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THE LEGACY OF DR. NELSON ANNANDALE AND HIS CONTRIBUTION TO THE TAXONOMY OF PHLEBOTOMINE SANDFLY SPECIES (DIPTERA : PSYCHODIDAE : PHLEBOTOMINAE) TRANSMITTING LEISHMANIASIS¹

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INTRODUCTION

Dr. T. N. Annandale was an extraordinary professional zoologist and gifted with administrative foresight. Under the stewardship of Annandale, the Zoological Survey of India was established on 1st July 1916 from the Zoological and Anthropological section of then known Indian Museum. He was primarily instrumental in the activities of Zoological Survey of India and laid the foundation for research on taxonomic zoology in India. This paper presents Annandale's contribution to the taxonomy of phlebotomine sandflies of which some are vectors of bishmaniasis.

BIOGRAPHY OF ANNANDALE

Academic pursuit : Dr. Thomas Nelson Annandale, D.Sc., C.I.E., F.R.S., F.L.S., C.M.Z.S. (Fig. 1) was borne at Edinburgh on 15th June 1876. He was educated at Rugby and at Balliol College, graduating in 1898. In 1899 he joined the Sheat Expedition to Malay Archipelago. From 1902 to 1904 he held a research fellowship in Anthropology in the University of Edinburgh and was awarded the degree of D.Sc. in 1905.

Research and professional excellence : Annandale came to India in 1904 and joined the Indian Museum as Deputy Superintendent and later he was appointed as Superintendent in 1907.

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During this period he was responsible to bring out the Records of Indian Museum and Memoirs of the Indian Museum in 1907. He became the Director of Zoological Survey of India and continued to hold the post until his death in 1924.

Annandale was interested in wide groups of animal taxonomy, their field biology and ecology. He worked on sponges, polyzoa, fresh and brackish water molluscs, termite and termite mounds, true flies, lizards and snakes and published his findings in a series of volumes in the Fauna of British India, Ceylon and Burma, in the Records of Indian Museum and Memoirs of Indian Museum and in the Journals of Asiatic Society of Bengal, Bombay Natural History. For carriers of human disease, his works on the fresh water molluscs suspected vector of schistosomiasis and phlebotomine sand flies transmitting leishmaniasis are worth mentioning.



Fig. 1. Dr. Thomas Nelson Annandale

Annandale was an Honorary Secretary to the Trustee of the Indian Museum for several years, President of Asiatic Society of Bengal in 1923 and twice the Chairman of the Zoology Section of Indian Science Congress and its President in 1924. Dr. Annandale died in Calcutta on 10th April 1924 [sources, ZSI 1990].

ANNANDALE'S CONTRIBUTION TO PUBLIC HEALTH ZOOLOGY

Medical Malacology : When the incidence of schistosomiasis occurred among the Indian troops returning from South Africa during the World War, Dr. Annandale was entrusted to take up the aetiology of the disease and its possible intermediate host. In his search for the intermediate snail host, Annandale travelled as far as Seistan Persia and to several places in India. He provided wealth information about the Indian fresh water molluscs collected from wide range of ecosystems including hill streams, ponds and lakes (Annandale, 1920b).

Taxonomy of Phlebotomine sand fly vectors of leishmaniasis : At the beginning of 20th century, a series of studies was made by the Europeans to explore the Dipterans, among other faunas, of India. Their interest for Indian Dipterans is that they represented not only bewildering diversity but also some of them, a serious pest of agriculture crops and of human diseases. They also extensively travelled across the Indian subcontinent to collect the Dipterans fauna, which were deposited both in their museums and in the Indian Museum.

During this period, Dr. T. N. Annandale joined the Indian Museum in 1904 and laid strong foundation to study the lower Diptera and public health entomology. A special 3 days fever [pappataciefieber, subsequently known popularly as leishmaniasis] being transmitted by the bite of Phlebotomine sand fly species was prevalent in Southern Europe and was believed to occur also in some parts of Northern India (Brunetti, 1912). This public health problem led and inspired Dr. Annandale for studying the natural history and taxonomy of Indian *Phlebotomus* sp. Annandale extensively travelled the entire India and its neighbouring regions to collect sand flies, provided flawless description and deposited them in the National collection of ZSI.

CATALOGUE OF PHLEBOTOMINES DESCRIBED BY ANNANDALE

Annandale described 6 species of phlebotomines, which were subsequently treated under different genera and subgenera by the reviewers for taxonomic stability. Of the 6 taxa, 3 species are known as species complex and 2 species are now considered as major vectors of leishmaniasis. Their current catalogue, taxonomic status, geographical distribution and biology in reference to leishmaniasis are as follows :

Genus *Phlebotomus* Rondani & Berte

Subgenus *Euphlebotomus* Theodor

Phlebotomus argentipes Annandale & Brunetti

Phlebotomua argentipes Annandale & Brunetti in Annandale, 1908 : 101 [male, female]. Lectotype male [designated Quate (1962b : 157)], India : Calcutta, 28.xii.1907; monsoon forest (ZSI Calcutta).

P. argentipes var. *marginatus* Annandale; 1910b : 62 [female]. Holotype female, Sri Lanka : Peradeniya, v. 1909. [Types lost : Quate (1962b : 157).] [Synonymized by Sinton (1932a : 59).]

P. annandalei Sinton, 1923a : 744 [male]. Holotype male, India : Madras, Guindy, 1.ii.1922 (Dep?). [Synonymized by Sinton (1925a : 789).]

P. argentipes var. *glaucus* Mitra & Roy, 1953 : 372 [female]. Syntypes 10 female, India : Maharashtra, Pune (AFMC, Pune). [Synonymized by Lewis (1967a : 24).]

Distribution : Bangladesh, Burma, India, Indonesia, Laos, Nepal, Pakistan, Sri Lanka, Thailand, Vietnam, Malaysia.

Biology : Geographical and biological variation may indicate a species complex; in parts of India it is markedly anthropophilic and an important vector of Visceral Leishmaniasis (Kala-azar) caused by *L. donovani* (Killick-Kendrick, 1990; Lane, 1988; Lewis, 1978, 1982, 1987 cited in Seccombe *et. al.*, 1993; Ilango *et. al.*, 1994). Based on the morphology, especially genital diversity as a source of species isolation and biogeography, *Phlebotomus argentipes* sensu lato has been revised to include 3 sibling species (Ilango, unpublished).

Subgenus *Larroussius* Nitzulescu

Phlebotomus major Annandale

Phlebotomus majo, Annandale, 1910a : 46 [male]. Lectotype male [designated Quate (1962b : 157)], India : Naini Tal; dry tropical scrub and thorn forest (ZSI Calcutta). Female : Sinton (1925b : 107).

P. major var. *grisea* Annandale 1911 : 320 (as var. of *major*). Syntypes, India : Darjiling, Kurseong, 1425 m, vi. 1910 & iv. 1911. [Types lost : Quate (1962b : 157).]

[Synonymized by Sinton (1932 : 59) & Quate (1962b : 157).]

P. crimicus Shtefko & Minkevich, 1923 : 52 [male, female]. Syntypes 1 male, 1 female, U.S.S.R. (MH, Sinferopol). [Synonymized by Perfil'ev (1966 : 279); poor description, position doubtful; Lewis (1982) suggested this may be *P. sergenti*.]

Distribution : India, Nepal, Pakistan, Thailand.

Biology : *P. major* s.l. has been infected with *L. infantum* (Adler & Theodor, 1957); occurs along Himalayan foot hills in India, where summer rains are heavy (Sinton, 1932a; Lewis, 1982 cited in Seccombe *et. al.*, 1993).

Notes : The *P. major* species complex is reviewed by Artemiev & Neronov (1984), Leger & Pesson (1987) and Lewis (1982). The taxa include *P. krimensis*, *P. major*, *P. neglectus*, *P. syriacus*, *P. wenyoni*, and *P. wui*, most of which have been referred to as *P. major* in the past (Seccombe *et. al.*, 1993).

Genus *Sergentomyia* Franca & Parrot

Subgenus *Neophlebotomus* Franca & Parrot

Sergentomyia malabarica (Annandale)

Phlebotomus malabarica Annandale, 1910a : 48. [male, female]. Lectotype male [designated Quate (1962b : 158)], India : Maddathorai, 16.xi.1908 (ZSI Calcutta).

Distribution : India.

***Sergentomyia zeylanica* (Annandale)**

Phlebotomus zeylanica Annandale, 1910b : 60. [male, female]. Lectotype female [designated Quate (1962b : 158)], Sri Lanka : Peradeniya, 17.v.1910; tropical rainforest (ZSI Calcutta). Male : (as *P. chalami*) Young & Chalam (1927 : 849).

P. chalami Young & Chalam, 1927 : 849. [male, female]. Syntypes, India : Bombay, Colaba, 25.ix-5.x.1926 (BMNH 1 male, 1 female; (CRI.Kas.))[Synonymized by Sinton (1928c : 319).]

Distribution : India, Sri Lanka.

Notes : Male of the type series of *zeylanica* reidentified as *P. argentipes*.

Subgenus *Parrotomyia* Theodor***Sergentomyia babu* (Annandale)**

Phlebotomus babu Annandale, 1910a : 49. [male, female]. Lectotype male [designated Quate (1962b : 158)], India : Calcutta, vi.1908; monsoon forest (ZSI Calcutta).

P. niger Annandale, 1911 : 320 (as var. of *babu*). Syntypes, India : Bihar, Pusa. [believed lost (Quate, 1962b : 158).][Synonymized by Sinton (1932a : 60).]

P. thapari Mitra & Roy, 1952b : 188 [female]. Holotype female, India : Maharashtra, Pune ('Poona'), Hadapsar (Dep?). [Synonymized by Lewis (1978 : 257).]

Distribution : Afghanistan, Bangladesh, India Mauritius, Pakistan.

Biology : *S. babu* s.l. has been revised as the species complex with inclusion of *Sergentomyia babu* (Annandale) sensu stricto, *S. shorttii* Adler & Theodor, *S. baghdadis* Adler & Theodor, *S. insularis* (Theodor) and *S. yercaudensis* sp. nov. All 5 species are known exclusively from the Oriental Region. Their biology in relation to leishmaniasis, ecological distribution and adaptive radiation were discussed (Ilango, 2003).

***Sergentomyia himalayensis* Annandale**

Phlebotomus himalayensis Annandale, 1910a : 50. [male, female]. Lectotype female [designated Quate (1962b : 158)], India : Darjiling District, Kurseong, 1500m, 3.vii.1908; mountain vegetation (ZSI Calcutta).

Distribution : India.

SUMMARY

Dr. Thomas Nelson Annandale, the founder Director of Zoological Survey of India, has been widely remembered for his exceptional interest in studying from invertebrates to anthropology. Among the contributions of Annandale, phlebotomine sand fly species transmitting leishmaniasis and fresh water snails as suspected vectors of schistosomiasis are the most important studies relevant to India. Annandale discovered and described 6 species of phlebotomines, of which *Sergentomyia babu*, *Phlebotomus argentipes* and *P. major* are super/or complex of sibling species and the latter

two are important vectors of visceral leishmaniasis. The disease is caused by the protozoan parasite, *Leishmania donovani* being transmitted by the bite of *P. argentipes* prevalent in Bihar, Uttar Pradesh, West Bengal, Tamil Nadu and in Bangladesh and, *L. infantum* by *P. major* from the foot hills of Himalayan Regions in India, Nepal and Pakistan. Among the sand fly species complex, *Sergentomyia babu* and *Phlebotomus major* have been revised while *P. argentipes* needs to be studied at gamma taxonomic level as its varieties stand valid species status and that will have an important bearing on the vector incrimination and control. This paper presents a brief biography of Annandale, his impeccable studies on the taxonomy of phlebotomine sand flies, their current catalogue and status of species known to transmit leishmaniasis.

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