to the sides of the neck where they are more ventral than dorsal and form a

dense cluster. Besides this, the eye-spots occur sparingly scattered over almost the whole length of the body, on the ventral side along and just within the margin of the body; there existing two or three eye-spots in width.



Text fig. 16. Distribution of eye-spots in *Bipalium trilineatum* STIMPSON.

The mouth-opening which leads into the peripharyngeal pocket is situated near the middle of the body, in the mid-ventral line.

In the specimens examined the genital organs were not yet developed at all.

Genus *Placocephalus* VON GRAFF.

16. *Placocephalus fuscatus* (STIMPSON).

(Pl. I., Figs. 8, 9.—Text figs. 17–19.)

Bipalium fuscatum, STIMPSON (62), pp. 25, 31.—DIESING (16), p. 515.—MOSELEY (45), p. 108 and (46), p. 290.—LOMAN (40), p. 64.

Placocephalus fuscatus, VON GRAFF (24), p. 121 and (25), pp. 461, 462.

This species, known as occurring in the Indo-Malay Archipelago, is exceedingly common in Japanese territories. Numerous specimens came under my observation.

The head in the preserved state is much depressed dorso-ventrally, of a semi-lunar shape with a round prominent lappet on either side, and only a little wider than the trunk, from which it is distinctly separated by a neck-like constriction. The fronta margin of the head in the creeping state gives rise to numerous serrated processes. The greater part of the trunk is of similar breadth, though it gradually tapers in the hind parts down to the bluntly pointed posterior extremity. The dorsal surface is slightly convex and the ventral nearly flat, but forming a slightly raised, median ridge almost throughout the whole length of the body. Large worms may reach 12 cm. in length and about 4 mm. in

breadth, while one of the smallest measured only 13 mm. long by 1.5 mm. broad.

The dorsal surface is of a uniform velvety black, except on the head, which reveals a dark rusty brownish tone. Ventrally, the colour is somewhat paler than that of the dorsal side, except for the surface of the sole which is, as usual, of a pale gray colour and anteriorly presents nearly the form of an arrow-head by reason of the shade of colour. On either side there exists a longitudinal zone much paler than the rest of the ventral surface.

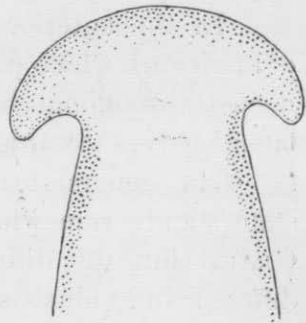
Numerous eye-spots are densely set, surrounding the entire fringe of the head lobe, and are continued round to the sides of the neck, where they are more ventral than dorsal and form a closely crowded cluster. Further, the eye-spots are arranged in sparse numbers almost throughout the whole length of the body, on the ventral side along and just within the margin of the body.

The mouth-opening which leads into the peripharyngeal chamber is placed slightly behind the centre of the body in the mid-ventral line.

The common genital aperture is situated at the hind end of the anterior third between the mouth-opening and the posterior end of the body.

The epidermis made up of columnar cells is much higher on the dorsal surface than on the ventral and provided with cilia on the surface of the sole only. Situated between the epidermic cells, except those that are on the sole-surface, are found minute and slender rhabdites, which originate from their mother-cells, scattered in fair abundance in the parenchyme farther inwards to the epidermis. Deeply embedded in the parenchyme along the median zone of the body are enormous quantities of slime glands which open out on the sole-surface.

Immediately beneath the basement membrane comes the superficial muscular system composed of two layers of outer circular



Text fig. 17. Distribution of eye-spots in *Placocephalus fuscatus* (STIMPSON).

and inner longitudinal fibres. The deep muscular system, separated from this by a zone of tissue, forms a thick layer which consists of two sets of fibres, longitudinal and circular, occurring intermingled without being arranged in a definite layer.

The mouth is a small opening situated near the centre of the peripharyngeal cavity, into which the plicated pharynx is protruded from above. The intestinal trunks give off numerous bifurcated lateral branches. Their direct walls are composed of a single epithelium made up of high cylindrical cells which are placed very closely together.

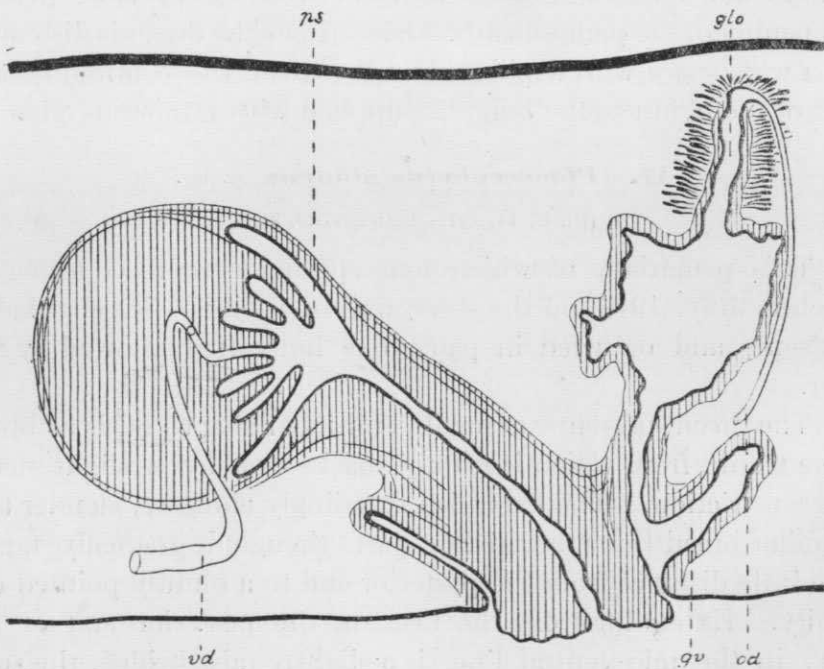
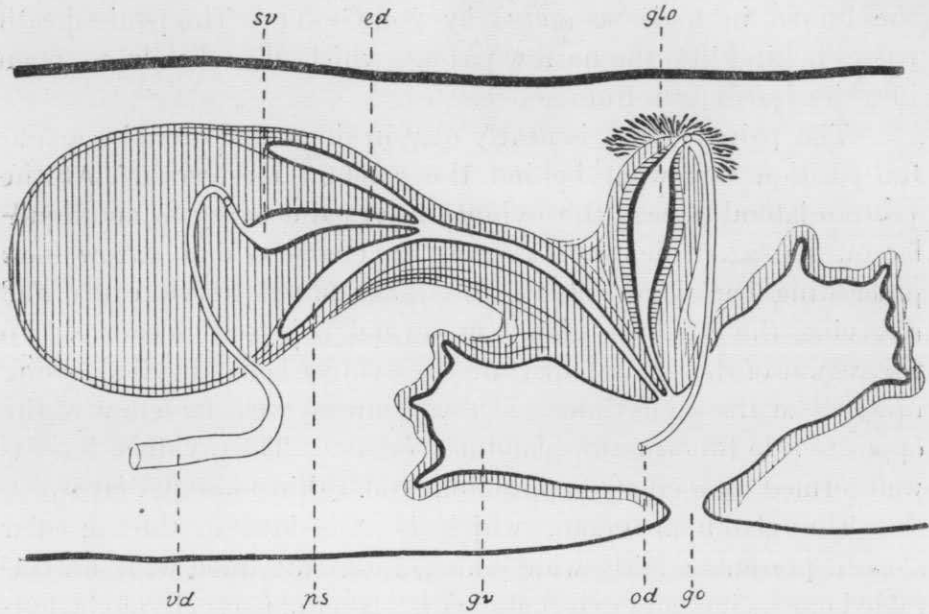
In the anterior region the nervous system presents a feature of meshwork which passes behind into two longitudinal cords, connected throughout by numerous commissures and provided with lateral nerves towards the nerve plexus.

The general feature of the copulatory organs in the normal state stands somewhat at variance from that described by von GRAFF, but the difference may be regarded as depending upon different individuals and the condition of expansion or contraction of the worm. A similar feature to that of von GRAFF I have obtained with an individual, as shown in Text fig. 19.

The genital aperture leads into the widely outbulged vestibulum, which at the bottom is lined with an epithelium made up of high columnar cells. The vestibulum receives the communications of the penis-sheath and the glandular organ.

Numerous testes are ventrally arranged in a row on each side of the body just outside the nerve cords, extending from behind the ovary to the insertion of the pharynx. The vasa deferentia, proceeding backwards, make an abrupt upward bend at the sides of the penis to enter the penis-bulb and to fuse into a common duct which soon communicates with the seminal vesicle.

The penis is divided into two parts, viz., the bulbous basal part of strongly muscular nature and the conical intromittent part lying almost horizontally in the penis-sheath. Enclosed in the latter part is a relatively narrow, smooth-walled seminal vesicle, which narrows behind into the ejaculatory duct, terminating at the tip of the penis. In one case the wall of the vesicle projects into



Text figs. 18 and 19. Sagittal sections of the copulatory organs of *Plac. fuscatus*, diagrammatically shown.

Index letters as in text figs. 1 and 8.

the lumen in folds, as stated by von GRAFF. The penis-sheath passes behind into the narrow passage which dips below to open into the vestibulum from above.

The paired ovary is nearly oval in shape and occupies a ventral position somewhat behind the cerebral meshwork. At the postero-lateral aspect the oviduct leaves the ovary as an ampullaceous passage which soon assumes the character of a narrow duct, proceeding backwards above the longitudinal nerve cords and receiving the vitelline glands at several points of its course. In the region of the genital aperture the oviduct bends mediad, rising upwards at the same time, and finally unites with its fellow of the opposite side to form the glandular organ. The oviduct has its wall formed by a ciliated epithelium and a thin muscular layer.

The glandular organ, which is embedded in the muscular sheath, presents a fairly wide lumen, internally lined with an unfolded epithelium and externally with a layer of parenchyme including muscular fibres, and opens into the vestibulum close behind the opening of the penis-sheath. Sometimes the organ is distended into a wide space with a plicated wall. Near the communicating point of the oviducts the organ is supplied with numerous glands.

17. *Placocephalus glaucus*, n. sp.

(Pl. I, Fig. 17.—Text figs. 20, 21.)

This planarian, of which four specimens were collected by myself in July, 1916, on the stone wall in Yoshino, is remarkably handsome and occurred in pairs, one individual followed by the other.

The head presents a small semi-lunar shape and is as broad as the trunk, from which it is only marked off by a slight neck-like constriction. The trunk is exceedingly elongate, slender and of similar breadth for the greater part, though it gradually tapers some little distance from the posterior end to a bluntly pointed extremity. Extending from the neck to the posterior end of the body, in the mid-ventral line, is a slightly raised ridge, the sole, rather less than one-third the breadth of the body. In length they range from 120 mm. to 200 mm., measuring 3.5–4 mm. in breadth.

The worm has, dorsally, a uniform deep green colour, except on the head, where the colour is grayish brown. The ventral surface is of a much lighter colour than the dorsal, except for the surface of the sole which is pale.

The eye-spots are arranged in one or two rows all round the margin of the head and continue sparingly for a considerable distance along the sides of the body. At the sides of the neck they are somewhat closely packed.

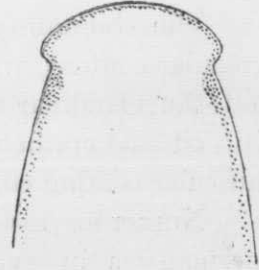
The mouth-opening is placed at about the hind end of the first third of the length of the body, leading into the peripharyngeal chamber.

The common genital aperture is situated at a short distance behind the mouth-opening.

The epidermis is made up of a layer of columnar cells which are of a greater height on the dorsal than on the ventral side. The cilia are present on the surface of the sole only. Wedged in between these cells, except on the sole, are numerous rhabdites of a spindle-like shape. Deep below the epidermis, in the parenchyme, exist such rhabdites as are still contained in their mother-cells. Besides the glands, deeply situated in the median line of the body and opening out on the sole-surface, there occur some glands which open in scattered distribution all over the surface of the body.

Directly inwards to the basement membrane is the superficial muscular system composed of the outer circular and the inner longitudinal layer. The deep muscular system is well developed all round in the parenchyme as a thick and continuous sheet, chiefly consisting of longitudinal fibres.

The mouth-opening lies near the middle of the peripharyngeal chamber, in which is disposed the plicated pharynx from above. The gut trunks give off numerous subdivided lateral branches, the epithelium of which shows no noteworthy features, consisting, as it does, of high columnar cells.



Text fig. 20. Distribution of eye-spots in *Placocephalus glaucus*, n. sp.

The nervous system consists, as usual, of two longitudinal cords which anteriorly join the cerebral meshwork. The cords are connected throughout their course by numerous fine transverse commissures. Laterally they send out numerous branches towards the nerve plexus.

The common genital opening leads into the vestibulum of an irregular contour, which receives the openings of the penis-sheath and the glandular organ from behind. The cavity is lined with a thin ciliated epithelium, external to which is a fairly well developed muscular coating composed of circular and longitudinal fibres.

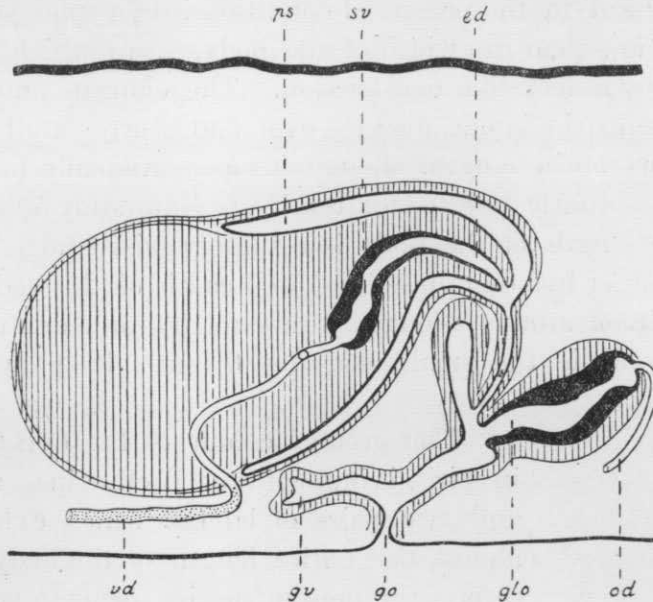
Numerous testes, each consisting of sperm-mother-cells and spermatozoa in several stages of development, occur close together in the ventral position of the body and are arranged in a single row along the outer side of the nerve cords, beginning from somewhat behind the ovary and extending behind to the insertion of the pharynx. The vasa deferentia, filled with spermatozoa, proceed straight backwards, just outside the nerve cords, and turn abruptly forwards and upwards, to enter the penis-bulb at the sides, and finally to unite into a common duct which communicates with the seminal vesicle.

In the penis there can be distinguished the semi-spherical bulbous part of muscular nature and the free conical intromittent part which is nearly horizontally disposed in the penis-sheath. Enclosed in the intromittent part is a relatively narrow seminal vesicle, which is lined with high columnar cells of a glandular nature. Posteriorly the vesicle is continuous with the ejaculatory duct, opening into the penis-sheath at the tip of the penis. The muscular fibres of which the penis is composed are arranged in two sets, circular and longitudinal, the fibres of the two sets occurring intermingled with one another.

The penis-sheath is in communication with the vestibulum through the narrow passage lined with a ciliated epithelium.

At some distance behind the cerebral meshwork is found the paired ovary which is of an oval shape and made up of ova in various stages of development. From its inner lateral aspect the oviduct springs in the form of a funnel-like widening which

soon takes the character of a narrow duct and pursues a backward course just above the nerve cords, receiving the vitelline glands at numerous points. The vitelline glands present an appearance of branching cellular masses, extensively distributed in the interspaces between the gut branches. Behind the common genital aperture the oviduct rises obliquely upwards, to open into the glandular organ from behind, without uniting with its fellow of the opposite side into a common duct. The oviduct shows a distinct lumen in its entire length. Its actual wall is formed by a richly ciliated epithelium, directly below which is a thin muscular layer.



Text fig. 21. Copulatory organs of *Plac. glaucus* in sagittal section. Diagrammatic. Index letters as in text figs. 1 and 3.

The glandular organ is a nearly oblong body with a thick muscular sheath, opening into the vestibulum at a point below the opening of the penis-sheath. The cavity is lined with an epithelium made up of high columnar cells of a glandular nature.

The vestibulum is supplied with an upwardly directed out-bulging, which appears to serve as a seminal receptacle during copulation.

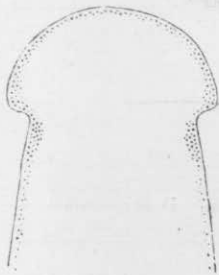
18. *Placocephalus virgatus* (STIMPSON.)

(Pl. I., Fig. 18.—Text fig. 22.)

Bipalium virgatum, STIMPSON (62), pp. 25, 30.—DIESING (16), p. 514.—MOSELEY (45), p. 51 and (46), p. 290.—LOMAN (40), p. 64.—VOL. GRAFF (25), p. 445.

Two specimens of the species, which seems to be identical with STIMPSON'S *Bipalium virgatum*, described by that author from the Loo Choo Islands, were collected by Professor WATASÉ, Dr. HÔZAWA and the late Mr. YASUDA in May, 1911, in the neighbourhood of Taihoku, Formosa.

The head in the preserved condition is of a small semi-lunar shape and less than the width of the body, from which it is only separated by a neck-like constriction. The elongate and slender trunk presents the lateral margins even and nearly parallel for the greater part of its length, though it tapers gradually in the hind parts to the bluntly pointed extremity. Extending over almost the entire length of the body is a slightly raised ridge, the sole, which is rather less than one-fifth the breadth of the body. The large specimen attains a length of about 150 mm. and a breadth of 4 mm., while the small measures 60 mm. long by 3 mm. broad.



Text fig. 22. Distribution of eye-spots in *Placocephalus virgatus* (STIMPSON)

The ground colour of the dorsal surface, in spirit, is buff with five dark stripes, a median and two pairs of lateral, which extend over almost the entire length of the body; in this respect the present species seems to be allied to *Placocephalus kewensis* MOSELEY, so that it may be referable to this species. The median stripe is very fine and loses itself on reaching a point somewhat behind the head. The inner pair are much the strongest of all, and the outer pair at the edge of the body become indistinct as they approach the hind end; on either side both coalesce at the neck into a small dusky patch. The ventral surface is similar in colour to the dorsal, except on the sole which is pale.

The eye-spots are arranged in one or more rows along the entire margin of the head and continue round to the sides of the neck, where they are somewhat closely packed. Besides this, the eye-spots are present sparsely scattered over the whole length of the body to the very tail.

The mouth-opening is placed at about the hind end of the first third of the body, leading into the peripharyngeal cavity.

The genital organs were not yet developed in the specimens examined.

Family Rhynchodemidæ VON GRAFF.

Genus *Rhynchodemus* LEIDY.

19. *Rhynchodemus Ijimai*, n. sp.

(Pl. I., Figs. 19, 20.—Text fig. 23.)

Some specimens representing this new species were obtained by the late Professor IJIMA in July, 1886, on the mossy stone wall under stones in Nikko and its vicinity.

The body in the living state is nearly circular in cross section, slender, and almost uniformly broad for its greater length, though it tapers more gradually to the rounded or somewhat truncated anterior extremity than to the posterior, which is bluntly pointed. On the ventral side of the anterior body-part, indistinctly marked off from the trunk by a gentle constriction, there is a depression, which is shallow but well-defined and is thrown into a series of wavy folds, lying just in front of the anterior termination of the sole and occupying about one-fifth the whole length of the body. Anteriorly and laterally the depression is bordered by a prominent ridge of a horseshoe shape, while posteriorly it gradually merges into the general ventral surface. Extending almost throughout the whole length of the body, from behind the said ventral depression, is the slightly raised sole, rather less than one-fifth the breadth of the body. In length the specimens range from 8 mm. to 14 mm., measuring 1-1.5 mm. in breadth.

The dorsal surface is of a dark olive-like brown colour, with a dark median zone, which medially encloses a light space nearly in

front of the middle of the body. The ventral surface is a somewhat paler shade of the same colour as the dorsal, except for the surface of the sole which is pale.

At a little distance behind the anterior end there are present two eyes, one on each side.

The mouth-opening is situated near the middle of the body, leading into the peripharyngeal chamber, in which is disposed the pharynx of a cylindrical shape.

The common genital aperture occupies a position behind the mouth-opening equal to about one-third the distance between the latter and the posterior end of the body.

The body is coated with a single epidermis made up of columnar cells, which are of a greater height on the dorsal side than on the ventral and possess cilia, but confined to the latter surface only. Situated between these cells, except on the ventral surface, are spindle-shaped rhabdites, which originate from their mother-cells, scattered in the parenchyme below the dermal musculature. On some occasions the rhabdites are seen to be in connexion with their mother-cells. Embedded in the parenchyme are enormous quantities of glands, opening out on the surface of the sole.

The musculature of the body presents no noteworthy features, consisting, as it does, of two systems, superficial and deep, which are rather more strongly developed on the ventral than on the dorsal side, doubtless in relation to the movements. Besides, dorso-ventral muscles occur, running between the intestinal branches.

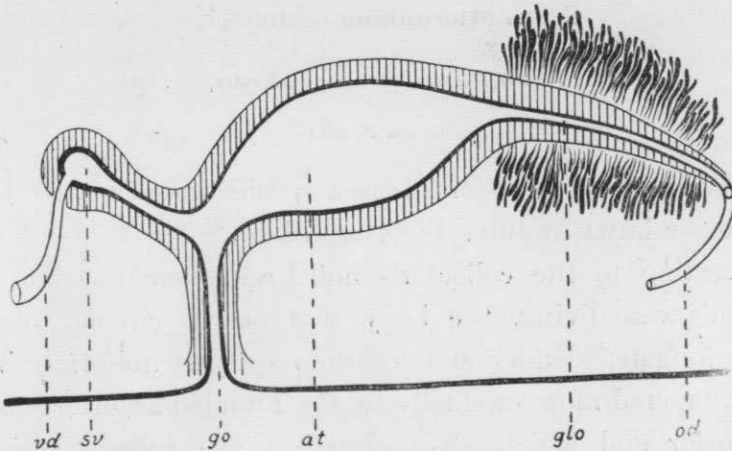
The mouth-opening is placed at about the centre of the peripharyngeal chamber with the pharynx horizontally disposed. The pharynx is a short cylindrical body, terminating conically at the free end. The gut trunks are provided with numerous bifurcated lateral branches, the epithelium of which consists of high cylindrical cells, each full of coarse, highly refractive granules.

The brain is a bilobed organ, situated at the anterior part of the body. Posteriorly each half of the brain-mass gives rise to one of the longitudinal nerve cords, which proceed straight backwards, running parallel to each other. Throughout their entire

course, the cords are connected by very numerous transverse commissures, and laterally give off numerous branches towards the nerve plexus, lying below the superficial muscular system.

The common genital opening leads into the moderately wide atrium with a wall composed of an epithelium of high columnar cells and a muscular coating. Anteriorly the atrium is in communication with the seminal vesicle and posteriorly with the glandular canal.

Numerous testes are ventrally arranged in a single row on each side of the body just outside the nerve cords, beginning from behind the ovary and extending posteriorly nearly to the insertion of the pharynx. The vasa deferentia, filled with spermatozoa, extend backwards to a point in front of the genital opening, where they bend inwards slightly rising upwards at the same time, and finally open, each separately, into the relatively narrow seminal vesicle. The vesicle shows a definite wall consisting of a single epithelium of columnar cells and a muscular coating, passing behind into a tubular passage which soon communicates with the atrium. In the species examined the male organ is wholly devoid of intromittent part of any sort.



Text fig. 23. Sagittal section of the copulatory organs of *Rhynchodemus ijimai*, diagrammatically shown.
at atrium.

Other letters as in text fig. 1.

The paired ovary, which is of a spherical shape, is placed nearly half-way between the anterior end of the body and the pharynx-insertion, one on either side close to the outer side of the longitudinal nerve cord. At the posterior aspect the oviduct leaves the ovary in the form of a funnel-like widening, which soon assumes the character of a narrow duct, proceeding straight backwards. Behind the genital opening it nears the median line, slightly rising at the same time, and finally unites with its fellow of the opposite side to form a common duct, the glandular canal. The direct wall of the oviduct is made up of a ciliated epithelium, beneath which comes a muscular layer. The vitelline glands, made up of closely-packed, large cells, extensively fill up the interspaces between the gut branches. They are in connexion with the oviduct at numerous points.

The glandular canal opens from behind into the atrium, after receiving enormous quantities of unicellular glands. The canal is internally lined with an epithelium of columnar cells and externally with a layer of parenchyme, including muscular fibres, and perforated by the ducts of the glands.

Genus **Microplana** VEJDOSKÝ.

20. ***Microplana ruteocephala***, n. sp.

(Pl. figs. 21-23.)

Three representatives of this new species were captured by the late Professor IJIMA in July, 1886, in Nikko.

According to the collector's notes and sketches taken when the animals were living, the body was nearly circular in cross section, elongate, slender and for the most part uniformly broad, though it tapered more gradually to the rounded anterior than to the posterior end which was pointed. The present species is wholly devoid of sensory grooves as well as of creeping sole. The largest specimen measured 22 mm. in length and 1.5 mm. in breadth, while smallest was 9 mm. long by 0.8 mm. broad.

The ground colour of the dorsal surface is uniformly light black with a slight touch of reddish tint, in front grading over into a red or yellow tone at the tip of the body. Extending over the surface is a fine black median stripe, which loses itself in front. The dark tone is carried to the ventral side with little difference in shade except for the mid-ventral surface which is pale.

The small eyes, which are two in number, occur on either side at the anterior tip of the body.

The mouth-opening is situated near the middle of the body, leading into the peripharyngeal pocket with the cylindrical pharynx.

Key to Species of the Terrestrial Planarians embodied in this Paper.

1. Eyes numerous.
 - A. Without head-lappets
 - a¹. Dark in colour.
 - a². Dorsal surface of a dark olive-like brown colour, marked with a dark median stripe. Two pairs of colourless spots at the lateral sides near the anterior tip of body *Geoplana bimaculata*. p. 2.
 - b². Body pale gray in colour, marked with a dark brown median stripe *Geoplana lapidicola* p. 3.
 - b¹. Light yellow in ground colour.
 - Body marked with a dark median stripe *Artioposthia japonica*. p. 3.
 - B. With head-lappets.
 - a¹. Without longitudinal stripe.
 - a². Head small lunar in shape.
 - Body of a bright orange colour *Perocephalus fulvus*. p. 7.
 - b². Head broad semi-lunar in shape.
 - a³. Ground colour brownish.
 - a⁴. Dorsal surface uniformly of a dark brownish colour *Bipalium venosum*. p. 8.
 - b⁴. Dorsal surface dark reddish brown in colour *Bipalium rufescentum*. p. 12.
 - b³. Ground colour dark.
 - a⁴. Dorsal surface uniformly velvety black *Placocephalus fuscatus*. p. 34.
 - d⁴. Body of a deep green colour *Placocephalus glaucus*. p. 38.
 - b¹. With longitudinal stripe.
 - c². Longitudinal stripe unpaired.
 - c³. With one stripe.
 - e⁴. Head without pattern.
 - a⁵. Ground colour yellow or brown.
 - a⁶. Body of a dirty yellowish colour . *Bipalium ochroleucum*. p. 13.
 - b⁶. Colour brownish orange mixed with a slight dark tone *Bipalium monolineatum*. p. 27.
 - c⁶. Body of a uniform umber brown colour *Bipalium hilgendorfi*. p. 22.
 - b⁵. Ground colour dark.
 - d⁶. Colour black mixed with a slight olive tint *Bipalium fuscolineatum*. p. 19.
 - e⁶. Colour dark with a touch of olive-like brown *Bipalium kisoensis*. p. 16.

- f*³. Head with pattern.
 Body uniformly brown with a slight touch of gray tint
 *Bipalium fuscocephalum*. p. 26.
 - d*³. With three or more stripes.
 - g*⁴. Stripes three.
 - e*⁵. Body of a dirty yellowish orange colour
 *Bipalium trilineatum*. p. 33.
 - e*⁵. Ground colour bluish gray with a touch of black
 *Bipalium trifuscostriatum*. p. 31.
 - h*⁴. Stripes five.
 Dorsal surface buff in colour *Placocephalus virgatus*. p. 42.
 - d*². Longitudinal stripes paired.
 Ground colour brown *Bipalium maculatum*. p. 31.
- II. Eyes two in number.
- A. With a groove on the ventral surface of the anterior body-end.
 Body of a dark olive-like colour with a dark median zone, enclosing a light
 space in front of the middle *Rhynchodemus ijimai*. p. 43.
 - B. Without groove.
 Ground colour uniformly light black with a slight touch of reddish tint, marked
 with a black median line *Micropalana ruteocephala*. p. 46.

List of Literature referred to.

1. BARCLAY, A., 1911. *Bipalium kewense* MOSELLY, a Land Planarian from Buchill, Glasgow. *The Glasgow Naturalist*, Vol. III., No. 4.
2. BEAUCHAMP, P. de, 1912. Planaires terrestres des Broméliacées de Costa-Rica, recueillies par M. C. PICADO. *Arch. Zool. expér. et génér.*, 5. Sér., T. X., No. 1.
3. BEAUCHAMP, P. de, 1913. Planaires des Broméliacées de Costa-Rica, recueillies par M. C. PICADO. *Ibid.*, T. 5, Notes et Revues, No. 2.
4. BENDL, W. E., 1908. Beiträge zur Kenntnis des Genus *Rhynchodemus*. *Zeitschr. f. wiss. Zool.*, Bd. LXXXIX.
5. BENDL, W. E., 1909. Europäische *Rhynchodemiden*. I. *Ibid.*, Bd. XCII.
6. BUCK, E., 1897. Beobachtungen an einer Landplanaie (*Geodesmus bilineatus*?) und deren Züchtung. *Der Zool. Garten*, Jahrg. 38.
7. BÜRGER, O., 1897. Bericht über eine Reise durch Columbien und Venezuela. *Nachr. d. Kgl. Ges. d. Wiss. zu Göttingen Geschäftliche Mittheil.*
8. BUSSON, B., 1903. Über einige Landplanarien. *Sitzungsber. Akad. Wien*, Vol. CXII.
9. CALMAN, W. T., 1902. On the Occurrence of Terrestrial Planarians in Scotland. *Ann. Scot. Nat. Hist.*, Edinburgh, 1902.
10. COCKRELL, T. D. A., 1897. *Bipalium kewense*. *Amer. Naturalist*, Vol. XXXI.
11. CROZIER, W. J., 1918. A Land Planarian found at Bermuda. *Ibid.*, Vol. LII.
12. DENDY, A., 1889. The Anatomy of an Australian Landplanarian. *Trans. Roy. Soc. Victoria*, Vol. I., part 2.
13. DENDY, A., 1896. Note on New Zealand Land Planarians. Part III. *Trans. New Zealand Inst.*, T. XIX.
14. DENDY, A., 1901. Note on New Zealand Land Planarians. Part IV. *Ibid.*, T. XXXIV.
15. DENDY, A., 1909. On Land Planarians from Auckland and Enderby Islands. Subantarctic Islands of New Zealand, Art. XXVII.
16. DIESING, C. M., 1861. Revision der Turbellarien—Abtheilung: *Dendrocoelen*. *Sitzungsberichte der mathem.-naturw. Classe der Kais. Akademie der Wissenschaften zu Wien*, Bd. XLIV.
17. DUPLESSIS, G., 1897–1898. Turbellaires des Cantons de Vaud et de Genève. Étude faunistique. *Revue suisse de Zool.*, T. V.
18. FUHRMANN, O., 1912. Voyage d'exploration scientifique en Colombie. Planaires terrestres de Colombie. *Mém. Soc. Neuchâteloise sc. nat.*, Vol. V.
19. FUHRMANN, O., 1914. Zwei neue Landplanarien aus der Schweiz. *Rev. suisse Zool.*, Vol. XXII.
20. GEBÄ, J., 1909. Landplanarien von Madagaskar und den Cemoren. In: A. VOELTZKOW, *Reise in Ostafrika in den Jahren 1903–1905*. *Wissenschaftliche Ergebnisse*, Bd. II.

21. GRAFF, L. von, 1896. Über das System und die geographische Verbreitung der Landplanarien. Verhandl. der deutschen Zool. Ges., VI.
22. GRAFF, L. von, 1896. Ueber die Morphologie des Geschlechtsapparates der Landplanarien. Ibid.
23. GRAFF, L. von, Neue Landplanarien (Viaggio Borelli IX). Boll. Mus. Zool. ed Anat. comp. Torino, T. XII., No. 296.
24. GRAFF, L. von, 1898. Bestimmungsschlüssel für die Indo-Malayischen Landplanarien. Annales du Jardin Botanique de Buitenzorg, Suppl. II.
25. GRAFF, L. von, 1899. Monographie der Turbellarien: II. Triclada Terricola (Landplanarien).
26. GRAFF, L. von, 1910. Vergleichung der nordamerikanischen und europäischen Turbellarien-fauna. Advance print from the Proceedings of the Seventh International Zoological Congress Boston, Meeting, August 19-24, 1907.
27. GRAFF, L. von. 1913. Turbellaria in: Dr. H.G. BRONN's Klassen und Ordnungen des Thier-Reichs. Bd. Würmer: Vermes.
28. IKEDA, I., 1911. Note on a new Land Planarian from Ceylon; Spolia Zeylonica, Vol. VII., part XXVII.
29. JAMESON, H. L., 1906. On some South African Planarians. Report 75th Meeting Brit. Ass. Adv. Sc.
30. JAMESON, H. L., 1907. On some Natal Land Planarians. Zool. Rec., Vol. XLIV.
31. KABURAKI, T., 1920. On the Occurrence of Placocephalus javanus (LOMAN) in Siam. Rec. Indian Mus., Vol. XIX., Part II.
32. KABURAKI, T., 1920. On the Terrestrial Planarians from the Islands of Mauritius and Rodrigues, with a Note upon the Canal connecting the Female Genital Organ with the Intestine. Quart. Journ. Micr. Sci., Vol. LXV.
33. KONINGSBERGER, J. C., 1912. Java Zoologisch en Biologisch. Aflv., IV. Buitenzorg.
34. KRAEPELIN, K., 1901. Ueber die durch den Schiffverkehr eingeschleppten Tiere. Mitt. Naturhist. Museum Hamburg, XVIII.
35. KRAEPELIN, K., 1901. Die Fauna der Umgegend von Hamburg. Hamburg in naturw. und medicin. Beziehung.
36. KRZMANOVIĆ, K., 1898. Beiträge zur Anatomie der Landplanarien. Zeitschr. f. wiss. Zool., Bd. LXV.
37. LAIDLAW, F. F., 1903. On a Land Planarian from Hurule, Male Atoll, with a Note on Leptoplana pardalis LAIDLAW. Fauna and Geog. Maldive Laccadive Archip., Vol. II., part 3.
38. LAIDLAW, F. F., 1903. Report on the Land Planarians. Fasciculi Malayenses-Zool., T. I.
39. LAUTERBORN, R., 1904. Beiträge zur Fauna und Flora des Oberrheins und seiner Umgebung. II. Faunistische und biologische Notizen. Mittheil. d. Pollichia, Jahrg. 1904.

40. LOMAN, J. C. C., 1888. Über den Bau von Bipalium STIMPSON, nebst Beschreibung neuer Arten aus dem indischen Archipel. Bijdragen tot de Dierkunde, 14. Afl.
41. MEIXNER, A., 1906. Zwei neue Landplanarien. Zool. Anz., Bd. XXIX.
42. MELL, C., 1903. Landplanarien der Madagassischen Subregion. Abhandl. d. Senkenb. naturf. Ges. Frankfurt, Bd. XXVII.
43. MELL, C., 1904. Die von OSCAR NEUMANN in Nordost-Afrika gesammelten Land Planarien. Zool. Jahrb., Abt. Syst., Bd. XX.
44. MORGAN, T. H., 1900. Regeneration in Bipalium. Arch. f. Entwicklungsmech., Bd. IX.
45. MOSELEY, H. N., 1875. On the Anatomy and Histology of the Landplanarians of Ceylon, etc., Phil. Trans. Roy. Soc., Vol. CLXIV.
46. MOSELEY, H. N., 1877. Notes on the Structure of Several Forms of Land Planarians, with a Description of two new Genera and several new Species, and a List of all Species at present known. Micr. Journ. (N. S.), Vol. XVII.
47. MÜLLER, JOS., 1902. Ein Beiträge zur Kenntniss der Bipaliiden. Zeitscher. f. wiss. Zool., Bd. LXXIII.
48. MÜLLER, JOS., 1907. Weitere Beiträge zur Kenntniss der Bipaliiden. Ibid., Bd. LXXXVI.
49. RITTER-ZAHONG, R. von., 1905. Landplanarien von Java und Ceylon, gesammelt von Prof. K. KRAEPELIN 1904. Mittheil. aus d. Naturhist. Museum. XXII. (2 Beiheft zum Jahrbuch d. Hamburg wissenschaftl. Anstalten, XXII).
50. SARASIN, P. und F., 1901. Ueber die geologische Geschichte der Insel Celebes auf Grund der Thierverbreitung. Ueber die geographische Verbreitung der Landplanarien. Materialien zur Naturgeschichte der Insel Celebes, Bd. III.
51. SARASIN, F., 1910. Ueber die Geschichte der Thierwelt von Ceylon. Zool. Jahrb, Suppl. XII.
52. SEKERA, E., 1896. Ueber einen interessanten Turbellarienfindort. Zool. Anz., Bd. XIX.
53. SCHARFF, R. F., 1900. Rhynchodemus Howesi: a new European Species of Terrestrial Planarian Worm. Journ. Linn. Soc., Vol. XXVIII.
54. SCHARFF, R. F., 1900. The Irish Species of Land Planarians. The Irish Naturalist, Vol. IX.
55. SCHARFF, R. F., 1901. Notes on the Irish Planarian Worms. Ibid., Vol. X.
56. SOUTHERN, R., 1907. Turbellaria. In: Contributions to the Natural History of Lambay. Ibid., Vol. XVI.
57. STEINMANN, P., 1911. Revision der schweizerischen Tricladen. Revue Suisse de Zool., Vol. XIX.
58. STEEL, THOS., 1897. Australian Land Planarians: Descriptions of new Species and Notes on Collecting and Preserving. Proc. Linn. Soc. N. S. Wales, Vol. XXII., Part I.
59. STEEL, THOS., 1897. Land Planarians from Fiji, with Description of new Species. Ibid.

60. STEEL, JOS., 1900. Australian Land Planarians. Descriptions of new Species and Notes on Collecting and Preserving. No. 2. Ibid., Part 4.
61. STEEL, THOS., 1900. Tasmanian Land Planarians. Descriptions of new Species, etc., Ibid.
62. STIMPSON, W., 1857. Prodromus descriptionis animalium evertibratorum quæ in Expeditione ad Oceanum Pacificum septentrionalem, Johanne Rodger Duce a Republic Federata missa, observavit et descripsit. Proc. Acad. Nat. Sc. Philadelphia, 1857.
63. STOLL, O., 1897. Zur Zoogeographie der landbewohnenden Wirebellosen, Berlin.
64. WALTON, L. B., 1905. A Land Planarian in Ohio. Ohio Naturalist, Vol. V.
65. WALTON, L. B., 1907. Land Planarians in the United States. Science, N. S., Vol. XXV.
66. WALTON, L. B., 1912. The Land Planarians of North America, with a Note on a new Species. Ibid. Vol. XXXV.
67. WOODWORTH, W. Mc M., 1896. Notes on Turbellaria. 1. On the Occurrence of Bipalium kewense (MOSELEY) in the United States. American Naturalist, XXX.
68. WOODWORTH, W. Mc M., 1898. On the Occurrence of Placocephalus (Bipalium) kewense in the Sandwich Islands. Science, N. S., Vol. VIII.
69. WHITEHOUSE, R. H., 1914. Land Planarians. Rec. Indian Mus., Vol. VIII., part 6.
70. WHITEHOUSE, R. H., 1919. Indian Land Planarians. Ibid., Vol. XVI., part 1.

Explanation of the Plate.

The figures indicated by affixing asterisks are those which were made by the late Professor LJIMA.

- Fig. 1.* *Geoplana bimaculata*, n. sp. in the living state, seen from the dorsal side, $\times 2.5$.
- Fig. 2.* *Artioposthia japonica*, n. sp. in the living state, dorsal aspect, $\times 1.5$.
- Fig. 3.* *Perocephalus fulvus*, n. sp. in the living state, dorsal view, $\times 5$.
- Fig. 4. *Bipalium fuscolineatum*, n. sp. in the creeping state, dorsal aspect, \times about 2.
- Fig. 5.* The same: \times about 3.
- Fig. 6. *Bipalium hilgendorfi* (VON GRAFF) in the living state, nearly natural size, dorsal aspect.
- Fig. 7. *Bipalium fuscocephalum*, n. sp. in the living state, seen from the dorsal side, $\times 2$.
- Fig. 8.* *Placocephalus fuscatus* (STIMPSON) in the living state, natural size, dorsal aspect.
- Fig. 9.* The same. Ventral aspect.
- Fig. 10. *Bipalium ruteofulvum*, n. sp. in the preserved state, seen from the dorsal side, natural size.
- Fig. 11. *Bipalium hisoensis*, n. sp. in the preserved state, natural size, dorsal aspect.
- Fig. 12. *Bipalium venosum*, n. sp. in the creeping state, natural size, dorsal aspect.
- Fig. 13. *Bipalium ochroleucum*, n. sp. in the preserved state, dorsal view, $\times 1.2$.
- Fig. 14. *Bipalium monolineatum*, n. sp. in the living state, dorsal aspect, \times about 2.
- Fig. 15. *Bipalium trifuscostriatum*, n. sp. in the creeping state, nearly natural size, dorsal view.
- Fig. 16. *Bipalium trilineatum* STIMPSON in the living state, natural size, dorsal aspect.
- Fig. 17. *Placocephalus glaucus*, n. sp. in the living state, natural size, dorsal view.
- Fig. 18. *Placocephalus virgatus* (STIMPSON), in the preserved state, natural size, dorsal view.
- Fig. 19.* *Rhynchodemus ijimai*, n. sp. in the living state, seen from the dorsal side, \times about 3.
- Fig. 20. The same. Ventral side of the anterior body-part, showing the depression. \times about 20.
- Fig. 21.* *Microplana ruteocephala*, n. sp. in the creeping state, seen from the dorsal side, $\times 3$.
- Fig. 22.* The same. Anterior part of the body, seen from the lateral side.
- Fig. 23.* The same. Anterior part of the body, dorsal aspect.



LIIMA et KABURAKI del.

T. KABURAKI: Terrestrial Planarians from Japanese Territories.