

THE RETIREMENT OF LIEUTENANT-COLONEL SEWELL.

Lt.-Col. Robert Beresford Seymour Sewell, the second permanent Director of the Zoological Survey of India, was born at Leamington, England, on 5th March, 1880, and after a very distinguished career of nearly 25 years of service in India has gone on leave preparatory to retirement from 22nd April 1933.

Sewell was a Scholar of Weymouth College from 1894-98, and for a short time in 1899 studied Zoology under Welden, Chemistry under Ramsay and Physics under Callender in the University College, London. In 1899 he joined Christ's College, Cambridge as an Exhibitioner, he later became a Scholar, and was connected with this institution till 1905. He took the Natural Science Tripos, Part I, of the Cambridge University in Class I in 1902, and was awarded the Bishop Porteus Gold Medal the same year. The following year he took part II of the Tripos in Class I, and for the research work done by him during his residence in the University was awarded the Darwin Research Prize in 1904. From 1902-05 he served as a Junior Demonstrator in Human Anatomy and from 1903-05 in Physiology in the University Laboratories. Sewell continued his medical studies in St. Bartholomew's Hospital, London, in 1905, in which year he was awarded the Shuter Scholarship, while the Matthews Duncan Prize in Midwifery and Gynaecology was bestowed on him in 1907. He took the M.R.C.S., L.R.C.P., of London in 1907, and passed the competitive examination for the Indian Medical Service in 1908.

After his arrival in India Sewell served as a medical officer in the Indian Army for about two years when, in view of his special scientific qualifications, he was selected for the post on board the R.I.M. S.S. "Investigator" of Surgeon Naturalist to the Marine Survey of India and he joined the ship in September 1910. Though his Zoological career starts from this date, Sewell had when posted as a medical officer at Sialkot, Punjab, made valuable observations on freshwater fishes which are particularly efficacious as destroyers of mosquito larvae; this work was published in 1912, in the form of a special pamphlet issued by the Trustees of the Indian Museum, in collaboration with the late Dr. B. L. Chaudhuri. In December 1911, Sewell was appointed as Officiating Professor of Biology in the Calcutta Medical College, and it was not till July, 1913, that he resumed his office of the Surgeon Naturalist. On the outbreak of the War in 1914, Captain Sewell reverted to military duty, and was attached as medical officer to 1/23 Sikh Pioneers. During the War he was in Aden, Egypt and Palestine and was mentioned in Despatches. While stationed at Aden he also served for a short period as the Health Officer of the Port of Aden. In 1919, his services were replaced at the disposal of the Civil authorities, and after serving for a year as the Officiating Superintendent, Zoological Survey of India, he reverted to his permanent post of Surgeon Naturalist. He continued in this capacity till 1925, when he was appointed Director of the Zoological Survey of India.

The biological work of the Marine Survey of India had been carried on for some thirty-five years when Sewell succeeded Captain Stewart as Surgeon Naturalist in 1910. This work had been carried out in close, though informal, connection with the Natural History Section of the Indian Museum. Except for the Survey Season of 1888 when Giles paid special attention to the nature of the sea-bed and the bottom deposits and which work was to some extent continued by Alcock, his successor, during the first year or two of his office, the biological investigations had been mainly confined to a systematic survey and making collections of the marine faunas of the various areas visited by the survey ship. Very rich and valuable collections of marine animals of almost all groups from different parts of the Indian Ocean had been obtained by the successive Surgeon naturalists, and for several years the work had been specially concentrated on the bathybial fauna. The reports on these collections have been published as "Natural History Notes from the R.I.M. S.S. 'Investigator'" in the *Annals and Magazine of Natural History* and in the *Journal of the Asiatic Society of Bengal*, and later in a series of monographs published by the Trustees of the Indian Museum and by the Zoological Survey of India since 1916. On his appointment as Surgeon Naturalist, however, Sewell found that the opportunities for deep-sea trawling, etc., were less frequent, and that with the changed conditions it would not be possible to carry out the programme of the biological work on the deep-sea fauna on the lines followed by his predecessors. He also recognised quite early in his career that there was an almost virgin field of study regarding the physical conditions under which the marine fauna exists. Soon after his appointment, therefore, he started his investigations of these conditions in detail, and as a result of his work came to the conclusion that "so far as this branch of Oceanography is concerned, the value of such expeditions as those of the 'Challenger', 'Valdivia', 'Siboga', etc., has steadily diminished. Each succeeding expedition has added less and less to the sum-total of our knowledge, and what seems to be urgently required now-a-days is an intensive study of comparatively small areas over a considerable period of time." Luckily for his researches the work of the "Investigator" during the greater part of his tenure was concentrated on specially interesting areas, such as the Andaman Sea, the Maldives, etc. The so far published results of his researches consist of six elaborate memoirs in a special volume of the *Memoirs of the Asiatic Society of Bengal*. In these memoirs Sewell has described in a masterly manner and in great detail the geography of the Andaman Sea and the Bay of Bengal, the temperature and the salinity of the coastal waters of the Andaman Sea and the temperature and the salinity of the deeper waters of the Andaman Sea and the Bay of Bengal. He has also collected materials on the Oceanography of that part of the Arabian Sea known as the Laccadive Sea and the results, when published, are sure to fill up a hiatus in our knowledge of the Oceanography of the Indian Ocean as a whole.

In addition he has studied in great detail the question of the formation of coral reefs and coral islands in the Andamans, the Gulf of Manaar and the Maldives. The first paper in this series entitled "A study of

recent changes of sea-level based largely on a study of coral-growths in Indian and Pacific Seas" was read before the International Congress of Zoology at Budapest in 1927, and a second paper on "The Coral Coasts of India" was published in the *Geographical Journal* last year.

In spite of his time being fully taken up with Oceanographical work, Sewell did not neglect pure biological investigations. With restricted facilities for such work he concentrated on the littoral fauna and a detailed systematic study of some of the organisms in the plankton, particularly the surface-living Copepoda. He was the first to introduce on the "Investigator" the use of nets for fishing in mid-water and the results obtained by him in 1911-12 showed how highly promising this new field for biological work is. The results of some of his work on the surface and mid-water fauna were published as papers in the *Records of the Indian Museum* on "The Capture of *Limulus* on the Surface", "Development of the Larva of *Lingula*", "Surface Living Copepoda of the Bay of Bengal" and "The Salps of the Indian Seas", while his paper on *Lithotrya nicobarica*—an interesting pedunculate Cirripede, and "Observations on growth in certain Molluscs and changes correlated with growth in the radula of *Pyrazus palustris*" resulted from his studies on the Littoral fauna of the areas he visited. Sewell did not neglect the deep-sea fauna also, for in 1912 he published a paper on the deep-sea fishes and another in collaboration with Dr. S. W. Kemp on the Decapods dredged by the "Investigator" during the Survey Season 1910-11.

In connection with the systematic survey of the freshwater molluscs of India started by the Zoological Survey of India in 1918 at the request of the medical authorities, Sewell in 1921 published a very detailed anatomical and bionomical work on the common banded snail—*Viviparus bengalensis*. About the same time he took up the study of the cercariae which occur in the indigenous freshwater molluscs of India. This work resulted in a number of papers and a very elaborate monograph which is thus described by Prof. H. B. Ward :

"The especial attention of workers in Medical Zoology is to be called to a monograph by R. B. Seymour Sewell from the laboratory of the Zoological Survey of India, published in the 'Indian Journal of Medical Research' (10, suppl. ; June 1922) in a study covering nearly 400 pages of text and illustrated by 32 full-page plates in colour and numerous text figures. The author has given a study of the cercariae of India that surpasses in extent and thoroughness any study hitherto made of this group in any part of the world. It would be hopeless to attempt a detailed review of so large a work here. Suffice it to say that it is sure to be indispensable to all workers in this field."

Since his appointment as Director, Zoological Survey of India, Sewell has published two elaborate monographs on some families of marine Copepods, and several contributions on the biological conditions governing the life of animals in estuaries and in restricted areas of freshwater such as the tank in the Museum Compound.

Soon after graduating at Cambridge, Sewell turned his attention to anatomical studies which were of special importance from the biological and anthropological points of view. He was attracted to this work by the researches of Professor Havelock Charles, who from his studies on the morphology of the lower extremity of the Punjabi had concluded that the skeletal peculiarities in the "hip-, knee-, and ankle-joints of the Punjabi skeleton are owing to the influence of the squatting and

sartorial postures which are commonly assumed by Orientals when engaged in their daily avocations or when indulging in rest after their labours" Further studies on foetal skeletons had led Professor Havelock Charles to the conclusion that the facets on certain bones of the lower extremity offer a good example of the inheritance of a character acquired by the Punjabi in the evolution of its racial type. Sewell from a careful study on the *astragalus*, published in a series of four papers in the *Journal of Anatomy and Physiology, Cambridge*, and based on the skeletons of Egyptians of the pre-dynastic Nagdah race, of the Fifth Dynasty to the Ptolemaic and Roman Period, of Europeans and others was able to show that the peculiar " facets occur in the foetus of the European, and probably all other races, whether the facets are found to be present in the adult or not " ; and was thus able to disprove the hypothesis of the inheritance of an acquired character as postulated by Professor Havelock Charles. He also published about the same time two other anatomical papers in the same journal.

The Director, Zoological Survey of India, also has under his charge the Ethnological and Anthropological collections of the Indian Museum, but no specially trained officer was in charge of these collections prior to Sewell's appointment as Director of the Zoological Survey. In 1925 Sewell strongly represented to the Government of India the necessity of the appointment of an anthropologist on the staff of the Zoological Survey for looking after the very valuable anthropological and ethnological collections in the Indian Museum, and a special officer was sanctioned for this work in 1927. Sewell was also from this time onwards able to revive his early interest in Anthropology, and since 1927 has published a number of valuable contributions on the racial ethnology of the Indians. Special attention may be directed to his presidential address delivered at Madras in 1929 to the Anthropological Section of the XVI meeting of the Indian Science Congress on " The origin of Man and the Population of India in the Past and in the Future." He has also published a number of interesting papers on human and animal remains excavated from the pre-historic site at Mohenjo-Daro and in Mekran ; the papers on the human remains were prepared in collaboration with Dr. B. S. Guha, Anthropologist of the Zoological Survey of India.

Sewell was elected a Fellow of the Asiatic Society of Bengal in 1917, and was awarded the M.A., and Sc.D. degrees of the Cambridge University within recent years. He was a Fellow of the Calcutta University in 1930-31, and did very valuable work in connection with the organisation of teaching of Zoology in the Calcutta University. He was elected President of the Zoology Section of the Indian Science Congress in 1927, and of the Anthropological Section in 1929, while he was the President of the Indian Science Congress in 1931. In 1930 he was appointed Chairman of the Quiquennial Reviewing Committee of the Indian Institute of Science, Bangalore. He was the President of the Asiatic Society of Bengal from 1930-32 and was awarded the Barclay Memorial Medal in 1932. For his services to the cause of Science in India he was awarded the title of the Companion of the Indian Empire in the New Year's Honours List of 1933.

Since his appointment as Director, Zoological Survey of India, a great deal of Sewell's time was taken up by administrative work, and he worked out in detail several schemes of far-reaching importance in connection with the work of the department under his care. As his distinguished predecessor, the late Dr. N. Annandale had pointed out, the staff of the department was hardly sufficient for carrying out a detailed zoological survey of the vast continental area of India. The valuable collections of the department are for want of sufficient space not only overcrowded but the rooms in which they are kept are not at all suitable for the storage of either spirit-preserved or dry collections, and owing to the absence of a marine biological station there is no possibility of any work on marine fauna being undertaken. Sewell soon after his appointment put up proposals for a five-year expansion scheme for the department ; these included, among other greatly needed improvements, the erection of a fire-proof spirit building for the reserve collections and offices of the department, an increase in the staff and the establishment of a marine biological station at Karachi. After long struggle most of the schemes were administratively approved, and it appeared almost a certainty that the department would before long be properly housed, equipped and manned for survey work. Unfortunately, however, as a result of the acute financial depression during 1931-32 not only were all the schemes of expansion shelved, but very drastic reductions were effected both in the personnel and in the annual budget grants of the department. The same circumstances are responsible for his premature retirement, but it is to be hoped that with the return of normal conditions the schemes for the expansion of work of the department initiated by Sewell will be revived and that it would be possible to carry out the programme of the work of the department as outlined by him.

Col. Sewell is personally a very charming man, always ready to help his colleagues and assistants in every possible way, and his loss to the Zoological Survey, due to his premature retirement, will be very keenly felt. Though his time was fully occupied with his own researches and administration, he was always ready to help young workers and encourage them in every possible way. He spared neither time nor energy for the progress of his department, while his work in connection with the administration of the Asiatic Society of Bengal and the Indian Science Congress, the reorganisation of teaching of Zoology in the Calcutta University and reviewing the work of the Indian Institute of Science at Bangalore was carried out with the same zeal and thoroughness which mark his scientific researches.

Fortunately, retirement from service does not mean severing his connection with Indian Science, as he has been selected as the leader of the "John Murray Oceanographical Expedition" This Expedition will be working in the Arabian Sea from the Persian Gulf down to the level of Madagascar, and east to west between India and Africa. The investigations will be carried out in special reference to the zonation of the fauna on the continental slopes between 50-1,000 fathoms. In addition to general Oceanographical investigations the nature of bottom deposits will receive special attention, and depth soundings carried

out in traverses extending over the entire area will, it is hoped, provide definite data regarding any old land connections or bridges between the two continents. The Expedition will enable Col. Sewell to extend further his Oceanographical investigations in the Arabian Sea and complete his earlier work. His colleagues and other scientists in India will follow the progress of the "John Murray Expedition" with great interest and the completed results of his work on this Expedition are sure to bring credit to his old department.

CALCUTTA,
April 28, 1933.

BAINI PRASHAD.

LIST OF PAPERS.

Zoological.

1. Capture of *Limulus* on the surface. *Rec. Ind. Mus.*, Vol. VII, Miscellaneous, 1912.
2. Note on the Development of the Larva of *Lingula*. *Rec. Ind. Mus.*, Vol. VII, Miscellaneous. 1912.
3. Notes on Decapoda in the Indian Museum. III. The species obtained by R.I.M. S.S. "Investigator" during the Survey-Season 1910-11. (In collaboration with S. W. Kemp). *Rec. Ind. Mus.*, Vol. VII, 1912.
4. Notes on the Deep-Sea Fish obtained by the R.I.M. S.S. "Investigator" during the Survey-Season 1910-11. *Rec. Ind. Mus.*, VII, 1912.
5. Notes on the Surface-living Copepoda of the Bay of Bengal. *Rec. Ind. Mus.*, Vol. VII, 1912.
6. Indian Fish of Proved Utility as Mosquito Destroyers. (In collaboration with B. L. Chaudhuri). Published by the Trustees of the Indian Museum, 1912.
7. Notes on the Fish fauna of certain Tanks in Bengal. (In collaboration with T. Southwell). *Special Bulletin No. I, Depart. Agriculture, Bihar and Orissa*, 1913.
8. Notes on the Biological Work of the R.I.M. S.S. "Investigator" during the Survey Seasons, 1910-11 and 1911-12. *Journ. and Proc. Asiatic Soc. Bengal* (New Series), Vol. IX, 1913.
9. Notes on Plankton from the Chilka Lake. *Rec. Ind. Mus.*, Vol. IX, Miscellaneous, 1913.
10. Some Observations on the Development of the Copepoda. *Proc. IXe Congress International de Zoologie*, Monaco, 1914.
11. Notes on Indian Fish. I. Notes on the genus *Malthopsis*. II. A new species of *Cryptocentrus*. *Rec. Ind. Mus.*, Vol. X, 1914.
12. The Surface-living Copepoda of the Gulf of Manaar. *Spolia Zeylanica*, Vol. IX; 1914.
13. A Preliminary Note on some new Species of Copepoda. *Rec. Ind. Mus.*, Vol. XVI, 1920.
14. The possible occurrence of *Schistosoma japonicum* Katsurada in India. *Rec. Ind. Mus.*, Vol. XVI, 1919.

15. Progress Report on a Survey of the Freshwater Gastropod Molluscs of the Indian Empire and of their Trematode Parasites. (In collaboration with N. Annandale). *Ind. Journ. Med. Research*, Vol. VIII, 1920.
16. The Fork-tailed Cercariae of India. *Proc. Asiatic Soc., Bengal*, Vol. XVI (Proc. 7th Indian Science Congress), 1920.
17. On *Mesocoelium sociale* (Lühe). *Rec. Ind. Mus.*, Vol. XIX, 1920.
18. The Banded Pond Snail of India (*Vivipara bengalensis*). (In collaboration with N. Annandale). *Rec. Ind. Mus.*, Vol. XXII, 1921.
19. *Cercariae Indicae*. *Ind. Journ. Med. Research*, Suppl. Vol. X, 1922.
20. The Hydrography and Invertebrate Fauna of Rambha Bay in an abnormal year. (In collaboration with N. Annandale). *Mem. Ind. Mus.*, Vol. V, 1922.
21. Observations on growth in certain Molluscs and on changes correlated with Growth in the Radula of *Pyrazuz palustris* (with a note on the radula by the late N. Annandale). *Rec. Ind. Mus.*, Vol. XXVI, 1924.
22. Crustacea Copepoda. *Mem. Ind. Mus.*, Vol. V, 1924.
23. The Adhesive Apparatus of the "Sucking Fish." *Nature*, Vol. CXV, 1925.
24. The Salps of Indian Seas. *Rec. Ind. Mus.*, Vol. XXVIII, 1926.
25. A Study of *Lithotrya nicobarica* Reinhardt. *Rec. Ind. Mus.*, Vol. XXVIII, 1926.
26. Investigations regarding an Epidemic of Fish Mortality in the Tank of the Indian Museum Compound. *Journ. Asiatic Soc., Bengal*, Vol. XXII, 1927
27. The Study of Zoology in India. (Presidential address to the Zoological Section). *Proc. Indian Sci. Congress*, 1927 (1928).
28. The Evolution of the Excretory System in certain groups of the Furcocercous Cercariae. *Rec. Ind. Mus.*, Vol. XXXII, 1930.
29. The Copepoda of Indian Seas. *Mem. Ind. Mus.*, Vol. X, 1929-32.
30. The History and Progress of the Zoological Survey of India. (Introduction). *Journ. Bombay Nat. Hist. Soc.*, Vol. XXXIII, 1930.
31. A Note on *Cercaria anomala* Rao. *Ind. Journ. Med. Research*, Vol. XVIII, 1930.
32. *Cercariae nicobaricae*. *Ind. Jour. Med. Research*, Vol. XVIII, 1931.
33. The Problem of Evolution, Part I. Experimental modification of bodily structure. (Presidential address). *Proc. Asiatic Soc., Bengal*, 1931.
34. The Problem of Evolution, Part II. The Trend of Evolution under Natural Conditions. (Presidential Address). *Proc. Asiatic Soc., Bengal*, 1931.
35. The Zoological Survey of India. *Nature*, Vol. CXXIX, 1932.

Geographical and Oceanographical.

36. Geographic and Oceanographic Research in Indian Waters. I. The Geography of the Andaman Sea Basin. *Mem. Asiatic Soc., Bengal*, Vol. IX, 1925.

37. Geographic and Oceanographic Research in Indian Waters. II. A Study of the Nature of the Sea-bed and of the bottom deposits of the Andaman Sea and Bay of Bengal. *Mem. Asiatic Soc., Bengal*, Vol. IX, 1925.
38. Geographic and Oceanographic Researches in Indian Waters. III. Maritime Meteorology in Indian Seas. *Mem. Asiatic Soc., Bengal*, Vol. IX, 1927
39. Geographic and Oceanographic Researches in Indian Waters. IV The Temperature and Salinity of the Coastal Waters of the Andaman Sea. *Mem. Asiatic Soc., Bengal*, Vol. IX, 1928.
40. A Study of recent changes of Sea-level based largely on a study of Coral growths in Indian and Pacific Seas. *Internat. Revue der ges. Hydrobiol. u. Hydrographie*, Vol. XX, 1928.
41. Geographic and Oceanographic Researches in Indian Waters. V Temperature and Salinity of the surface-water of the Bay of Bengal and Andaman Sea with reference to the Laccadive Sea. *Mem. Asiatic Soc., Bengal*, Vol. IX, 1929.
42. Geographic and Oceanographic Researches in Indian Waters. VI. The Temperature and Salinity of the Deeper Waters of the Bay of Bengal and Andaman Sea. *Mem. Asiatic Soc., Bengal*, Vol. IX, 1932.
43. The Coral Coasts of India. *Geographical Journal*, Vol. LXXIX, 1932.

Anatomical (Human).

44. A Study of the Astragalus. *Journal of Anatomy and Physiology*, Vols. XXXIX and XL, 1904-1906.
45. Anatomical Notes : I. Phalanx possessing two Epiphyses. II. An Interarticular Fibro-Cartilage between the Astragalus and the Malleolus of the Fibula. III. Lamellae in Faetal Astragalus. *Journal of Anatomy and Physiology*, Vol. XLI, 1905-06.
46. The Small or Superficial Thyro-Arytenoideus Muscle. *Journal of Anatomy and Physiology*, Vol. XXXIX, 1905.

Medical.

47. The Schistosomiasis in India. *Ind. Med. Gazette*, Vol. LIV, 1919.
48. Notes on Certain Cases of Fever. *Ind. Med. Gazette*, Vol. LV, 1920.

Anthropological.

49. A Survey Season in the Nicobar Islands on the R.I.M. S.S. "Investigator." *Journ. Bombay Nat. Hist. Soc.*, Vol. XXVIII, 1923.
50. Dug-Out Canoe in Algoa Bay. *Nature*, Vol. CXX, 1927.
51. Racial Ethnology. (Souvenir : The Indian Empire). *VIIth Congress Far Eastern Ass. Tropical Med.*, 1927.
52. Report on the Human Remains excavated at Nal, Baluchistan. (In collaboration with B. S. Guha). *Memoirs of the Archaeological Survey of India*, No. 35, 1929.

53. **The Origin of Man and the Population of India in the past and the future.** (Presidential Address : Anthropology Section). *Proceedings Indian Science Congress*, 1929.
54. **Report on the Zoological and Human Remains excavated at Mohenjo-Daro.** (In collaboration with B. S. Guha). *The Indus Valley Civilisation and Mohenjo-Daro*, Vol. II, 1931.
55. **Report on a collection of bones made by Sir Aurel Stein in Mekran.** (In collaboration with B. S. Guha). *Mem. Archaeological Survey of India*, Vol. XLIII, 1931.

FURTHER NOTES ON CRUSTACEA DECAPODA IN THE INDIAN MUSEUM.

V ON *EUTRICHOCHELES MODESTUS* (HERBST): FAMILY AXIIDAE.

By B. CHOPRA, D.Sc., Zoological Survey of India, Calcutta.

(Plate VI.)

In 1875 Wood-Mason¹ exhibited before a meeting of the Asiatic Society of Bengal a rare Decapod Crustacean that had been described and figured by Herbst² over 80 years earlier under the name of *Cancer modestus*. Wood-Mason set up a new genus for the reception of this curious animal, and though he did not give any definition for his genus, he discussed briefly its relationships with other allied forms. According to Wood-Mason *Eutrichocheles*, as he designated his new genus, was a member of the family Astacidae (Nephropsidae of later writers), although he believed that it showed a close affinity to Thalassinidae also. In fact according to him *Eutrichocheles* afforded a connecting link between the two families.

Since Wood-Mason's brief announcement no reference to this animal appeared in the literature for over 40 years, till de Man³ referred to it in 1916 in his account of the Siboga Expedition Nephropsidae. Following Wood-Mason he too included *Eutrichocheles*, though without making any comments on it, in the family Nephropsidae.

A year later Bouvier⁴ also accepted the same position for *Eutrichocheles* and included it in the same family. Like Wood-Mason, Bouvier also recognised its close affinity to *Nephropsis*, and in fact referred to *Eutrichocheles* as "un *Nephropsis* à fortes pinces largement béantes et à pédoncules oculaires vraisemblablement terminés par des yeux"

Recently Professor Heinrich Balss of the Zoologische Sammlung des Bayerischen Staates, München, drew my attention in a letter to this interesting animal. In connection with some work that he was engaged on at the time he had occasion to examine critically Herbst's description and figure of this rare animal. This examination led him to the conclusion that *Eutrichocheles* had been wrongly included in the family Nephropsidae, but was beyond doubt a member of the Axiidae, and most probably of the genus *Axiopsis*. As the only example of *Eutrichocheles modestus*, probably in existence at the present time, is preserved in the Indian Museum, Dr. Balss asked me to examine it for him, and verify his views in the matter. As will be seen from the present note the views held by Dr. Balss are correct in so far as *Eutrichocheles* is undoubtedly a member of the family Axiidae, and not of the Nephropsidae, as has hitherto been believed.

¹ Wood-Mason, *Proc. As. Soc. Bengal*, 1875, p. 231; also *Ann. Mag. Nat. Hist.* (4) XVII, p. 264 (1876).

² Herbst, *Krabben II*, Heft 5, p. 173, pl. xliii, fig. 2 (1794).

³ de Man, *Siboga Exped. Rep. XXXIXa*², p. 96 (1916).

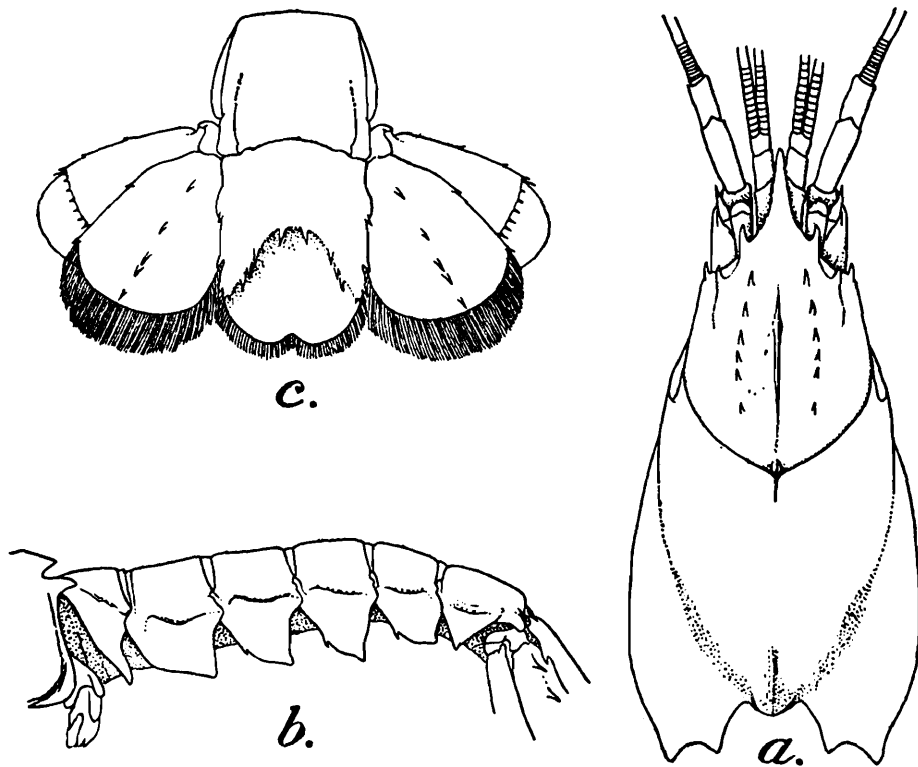
⁴ Bouvier, *Result. Campg. Sci. Albert Monaco L*, p. 14 (1917).

I am very thankful to Dr. Balss for directing my attention to this interesting animal. I have also had the benefit of his opinion and advice on this note, as the manuscript and some of the figures that illustrate it were sent to him in the first instance for any use that he cared to make of these. It is at his suggestion that the note, along with photographs of the animal and of some of the legs, is now being published. Though Herbst's excellent figure of the animal is on the whole correct, the rarity of his work has induced me to publish these photographs. My best thanks are due to Dr. Balss for all the help and suggestions that I have received from him.

A careful examination of Herbst's description and figure, as also of the fine example of *E. modestus* preserved in the collection of the Indian Museum, has made it clear that Wood-Mason, de Man and Bouvier were wrong in including *Eutrichocheles* in the family Nephropsidae of the Astacura section of Reptantia. In members of the family Nephropsidae, to mention only a few of the important characters, the carapace always overlaps the first abdominal somite, the abdominal terga overlap one another, and the first three legs are chelate. *Eutrichocheles*, on the other hand, unmistakably shows the characters of the Axiidae, which according to the present-day classification is included in the tribe Thalassinidea of the section Anomura. In *Eutrichocheles*, as in other members of the family Axiidae, the carapace does not overlap the first abdominal somite, the abdominal terga do not overlap one another, and only the first two pairs of legs end in chelae. Further, as is usual in the family, the last thoracic somite is movable, and the last thoracic sternum is separate. There can thus be no doubt that *Eutrichocheles* is a member of the family Axiidae, but its position and relationships within the family are not so clear.

Before discussing the relationship of *Eutrichocheles* with the other genera of the Axiidae, it may be useful to supplement briefly Herbst's original description of the species. This excellent and accurate description agrees in almost every particular with Wood-Mason's example of the species in the Indian Museum collection. The carapace (Plate VI, fig. 1, text-fig. 1a) is arched, and is distinctly keeled along the dorsal edge. The keel is very prominent in the anterior part, and though it becomes somewhat indistinct behind the cervical groove, it can again be clearly seen near the posterior extremity of the carapace. The four rows of forwardly-directed spines on the anterior part of the carapace, described by Herbst, are very distinctly seen in the Indian example. There are two rows on each side of the median keel. The outer row is short and consists of two comparatively large teeth, placed on the ridge that runs in continuation of the rostrum on the gastric region on each side of the carapace. The inner row consists of six small teeth, and only slightly falls short of the cervical groove. The rostrum is straight, with toothed sides, and ends in a bluntly-pointed tip. It extends up to the base of the ultimate segment of the antennular peduncle, or to about the middle of the long penultimate joint of the antennal peduncle. The antennal spines are considerably reduced, but both of them can be distinctly made out. Both the spines are somewhat pointed, but the inner, which is longer than the outer, is more sharply pointed. The

spines are very clearly seen in text-figure 1a, and one of them can be made out in the photograph also. The eye-peduncles are comparatively short, and the corneae are without pigment. The surface of the carapace, especially behind the cervical groove, is minutely punctate.



TEXT-FIG. 1.—*Eutrichocheles modestus* (Herbst).

a. Dorsal view of carapace, rostrum, etc. : $\times 2$.

b. Lateral view of abdominal somites : $\times 2$.

c. Dorsal view of last abdominal somite, telson and uropods : $\times 2$.

The abdominal segments (text-fig. 1b, plate VI, fig. 1) are as described and figured by Herbst. The first pleura are somewhat reduced, and are more or less acutely pointed; the 2nd-5th are angular, the 2nd being the largest, and the next three being provided with a small tooth each on the anterior margin. These teeth are not mentioned by Herbst in his description of the species, nor are they shown in his figure. The 6th pleura are triangular, and sharply pointed.

The telson (text-fig. 1c) is quadrangular in shape, and has the posterior margin broadly rounded, with a somewhat deep notch in the middle. The teeth, etc., on it are as shown in Herbst's figure. There is a distinct obliquely transverse suture, with spines on it, near the distal end of the exopod of the uropod, and a longitudinal ridge of spines on the endopod.

The chelipeds are massive and unequal on the two sides—in the Indian Museum example the one on the left side is bigger than that on the right. The arm (Pl. VI, fig. 2) on both sides is short, and is only sparsely tuberculate near its distal extremity, but the wrist and the palm are densely so. There are four short recurved spines on the upper border of the arm, and some similar spines are present on the lower border also. The wrist is short and globular. The hand has the palm

compressed, and its height somewhat exceeds its length along the upper border. It is densely covered with tubercles, and along its upper border there is a low crest of short, blunt spines, some of which appear to be only sharply-pointed tubercles. The fingers are also compressed, are sharply hooked at the tips, and leave a gap when they meet. The dactylus has a number of small tubercles near the base, and has a carina of granules or small tubercles along its upper border. It has three large teeth on the proximal part—two of these are placed near the base, while the third is almost on the middle of the cutting edge—and a row of small ones, extending from about the middle to the tip of the finger. The fixed finger is almost straight, and has a raised ridge on its side, and a row of granules on the lower border, similar to the one on the upper border of the movable finger. The large blunt tooth near the base has a number of small teeth on it, and there is another large tooth placed a little beyond the middle of the cutting edge. Between these two teeth there are four smaller teeth, and in addition to these there is a row of almost minute teeth extending distally from the large tooth on the middle, but not quite reaching up to the tip. The right cheliped differs from the other chiefly in the smaller palm, in having two and somewhat smaller teeth on the dactylus—the one about the middle of the finger in the other chela being absent here—and in having only one large, pointed, spine-like tooth on the fixed finger.

The walking legs are somewhat slender, only those of the first pair (2nd peraeopods) are chelate, the others being monodactylous. The merus of the first walking leg has two or three spines on the lower border, besides being profusely hairy; the carpus has also a cluster of long hairs on the distal part of the upper margin; the palm and the fingers are more or less smooth, the former being considerably shorter than the latter. The third peraeopods (2nd walking legs) are the longest. The merus is long and cylindrical, and has no spines or hairs on its lower border; the other segments are also smooth, and the dactylus, which is rather short, is sharply pointed.

The pleopods of the first pair in the single female example that I have seen are very much reduced, and are represented by short, uniramous, stumpy structures.

From the foregoing description it seems clear that within the family Axiidae *Eutrichocheles* finds a place in the group in which, according to Borradaile¹ and de Man,² *Axiopsis* Borradaile and *Calocaris* Bell are included. The presence of a distinct suture on the exopod of the uropod excludes it from the group in which *Axius* and certain other genera are placed. In the former group *Eutrichocheles* shows a greater resemblance to *Calocaris* than to any other genus. The presence of an arched back, with a distinct keel running along its dorsal edge, and of eyes without pigment indicates an unmistakable affinity to *Calocaris*, and, further, the reduced antennal spines to the subgenus *Calocaris* s. s. In *Axiopsis* the back is flat, and the posterior part of the carapace is rounded and not carinate. The only other genus in this group is *Oxyrhynchaxius*

¹ Borradaile, *Ann. Mag. Nat. Hist.* (7) XII, pp. 534-551 (1903).

² de Man, *Siboga Exped. Rep.* XXXIXa⁵, pp. 1, 2 (1925).

Parisi,¹ but according to de Man² this genus is probably identical with the sub-genus *Calastacus* Faxon, of the genus *Calocaris*. In *Oxyrhyncharius*, though a keel is present along the mid-dorsal line of the carapace, the eye-peduncles are very long and the antennal spines are also large.

The question whether Wood-Mason's *Eutrichocheles* is identical with *Calocaris* Bell or not requires careful consideration. If only the characters given by Alcock,³ Borradaile and de Man for the definition of *Calocaris* are taken into account, Herbst's species should also be included in this genus, but a careful examination of the species of *Calocaris* in the collection of the Indian Museum and of the available descriptions and figures of the other species leaves no doubt in my mind that *Eutrichocheles* and *Calocaris* are distinct from one another, or at best, the former can perhaps be regarded as a separate sub-genus of the latter. I am, however, of the opinion that the two genera are quite distinct. *Eutrichocheles* can be easily distinguished from *Calocaris*, among other characters, by its large size, the presence of four longitudinal rows of spines on the anterior part of the carapace, the very massive, strongly tuberculate and dis-similar claws, and by the fact that the pleura of the abdominal somites are angular and not rounded, and are each provided with a spine on the anterior margin. In *Calocaris* the pleura appear to be always rounded.

Eutrichocheles modestus appears to be a very rare species. Herbst's example, on which the original description is based, is said to have come from the East Indies; the only other known specimen, on which Wood-Mason based the generic name, is preserved in the Indian Museum. The exact provenance of this example also is not known, but it was collected somewhere off the Arakan coast of Burma. In the books of the Museum it is registered under No. 1405, and is said to have been received in exchange from some unspecified institution. The specimen is in a fairly good state of preservation, and is about 73 mm. from the tip of the rostrum to the posterior extremity of the telson. At the present time it is almost uniformly white in colour, the red pigment mentioned by Herbst in his specimen, and also shown in his figure, is nowhere visible in the Indian example now.

In the end I have to express my thanks to Mr. K. N. Das, M. Sc., Assistant, Zoological Survey of India, for the help he has given me in the preparation of this note.

¹ Parisi, *Atti Soc. Ital. Sci. Nat. Pavia* LVI, pp. 17-23 (1917).

² de Man, *Siboga Exped. Rep.* XXXIX a⁵, p. 2, foot-note (1925).

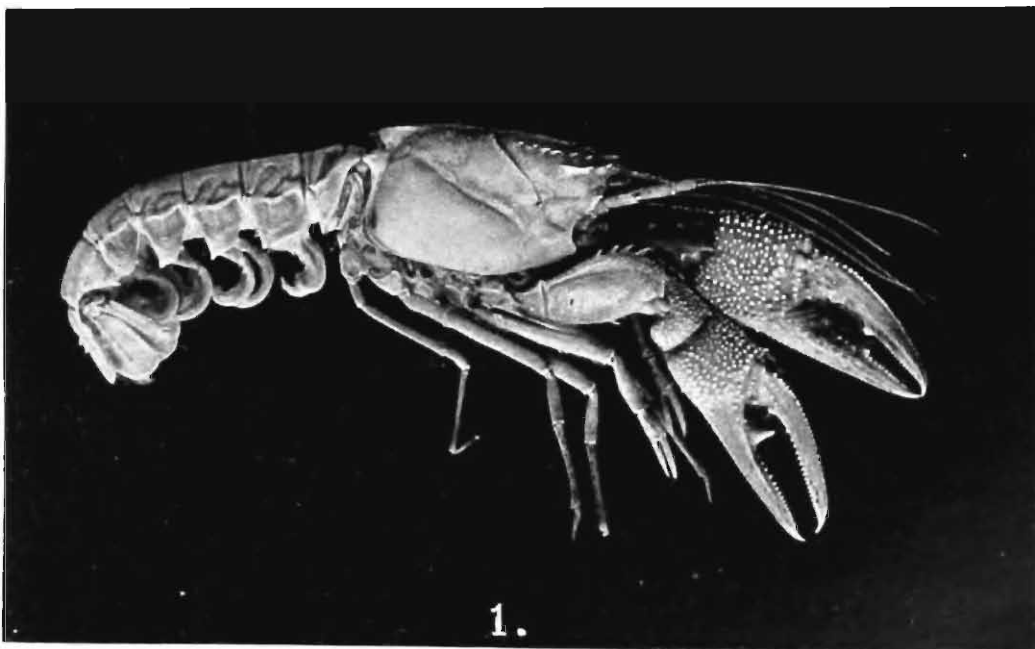
³ Alcock, *Cat. Indian Deep-Sea Crust. Decapoda*, pp. 187, 188 (Calcutta : 1901).

EXPLANATION OF PLATE VI.

Eutrichocheles modestus (Herbst).

Fig. 1.—Side view of the whole animal : natural size.

Fig. 2.—Right cheliped and first two walking legs : $\times 2$.



Subodh Mondul photo.

Eutrichochelus modestus (Herbst).

REMARKS ON TONNOIR'S THEORY OF THE EVOLUTION OF THE VENTRAL SUCKERS OF DIPTEROUS LARVAE.

By SUNDER LAL HORA, D.Sc., F.R.S.E., F.A.S.B., Assistant Superintendent, Zoological Survey of India, Calcutta.

After studying the early stages of the remarkable Indian Psychodid insects of the genera *Horaiella* and *Neotelmatoscopus* discovered by me in the Teesta Valley, Tonnoir¹ has tentatively proposed a new theory of the evolution of the ventral suckers of Dipterous larvae. His views are at such great variance with our knowledge of the form of hill-stream animals that, after a perusal of his manuscript, I wrote to him about the weak points in his chain of arguments. To this I have received no reply, and as the article is now published, I avail myself of the opportunity to show how faulty his explanation is.

Tonnoir traces the evolution of the sucker from very flattened forms, in which the ventral surface is horizontal and can be closely applied to the substratum. The dorso-ventral muscles of such a Dipterous larva would be able to convert the entire ventral surface into one large sucker. In the next stage, according to him, a fringe of hairs is developed round the margin "to facilitate the retention of the suction or vacuum." "In order to allow more mobility" the fringe now migrates towards the axis of the body, where, during the course of further evolution, it becomes discontinuous and forms a series of oval, more or less complete discs, which ultimately become perfected into powerful suckers, such as are to be found in the larvae of the Blepharoceridae. Tonnoir explains his theory with the help of a good diagram and states that in accordance with his theory the organs of attachment of the larvae of *Sycorax*, *Horaiella*, *Maruina*, *Neotelmatoscopus* and the Blepharoceridae would form an evolutionary series.

For a critical study of Tonnoir's views, noted above, it seems desirable to direct attention to the form of the body and the organs of attachment in the torrential population as a whole. As an adaptation to life in swift currents, the representatives of several groups of animals have evolved suckers or sucker-like adhesive devices to withstand the tearing away action of the rushing waters. A fairly detailed comparative study of these devices, in different groups of animals that have taken to living in torrential streams, is contained in my paper² on the "Ecology, Bionomics and Evolution of the Torrential Fauna, with special reference to the organs of attachment." In the same paper an account is given of the body-forms of these animals, and the physical principles involved in the mechanisms of attachment are also discussed. For a comprehensive study of the problem reference should, therefore, be made to this paper.

¹ Tonnoir, *Rec. Ind. Mus.*, XXXV, pp. 73, 74 (1933).

² Hora, *Phil. Trans. Roy. Soc. London*, (B) CCXVIII, pp. 171-282, pls. xv-xviii (1930).

The brook inhabitants are either greatly flattened dorso-ventrally or are cylindrical in form. The latter shape is suitable only for those animals that dangle freely in the current which flows on all sides of the animals, and, therefore, presents a stream-line form on every side. In most of the torrential animals the ventral surface is flat and horizontal, and this flattening becomes more and more pronounced as the animals invade swifter and swifter currents. The object of this modification is to enable the animal to cling to the substratum as firmly as possible, and this is secured by lessening the pressure on the under surface of the animal. Let us suppose that the water flows beneath an animal living in a torrential stream. Naturally the speed of the water will be retarded in this region and it will mean that the rate of flow of the current above the animal will be greater than that of the current below it. According to the principles of hydraulics, the pressure on the dorsal surface will thus be lowered and this will naturally tend to lift the animal from the substratum. A number of animals obviate this tendency by shooting out this water from beneath them with considerable force. Fishes do so with the inner rays of the pectoral fins, the Heptageniid nymphs (Ephemeroptera) by their gill lamellae and the larva of *Psephenus* (Coleoptera) and the nymph of *Prosopistoma* (Ephemeroptera) with the help of their tails. In the most highly adapted forms, such as the nymph of *Iron* (Ephemeroptera) and a number of Sisorid and Homalopterid fishes, the entire ventral surface becomes converted into a broad disc which when applied to the substratum is probably water-tight. According to Tonnoir's theory this useful process of increased flattening and the ultimate conversion of the entire ventral surface into a broad disc is reversed, for he supposes that in the evolution of the suckers the marginal adhesive fringe of forms like *Horaiella* shifted from the margins to the middle of the body. For purposes of adhesion there cannot be any advantage to the animal in the reverse process and to me it seems full of dangers, for frolicking about is a dangerous pastime in swift currents and, therefore, the inhabitants of brooks develop more and more statozoic habits, and there seems no desire on their part to secure "more mobility." From the evidence afforded by the modifications of the body-forms of brook inhabitants, it would appear that the larvae of *Sycorax* and *Horaiella* are more highly adapted for life in swift currents than are the larvae of *Maruina* and *Neotelmatoscopus*, in spite of the fact that the latter are provided with series of adhesive discs on their ventral surface. In fishes, a group of animals about which I am less ignorant, a regular series exists among the Sisoridae showing the shifting of the adhesive pad from the central part of the body to the periphery. I (*loc. cit.*, p. 236) refer here to the forms represented by the genera *Erethistes*, *Laguvia*, *Glyptothorax*, *Pseudecheneis*, *Glyptosternum*, etc. As I have already explained, when a fish begins to rest with the head pointing up-stream and the front part is pressed against the substratum, the thoracic part of its body comes in contact with the rocks, and consequently rugose adhesive pads appear in this region first of all. When the form becomes greatly flattened, these adhesive pads are replaced by similar pads that develop on the ventral surface of the outer rays of the paired fins. Even in species of *Garra* (*loc. cit.*, p. 234) that

live in very swift currents, the sucker becomes reduced and pads are developed on the rays of the paired fins. So far as I have been able to ascertain, the suckers of the chiton-shaped Blepharocerid larvae are proportionately smaller in size than those of the deeply segmented larvae. The reduction of the suckers in the broad larvae is compensated both by the form as well as by the spines and adhesive papillae that are developed on the ventral surface round the margin. It would thus appear that from the knowledge we possess Tonnoir's supposition cannot be correct.

The probable mode of origin and evolution of the powerful suckers of the fish *Garra*¹ and of the tadpoles of *Rana afghana*² have been studied from the developmental series of these animals. In both of them the sucker starts as a callosity of the skin which, by stages, becomes differentiated into the various structures of the discs of the respective animals. It is thus seen that in the fish and the tadpole the sucker develops as a totally new organ, and does not replace any pre-existing organ of attachment. The case of the Dipterous larvae, as well as of several other insect larvae, is different. Some of these possess pseudopods for progression on land, for burrowing or for crawling about in vegetation. When, by competition or some other impelling force, a number of them are obliged to invade flowing waters, these very pseudopods help them in fixation. Under the stress of stronger and stronger currents, the pseudopods become more and more perfected as organs of adhesion till in the Blepharoceridae, that live in the fiercest currents, they assume the form and function of perfect vacuum suckers. Tonnoir admits that in the sucker of the very young larvae of the Blepharoceridae "the number of rods is not as large and that the valvular gate is not yet present." It may also be pointed out that at this stage the structure of the funnel-like depressions is also different; they are represented by triangular spaces. In the earlier stages the characteristic piston of the Blepharocerid suckers is also in a nebulous condition. I have shown already that before the development of the valvular gateway, the discs of the Blepharocerid larvae cannot act as vacuum suckers, and that at this stage they can be compared with the pseudopods of insects. In order to give an idea of the working of the discs of the young Blepharocerid larvae, I compared them with the pseudopods of the Lepidopterous larvae.

My view regarding the evolution of the Blepharocerid sucker receives support from the fact that the body of the larva has become segmented secondarily round these points of fixation. From this consideration I advanced the view that in the ancestral form of the Blepharoceridae the pseudopods were probably present on the second to the seventh abdominal segments. The discovery of the larvae of *Neotelmatoscopus*, in which the pseudopod-like discs are present on the second to the seventh abdominal segments, is very significant and deserves more than casual attention. Feuerborn³ and Tonnoir (*loc. cit.*) have already referred to this character in connection with the affinities of the Blepharoceridae. I am not in a position to discuss the relationship of the Blepharoceridae

¹ Hora, *Rec. Ind. Mus.*, XXII, pp. 639-643 (1921).

² Hora, *Trans. Roy. Soc. Edinburgh*, LVII, pp. 469-472 (1932).

³ Feuerborn, *Arch. Hydrobiol.*, Suppl.-Bd. XI, pp. 55-128 (1932).

and the Psychodidae, but I hope some other student will make an unprejudiced study of this point. Whatever light the discovery of the *Neotelmatoscopus* larvae may shed on the probable ancestry of the Blepharoceridae, it is abundantly clear to me that *Maruina* and *Neotelmatoscopus* cannot be closely related. I do not agree with Tonnoir that the presence of eight 'suckers' in the larvae of *Maruina* represents a more primitive character than the six-sucker condition found in the larvae of *Neotelmatoscopus*; to my mind the variation in the number of suckers in the two forms denotes that *Maruina* and *Neotelmatoscopus* are evolved from different ancestors, the larvae of which possessed eight and six pseudopods respectively. It has been pointed out by Tonnoir that the larvae of the Psychoidae are eminently plastic in their faculty of adaptation. It is little wonder then that diverse types of larvae first developed pseudopods on various segments of the body, and that in those larvae that took to life in flowing waters, the pseudopods became transformed into sucking discs. The great diversity of form in the larvae would also explain the evolution of the very peculiar larvae of *Horaiella*. *Horaiella* is probably derived from an ancestral stock in which the larvae were greatly flattened dorso-ventrally. This form became still further accentuated under the stress of swift currents. It would thus seem that *Horaiella*, *Maruina* and *Neotelmatoscopus* are evolved from entirely different ancestral forms and whatever similarity they now possess is due to convergence in response to the similar special habitat.

ON THE ANATOMY OF *MARPHYSA GRAVELYI* SOUTHERN.

By R. GOPALA AIYAR, M.A., M.Sc., Madras.

INTRODUCTION.

The following investigation was mostly carried out at the Department of Oceanography, University of Liverpool, on material taken from India. Observations on the living worms were made at the University Zoological Laboratory, Madras, and were of invaluable help in elucidating points particularly in regard to the vascular system and the nephridia, a knowledge of which could not be easily gained from preserved material.

For killing and preserving Pouin's fluid, corrosive sublimate, corrosive acetic, 2 per cent. ammonium bichromate or 0.5 osmic acid was tried. Sublimate mixtures, followed by Mann's methyl-blue Eosin, or Heidenhain's iron-haematoxylin stain gave the most satisfactory results. For the brain and the sense organs ammonium bichromate and osmic acid were both found to be useful. Fixing in osmic vapour followed by maceration in 40 per cent. alcohol was employed for studying certain histological details. For nephridia, injection of carmine was tried, but though the worms survived the treatment for twelve hours, subsequent examination showed no carmine particles in the nephridia.

For peripheral nerves, vital staining with methylen blue and Bielschowsky's nerve staining with silver nitrate were tried, but several points could not be cleared up.

I am deeply grateful to the late Professor Johnstone of the Department of Oceanography for guiding me in my work during my stay at Liverpool. I wish to express my very sincere indebtedness to Mr. Daniel of the same department for several useful suggestions and his untiring zeal in helping me during the progress of this work, and to Mr. Tudor Jones of the School of Tropical Medicine, Liverpool, for giving me hints in connection with nerve staining. I am also thankful to Lt. Col. R. B. Seymour Sewell and Dr. B. Prashad of the Indian Museum, Calcutta, for going through the manuscript and making several valuable suggestions.

Marphysa Quatrefages.

Marphysa is a widely distributed genus; species of it have been recorded from all coasts, though so far only a few have been described from the Indian coasts; namely *M. mossambica* (Peters), *M. furcellata* (Crossland), *M. mcIntoshi* (Crossland), *M. gravelyi* (Southern) and *M. sanguinea* (Montagu). Of these *M. gravelyi* has taken to a brackish water life while the others are marine with a littoral habitat.

Marphysa gravelyi, which forms the subject of this memoir, occurs in large numbers near Madras, wherever brackish water conditions prevail. I have not found it to occur on the sea shore, but only in those low-lying parts of the Madras Coast which, while retaining their connection with the sea during the rainy months, are completely cut off from it during the rest of the year. The general physical conditions of

such areas are similar to those of the Chilka Lake described by Annandale and Kemp (1915). There is the same flooding and consequent decrease in salinity during the rainy months. During the hot weather a sand bar forms gradually and all connection with the sea is lost. The soil in these areas is partly clay and partly sand. These worms show a preference for the less sandy parts, and seem to thrive in places where there is admixture of sewage water. Like *Arenicola* of the European coasts, they live head downwards in burrows, which may be located by the worm castings. The burrows of two or three individuals often merge underground. The walls of the burrows are usually lined with sand grains, cemented together with mucus. Frequently the worms take up their abode in the empty tubes of *Diopatra variabilis*, another Eunicid which is of common occurrence in the brackish waters of these parts. Like *Marphysa sanguinea* in Europe this form is used as a bait for fish. With a strong flat piece of wood the local fishermen dig up large lumps of clay which are taken out of the water and then carefully examined for worms which are dislodged without injury from the clay and kept in water in earthenware vessels. The worms do not exhibit any rapid movements when caught. When a sufficient number has been collected, they are carefully washed several times, freed from all adhering sand-grains and left in pots of clean water. Care is taken to place only the entire worms together. Introduction of broken worms, as has been observed in *Arenicola* by Ashworth (1904), has a softening effect on healthy animals, probably due to the admixture of coelomic fluid with water. If kept cool in the open at night, they live for two to three days but after that they are useless as bait as they become flaccid and motionless and the skin also peels off. During day the men, while engaged in fishing, frequently change the water to keep the worms in a healthy condition as living worms only can be used as bait. On a low estimate about 150 fishermen are engaged daily throughout the year, in and around Madras, in digging up the worms for bait to catch such fishes as *Sillago sihama* (the Indian whiting), *Chrysophrys berda* (the black rock-cod), *Therapon jarbua*, *Therapon quadrilineatus*, species of *Mugil*, *Etroplus suratensis*, *Lates calcarifer* and species of *Ophicephalus* (the murrel), and *Sciaena*. All these take bait freely. Most of the species of fish mentioned live in the sea, but also enter brackish waters. McIntosh (1910) mentions that the closely related *M. sanguinea* is used as a bait by the fishermen of St. Peter Port and Channel Islands, generally under the term 'Varme,' being highly prized as a tempting bait for the capture of whiting, wrasses, and other ordinary fishes, as well as dog-fish. The men search for the worms with spades at low water. The fishermen of Marseilles also use *M. sanguinea* as bait.

The Madras worms lay their eggs in large cylindrical masses of jelly, about nine inches long and $1\frac{1}{2}$ inches in diameter, narrowed at one end to a stalk, which is enclosed in the burrow of the worm. Though mature worms are not rare all the year round, there is a distinct reproductive period immediately after the onset of the rainy weather (October), when the egg masses are produced in very great abundance. The larvae pass their initial stages of development in the jelly, but later, when about half a dozen setigerous segments have been formed, the creeping mode of

life is commenced. It is interesting to note that there is no free swimming stage at all, and the adult characters are acquired very slowly. Other details of development, in so far as the external characters are concerned, have been published by me in a previous paper (1931).

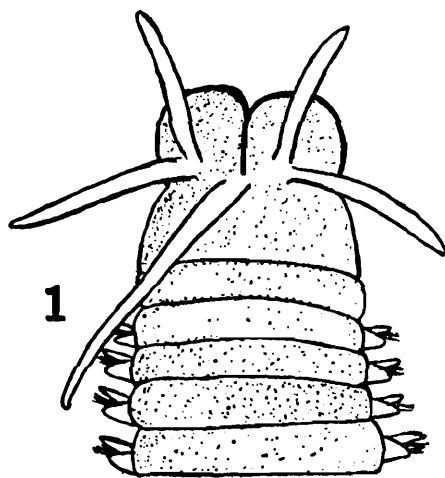


FIG. 1.—Anterior end of worm, dorsal view.

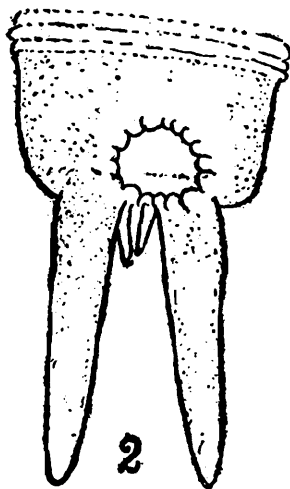


FIG. 2.—Anal end of worm, dorsal view.

External characters.—Some of the largest worms are nearly 45 cm in length and contain more than 700 segments. The anterior end of the body up to the 5th segment is cylindrical, but behind this segment it is dorsoventrally flattened. The skin is iridescent, and the first few anterior segments are greenish. The posterior region is usually blood-red in colour but the intensity of colour in this region varies according to the state of contraction of the body. The gills vary from deep red to yellowish red. The tentacles are light yellow. The head has a deep notch (Fig. 1) which is continued back dorsally as a median groove to the base of the middle tentacle and ventrally to the mouth. The lobes of the prostomium are almost spherical, slightly broader in front than behind, and as long as, or a little longer than, the peristomium. Eyes, when present, are very small and are situated at the base of and external to the intermediate tentacles. They are, however, better developed in the young than in the full grown forms. There are five fleshy tentacles which are not ringed. The median tentacle, which is the longest, is twice as long as the prostomium and extends, when folded back, to the posterior edge of the second pedigerous segment. The anal segment (Fig. 2) is

rounded and the anal opening is directed dorsally and has thick tumid lips. Two pairs of anal cirri are present, the ventrals being much the shorter.

Various terms have been employed by different authors to describe the pieces forming the dental armature. Those employed by Southern are used here and the corresponding terms used by other English workers are given within brackets. The mandibles (Fig. 4) are mostly jet black, the posterior ends being light in colour. The anterior end is truncate and ringed, and the inner edge is black while the outer is more lightly coloured. The maxillae (*mx.*) (forcipate jaws) are stout with supports which are fused together along their whole length and are shorter than the blades. The anterior end of the blade is black. The maxillary plates (*mx. p.*) (second pair of maxillae) have six teeth on the right side and only five on the left. The azygos plate (*az. p.*) (third pair of maxillae) is crescent shaped. Its rim is thickened and is very black and is provided with 12-13 teeth. The right anterior crescentic plate (*cr. p.*) (fourth pair of maxillae) has eight teeth. The left is smaller and has six teeth. Two rectangular horny pieces (*r. p.*) (fifth pair of maxillae) with thickened rims occur in front of the dental apparatus. There is usually an extra anterior crescentic plate, on one side.

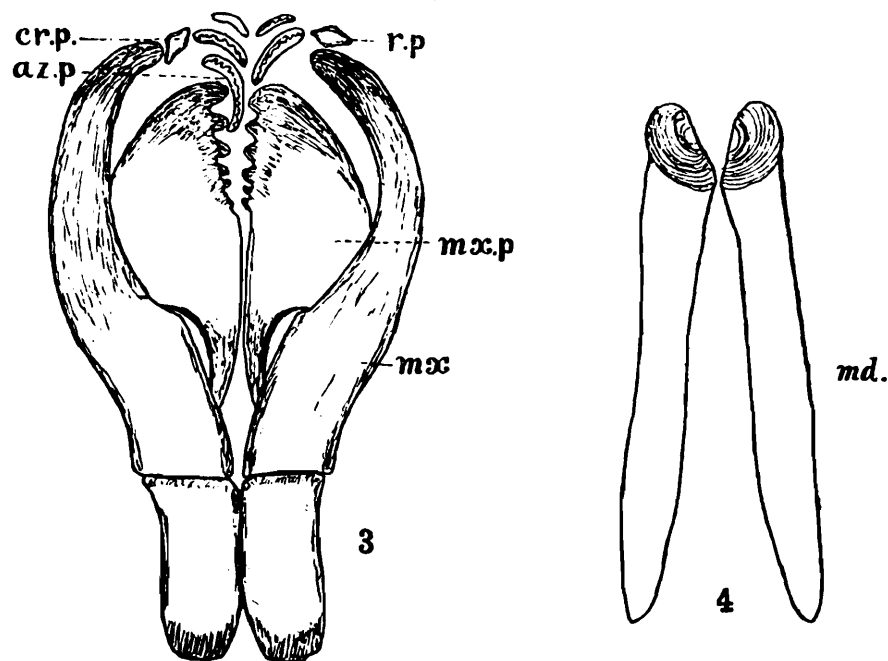


FIG. 3.—Dorsal view of dental armature; mandibles are not shown. *az.p.* Azygos plate; *cr.p.* Crescentic plate; *mx.* Maxilla; *mx.p.* Maxillary plate; *r.p.* Rectangular piece.

FIG. 4.—*md.* Mandible.

The feet increase in size up to the 9th or 10th segment. The first foot (Fig. 5) has a dorsal cirrus, broad at the base and rapidly narrowing to a blunt point. It is highly vascular. The ventral cirrus is stouter and shorter. Between the two is a rounded lobe with a fillet in front. There are three black acicula. Above these there is a group of capillary setae of various lengths with flattened, very finely serrated blades. The ventral group consists of several compound setae with very minutely serrated terminal blades.

The 10th foot (Figs. 7 and 8) has 4 black acicula and two fillets. The acicula are more internally paced and the two groups of setae are enclosed between two fillets (Fig. 8). The acicula are black except at their tips where they are light yellow,

In the 40th foot (Fig. 9) the dorsal and ventral cirri are smaller. The median lobe is provided with two fillets and three acicula. The dorsal

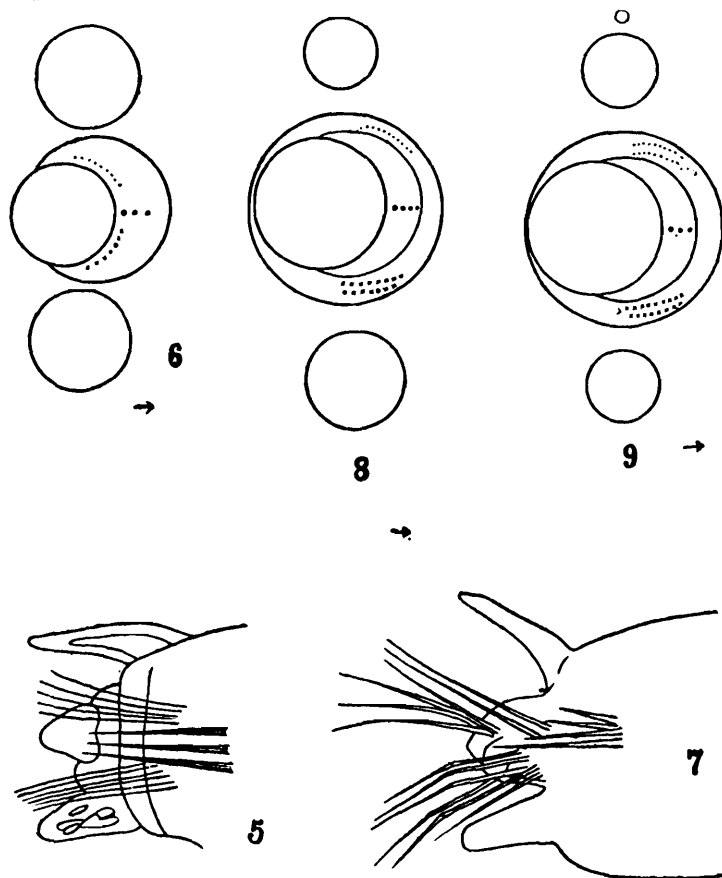


FIG. 5.—First parapodium.

FIG. 6.—Parapodial diagram of first foot, side view; arrow points to the front.

FIG. 7.—10th parapodium.

FIG. 8.—Parapodial diagram of 10th foot, side view; arrow points to front end.

FIG. 9.—Parapodial diagram of 40th foot; arrow points anteriorly.

group of setae has very often, in addition, one comb seta. The comb seta projects only one third up the side of the other setae. The teeth of the comb are very fine and the two outer teeth are longer. The ventral group of setae consists of compound setae with uniformly serrated blades. Along with the ventral group of setae is a hook seta, the tip of which is protected by two minute wings.

Behind the 150th foot (Figs. 10 and 11), in moderately large specimens, the compound setae on the ventral side are gradually replaced by capillary setae and the replacement is complete before the 250th foot is reached. A single aciculum is present which has a powerful spine with a guarded tip on the ventral side. In addition to the capillary setae in the dorsal set, comb setae of two kinds are present (Fig. 12). There may be as many as 4-5 comb setae in a group. One kind is shorter than the other, is abruptly broadened at the distal end, and is provided with 14-15 coarse long teeth (Fig. 13). The second kind of comb seta is longer and projects more to the outside. The distal end is spatulate and has 23-26 fine short teeth of which the outermost on each side projects beyond the rest (Fig. 14).

Branchiae.—The gills are well developed and are found on the greater part of the body, commencing in full sized specimens from about the 30th segment. They attain their full development in the posterior two-thirds of the body. They are typically pectinate, and in big specimens,

as many as 12 filaments may be seen in some of the gills. The filaments are not ringed, and the branchiae do not meet over the back of the worm.

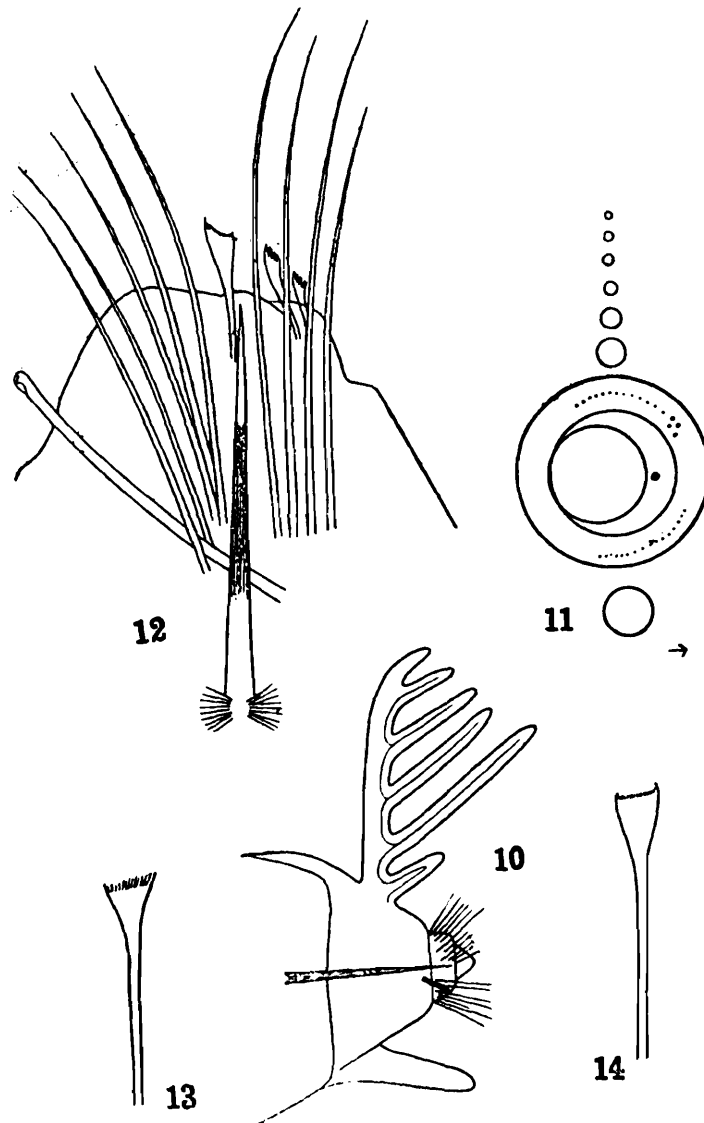


FIG. 10.—450th parapodium of a medium sized worm.

FIG. 11.—Parapodial diagram of 450th parapodium.

FIG. 12.—Parapodium from a posterior segment of a large worm to show the nature of setae. Cirri and gill are not shown.

FIG. 13 and FIG. 14.—Two forms of comb setae.

There is considerable variation in the distribution of the gills and in the number of filaments they carry. In some cases the first gill is present on one side only. The following table gives the variations for 4 specimens.

No. of Specimen.	1	2	3	4
Total No. of segments in each	168	200	215	250
Segments with gills of—				
1 filament	21-22	22-25	21-24	24-
2	23-39	26-48	25-37	26-38
3	40-49	49-66	38-52	38-47
4	50-78	67-131	52-90	48-75
5	79-124	80-112	90-170	75-140
Reduction of filaments in segments	125-168	113-200	171-215	141-250

In a big specimen with 650 segments, the first gill filament was on the 31st segment, and the maximum number of filaments was 12.

The present form is very peculiar in having capillary setae in the lower setigerous group of the feet in the middle and posterior segments. During the development of the worm, the posterior segments give rise to both compound and capillary setae until the growing worm has 120-150 segments. When about 150 segments have been formed only capillary setae are produced in the posterior segments.

The Madras worm differs from the typical specimens of *Marphysa graveleyi* in having two kinds of brush setae, one with a few coarse teeth and the other with a larger number of finer teeth. The published figures of the brush setae of *Marphysa graveleyi* do not resemble these. The Madras form differs also in having 12-13 teeth on the azygos plate, in having the compound setae slightly different and in the larger number of branchial filaments.* Eyes are present in young individuals only.

The present form shows some resemblance to *M. californica* but differs in:—

- (1) The tentacles are not ringed,
- (2) The median tentacles are the longest,
- (3) The presence of fewer acicula in large specimens,
- (4) The variability in the number of teeth in the dental apparatus,
and
- (5) The relative length of the segments.

The *cuticle*, which is a characteristic structure in the Annelida, forms the external covering of the body. It not only covers the body, gills and the parapodia but is also continued into the mouth forming an internal lining to the pharynx and the dental pouch. It has a stratified appearance, consists of several layers, 8-12 of them being made out in some regions of the body. It stains blue with Mann's methyl-blue eosin after fixation in corrosive sublimate. The thickness of the cuticle varies and, speaking generally, it is thicker on the ventral surface than on the dorsal. On the gills, parapodia, and the posterior segments it is very thin.

Below the cuticle there is the hypodermal layer, which by its activity gives rise to the cuticle. It is generally formed of a single layer of vertically elongated cells (Fig. 15). In some parts of the body, it is more than one cell in thickness. They are short, for instance, on the anterior and the posterior face of each parapodium, while below they are more elongated. The protoplasm of the cells is granular and the cell boundaries are well marked, when properly stained. The nuclei are spherical to oval and stain well with iron-haematoxylin and Mann's methyl-blue eosin. They lie generally near middle of the length of the cells. The chromatin in the nucleus is granular and forms a network. In the newly formed posterior segments the cells are for the most part very short,

* For the reasons stated above it was my intention to describe the Madras *Marphysa* as a new species, and Southern to whom the specimens were sent also thought them to be different from *M. graveleyi*. Fauvel, however, to whom the specimens were sent by Dr. Graveley of the Madras museum refers them to *M. graveleyi*, and I have followed the identification of the French authority.

though considerably elongated ventro-laterally where the ventral surface of the body wall passes into the lower half of the parapodia. Fig-

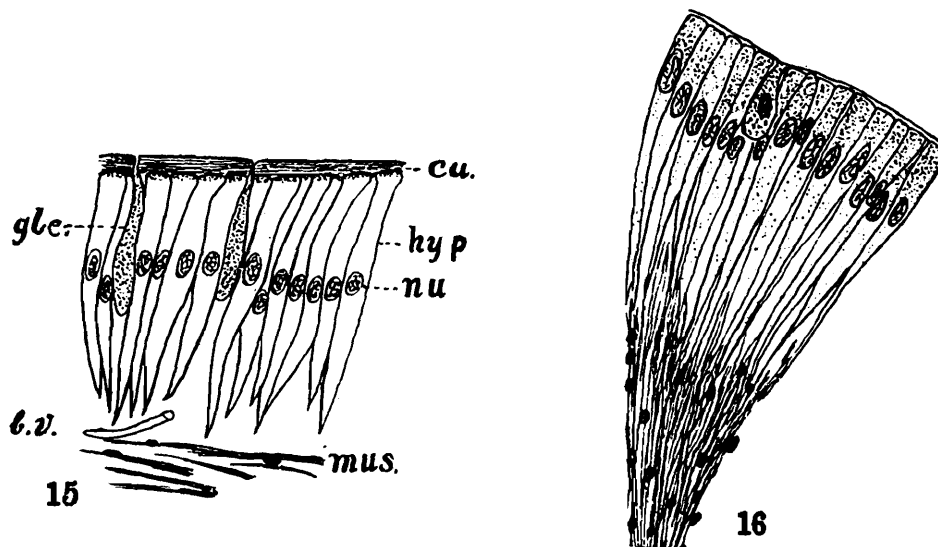


FIG. 15.—Hypodermal cells from the side of the body. *b.v.* Blood vessel; *cu.* Cuticle; *gl.c.* Gland cell; *hyp.* Hypodermis; *mus.* Muscles; *nu.* Nucleus.
FIG. 16.—Prostomial cells.

ment granules occur at the outer ends of the cells and are more numerous in the cells of the prostomium (Fig. 16) and peristomium than in the rest of the body, and in these regions the nuclei are situated in the outermost half of the cells.

In addition to the hypodermal cells there are gland cells which occur singly. These are (Fig. 15 *gl. c.*) elongated and have granular contents and oval nuclei. They open through pores in the cuticle.

Parapodial Glands.—In addition to the gland cells in the hypodermis there are other glandular structures which do not belong to that layer, but occupy definite positions in relation to the body wall. The more important of these glands are specially well developed in the parapodia of the middle and the posterior segments, and may be called parapodial glands. Each gland (Fig. 17) lies ventral to the setigerous tuft and consists of large protoplasmic cells which do not stain readily. The cells are slightly elongated and have their inner ends broader than the outer. They are all closely packed together and there is no internal cavity. Jourdan (1887) has suggested that in *Eunice harassii* the cells open by separate pores to the outside. No pores of the kind described could be made out in this form. The same author has suggested that the glands secrete mucus. There is no doubt that this is so. The eggs of this worm are known to be laid in a jelly which is formed by the action of water on mucus. Often, when the worm is irritated the glands secrete rapidly and the mucus swells up in water in the form of minute masses of jelly on either side.

Pigment glands.—Below the dorsal cirrus in each parapodium there is another gland about the nature and function of which there has been some confusion. These glands are easily seen in transverse and longitudinal sections and in the living worm appear as dark pigment spots. Such structures are of common occurrence in species of *Eunice* also, and were considered as segmental organs by Ehlers (1864-8). Later Claparede (1871) pointed out the misapprehension, but thought them to

be visual in function. Fig. 18 shows one of these glands. There is a rather eccentrically placed cavity filled with pigment. Projecting into

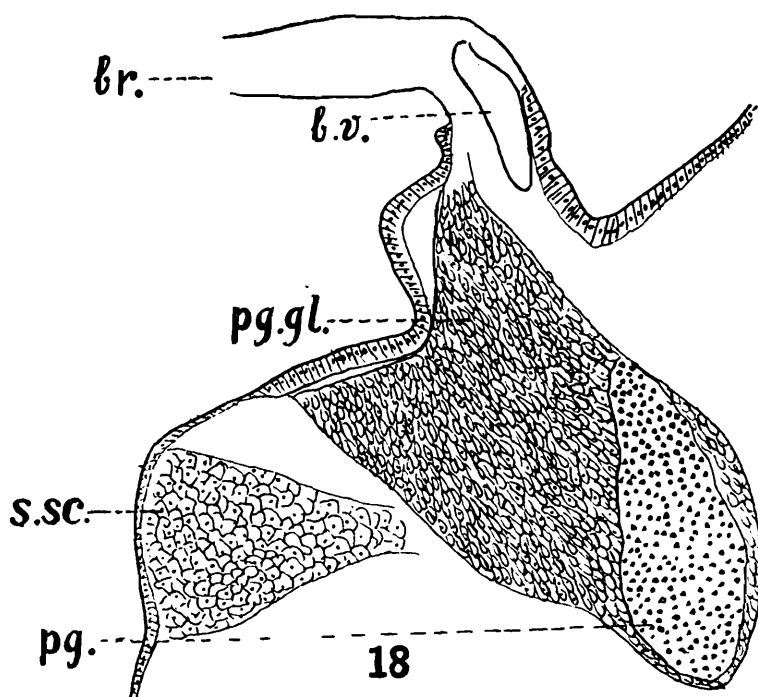
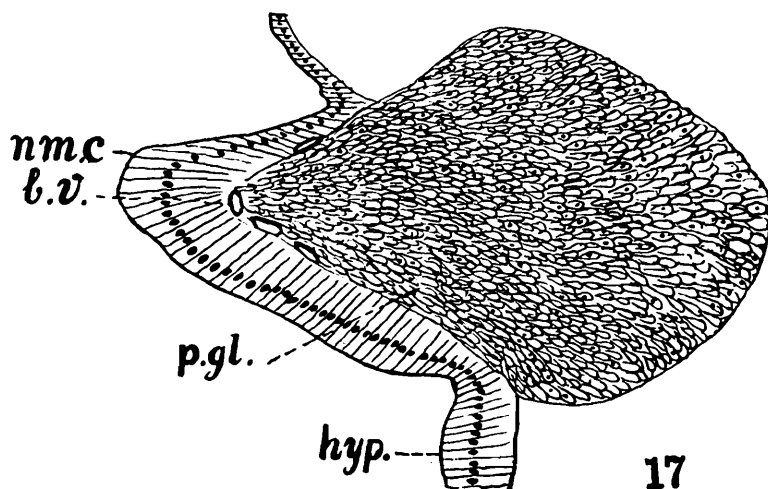


FIG. 17.—A parapodial gland. *b.v.* Blood vessel; *p.gl.* Parapodial gland; *hyp.* Hypodermis; *nmc.* Neuropodial cirrus.

FIG. 18.—A pigment gland. *br.* Gill; *b.v.* Blood vessel; *pg.* Pigment; *pg.gl.* Pigment gland; *s.sc.* Setal sac.

the mass of pigment are sometimes seen two or three slender spines which are the only representatives of the absent notopodium. No duct of any kind could be seen. The cells constituting the walls of the pigment gland are very similar to those of the parapodial glands. Pruvot (1885) has suggested that the pigment granules are formed as the result of the katabolic activity (*désassimilation*) of the cells and are actually of the nature of an excretory product got rid of in a manner not clearly understood. Jourdan (1887) basing his conclusions on a histological study has supported Pruvot's suggestions.

It is interesting to note that in sections of newly formed segments the pigmental organs contain very little pigment. Further, pigment formation becomes very pronounced when the coelomic cavity is filled with reproductive elements. These facts seem to point to the conclusion

that the cells are homologous to those forming the parapodial glands and that the centrally placed cells undergo degeneration and that the rate of degeneration is greatest during the reproductive phase.

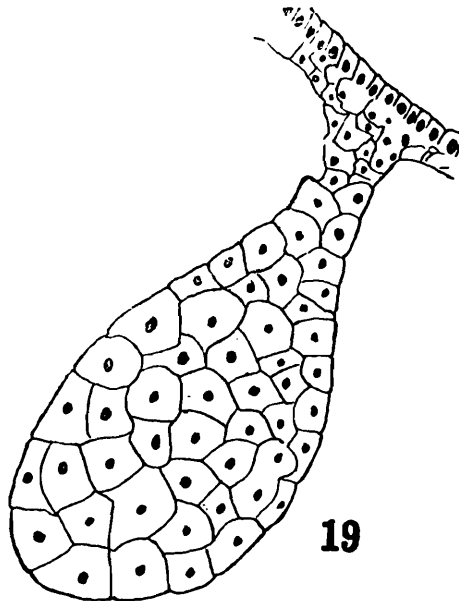


FIG. 19.—A solid gland from the peristomium.

Other glands.—Besides the glands mentioned there are others, which I believe are recorded here for the first time, and which are confined to the anterior end of the peristomium only. They are in the form of clusters (Fig. 19) and occur in grape-like bunches on the sides and on the ventral part of the peristomium bounding the entrance to the mouth. The cells composing the glands are highly protoplasmic and the nuclei are difficult to stain. Though the narrow end of the cell clusters are in relation with the hypodermis, no duct could be made out. The glands seem to belong to the category of solid glands and probably secrete mucus.

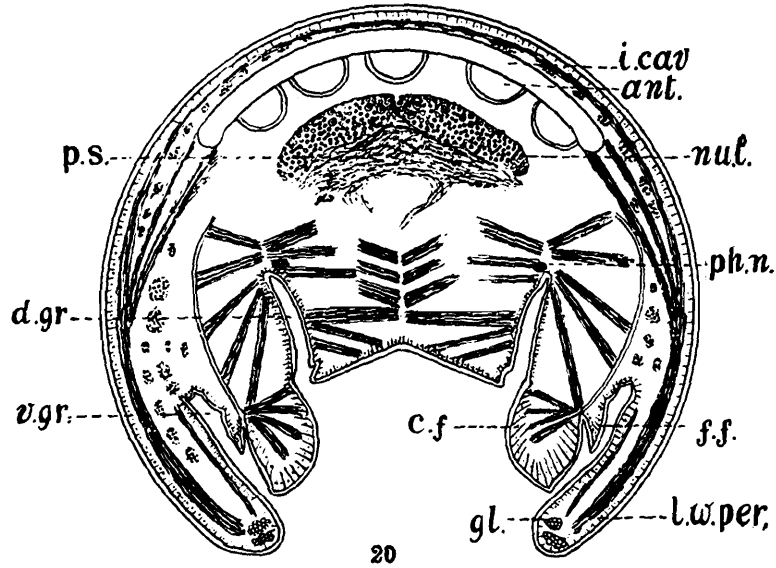
There is very little connective tissue between the hypodermis and the underlying circular muscle-sheath. The muscle-sheath is generally of uniform thickness throughout the body but is better developed behind the prostomium in the region of the pharynx, especially on the ventral side. Intersegmentally it is interrupted and laterally it is carried inwards along the ventral and dorsal bands of longitudinal muscle. In the newly formed posterior segments it is but little developed and is hardly recognizable. No intermuscular substance in the form of any connective tissue has been observed.

The layer of longitudinal muscles is internal to the circular muscles and consists of four large bands, two dorsal and two ventral (Fig. 32). The dorsal bands, unlike those of *Nereis*, are closely apposed and the blood vessels are therefore completely pushed into the body cavity, whereas in *Nereis* the two bands are separated by the single dorso-median blood vessel. The ventral bands are well developed, and are separated from each other by the median ventral nerve cord. The dorsal and the ventral bands are separated by a space on the sides occupied by septal muscles which work the setae. In the middle and the posterior segments the ventral bands are better developed, while in the pharyngeal region the dorsals are more powerfully developed.

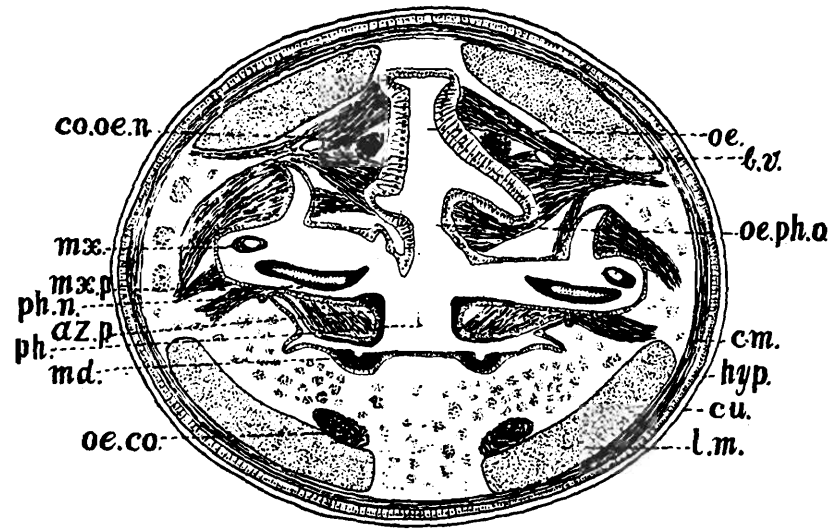
In the anterior region the dorsal bands are attached to the base of the prostomium and the ventrals to the extreme anterior end of the peristomium. McIntosh (1910) has observed the strong development of the ventral bands in species of *Marphysa* generally. In a number of Eunicids studied by various workers the powerful development of the longitudinal bands has been observed. In *Eunice* and *Lysidice*, the dorsal bands are better developed than the ventral, while in *Marphysa* the reverse is the case in the greater part of the body. Under high magnification the longitudinal muscle fibres appear to be flattened and to have a wavy margin, and obliquely cut ends. Often an oval nucleus can be seen about the middle of the muscle fibre. The oblique muscles are uniformly developed and are characteristic of the Polychaetes. They are practically absent in the first few segments where the coelomic cavity is almost obliterated by the greatly developed dental pouch. Behind the dental pouch they occur in each segment. From the dorso-lateral border of the nerve sheath of the ventral nerve cord they pass obliquely outwards and upwards external to the outer side of the dorsal longitudinal muscle on each side and are inserted into some of the circular muscles. By this arrangement, they divide each compartment into three parts, a central containing the two dorsal blood vessels and the alimentary canal, and the two lateral containing the nephridia and the vascular loops (Fig. 32).

The *alimentary canal* commences in the mouth, which in front, is in continuation with a deep groove on the ventral side of the prostomium. The front end of the peristomium does not project uniformly all round but the upper portion extends a little more forwards than the lower. Fig. 20 is a transverse section of the worm just in front of the lower lip of the peristomium. It will be seen that in this region the entrance to the mouth is formed by the overhanging lateral walls (*l. w. per.*) of the extreme anterior end of the peristomium. On the inner side of the lateral wall there are two deep grooves (*v. gr.* and *d. gr.*) on either side, which mark off the more centrally placed structures including the roof of the mouth. Between these lie two folds, the upper (*c. f.*) large and cushion-like, the lower (*f. f.*) small and frill like. The cuticle on the roof of the mouth is thick while the folds are covered by thin cuticle only. The hypodermal cells below the cuticle are normal, except on the folds mentioned where they are greatly elongated and some of them can be observed to have their bases produced into protoplasmic processes passing into the tissues below (Fig. 44). There can be no doubt, considering their position, shape and arrangement, that they are sensory cells.

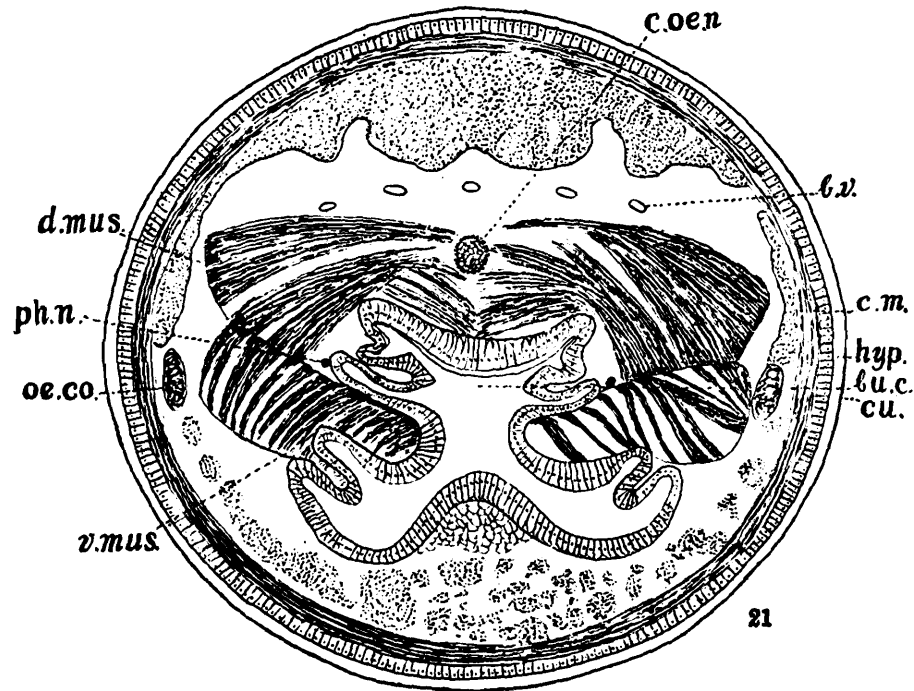
The mouth leads into a buccal cavity which occupies the anterior half of the peristomium. The floor of the cavity is pierced by a median longitudinal slit—the pharyngo-oesophageal slit—leading into a ventrally placed pharynx or dental pouch. The slit extends up to the first setigerous segment. The dental pouch is highly muscular and is a sort of *cul-de-sac*, characteristic of the Eunicidae. It is lined throughout by cuticle, which, in certain regions, is thickened into the jaws, constituting the dental armature. The pouch extends up to the middle of the 6th setigerous segment. It is highly interesting to note that while in forms like *Nereis* the muscular pharynx containing the



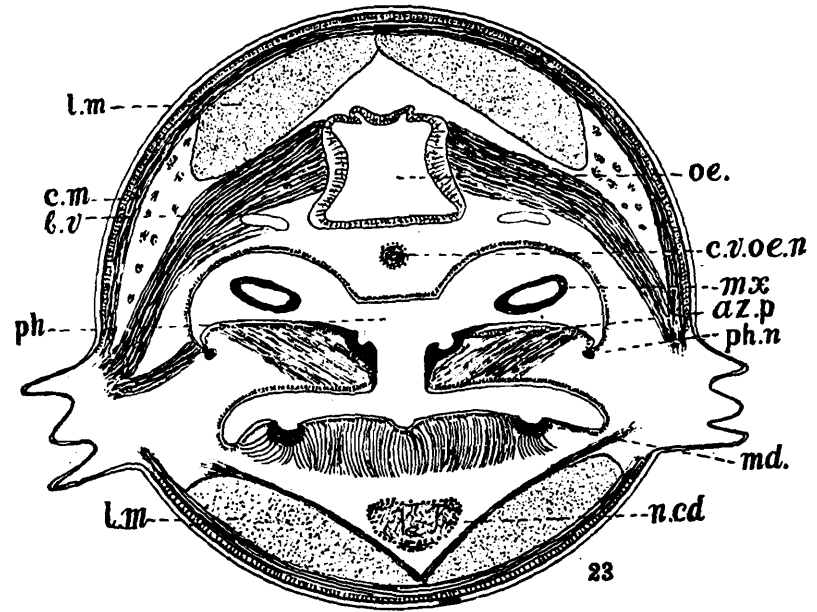
20



22



21



23

FIG. 20.—Transverse section of the worm through the part just in front of the lower lip of the peristomium. *ant.* Antenna; *c.f.* Cushion like fold; *d.gr.* Upper groove on the side of the roof of the mouth; *f.f.* Frill like fold; *gl.* Gland; *i.cav.* Interspace between peristomium and base of prostomium; *l.w.per.* Lateral wall of peristomium; *nu.l.* Nuclear layer; *p.s.* Punctated substance; *ph.n.* Pharyngeal nerve of the stomato-gastric nervous system; *v.gr.* Lower groove.

FIG. 21.—Transverse section through the anterior part of the peristomium. *b.v.* Blood vessel; *bu.c.* Buccal cavity; *c.m.* Circular muscles; *c.oe.n.* Common dorsal oesophageal nerve of the stomato-gastric nervous system; *cu.* Cuticle; *d.mus.* Upper group of muscles of the dental pouch; *hyp.* Hypodermis; *oc.co.* Oesophageal commissure; *ph.n.* Pharyngeal nerve of the stomato-gastric nervous system; *v.mus.* Ventral group of muscles of the dental pouch.

FIG. 22.—Transverse section through the posterior part of the peristomium. *az.p.* Azygos plate; *b.v.* Blood vessel; *c.m.* Circular muscles; *co.oe.n.* Commissural oesophageal nerve of the stomato-gastric nervous system; *cu.* Cuticle; *hyp.* Hypodermis; *l.m.* Longitudinal muscles; *md.* Mandible; *mx.* Maxilla; *mx.p.* Maxillary plate; *oe.* Oesophagus; *oe.co.* Oesophageal commissure; *oe.ph.o.* Oesophageo pharyngeal opening; *ph.* Pharynx; *ph.n.* Pharyngeal nerve of the stomato-gastric nervous system.

FIG. 23.—Transverse section passing through the third setigerous segment. *az.p.* Azygos plate; *b.v.* Blood vessel; *c.m.* Circular muscles; *c.v.oe.n.* Common ventral oesophageal nerve of the stomato-gastric nervous system; *l.m.* Longitudinal muscles; *md.* Mandible; *mx.* Maxilla; *n.cd.* Nerve cord; *oe.* Oesophagus; *ph.* Pharynx; *ph.n.* Pharyngeal nerve of the stomato-gastric nervous system.

jaws lies in a direct line with the gullet, in the Eunicids, the pouch occupies a position which is unique in the Polychaetes. Figs. 21-24 show the relationship of the dental pouch and the gullet in the seven anterior segments. It will be seen that the pouch occupies so much of the body space that the gullet is highly compressed and occupies a dorsal position. Anteriorly, the pouch and the gullet are encircled by muscles while posteriorly they are practically free. In segments 7 and 8 the gullet makes a sharp bend downwards and again turns upwards thus forming a distinct U-shaped loop from the anterior limb of which a few muscles pass to the posterior blind end of the dental pouch. These muscles probably aid the retractors of the pouch. At this point a bundle of muscles passing on each side from the posterior end of the dental pouch, runs outwards and backwards on either side of the U-shaped bend of the gullet and is inserted into the body-wall. These two bundles are the great retractors (*r. m.*) of the dental pouch (Fig. 26).

The dental pouch is circular in section and contains the complicated jaw apparatus. It is developed very early, being present even in the nectochaeta stage of development. The muscles which work the jaws are symmetrically disposed and they are so well developed that they project into the lumen of the pouch as thick cushions carrying the dental armature (Fig. 21). They may be said to fall roughly into two groups, the dorsal and ventral, and according as the jaws are attached to the dorsal or the ventral group they have been called "superior" and "inferior" by various workers. The mandibles (inferior jaws) are worked by the ventral group of muscles. The remaining pieces of the dental armature are carried by the dorsal group and hence the maxillae, the maxillary plates and the azygos plates are dorsal in position (Fig. 22), while the mandibles or the lower jaws are ventral in position, but the position of the dental pieces in a section varies very much according to the state of contraction of the muscles of the dental pouch at the time of fixation. In Fig. 25 which is an instance in point, the jaw

apparatus seems thrust forward and the various pieces have an unusually anterior position. The muscles carrying the mandibles, as shown in

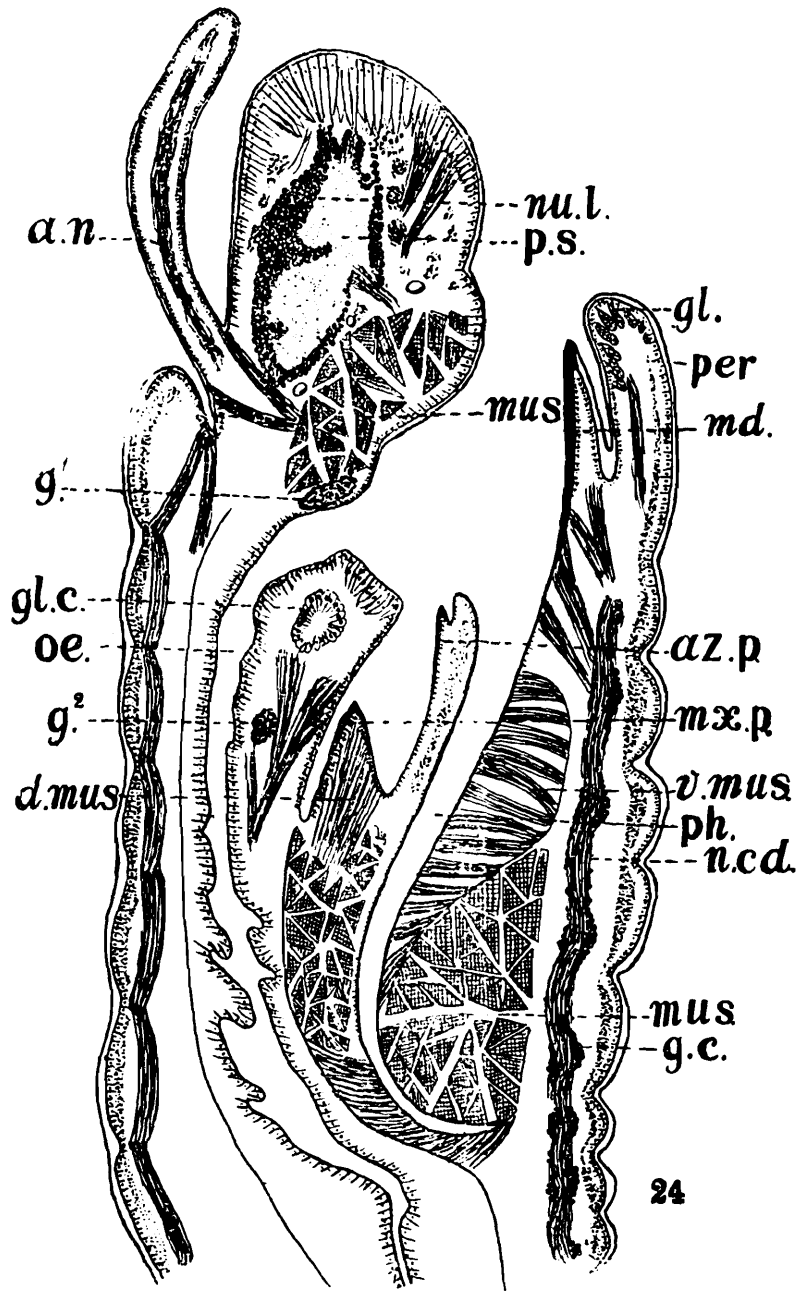


FIG. 24.—Vertical longitudinal section of the anterior end of worm. *a.n.* Antennal nerve; *az.p.* Azygos plate; *d.mus.* Upper group of muscles of the dental pouch; *g.c.* Ganglion cell; *g.¹* & *g.²* Ganglia of the stomato-gastric nervous system; *gl.* Gland; *gl.c.* Gland cells; *md.* Mandible; *mus.* Muscles; *mx.p.* Maxillary plate; *n.cd.* Nerve cord; *nu.l.* Nuclear layer; *oe.* Oesophagus; *per.* Peristomium; *ph.* Pharynx; *p.s.* Punctated substance; *v.mus.* Ventral group of muscles of the dental pouch.

the figure, project so much that the extremities of the mandibles meet along the midventral line dividing the central cavity into a narrow ventral lumen and a more spacious dorsal chamber containing the rest of the dental armature. Behind the posterior end of the mandibles the muscle ridges actually fuse and form a partition between the dorsal and ventral chambers. The posterior end of the dental pouch is firm and it is to this part that the great retractor muscles (Fig. 26, *r.m.*) are attached. In life, the dorsal pieces of the dental armature can be seen to protrude and have a large amount of play on one another, as well as against the lower jaw.

The colour, strength, and number of teeth on the dental pieces vary according to the age of the animals. Ehlers (1864-68) based his classification of the Eunicids into 'Eunicia labidognatha' and 'Eunicia priognatha' on certain differences in the dental characters. Bonnier (1893) subsequently pointed out the highly artificial nature of this classification and showed how *Ophryotrocha* would belong to the former group when young and to the latter when adult.

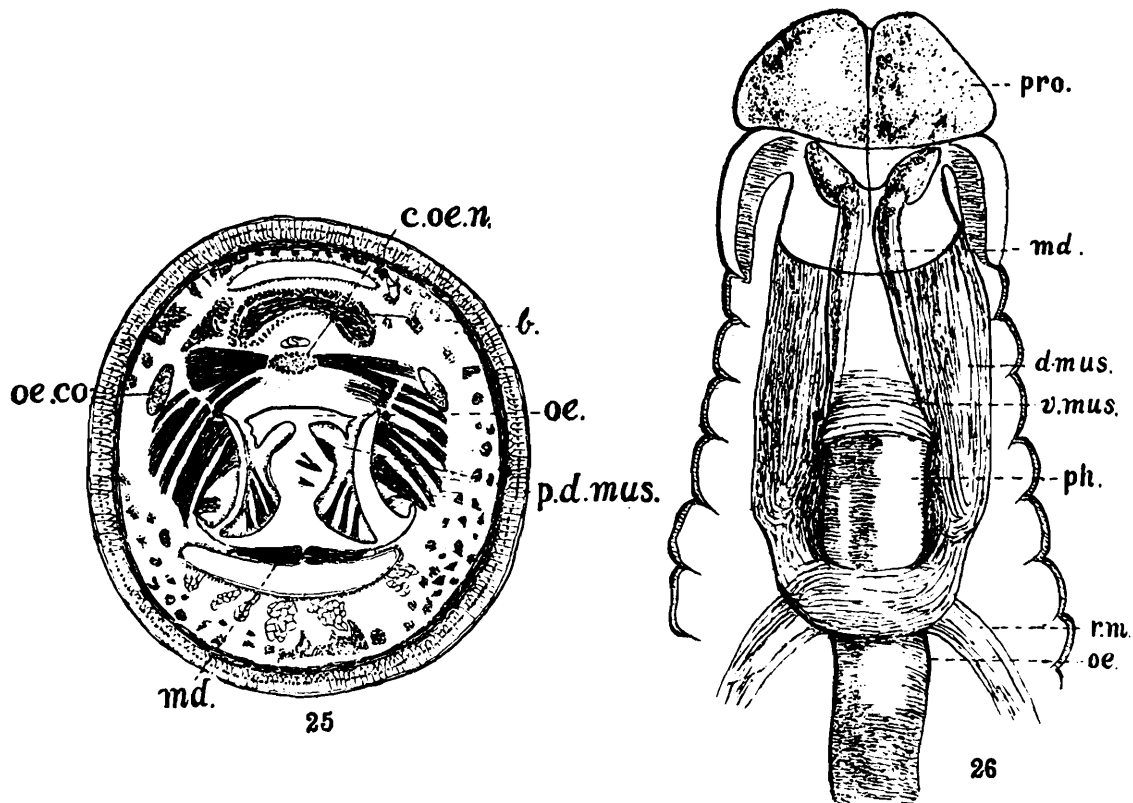


FIG. 25.—Transverse section through peristomium with the dental armature in a forward position. *b.* Brain; *c.o.e.n.* Common dorsal oesophageal nerve of the stomatogastric nervous system; *md.* Mandible; *oe.* Oesophagus; *oe.co.* Oesophageal commissure.

FIG. 26.—Diagram of dental pouch dissected from the ventral side to show the retractor muscles. *d.mus.* Upper group of muscles of the dental pouch; *md.* Mandible; *oe.* Oesophagus; *ph.* Pharynx; *pro.* Prostomium; *r.m.* Retractor muscle; *v.mus.* Ventral group of muscles of the dental pouch.

The gullet at its commencement is cylindrical and has very thick walls (Fig. 27). Projecting into its lumen are four or five longitudinal ridges which almost occlude the internal space. These ridges are made up of a large number of protoplasmic cells of a glandular nature. The cells are very granular and are not arranged in clusters or groups but have a compact arrangement all round the walls of the gullet. The gullet may be said to pass into the intestine in the 7th and the 8th segments. About the 40th segment in full grown worms the intestine has lateral diverticula (Fig. 28). The lumen of the intestine also becomes very spacious and several folds project inwards (Fig. 29) thus greatly increasing the inner surface of the intestine. There may be as many as six to eight folds on each side. Two of these lie close to each other near the median ventral line giving rise to a median groove (Fig. 29, *c. gr.*), which is ciliated in the posterior segments. Such a groove is by no means peculiar to this form but has been described in other Polychaetes also. Eisinger figures it for Capitellids under the name of 'nebandarm' (1887).

The wall of the intestine (Fig. 30) consists, from within outwards, of an epithelial layer, a layer of longitudinal muscles, a layer of circular

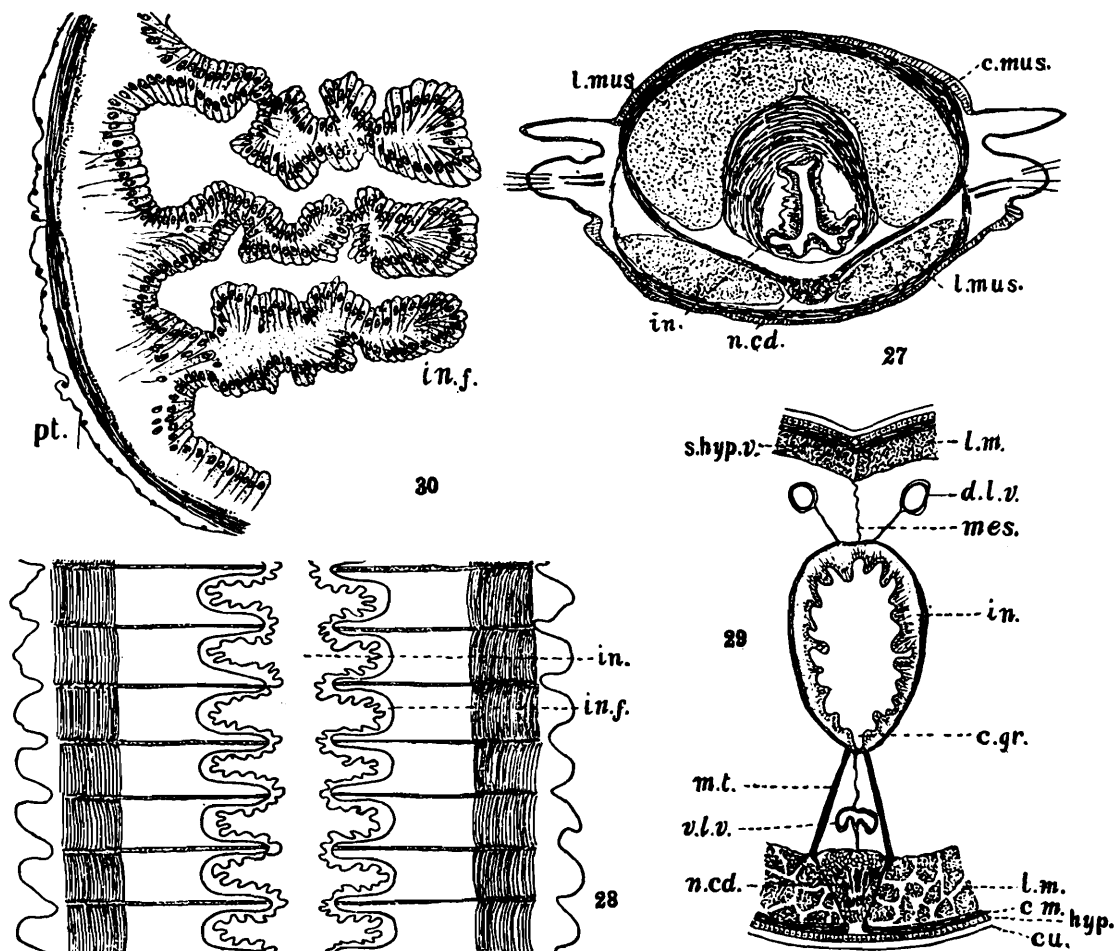


FIG. 27.—Transverse section through the body behind dental pouch to show great development of the dorsal longitudinal muscles. *c.mus.* Circular muscles; *l.mus.* Longitudinal muscles; *in.* Intestine; *n.cd.* Nerve cord.

FIG. 28.—Horizontal section of a big worm behind 50th segment showing diverticula of the alimentary canal. *in.* Intestine; *in.f.* Folds of intestine.

FIG. 29.—Diagram showing the relation between the alimentary canal, main blood vessels and the body wall. *c.gr.* Ciliated groove; *c.m.* Circular muscles; *cu.* Cuticle; *d.l.v.* Dorsal longitudinal vessel; *hyp.* Hypodermis; *in.* Intestine; *l.m.* Longitudinal muscles; *mes.* Mesentery; *m.t.* Muscle tunnel; *n.cd.* Nerve cord; *s.hyp.v.* Sub-epidermal blood vessel; *v.l.v.* Ventral longitudinal blood vessel.

FIG. 30.—Diagram of intestinal folds (Highly magnified). *in.f.* Folds of intestine; *pt.* Peritoneum.

muscles and externally the coelomic epithelium. The inner intestinal epithelial membrane consists mainly of a large number of elongated cells. These are very granular and the nuclei are placed almost in the middle of the cells. Most of these cells have probably a digestive function while a few secrete mucus. The longitudinal and circular layers of muscles are best developed in the first 40-50 segments, while in the following segments these layers are thin, particularly the longitudinal. The coelomic epithelial covering consists of rather flat cells in which large nuclei could be seen in places.

The intestine of a freshly captured worm contains a quantity of mud mixed with fragments of animal and vegetable matter. Pieces of *Enteromorpha*, a common form of alga in the brackish water, have been noticed. Remains of molluscan shells have also been observed. There is no doubt that these worms take in large quantities of mud with a

considerable amount of organic matter and as this passes down, it is probably well mixed with mucus secreted from the mucus cells of the gullet. Once in the intestine, the food is subjected to the action of the digestive juices from the cells of the intestinal fold and the faecal matter is gradually moulded into cylindrical pellets which are voided at the anus.

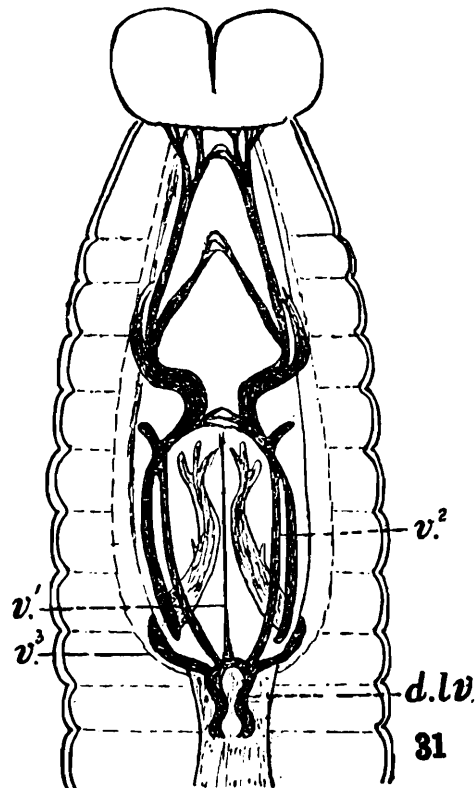


FIG. 31.—General diagram of blood vessels in the anterior region. Dorsal view. Capillaries are not shown. *d.l.v.* Dorsal longitudinal vessel; v^1 , v^2 and v^3 . Anterior branches of dorsal vessels.

The *Vascular system* consists of a closed system of tubes. It is very well developed in this worm. Running above the alimentary canal are two dorsal longitudinal blood-vessels in which the blood travels forwards (Fig. 29). Below the intestine there is a single blood-vessel, running above the nerve cord. These three vessels constitute the essential part of the vascular system. The two dorsal vessels are held in position by folds of peritoneum. They are peculiar in that, instead of occupying a position internal to the circular layer of muscles and between the right and the left longitudinal bands of muscles, as in *Nereis* for instance, they lie entirely in the body cavity in the greater part of their course. In front, the two vessels unite and from the loop thus formed spring five vessels one of which is small and median and the rest large and paired (Fig. 31). The median vessel is continued forwards (v^1). The inner paired vessel (v^2) runs forward, becomes enlarged and gives rise to two or three blind branches, and on reaching the anterior end breaks up into small vessels. The outer paired vessel (v^3) turns downwards after its origin and enlarges into a sinus before entering the space between the gullet and the pharynx, and finally divides into a number of branches. Capillary connections exist between the vessels on one side and also between the corresponding vessels of the opposite sides.

Each dorsal vessel gives off anteriorly in each segment a lateral branch (*l. v.*) which runs outwards along the anterior septum of the

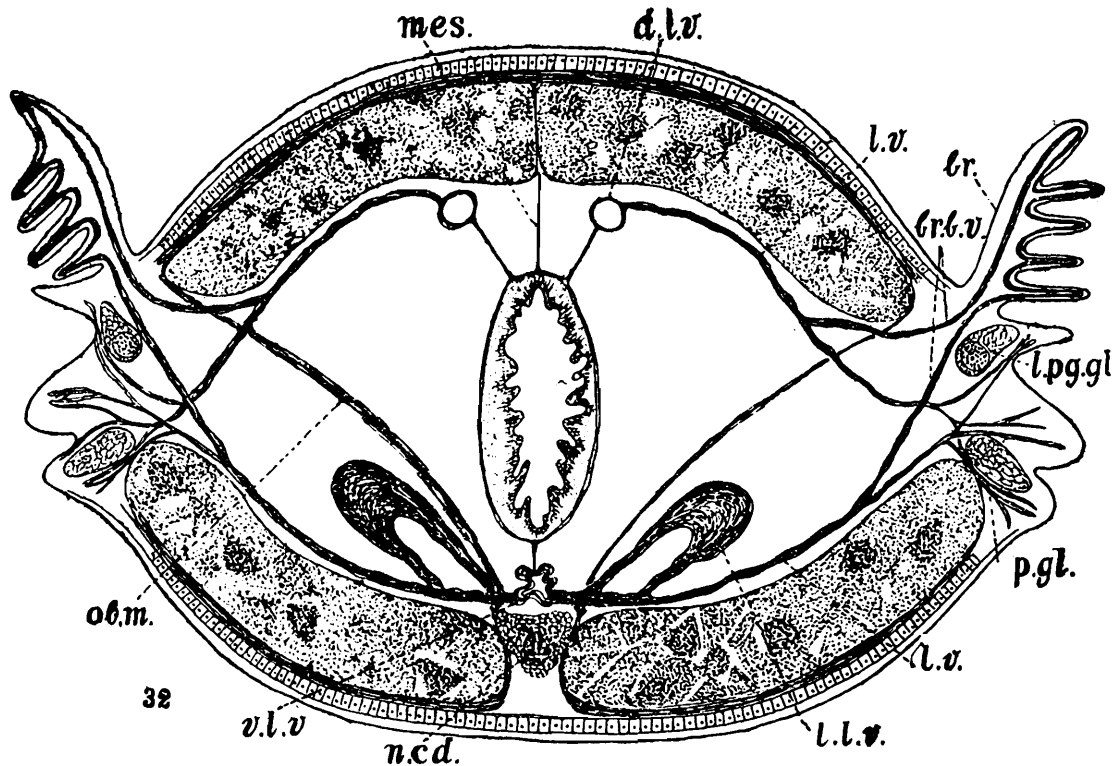


FIG. 32.—Diagram showing the general arrangement of the blood vessels in a segment. *br.* Gill; *br.b.v.* Blood vessel to the gill; *d.l.v.* Dorsal longitudinal vessel; *l.l.v.* Loop of lateral vessel; *l.pg.gl.* Lateral pigment gland; *l.v.* Lateral vessel; *mes.* Mesentery; *n.c.d.* Nerve cord; *ob.m.* Oblique muscles; *p.gl.* Parapodial gland; *v.l.v.* Ventral longitudinal blood vessel.

segment just internal to the longitudinal layer of muscles and divides into two branches (Fig. 32). The dorsal branch (*br. b. v.*) runs upwards and is soon accompanied by a branch from the ventral lateral blood vessel about to be mentioned. The two lie close together near the base of the gill, when one is present in the segment, and supply that organ. The other branch runs downwards and backwards and is soon in close proximity to a branch of the ventral lateral blood vessel. They break up into capillaries which supply the parapodium and also the body wall.

The two median dorsal vessels are not simple straight tubes. They are dilated segmentally and constricted intersegmentally, the dilated portions being filled with blood. The narrow parts are free from blood. It is also seen that the dilated portions in which the blood collects, when the animal is killed, have very thin walls in which muscle fibres are poorly developed (Fig. 33). The alternating intersegmental narrow parts have several layers of circular muscle fibres.

The single ventral vessel lies in a distinct tunnel (*m. t.*) formed by a number of muscle fibres, rather loosely arranged. Like the dorsal vessels, the ventral vessel is segmentally dilated and intersegmentally constricted (Fig. 34). The dilated parts, which are much more conspicuous here than in the dorsal vessels, are extremely thin walled, while the intersegmental portions are well provided with several layers of circular muscles. In the hind region of each segment the median ventral vessel gives off on each side a lateral vessel. Each such vessel, near its origin, forms a U-shaped loop with a dilatation at the bend which

projects freely into the body cavity. The U-shaped structure with its limbs arising close together appears to be a bag with a single stalk and was called ampulla by Delle Chiaje. A careful examination however

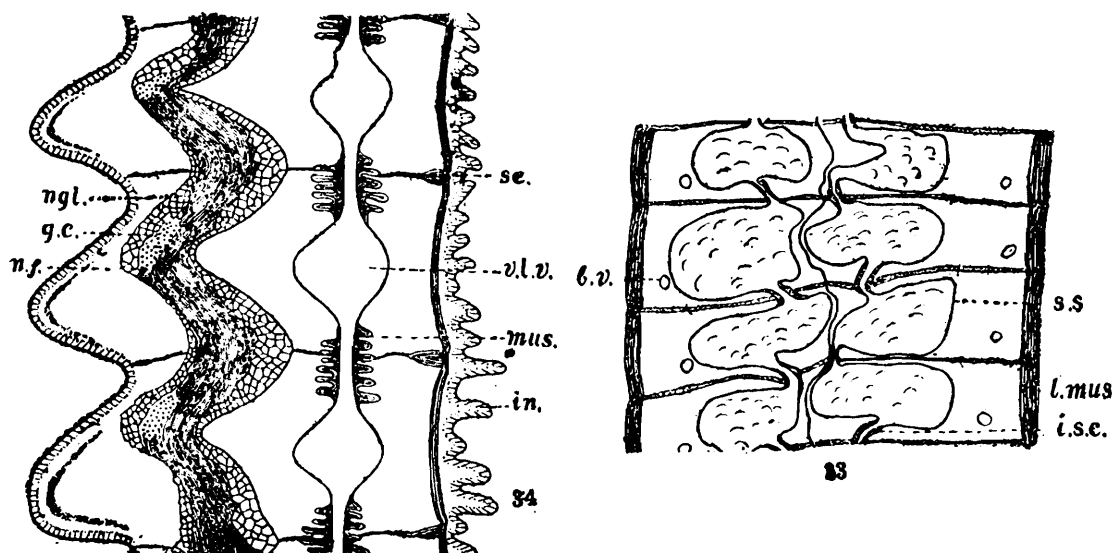


FIG. 33.—Diagram of a horizontal section showing the constricted nature of the dorsal blood vessels. *b.v.* Blood vessel; *i.s.c.* Intersegmental constriction of dorsal longitudinal blood vessel; *l.mus.* Longitudinal muscles; *s.s.* segmental dilatations of dorsal vessels.

FIG. 34.—A longitudinal section of the nerve cord and the median ventral blood vessels showing the segmental dilatations and the intersegmental constrictions of the blood vessel. *g.c.* Ganglion cell; *mus.* Muscles; *in.* Intestine; *n.f.* Nerve fibrillae; *ngl.* Neuroglia; *se.* Septum; *v.l.v.* Ventral longitudinal blood vessel.

shows the two arms of the loop. These vascular loops are contractile and are of approximately uniform size throughout, except at the anterior end, where behind the dental pouch, in segments 7-10, they are considerably larger. In the living worm 5 or 6 loops belonging to consecutive segments, as well as the swollen portions of the dorsal and ventral vessels can be seen to contract together. Each lateral vessel, after giving off the loop, runs to the inner border of the longitudinal muscle band and on reaching the base of the parapodium divides into two branches. One of them runs forwards and upwards and arriving by the side of the corresponding branch from the longitudinal dorsal blood vessel

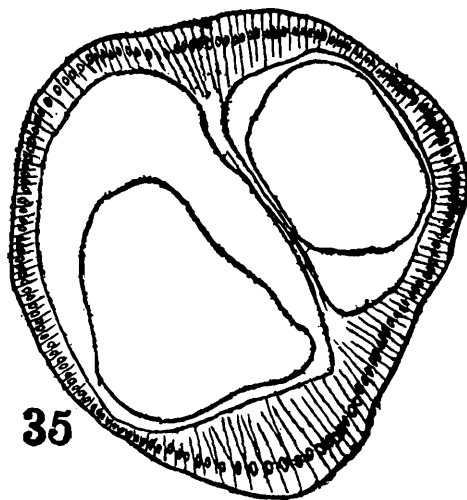


FIG. 35.—Section through the base of gill.

reaches the base of the gill. The two vessels then run up to the tip of the gill and there unite thus forming the ascending and descending

vessels of the gill (Fig. 35). They are connected by minute transverse branches during their course.

The ventral median vessel divides into two branches at the hind end of the dental pouch. Each branch runs outwards and divides again into three branches (Fig. 36), one of which (*b. v.¹*) runs along the outer side of the muscles of the dental pouch, the second (*b. v.²*) runs forward along the body wall giving off some branches in its course; the third (*b. v.³*) sharply turns backwards and divides into small branches in the body wall. All the vessels give off numerous small branches which anastomose into a network on the walls of the dental pouch. At the point where the three vessels branch on each side there is a bag-like swelling (*am.*) which is seen to be filled with blood.

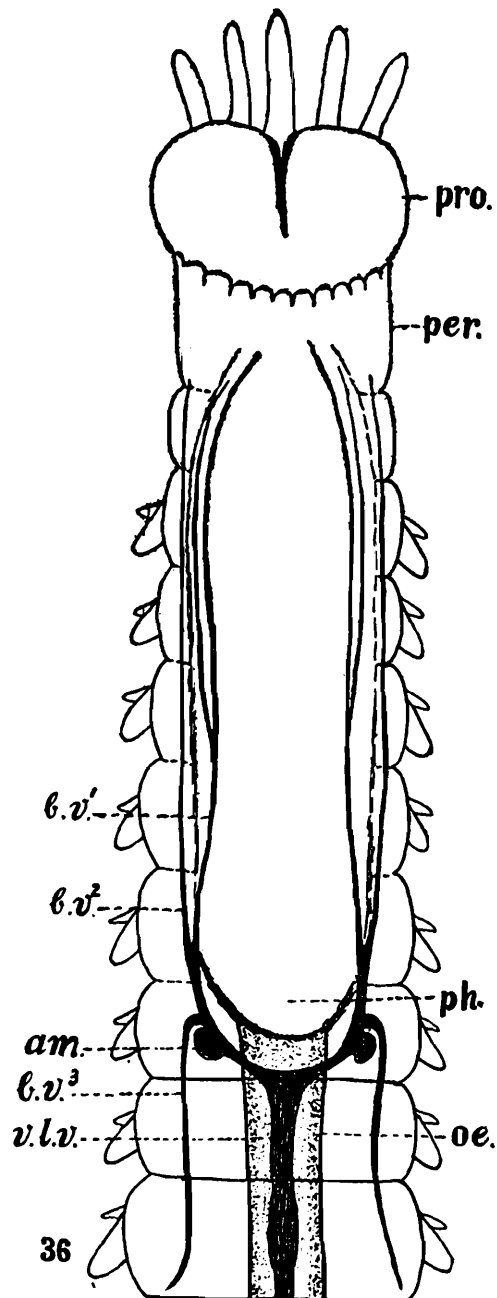


FIG. 36.—Diagram showing the main blood vessels on the ventral side of the dental pouch. Capillaries are not shown. *am.* Ampulla; *b.v.¹*, *b.v.²* and *b.v.³* Branches of main blood vessel; *oe.* Oesophagus; *per.* Peristomium; *ph.* Pharynx; *pro.* Prostomium; *v.l.v.* Ventral longitudinal blood vessel.

In addition to the connection which exists between the dorsal and the ventral vessels by means of lateral branches and capillaries there is

another connection which, though not quite so pronounced, is none the less important. This consists of minute vessels which are given off from the two dorsal vessels and the single ventral vessel. These vessels are not of very regular occurrence. They break up into capillaries in the walls of the intestine and freely unite together thus bringing about a very close connection between the dorsal and the ventral median blood vessels. The vessels which supply the parapodia form the capillaries, some of which pass up the sides of the body wall just below the hypodermis and divide into a very fine richly branched network of capillaries ramifying immediately below the skin.

Ultimately they open into a small dorso-median longitudinal subdermal vessel which sends down in each segment minute vessels which running between the two bands of dorsal longitudinal muscles reach the body cavity and open into the right or left dorsal longitudinal vessel.

It will thus be seen that the vascular system is very well developed. All the parts are well provided with capillaries. The blood is deep red and is without corpuscles. The presence of the segmental contractile loops of the ventral lateral blood-vessels, however, introduces a factor which greatly alters the nature of the circulatory processes. The loops not only enable an independent segmental circulation to be kept up in each segment, but also by sending a branch to the gill, which, after oxygenation returns the blood to the upper lateral vessel, make the blood in the dorsal vessels arterial, while it is venous in the ventral. The walls of the smaller blood-vessels are very thin and membranous, and as far as can be made out have no definite structure. No nuclei have been made out in their walls and the vessels are always filled with blood of a deep red colour.

The vascular system of *Eunice sanguinea* (*Marphysa sanguinea*) was worked out in a general way by Milne Edwards (1838). He noticed the two dorsal blood vessels and the single ventral blood-vessel, as also the loops of the ventral lateral blood vessels which he figures as mere bends in the lateral vessel. His figure shows the two dorsal vessels uniting in front about the 15th segment into a single vessel which is continued forwards in the form of a single dorsal vessel to the terminal portion of the body. He describes the vessel as being contractile. In regard to the median ventral vessel he does not go into details with reference to its fate at the anterior end. He makes a comparison between the circulatory system in *Terebella* and that in *Eunice* and points out that the branchiae in *Terebella* are both contractile and respiratory, while in *Eunice* the circulation is brought about by the contraction of the vascular loops to which also he attributes the capacity that mutilated portions of *Eunice* have of remaining alive some time after separation from the worm.

The central nervous system comprises the brain, the oesophageal commissures, the stomato-gastric system and the median ventral nerve cord (Fig. 37).

The brain has been studied in species of the allied genus *Eunice* by Grube (1838), Quatrefages (1844), Ehlers (1864-68), Pruvot (1885), Jourdan (1887), Racovitza (1896), and Heider (1925). Racovitza in his classical work on the Polychaete brain (encéphalon) distinguishes three regions—Cerveau antérieur, Cerveau moyen, Cerveau postérieur.

The terms may be rendered into the fore-brain, the mid-brain, and the hind-brain. Often these three parts are distinguished according to

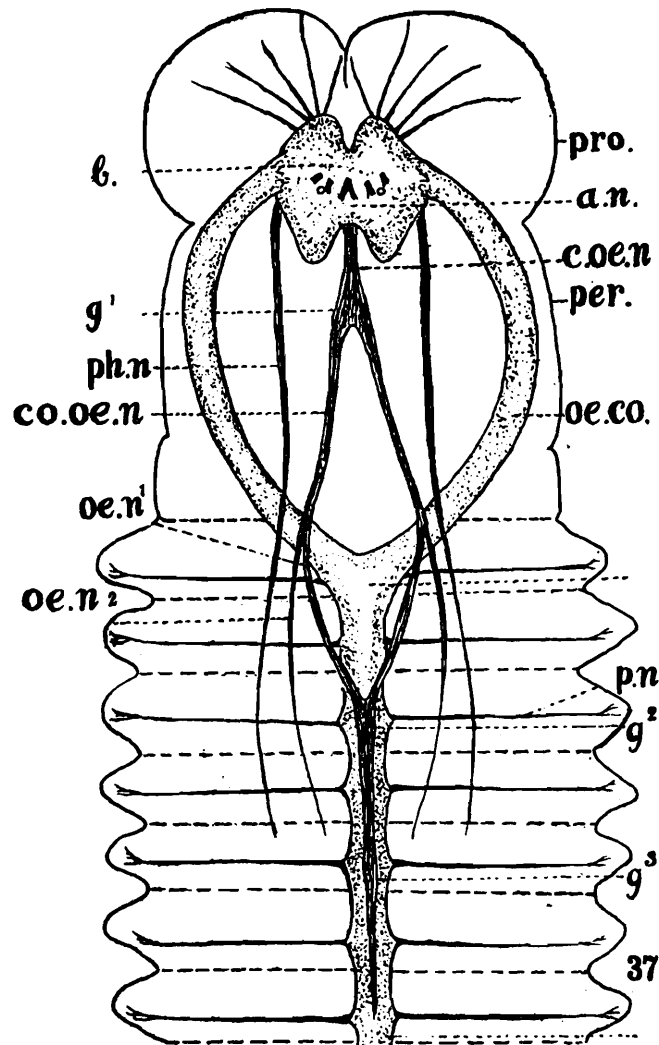


FIG. 37.—A diagram of the nervous system. *a. n.* Antennal nerve; *b.* Brain; *c.o.e.n.* Common dorsal oesophageal nerve of the stomato-gastric nervous system; *co.o.e.n.* Commissural oesophageal nerve of the stomato-gastric nervous system; *g.¹ g.² and g.³* Ganglia of the stomato-gastric nervous system; *oe.co.* Oesophageal commissure; *oe.n.¹* Ventral oesophageal nerve branch of the stomato-gastric nervous system; *oe.n.²* Dorsal nerve branch of the stomato-gastric nervous system; *per.* Peristomium; *ph.n.* Pharyngeal nerve of the stomato-gastric nervous system; *p.n.* Podial nerve; *pro.* Prostomium.

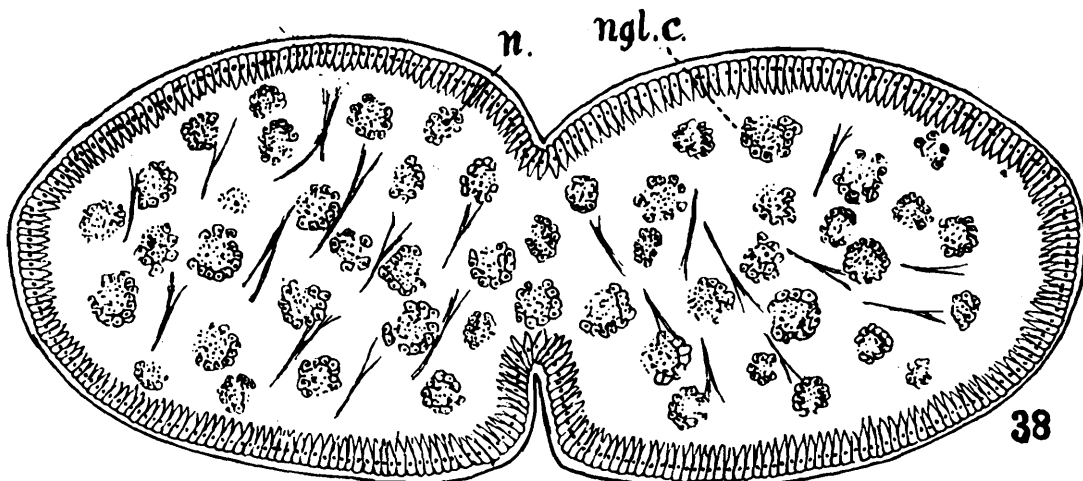


FIG. 38.—Transverse section through the prostomial lobes. *n.* Nerve; *ngl.c.* Neuroglia cells.

their supposed functions as the taste ganglia, the tactile and optic ganglia and the olfactory ganglia. According to the polychaete plan

of brain the palp ganglia are associated with the anterior brain, the antennary and optic ganglia with the mid-brain and the nuchal ganglia with the posterior brain. In some polychaetes the ganglia mentioned

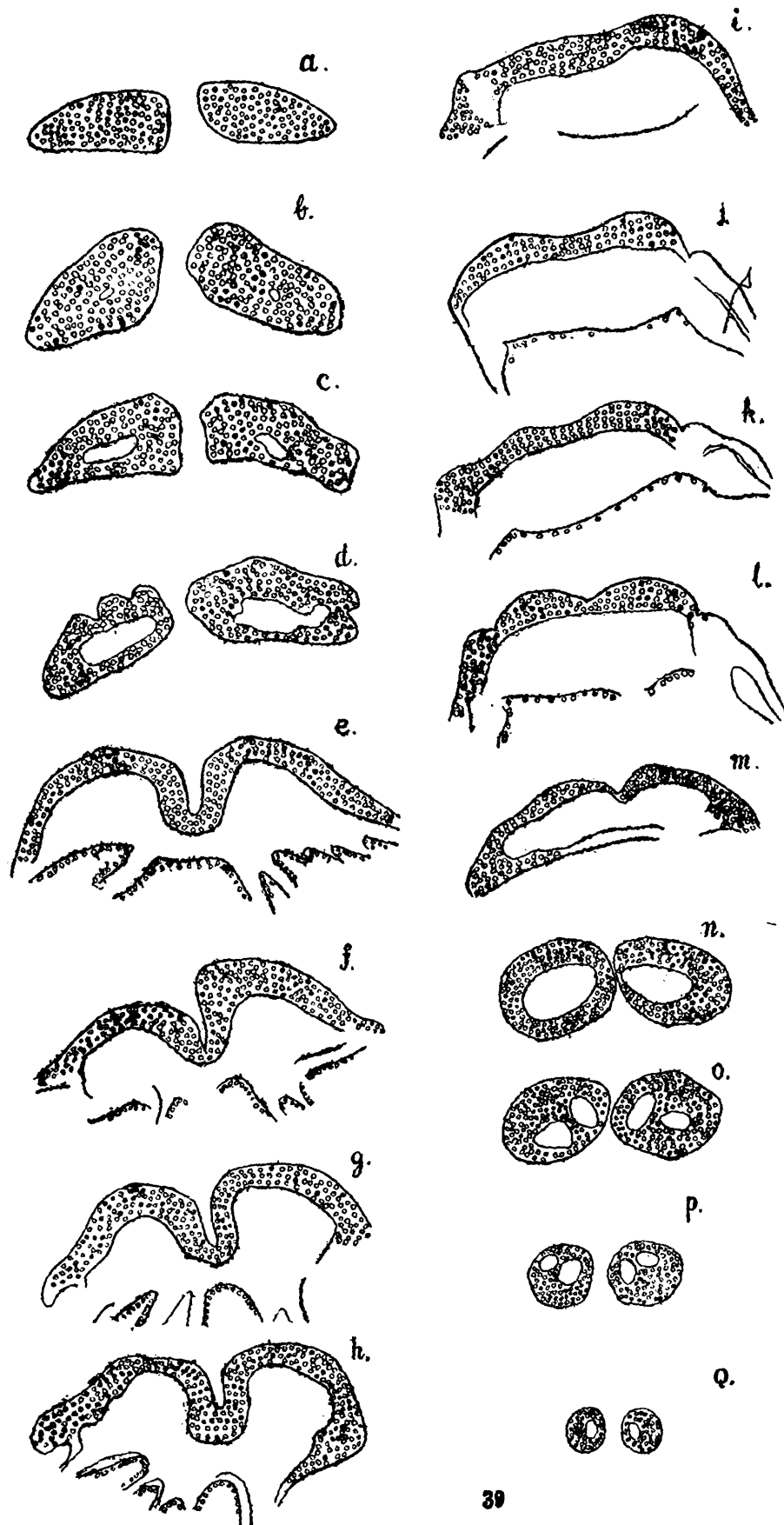


FIG. 39.—Diagram of a series of sections showing the relationship of the two halves of the brain and the arrangement of the ganglion cells of the brain. (Sections showing the origin of antennae are not included.)

are not fused but stand in close proximity, though more or less distinct.

In the present form the anterior and the middle moieties are distinct and well developed. The posterior part, however, is much less distinct and has undergone almost complete absorption into the middle part.

The brain measures but little more than half a millimetre in length even in large specimens and occupies the posterior part of the prostomium immediately below the hypodermis. Anteriorly the right and left portions of the front brain are quite separate and, in the space between the two portions, the fibrous and other non-nerve elements pass to become connected with the hypodermis. A little behind, the two halves unite, but are separated by a deep dorso-median groove. Further behind the groove gradually disappears until the mid-brain is reached. Posteriorly, there is again a separation of the right and left sides but it is not quite so pronounced as in the front region (Fig. 39).

The dorsal surface of the brain is more or less arched throughout, and lies close to the superficial skin. Ventrally the brain is flat and is limited by a membrane below which are the muscles. Heider (1925) describes the mid-brain of *Eunice punctata* (Risso) as being formed of two parts—an anterior mid-brain and a posterior mid-brain. I have not been able to observe this distinction externally in *Marphysa* but judging from the arrangement of the ganglion cells, it seems that such demarcation exists (Fig. 24).

Anterior brain.—The two horns of the anterior brain fill up the basal part of the prostomium. Numerous nerves are given off from the front of the brain. These consist of several very fine nerve fibrils having a wavy course. The bundles of fibrils composing the nerves are separated from one another by fibrous tracts and neuroglial tissue (Fig. 38, *ngl. c.*). The anterior brain also gives from its ventral side two pairs of nerves constituting the stomato-gastric system. The latter will be described under a special section.

The *mid-brain* constitutes the best developed and the broadest part of the brain. The front part is marked into right and left halves by a groove but in the posterior part the surface appears to be level.

The antennal nerves take their origin from the core of the brain substance and occupy the axis of the antennae in their course to the tips (Fig. 46). The lateral antennal nerves have their origin in the front part of the middle brain while the intermediate and median antennae have theirs in a more posterior position. Pruvot (1885) showed the origin of the median antennal nerve by means of two roots and suggested that the median antenna has really been formed by the fusion of two antennae. Heider (1925) has recently observed that the nerves to all the antennae in *Eunice torquata* and *E. fasciata* arise by means of two roots. In the present form the nerves to the lateral and the intermediate antennae seem to arise by a single root only. The nerve supplying the middle antenna (Fig. 47) is composed of two bundles of nerve fibrillae at the base of the antenna but in the antenna itself they unite completely.

The eyes, when present, have a position just external to the origin of the nerves passing to the intermediate antennae. They are sub-

epidermal and are pressed against the brain mass. No special optic nerves or lobes are observed to be present.

The oesophageal commissures have their origin from the inner core of the broadest part of the mid-brain. They curve outwards and downwards to the first setigerous segment, and unite together to form the first pair of ganglia of the ventral chain. They have a covering of ganglion cells at the base but as the commissures reach the ventral side very few ganglion cells are noticed.

Pruvot (1885) and Heider (1925) state that each one of the commissures in *Eunice torquata* arises by two roots. Heider further states that one of these roots arises from the anterior brain and the other from the mid-brain. In the present form also the commissures arise by two roots (Fig. 40) which are very short and unite into a single nerve before they are well out of the rind of the ganglionic cells of the brain. There are no indications of branches being given off from the commissures. Quatrefages does not describe any in *Eunice sanguinea*.

. *Histology of the brain*.—The brain is covered dorsally by the hypodermis and the cells forming it are of three kinds (Fig. 16). Ordinary columnar cells, gland cells with moderately elongated nuclei and granular contents, and thirdly slender sensory cells whose bases seem to be embedded in the substance of the brain. There are no cells of any kind between the lower surface of the hypodermis and the brain. On the dorsal surface the association between the brain and the hypodermis seems to be intimate but on the ventral side it seems to be less so.

Below the brain there is a strong membrane, and still further below there are masses of muscle tissue richly supplied with blood vessels lying between the membrane and the hypodermis.

The outer portion of the brain (Fig. 47 *nu. l.*) is formed by a complete layer of ganglion cells. This layer is best developed on the dorsal surface and at the sides. Ventrally the layer is thin and in some parts even absent. The nuclei are round and fill up almost completely the entire cell area, there being only a thin pellicle of protoplasm. There is a distinct nuclear membrane. They are best stained with iron haematoxylin or Mann's methyl-blue eosin.

A transverse section of the brain through the anterior region shows these ganglion cells crowded together in the dorso median line, less so on the sides and still less on the ventral side. A section passing through the posterior part of the anterior brain shows a different state of things. The right and the left halves of the brain, as has been stated above, are separated by a deep median groove. The ganglion cells are well developed dorsally. The two halves are connected by a bridge of feltlike substance to be described presently. In between the ganglion cells minute fibrils could be seen to run into the internal substance of the brain. What relationship these fibrils bear to the ganglion cells on the one hand and to the felt like substance on the other is a problem which has not been satisfactorily solved. Jourdan (1887) says that in *Eunice* these ganglion cells are provided with 2 fibrils. Unfortunately my preparations do not show the existence of these fibrils. There is a certain amount of uncertainty in regard to the nature of the cells constituting the so-called nuclear layer. The most important

characteristic of the ganglion cells is the greatly reduced protoplasmic covering and for this reason they have been regarded by Jourdan as primitive ectodermal cells which have had an arrested development.

In addition to these cells, there are other ganglion cells which, by reason of their size, should be called giant ganglion cells. They are less numerous and have a restricted distribution. They are entirely confined to certain parts of the dorsal surface of the brain, and are absent in sections passing through the anterior part of the brain. These cells are 4-6 times the size of ordinary ganglion cells of the nuclear layer. They are spherical or pear shaped (Fig. 47 *g.g.c.*) with a large nucleus and a distinct nuclear membrane. The cytoplasm is massive and seems to be produced on one side into a blunt protoplasmic process. It is difficult to trace the ultimate fate of these protoplasmic processes: probably they get inextricably lost in the middle of the fibrils amongst which the ordinary ganglion cells lie.

The punctated substance (p. s.) forms the inner core of the brain. It does not stain readily. In transverse sections it appears to be finely granular and interspaced with minute fibrils. In longitudinal sections of the brain it is seen to be composed of extremely fine fibrils forming a felt work. These fibrils have a wavy course and are of uniform thickness throughout. Nuclei have not been noticed. All the nerves arise from this inner core of the brain.

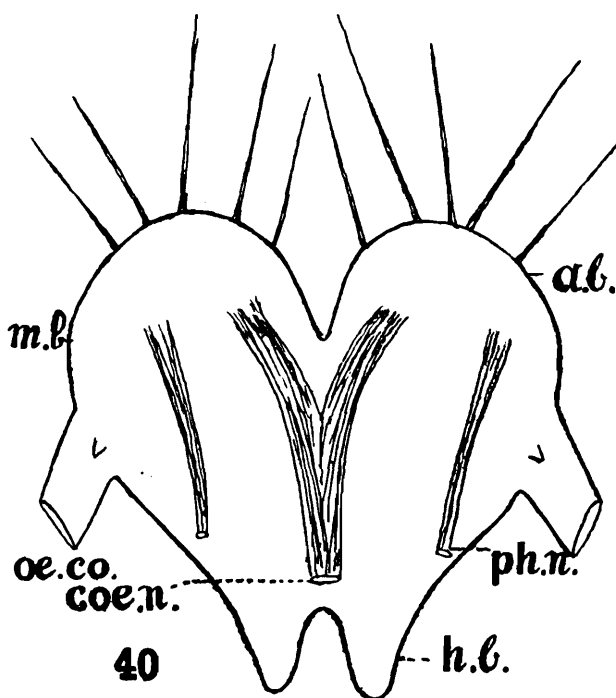


FIG. 40.—Diagram of the ventral view of the brain. *ab.* Anterior brain; *c.oe.n.* Common dorsal oesophageal nerve of the stomato-gastric nervous system; *h.b.* Hind brain; *m.b.* Middle brain; *oe.co.* Oesophageal commissure; *ph.n.* Pharyngeal nerve of the stomato-gastric nervous system.

The stomato-gastric system.—Grube (1838) was probably the first to point out the existence of a stomatogastric system in *Eunice*. Ehlers (1864-68), Quatrefages (1844), Pruvot (1885) and Heider (1925) have described it in certain genera of Eunicidae. The description given by the last mentioned author for *Eunice fasciata* and *E. punctata* seems to be the most complete.

The following is based on dissections under the binocular and on serial sections. There are four nerve strands constituting this system (Figs. 37 and 40). All of them arise from the punctated substance of the brain and emerge at the same level from the ventral side of the anterior brain. Quatrefages distinguishes the inner two as the supra-oesophageal and the outer as the sub-oesophageal strands. They have also been referred to simply as the oesophageal and pharyngeal strands of the stomato-gastric system. The oesophageal strands, at their origin and throughout their course, are stouter than the pharyngeal nerves. They arise slightly apart, turn sharply backwards converging towards each other, and fuse into a stout median cord running a little below the brain (Figs. 21, 37 and 40, *co.oe.n.*). Some distance behind, this cord swells out into a ganglion with a covering of ganglion cells very similar to those of the nuclear layer of the brain (Figs. 25, 37, g^1). From this ganglion, the supra-oesophageal ganglion of the stomato-gastric nervous system, two strong nerves invested by ganglion cells are given off behind (Fig. 37, *co.oe.n.*). They run on either side of the dorso median line of the gullet (Fig. 22, *co.oe.n.*). In the posterior part of the peristomial segment they lie just external to the dorsolateral cushion like thickenings of the gullet. Gradually the two nerves pass to the ventral side, and on reaching a point just above the level of the sub-oesophageal ganglia of the ventral chain (1st setigerous segment) each gives off a slender branch (Fig. 37, *oe.n^2*) which is continued backwards, gradually taking up a position dorsal to the gullet. The two main strands, however, continue their downward course until they meet below the gullet in the third setigerous segment and fuse together into a ganglion (g^2), the infra oesophageal ganglion of the stomato-gastric system. This ganglion is continued as a median strand between the gullet and the dental pouch until the 5th setigerous segment is reached where the ganglion (g^3) is formed. In the following few segments the ganglion is continued as a mere strand of nerve.

The pharyngeal strands already mentioned, also take their origin from the ventral surface of the anterior brain (Figs. 37 and 40, *ph.n.*). At first they run on the inner side of the dorsal groove on the side of the roof of the mouth (Fig. 20, *ph.n.*). Later on they pass external to the grooves and after a short course are completely lost in the muscles of the dental pouch. No branches are seen to be given off. No ganglion cells have been noticed in relation to them and they are probably motor in function.

The *ventral nerve cord* is formed, as in all Polychaetes, by the oesophageal commissures meeting below the gullet to form a ganglionated nerve chain. The two nerve strands are completely fused together and distinction between them has been lost. The nerve cord thus formed is slightly swollen to form a ganglion in each segment. Unlike the brain which has the epidermis in close relation to its dorsal side, the nerve cord in the present form has totally lost its connection with the ectoderm, and lies internal to the circular layer of muscles and between the two ventral bands of longitudinal muscles. In cross section it appears to be almost rectangular in the extreme anterior end, and triangular in the middle and the posterior parts of the body.

The ventral nerve cord consists of an outer sheath the neurilemma (nlm.) and an inner layer of translucent cells, the neuroglial layer

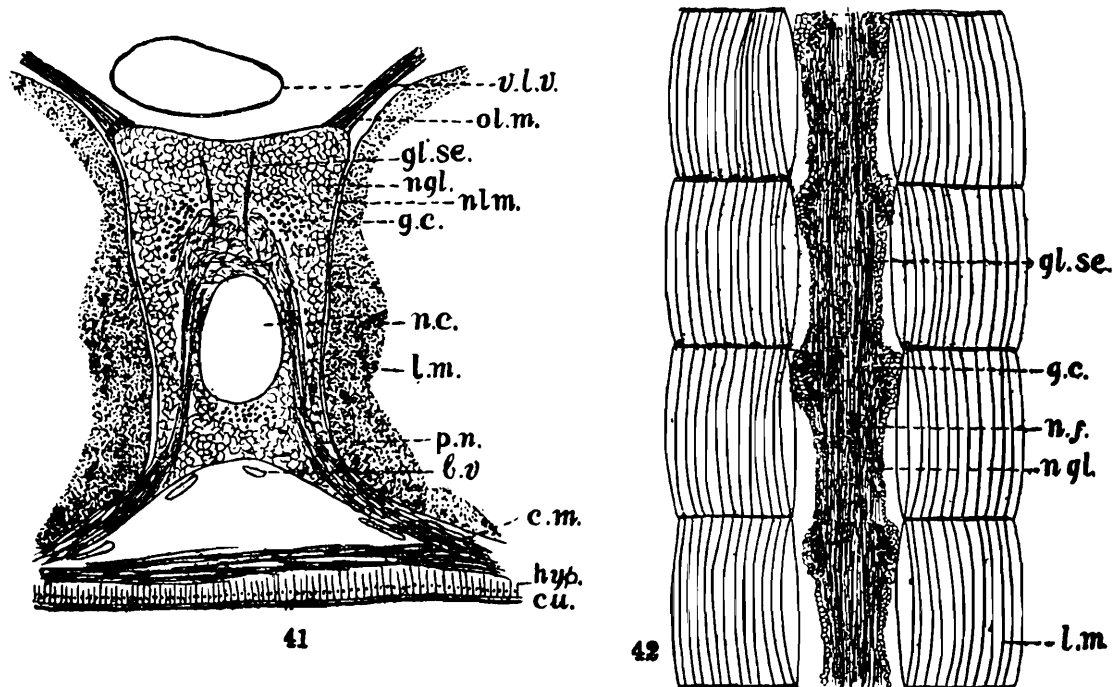


FIG. 41.—A transverse section of the ventral nerve cord. *b.v.* Blood vessel; *c.m.* Circular muscles; *cu.* Cuticle; *g.c.* Ganglion cell; *gl.se.* Glia septum; *hyp.* Hypodermis; *l.m.* Longitudinal muscles; *n.c.* Neural canal; *ngl.* Neuroglia; *nlm.* Neurilemma; *ob.m.* Oblique muscles; *p.n.* Podial nerve; *v.l.v.* Ventral longitudinal blood vessel.

FIG. 42.—A horizontal section of the nerve cord. *g.c.* Ganglion cell; *gl.se.* Glia septum; *l.m.* Longitudinal muscles; *n.f.* Nerve fibrillae; *ngl.* Neuroglia.

(*ngl.* Fig. 41). Below this there are small distinctly nucleated cells with very little of protoplasm. These cells are the ordinary ganglion cells and are similar to those of the nuclear layer of the brain. Forming the inner core of the cord, there is the punctated substance formed of very minute wavy fibrils, as in the brain. The inner core is split vertically by two septa (*gl. se*)—the glia septa—so that it appears to be composed of three strands. In the posterior segments, sometimes three glia septa could be seen so that there then appears to be four strands in all; but this is unusual. Pruvot (1885) mentions the occurrence of a pigment sheath for the nerve cord in *Eunice torquata* and Ehlers (1864-68) describes a similar sheath in *E. harassii*. No pigment sheath is present in *M. gravelyi*. The ganglion cells of the nerve cord lie in three groups in the ganglionic enlargements and are practically absent in the interganglionic portions. Two of these groups are dorso-lateral and the third ventro-median (Fig. 41). Giant ganglion cells are not present in any part of the nerve cord. Below the central axis formed by the punctated substance is a median canal. In *Eunice fasciata* and *E. torquata* (Heider 1925) a similar canal has been described as a colossal nerve fibre; but Jourdan (1887) did not consider it as such. Similar so-called nerve fibres have been described in other Polychaetes also, but in some they have been referred to as a mere canal. From the fact that in *Marphysa gravelyi* it exhibits no structure, and does not take stain, it seems to be of the same category. It varies slightly in position in different parts of the nerve cord. It may be central or

more ventral, may be round or triangular in vertical cross section, or altogether absent as in the extreme posterior end of the body. Probably in the living animal the canal is filled with a semifluid substance of a colloidal nature which after fixation and subsequent treatment is found to form an irregular strand connected at some points with the wall of the canal by delicate threads of the same substance.

A pair of podial nerves (*p.n.*) arise from the lateral strands of each ganglionic enlargement of the punctated substance. Ehlers (1864-68) describes three pairs of podial nerves in *E. harassii*. Quatrefages (1844) describes and figures five pairs in *Marphysa sanguinea*. Pruvot (1885) and Heider (1925) mention the occurrence of a single nerve only in *Eunice torquata*. In *M. graveleyi* there is only a single pair of podial nerves in each segment. Each nerve runs downwards and outwards to the space between the longitudinal and circular muscles and at the base of the parapodium branches into two or three minute nerves supplying the parapodium. It has not been possible to make out the 'ganglion de renforcement' of French authors—from which nerves are supposed to be given off. Preparations of the nerve by Bielchowsky's methods show that the branches run externally to the longitudinal muscles giving off numerous fine branches in their course.

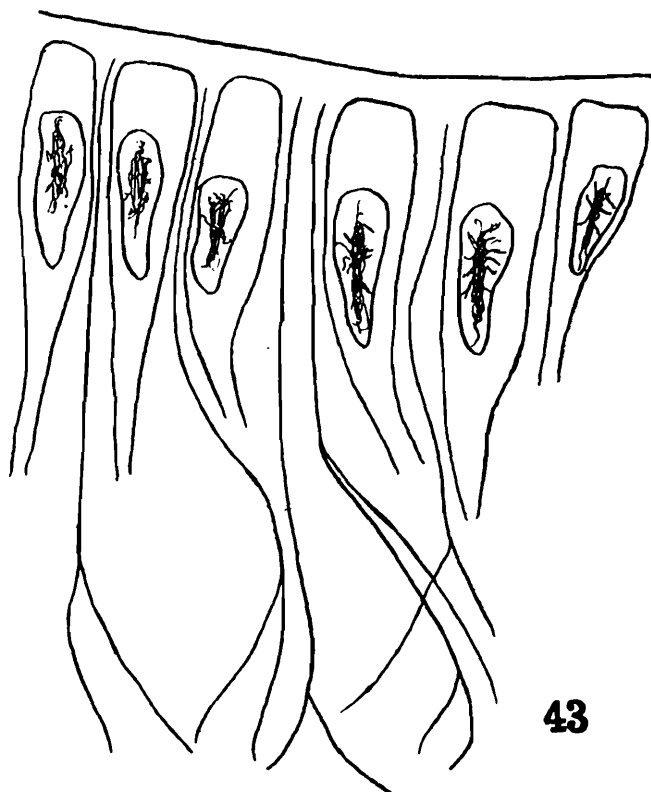


FIG. 43.—Hypodermal cells; the nerve endings are shown as emanating from a network.

There seems to be a network of very minute nerve fibrils just below the epidermis (Fig. 43). Smallwood (1926-27) in his paper on the peripheral nervous system of *Lumbricus terrestris* describes the existence of a network of fibrils below the hypodermis. He has demonstrated in that form the occurrence of a connection between the basal ends of the sensory cells of the hypodermis and the subepithelial network. I have been able to observe what appears to correspond to the network mentioned by him, but not the connection with the sensory cells or the two kinds of nerve fibrils which he describes.

The sense organs are the prostomium, the antennae, the frill like folds already mentioned as occurring on the undersurface of the prostomium, the eyes, the dorsal and the ventral cirri, and the anal cirri.

As stated above some of the hypodermal cells on the prostomial lobes, especially on the dorsal side are elongated and have their slender inner ends continued, in some parts, as far as the ganglion cells of the nuclear layer of the brain. In front, where the cells are separated from the brain by a greater space, the inner ends of the cells are connected with fine nerve fibrils which emanate from the brain. The greatly elongated cells covering portions of the lateral folds at the entrance into the mouth have their bases also extended. These cells are all no doubt sensory in function.

Eyes are formed in the early stages of development of the worms. In the metatrochal stage there is a pair of larval eyes of darkish brown colour on the prostomium. They undergo gradual reduction as the larva grows and additional segments are added. When the tiny worms are provided with 13-14 pairs of parapodia the larval eyes almost disappear, and the adult pair of eyes commence to form just external to the point at which the intermediate tentacles appear some time later.

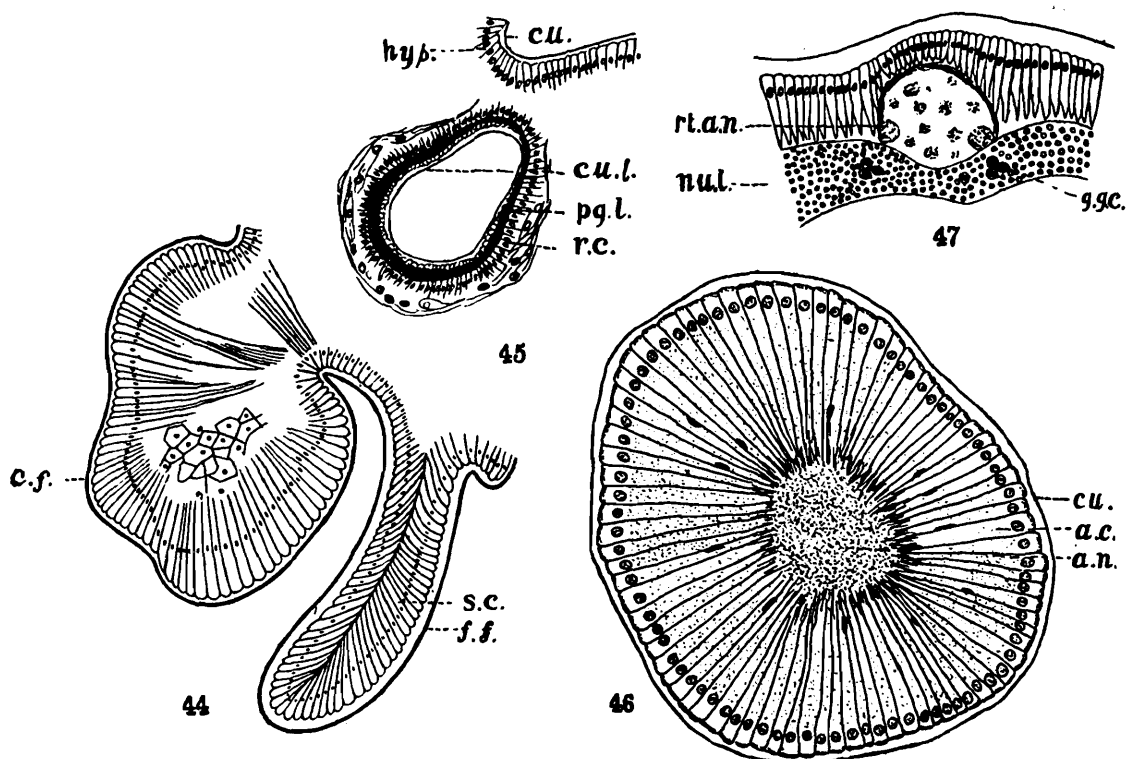


FIG. 44.—Section through the cushion and the frill like folds on either side of the roof of the mouth, showing the highly elongated cells. *c.f.* Cushion like fold; *f.f.* Frill like fold; *s.c.* Sense cell.

FIG. 45.—Section of the eye. *cu.* Cuticle; *cu.l.* Cuticular lens; *hyp.* Hypodermis; *pg.l.* Pigment layer; *r.c.* Retinal cells.

FIG. 46.—Transverse section of an antenna showing the axial position of the antennal nerve cord and the greatly elongated antenna cells. *a.c.* Antennal cells; *a.n.* Antennal nerve; *cu.* Cuticle.

FIG. 47.—Section showing the double origin of the median antennal nerve, at its very commencement. *g.g.c.* Giant ganglion cell; *nu.l.* Nuclear layer; *rt.a.n.* Root of nerve to antenna.

At this stage the worm is provided with two pairs of eyes, the anterior pair being very greatly reduced prior to their final disappearance, and

the posterior pair developing quickly and remaining functional longer. As the worm develops its cryptic habits these also degenerate and become subepidermal lying pressed against the ganglion cells of the mid-brain. The eye is almost spherical in shape with a cavity filled by a cuticular lens (Fig. 45). The wall of the eye has a single layer of elongated cells with oval nuclei occupying their inner half. There is a layer of intense black pigment near the base of the cells. Degeneration may even proceed further, and in very large worms the eyes seem to be completely absent.

There are five antennae which arise directly from the brain. It may be inferred from this fact that they are sensory organs of primary importance. In transverse and longitudinal sections of material fixed by 0.5 osmic or 2 per cent. ammonium bichromate the structure of the antenna can be made out easily. The antennal nerve which runs along the axis consists of a large number of fibrils of a wavy nature and does not fill the entire inside of the antenna (Fig. 24. *a.n.*). The cells of the antennal wall are greatly elongated with their inner ends so slender that they seem to be in close connection with the nerve fibrils. Except at the base of the antenna there are no muscle fibres in the wall.

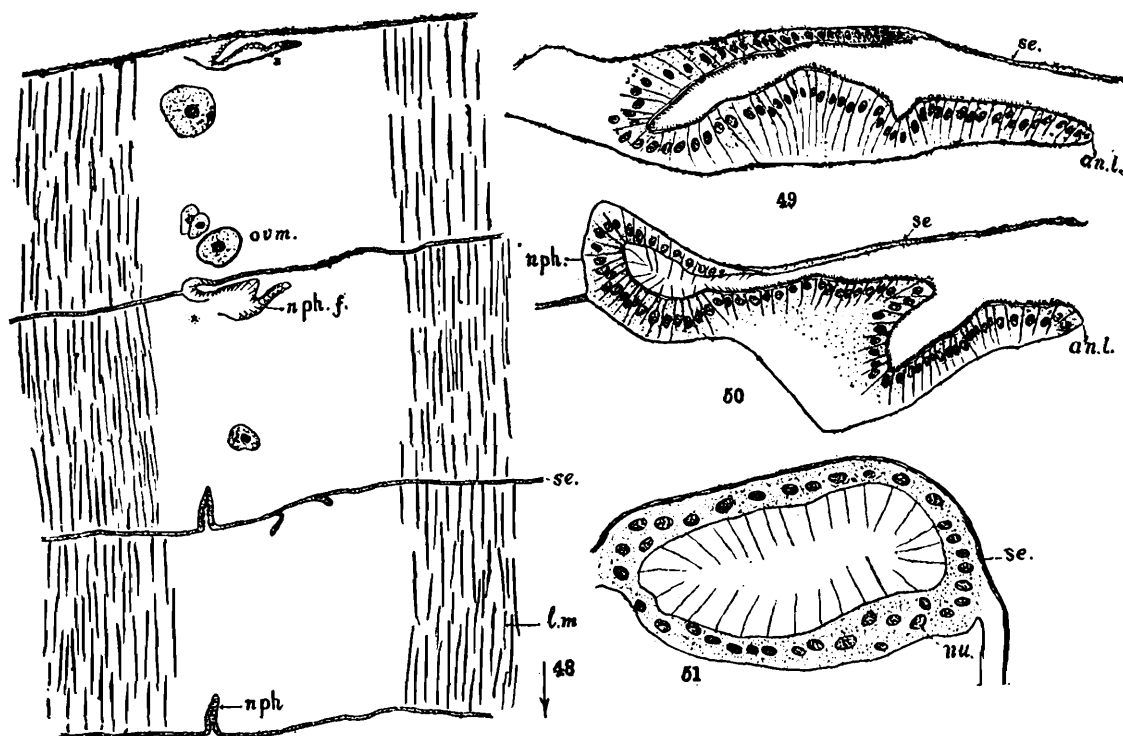


FIG. 48.—Longitudinal vertical section of segments from the middle region of a female worm to show position and origin of nephridia; *l.m.* Longitudinal muscles; *nph.* Nephridium; *nph.l.* Nephridial funnel; *ovm.* Ovum; *se.* Septum.

FIG. 49.—Section through the nephridial funnel. *an.l.* Anterior lip; *se.* Septum.

FIG. 50.—Section through the funnel and the commencement of the nephridium at the mark* in fig. 48. *an.l.* Anterior lip. *nph.* Nephridium; *se.* Septum.

FIG. 51.—Transverse section passing through the conducting part of the nephridium. *nu.* Nucleus; *se.* Septum.

Quatrefages (1865) mentions the occurrence of an otocyst in *Marphysa sanguinea*. This was shown to be a misapprehension by Fauvel (1907), who observed that the otocyst was generally absent in the Eunicidae. There is no trace of an otocyst in *M. gravelyi*.

Nephridia.—Goodrich (1900) states that nephridia with large coelomic funnels occur in the Eunicids. In *M. graveleyi* they occur in all segments except a few of the anterior segments and lie close to the posterior face of the anterior septum in each segment. They do not project into the coelomic space but have a more or less straight course to the base of the parapodium. Each nephridium is wide at its inner end and pierces the septum in front at a level with the pigment gland of its side, but does not project very much into the next segment. The funnel is ciliated, and is close to the anterior side of the septum. One side of the funnel is closely pressed against the septum while the opposite is free with its lip projecting well beyond the level of the posterior lip (Figs. 48, 49, and 50).

The walls of the nephrodium are formed of delicate, rather ill defined cells, full of minute granules and with moderately large nuclei (Fig. 51). The conducting part of the nephridium is a well defined but narrow ciliated tube which passes along the inner margin of the ventral longitudinal muscles, and turning round its outer border, pierces the circular muscles, which are but slightly developed in this part (Fig. 52). It finally opens on the lower side of the ventral cirrus, slightly in front.

Cosmovice (1879) observed the funnel of the nephridium of *Marphysa sanguinea* but the external opening escaped his notice.

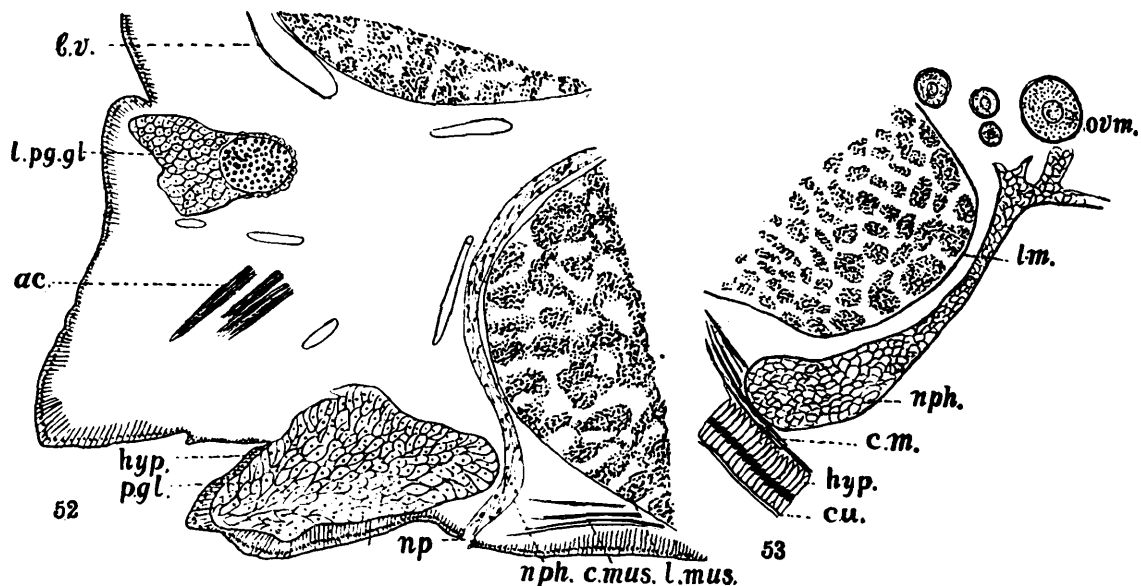


FIG. 52.—Section of the outer part of the parapodium showing position of pigment gland, parapodial gland and nephridium. *Ac.* Aciculum; *b.v.* Blood vessel; *hyp.* Hypodermis; *l.pg.gl.* Lateral pigment gland; *n.p.* Nephridiopore; *nph.* Nephridium; *p.gl.* Parapodial gland.

FIG. 53.—The outer half of an enlarged nephridium of a fully mature female worm. *c.m.* Circular muscles; *cu.* Cuticle; *hyp.* Hypodermis; *l.m.* Longitudinal muscles; *nph.* Nephridium; *ovm.* Ovum.

The reproductive organs take the form of proliferations of the coelomic epithelium covering the blood vessels and the septa. The sexual elements are absent in the anterior one-third part of the body and in several segments at the posterior end. Ripe sexual elements have not been observed in worms of less than 150 segments. In fully ripe individuals with 400-750 segments the sexual products are confined roughly to the middle one-third of the body. This localisation of sexual elements is known to occur in other Eunicids also (Fage, 1927). In *Eunic*

harassii about thirty of the anterior and thirty of the posterior segments are stated to be devoid of sexual elements. A similar condition is said to prevail in *E. vittata*. In *Lysidice ninetta* sexual elements have been noticed after the 25th segment, in *Nematonereis unicornis* after the 62nd, and in *Lumbriconereis latreillei* the first 80 and the last 34 segments in the female have been found without sexual products. It seems therefore that the restriction of genital cells to the middle region of the worm is a characteristic of Eunicids in general.

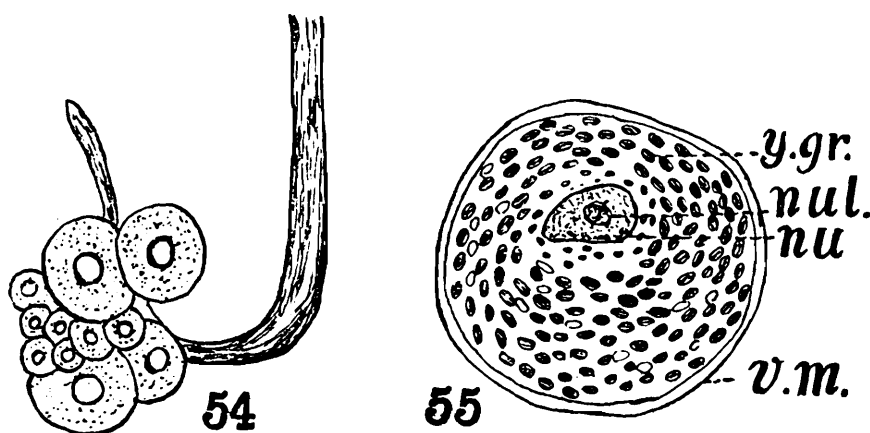


FIG. 54.—A blood vessel carrying eggs.

FIG. 55.—A ripe ovum. nu. Nucleus; nul. Nucleolus; v.m. Vitelline membrane; y.gr. Yolk granules.

In the present form the sexual region is recognised by its tense inflated appearance, and in the ripe females the eggs can be seen shining through the body wall. Difference in colouration between the sexes has been observed in a few forms as in the Atlantic Palolo, *Eunice viridis*. In sexually ripe individuals of *M. gravelyi* the gills have a markedly vivid scarlet colour, but are otherwise of no value in differentiating the sexes. The body of the ripe male is whitish in colour while that of the female is pinkish owing to the colour of the eggs inside.

The ova are developed from the coelomic epithelium covering the finer blood vessels on the posterior face of the anterior septa of the middle segments. When shed they float freely in the coelomic cavity. Roughly speaking the young ova are found attached to the blood vessels in the course of the nephridia. They have fairly clear protoplasm of homogeneous appearance. As they grow, they are filled with yolk granules of varying size. The nucleus of the fully ripe ovum is vesicular and a distinct nucleolus is present. There is a moderately thick but smooth vitelline membrane. The larger yolk granules are situated in the outer portions of the cytoplasmic area. The granules in the immature ova stain more deeply than in the fully mature eggs.

In the male the minute blood vessels of the dorsal lateral vessel in each segment give rise to nodular proliferations (Fig. 56). These give rise to the spermatogonia which at a very early stage are detached from the coelomic epithelium and undergo the rest of the development while floating in the coelomic fluid. No acrosome could be made out in the

ripe sperm (Fig. 58). The wedge shaped piece which stains very deeply, is the head. At its hind are two minute swellings with a notch between from which a long extraordinarily fine flagellum has its origin. The swellings probably constitute the middle piece.

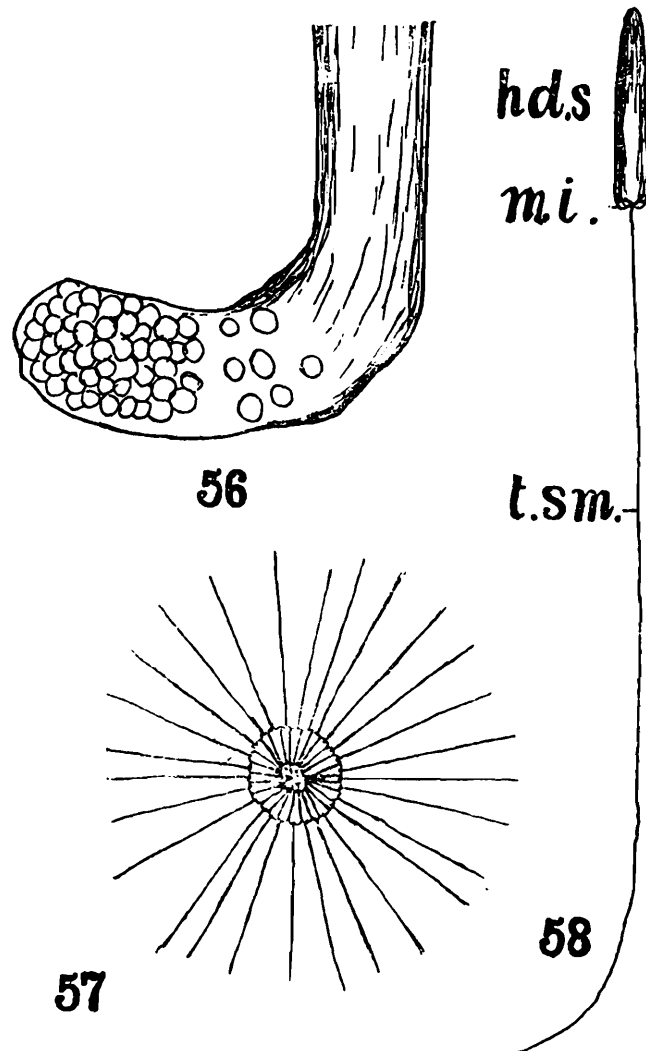


FIG. 56.—A blood vessel from a male worm showing origin of spermatogonia.

FIG. 57.—A cluster of almost ripe sperms.

FIG. 58.—A fully ripe sperm. *hd.s.* Head of sperm; *m.i.* Middle piece; *t.sm.* Tail of sperm.

The ripe sperms are found to pass even in between the muscles to the space between the muscles and the richly vascular skin. They often fill up the bases of the parapodia penetrating to the base of the dorsal cirrus. In fact, they are found so near the dorsal surface in fully ripe individuals that the smallest puncture of the skin lets the male product ooze out in a thin milky stream. Often they are found in regular aggregations along the course of the dorsal blood vessels.

The fully mature condition of the sexes is accompanied by certain structural changes which are highly interesting. With the reduction in thickness of the longitudinal bands of muscles, the coelomic space increases and this is in marked contrast to the muscles of the anterior segments in which no such reduction takes place (Fig. 60). Fage (1927) mentions the occurrence in certain Eunicids of degeneration of longitudinal muscles accompanied by deposition of pigment. The dorsal blood vessels in the region of the longitudinal muscles (Fig. 59).

d.l.v.) are very much swollen. The sexual elements pass to the outside by the nephridia. This is no doubt easy in the case of sperms, but

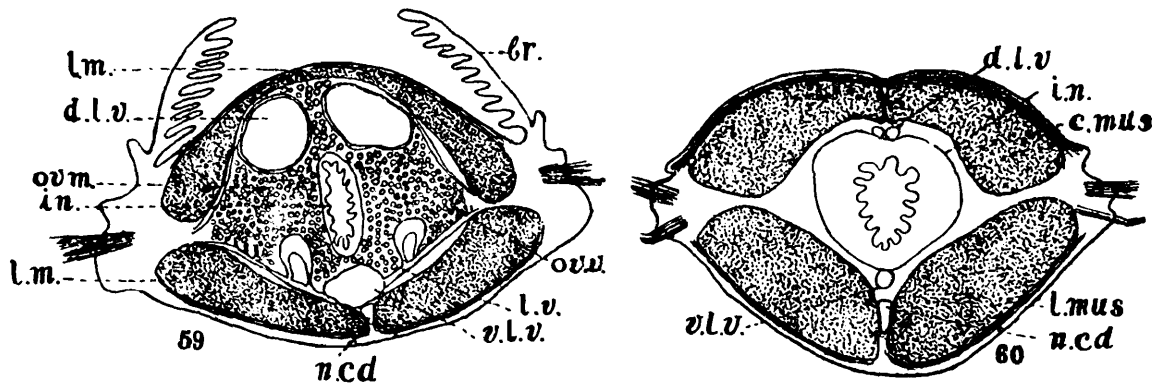


FIG. 59.—Transverse section through the sexual region of a female worm showing enlargement of blood vessels and reduction of longitudinal muscles. *br.* Gill; *d.l.v.* Dorsal longitudinal vessels; *in.* Intestine; *l.m.* Longitudinal muscles; *l.v.* Lateral vessel; *n.cd.* Nerve cord; *ovm.* Ovum; *ov.v.* Egg bearing blood vessel; *v.l.v.* Ventral longitudinal blood vessel.

FIG. 60.—Transverse section passing through the anterior non-sexual part of the same worm where no enlargement of blood vessel and reduction of muscles take place.

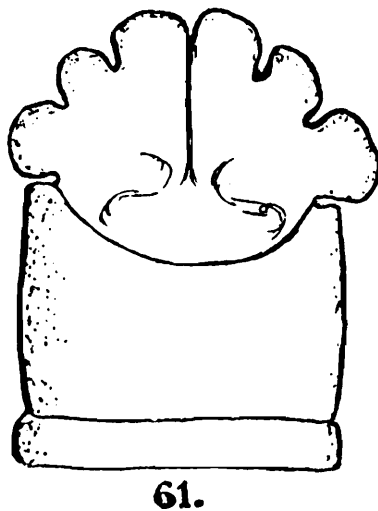


FIG. 61.—Diagram of worm with regenerated prostomial lobes.

the ova which are comparatively large cannot find their way out through the nephridia, unless the diameter of the nephridial canal increases. A comparison of nephridia of unripe individuals with the nephridia of mature animals from the sexual segments reveals the fact that the nephridial passage actually increases in diameter as the individuals mature, enabling the eggs to pass through them to the outside (Fig. 53). Ova have been often noticed half way down the nephridial passage. Even then it is not easy to explain why the fully developed ova always accumulate in small groups along the course of the dorsal blood vessels in the sexual region of the worm. Liberation of eggs has been known to occur by rupture of the body wall in several Polychaetes but it is not certain whether a similar phenomenon occurs in *M. graveleyi*.

Regeneration has been observed in *M. graveleyi*. The gills, anal cirri, and the tail region are the parts of the body which are most easily damaged. All these structures are soon regenerated. The regenerated

parts often differ from the lost ones in size as in the case of the gills, in the branching as in the case of the anal cirri, and in the larger number of segments as in the hind part of the body. In one specimen the prostomial lobes had evidently been regenerated but these were found to be abnormal in that each lobe was found to be subdivided (Fig. 61).

BIBLIOGRAPHY.

- Aiyar, R. G., 1931. "An account of the development and breeding habits of a brackish water Polychaete worm of the genus *Murphyssa*." *Journ. Linn. Soc.* XXVII. London.
- Allen, E. J., 1905. "The anatomy of *Poecilochaetus*. Clap." *Quart. Journ. Micr. Sci. N. S.* XLVIII. London.
- Andrews, E. H., 1892. "On the eyes of Polychaetous Annelids." *Journ. Morphology.* VII. Philadelphia.
- Annandale, N. and Kemp, S. W., 1915. "Fauna of the Chilka Lake, Introduction." *Mem. Ind. Mus.* Vol. V Calcutta.
- Ashworth, J. H., 1902. "The anatomy of *Scalibregma inflatum* Rathke." *Quart. Journ. Micr. Sci. N. S.* XLV. London.
- Ashworth, J. H., 1904. "Arenicola." *L. M. B. C. Memoirs.*
- Bonnier, J., 1893. "Notes sur les Annelides du Boulonnais *Ophryotrocha peurilis* et appareil Maxillaire." *Bull. Sci. et France et Belgique.* XXV
- Claperède, E., 1868. "Les Annelides Chétopodes du golfe de Naples." Claperède, E., 1871. Supplement.
- Cosmovici, L. C., 1879. "Glandes Génitales et organes Segmentaires des Annélides Polychètes" *Arch. Zool. Exp. Gen.* VIII. 1879-80. Paris.
- Crossland, C., 1903. "On the marine fauna of Zanzibar and British East Africa." *Proc. Zool. Soc.* II. London.
- Dehorne, A., 1922. "Destruction et phagocytose des fibres musculaires à la fin de la maturation des ovocytes chez *Hediste diversicolor*". *C. R. Soc. Biol.* LXXXVII. Paris.
- Ehlers, E., 1864—1868. "Die Borstenwürmer." (Leipzig).
- Eisig, H., 1887 "Monographie der Capitelliden des Golfes von Neapel." *Fauna u. Flora des Golfes von Neapel.* XVI.
- Fage, L., 1906. "Recherches sur les Organes Segmentaires des Annélides Polychètes." *Ann. Sci. Nat. Zool.* (9th Ser.) III. Paris.
- Fage, L., 1925. "Les formes épitoques des Eunicien." *C. R. Acad. Sci.* CLXXXI. Paris.
- Fage, L. et Legendre, R., 1927 "Pêches planctoniques a la lumière." *Arch. Zool. Exp. Gen.* LXVII. Paris.
- Fauvel, P., 1907 "Les otocysts le Polychètes." *Ann. Sci. Nat. Zool.* (9th Ser.). VI. Paris.
- Goodrich, E. S., 1897, 1899 and 1900. "On the nephridia of Polychaeta." *Quart. Jour. Micr. Sci.* XL, XLI, XLIII. London.
- Gravier, Ch., 1923. "La ponte et l'incubation chez les Annelides Polychaetes." *Ann. Sci. Nat. Zool.* (10th Ser.). VI. Paris.
- Grube, A. E., 1838. "Zur Anatomie und Physiologie der Kiemen Würmer."

- Heider, K., 1925. "Über Eunice-Systematiches, Keifersack, Nervensystem." *Zeit. Wiss. Zool.* CXXV .Leipzig.
- Herpin, R., 1924. "Essaimage et développement d'un Eunicien et d'un Sylliden." *C. R. Acad. Sci.* CLXXVI. Paris.
- Jourdan, M., 1887 "Etudes Histologiques sur la deux Especies du Genre Eunice." *Ann. Sci. Nat. Zool.* (7th Ser.). II. Paris.
- McIntosh, W C., 1877 "The great Nerve cords in Marine Annelids." *Proc. Roy. Soc.* London.
- McIntosh, W C., 1894. "A contribution to our knowledge of the Annelida." *Quart. Journ. Micr. Sci.* XXXVI. London.
- McIntosh, W C., 1910. "A Monograph on British Annelids." II. pt. ii. *Ray Soc.* London.
- Milne Edwards, 1838. "Circulation dans les Annelides." *Ann. Sci. Nat.* X. Paris.
- Pruvot, G., 1885. "Sur le système nerveux des Annélides Polychètes." *Arch. Zool. Exp.* (2). III. Paris.
- Quatrefages, Ade, 1844. "Sur la système nerveux des Annélides." *Ann. Sci. Nat.* (3) II.
- Quatrefages, Ade, 1865. "Histoire naturelle des Annelides."
- Racovitza, E. G., 1896. "Le lobe céphalique et l'éncephale des Annelides Polychètes." *Arch. Zool. Exp.* (3) IV Paris.
- Schmarda, 1861. "Wirbellose Thiere."
- Smallwood, 1926 and 1927 "The peripheral nervous system of the common Earthworm." *Journ. Comparative Neurology.* Philadelphia.
- Southern, R., 1921. "Fauna of the Chilka Lake: Polychaeta." *Mem. Ind. Mus.* V Calcutta.

ACANTHOCEPHALA FROM NORTHERN INDIA.*

II. A NEW SPECIES OF *Centrorhynchus* (*C. maryasis*, sp. nov.) FROM A HIMALAYAN BIRD, *Urocissa melonacephala occipitalis* (Blyth).

By M. N. DATTA, M.Sc., M.R.A.S., Zoological Survey of India, Calcutta.

(PLATE VII.)

During a survey of the Kumaon Hills in May and June 1930, under the supervision of Dr. H. S. Pruthi, Assistant Superintendent, three specimens (2 females and 1 male) of *Urocissa melanocephala occipitalis* (Blyth) were shot on the bank of a stream which flows about $1\frac{1}{2}$ miles east of Bhowali. I examined the intestines of these birds and found that they were heavily infected with Acanthocephalan parasites. The total number of parasites collected was 29. The worms were carefully detached from the intestinal walls and left overnight in normal salt solution. After about 16 hours in salt solution the worms became sluggish and were properly expanded. A few drops of 0.5 per cent. solution of Cocaine hydrochloride were then added to narcotise the worms and after a couple of hours some were flattened between two slides and fixed in Bouin's fluid. All the specimens, after washing, were preserved in 70 per cent. alcohol for further study in the laboratory. Full anatomical details could be studied in the flattened worms mounted in Canada Balsam after staining them in a solution of equal parts of Delafield's Haematoxylin and Haemalum. The worms are of a distinct olive colour.

The males are comparatively more slender and smaller than the females. The gravid females in which the lumen of the body is congested with liberated ova are a bit darker in colour. The adult males vary from 5.5—15.0 mm. in length and 1.3—2.0 mm. in breadth and the females from 4.0—18.0 mm. in length and 1.0—3.0 mm. in breadth.

The body is long and cylindrical, having a rounded proboscis at the anterior end and its maximum breadth is near the middle of the body after which it tapers towards the posterior extremity which is bluntly rounded.

The Proboscis (Fig. 3) is globular and is followed by a short neck. The proboscis and the neck are armed with 24—28 rows of 14—16 hooks in each row, radially and symmetrically arranged. The hooks on the proboscis and specially near the middle are very strong and curved, they all have rectangular bases which are embedded in the wall of the proboscis thus giving the worm a strong organ of fixation. The hooks on the neck are slender while the last 2 or 3 rows are minute and thorny.

Measurements of hooks.

	Ant. row.	Middle row.	Last row.
Length	0.047 mm.	0.056 mm.	0.037 mm.
Breadth	0.019 mm.	0.019 mm.	0.009 mm.

* The present paper forms the second instalment of a series of papers which I propose to publish under the above title. The first of this series referred to in the list of references was published in the *Ann. Trop. Med. Parasitol* in 1929.

The Proboscis-sheath (Fig. 3) which has a double-layered muscular wall, originates from the middle of the proboscis, near the constriction formed at the junction of the proboscis and the neck. Strong bands of muscles are attached to the posterior end and also in the cavity of the sheath. These muscular bands known as the retractor and protractor muscles form the motor-system for the protrusion and retraction of the proboscis.

The Central Nervous system (Fig. 3) consists of a single nerve ganglion situated on the middle of the wall of the proboscis sheath. Branches from this ganglion are distributed in the anterior part of the body.

The Lemnisci are two elongated and narrow muscular folds which arise from the anterior end of the body just behind the constriction at the base of the neck. They are longer than the proboscis sheath and are composed of subjacent hypodermis and some muscle fibres. Their size as compared with that of the proboscis sheath varies in various species of *Acanthocephala* and is of some value in the systematic studies of these worms.

The body-wall is composed of an outer thick layer of cuticle followed by a thick layer of subjacent hypodermis in which are found scattered here and there nuclei and the canals and canaliculi of the lacunar system (Verma & Datta, 1929). Below the hypodermis there is a layer of longitudinal muscle fibres. In the body-wall small patches of minute branched nuclei are found scattered in the hypodermis.

The male genitalia (Fig. 5) lying in the posterior two-third of the body consist of a pair of ovoid testes, two vasa-efferentia, a vas-deferens, a seminal vesicle, three long cylindrical prostatic glands, a penis and a funnel-shaped bursa. The two testes are oval and nearly equal in size. They lie closely apposed one behind the other, an efferent duct leads from each of these and running backwards for a short distance joins the duct from the other side to form the vas-deferens; the latter ends in a strong muscular conical organ—the Penis. Near the commencement of the vas-deferens lies the club-shaped seminal vesicle. In mature specimens the vas-deferens is seen packed with sperms. The three prostatic glands are long and cylindrical structures situated a little behind the posterior testes. The ducts leading from these glands run alongside the vas-deferens and then join to open into a common opening near the base of the penis. The penis projects into a bell-shaped bursa, which has a frilled muscular wall. When the worm is pressed or during the time of copulation, the bursa projects outward as a bell at the posterior end. The genitalia are covered by a thin membrane of connective tissue. A ligament—the genital ligament—keeps the genitalia in place being attached at one end to the membranous covering and at the other end to the posterior end of the proboscis-sheath.

The female genitalia (Fig. 6) consist of the Ovary, the Uterine bell, the Uterus, the Vagina and the Vulva. The ovary is a rounded structure attached near the posterior end of the proboscis-sheath by means of the genital ligament and is seen only in very young specimens. In mature worms the ovary bursts, liberating the oval egg-balls which float in the lumen of the body. The egg-balls consist of ova in various

stages of development. The uterine bell is a funnel-shaped structure with a number of regularly arranged guard cells. The movements of these cells serve the function of sorting out the mature and the immature ova (Verma & Datta, 1929). Only the mature ova pass into the uterus for fertilization. The ova, after fertilization, collect at the posterior end of the uterus and from there make their exit through the narrow vagina. The uterus is a long tube and its wall is very flexible. The vaginal wall is composed of very strong muscle fibres and the two ends of the vaginal canal are guarded by a couple of strong sphincter muscles. These sphincters control the exit of the fertilized ova, which can only come out in single row through the narrow canal of the vagina. At the posterior end of the vagina there are two small sac-like structures which open by means of small thin tubes into the vulva. The secretion from these glands probably serves the function of lubricating the vulva.

Only one pair of these worms were found copulating when the specimens were collected. The bursa of the male was found to have been thrust into the vulva of the female. This pair was kept in salt solution, and after some time by contraction the bursa was ejected and the two worms separated.

In this collection I found one very young male specimen (Fig. 8) in which the proboscis, the spines, the proboscis-sheath, a pair of testes and the bursa only were developed.

In assigning these worms to the genus *Centrorhynchus* I have relied on the size and shape of the body of the male and the female, the absence of spines on the body, the lemnisci being longer than the proboscis-sheath, the presence of a distinct neck on the proboscis, the presence of the central nervous system on the middle of the proboscis-sheath and the presence of three prostatic glands.

TABLE I.

Chart showing the points of difference between *Centrorhynchus maryasis*, sp. nov. and other related species.

Name of species.	Size of the body.	Dimensions of the Proboscis.	HOOKS ON THE PROBOSCIS.	
			No. of rows.	No. in each row.
<i>C. asturinus</i> (Johnston and Deland, 1929).	Male 18.0 mm. long and 0.6 mm. broad. Female 28.0 mm. long and 0.8 mm. broad.	0.85 mm. long and 0.25 mm. broad.	40	30
<i>C. pinguis</i> (Van Cleave, 1918).	Male 8.5 mm. long and 1.55 mm. broad. Female 15 mm. long and 2.5—1.2 mm. broad.	0.77 mm. long	32	16

TABLE I—*contd.*

Chart showing the points of difference between *Centrorhynchus maryasis*, sp. nov. and other related species—*contd.*

Name of species.	Size of the body.	Dimensions of the Proboscis.	HOOKS ON THE PROBOSCIS.	
			No. of rows.	No. in each row.
<i>C. aluconis</i> (Muller, 1780).	Male 6—25 mm. long and 0.5—0.6 mm. broad. Females 11—45 mm. long and 0.8—1.5 mm. broad.	1.0—1.5 mm. long and 0.3 mm. broad.	30	15
<i>C. spinosus</i> (Kaiser, 1893).	Male 30—45 mm. long and 0.9—1.1 mm. broad. Female 40—60 mm. long and 1.5 mm. broad.	0.65 mm. long	30—32	24
<i>C. corvi</i> Fukui 1929.	Male 13—14 mm. long and 0.9—1.0 mm. broad. Females 19.7—19.8 mm. long and 1.5 mm. broad.	0.43—0.51 mm. long and 0.44—0.48 mm. broad.	36—40	11—12
<i>C. maryasis</i> , sp. nov., 1932.	Male 5.5—15 mm. long and 1.3—2 mm. broad. Females 4—18 mm. long and 1.0—3 mm. broad.	0.79 mm. long and 0.48 mm. broad.	24—28	14—16

From the above table it is clear that the main points of difference between the new and the other closely related species consist in the size of the body of the male and the female, in the numbers of longitudinal rows of hooks and of hooks in each row on the proboscis.

In the new species, *Centrorhynchus maryasis*, the males are generally more slender and smaller than the females of about the same age. A distinct neck is present, the hooks in the middle of the proboscis are larger, stronger and more curved than those on the neck. The wall of the proboscis-sheath is double-layered and is attached near the middle of the proboscis. The central nervous system is situated near the middle of the wall of the proboscis-sheath. The three prostatic glands are long and cylindrical structures. There are no spines on the body-wall.

In conclusion I have to express my gratitude to Dr. Bains Prashad, Director, Zoological Survey of India, for his kind and unceasing help, as also for going through the manuscript.

Host.—*Urocissa melanocephala occipitalis* (Blyth).

Location.—Intestine.

Locality.—Kumaon Hills (near Bhowali).

Type-specimens, No. W $\frac{3000}{1}$, with all the preparations, are deposited in the reserve collection of the Zoological Survey of India, Indian Museum, Calcutta.

TABLE II.

Measurements of flattened specimens in millimeters.

Specimens.	1	2	3	4	5	6
Total length of individual	14.00	6.60	5.60	16.00	10.00	4.60
Maximum breadth	2.00	1.40	1.30	3.00	1.50	1.00
Proboscis with neck—						
Length	0.76	0.79	0.73	0.81	0.79	0.69
Breadth .	0.47	0.48	0.41	0.49	0.47	0.39
Proboscis-sheath—						
Length	0.79	1.11	0.79	0.85	0.90	0.77
Breadth	0.30	0.32	0.28	0.39	0.31	0.27
Leninisci—						
Length .	1.30	1.82	0.93	1.40	1.16	0.90
Breadth .	0.15	0.17	0.09	0.17	0.19	0.08
Testes—						
Anterior—						
Length	0.71	0.87	0.41	..	..	..
Breadth	0.39	0.59	0.28	..	..	..
Posterior—						
Length	0.69	0.87	0.41	..	..	..
Breadth	0.37	0.56	0.28	..	..	..
Prostatic glands—						
Length (mass) .	3.44	2.33	1.45	..	..	..
Breadth (single)	0.07	0.06	0.04	..	..	..
Seminal vesicle—						
Length .	1.49	1.12	1.02	..	..	..
Breadth .	0.41	0.26	0.28	..	..	..
Bursa—						
Length .	0.99	0.97	1.02	..	..	..
Breadth .	0.79	0.52	0.28	..	..	..
Uterine bell—						
Length	..	..	..	0.35	0.34	0.26
Breadth	..	..	..	0.12	0.15	0.09
Uterus—						
Length .	..	..	..	0.93	0.84	0.78
Breadth	..	..	..	0.09	0.11	0.07
Vagina—						
Length	..	..	..	0.28	0.19	0.20
Breadth	..	..	..	0.13	0.09	0.09

N.B.—Specimens Nos. 1—3 are males and Nos. 4—6 are females.

(1. adult) 2. medium sized, and 3. small male.

4. adult, 5. medium sized, and 6. small female.)

REFERENCES.

- Datta, M. N. (1928). On *Echinorhynchus robustus* n. sp. from common crows, *Corvus corax* and *C. splendens* of Allahabad. *Allahabad University Studies* IV, pp. 41-61.
- Luhe, M. (1911). *Die Susswasserfauna Deutschlands* XVI, Acanthocephalen. Jena.
- Marvel, L. de, (1905). Monographie des Acanthocephales d'oiseaux. *Revue Suisse Zoologie* XIII, pp. 195-387.

- Southwell, T. and Macfie, J. W. S. (1925). On a collection of Acanthocephala in the Liverpool School of Tropical Medicine. *Ann. Trop. Med. Parasitol.* XIX, pp. 140-184.
- Travassos, L. (1926). Contribuicoes para o conhecimento de fauna helminthologica brasileira, XX. *Memorias Instituto Oswaldo Cruz.* XIX, pp. 31-125.
- Van Cleave, H. J. (1916). Acanthocephala of the genera *Centrorhynchus* and *Mediorhynchus* (new genus) from North American Birds. *Trans. Amer. Micros. Soc.* XXXV, pp. 221-232.
- Van Cleave, H. J. (1918). Acanthocephala of North American Birds. *Trans. Amer. Micros. Soc.* XXXVII, pp. 19-47
- Van Cleave, H. J. (1923). A key to genera of Acanthocephala. *Trans. Amer. Micros. Soc.* XLII, pp. 184-191.
- Van Cleave, H. J. (1924). A critical study of the Acanthocephala described and identified by Joseph Leidy. *Proc. Acad. Nat. Science, Philadelphia* LXXVI, pp. 279-334.
- Verma, S. C. and Datta, M. N. (1929). Acanthocephala from Northern India. I—A new genus *Acanthosentis* from a Calcutta fish. *Ann. Trop. Med. Parasitol.* XXIII, pp. 483-498.

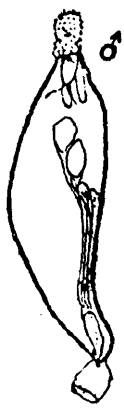
EXPLANATION OF PLATE VII.

Centrorhynchus maryasis, sp. nov.

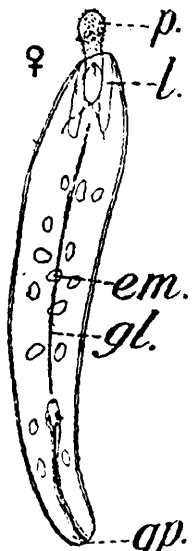
- Fig. 1.—Lateral view of pressed male specimen. × 8.
Fig. 2.—Lateral view of pressed female specimen. × 8.
Fig. 3.—Anterior portion of the body highly magnified.
Fig. 4.—Hooks of the anterior, middle and last rows.
Fig. 5.—Male genitalia. × 10.
Fig. 6.—Female genitalia.
Fig. 7.—Ova highly magnified.
Fig. 8.—A young male specimen, the only one found in the collection.

REFERENCE TO LETTERINGS.

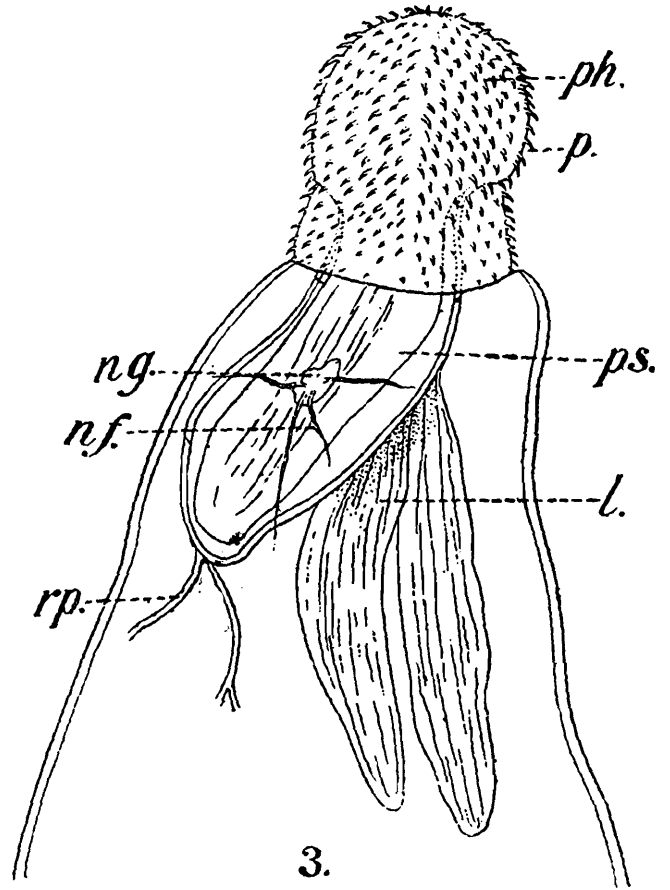
b., bursa; *c.*, cuticle; *e. m.*, egg mass; *g. l.*, genital ligament; *g. p.*, genital pore; *h.*, hypodermis; *l.*, lemnisci; *n. f.*, nerve fibres; *n. g.*, nerve ganglion; *o. e.*, ovejector; *o. v.*, fertilised ova; *p.*, proboscis; *p. d.*, prostatic duct; *p. e.*, penis; *p. g.*, prostatic glands; *p. h.*, proboscis hooks; *p. s.*, proboscis-sheath; *r. p.*, retractor muscles of the proboscis; *s. v.*, seminal vesicle; *t.*, testes; *u.*, uterus; *u. b.*, uterine bell; *v.*, vagina; *v. d.*, vas deferens; *v. e.*, vasa efferentia.



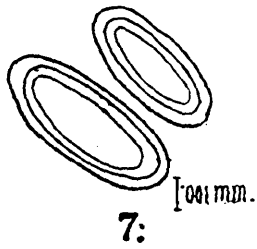
1.



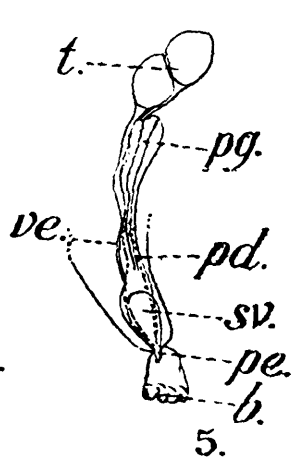
2.



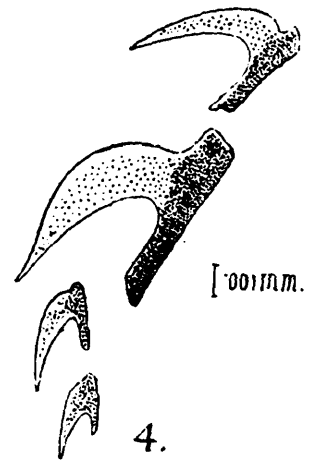
3.



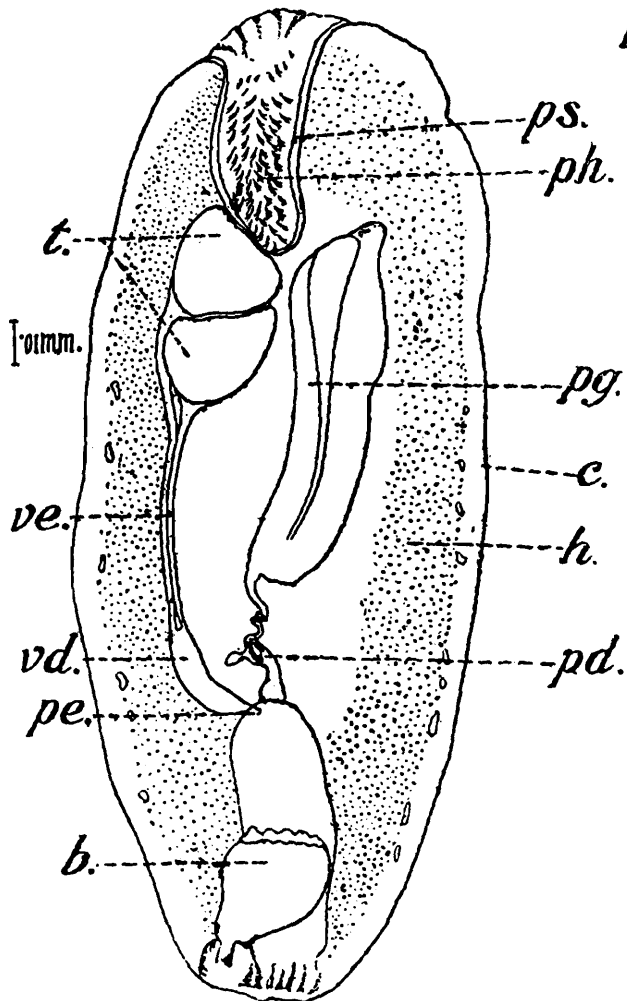
7.



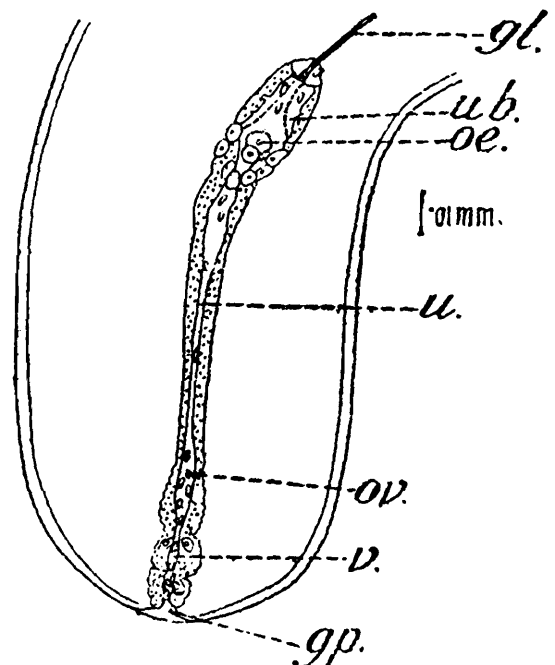
5.



4.



8.



6.

Centrorhynchus maryasis, sp. nov.

RECORDS AND DESCRIPTIONS OF *BREMUS* AND *PSITHYRUS*
FROM INDIA (BREMIDAE : HYMENOPTERA).

By THEODORE H. FRISON, *Illinois State Natural History Survey, Urbana, Illinois.*

This paper is a report concerning material sent to me for study and identification by Dr. Hem Singh Pruthi of the Zoological Survey of India, Indian Museum, Calcutta, India. In addition to the records of previously described species and varieties, there are presented the descriptions of two new species of true bumblebees (*Bremus*=*Bombus*) and two new species of the false or inquiline bumblebees (*Psithyrus*).

Types of one of the new species of *Bremus* and the two new species of *Psithyrus* are deposited in the collection of the Indian Museum. The type of the other new species of *Bremus* is deposited in the United States National Museum, Washington, D. C., because the description of this species is based mostly on a series of specimens loaned by this institution. The description is, however, included in this paper because of the presence of one specimen from India.

My thanks are due to Dr. Hem Singh Pruthi and the Indian Museum for the loan of most of this material, to the United States National Museum for the loan of the other material included in this paper, to Dr. O. W. Richards, Oxford, England, for numerous comparisons of typic material in the British Museum and other information, and to Mr. Carl Mohr, Assistant Entomologist, Illinois State Natural History Survey, for making the drawings.

Genus **Bremus** (= *Bombus*).

Subgenus **Orientalibombus** Richards (1929).

Bremus haemorrhoidalis (Smith).

37 workers, Pindi Point, Murree, ca. 7242 ft., Punjab, Sta. 33, 23, 24-IX-28 (H. S. Pruthi); 1 worker, Murree near Sunny Bank, 6,500 ft., Punjab, Sta. 1, 3-IX-28 (H. S. Pruthi); 2 workers, Kohala, Murree Subdivision, 2,000 ft., Punjab, Sta. 34, 30-IX-28 (H. S. Pruthi); 3 workers, small vegetable garden near Kuldanna, Murree Subdivision, 7,006 ft., Punjab, Sta. 18, 11-IX-28 (H. S. Pruthi); 4 workers, Country around about Gharial, Murree Subdivision, ca. 6,000 ft., Punjab, Sta. 28, 19-IX-28 (H. S. Pruthi); 2 workers, Tret, Murree Subdivision, 3,306 ft., Punjab, Sta. 38, 5-X-28 (H. S. Pruthi); 1 worker, Kandaghat, Simla Hills, alt. 3,500—4,600 ft., Sta. 2, VIII-25 (B. Chopra); 1 male, Chhangla Gali, Abbotabad district, Punjab, 8,450 ft., 3-X-28 (H. S. Pruthi).

Bremus haemorrhoidalis var. **albopleuralis** (Friese).

1 male, Simla, W Himalayas, alt. 6,000—7,000 ft., Sta. 1, jungle, VIII, IX-25 (B. Chopra).

Bremus monticolans (Richards).

1 queen, Nampakha, N. Shan States, Burma, ca. 3,700 ft., 17-XII-26 (H. S. Rao); 1 worker, Pangsang, Tawng Peng State, North Shan States, U. Burma, 4,200 ft., Feb.-April—1915 (J. Coggin Brown); 1 worker, Selan, N. Shan States, Burma, 2,500 ft., 8, 9-XII-26 (H. S. Rao).

The queen and one worker from Selan have been compared for me by Dr. O. W. Richards with the types of this species in the British Museum.

Bremus orientalis var. **buccinatoris** (Smith).

1 worker, Kurseong, E. Himalayas, alt. 4,700—5,000 ft., 25-VI-10 (N. Annandale).

This worker was compared for me by Dr. O. W. Richards with the type of *buccinatoris* Smith in the British Museum.

Subgenus **Lapidariobombus** Vogt (1911).**Bremus rufofasciatus** var. **ladakhensis** (Richards).

2 queens, Nagaberan, Kashmir, 10,000—10,500, by side of stream (H. Bion).

The yellowish color of the pubescence on the first dorsal abdominal segments, as well as on the prothorax and postscutellum, indicates that these specimens are best considered as the color variety *ladakhensis*. On one of the queens the pubescence on the apical half of the second dorsal abdominal segment is black.

Bremus simillimus (Smith).

1 queen, Mt. Hattu near Bagli, Simla Hill States, 10,400 ft., 10-X-21 (S. W. Kemp).

This specimen has been compared for me by Dr. O. W. Richards with the type in the British Museum.

Subgenus **Rufipedibombus** Skorikov (1922).**Bremus eximius** (Smith).

1 worker, Darjiling district, Singla, alt. 1,500 ft., 1913 (Lord Carmichael's collection).

Subgenus **Pratobombus** Vogt (1911).**Bremus atrocinctus** (Smith).

1 worker, Darjiling district, Singla, alt. 1,500 ft., 1913 (Lord Carmichael's collection).

Subgenus **Diversobombus** Skorikov (1922).**Bremus mimeticus** var. **insidiosus** (Richards) (1931).

1 worker, Murree, Punjab, Sta. 6, ca. 7,242 ft., 4-IX-28 (H. S. Pruthi); 2 workers, Pindi Point, Murree, Punjab, ca. 7,242 ft., Sta. 33, 23, 24-

IX-28 (H. S. Pruthi); 1 worker, Wild grass near Kuldanna, Murree Sub-division, Punjab, ca. 7,006 ft., Sta. 19 (H. S. Pruthi); 3 workers, Simla, W Himalayas, alt. 6,000—7,000 ft., Sta. 1 jungle, VIII, IX-25 (B. Chopra); 1 worker, Kandaghat, Simla Hills, alt. 3,500—4,600 ft., Sta. 2, VIII-25 (B. Chopra).

Data associated with these workers were sent to Dr. O. W. Richards and recorded by him (1931) when this species and variety were originally described. A few of the workers recorded as variety *insidiosus* by Richards from material in my possession but not seen by Richards belong to the variety *geminatus* (Richards) (1931). This variety is parallel in coloration to *B. haemorrhoidalis* (Smith) but is easily separated because of the strongly pointed apex of the mesobasitarsus.

***Bremus mimeticus* var. *geminatus* (Richards) (1931).**

2 workers, Simla, W Himalayas, alt. 6,000—7,000 ft., Sta. 1 jungle, VIII, IX-25 (B. Chopra); 3 workers, Kandaghat, Simla Hills, alt. 3,500—4,600 ft., Sta. 2, VIII-25 (B. Chopra); 1 worker, Ghuma, Simla Hills, alt. 3,700 ft., 8-IX-25, in jungle (B. Chopra).

These specimens were all recorded as var. *insidiosus* (Richards) by Richards (1931) due to my sending to him under the name *mimeticus* all data associated with the above specimens previous to the description of *geminatus*. This is a minor color variety differing from variety *insidiosus* in having sides of thorax whitish or gray instead of black. One worker of this variety has been compared for me by Dr. O. W., Richards with the type in the British Museum.

***Bremus mimeticus* var. *gantokiensis* (Richards) (1931).**

1 large worker, Kurseong, E. Himalayas, ca. 5,000 ft., 7-III-28 (Gopi Ram).

This specimen has been compared for me by Dr. O. W. Richards with the type in the British Museum.

***Bremus mimeticus* var. *turneri* (Richards) (1931).**

1 worker, Shillong, Khasi Hills, Assam, 3-X-26 (R. B. S. Sewell).

This specimen has been compared for me by Dr. O. W. Richards with the type of this variety in the British Museum.

Subgenus ***Bremus*** Jurine, s.s. (1801).

***Bremus tunicatus* (Smith).**

21 workers and 29 males, Chhangla Gali, Abbotabad Dist., Punjab, 8,450 ft., 3-X-28 (H. S. Pruthi).

Subgenus ***Alpigenobombus*** Skorikov (1914).

***Bremus mastrucatus* var. *kashmirensis* Friese).**

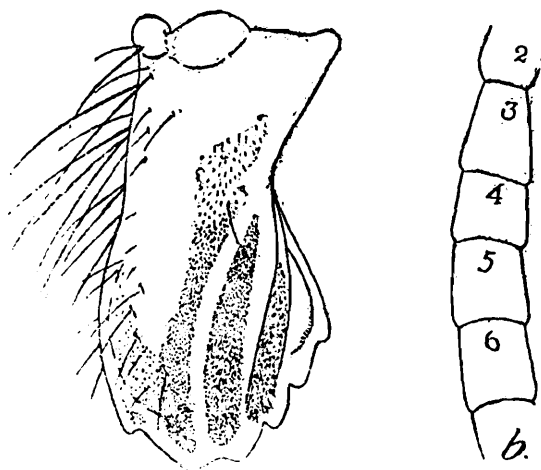
3 queens, Nagaberan, Kashmir, alt. 10,000—10,500 ft., by side of stream (H. B. Bion); one queen, Gilgit Road, 11,000 ft., 25-VI-95,

Bremus orichalceus (Friese).

1 worker, Kandaghat, Simla Hills, alt. 3,500—4,600 ft., Sta. 2, VIII-25 (B. Chopra); 1 worker, Simla, W Himalayas, alt. 6,000—7,000 ft., jungle, Sta. 1, VIII, IX-25 (B. Chopra).

Bremus grahami, sp. nov.

Worker.—Face, occipital orbits and occiput with long hairs mostly black but sometimes whitish-gray, short hairs dominantly whitish-gray. Labrum with a conspicuous cup-like depression occupying middle one-third of width, lateral tubercle-like areas prominent, rough and punctate on mesal and upper surfaces and smooth and polished on lower surface; shelf-like projection (lamella) prominent and about one-third width of labrum. Mandibles (Fig. 1a) many-toothed, similar in general to those



TEXT-FIG. 1.—*Bremus grahami*, sp. nov. a. dorsal view of right mandible; b. third, fourth and fifth antennal segments.

of *B. mastrucatus* (Gerst.) and other members of the subgenus *Alpigenobombus* Skorikov (1914). Disk of clypeus smooth and shining, with a few minute and a few medium-sized scattered punctures; anterio-lateral corners and area surrounding disk with numerous punctures. Malar space short, less than its width at articulation of mandibles; about equal in length to third antennal segment, smooth and shining, about one-sixth as long as greatest length of and less than one-half greatest width of compound eye. Ocelli situated just above narrowest part of vertex, lateral ocelli separated from one another by about the same distance as each lateral ocellus is distant from inner margin of the compound eye, each ocellus with a diameter about equal to width of second antennal segment; area directly laterad of each lateral ocellus polished and impunctate for one-third of distance to inner margin of compound eye, remaining two-thirds of area extending to compound eye both polished and with scattered punctures. Flagellum about twice as long as the scape; third antennal segment longer than fifth segment, about as long as malar space, fifth segment longer than fourth (Fig. 1b).

Dorsum of thorax, except for smooth and polished area on disk, with a longitudinal stripe of whitish or grayish-white hair in center,

remainder of dorsum of thorax with black and whitish-gray hairs intermixed; pleurae with upper portion concolorous with lateral portions of dorsum and with lower portions more whitish.

Dorsum of abdomen with whitish hairs on first and basal portion of second segments, remainder of second segment and third segment with black hairs, fourth, fifth and sixth segments with ferruginous hairs. Venter of abdomen with light hairs; hypopygium (sixth ventral segment) without a median carina.

Legs with hairs dominantly black, except for short ferruginous hairs on tarsal segments and long more whitish hairs on coxae and trochanters. Metatarsus of both middle and hind legs without a pronounced, sharp, spine-like projection at outer apical angle.

Wings distinctly darkened but not so much as in *B. orichalceus* (Friese) of the same subgenus.

Length, 15 millimeters; spread of wings, 28 millimeters; width of abdomen at second segment, 6 millimeters.

Holotype.—Worker, July 25, 1925, altitude 11,000 ft., Washan, Szechuen, China, collected by D. C. Graham. Deposited in the collection of the United States National Museum. *Paratypes*.—1 worker, July 26, 1925, altitude 11,000 ft., Washan, Szechuen, China (D. C. Graham); 1 worker, Suifu, Szechuen, China (D. C. Graham); 1 worker, June 23-27, 1929, altitude 2,000—5,000 ft., Yachow to Mupin, Szechuen, China (D. C. Graham); 1 worker, August 27, 1921, altitude 6,000 to 7,500 ft., Mt. Omei, Szechuen, China (D. C. Graham); 1 worker, August 10, 1925, altitude 9,500 ft., Gieh Yin Temple, Mt. Omei China (D. C. Graham); 1 worker, 1913, altitude 1,500 ft., Singla, Darjiling District (Lord Carmichael's collection). Two paratypes deposited in the collection of the United States National Museum, 1 paratype from Singla deposited in the collection of the Zoological Survey of India, remaining paratypes in the collection of the author.

Although the type and all but one of the paratypes of this new species are specimens collected in China, this new species is described in this paper because of the presence in the material of the Indian Museum of a single specimen from Singla.

This species is named in honor of D. C. Graham who has collected large series of bumblebees in China for the United States National Museum, Washington, D. C. These specimens are now being studied by the author.

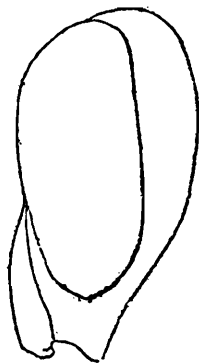
In color *B. grahami* Frison is very suggestive of *B. funerarius* var. *lateritius* (Friese), but it differs from this species in numerous structural characters such as the length of the malar space and tothing of mandibles. Within the subgenus to which it belongs I know of no other species with the same color pattern.

Subgenus **Sibiricobombus** Vogt (1911).

Bremus oculatus, sp. nov.

Male.—Clypeus with a small bare and polished area on mesal anterior portion near clypeal-labral suture; short pubescence on interior portion black but whitish on posterior portion, long hairs black. Labrum

with slightly elevated, polished, and rather weakly separated linear areas on posterior half, anterior portion somewhat concave, moderately punctate, and with dark or golden brown hairs. Mandibles bidentate at tip, with long brownish or golden-tipped hairs fringing lower edge. Black pubescence surrounding bases of antennae, that on posterior portion of occiput and on occipital orbits whitish or whitish mixed with black. Malar space (Fig. 2) about as long as its width at



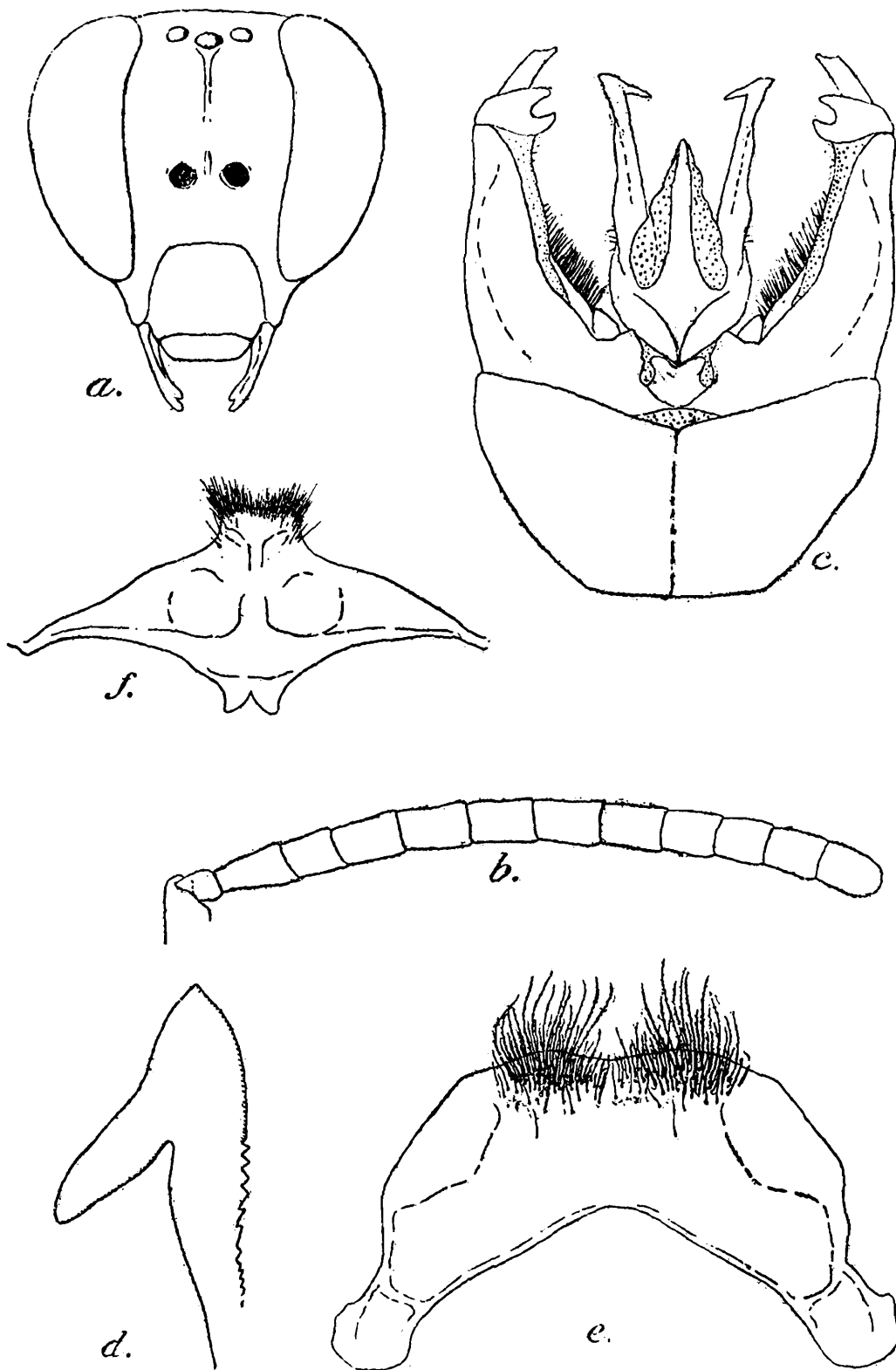
TEXT-FIG. 2.—*Bremus oculatus*, sp. nov. Lateral view of head showing comparative width of malar space.

articulation of mandibles, about one-fifth as long as length of compound eye. Compound eyes large and bulging from sides of head (Fig. 3a) somewhat as in *B. (Sibiricobombus) niveatus* (Kriechbaumer); distinctly punctate on lower half near articulation with mandibles, upper half smooth and shiny. Ocelli rather large, situated in narrowest part of vertex, each lateral ocellus separated from median ocellus by about one-half of its diameter, each lateral ocellus separated from inner margin of compound eyes by a distance slightly less than combined diameters of two ocelli, area between each lateral ocellus and inner margin of compound eye smooth and polished except for a few punctures near margin of compound eye. Flagellum (Fig. 3b) about two and one-half times as long as scape, third flagellar segment longer than fourth and about as long as fifth.

Dorsum of thorax with center or disk with a small longitudinal smooth and impunctate area. Dorsum, pleurae, and sternum covered with short, even, whitish or hoary pubescence, a few black hairs intermixed on metapleurae.

Dorsum of abdomen with pubescence on segments colored as follows: first whitish or hoary; second whitish—except that basal lateral portions are shaded with pale fulvous; third dominantly black with some whitish along posterior margin; fourth to seventh segments with bright ferruginous pubescence, except for occasional whitish hairs or whitish-tipped hairs. Pubescence on sides blackish, that on most of sternum whitish except for short ferruginous hairs on edge of hypopygium. Hypopygium with a well developed carina along apical border, carina indented in middle; area anterior to carina shiny, slightly shagreened and with small punctures; a membranous flap posterior to carina,

Sagittae of genitalia (Fig. 3c) long and slender, heads (Fig. 3d) with V-shaped hooks which are slightly toothed on outer margins; volsellae



TEXT-FIG. 3.—*Bremus oculatus*, sp. nov. a. front view of head showing bulging eyes; b. flagellum of antennae; c. dorsal view of male genitalia; d. head of sagitta of male; e. outer spatha of male; f. inner spatha of male.

elongated and projecting far forward beyond squamae, toothed on inner apical angles; squamae deeply indented on inner margin; uncus elongate or linear. Outer spatha (Fig. 3e) and inner spatha (Fig. 3f) as in figures.

Long hairs on tibiae and tarsi black tipped with whitish, hairs on femora and trochanters black tipped with whitish or all whitish, short hairs on tarsi golden brown. Metatarsus of hind leg but slightly arcuate on upper edge; outer surface slightly concave; upper apical angle not sharply produced; about four times as long as wide. Metatarsus of middle leg without a pronounced projection.

Wings light, slightly stained with brown, nervures prominent.

Length, 20 millimeters; spread of wings, 37 millimeters; width of abdomen at second segment, 8 millimeters.

Holotype.—Male, "Baghi, Simla Hill States, 8,800 ft., 7, 8-X-21, S. W Kemp" *Paratypes*.—Two males with same data as holotype and one male "Mt. Hattu near Baghi, Simla Hill States, 10,400 ft., 10-X-21, S. W Kemp" Holotype and the paratype from Mt. Hattu deposited in the collection of Indian Museum, Calcutta, India, two paratypes with same data as type deposited in the collection of the author.

The head of this species and large size of the compound eyes are suggestive of *B. (Sibiricobombus) niveatus* (Kriechbaumer). It differs, however, in shape of volsella, comparative lengths of antennal segments, difference in coloration of thorax, etc.

Genus **Psithyrus**.

Subgenus **Psithyrus** (*s. s.*) Lepeletier (1832).

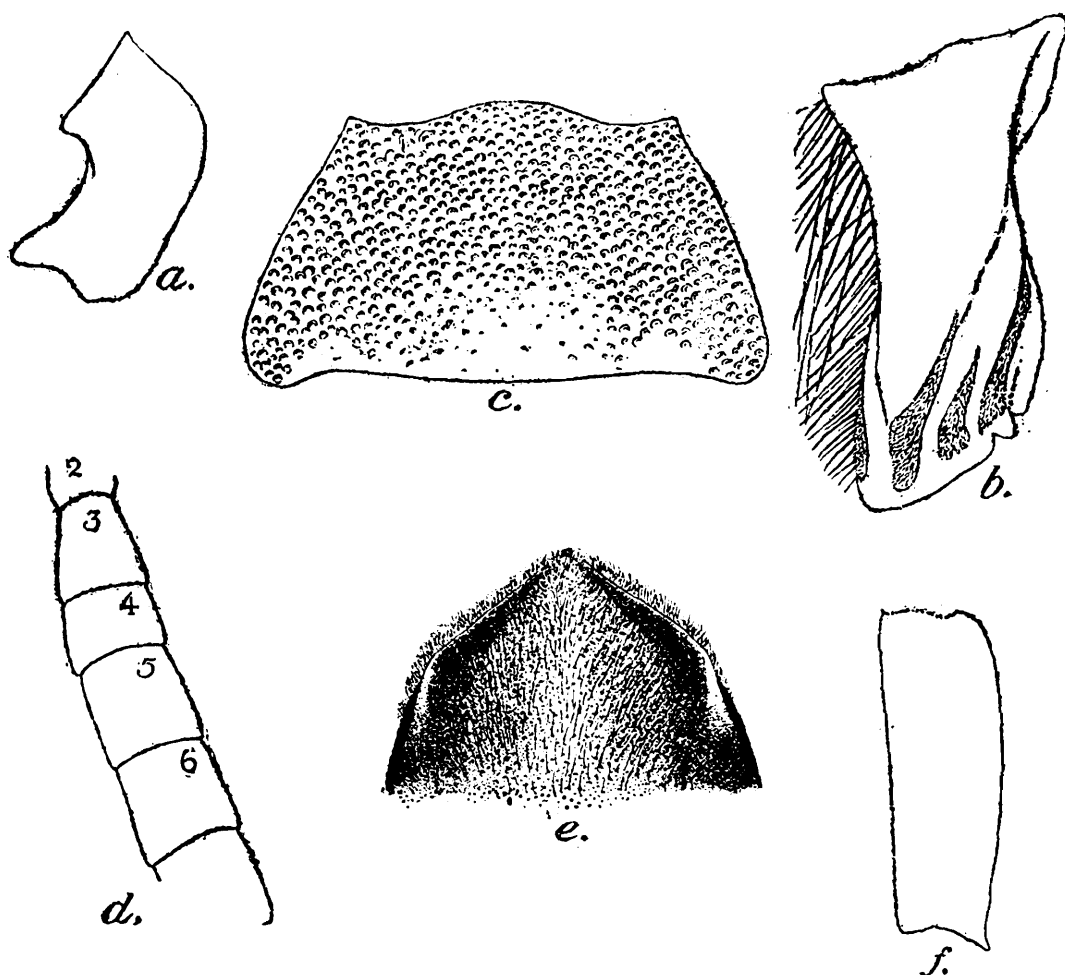
Psithyrus cornutus, sp. nov.

Female.—Long hairs on face, occipital orbits and occiput black short hairs light yellowish. Labrum with lateral tubercles well developed and distinctly separated by an impunctate depression, median anterior portion of labrum developed into a large conical tubercle much higher than lateral tubercles (Fig. 4a). Mandibles as illustrated (Fig. 4b). Clypeus with numerous coarse punctures except on median anterior margin (Fig. 4c). Malar space about as long as wide at articulation of mandibles, smooth and polished, with some scattered minute punctures; about equal in length to third and fourth antennal segments combined. Ocelli situated just above narrowest part of vertex, lateral ocelli separated about as far as each lateral ocellus is distant from inner margin of compound eye, about equal in size to second antennal segment; area directly laterad of each lateral ocellus smooth and impunctate for about one-half of distance to inner margin of compound eye, remaining half adjacent to compound eye coarsely punctate. Flagellum about twice as long as scape, scape with numerous punctures and not smooth and polished; third and fifth antennal segments about equal in length and the fourth much shorter than either (Fig. 4d).

Dorsum and pleurae of thorax covered with yellow hairs except for a broad transverse band of black hairs between bases of wings.

Dorsum of abdomen with yellow hairs on first segment, second and third segments black except for a few yellow hairs on basal middle portions, fourth and fifth segments covered with long whitish hairs, hairs on sixth segment very short and fulvous or tawny in color. Sixth

dorsal segment with numerous punctures except on basal median portion and longitudinal line on meson where it is smooth and polished. Hairs on venter of abdomen mostly pale fulvous. Sixth ventral segment (Fig. 4e) with a more or less impunctate, polished median longitudinal slightly convex ridge, remainder of integument well punctate except basal portion, ridges on sides of segment angular and prominent as in the subgenus *Psithyrus* (s. s.).



TEXT-FIG. 4.—*Psithyrus cornutus*, sp. nov. a. lateral view of labrum showing conical tubercle on lower portion; b. dorsal view of right mandible; c. clypeus showing punctures; d. third, fourth and fifth antennal segments; e. sixth ventral abdominal segment; f. metatarsus of left hind leg.

Legs with long light yellowish hairs on ventral parts of coxae; trochanters and femora; hairs on tibiae and basal portion of metatarsi mostly black; short hairs on most of metatarsi and remaining tarsal segments ferruginous. Metatarsi of middle and hind legs (Fig. 4f) with a pronounced spine-like projection.

Wings rather deeply and uniformly stained with brown.

Lengths, 18 millimeters; spread of wings, 35 millimeters; width of abdomen at second segment, 7 millimeters.

Holotype.—Female, June 14, altitude 11,000 feet, Andarban, Garhwal, W Himalayas (Tytlor). Deposited in the collection of the Indian Museum, Calcutta, India.

This new species runs in the recent key of Popov (1931) to the subgenus *Psithyrus* (s. s.). It is possible, however, that the male of this

new species when discovered may show structural characters of the subgenus *Ashtonipsithyrus* Frison. As Popov (1931, p. 133) has already noted, the females of the North American *suckleyi* Greene have a sixth ventral abdominal segment very suggestive of the subgenus *Psithyrus* (s. s.).

It is separated from *rupestris* Fabr. and *branicki* Rad. by having the sixth dorsal abdominal segment slightly polished and not shagreened or wrinkled. It differs from *chinensis* (F. Mor.) and *morawitzi* Friese by the presence of its prominent conical projection or tubercle on middle anterior portion of labrum and in color pattern. The prominent conical tubercle on the middle anterior portion of the labrum, not developed to such an extent upon any other species of *Psithyrus* studied by me, is an exceptional character for the recognition of this species.

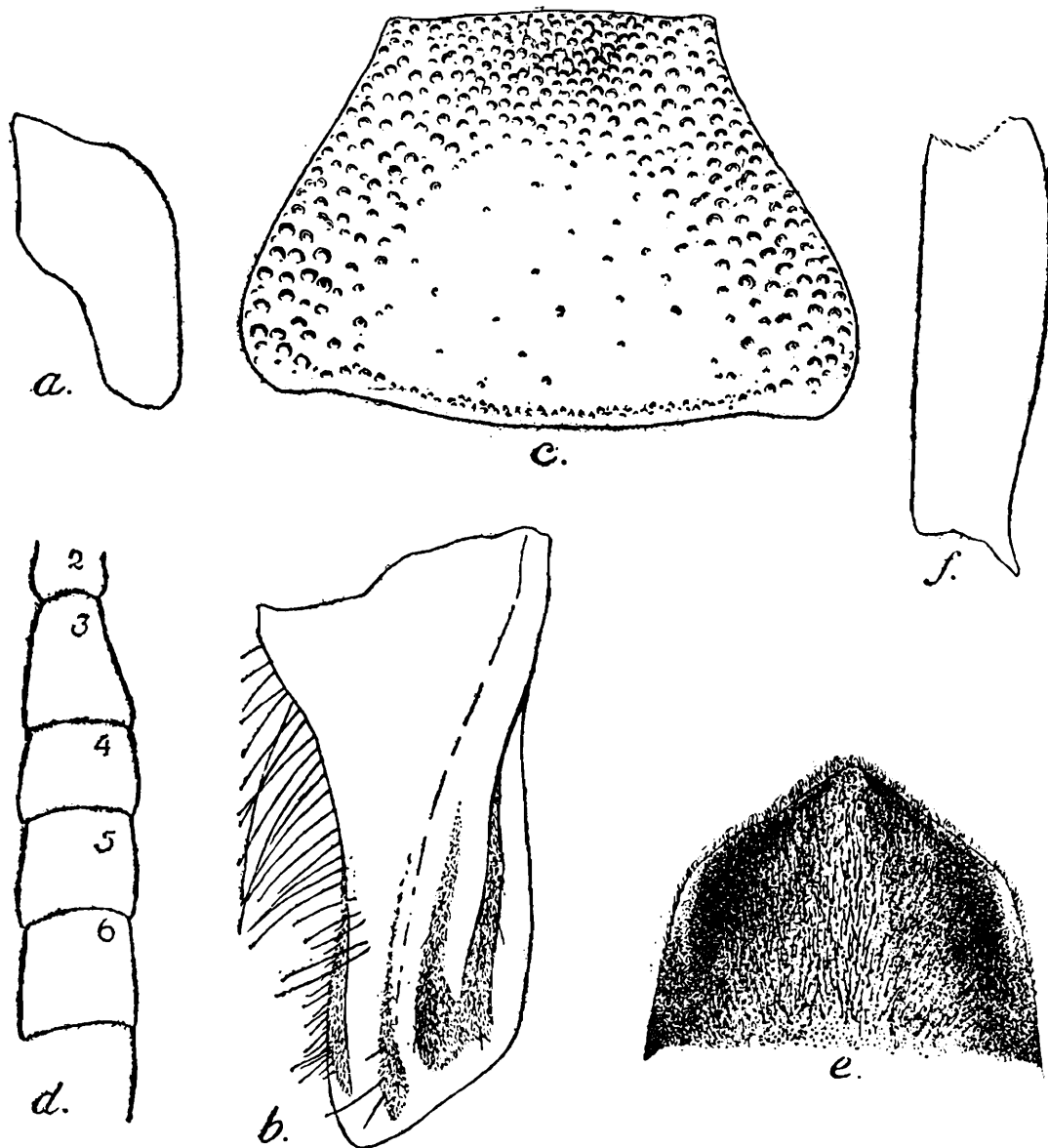
***Psithyrus novus*, sp. nov.**

Female.—Hairs on face, occiput and occipital orbits black. Labrum with lateral tubercles well developed and widely separated by a depression which is polished and impunctate above, areas below and on sides of lateral tubercles coarsely punctate and slightly shagreened; median anterior portion of labrum with a broad shelf-like projection or lobe (Fig. 5a). Mandibles as illustrated (Fig. 5b). Clypeus with numerous coarse punctures on sides and upper portion, disk polished and with scattered punctures (Fig. 5c). Malar space about as long as width at articulation of mandibles, about as long as third and fourth antennal segments combined, half adjacent to compound eye polished but with numerous, distinct small punctures, lower half adjacent to mandibles impunctate and polished. Ocelli situated above narrowest part of vertex, lateral ocelli separated by a distance slightly less than each lateral ocellus is distant from inner margin of compound eye, anterior ocellus larger than lateral ocelli, diameter of lateral ocelli about equal to that of second antennal segment; area directly laterad of each lateral ocellus smooth and impunctate for about one-half of distance to inner margin of compound eye, remaining half with numerous coarse punctures. Flagellum about twice as long as scape, scape although with scattered small setiferous punctures, mainly smooth and polished so that it contrasts with flagellum; third antennal segment much longer than fifth, the fifth longer than fourth (Fig. 5d).

Dorsum of thorax tawny except for a poorly defined black transverse band between bases of wings; pleurae with upper anterior portions concolorous with dorsum, lower and posterior portions with pubescence becoming more brown.

Dorsum of abdomen with first and second segments covered with dull yellowish pubescence, third and fourth segments with black pubescence, fifth segment with pubescence on basal and middle portions black and that on posterior and lateral margins brownish or ferruginous, sixth segment with short, fine brownish-black pubescence. Sixth dorsal segment closely punctate except on basal middle portion and slightly shagreened. Hairs on venter of abdomen brownish-black. Sixth ventral segment (Fig. 5e) slightly convex in middle, shiny but with

numerous punctures over most of surface ; ridges on sides of segment angular and well developed as in the subgenus *Psithyrus* (*s. s.*).



TEXT-FIG. 5.—*Psithyrus novus*, sp. nov. a. lateral view of labrum showing lack of pronounced tubercle on lower portion ; b. dorsal view of right mandible ; c. clypeus showing punctures ; d. third, fourth and fifth antennal segments ; e. sixth ventral abdominal segment ; f. metatarsus of left hind leg.

Legs clothed with black or brownish hairs except for short ferruginous hairs on tarsi. Metatarsi of middle and hind legs (Fig. 5f) with a pronounced spine-like projection.

Wings well stained with brown.

Length, 20 millimeters ; spread of wings, 37 millimeters ; width of abdomen at second segment, 8 millimeters.

Holotype.—Female, by side of stream, altitude 10,000—10,500 ft., Nagaberan, Kashmir (H. Bion). Deposited in the collection of the Indian Museum, Calcutta, India.

This new species runs in the recent key of Popov (1931) to the subgenus *Psithyrus* (*s. s.*). It is possible, however, that the male of this new species when discovered may show structural characters of the subgenus *Ashtonipsithyrus* Frison. As Popov (1931, p. 133) has already noted the females of the North American *suckleyi* Greene have a sixth

ventral abdominal segment very suggestive of the subgenus *Psithyrus* (s. s.).

It differs in color and structure from the species *branicki* Rad. and *rupestris* Fabr. in having the lateral tubercles on labrum well developed and deeply separated and by not having the sixth dorsal abdominal segment as wrinkled, closely punctate or shagreened. It differs from *chinensis* (F. Mor.) in color and in having the hind metatarsus more than three times as long as broad; and from *morawitzi* Friese in the absence of ferruginous pubescence on the third and fourth dorsal abdominal segments.

LITERATURE.

- Jurine, L., ed. Panzer, G. W. F. (1801). Nachricht von einem neuen entomologischen Werke, des Hrn. Prof. Jurine in Geneve (Beschlufs)—*Erlangen Litteratur-Zeitung*, I, p. 165.
- Lepelletier de St. Fargeau, A. (1832). Observations sur l'ouvrage institué "Bombi Scandinaviae Monographico Tractato. *Ann. Soc. Ent. France*, 1, pp. 366—382.
- Popov, V. B. (1931). Zur Kenntnis der paläarktischen Schmarotzerhummeln (*Psithyrus* Lep.). *Eos. Madrid*, VII, pp. 131—209.
- Richards, O. W. (1929). A Revision of the Humble-Bees allied to *Bombus orientalis* Smith, with the Description of a new Subgenus. *Ann. Mag. Nat. Hist.* (10) III, pp. 378—386.
- Skorikov, A. S. (1914). New Forms of Bumblebees. *Revue Russe d'Entom.* XIV, pp. 119—129.
- Skorikov, A. S. (1922). Palearctic Bumblebees: General Biology including Zoogeography. *Bull. Stat. Regionale Protect. d. Plantes à Petrograd*, IV, pp. 1—160.
- Vogt, O. (1911). Studien über das Artproblem. Teil 2. Über das Variieren der Hummeln. *Sitzungsb. Ges. Nat. Freunde Berlin*, I, pp. 31—74.

ON FOUR NEW RHYNCHOTA OF THE FAMILY ALEURODIDAE
FROM BURMA.

By KARAM SINGH, *M.Sc.*, Department of Zoology, Science College,
Nagpur.

Genus *Aleurotrachelus* Quaintance and Baker (1914).

Aleurotrachelus tuberculata, sp. nov.

(PLATE VIII).

Locality.—Horticultural gardens, Rangoon. Insein.

Host.—*Ficus* sp.

Pupa case.—(Fig. 1) Black, with a short fringe of apposed wax filaments; waxy secretion on the dorsum arranged in the form of narrow white bands on the ridges. Margin (Fig. 4) with two rows of rounded teeth, the teeth in the inner row alternating with those in the outer and having semielliptical pores at their bases outwardly; a pair of fine bristles arising from the teeth in the outer row towards the caudal margin; at the bases of some of the teeth in the inner row, there are inwards short inconspicuous papillae. Dorsum with a distinct ridge and the usual folds, characteristic of the genus; with five pairs of long spines, three pairs situated sub-medially on the cephalothorax, a pair cephalad of the vasiform orifice and a pair near the caudal margin; dorsum also provided with small tubercular papillae (Fig. 5) disposed on the greater part of the cephalothorax except on the longitudinal folds, along the abdominal transverse folds, and also on the medial ridge, the segmentation of which is indicated by a concentration of papillae arranged in transverse rows; submargin with indistinct irregular radial streaks; a pair of translucent eye spots indicated on the sides of the first pair of spines; tracheal folds or pores not indicated; minute circular pores sparsely spread over the dorsum.

Vasiform orifice (Figs. 2, 3) semielliptical, situated on a conspicuous elevation, and surrounded by the caudal continuation of the medial ridge which narrows posteriorly; operculum similarly shaped, entirely covering the orifice and obscuring the lingula.

Length of case 0.558 mm.; breadth 0.342 mm.; length of vasiform orifice 0.042 mm.; breadth 0.034 mm.; length of spine 0.126 mm.

Adults unknown.

This species differs from other species of the genus in the presence of tubercular papillae arranged on the dorsum in the manner described above. It is always found on the underside of leaves, generally associated with *Aleurothrixus indicus* Singh (1931), but is never very abundant. Collected by the author in October 1929. Numerous specimens on slides and leaves in my collection. Type in the Indian Museum (No. $\frac{4592}{H 7}$).

Genus **Pealius** Quaintance and Baker (1914).**Pealius kalawi**, sp. nov.*Locality*.—Kalaw.*Host*.—*Laurus* sp.

Pupa case.—(Fig. 10) Colourless, elliptical, with a narrow palisade of wax, slightly elevating the case from the leaf. Margin (Fig. 12) of close-set teeth, provided with thirteen pairs of short bristles with tubercles at their bases; a narrow portion of submargin presenting a corrugated appearance here and there. Dorsum distinctly segmented, thoraco-abdominal suture reaching the margin, sparsely covered with small papillae, and a pair of circular markings submedially on each of the abdominal as also the thoracic segments; thoracic tracheal folds and pores not indicated.

Vasiform orifice (Fig. 11) almost semicircular with the cephalic margin straight; the rim internally with a few folds, bounded laterally by chitinized bands which extend to the caudal margin bounding the caudal furrow between them. Operculum subrectangular, rounded laterally, setose, covering about $\frac{2}{3}$ of the orifice; lingula swollen at the tip, setose, and extending to the caudal rim of the orifice; the caudal furrow broad anteriorly, forming more or less of a pit round the vasiform orifice, narrowed posteriorly and sculptured reticulately as indicated in figure 2.

Length of case 0.864 mm.; breadth 0.63 mm.; length of vasiform orifice 0.029 mm.; breadth 0.034 mm.

Adults unknown.

This species is assigned to the genus *Pealius*, owing to the characters of the vasiform orifice, though the other characters are by no means typical of the genus. The bands on the sides of the orifice recall the genus *Aleurolobus*, but in this case this boundary is not trilobed. Not abundant. Collected by the author in December 1929. Numerous specimens on slides and leaves in my collection. Type in the Indian Museum. (No. $\frac{4593}{H 7}$).

Genus **Setaleyrodes** Takahashi (1931).**Setaleyrodes takahashia**, sp. nov.*Locality*.—Kalaw.*Host*.—*Streblus asper*.

Pupa case.—(Fig. 8) Colourless, surrounded by a high palisade of wax, elevating it from the surface of the leaf, on the under side of which it is generally found sticking to the sides of the thick veins. Elongate, elliptical in form; margin (Figs. 6, 7) entire, incurved ventrally with a pair of fine setae caudally; submargin bearing suture-like lines and provided as a rule with seven pairs of strong spines of unequal length, of which three pairs are disposed cephalad, the other three caudad and one about the middle of the abdomen. Dorsum distinctly segmented, sparsely pitted all over except its median area which is occupied by a conspicuous ridge on the abdomen; the ridge with prominent subconical elevations (Fig. 6) on the first four abdominal segments, and a pair of

circular or oval markings laterally on each of the abdominal segments, except the last; there are also a few circular or oval markings submedially on four of the cephalothoracic segments; the thoraco-abdominal suture reaching the margin; tracheal folds and pores not indicated.

Vasiform orifice (Fig. 9) situated on the caudal termination of the ridge, subcordate, the cephalic margin straight with a thick rim and with a few folds inwards; operculum more or less similarly shaped, setose, filling about two-thirds of the orifice; lingula cylindrical with its caudal tip slightly swollen, setose, and protruding a little beyond the operculum. Vasiform orifice bounded on either side by a low ridge which continues to the caudal margin; caudal fold forming a depression postero-laterally of the orifice, and sculptured as shown in figure 9.

Length of case 0.81 mm.; breadth 0.27 mm.; length of vasiform orifice 0.037 mm.; breadth 0.037 mm.; average length of spine 0.126 mm.

Adults unknown.

This species closely resembles *Setaleyrodes mirabilis*, Takahashi (1931), from which it differs in the characters of the margin, details of the vasiform orifice and the caudal furrow. It also bears a superficial resemblance to *Aleurotulus arundinacea* Singh (1931). Not abundant. Collected by the author in December 1929. About a dozen specimens on slides and leaves in my collection. Named after Mr. Ryoichi Takahashi as a token of esteem. Type in the Indian Museum. (No. $\frac{4594}{H 7}$).

Genus **Trialeurodes** (Ckll.) Quaintance and Baker (1914).

Trialeurodes meggitti, sp. nov.

Locality.—Kalaw.

Host.—*Ficus* sp.

Pupa case.—(Fig. 14) colourless surrounded by a low waxen palisade on the underside of leaves. Margin (Fig. 15) crenulated, of close set wax tubes, with narrow indentations between, provided with two pairs of setae, a pair cephalad and a pair caudad; submargin covered with numerous irregularly distributed sub-conical elevations (Fig. 16) which superficially appear as crescentic chitinous markings. Dorsum free from the elevations, distinctly segmented, the sutures not extending to the submargin. Thoracic tracheal folds faintly discernible, terminating in a few deeper indentations on the margin; caudal fold in the form of a wide shallow furrow joining the orifice with the margin and terminating in a few deeper indentations, cephalad of which there is a pair of spines.

Vasiform orifice (Fig. 13) subtriangular, with the cephalic margin straight, lateral margins thickly chitinized; operculum lobed marginally, and with a notch on the posterior border, setose, covering about half of the orifice; proximal half of the lingula cylindrical covered by the operculum, distal half subcircular, setose, with a conspicuous notch at the tip, and provided with two pairs of setae on the posterior border, lying exposed in the narrower caudal portion of the vasiform orifice, which has some irregular lines in it. Legs and antennae normal.

Length of case 0.9 mm.; breadth 0.68 mm.; length of vasiform orifice 0.075 mm.; breadth 0.058 mm.

Adults.—Of the usual colouration, and snowy white wings, with the ordinary venation; antennae of seven segments, in the male I segment, 0.016 mm.; II club-like, 0.042 mm.; the remainder cylindrical, imbricate III, 0.1 mm., with two spiked sensoria near the distal end; IV, 0.033 mm.; V, 0.05 mm., with two spiked sensoria at the distal end; VI, 0.037 mm. with a single spiked sensorium; VII, 0.033 mm. with a spiked sensorium and a seta at the distal end.

Vasiform orifice normal, almost covered by the operculum with the lingula projecting behind; penis a little shorter than the claspers, which have a conical tooth and a few spines directed inwards near the distal end. Females larger in size than the males.

This species appears to have some resemblance to *Trialeurodes merlini* Bemis (1904), from which, however, it differs in respect of the distribution of the papilla-like elevations, and the shape of the vasiform orifice. Collected by the author in December 1929. Fairly common. Numerous specimens on leaves and slides in my collection. Types in the Indian Museum. (Nos. $\frac{4595-96}{H 7}$).

Named after Dr. F. J. Meggitt, Professor of Biology in the University of Rangoon. My sincere thanks are due to him, for providing me with every facility, during my stay at the University College, to keep up my interest in the group.

REFERENCES.

- Bemis, F. E. The Aleyrodids or mealy-winged flies of California, with reference to other American species. *Proc. U. S. Nat. Mus.*, XXVI, No. 1362 (1904).
- Quaintance, A. L. and Baker, A. C. Classification of the Aleurodidae. *U. S. Dept. Agric. Bur. Ent. Tech. Ser.* No. 27, pt. 2 (1914).
- Singh, Karam. A contribution towards our knowledge of the Aleurodidae (white flies) of India. *Mem. Dept. Agric. India*, XII, No. 1 (1931).
- Takahashi, Ryoichi. Some Formosan whiteflies. *Journ. Soc. Trop. Agric. Formosa*, III, No. 3, pp. 218—224 (1931).

EXPLANATION OF PLATE VIII.

Aleurotrachelus tuberculata, sp. nov.

- FIG. 1.—Pupa case. $\times 100$.
FIG. 2.—Side view of Vasiform orifice. $\times 450$.
FIG. 3.—Dorsal view of Vasiform orifice. $\times 450$.
FIG. 4.—Margin of case. $\times 450$.
FIG. 5.—Tubercular papillae on case. $\times 450$.

Setaleyrodes takahashia, sp. nov.

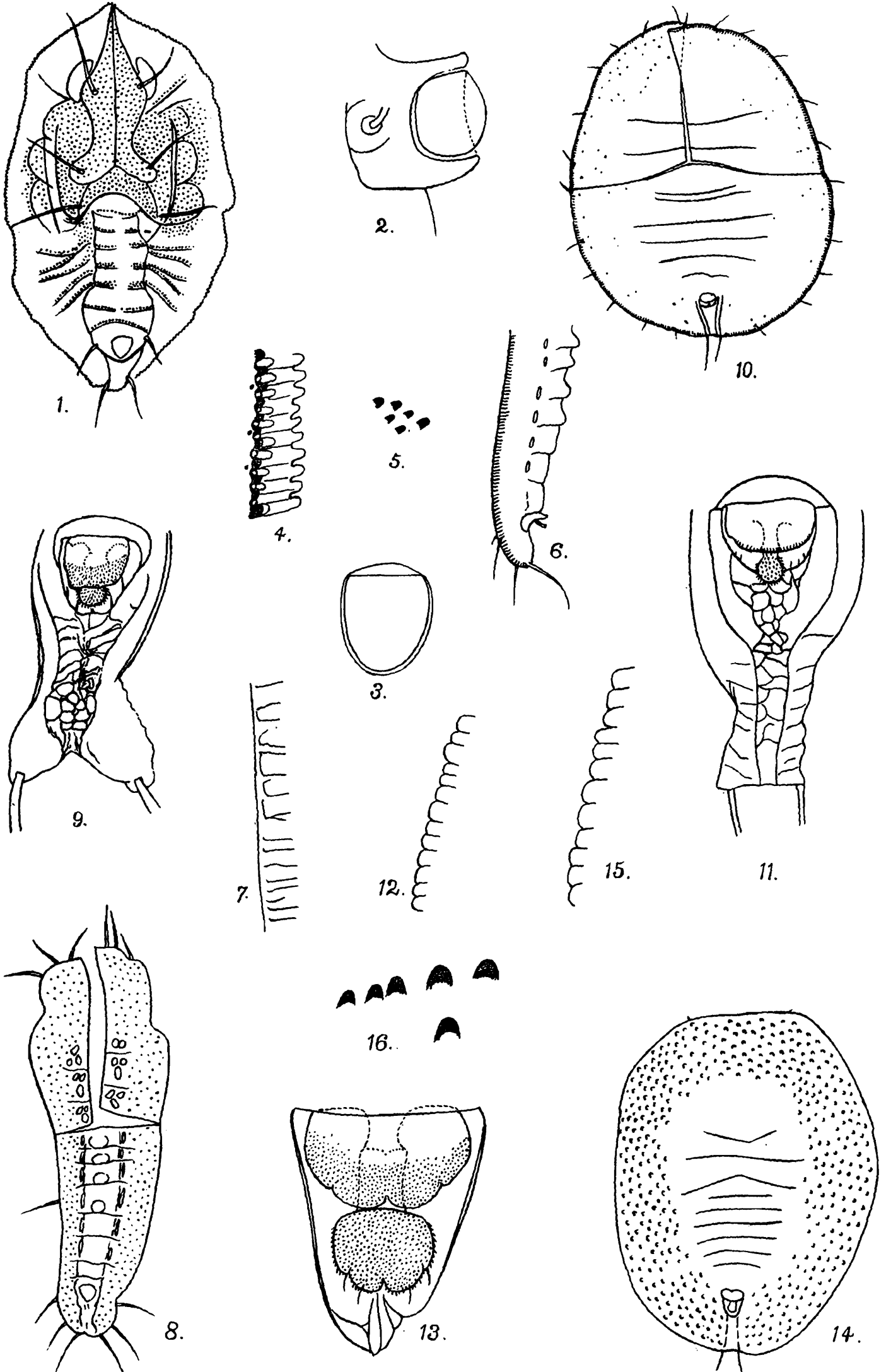
- FIG. 6.—Side view of the posterior half of the case. $\times 100$.
FIG. 7.—Margin of case. $\times 450$.
FIG. 8.—Pupa case. $\times 100$.
FIG. 9.—Vasiform orifice and anal tracheal fold of case. $\times 450$.

Pealius kalawi, sp. nov.

- FIG. 10.—Pupa case. $\times 100$.
FIG. 11.—Vasiform orifice and anal tracheal fold of case. $\times 360$.
FIG. 12.—Margin of case. $\times 450$.

Trialeurodes meggitti, sp. nov.

- FIG. 13.—Vasiform orifice of case. $\times 450$.
FIG. 14.—Pupa case. $\times 80$.
FIG. 15.—Margin of case. $\times 450$.
FIG. 16.—Elevations on case. $\times 450$.



K. S. del.

BURMESE ALEYRODIDAE.

INDOMALAYISCHE THYSANOPTEREN V.

REVISION DER INDOMALAYISCHEN ARTEN DER GATTUNG *Haplothrips* SERV

Von H. PRIESNER, *Cairo, Aegypten.*

Im Jahre 1921 veröffentlichte ich in *Treubia* (Bd. II, pp. 1-20) Studien über die indomalayischen Arten der Gattung *Haplothrips*. Umfangreiche Aufsammlungen, besonders die Kollektion des Buitenzorger Zoologischen Museums, geben mir Gelegenheit, meinen schon in der genannten Arbeit ausgesprochenen Wunsch, diese berichtigen und ergänzen zu können, in Erfüllung zu bringen. Zu besonderem Dank bin ich meinem Freunde Prof. Dr. H. H. Karny für die Abtretung des gesamten Materials verpflichtet.

Im folgenden sind die einzelnen Arten, soweit ich dies für nötig hielt, kurz besprochen; ausführlichere Beschreibungen sind nur dort gegeben, wo es sich um neue oder ungenügend beschriebene Arten handelt. Aus dem Gebiete sind jetzt 32 sichere Arten bekannt.

Von einer Einteilung derselben in Gruppen (Subgenera) möchte ich lieber absehen. Viel wichtiger scheint mir, eine Bestimmungstabelle aufzulegen, die ich ohne Rücksicht auf etwaige Verwandtschaft abfasste und so lediglich praktischen Zwecken dienlich zu machen suchte. Die Reihenfolge und die Bemerkungen geben über die Verwandtschaft einigen Aufschluss; es sei hier nur erwähnt, dass die Formen No. 3-8 in die *Xylaplothrips*-Verwandtschaft zu gehören scheinen, No. 1 und 2 stehen separiert, auch voneinander, 9-18 sind *Haplothrips* s. str., 19-22 gehören ins Subgenus *Trybomiella* Bagn., 23 vermutlich zu *Zygothrips*, und No. 24 ist sehr wahrscheinlich ein *Karnyothrips*.

***Haplothrips euphorbiae* Priesner.**

1931. *Miscell. Zool. Sumatrana*, LVIII.

Der Beschreibung (*l.c.*) ist nichts hinzuzufügen, ausser am Fundorte der Typen wurde die Art noch gefunden:

Sumatra, Medan, XII, 1923, an *Euphorbia hirta*. leg. L. Fulmek.

„ Amplas, 22. XII. 1923, an *Euphorbia hirta*-Blüten, leg. L. Fulmek.

„ Medan, 25. VI, an *Boehmeria nivea*, leg. L. Fulmek.

Die Art stellt einen ganz aberranten Typus dar, besonders durch den Bau der Larve, die Primärlarve ist noch nicht bekannt. Im Imago-Stadium ist die Art durch den langen, schmalen Kopf, das symmetrische 3. Glied der ganz schwarzen Fühler und die getrübbten, schaltwimperlosen Flügel leicht kenntlich. Sie ist Gallenerzeuger an *Euphorbia hirta*.

***Haplothrips fumipennis*, sp. nov.**

Bei der Untersuchung dieser Art erinnert man sich an Bagnalls *Neoheegeria fumipennis* vom Himalaya-Gebiet, doch kommt diese Art

für den Vergleich nicht in Betracht; die Flügel sind viel schmaler (24 mal so lang als breit), die Abdominalborsten dunkel und der Tubus im Vergleich zum Kopf länger, die Terminalborsten kürzer.

♀: Schwarzbraun, Mittel- und Hinterbeine ganz dunkel, Vorder- tibien braungelb, an der äussersten Basis und an den Rändern dunkel, Vordertarsen braungelb; an den Fühlern das 1. und 2. Glied wie der Kopf gefärbt, das 3. hellgelb, aber dennoch mit schwacher fleckiger Dorsaltrübung, vor dem Ende oder ausgedehnter angeraucht, das 4. in der Basalhälfte (oder weniger) hellgelb oder nur bräunlichgelb, übrigens rauchig oder wolkig getrübt, das 5. und 6. nur am Grunde gelb oder fast ganz dunkel, das 7. und 8. ganz dunkel. Borsten am Vorderkörper schwärzlich, am Hinterleib nur etwas getrübt; Flügel der ganzen Länge nach stark rauchig getrübt, immerhin gegen das Enddrittel stärker aufgehellt, an der Basis überdies, hinter der Schuppe, die selbst grau ist, mit einer bogig begrenzten, fast hyalinen Fläche, die sich etwa vom Ende der Schuppe bis zum Beginne der Hinterrandfransen erstreckt und nur die Hinterrandhälfte des Flügels einnimmt, während die Vorderrandhälfte des Flügels an der ganzen Basis stark getrübt ist.

Kopf etwa 216 μ , samt Interantennalfortsatz 234 μ lang, hinter den Augen am breitesten, 200 μ , Seiten wenig gerundet, nach hinten leicht verengt; Mundkegel schmal abgerundet; die Augen sind lateral 78, dorsal gemessen, 83 μ lang; Postokularborsten gut entwickelt, die Seiten des Kopfes überragend, dunkel, am Ende breit offen, geknöpft aussehend, etwas kürzer als 1 Auge; sie sind 11 μ von den Augen entfernt; Fühler 380-433 μ lang; Gliederlängen (-breiten) vom 3. an: 62 (29), 62-64 (35), 56 (31), 49 (26), 45 (22), 29-31 (12) μ . Das 3. Glied mit nur 1 Sinneskegel, aussen, das 4. mit 2+2; das 3. Glied leicht asymmetrisch, gut doppelt so lang als breit, in manchen Fällen aber nur 59:34 μ . Prothorax 156-173 μ lang, ohne Coxen etwa 330 μ breit, seine Borsten verhältnismässig sehr lang; die Vordereckenborsten schon ca. 50-56 μ ; alle Borsten dunkel mit hellem, offenem Ende; die Hintereckenborsten 84-98 μ lang, wenig gebogen. Vorderschenkel etwas verdickt, Vordertarsen beim ♀ mit deutlichem Zähnen. Mesothorax 372 μ breien Flügel 1.02 mm. lang, an der breitesten Stelle 118 μ breit, die Basalborsten 62, 67-70 und 105 μ lang, die beiden ersten am Ende offen, die letzte spitz. Flügel in der Breite normal. Schaltwimpern 8-10, in einem Falle nur 6. Mittel- und Hinterbeine schlank, Abdomen normal, Tubus kurz, konisch, 163-182 μ lang, an der Basis 73-80 μ , am Ende 39-42 μ breit. Terminalborsten etwa 170 μ lang, Borsten am 9. Segment lang, B. 1 etwa 98-101, fast spitzig, B. 2 nur 106 μ , spitzig, die nächste, ventrale wieder länger.—Körperlänge (kontrahiert): 1.9 mm., normal: 2 mm.

Ich habe Stücke mit spitzigen oder bleistiftförmigen Borsten vor mir, bei denen die Basalborsten der Flügel 73, 78 und 112 μ messen. *Jedenfalls ist das Borstenende bei dieser Art variierend.* Die spitzborstige Form, bei der die helle Oeffnung nicht sichtbar ist, sondern eine Bleistiftform der Borsten resultiert, kann nicht als var. bezeichnet werden, da es sich um verschiedene Erhaltungszustände der Borsten handelt, je nachdem das Ende geschlossen oder geöffnet ist, was mit dem bei der Tötung herrschenden Wasserzustande zusammenhängt.

Dieselbe Erscheinung kann man auch bei *H. subtilissimus* Hal. (Europa) beobachten. Diese Ausnahmen vermindern durchaus nicht den generellen systematischen Wert der Borstenformen.

Fundort: Java, Tjibodas, 1400 m, 22-7-1920, *Polygonum chinense*, Blattgalle No. 4298, Docters van Leeuwen leg.

Es handelt sich hier zweifellos um jene Galle, die von Docters van Leeuwen beschrieben ist in: *The Zooecidia of the Nederlands East Indies*, 1926, p. 176, No. 372.

♀♀, Goen Lawoe, 3200 m., 18-XI-1924, in Blüten von *Polygonum chinense*, Docters van Leeuwen leg.

Die folgenden Nummern 3-9 scheinen unter *Haplothrips* am ehesten zu *Xylaplothrips* zu gehören, welches Subgenus ich für die Art *fuliginosus* Schille errichtete, sie können aber ebensogut als "wehrlose" *Androthrips*-Arten bezeichnet werden, sie gehören in die nächste Verwandtschaft von *Androthrips* und bilden also den Uebergang von *Haplothrips* zu *Androthrips*.

Haplothrips inquilinus Priesner.

1912. *Haplothrips aculeatus* Karny, *Marcellia*, XI, p. 121.
 1913. *Haplothrips aculeatus* Karny & Docters van Leeuwen, *Bull. Jard. Bot. Buitenzorg*, (2), X, pp. 7, 19, 65 (partim).
 1915. *Haplothrips aculeatus* Karny & Docters van Leeuwen, *Zeitschr. wissensch. Ins. Biol.*, XI, p. 87 (partim).
 1921. *Haplothrips inquilinus* Priesner, *Treubia*, II, 1, pp. 4, 6, fig. 2.
 1923. *Haplothrips inquilinus* Karny, *Treubia*, III, p. 309.
 1923. *Haplothrips inquilinus* Karny, *Journ. Siam Soc.*, XVI, p. 112.
 1926. *Haplothrips inquilinus* Docters van Leeuwen, *Zooecid. Nederl. East Indies*, pp. 212, 1431.
 1926. *Haplothrips inquilinus* Karny, *Mem. Dept. Agric. Ind., Ent. Ser.*, IX, 6, p. 216.
 1926. *Haplothrips inquilinus* Priesner, *Treubia*, VIII, Suppl., pp. 95, 96, 245, 252, Taf. VIII, figs. 34, 35.
 1928. *Haplothrips inquilinus* Ramakrishna Ayyar, *Mem. Dept. Agr. Ind.*, X, 7, p. 292.

Diese Art ist von mir 1921 eingehend beschrieben worden, 1926 wurde die Beschreibung der mutmasslichen Larve hinzugefügt, die auch heute noch zweifelhaft bleiben muss.

Neue Fundorte: ♀, N. W. Soemba, Laora, IV. 1925, Dammerman leg., No. 101.—Sumatra, Medan, 26-VIII-1922, an kleiner *Ficus* sp. auf Oelpalme, leg. L. Fulmek.

Haplothrips incognitus, sp. nov.

Gehört in die *inquilinus*-Gruppe. Bildet wohl auch einen Uebergang zu *Karnyothrips* Wats.

♀: Braun, rotes Pigment im Körper spärlich verstreut, Mundkegel licht (gelblich), Schenkel hellbraun, die Vorderschenkel am Ende breit, die Mittelschenkel nur schmal hellgelb, alle Tibien und Tarsen hellgelb. Borsten am Körper licht, Analborsten dunkel. Flügel deutlich getrübt, an der Basis ziemlich licht, mit schwacher Aufhellung etwa in der Mitte und gegen das Ende; auch die Hinterflügel getrübt. Fühler schwärzlich, nur das 2. und 3. Glied hell gelblich-graubraun, das 2. am äussersten Grunde und an den Seiten getrübt, das 3. am Ende schattiert, die Glieder 4-8 gleichmässig und auffallend dunkler.

Kopf 156, samt Interantennalfortsatz 168 μ lang, in der Mitte der Seiten hinter den Augen am breitesten, 138 μ ; die Augen seitlich und dorsal nur 52 μ lang, also nur sehr mässig gross; Postokularborsten von den Augen ziemlich weit, 13-15 μ abstehend, hyalin, lang, etwa 45 μ , geknöpft; die hinteren Ocellen in der Mitte der Netzaugen; Mundkegel kurz, schmal abgerundet, mit schlanken Maxillarpalpen (43 μ); Fühler 303-311 μ lang, mit symmetrischem 3. Glied, das zwei Kegel trägt; das 7. Glied ist an das 8. breit angeschlossen, mit ihm fast ein Ganzes bildend; das 2. Glied von oben gesehen hinter der Basis etwas zusammengedrückt-geschnürt; Fühlergliederlängen (-breiten): 22 (B. 31, Sp. 22), 42 (28), 42 (26), 48 (26), 48 (21), 41 (20), 41 (20), 21-22 (13) μ . Prothorax 112 μ lang, ohne Coxen 208 μ breit; Hintereckenborsten 48-50 μ lang, hell, geknöpft; (Vordereckenborsten abgestossen, aber sicherlich wohl entwickelt, da die Poren gross sind). Coxenborste 38 μ , geknöpft, hell. Vorderschenkeldicke 70 μ ; Vordertarsen mit sehr kleinem, kaum sichtbarem Zähnchen, das dicht vor der Stabplatte steht. Pterothorax 242 μ breit und etwa ebenso lang, also verhältnismässig schlank. Flügel wenig breit, von der Mitte zum Ende wenig erweitert, Fransen wenig dicht, Schaltwimpern 4, alle drei Basalborsten stark geknöpft, die dritte etwa 48 μ lang, die beiden ersten kürzer (nicht messbar). Abdomen normal, Tubus 104 μ lang, am Grunde 53, am Ende 28 μ breit. Borsten am 9. Segment sehr lang, *sämtlich haarartig spitzig*, B. 1: 118-120, B. 2 ca. 148 μ , die zwischen diesen gelegene B. 2a aber etwa 56 μ lang; Terminalborsten etwa 170 μ lang, also viel länger als der Tubus.

Fundort: 1 ♀, Java, Buitenzorg, 2-V-1923, angefliegen, H. H. Karny leg.

Haplothrips fungicola, sp. nov.

Sehr ähnlich *pictipes* Bagn., aber die Augen kleiner und der Tubus kürzer, gedrungener.

♀: Hell graubraun, die Fühler ebenso, vom 5. bis 8. Glied ganz dunkel, das 3. Glied ist gelblich mit diffuser grauer Trübung, das 4. Glied etwas dunkler als das 3., wolkig grau, aber heller als die folgenden; die Schenkel sind am Ende etwas aufgehellt, die Tibien sind getrübt, aber an beiden Enden gelblich, Tarsen hell; Flügel schwach getrübt, mit dunkler Basalplatte, die Trübung der Fläche vor der Mitte am stärksten. Borsten am Körper schwach getrübt.

Kopflänge 138 μ , samt Interantennalfortsatz 156 μ , Breite nicht genau messbar, Augen kleiner als bei *pictipes*, sie haben eine laterale Länge von nur 45 μ , dorsal 52 μ , die Wangen hinter denselben messen lateral 93-95 μ ; Postokularborsten wie die meisten dorsalen Körperborsten geknöpft, nur 8 μ von den Augen entfernt und sind etwas kürzer als die Augen; Ocellen in normaler Lage, die beiden hinteren vor der Mitte der Netzaugen; Mundkegel breit abgerundet, kurz, Fühlerlänge 268 μ ; Gliederlängen (-breiten): 17 (B. 28, Sp. 21), 36-39 (23), 36 (21), 39 (24), 38 (20), 36 (18), 36 (17), 25 (10) μ ; das 1. Glied gegen das Ende stark verengt, das 3. symmetrisch, zum Ende sehr stark erweitert, mit zwei Sinneskegeln, das 4. mit deren vier, das 8. Glied am Grunde etwas aber wenig geschnürt, nicht deutlich spindel-

förmig (cf. *pictipes*, wo es am Grunde auf eine längere Strecke verengt ist). Prothorax 100 μ lang, die Vordereckenborsten deutlich, etwa 25-28 μ , die Hintereckenborsten 45 μ , die inneren kürzer. Vordertarsen mit sehr kleinem Zähnchen, Vorderschenkel etwas verdickt. Flügel 554 μ lang, schmal, in der Mitte verengt, alle drei Basalborsten geknöpft, die dritte etwa 36 μ lang, Schaltwimpern 5. Borsten am 9. Segment, B. 1: 70 μ , fast spitzig, B. 2 spitzig, 78-81 μ , Tubus 90 μ lang, am Grunde 48, am Ende 25 μ breit, demnach nur 0.6 der Kopflänge und 1.8 mal so lang als am Grunde breit. Terminalborsten etwa 98 μ , daher etwas länger als der Tubus.

Fundort: Sumatra, Wai Lima, Lampongs, 29-XI-1921, im Urwald in ehemaliger Pfefferplantage, an der Unterseite von Holzschwämmen (Polyporaceae?) (Karny No. 228).

Haplothrips sororculus Schmutz.

1913. *Haplothrips sororculus* Schmutz, *Sitzungsb. Akad. Wiss. Wien.*, p. 1036.
 1921. *Haplothrips sororculus* Karny, *Denkschr. Akad. Wiss. Wien.*, p. 16.
 1925. *Haplothrips sororculus* Ramakrishna Ayyar, *Journ. Bombay Nat. Hist. Soc.*, p. 8.
 1921. *Haplothrips sororculus* Priesner, *Treubia*, II, 1, p. 7, fig. 4 (p. 6).

H. sororculus kann heute noch nicht genauer behandelt werden, da das einzige Stück, das mir zur Verfügung steht, beim Umpräparieren die Fühler verlor. Es muss also das Uzel-Material noch einmal untersucht werden. Die Art kommt sicherlich dem *pictipes* Bagn. am nächsten und ist mit ihm vielleicht identisch. Sie gehört sicherlich in die eben behandelte Gruppe, des symmetrischen mit 2 Sinneskegeln versehenen Gliedes der Fühler wegen, das 1.45-1.5 mal so lang als breit ist. Tubus wie bei *pictipes*. Ich hoffe später noch einmal auf diese Art zurückkommen zu können, momentan muss sie als zweifelhaft gelten, da die Originalbeschreibung ungenügend ist.

Haplothrips pictipes Bagnall.

1919. *Haplothrips pictipes* Bagnall, *Ann. Mag. Nat. Hist.*, (9) IV, p. 273.
 1925. *Haplothrips pictipes* Ramakrishna Ayyar, *Journ. Bombay Nat. Hist. Soc.*, Sep. p. 8.
 1928. *Haplothrips pictipes* Ramakrishna Ayyar, *Mem. Dept. Agr. Ind.*, X, 7, p. 292.

Ich sah typische Stücke aus der Sammlung Ramakrishna Ayyar verweise im übrigen auf die Beschreibung durch Bagnall, habe nur hinzuzufügen, dass die Art kurzes, symmetrisches 3. Fühlerglied hat und sicherlich in die eben behandelte Gruppe gehört. Ich habe nun weiterhin 1 Exemplar aus Sumatra und eines aus Java vor mir, die in der Fühlerfärbung und den Kopfmaszen etwas abweichen; ich nenne sie:

Haplothrips pictipes var. *malayensis*, nov.

♀: Graubraun, mässig dunkel, Beinfärbung wie bei *pictipes*, an den Fühlern nur das 3. Glied licht, gegen das Ende, besonders oben deutlich grau schattiert, das 4. bis 8. Glied ganz dunkel. Flügel

schwach grau getrübt, deutlich nur vor der Mitte, zwischen dieser Trübung und der Basalplatte wieder heller.

Kopf nur 120 μ (samt Interantennalfortsatz 138 μ) lang, hinter den Augen 133 μ breit, Seiten stark gerundet, nach hinten stark verengt. Augen seitlich 50 μ lang, die Wangen hinter denselben 81-84 μ lang. Fühler 268 μ . Fühlergliederlängen (breiten): 25 (B. 28, Sp. 21), 36 (22), 36 (24), 36 (22), 36 (20), 36 (18), 34 (16), 27 (8) μ . Das 1. Glied zum Ende stark verengt, mit etwas konkaven Seiten, das 3. am Grunde sehr dünn, zum Ende stark erweitert, vor dem Ende aber fast eckig eingezogen, 3.-7. Glied fast gleich lang, das 3. Glied mit 3 Sinneskegeln. Mundkegel zum Ende stark verengt, dort abgerundet. Prothorax 95 μ lang, ohne Coxen 190 μ breit, Vorderbeine etwas verstärkt, Vordertarsen mit *sehr deutlichem* Zähnchen. Pterothorax 225 μ breit. Schaltwimpernzahl 5. Tubus etwa 97 μ lang, am Grunde 45, am Ende 25 μ breit. Terminalborsten etwa 125 μ lang. Borsten 1 am 9. Segment etwa 70 μ lang.

Fundort: Medan, Sumatra, V 1922, in Blüten von *Impatiens balsamina*.

Haplothrips inquinatus Karny.

1921. *Haplothrips inquinatus* Karny, *Treubia*, II, 1, p. 78, fig. 33, 34a.

Auch diese Art gehört zweifellos der *inquinatus*-Gruppe, an, sie wurde auch von Karny speciell mit *inquinatus* verglichen. Ich verweise auf die oben zitierte Beschreibung, möchte nur die wesentlichen Punkte hervorheben und einiges ergänzen.

Die Fühler sind fast ganz dunkel, die Flügel fast der ganzen Länge nach getrübt, der Kopf bei ungepressten Stücken 156 (173) μ lang, 138 μ breit. Borsten am Körper schwach getrübt. Augenzahl lateral 59, dorsal 67 μ , Wangen hinter den Augen seitlich 104 μ lang. Postokularborsten von den Augen etwa 8 μ -entfernt. Fühler 295 μ lang. 3. und 4. Fühlerglied gleichlang, das 5. kaum kürzer. Masze: 25 (B. 31, Sp. 25), 39-42 (25), 42 (25), 42 (28), 39 (22), 35 (20), ? (19), ? (8) μ . Das 8. Glied spindelförmig. 3. Glied mit 3 Sinneskegeln, das 4. mit 4. Mundkegel breit gerundet. Prothorax 101-104 μ lang, ohne Coxen 182-190 μ breit. Vordereckenborsten gut entwickelt, Hintereckenborsten etwa 45-48 μ lang, alle geknöpft. Vorderbeine schwach verdickt, Vordertarsen mit deutlichem Zahn. Mesothorax 208 μ breit, Länge bis zur Basis der Hinterhüften 225 μ . Flügel etwa 0.69 mm. lang, mit 5-6 Schaltwimpern. B. 1 des 9. Segmentes über 85, fast spitzig, B. 2 etwa 90 μ , spitzig. Tubus 100 μ lang, am Grunde 46, am Ende 25 μ breit. Terminalborsten 140 μ lang.

♂: Mit stärkerem Tarsenzahn als das ♀. B. 2 am 9. Segment ist eine kurze (28 μ), Borste, nicht dornartig. Tubus 90 μ lang, am Grunde 39, am Ende 22 μ breit.

Fundorte: Karnys Type stammt aus dem Salak-Gebiet (700 m), weitere Stücke (♀♂) wurden von Fulmek (No. 18) in Tjibodas in 1400 m Höhe, 1923, gefunden. Sie stimmen mit Karnys Type überein.

Die nun folgenden Arten 10-21 gehören in die *aculeatus*-Gruppe.

Haplothrips certus Priesner.

1929. *Haplothrips certus* Priesner, *Treubia*, IX, 2, p. 194.

Die der Originalbeschreibung zugrunde liegenden Stücke sind frische, die Tiere können, völlig ausgefärbt viel dunkler sein. Braunschwarz bis schwarz, rotes Pigment reichlich vorhanden. Mittel- und Hinterbeine einschliesslich Tarsen ganz dunkel; Vordertibien gegen das Ende aufgehellt, gelblichgrau, Vordertarsen gelbgrau. An den Fühlern das 3. Glied wie bei *aculeatus* gelb, selten getrübt, das 4. und 5. mehr weniger stark, undeutlich abgegrenzt getrübt, bisweilen wolkig, das 6. in der Regel dunkler als das 5. und nur am Grunde etwas aufgehellt, die beiden Endglieder ganz dunkel. Prothoraxborsten stark getrübt, Abdomenborsten ziemlich licht. Der Mundkegel ist ziemlich zugespitzt, etwa wie bei *ceylonicus*. Vordertarsen mit *sehr deutlichem* Zähnchen. Die Hintertarsen haben innen am Ende des ersten Gliedes einen dunklen Dorn und 1 Börstchen, während sich bei allen anderen *Haplothrips*-Arten dieser Gruppe und dieses Faunengebietes, 1 weiteres zartes Börstchen an Stelle des dornartigen befindet. Zur Beschreibung des ♂ ist nachzutragen, dass der Penis am Ende plötzlich etwas erweitert ist, und in der Mitte des Endrandes tief ausgeschnitten ist, die vorragenden Seiten des Spitzenteiles sind schräg abgestutzt (dies von oben gesehen). Der Dorn (B. 2) am 9. Segment ist gewöhnlich sehr dunkel.

Fundort: Die Typen stammen von den Mentawai-Inseln, die Art wurde aber nunmehr durch Fulmek auch von Sumatra nachgewiesen und zwar immer an *Cyperus*-Arten gefunden.

Gedong, Djohore, Südostküste, 17-VIII-1922, an *Cyperus procerus* Rottb. und *Cyperus dilutus* Vahl.

Medan, mit Larven an *Cyperus brevifolius*.

Haplothrips aculeatus (F.) ?

Literaturzitate sieh in: Priesner, *Thysanopt. Europas*, 1928, p. 597.

Besitze ein einziges Exemplar eines *Haplothrips* aus Blüten von *Crotalaria saltiana* Andt., aus Sha-tin, China, 10-XI-1920, gesammelt von Docters van Leeuwen (No. 89), das ich von *Haplothrips aculeatus*, einer der häufigsten paläarktischen Blasenfuss-Arten, nicht sicher unterscheiden kann.

Der Tubus scheint wohl etwas kürzer zu sein, $109 : 62 \mu$; das Tier ist von den Malayischen Arten dem *certus* am nächsten, mit dem es die ziemlich starke Borste innen am 1. Gliede der Hintertarsen gemein hat, ferner die Form der Fühler. Der Mundkegel ist beim europäischen *aculeatus* etwas breiter abgerundet. Von *certus* ist das Stück durch die viel kürzere Borste 3 der Flügelbasalborsten und die vollkommen spitzigen Borsten am Prothorax leicht zu unterscheiden.

Nur weiteres Material kann entscheiden, ob es sich hier wirklich um den typischen *aculeatus* handelt oder doch um eine andere, wohl sehr ähnliche Art, oder etwa eine östliche Rasse desselben.

Haplothrips gowdeyi (Franklin).

Vollständiges Literaturverzeichnis in: Priesner, A Review of the African Haplothrips-Species, *Bull. Soc. Ent. d'Egypte*, 1931, p. 261.

Hiezu kommt noch als Synonym:

1913. *Haplothrips soror* Schmutz, *Sitzgsber. Akad. Wiss. Wien*, p. 1039.
 1915. *Haplothrips soror* Karny, *Zeit. wiss. Ins.-Biol.*, XI, 3 4 p. 87.
 1921. *Haplothrips soror* Priesner, *Treubia*, II, 1, p. 6.
 1921. *Haplothrips soror* Karny, *Denkschr. Akad. Wiss. Wien*, 98, p. 16.
 1923. *Haplothrips soror* Karny, *Journ. Siam Soc. Ent.*, XVI, 2, p. 112.
 1922. *Haplothrips soror* Karny, *Treubia*, III, 1, p. 110.
 1925. *Haplothrips soror* Ramakrishna Ayyar, *Journ. Bombay Nat. Hist. Sec.*,
 Sep. p. 8.
 1925. *Haplothrips soror* Karny, *Bull. Ent. Res.*, XVI, p. 137.
 1926. *Haplothrips soror* Karny, *Mem. Dept. Agr. Ind., Ent. Ser.*, IX, 6, p. 216,
 Pl. XX, fig. 3.
 1926. *Haplothrips soror* Bagnall, *Ann. Mag. Nat. Hist.*, (9), XVIII, p. 548.
 1928. *Haplothrips soror* Ramakrishna, *Mem. Dept. Agr. Ind.*, X, 7, p. 292,
 Pl. XXXIII, fig. 3.

Ich habe meiner Charakteristik dieser Species des Jahres 1931 (1. c. p. 262) nichts hinzuzufügen, führe daher hier nur die mir weiterhin bekanntgewordenen Funde an:

Tjibodas, 1923, 1400 m, Fulmek, No. 79; Karny, No. 16.

Prapat, Tobasee, 4-VI-1922, an *Tagetes* sp. (Zierpflanze), leg. Fulmek.

Pil Cahu, ca. 600 m, 14-XII-1920, in Blüten von *Phyllostegia grandiflora* Benth, leg. Docters van Leeuwen.

Haplothrips imperatae, sp. nov.

♀: Braunschwarz, rotes Pigment mässig stark entwickelt, so dass lichte Stücke wahrscheinlich nicht ganz hellrot sind; die Fühler zeigen keine auffallenden Farbunterschiede der Glieder, das 3. Glied ist gelblich, aber wie bei *ganglbaueri* mit leichtem grauen Stich, das 4. und 5. Glied sind leicht wolkig getrübt, das 6. ebenso oder etwas dunkler, aber immer lichter als die beiden ganz dunklen Endglieder, Beine dunkel die Mittel- und Hintertarsen dunkel gelbgrau, also stark getrübt, die Vordertibien nur am Ende aufgehell, die Vordertarsen gelbgrau oder graugelb, Flügel glashell, nur an der Basis und Schuppe getrübt, die Prothoraxborsten und die Borsten an der Vorderflügelbasis sind nur schwach getrübt, dasselbe gilt von den Borsten am 9. Segment, während die Analborsten dunkel sind.

Kopf 208, samt Interantennalfortsatz 225 μ lang, hinter den Augen, etwa in der Mitte der Seiten am breitesten, dort 190-195 μ breit; Mundkegel breit gerundet, nur das halbe Prosternum bedeckend, Augen verhältnismässig klein, dorsal 78, lateral 69 μ lang, Postokularborsten sehr weit nach aussen gerückt, vom Seitenrand nur etwa 14 μ , von den Augen nur 3-6 μ entfernt, kurz, offen, die Kopfseiten nicht überragend, nicht ganz halb so lang wie 1 Auge; Wangen deutlich gerundet, Interantennalfortsatz 14 μ breit; Börstchen an den Kopfseiten sehr zart, schwächer als bei *certus*, Fühler nur 294-312 μ lang, ihr 1. Glied zum Ende verengt, das 3. Glied kurz, seitlich stark gerundet, ähnlich wie bei *gowdeyi* (*soror*), innen ohne, aussen mit 1 Sinneskegel, die übrigen Glieder ohne Besonderheit; Gliederlängen (-breiten): 25 (B. 34, Sp. 28), 45 (28), 41-42 (27), 50 (31), 46 (25), 42 (22), 36-38 (20), 25 (11) μ .

Vorderbeine etwas kräftiger als die anderen, an den Vordertarsen vermag ich kein Zähnchen zu erkennen. Prothorax 164 μ lang, ohne Coxen 260 μ breit, seine Borsten geknöpft, die Vordereckenborsten klein (ca. 28 μ), aber entwickelt, die Hintereckenborsten etwa 60 μ , gerade oder schwach gebogen. Pterothorax nur mässig breit, etwa 303-320 μ , die Flügel nur mässig breit, ihre Basalborsten 28, 31 und 56 μ lang, die beiden ersten deutlich geknöpft oder offen, die dritte am Ende praktisch spitzig. Schaltwimpern 7-9. Borsten am 9. Segment gut entwickelt, B. 1: 64-67, am Ende schmal abgerundet, B. 2: 104 μ . Tubus kurz konisch, 132 μ lang, am Grunde 69, am Ende 34 μ breit, Terminalborsten etwa 170 μ . Gesamtkörperlänge (gedehnt): 2.1 mm.

♂: Sehr ähnlich dem ♀; das 3. Fühlerglied 38: 24 μ , der Dorn am 9. Segment 28 μ lang und etwas getrübt, Penis vor dem Ende plötzlich verengt, dann ein kurzes Stück geradlinig, am Ende breit abgestutzt.

Fundort: ♀♀♂, Sumatra, Medan, Goenoeng-Rinteh, an *Imperata exaltata*, zusammen mit etwa derselben Anzahl *H. ganglbaueri*, leg. Fulmek (No. 1).

Haplothrips tenuipennis Bagnall.

1918. *Haplothrips tenuipennis* Bagnall, *Ann. Mag. No. Hist.*, IX, p. 210.
 1925. *Haplothrips tenuipennis* Ramakrishna Ayyar, *Journ. Bombay Nat. Hist. Soc.*, Sep. p. 8.
 1925. *Haplothrips tenuipennis* Blunck, in Sorauer, *Handb. f. Pflanzenkrkht.*, p. 268.
 1928. *Haplothrips tenuipennis* Ramakrishna Ayyar, *Mem. Dept. Agr. Ind.*, X, 7, p. 292.
 1929. *Adraneothrips tenuipennis* Bagnall, *Ann. Mag. Nat. Hist.* (10), III, p. 606.

Diese Art ist ein richtiger *Haplothrips*, nicht wie Bagnall meint, zu *Adraneothrips* Hood gehörig; der von Bagnall beschriebene (l. c.) *A. fuscicornis* dürfte in die *inquilinus*-Gruppe gehören und ist wohl mit *inquinatus* sehr nahe verwandt.

Ich verweise auf die Beschreibung und führe an, dass diese Art in Indien, Darjiling Distr., an Tee-Büschen gefunden wurde.

Haplothrips ganglbaueri Schmutz.

1913. *Haplothrips ganglbaueri* Schmutz, *Sitzgsber. Akad. Wiss. Wien*, p. 1034.
 1913. *Haplothrips aculeatus* Karny, *Bull. Jard. Bot. Buitenzorg*, X, p. 13, 65 (partim).
 1915. *Haplothrips aculeatus* Karny, *Zeit. wiss. Ins.-Biol.*, XI, p. 87 (partim).
 1921. *Haplothrips ganglbaueri* Priesner, *Treubia*, II, 1, p. 2, 7, fig. 1.
 1925. *Haplothrips ganglbaueri* Ramakrishna Ayyar, *Journ. Bombay Nat. Hist. Soc.*, Sep. p. 8.
 1926. *Haplothrips ganglbaueri* Karny, *Mem. Dept. Agr. Ind.*, IX, 6, p. 217, fig. 18, Pl. XXI, fig. 1.
 1928. *Haplothrips ganglbaueri* Ramakrishna Ayyar, *Mem. Dept. Agr. Ind.*, X, 7, p. 292.

Diese Art, eine der häufigsten des Indo-Malayischen Gebietes, habe ich 1921 eingehend beschrieben und ich habe der Beschreibung nur hinzuzufügen, dass das rote Pigment auch entwickelt sein kann, wenn auch nicht reichlich, so dass meine Bemerkung (l. c. p. 3), dass kein rotes Pigment vorhanden sei, nicht immer zutrifft, wie dies ja auch bei *Haplothrips aculeatus* der Fall ist. Ich kann ein Reihe Fundangaben anfügen.

Java : Buitenzorg, zahlreich in Reisblüten, III, IV, 1919, W. C. van Heurn.—1♂, Buitenzorg, 29-III-1921, angefliegen, H. H. Karny.—♂ ♀ und Larve, Buitenzorg, 4-VIII-1924, in Blattgalle von *Vernonia cinerea* (♂ ♀),—♂ ♀, Buitenzorg, in Grasblüten von *Themeda arquens* Harsb., leg. H. Docters van Leeuwen.—♂ ♀, Buitenzorg, 5-VII-1924, in Blüten von *Polytrias amaura* O. K. (Graminee), leg. H. Docters van Leeuwen.—♂ ♀, Larve, Buitenzorg, 26-VI-1923, in Blüten von *Killingia monocephala* Rottb. (Cyperacee), leg. H. Docters van Leeuwen.—♀♀ ♂♂, Tjitjoeroek Salak, 6-III-1921, ca. 1000 m, von Gebüsch geketschert, Karny.—♀♀ ♂♂, Goen Salak, Goen Boender, ca. 600 m, 4-VIII-1925, in Blüten von *Paspalum* sp. (Graminee), leg. Docters van Leeuwen.—♂ ♀, G. Gedeh, Tjibodas, ca. 1450 m, in Blütenständen von *Paspalum* sp., 1-VII-1925, Docters van Leeuwen.—♀, Tjampea, Gg. Tjibodas, 14-VI-1925, im Urwald geketschert, Karny.—♀, Gg. Gedeh, Tjibodas, ca. 1600 m, 8-IX-1925, in Blattgalle auf *Rubia cordifolia* L., leg. Docters van Leeuwen.—♀♀, Pangrango, 3000 m, 1923, Fulmek (No. 54).—♂ ♀♀, Semarang, 17-IX-1913 in Blüten von *Imperata arundinacea* Cyrill., leg. D. van Leeuwen.—♂♂ ♀♀, Semarang, 7-IX-1912, in Blüten eines Grases, leg. D. van Leeuwen.—♂, Semarang, 25-VIII-1913, in Blüten von *Solanum torvum* Schw., D. van Leeuwen leg.

Sumatra : ♂♂ ♀♀ Bindjej Estate, Ostküste, 17-II-1922, an den Stempelfäden blühender Maiskolben, leg. Fulmek.—Goenoeng-Rinteh, Medan, an *Imperata exaltata*, leg. Fulmek (No. 1).—Prapat, Tobasee, Ostküste, 4-VI-1922, an *Andropogon amboinicus*, leg. Fulmek (No. 4).—♀, Medan-Siantar, 17-VII-1921, angefliegen, leg. Karny.—♀♀ ♂, Fort de Kock, 920 m, III. 1921, in Mais-Blüten, leg. Jacobson (No. 1191).

Krakatau : ♀, 19-VII-1924, in Blüten von *Ischaemum muticum*, leg. Docters van Leeuwen.

Haplothrips themedae, sp. nov.

Dem *H. ganglbaueri* sehr ähnlich, aber durch hyaline Prothoraxborsten, gestreckteren Kopf, wohl entwickeltes, viel deutlicheres Tarsenzähnen, auch schlankeres 3. Fühlerglied spezifisch verschieden.

♀ : Dunkelbraun bis schwarzbraun, rotes Pigment in mässiger Menge vorhanden ; Vorderschenkel und Mittel- und Hinterbeine dunkel, die Mittel- und Hintertarsen graugelb, die Vordertibien gelb, *am Aussenrande getrübt*, Vordertarsen hellgelb ; Fühlerglieder 1 und 2 wie der Kopf gefärbt, das 3. ganz hellgelb, das 4. hellgelb, aber oben wie das 5. mit Ausnahme des Grundes leicht wolkig getrübt, das 6. Glied wolkig dunkel, am Grunde graugelb, das 7. und 8. Glied dunkel ; die Borsten am Körper hyalin oder fast so, nur die Analborsten dunkel ; Flügel hyalin.

Kopf gestreckt, 173-182 (samt Interantennalfortsatz 197) μ lang etwa in der Mitte der Seiten 147-152 μ breit ; Wangen nur ganz schwach, gleichmässig gerundet ; Mundkegel kaum schmaler als bei *ganglbaueri* ; Postokularborsten von den Augen etwa 13 μ entfernt ; Fühler 294-303 μ lang ; Gliederlängen (-breiten) : 17-18 (B. 28, Sp. 22), 42 (25), 43 (21), 45 (27), 42 (23), 39 (22), 36 (20), 22 (11) μ ; das 2. Glied seitlich

stark gerundet, das 3. gestreckt, asymmetrisch, mit nur 1, dem äusseren Sinneskegel, das 4. mit vier Kegeln. Prothorax 118 μ lang, ohne Coxen (nicht gepresst) 208 μ breit, samt diesen 225 μ breit; Vordereckenborsten entwickelt, dünn, nur etwa 22-25 μ lang, wie die übrigen geknöpft Hintereckenborsten 45-48 μ lang; Vorderschenkel schwach verdickt, Vordertarsenzähnen deutlich, viel stärker entwickelt als bei *ganglbaueri*. Pterothorax *gestreckt*, 235 μ breit, bis zur Basis der Hinterhüften 277 μ lang. Mittel- und Hinterbeine ohne Besonderheit. Flügel schmal, die Fransen nicht dicht, die Basalborsten 28, 28 und 50 μ lang, sämtlich geknöpft; Schaltwimpern 5-7. Abdomen schlank, die Borsten licht, B. 1 am 9. Segment etwa 98 μ , nicht in eine haardünne Spitze ausgezogen, B. 2 haar dünn zugespitzt, etwa 84-87 μ lang; Tubus 100 μ lang, am Grunde 53, am Ende 28 μ breit; Terminalborsten 140 μ lang, demnach viel länger als der Tubus.—Körperlänge (stark gedehnt): 1.8 mm.

Die Art hat ganz den Habitus von *Haplothrips ganglbaueri*, und scheint ihm am nächsten verwandt zu sein, sie ist wie dieser, Grasbewohner.

♂: Während bei *ganglbaueri* das 3. Fühlerglied etwa 31: 20 μ misst, ist es hier 35: 20 μ , also deutlich länger. Die Augenzahl verhält sich zur Wangenlänge hinter denselben wie 3.5: 4 bei *ganglbaueri*, aber 3.5: 4.5 bei *themeda*. Das Tarsenzähnen ist etwas breiter. Bei *ganglbaueri* ist der Pterothorax 190: 190 μ , bei *themeda* 225: 190 μ , also länger als breit. Schaltwimpern 5-6.

LARVE.

II. *Stadium*: Diese ist sehr ähnlich der des *ganglbaueri*, jedoch mit ihr nicht identisch. Das 3. Fühlerglied ist auch bei lichten Stücken deutlich getrübt, während es bei *ganglbaueri* auffallend lichter ist als die übrigen Glieder. Rotes Pigment ist im Körper bei gut ausgefärbten Larven stärker entwickelt als bei *ganglbaueri*, so im Kopf und Prothorax, dann im Metathorax, je 1 kleiner Seitenfleck im 1. und 2., das ganze 3. und 4. Segment rot, mit Spuren von Rot im 5. Segment, ebenso die vier letzten Segmente rot. Die Beine sind, besonders an den Aussenrändern stark grau getrübt, alle übrigen dunklen Stellen wie bei *ganglbaueri*.

Kopf 84 μ lang, an den Augen 78 μ breit. Borste 6 am Pronotum misst 42 μ (bei *ganglbaueri* 38 μ); die Borsten am Abdomen wie bei *ganglbaueri*, am 9. Segment finden sich 1 Paar Ruderplatten-artige und zwei Paar (B. 2 u. 3) Gabelborsten; die Borsten der vorderen Segmente geknöpft., die Borsten des Thorax fast trichterig. Ich habe nur zwei nicht sehr günstig erhaltene Stücke vor mir, so dass nur weiteres Material eine eingehende, vergleichsweise Behandlung der beiden Larvenformen gestatten kann, die weitere Unterschiede ans Licht fördern wird. Ich besitze auch 1 Stück der Larve des 1. Stadiums, die ich mangels Vergleichsmaterials hier nicht behandeln will.

Fundort: ♂♂ ♀♀, Larve, Prapat, Tobasee, Sumatra, 4-VI-1922, an *Themeda gigantea*, leg. Fulmek.

Haplothrips ceylonicus Schmutz.

1913. *Haplothrips ceylonicus* Schmutz, *Sitzgsb. Akad. Wiss. Wien*, CXXII, p. 1038.
 1921. *Haplothrips ceylonicus* Priesner, *Treubia*, II, 1, p. 7.
 1925. *Haplothrips ceylonicus* Karny, *Delit. Proefstat. Medan*, No. 23, p. 44, fig. 17.
 1925. *Haplothrips ceylonicus* Ramakrishna *Journ. Bombay Nat. Hist. Soc.*, Sep. p. 8.
 1926. *Haplothrips ceylonicus* Karny, *Mem. Dept. Agr. Ind.*, IX, 6, p. 217, fig. 17.
 1928. *Haplothrips ceylonicus* Ramakrishna *Mem. Dept. Agr. Ind.*, X, 7, p. 291.
 1929. *Haplothrips ceylonicus* Moulton, *Rec. Ind. Mus.*, XXXI, 2, p. 98.

Da die Art nirgends eingehender behandelt wurde, möchte ich ihre wesentlichen Merkmale hervorheben.

Die in den beiden Endfünfteln oder im Enddrittel hellgelben Mitteltibien, die am Ende gelben Hintertibien und die fast ganz hellgelben Vordertibien, ferner die hellgelben Tarsen sind wichtige Charakteristika der Art. Die Fühler sind gestreckt, das 3. Glied doppelt oder mehr als doppelt so lang als breit, mit 1 Sinneskegel, die mittleren vier Fühlerglieder sind hellgelb, wenn auch das 6. Glied am Ende bisweilen verwaschen getrübt ist; beim ♀ ist das 7. und 8. Glied immer auffallend dunkler als das 6. Die Postokularborsten sind den Augen sehr nahe, nur 6-7 μ abstehend, diese sowie die Prothoraxborsten stark getrübt, Vordertarsen ohne Spur eines Zähnnchens (nur die Klaue der Unterseite vorhanden), Mesothorax gewöhnlich 330 μ breit, alle drei Borsten der Vorderflügelbasis geknöpft, Schaltwimpern 7-9. Borsten am 9. Abdominalsegment mit Ausnahme von B. 1, die hyalin ist, wenigstens an der Basis getrübt, B. 1 am Ende schmal abgerundet. Tubuslänge 112 μ , Breite an der Basis 59 μ , am Ende 32 μ . Analborsten 155 μ , länger als der Tubus.

Das ♂ hat deutliches Tarsenzähnnchen, an den Enden des 3.-6. Fühlergliedes treten bisweilen leichte aber deutliche Trübungen auf. Der Penis ist von oben gesehen vor dem äussersten Ende etwas geschnürt.

Kurzfühlerige Stücke sind durch die Tibienfärbung und den Mangel des Tarsenzähnnchens von *vernoniae* zu unterscheiden.

Fundorte: Sumatra: ♂ ♀ Prapat, Tobasee, 4-VI-1922, an *Tephrosia candida*, leg. Fulmek.—♂♂ ♀♀ Medan, 26-VIII-1922, in Blüten von *Desmodium polycarpum*, leg. Fulmek.—♂♂ ♀♀, Wai Lima, Lampongs, 17-XII-1921, Kampomg-Gebüsch, in *Lantana*-Blüten, leg. Karny (No. 480); ibidem, 7-XII-1921, leg. Karny.

Java: ♂ ♀, Buitenzorg, VI. 1922, in Blüten von *Clerodendron fragrans*, leg. Smith.—2♀♀, Semarang, 5-IX-1912, in Blüten von *Crotalaria saltiana* Andt., leg. Docters van Leeuwen.—♀, Tjandi b. Semarang, 6-VII-1913, in Blüten von *Dunbaria* sp., leg. Docters van Leeuwen.-

Riouw Archipel: ♂, Doerian, VI. 1923, von niederen Pflanzen gekeschert, leg. Dammerman (No. 33).

Bemerkung: Hood hat (*Pan Pacific Entomol.*, III, 4, 1927, p. 176) *Haplothrips ceylonicus* Schm. zu *Karnyothrips* gezogen und als Synonym mit *Karnyothrips flavipes* Jones (= *Haplothrips oneco* Watson) erklärt, u. zw. auf Grund eines ihm von Karny aus Sumatra (von Fulmek an

Tabakblättern gesammelten) Stückes. Es kann sich hier nur um eine Fehlbestimmung von Karnys Exemplar handeln :

1. Kann *Haplothrips ceylonicus* nie zu *Karnyothrips* gezogen werden, da die Analhaare viel kürzer sind, als etwa bei *K. melaleucus*, der mir bekannt ist, und da das Tarsenzähnchen bei *ceylonicus* völlig fehlt.

2. Besitze ich *Haplothrips oneco* Watson, aus Watsons Sammlung, der tatsächlich ein *Karnyothrips* im Sinne Hoods ist und mit *Karnyothrips longisetis* (Bagn. = *Haplothrips longisetis*) übereinstimmt.

***Haplothrips ceylonicus* var. *mangiferae* nov.**

Dem *ceylonicus* durch den völligen Mangel des Tarsenzähnchens, die gelben Mittel- und Hintertarsen, die Fühlerbildung, den Gesamthabitus und alle übrigen Merkmale so sehr ähnlich, dass es nicht möglich ist, diese Form als besondere Art aufzufassen. Sie unterscheidet sich durch die nur an der äussersten Spitze hellgelben Mitteltibien, ferner die kaum aufgehellten Hintertibien. Von *vernoniae* ist diese Form durch den Mangel des Tarsenzähnchens, die hellen Mittel- und Hintertarsen und die am Ende hellen Mitteltibien sicher spezifisch verschieden, ferner durch den Besitz von 2 Sinneskegeln am 3. Gliede, von denen der innere allerdings sehr leicht zu übersehen ist.

Kopfform, Stellung der Borsten, Augenlänge und Fühlerbildung wie bei *ceylonicus*, so dass sich eine genauere Beschreibung erübrigt, Mundkegel noch etwas spitziger als bei der genannten Art, man könnte das Tier daher auch bei *Neoheegeria* behandeln, und es wäre durchaus nicht verwunderlich, wenn sie von einem anderen Autor noch einmal als *Neoheegeria*-Art beschrieben würde. Kopf 164, samt Interantennalfortsatz 173 μ lang, 155 μ breit; Fühler 329-346 μ lang; Gliederlängen (-breiten) vom 3. Gliede an: 48 (25), 52 (31), 45 (25), 42 (22), 36 (18), 21 (10) μ . Das 3. Glied kaum doppelt so lang als breit oder etwas weniger (1.8-1.9 mal), auf beiden Seiten mit je einem Sinneskegel, von denen der innere kleiner ist als der äussere, das 4. Glied mit 4 Sinneskegeln. Prothorax und seine Borsten wie bei *ceylonicus*. Mesothorax bei nicht gepressten Stücken 240-295 μ breit. Flügelbasalborsten wie bei *ceylonicus*, die dritte spitzig; Schaltwimpern 8-10, auch bei kleinen Stücken mindestens 8. Tubus 106 μ lang, am Grunde 62, am Ende 32 μ breit. Terminalborsten länger als der Tubus. Borsten am 9. Segment licht, B. 1 nicht ganz scharf haarartig, wie dies auch bei *ceylonicus* der Fall ist.

♂: Vom ♂ des *ceylonicus* nur durch die Färbung der Tibien und die zwei Sinneskegel am 3. Fühlerglied zu unterscheiden. Vordertarsen mit breitem, kurzem Zähnchen, Vorderbeine verdickt. Penis an der äussersten Spitze etwas geschnürt.

Fundort: ♀♀♂, Semarang, Java, 25-VIII-1912, in Blüten von *Mangifera indica* L., leg. Docters van Leeuwen.

***Haplothrips chinensis*, sp. nov.**

♀: Dunkel braunschwarz, Schenkel ebenso, Vordertibien dunkel, nur in der Mittellinie etwas aufgehellt, die Ränder immer dunkel, Vordertarsen gelblichgrau, Mittel- und Hintertibien ganz dunkel, ohne Auf-

hellung an der Spitze, Mittel- und Hintertarsen dunkelgrau. Prothoraxborsten dunkel, Borsten am Abdomen nur an der Basis getrübt, Terminalborsten dunkel; Flügel hyalin; Borsten an der Flügelbasis getrübt. Das 1. und 2. Fühlerglied wie der Körper gefärbt, das 3.-6. Glied gelb, das 4. am Ende kaum, das 5. und 6. deutlich, aber schwach und diffus getrübt, die beiden Endglieder dunkel.

Kopf normal, von den Augen an 200, samt Interantennalfortsatz 216 μ lang, 173 μ breit, Mundkegel schmal abgerundet, bei gepressten Stücken daher spitzig; Augen lateral 70, dorsal 78 μ lang, Postokularborsten wie die Prothoraxborsten geknöpft, die ersteren von den Augen etwa 14 μ abstehend; an den Fühlern das 3. Glied asymmetrisch, gestreckt, etwa doppelt so lang als breit, Gliederlängen (-breiten) vom 3. an: 53 (26), 53-55 (32), 50 (27), 45-46 (22), 42 (20), 25 (11) μ ; das 3. Glied mit nur 1, dem äusseren Sinneskegel. Prothorax von normaler Form, Breite samt Coxen 260 μ . Hintereckenborsten dunkel, lang, Vordereckenborsten gut entwickelt, variieren aber in der Länge, alle sind schwarz oder getrübt, mit hellem, offenen Ende. Tarsenzähnen sehr klein. Mesothoraxbreite 277 μ . Flügellänge etwa 0.83 mm; Flügel schmal, zwei der Basalborsten geknöpft, 42 μ , die dritte spitzig, gut 65-57 μ . Schaltwimpernzahl 6-10. Tubus 138 μ lang, am Grunde 64, am Ende 32 μ breit. Terminalborsten etwa 155 μ ; Borsten am 9. Segment, B. 1 nicht ganz scharf, wie gewöhnlich etwas abgerundet, die anderen haarfein zugespitzt.

Fundort: ♀♀, *China*, Hongkong, auf ungefähr 500 m hohem Berggipfel, in Blüten von *Lantana camara*, 7-XI-1920, leg. Docters van Leeuwen (No. 84).

Diese Art ist dem *vernoniae grandior* sehr ähnlich, aber dunkler, der Kopf schmaler, ebenso der Thorax, ein greifbares Unterscheidungsmerkmal ist aber nur die Stellung der Postokularborsten, die von den Augen deutlich weiter abgerückt sind als bei *vernoniae*.

Haplothrips vernoniae Priesner.

1921. *Haplothrips ceylonicus* var. *vernoniae*, Priesner, *Treubia*, II, 1, pp. 4, 7.
 1925. *Haplothrips ceylonicus* var. *vernoniae*, Priesner, *Bull. Deli Proefstat.* No. 23, fig. 17.
 1928. *Haplothrips ceylonicus* var. *vernoniae*, Ramakrishna Ayyar, *Mem. Dep. Agr. Ind.*, X, 7, p. 292.

Es besteht kein Zweifel mehr, dass diese Form von *ceylonicus* spezifisch verschieden ist; ich habe reiches Material zur Hand, die Art hat weite Verbreitung. Eine kurze Charakteristik ist nötig:

Fühler, 3. Glied hellgelb, 4.-6. Glied gelb, aber jedes am Ende oder an der Endhälfte schwach getrübt, 1., 2., 7., und 8. Glied dunkel; 3. Glied asymmetrisch, meist 39-42 (24-25) μ lang (breit), 4. Gl. 50, 6. Gl. 42 μ lang; 3. Glied mit 1 Sinneskegel. Postokularborsten von den Augen 8-11 μ abstehend. Mundkegel zugespitzt, aber kurz. Augenslänge lateral 69, dorsal 78 μ . Prothoraxlänge 120 μ , Vordereckenborsten 31, Hintereckenborsten über 53-56 μ , schwärzlich. Mesothorax 285-295 μ breit. Vordertarsen gelb, *Tarsenzahn fast verkümmert*, Vordertibien gelb, an den Rändern dunkler, Mittel- und Hintertibien *am Ende nicht deutlich aufgehellt*, Mittel- und Hintertarsen gelb, aber merklich grau getrübt, Tubus 113 μ lang, am Grunde 59, am

Ende 31 μ breit. Terminalborstenlänge 140 μ . B. 2 des 9. Segmentse 90 μ , B. 1 ca. 85 μ , fast spitzig, hell. Schaltwimpern 7-8.

Von Stücken des *H. ganglbaueri*, die rotes Pigment führen, ist diese Art durch breiteres Mesosternum, etwas längeren Tubus, dunklere Prothoraxborsten, helleres 6. Fühlerglied, längere Augen, etc. verschieden.

Die Typen stammen von Semarang, aus den Blumen und gerollten Blättern von *Vernonia cinerea*, 3-VII-1912, leg. Docters van Leeuwen.

Weitere Fundorte :

Java : ♀, Semarang, 7-IX-1912, in Blüten eines Grases, leg. Docters van Leeuwen.—Batavia, ♂♂♀♀, 22-VII-1920, in Blüten der Leguminose *Derris uliginosa*, leg. Karny.—♂♂♀♀, Batavia, 22-VIII-1920, in Blüten von *Ruellia tuberosa* (*Acanthaceae*), leg. Karny.—♀, Bogor, 20-II-1929, an *Dioscorea* sp., leg. v. d. Goot.—Oengaran Gebirge, ca. 900 m, 22-X-1913, in Blüten von *Spilanthus acmella* (*Compositae*), leg. Docters van Leeuwen.—Soengei Bakasa, 20-IX-1922, *Phytolacca octandra*, leg. Fulmek.

Sebesie : ♀♀, 24-IV-1921, an *Wedelia biflora* DC. (*Compositae*).—

Verlaten Eiland : 26-IV-1921, an *Wedelia biflora*, leg. Docters van Leeuwen.

Sumatra : Medan, ♀, 8. 1922, leg. Fulmek.—Medan, 19-VIII-1922, an *Lantana trifolia* L.—Goen-Mariah, 600 m, 12-VII-1925, an *Tithonia tagetifolia* (*Compositae*), leg. Fulmek.—Fort de Kock, 920 m, 11. 1920 in *Dahlia*-Blüten, leg. E. Jacobson (No. 1066).—♂♂♀♀, Prapat, Toba-See, 4-VI-1922, an *Rudbeckia laciniata* leg. Fulmek.—Ibidem, an *Tagetes* sp., leg. Fulmek.—

Formosa : Taihoku, 9-VI-1921, an *Cucumis sativa*, T. Okuni leg.—Taihoku, 13-VI-1921, *Melastoma candidum* Don., leg. T. Okuni.

Die Fundangaben zeigen, dass diese Art *Compositen* häufig besucht.

Haplothrips vernoniae var. **grandior** nov.

♀ : Kräftiger gebaut als die typische Form, Mesothorax ungefähr 330 μ breit. Fühler 329-337 μ lang, das 3. Glied gestreckter als beim typischen *vernoniae*, etwa doppelt so lang als breit. Masze : vom 3. Gliede an : 48 (24), 50 (31), 46 (26), 42 (24), 39 (20), 25 (11) μ . Die Mittel- und Hintertarsen sind deutlich getrübt. Tubus 130 μ lang, an der Basis 60 μ breit.

Es bestehen keine weiteren Unterschiede gegenüber *vernoniae* typ., man kann die eben behandelte Form als eine kräftigere Rasse bezeichnen.

Fundort : ♂♂♀♀, *Formosa*, Taihoku, 11-X-1921, an *Cirsium japonicum* DC. ; ibidem, 1-III-1921, an *Lactuca scariola* var. *sativa* Bisch. ; an *Momordica charantia* L. ; sämtlich leg. Okuni.

Haplothrips (Hindsiana) apicalis Bagnall.

1915. *Hindsiana apicalis* Bagnall, *Ann. Mag. Nat. Hist.* (8), XV, p. 323.

1925. *Hindsiana apicalis* Ramakrishna, *Journ. Bombay Nat. Hist. Soc.*, Sep. p. 8.

1928. *Hindsiana apicalis* Ramakrishna, *Mem. Dept. Agr. Ind.*, X, 7, p. 290.

Von Bagnall erhielt ich ein Präparat dieser Art, das brachyptere Exemplare enthält ; Bagnall hat über die Flügel in seiner Beschreibung (*l.c.*) nichts erwähnt.

Ich habe nun auch die f. macroptera vor mir, aus Java und Indien (coll. Ramakrishna), die zeigt, dass die Flügel nur schwach verengt

sind, und dass der Pterothorax bei dieser Form nicht breiter ist als bei der f. brachyptera, die mir gleichfalls aus Indien und Java vorliegt. Da die Art stark variiert, möchte ich hier die Beschreibung ergänzend wiederholen und die Larve behandeln. Da die Schaltwimpern fehlen, könnte man das Tier auch zu *Trybomiella* stellen.

♀, f. macroptera: Gelbbraun bis braun, jedoch in der Regel nicht gleichmässig gefärbt, gewöhnlich so, dass der Kopf, der Mesothorax und etwa die Vorderrandhälfte jedes Abdominalsegmentes vom 2.-6. dunkler braun sind, ebenso die ganzen Segmente 7-10, während der Prothorax und Metathorax und die übrigbleibenden Teile der Abdominalsegmente mehr gelbbraun oder orange sind. Auch die Beine sind nicht einheitlich gefärbt, die Mittel- und Hinterschenkel sind immer lichter als die Tibien, orange, mit mehr weniger getrübt Vorderrand, Vorder-schenkel ganz, oder wenigstens am Aussenrand breit graubraun, Tibien graubraun, die vorderen gelblich, am Aussenrande graubraun, Vordertarsen gelblich, Mittel- und Hintertarsen deutlich getrübt, gelbgrau. Ganz dunkle Stücke können schwarzbraun sein, mit hellbraunem Hinterabschnitt des Pronotums und hellbraunem Metathorax, aber auch bei solchen Stücken sind die Mittel- und Hinterschenkel etwas lichter als die entsprechenden Tibien; die Vorderbeine sind ganz dunkel. Flügel vollkommen hyalin. Das 1. und 2. Fühlerglied wie der Kopf gefärbt, das 2. in der Endhälfte oder weniger, gelblich aufgehellt, das 3. bis 5. hellgelb, das 5. in manchen Fällen am Ende etwas getrübt, das 6. schwächer oder stärker getrübt, das 7.-8. dunkel. Borsten am Körper licht. Das Mesodermalpigment ist gleichfalls auffallend verteilt, doch ist das nur bei blasseren Stücken klar zu sehen, so dass rotes Pigment nur im Kopf und den drei letzten Hinterleibssegmenten aufscheint, während der übrige Körper gelbe Pigmentzellen führt.

Kopf 190 (samt Iaf. 200) μ lang, in der Mitte der Seiten 165 μ breit; Augen lateral etwa 67, dorsal 70 μ lang, die hinteren Ocellen stehen etwas vor der Mitte der Netzaugen; Postokularborsten etwa halb so lang wie die Augen, etwa 8-11 μ von ihnen abstehend, hyalin, offen; Mundkegel sehr breit gerundet; Fühler etwa 363 μ lang, Gliederlängen (-breiten) vom 2. an: 50 (29), 53 (28), 56 (29), 52-53 (28), 48 (24), 49 (21), 32 (13) μ ; das 3. Glied asymmetrisch, mit 1 Sinneskegel, das 4. mit vier, das 7. Glied am Grunde nicht deutlich verengt, aber deutlich schmaler als das 7. am Ende. Prothorax etwa 138 μ lang, ohne Coxen 242 μ breit; Vordereckenborsten deutlich sichtbar, etwa 28 μ lang, dünn, hyalin, offen, Hintereckenborsten mässig lang, doch sicher über 42 μ , wohl etwa 56 μ lang; Vorderschenkel nicht verdickt, Vordertarsen mit einem kleinen, aber deutlichen Zähnchen. Mesothorax 268-295 μ breit, etwas breiter als lang. Flügel in der Mitte nur schwach verengt, die Basalborsten hyalin, am Ende etwas knopfig oder wenigstens offen, in der Länge voneinander wenig verschieden; Schaltwimpern fehlen. Borsten am Abdomen hyalin, B. 1 des 9. Segmentes etwa 112 μ , schmal abgerundet, B. 2 etwa 93 μ , ebenso, B. 3 spitzig. Tubus kurz und breit, 104 μ lang, am Grunde 64, am Ende 34 μ breit, demnach nur 1.6 mal so lang als am Grunde breit, Terminalborsten etwa 135 μ lang, also deutlich länger als er Tubus.—Körperlänge (normal gedehnt): 1.43 mm.

♀, f. brachyptera: Flügel zu einem kurzen Stummel reduziert, der zum Ende des 1. Abdominalsegmentes reicht und auf dem die drei Basalborsten stehen. Der Pterothorax hat dieselbe Breite wie bei der f. macroptera.

♂: Auch das ♂ tritt in 2 Formen auf, die sich nur durch die Ausbildung der Flügel unterscheiden. Vorderschenkel verdickt, Vordertarsen mit kräftigerem Zähnchen als beim ♀. B. 2 des 9. Segmentes wie sonst bei *Haplothrips*, dornartig.

LARVE.

II. Stadium: Gelb, 8.-10. Abdominalsegment rot, im Kopf spärliche Stränge roten Pigmentes. Schenkel blass gelblichgrau, Tibien dunkler. Fühler, 1. und 3. Glied hellgrau, 2. dunkelgrau, am Endteil weisslich, 4.-7 dunkelgrau. Kopf, Prothoraxplatten und Plättchen am übrigen Thorax sehr schwach getrübt, Seitenplatten am 8. Segment und das 9.-11. Segment des Abdomens getrübt.

Kopf an den Augen 100 μ breit und etwa ebenso lang, Fühlergrunddistanz 22 μ . Kopfborsten wie die übrigen hyalin, offen oder schwach geknöpft, die Inneraugenborste etwa 28 μ lang. Fühler nur 208 μ lang. Gliederlängen (-breiten): 17 (31, Sp. 25), 25 (19), 42 (20), 36 (21), 35 (20), 25-27 (11), 25(8) μ ; das 7. Glied vom 6. scharf abgegrenzt, das 4. mit kurzem, etwas gebogenem Sinneskegel, das 3. am Grunde dünn, wie für *Haplothrips* charakteristisch. B. 1 am Pronotum rudimentär, B. 3 mässig lang, diese und alle folgenden offen, B. 6 etwa 36-40 μ , also kurz, fast geknöpft, B. 7: 17 μ , fast spitzig; Lateralborste am 7. Abdominalsegment 42-45 μ , geknöpft, B. 3 am 8. Segment ebenso, am 9. Segment B. 1 lang, spitzig, nicht messbar, aber wohl etwa 70-85 μ , B. 2 geknöpft, 42-48 μ , B. 3 ebenso, B. 4 haarartig, spitzig. Das 9. Segment viel breiter als lang, Länge vielleicht 53 μ , Breite an der Basis 87 μ , am Ende 70 μ . 10. Segment etwa 56 μ lang, am Grunde 53, am Ende 25 μ breit. Analborsten gut 170 μ lang.

Ich besitze nur 1 Stück der Larve, die sicherlich hierher gehört, wie die mit der Imago korrespondierende Pigmentierung zeigt.

Fundorte: ♂♂♀♀, Larve, Java, Buitenzorg, 1921, von Zwiebel—Feldern, leg. W. C. van Heurn, zusammen mit zahlreichen *Haplothrips ganglbaueri*.

Haplothrips ramakrishnai Karny.

1925. *Haplothrips ramakrishnai* Ramakrishna, *Journ. Bombay Nat. Hist. Soc.*, Sep. p. 11.
 1926. *Haplothrips ramakrishnai* Karny, *Mem. Dept. Agr. Ind.*, IX, 6, p. 218, fig. 19, Pl. XXI, fig. 2.
 1928. *Haplothrips ramakrishnai* Ramakrishna, *Mem. Dept. Agr. Ind.*, X, 7, p. 292.
 1931. *Haplothrips ramakrishnai* Ramakrishna & Margabandhu, *Journ. Bombay Nat. Hist. Soc.*, XXXIV, 4, p. 1038.

Zu dieser Art verweise ich auf die von Karny gegebene Beschreibung, die Art wurde ausserhalb Indiens noch nicht aufgefunden.

Haplothrips sesuvii, sp. nov.

Zum Subgenus *Trybomiella* gehörig, ähnlich *ramakrishnai*, aber die Augen kleiner, innen etwas ausgerandet, der Tubus kürzer, breit konisch, daher von obiger Art leicht zu unterscheiden.

♀: Kastanienbraun bis schwarzbraun, die Mittel- und Hinterbeine samt Tarsen dunkel, die Vordertibien gegen die Spitze gelb-bräunlich, in allmählichem Uebergang, die Vordertarsen gelbbraun. Fühler dunkel, nur das 3. Glied licht, aber nicht rein gelb, sondern graugelb, wolzig grau getrübt, das 4. ganz dunkel, aber etwas wolzig, und daher etwas lichter als das 5. Borsten am Körper hyalin, ebenso die breiten Flügel.

Kopf etwa 200 μ , samt Interantennalfortsatz 208 μ lang, nach hinten etwas erweitert, hinter der Mitte etwa 182-190 μ breit; die Augen kleiner als bei *ramakrishnai*, seitlich 66-69 μ , oben 73 μ lang, innen, um den ziemlich weit vorstehenden hinteren Ocellen Platz zu machen, deutlich ausgerandet, hinten flach zugerundet, an den Wangen keine deutlichen Börstchen, Postokularborsten *nicht* vorragend, stumpf, hyalin, ihre Insertionsstellen von den Augen 20 μ abstehend, Mundkegel kurz, breit gerundet; Fühler kurz, etwa nur 330 μ lang. das 3. Glied kurz, mit 2 Sinneskegeln, das 4. mit deren vier; das 8. Glied an das 7. breit anschliessend, an der Basis am breitesten; Gliederlängen (-breiten) vom 2. Gliede an: 45-48 (28), 45-46 (28), 50(32), 48-49 (29), 45 (25), 42(21), 28-31 (17) μ . Prothorax stark quer, 120-130 μ lang, ohne Coxen 310 μ breit, Vordereckenborsten kurz, dick, hyalin, offen, etwa 28 μ . Hintereckenborsten ebenso, etwa 50 μ lang; Vorderbeine etwas kräftiger als die Mittel- und Hinterbeine, die Tarsen mit kleinem, aber deutlichem und spitzigen Zähnen, knapp vor der Stabendplatte. Mesothorax breiter als lang, etwa 363-380 μ breit; Flügel breit, in der Mitte stark verengt, ohne Schaltwimpern; alle drei Basalborsten geknöpft, hell, in der Länge voneinander wenig verschieden, die beiden ersten 36-39, die dritte 39-42 μ lang. Borsten 1 und 2 der hyalinen Borsten des 9. Segmentes am Ende abgerundet, nicht scharfspitzig, etwa 85 μ lang, B. 3. spitzig. Tubus etwa 112 μ lang, am Grunde 67, am Ende 36 μ breit. Terminalborsten zwar etwas länger als der Tubus, aber nur etwa 140 μ lang, am Grunde verhältnismässig wenig getrübt.—Körperlänge (gedehnt): 2 mm.

LARVE.

II. Stadium. Ein einziges Stück der Larve, das sehr gut erhalten, und gut charakterisierbar ist, liegt vor.

Gelb, mit wenig Pigment im Kopf, aber reichlich rot in den 3-4 letzten Abdominalsegmenten. Die Fühler sind (mit Ausnahme des weisslichen Endteiles des 2. Gliedes) einfarbig grauschwarz. Dunkel sind ferner die Kopfplatten mit 1 Zentralplättchen, die grossen Pronotumplatten, die Borsteninsertionsstellen im Thorax und Abdomen, etwa 40 μ breite Basalplättchen am Mesonotum und borstenfreie Plättchen am Meso- und Metanotum, dann komplette Seitenplatten am 8. und das 9.-11. Segment des Abdomens. Beine schwächer grau getrübt als die Antennen.

Kopf etwa 110 μ lang (Breite nicht messbar), Kopfborsten offen oder schwach geknöpft, hyalin wie alle übrigen dorsalen Körperborsten, die Inneraugenborste etwa 20-22 μ , die Innenborste der 2. Querreihe 34 μ lang; Fühler etwa 110 μ lang, Gliederlängen (-breiten): 17 (?), 28 (20), 45 (21), 42 (22), 36 (18), 28(14), 22 (8) μ ; Sinneskegel am 4. Glied kurz, fast gerade. B. 1 am Pronotum sehr klein, B. 3 etwa 34,

wie alle übrigen am Ende breit offen, B. 5: 34-36, B. 6: 42-45, B. 7: 28 μ . Längste Borste am Metanotum (B. 6): 45 μ . B. 1 am 1. Segment des Abdomens 28 μ , B. 2: 34 μ ; Borsten am 7. Segment: 42, 48-50 und 56 μ ; die Borsten des 8. Segmentes alle etwa 42 μ lang; am 9. Segment, B. 1 lang, etwa 100 μ , am Ende abgerundet oder sehr schlank geknöpft, B. 2, 3 stark geknöpft, 36-42 μ , B. 4 spitzig, 93-98 μ ; das 9. Segment ist 70 μ lang, das 10. Segm. 67 μ , ersteres breiter als lang, letzteres am Grunde 57, am Ende 28 μ breit. Analborsten etwa 180 μ lang.—Die erwachsene Larve misst gedehnt etwa 1.38 mm.

Fundort: ♀♀, Larve, *Eiland Leiden b. Batavia*, 20-IV-1924, in Blüten von *Sesuvium portulacastrum* C., leg. Docters van Leeuwen.

Haplothrips tirumalraoi Ramakrishna & Margabandhu.

1931. *Haplothrips tirumalraoi* Ramakrish. & Margab., *Journ. Bombay Nat. Hist. Soc.*, XXXIV, 4, p. 1038.

Ich habe diese Art nicht vor mir, verweise daher auf die Beschreibung (*I. c.*), die untenstehende Uebersicht lässt sie von den übrigen Vertretern des Subgenus *Trybomiella* unterscheiden.

Haplothrips (Zygothrips) andhra Ramakrishna.

1928. *Zygothrips andhra* Ramakrishna, *Mem. Dept. Agr. Ind.*, X, 7, p. 290.

Auch diese Art habe ich nicht gegenwärtig, so kann ich nur auf die Beschreibung verweisen und nehme an, dass es sich wirklich um eine in die Untergattung *Zygothrips* (kein Sinneskegel am 3. Fühlerglied) gehörige Art handelt.

Haplothrips terminalis Schmutz.

1913. *Haplothrips terminalis* Schmutz, *Stzungsab. Akad. Wiss. Wien*, CXXII, p. 1033.

1915. *Haplothrips terminalis* Karny, *Zeit. Wiss. Ins-Biol.*, XI, p. 87.

1916. *Haplothrips terminalis* Karny, *Zeit. Wiss. Ins-Biol.*, XII, p. 129.

1921. *Haplothrips terminalis* Priesner, *Treubia*, II, 1, p. 6.

1921. *Haplothrips terminalis* Karny, *Treubia*, II, 1, p. 32.

1925. *Haplothrips terminalis* Ramakrishna, *Journ. Bombay Nat. Hist. Soc.*, Sep. p. 8.

Diese Art, zweifelhaft ob zu *Haplothrips* gehörig, vielleicht ein *Karthyothrips*, ist wiederholt zitiert, aber noch nicht nachuntersucht worden; ich kann daher hierüber auch heute noch keine definitiven Angaben machen. Ich habe diese Art in die Tabelle nicht aufgenommen.

UEBERSICHT ZUR BESTIMMUNG DER INDOMALAYISCHEN HAPLOTHRIPS-ARTEN.

A	Macoptere Formen	1
	Brachyptere Formen	cf. <i>apicalis</i> (34)
1	Schaltwimpern vorhanden	2
—	Schaltwimpern fehlen	33
2	Flügel deutlich getrübt, doch mitunter nur schwach	3
—	Flügel glashell	10
3	Prothoraxborsten geknöpft	4
—	Prothoraxborsten fast spitzig	cf. <i>fumipennis</i> , sp. nov.

- 4 Das 3. Fühlerglied asymmetrisch, schmal, Flügel stark getrübt, nur nahe der Basis am Hinterrande aufgehell. Grosse Art vom Habitus einer *Neoheegeria*. Prothoraxborsten lang . . . *fumipennis*, sp. nov.
- Das 3. Fühlerglied symmetrisch. Flügeltrübung schwächer . . . 5
- 5 Das 3. bis 6. Fühlerglied an der Basis hellgelb, am Ende mehr weniger ausgedehnt getrübt. Augen gross, Vorderschenkel am Ende breit gelb . . . *inquilinus* Pr.
- Das 6. Fühlerglied am Grunde nicht auffallend gelb oder es ist ganz dunkel . . . 6
- 6 Tibien ganz hellgelb, das 7. Fühlerglied mit dem 8. zusammen ein Ganzes bildend. Vorderschenkel am Ende breit gelb, das 2. und 3. Fühlerglied am hellsten von allen. Tubus sehr kurz . . . *incognitus*, sp. nov.
- Tibien nicht ganz hellgelb, wenigstens die Mittel- und Hintertibien im mittleren Teil getrübt . . . 7
- 7 Laterallänge der kleineren Augen 45 μ . Tubus nur 1.8 mal so lang als am Grunde breit. Mundkegel breit gerundet. Das 3. und 4. Fühlerglied etwas aufgehell . . . *fungicola*, sp. nov.
- Laterallänge der Augen 56-60 μ , Augen grösser. Tubus 2.2-1 mal so lang als am Grunde breit . . . 8
- 8 Das 3. Fühlerglied gelblich, grau getrübt, das 4. hinter dem Stielchen mit gelbem Ring, ganz wenig breiter als das 3 . . . *sororculus* Schm., *pictipes* Bagn.
- 9 Kopf etwas breiter als lang oder so lang wie breit. Das 3. Fühlerglied ganz wenig breiter als das 4 . . . *pictipes* var. *malayensis* nov.
- Kopf deutlich länger als breit. 3. und 4. Fühlerglied gleich breit . . . *inquinatus* Karny.
- 10 Auch das 3. Fühlerglied wenigstens zum Teil getrübt, oder die Glieder 3-8 einfarbig blassbraun, hierbei 3-5 etwas lichter . . . 11
- Das 3. Glied rein hellgelb . . . 14
- 11 Das 3. Glied ohne Sinneskegel (?) . . . (*Zygothrips*) *andhra* Ram.
- 3. Glied mit wenigstens *einem* Sinneskegel . . . 12
- 12 Das 3. Fühlerglied symmetrisch,, Vorderschenkel am Ende gelb. . . 5
- Das 3. Glied schwach asymmetrisch. Vorderschenkel am Ende nicht aufgehell . . . 13
- 13 Borsten am Prothorax und Borsten 1 und 2 der Flügelbasis geknöpft, getrübt . . . cf. *certus* Pr., *ganglbaueri* Schm.
- Borsten am Prothorax und an der Vorderflügelbasis spitzig, hell. Mittel- und Hintertarsen bei dunklen Stücken licht . . . *aculeatus* F.
- 14 Das 3. Fühlerglied sehr kurz, *seitlich stark gerundet* . . . 15
- Das 3. Glied länger, schmaler, wenigstens 1.45 mal so lang als breit, meist fast doppelt so lang als breit oder noch gestreckter . . . 17
- 15 Das 3. Glied mit zwei Sinneskegeln, symmetrisch . . . cf. *sororculus* Schm.
- Das 3. Glied leicht asymmetrisch, mit 1 bis 2 Sinneskegeln . . . 16
- 16 Kopf normal, *Prothoraxborsten ganz dunkel*. 3. Fühlerglied mit zwei etwa gleichlangen Sinneskegeln. Auch die dritte Borste an der Vorderflügelbasis geknöpft . . . *gowleyi* Frkl.
- Kopf hinten stark verengt, Seiten daher stark gerundet. Augen kleiner. Prothoraxborsten licht. Der innere Sinneskegel am 3. Glied sehr klein, verkümmert. Postokularborsten kürzer. Die 3. Borste an der Flügelbasis spitzig . . . *imperatae* sp. nov.

- 17 Das 3. Fühlerglied symmetrisch . 18
 — Das 3. Fühlerglied asymmetrisch, mit meist nur 1 Sinneskegel . 20
- 18 Die langen Borsten an den Hinterecken des Prothorax gegen das Ende etwas gebogen, dann geknöpft, ihre Länge etwa 0·7 der Pronotumlänge cf. *inquilinus* Pr.
 — Diese Borsten kürzer 19
- 19 Schaltwimpern 3 bis 6. Drittes Fühlerglied dick, an der Basis sehr dünn, völlig symmetrisch. Vordertarsen mit deutlichem Zähnchen cf. *sororculus* Schm.
 -- Schaltwimpern 7 bis 9. Das 3. Glied schmal, nur schwach asymmetrisch, das 4. Glied deutlich breiter. Flügel sehr schmal, Vordertarsen ohne Zähnchen . *tenuipennis* Bagn.
- 20 Schaltwimpernzahl 7-8¹ 21
 — Höchstens 7 Schaltwimpern vorhanden¹ 26
- 21 Mitteltibien am Ende ziemlich breit gelb, die Hintertibien schmal gelb. 3. Fühlerglied meist doppelt so lang oder noch gestreckter. Prothoraxborsten ganz dunkel. Weibchen an den Vordertarsen ohne Zähnchen *ceylonicus* Schm.
 -- Mitteltibien am Ende höchstens schmal gelb, meist einfarbig 22
- 22 Erstes Glied der Hintertarsen innen mit einem meist dunklen Sporn. Mittel- und Hintertarsen ganz dunkel. Vordertibien zum grössten Teil dunkel cf. *certus* Pr.
 — Erstes Hintertarsenglied innen nur mit schwachem, hellen Börstchen 23
- 23 Das 3. Fühlerglied doppelt oder mehr als doppelt so lang als breit 24
 — Das 3. Fühlerglied nur 1·7—1·8 mal so lang als breit *vernoniae* Pr.
- 24 Mitteltibien am Ende etwas gelblich aufgehellt. 3. Fühlerglied mit zwei Sinneskegeln, wovon der eine undeutlich ist. Weibchen ohne Tarsenzähnchen *ceylonicus* var. *mangiferue*, nov.
 — Mitteltibien am Ende ohne merkliche Aufhellung, Mittel- und Hintertarsen stark getrübt. 3. Fühlerglied mit 1 Sinneskegel. Weibchen mit sehr kleinem Tarsenzähnchen 25
- 25 Postokularborsten von den Augen weiter (15 μ) abstehend. Körper schwarzbraun, Mittel- und Hinterbeine ganz dunkel *chinensis*, sp. nov.
 — Postokularborsten den Augen sehr nahe (6-8 μ). Körper lichter, rotes Pigment stark durchscheinend, Mundkegel spitziger *vernoniae* var. *grandior*, nov.
- 26 Mitteltibien im Enddrittel oder in den beiden Endfünfteln hellgelb cf. *ceylonicus* Schm.
 — Mitteltibien dunkel, nur am äussersten Rande bisweilen aufgehellt 27
- 27 Mittel- und Hintertarsen gelblich oder nur schwach getrübt 28
 — Mittel- und Hintertarsen stark getrübt, Mundkegel ziemlich spitzig 31
- 28 Borsten an den Hinterecken des Prothorax nicht ganz dunkel, entweder ganz blass oder schwach getrübt 29
 — Borsten an den Hinterecken des Prothorax auch bei lichten Stücken dunkelgrau oder schwärzlich. Penis wie bei *ganglbaueri*; 3. Flügelbasalborste spitz cf. *vernoniae* Pr.

¹ In Zweifelsfällen führen beide Wege zum Ziel.

- 29 Tarsenzähnen wohl entwickelt. Prothoraxborsten ganz licht. 3. Fühlerglied ganz schmal. Augenlänge 4-10 der ganzen Kopflänge. Pterothorax vom Vorderrande bis zur Basis der Hinterhüften länger als breit *themedae*, sp. nov.
- Tarsenzähnen sehr klein. Prothoraxborsten getrübt. 3. Fühlerglied weniger schmal 30
- 30 Penis des Männchens einfach. Mundkegel abgerundet. Mittel- und Hintertarsen gelblich, schwach grau getrübt. Alle drei Borsten an der Flügelbasis geknöpft oder abgerundet. Augenlänge $\frac{4}{9}$ der gesamten Kopflänge *ganglbaueri* Schm.
- Penis des Männchens von oben gesehen am Ende ausgerandet, wie gespalten. Mundkegel stärker zugespitzt (ähnlich *vernoniae*). Mittel- und Hintertarsen dunkel. Die 3. Borste an der Vorderflügelbasis haarartig, spitzig, die beiden ersten geknöpft *certus* Pr.
- 31 Das 1. Glied der Hintertarsen innen mit verh. starker, dornartiger Borste. Vordertibien zum grössten Teil dunkel *cf. certus* Pr.
- Das 1. Glied der Hintertarsen innen nur mit schwachen Börstchen 32
- 32 Das 3. Glied der Fühler 1.7-1.8 mal so lang als breit *cf. vernoniae* Pr.
- 3. Fühlerglied doppelt so lang als breit *cf. vernoniae* var. *grandior* Pr.
- 33 Fühler ganz schwarz. Kopf langgestreckt. Fühlerendglieder verhältnismässig lang. 3. Fühlerglied symmetrisch. Flügel schwach aber deutlich getrübt *euphorbiae* Pr.
- Anders 34
- 34 Das 3. bis 6. Fühlerglied hellgelb, die übrigen dunkel. Mittel- und Hinterschenkel lichter als die Tibien. Rotes Pigment bei Imago und Larve meist nur in den Endsegmenten des Abdomens *apicalis* Bagn.
- Fühler dunkler. Schenkel nicht lichter als die Tibien. Immer macropter 35
- 35 Das 3. Fühlerglied mit zwei Sinneskegeln 36
- Das 3. Fühlerglied mit nur 1 Sinneskegel; Tubuslänge etwa $\frac{0.6}{1}$ der Kopflänge *tirumalraot* Ram.
- 36 Tubus länger und schmaler, seine Länge 0.66-0.73 der Kopflänge (ohne Interantennalfortsatz). Tubus 2.2 mal so lang als am Grunde breit. Augen (seitlich gemessen): Wangen (hinter den Augen) = 5.5 : 5.6 *ramakrishnai* Karny.
- Tubus kurz konisch, seine Länge 0.85-0.6 der Kopflänge. Tubus 1.8 mal so lang als am Grunde breit. Augen : Wangen = 3.8 : 8.2 *sesuvii*, sp. nov.

VERZEICHNIS DER ARTEN UND DEREN VERBREITUNG.

- Haplothrips aculeatus* (F.)—Paläarktische Region, ohne Nordafrika.
Haplothrips andhra Ram.—Indien.
Haplothrips apicalis Bagn.—Indien, Java.
Haplothrips certus Pr.—Sumatra, Mentawai.
Haplothrips ceylonicus Schm.—Indien. Malayische Inseln.
Haplothrips ceylonicus var. *mangiferae* Pr.—Indien?, Java.
Haplothrips chinensis Pr.—China.
Haplothrips euphorbiae Pr.—Sumatra.
Haplothrips fumipennis Pr.—Java.

- Haplothrips fungicola* Pr.—Sumatra.
Haplothrips ganglbaueri Schm.—Indien, Malayische Inseln.
Haplothrips gowdeyi (Frkl.)—Kosmopolit.
Haplothrips imperatae Pr.—Sumatra.
Haplothrips incognitus Pr.—Java.
Haplothrips inquilinus Pr.—Indien, Malayische Inseln.
Haplothrips inquinatus Karny.—Java.
Haplothrips pictipes Bagn.—Indien.
Haplothrips pictipes var. *malayensis* Pr.—Sumatra.
Haplothrips ramakrishnai Karny.—Indien.
Haplothrips sesuvii Pr.—Java (Eiland Leiden).
Haplothrips sororculus Schm.—Indien (Ceylon).
Haplothrips tenuipennis Bagn.—Indien.
Haplothrips terminalis Schm.—Indien (Ceylon).
Haplothrips tirumalraoi Ram.—Indien.
Haplothrips themedae Pr.—Sumatra.
Haplothrips vernoniae Pr.—Indien, Indomalayische Inseln, Formosa.
Haplothrips vernoniae var. *grandior* Pr.—Formosa.

TWO WINGED MOSSMITES OF THE NILGIRI HILLS.

By ARTHUR PAUL JACOT.

(Plate IX).

In 1910 (2, p. 118) two species of Galuminae (Oribatoidea-Acarina) were so badly described that it is not possible to determine the genus, in one case not even the subfamily to which they belong. As I had the good fortune of finding the cotypes of these species I hasten to make them known to my colleagues.

Galumna tessellata (Ewing).

(Plate IX, figs. 1-3).

1910. *Oribata tessellata*, Ewing, *Trans. Acad. Sci. St. Louis* XIX, p. 118.

Diagnostic characters.—Fairly large (0.88×0.67 mm.); rostral bristles short, very fine; lamellar bristles fairly long, appressed; interlamellar bristles lacking; abdomino-cephaloprothoracic suture indefinite, internal; pseudostigmatic organs very slender, straight, head a slight widening of pedicel, distal end obtuse to pointed, finely burred (figure 1); porose areas small, anterior the largest, mesonotal very lateral; a median porose area of about twenty-five pores; cephaloprothorax and parasterna with fine, broken, crenulate, combing; pteromorphae sculptured with fine network (figure 3); bristle of parasterna I not gular but anterior; genital cover bristles 1 not marginal, genital cover bristles not in a straight line; paramesal bristles about midway between apertures; paranal bristles and pseudofissurae posteriad of center of sides of aperture.

Description.—Shape ovate, notogaster slightly truncate behind; cephaloprothorax tapering, not steep; rostrum not distinct in dorsal aspect; rostral bristles inserted on slightly raised edge; lamellae projecting from surface of cephaloprothorax, mesal edge directed laterad of interlamellar bristles; lamellar bristles surpassing middle of rostral; interlamellar bristles distant from shadow of tectopedia I, with raised chitin scale on lateral side; abdomino-cephaloprothoracic suture seen to be internal when focused on with four millimeter objective, being on a lower level than the cephaloprothoracic sculpturing which fades out beyond the rather prominent, linearly arranged, mandible retractor scars; anterior porose areas semioval; adalar very small, circular; mesonotal also very small, close together, far down on sides, mesal mesonotal distant from its mesal insertion; pteromorphae typical, pivot slender, near angle, anteroproximal edge of pteromorphae cut out around pivot to fit about bulge of pseudostigmatic area, veining anastomosing, groove distinct, ribs thin but well formed, insertion and channel distinct, not conspicuous, pseudofissura rather large, sculpturing extending over entire anterior half to ventral edge, and posteriad along ventral half. The veining is on the ventral or ental part of the pteromorphae, the sculpturing on the dorsal (lateral).

Ventral plate wings broad, anterior end obliquely truncate; tectopedia II sharply angled, extending posterolaterad of wings; tectopedia

III small; tectopedia IV elongate triangular; apodemata I rather long, with well formed posterior head; apodemata II-III longer, with fairly long anterior and much longer, strongly curved posterior ceriphs; apodemata IV parallel with II-III; no gular or sternal bristles; lacunae between apodemata I and II-III distinct, ovate; bristles of parasterna III not discernible, of parasterna IV as usual in the genus *Zetes* (figure 2); genital aperture with anterior edge flattish, posterior edge undulate; sides not strongly converging; genital cover bristles 2 and 3 sub-equally approximate, much more approximate than bristles 1, bristles 4 with long, slender channel; paramesal bristles more approximate than diameter of genital covers; anal aperture with strongly converging sides and weak anterior corners, frame distinct; subanal muscle plate oval; anal cover bristles sub-equally approximate, anterior bristles nearer median than lateral or anterior edge of covers; paranal bristles in the one specimen before me on opposite ends of pseudofissurae on each side; post-anal bristles sub-equally spaced, lateral bristles rather distant from corners; mesal pair more remote than cover bristles.

Dimensions of the one male (?) available: total length of body 884, breadth of same 672, length of pteromorphae 484, interlamellar bristle span 200, median length of ventral plate 680, camerostome to genital aperture 123, length of genital aperture 102, breadth 115, genital aperture to anal aperture 197, length of anal aperture 180, breadth 198 microns.

This species, by its sculptured cephaloprothorax, recalls the South American *Z. australis* (1). It is primitive in its small porose areas and the veining of the pteromorphae. The position of the bristle of parasterna I and the position of apodemata IV are unusual.

Type locality.—From moss in wattle grove on hillside near Springfield Post Office, elevation about 6,000 feet, Nilgiri Hills, South India, collected by R. L. Ewing.

***Galumna nilgiria* (Ewing).**

(Plate IX, figs. 8-11).

1910. *Oribata nilgiria*, Ewing, *Trans. Acad. Sci. St. Louis* XIX, p. 118.

Diagnostic characters.—Size rather small (0.36 × 0.27 mm.); rostral bristles absent to invisible, lamellar bristles small, fine, peripheral; interlamellar bristles minute; anterior porose areas long, well developed; adalar porose areas bluntly short-triangular; pseudostigmatic organs not long, straight, pedicel slender, head less than half length of pedicel, spatulate, with what seems to be recurved edges, finely barbed (figure 10); mesonotal porose areas circular, the mesal twice the diameter of the lateral; a median porose area rather far posteriad; pteromorphae with very weak veining; ventral plate wings broad; tectopedia II still broader; tectopedia IV equilaterally triangular; genital cover bristles nearer lateral than median edge of covers; paranal bristles at center of aperture.

Description.—Color pale amber yellow; shape broadly ovate; cephaloprothorax broad, frons concave; rostrum not differentiated in dorsal aspect; lamellae barely projecting beyond surface of cephaloprothorax, slender, mesal edge directed laterad of interlamellar bristle insertion, cephaloprothorax projecting markedly ventrolaterad, rostral

insertions close to edge of camerostome very posteriad; mandible retractor scars minute, linearly arranged; adalar porose areas with anterior side much more oblique than posterior; a fine pseudofissura between mesal adalar insertion and mesal mesonotal insertion; pteromorphae slightly undulate, pseudofissura (on ventral face) slender, groove open anteriorly, posterior rib well formed but thin.

Ventral plate wings with anterior end undulate; tectopedia II seems to be double (figure 11), amply exposed posterolaterad of wings; tectopedia III slender, formed by projection of an acetabulum; apodemata I curved, with a short anterior and a medium long posterior ceriph; apodemata II-III longer, with a short anterior and a long posterior ceriph; apodemata IV short, diagonal, almost touching the preceding and joined to it by a plate extending to end of ceriph; gular bristles rather approximate; genital aperture with anterior and posterior edges strongly undulate, sides not strongly converging; cover bristles 1 distant from anterior edge, bristles 4 distant from median edge, with channel; paramesal bristles slightly more remote than diameter of genital aperture, somewhat nearer genital than anal aperture; anal aperture with poorly developed anterior corners, sides strongly tapering, frame broad anteriorly, tapering out at sides; subanal muscle plate ovate, broad end posteriad; pseudofissurae short, at center of sides; paranal bristles slightly posteriad of pseudofissurae, cover bristles midway between lateral and median sides so that posterior bristles are much more remote than anterior, quite distant from each other; postanal bristles subequally spaced, lateral bristles not close to corner of aperture.

Dimensions of a rather flattened out male: total length 361, breadth 270, length of pteromorphae 197, interlamellar bristle span 49, median length of ventral plate 270, camerostome to genital aperture 61, length of genital aperture 45, breadth 53, genital aperture to anal aperture 70, length of anal aperture 79, breadth 84 microns.

This species, somewhat resembling *G. curvum ventralis* (4, p. 284, figs. 67, 68) in size and in reduction of cephaloprothoracic bristles, is very distinct in shape of pseudostigmatic organs, much larger porose areas, lack of notogastral bristles, position of genital cover bristles 1 and of paramesal bristles.

Type locality.—Found with the preceding but in much smaller numbers.

As *G. nilgiria* is a pale colored species and correspondingly translucent, the ental leg parts are quite distinct. These are illustrated in figure 9 where, in the case of each leg the coxal (proximal) trochanter is indicated by a broad solid line and the coxa by the letter c. This means that the femora of legs I and II include the femoral (distal) trochanter and that the member of legs III and IV which was formerly called coxa is the second trochanter. Thus in the two pairs of anterior legs the femoral trochanters become reduced while in legs III and IV they become highly developed. Coxae I and II resemble a spoon bowl so that when viewed in one aspect they seem somewhat oval or circular (figures 4, 6, 8 and 9) but when rotated ninety degrees they appear crescentic (figures 5 and 6). The distal end of this spoon is not an elongated handle but a wheel much resembling a railroad car wheel including the flange. Figure

4 shows this wheel to best advantage, with the chitin of the wall of the cephaloprothorax (shaded lines) above it. Figures 6 and 8 show similar arrangements in different species. This carwheel, I take to be the coxal trochanter fused to the coxa. In figure 6 only the end of the femur is shown. Figures 5 and 7 show this trochanter rotated ninety degrees. The shaded portion of the trochanter in figure 5 is in section, actually the trochanter has a rim projecting over the ends of the femoral trochanter. This is indicated in figure 5 by the straight line joining the ends of the rim of the trochanter. The trochanter of legs II has a very different appearance (figure 7) being housed in the end of the femur and articulated with the coxa by a point. This indicates that instead of being wheel-like, it is like a narrow section cut across a wheel.

Coxal trochanters I and II are held in place by two acetabulae, an anterior bearing on the trochanter, and a posterior bearing on the pedicel joining the trochanter to the coxa. In figure 5 the anterior acetabulum is illustrated by simple lines, the posterior by shaded lines. Coxal trochanters III and IV have this arrangement reversed. Figure 9 should make this clear if it be borne in mind that coxa III is almost vertical so that some of its parts are foreshortened. In figure 9 the minor acetabulum of each leg is shaded.

Other figures of these parts will be found in another paper (3). A secondary pivot of the ball and socket type is illustrated for legs II (3, pl. XIV, figs. 140 and 141) in *Galumna hawaiiensis*. In *G. lanceatum octopunctatum* (figure 7) this secondary pivot is short and does not enter the femur. In figure 141 (3) the acetabulum has the appearance of being part of the body wall.

BIBLIOGRAPHY.

1. Berlese, A.—Acari Nuovi. Manipulus IX, *Redia* X, pp. 113-150, pls. i-iv (1914).
2. Ewing, H. E.—New Acarina from India. *Trans. Acad. Sci. St. Louis* XIX, pp. 113-121, pl. xxxv (1910).
3. Jacot, A. P.—Some Hawaiian Oribatoidea. *Bull. Bernice P. Bishop Museum Honolulu* (1933).
4. Williamson, C.—Oribatei (Acari), gesammelt von der Deutschen Limnologischen Sunda-Expedition. *Archiv Hydrobiol. Suppl.* IX, "Tropische Binnengewasser II," pp. 240-305, 81 text-figures (1931).

EXPLANATION OF PLATE IX.

Galumna tessellatala (Ewing).

- FIG. 1.—Pseudostigmatic organs $\times 440$.
FIG. 2.—Dorso-ventral aspect, mouth parts and legs omitted $\times 100$.
FIG. 3.—Pteromorph sculpture $\times 200$.

Galumna longipluma (Berlese).

- FIG. 4.—Coxa of legs I, face view, proximal end of femur cross hatched $\times 440$.

Parakalumna robustum (Banks).

- FIG. 5.—Coxa of legs I, edge view, coxal trochanter in section (stippled), minor acetabulum shaded $\times 200$.
FIG. 6.—Coxa of legs I of another species.

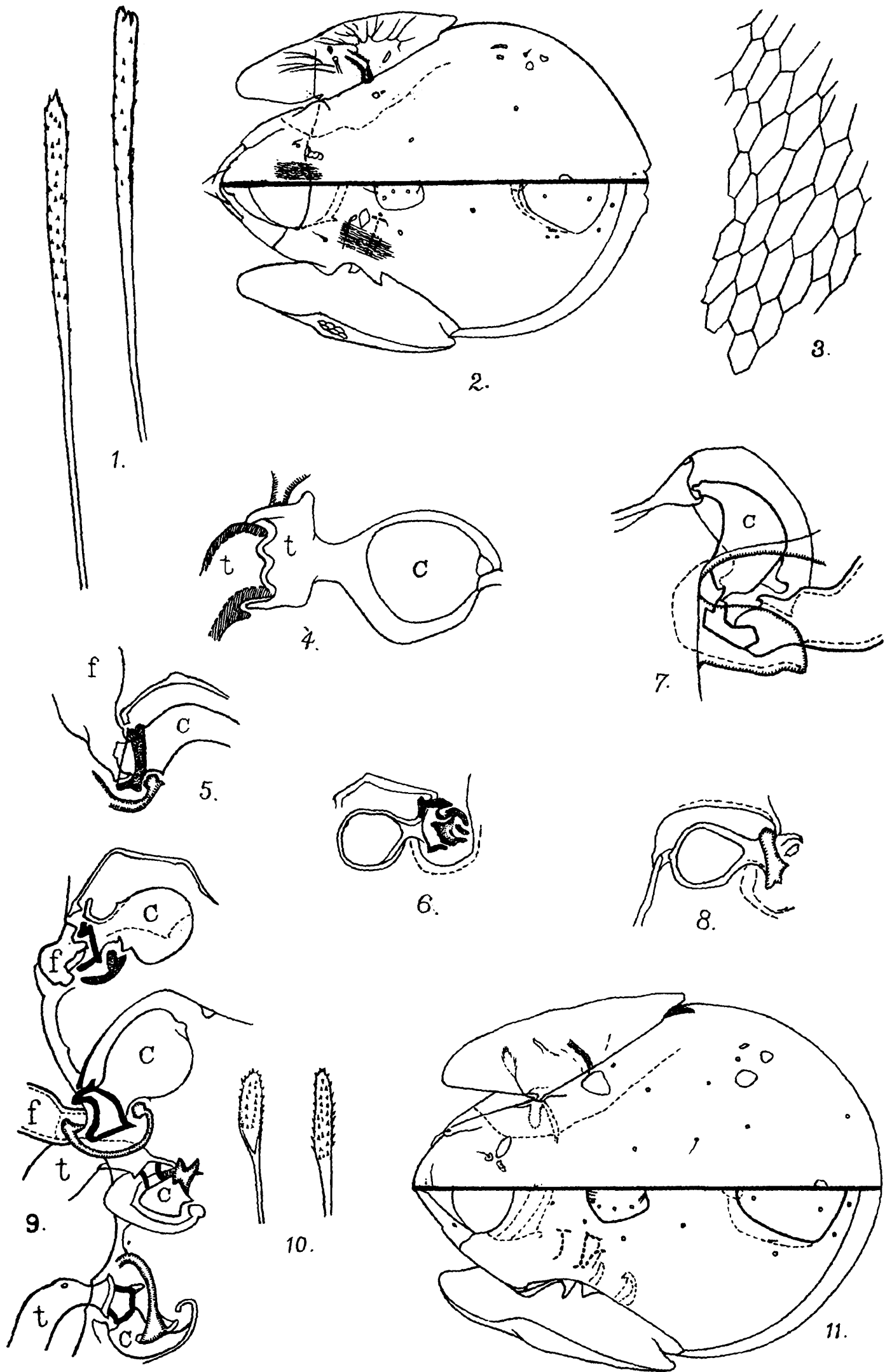
Galumna lanceatum octopunctatum (Ewing).

- FIG. 7.—Coxa of legs II, edge view, the trochanter indicated by a broad line ; tectopodia III indicated by a shaded line $\times 440$.

Galumna nilgiria (Ewing).

- FIG. 8.—Coxa of legs II, coxal trochanter indicated by shaded line $\times 440$.
FIG. 9.—Coxa of legs I to IV, coxal trochanter indicated by broad line, minor acetabulae by shaded line $\times 440$.
FIG. 10.—Pseudostigmatic organs $\times 440$.
FIG. 11.—Dorso-ventral aspect, mouth parts and legs omitted $\times 200$.

The magnifications after the various figures give the ratios of relative enlargements, not the actual magnifications.



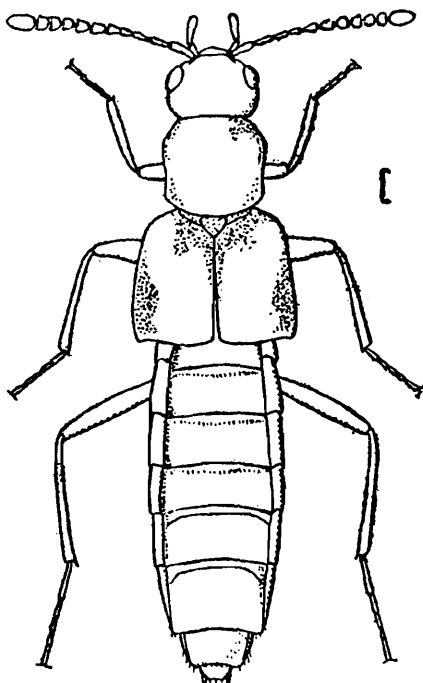
INDIAN MOSS-MITES

DESCRIPTION OF A NEW STAPHYLINID BEETLE FROM THE PUNJAB.

By MALCOLM CAMERON, M.B., R.N., F.E.S.

Chilopora indica, sp. nov.

Black, greasy lustrous, densely and finely punctured and pubescent; elytra yellow, scutellary region and the sides near the posterior angles of the elytra slightly infuscate, the posterior margin of the abdominal segments narrowly and obscurely reddish. Antennae reddish-yellow. Legs yellow. Length 3.75 mm. In size and build scarcely differing from *longitarsis* Kr., but differently coloured and the sculpture throughout equally dense but finer. Head narrower than the thorax, the post-ocular region rounded and gradually retracted behind, densely and finely punctured and with a fine coriaceous ground sculpture. Antennae rather long; 3rd joint a little longer than 2nd; 4th a little longer than broad; 5th to 10th of equal length, but gradually increasing in width, transverse; 11th as long as the two preceding together. Thorax slightly longer than broad, sides rounded in front, slightly retracted behind, posterior angles obtuse; in the middle of posterior half with



TEXT-FIG. 1.—*Chilopora indica*, sp. nov.

an obsolete impression; sculpture etc., as on head. Elytra (measured from the base) about a third longer and a good deal broader than thorax, extremely finely and very closely punctured. Abdomen extremely finely and very densely punctured and pubescent throughout.

Punjab ; Khewra, Salt Range, Sta. 5. Under stones in slightly moist soil. 9th April 1931. Four specimens (Coll. Hem Singh Pruthi). Types in the Indian Museum, Calcutta (No. $\frac{2718}{44}$) and one specimen in my collection.

THE TYPE LOCALITY OF THE GECKO, *HOPLODACTYLUS*
DUVAUCELII DUM. AND BIBR.

By MALCOLM A. SMITH.

In my paper "Remarks on some Old World Geckoes"¹ I suggested that the types, and only known specimens, of *Hoplodactylus duvaucelii* Dum. and Bibr. could not have come from Bengal, as is generally stated, but that some error must have occurred when labelling the specimens. It was highly improbable that a genus which was known otherwise only from New Zealand should inhabit also the Indian region.

This view has now been confirmed by the arrival of a living specimen of *H. duvaucelii* at the Gardens of the Zoological Society of London. It was caught on the Island of Hen and Chickens, off the East Coast of North Island, New Zealand, and shows well the two characters by which it differs from its close ally, *H. pacificus*, namely the greater number of lamellae beneath the toes and the larger size. The living specimen is considerably larger than the types, measuring 135 mm. from snout to vent.

At the same time I take the opportunity of correcting two typographical errors which through no fault of mine, occur in the same article.

On page 12, line 4 from the bottom, "*specifica*" should read "*pacifica*."

On page 12, line 3 from the bottom, "specimens" should read "species."

¹ *Rec. Ind. Mus.* XXXV, p. 13 (1933).

