

FIFTY YEARS OF FAUNISTIC SURVEY IN INDIA. HELMINTHOLOGICAL STUDIES AND ZOOLOGICAL SURVEY OF INDIA

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The Zoological Survey of India was established as a department of the Government of India in July 1916. Since then the Survey has been actively engaged in studies particularly in the field systematic zoology, field surveys, studies on morphology, anatomy, ecology, distribution, zoo-geography, evolution, etc. In 1969 the Department organised a seminar on fifty years of faunistic survey in India, the junior author as a convenor. The studies made by the Survey in the field of helminthology during the course of last more than fifty years which were presented before the seminar, are dealt with in this paper.

Countries situated in tropical and subtropical regions provide the most optimum conditions for the growth and propagation of helminth parasites. India being in a tropical zone is by no means an exception to this and her helminth fauna are rich both in number and variety. Helminths are mostly endoparasites though a large numbers are ectoparasites and free-living also. They are divided in various broad groups, viz., Trematoda, Cestoda, Nematoda, Acanthocephala, etc. Some of the dreadful diseases such as Schistosomiasis, Fascioliasis, Filariasis, Dracunculiasis, Ankylostomiasis and several other diseases are caused by the infections of various worms which bring untold misery and sufferings to the human beings. Livestock and other animals also fall prey to them. Even agricultural crops, vegetables and flowering plants are not immune from their fierce attacks. Stoll (1947) estimated that 114,400,000 human beings are suffering from Schistosomiasis alone and 32 million people are supposed to be suffering from filarial diseases, throughout the world. Geographical distribution of helminth diseases is even more than that of Malaria, Small pox, Cholera, Typhoid, etc. Therefore, the study of helminths evoked considerable interest from the dawn of civilization. Our Vedic literature bears ample testimony to this. Sushruta in his treatise entitled, 'Krimi Roga Pratishedh' referred to twenty kinds of worms. Charaka and Vab Prakash have also dealt with this group with considerable competence.

Earliest record of helminths in India from modern systematic point of view was made by Gilchrist (1841-1846) in his book entitled 'A practical treatise on the diseases of elephants, camels and horned cattle' He described two types of worms which are possibly *Fasciola jacksoni* and *Pseudodiscus hawkesi*. Cobbold (1882) made the earliest record of Schistosomiasis in India. In a meeting of Medical Chisurgical Society in London, he declared that the cattle and sheeps in India were infected

with schistosomes. Bombford (1886) reported the characteristic schistosome egg—oval with terminal spine, from the transport dept. bullock of Calcutta. He tentatively identified these eggs to be that of *S. haematobium* a parasite of man and monkey. Durjardin (1842), Cobbold (1869-1882), Bomford (1887) Shipley (1903), Gaiger (1906) etc., made sporadic reports of various helminths from India but no systematic surveys were made till recently.

Zoological Survey of India can justifiably be proud for initiating the stimulus and enthusiasm for comprehensive surveys and detailed studies on the helminth fauna of India. Dr. B. Prasad (1918) of this dept., is the first Indian worker to report some helminths from fishes. It is fascinating and very much interesting to trace the history of these studies in Zoological Survey of India by Sewell (1918-22), S. W. Kemp (1919-22), Southwell (1918-26), Chauhan (1945-69), Mukherjee (1960-69), Srivastava (1961-69), Soota (1954-69) and Gupta (1962-69).

R. T. Leiper, head of Bilharzia Mission in Egypt and Middle East first drew the attention of Govt. of India to the possibility of the spread of Schistosomiasis in India through the heavily infected Indian soldiers who were returning back after the First World War from Middle East and South Africa, endemic focus of Schistosome diseases. So the fear of spread of human Schistosomiasis in India became a problem, haunting the parasitologists and medical practitioners from the beginning of this century. There were two possibilities to be searched out to confirm if the spread of the Schistosome disease could become a menace in this country. First was to search whether the intermediate mollusc hosts reported in other countries as vectors for schistosomes could be found in India. Secondly, it was to be confirmed also whether the locally available Snails were capable of harbouring the schistosome cerceriae.

Govt. of India initiated a scheme financed jointly by the Education Department and the Indian Medical Research Fund to conduct a survey to know all about the possibilities of the spread of Schistosomiasis in India. In 1918 Zoological Survey of India consisting of four officers only at that time, was invited to assist the medical authorities in their task. This in a way laid the foundation stone for the helminthological research in India in a planned way. Annandale (1918) conducted a survey of the potential mollusc hosts in South India. Kemp and Graveley (1918) started the investigation in the neighbourhood of Hyderabad where more than one hundred soldiers returned from Egypt after First World War were reported to be suffering from schistosomiasis by Dr. A. Lankester, Director of Medical and Sanitation Department, Hyderabad. All together 928 snails were examined, 36 snails were found to harbour fork tailed cercariae of schistosome group. On detailed examination they were found not to belong to human schistosome. 450 snails were exposed to the active miracidium of *Schistosoma haematobium* obtained from the eggs in the urine of the patients suffering from Schistosomiasis. Results were found to be entirely negative. Efforts to bring the molluscs from the vicinity of Hyderabad to Calcutta were made but most of the snails died in transit, possibly due to the constant vibrations in the train. Ultimately one patient suffering from schistosomiasis was brought to Calcutta. Further experiments were conducted in the laboratories of Zoological Survey of India. Locally available molluscs and some of the living snails brought from different parts of

the country were exposed to the active miracidium obtained from the urine of the said patient. Molluscs of the genera *Melania*, *Ammicola*, *Bithynia*, *Vivipera*, *Pachylabra*, *Lymnaea Planorbis*, *Metania* were tried in this investigation with negative results. Kemp and Graveley (1919) after an exhaustive survey concluded that the intermediate snail hosts reported in other countries belonging to the genus *Bullinus*, *Physopsia* and *Hyposbia* are not represented in India. The other genus *Planorbis* though found in India is not capable of harbouring human schistosome. Annandale and Sewell (1920) continued this work. They surveyed the freshwater gastropods of the Indian empire and Baluchistan. Snails from different districts of Bengal were also exposed to the living miracidium of *S. haematobium*. Results were negative. Sewell (1914) obtained a cercariae from a tank near Russa Road, Calcutta, which he reported to be indistinguishable from the typical cercariae of *S. japonicum* Katsurada except in some variations in length and some other minor characters. This is a very important parasites of man in China and Japan. Sewell described this as *Cercariae indicae* which develops either in *Planorbis exustus* or in *Lymnaea amygdalum*. Ultimately, it was experimentally proved by Rao (1934) that the *Cercariae indicae* actually develops into *Schistosoma nasalis*, a parasite of livestock. It was a great honour for Zoological Survey of India when in 1924 Dr. N. Annandale was invited by the Parasitological Laboratory, Peking Union Medical College to solve the confusion in the identification of Chinese and Japanese snail hosts of *Schistosoma japonicum*. After examining a large collections of snails from China, Japan and Formosa present in the laboratory of Zoological Survey of India, he concluded that all the molluscan hosts reported as the intermediate hosts belonged to a single genus *Oncomelania* Gredler. He suggested to split the genus in two genera, *Katayamae* and *Hemibiae*. Thus a long standing problem of correct identification of intermediate snail hosts of *S. japonicum* had been solved.

Sporadic reports of Schistosome disease were being made from different parts of India against the optimistic view of the workers about the nonpossibility of spread of this disease. Reports by De sa and Monteiro (1949) and, Gadgil and Shah (1952) confirmed beyond doubt that a considerable number of the local population in the village Gimvi, in the Guhagarh Taluka, Ratnagiri District, Bombay, are suffering from Schistosomiasis. Chauhan and Ramakrishna (1954) conducted a survey at the request of the Indian Council of Medical Research, in the village Gimvi, the suspected endemic focus of human Schistosomiasis in this country. After an exhaustive survey they opined the existence of Schistosomiasis was not very new there. Furcocercus cercariae resembling that of *S. haematobium* were found emerging from the locally available mollusc, *Ferrissia tenuis* (Bourg.). Shah and Gadgil (1955-56) and Jhala (1956) obtained from experimental animals in the laboratory the entire worm, *S. haematobium* infecting them with miracidium obtained from the mollusc *Ferrissia tenuis*. This is an epoch making event in the history of Schistosome research as it is in contradiction to the general belief held by specialists that only the planorbid mollusc can act as intermediate host of Schistosomes. Chauhan (1954) obtained two types of bifurcate cercariae, some are regarded as brevicaudate and others as longifurcate. In his opinion the brevicaudates are those of human schistosome and the longifurcate cercariae

are those of some avian schistosome probably belonging to the genus *Ornithobilharzia*. In the final analysis it was felt that further experiments are necessary before finally declaring that the infection at the village Gimvi is by *S. haematobium*. After carefully examining the morphology of characteristic terminal spined eggs and the clinical symptoms of the blood fluke it appeared that if these were not the true cases due to *S. haematobium* it might probably be an infra specific variety or a geographical race, a strain of the type. Chauhan and Chauhan (1956) and Chauhan (1957, 1959, 1963) reviewed in detail the schistosome research in India.

In the foregoing pages an appraisal of the work done by the departmental scientists and the contributions they made for correct diagnosis of schistosomiasis have been made. This is essential to eradicate schistosomiasis, one of the most formidable enemy of human race, which takes a heavy toll in our neighbouring countries such as China, Japan, Formosa, Hongkong, Africa, Phillipine, Madagascar, etc.

Now we shall concentrate on the work done in other fields of helminthology by the departmental scientists and for convenience these works will be dealt groupwise.

TREMATODA

Southwell and Prashad (1918) recorded some larval trematodes from fishes of Bengal and described a new species *Clinostomum piscidium* from *Nandus nandus* and *Trichogaster fasciatus*. Sewell (1920) recorded *Mesocoelium sociale* Lühe from *Rana tigrina* from Indian Museum tank and studied the seasonal variations of infection. Sewell (1922) published his monumental work '*Cercariae indicae*' which is still regarded as the most authentic work on the subject done so far. Sewell continued the work of cercariae and in 1930 published a paper tracing the evolution of excretory system in *Furcocercus cercariae*. Faust (1927) described two strigeids from Kashmir out of some collections sent to him by the Director, Zoological Survey of India. Chauhan (1940) described two new species *Eumegacetes microdiosus* from *Temenuchus pagodarum* and *Prosthogonimus macracetabulus* from *Passer domesticus*. Bhalerao (1942) described *Azygia angusticauda* Stafford 1904—from *Mastacembelus pancalus* out of some collections sent to him from Zoological Survey of India. Chauhan (1943) described a new species *Mehratrema polynemusini* from marine fishes *Polynemus indicus*, *Muraensox talabunoides* and *Sciaena* sp. Chauhan (1943) studied the gasterostome and described four new species in the family Bucephalidae (Braun, 1883). Chauhan (1945) described six new species belonging to three genera of the family Hemiuridae Lühe, 1901 from marine fishes along with the record of *Stomachicola muraenesocis* Yamaguti, 1934 and transferred *Lecithocladium longicaudum* Shen, 1935 in the genus *Stomachicola*. Chauhan (1945) concentrated on the study of Monogenetic trematodes from the marine fishes for the first time in India in a planned way. In a series of papers (1945, 1950, 1952, 1953) he initiated the studies in this unexplored field of Helminths. Chauhan and Bhalerao (1945) described a new species *Tricocotyle secundus* from dog fish *Scoliodon sorrakowah* and later on in 1945 described it in detail as *Loimos secundus* (Chauhan and Bhalerao, 1945). Chauhan

(1945) established two new genera *Bilateracotyle* with the species *B. chirocentrosus* from the gills of marine fishes *Sciaena belengeri* and *Chirocentrus dorab*. The second genus *Pricea* was established for the reception of three species *P. multae* from *Cybiium lanceolatus* and *P. microcotylae* from *Scomber microlepidotus* and *P. minimae* from *Thynnus pelamys*. Chauhan (1945) also described four new forms: *Ancyrocephalus alatus*; *Lamellodiscus belengeri*; *Pseudaxone indicana* and *Cyclocotyla multaetesticulae*. The last species was later on transferred to the genus *Choricotyla* and the first one in the genus *Diplectanum*. Elaborate keys for the subfamily *Tetraonchinae* and of the genus *Cyclocotyla* were also included in the paper. A new subfamily *Microcotylinae* was proposed for the reception of *Microcotyle*, *Bictylophora* and *Centracolpa*. Baugh (1949) described a new species *Psilorchis thapari* from *Athena bramainica*. Chauhan (1950) added two new species *Mazocraeoides prashadi* from Clupeid fishes and *Mazocraes orientalis* also from the same host. In 1952 he reviewed the family Capsalidae and described a new species *Capsala gouri* from *Thynnus thunnin*. Chauhan (1953) reviewed the works on the monogenetic trematodes in India in detail. Chauhan's comprehensive works on the Indian forms of *Aspidogastrea*, *Gasterostomata* and *Prosostomata* published in 1953 are the works of basic reference which stimulated further research in these fields. Hora (1953) studied in detail the possibilities of control of mollusc shell through fish farming with an eye for the control of various trematode diseases of livestock, viz., Fascioliasis, Amphistomiasis, Schistosomiasis, etc. In this paper a very useful table, prepared by Dr. B. S. Chauhan, listing the common helminth paarsites of cattle, goat and sheep in which the molluscs act as intermediate host was included. Chauhan (1955) discussed in detail the taxonomic position and geographical distribution of the fish trematodes *Isoparorchis hypselobagri* Southwell, 1913. Chauhan (1956) reviewed the progress of sciences in India during the years 1935-1950. In the Presidential Address given at the Golden Jubilee Session of Indian Science Congress in 1962 Chauhan traced the development of helminthological research in India and emphasised the need to establish an Institute of Parasitology. Mukherjee and Chauhan (1965) published the fifth part of 'Studies on the trematode fauna of India' in continuation of the series initiated by Chauhan in the year 1953.

Gupta (1959) described a new species *Haematotrephus kashmirensis* from *Himantopus himantopus*. Gupta and Srivastava (1960) published the description of a new species *Fastula chauhani* from *Hilsa illisha*. Srivastava (1961) added two new species in the genus *Phyllodistomum* Braun, 1899 and prepared a host parasite list of the Indian species of the genus. Srivastava (1962) described a new species *Pycnadena komiyai* from *Chela gora*. In 1962 he created a new genus *Rhynchocreadium* to accommodate the species *R. aculeatum* from *Rhynchobdella aculeata*. Mukherjee (1962) described the development and morphology of the miracidium of *Stunkardia dilymphosa* from turtle. Mukherjee (1963) described two new amphistomes from sheep and goat and two new cercariae from freshwater molluscs. Srivastava (1963) added three new species in the genus *Bucephalus* Nicoll, 1914 from freshwater fishes and suggested the synonymy of *Bucephalus indicus* Srivastava 1938 with *B. tridentacularis* Verma, 1936. Srivastava (1963) described a new form *Folliorchis vermai* from *Eutropiichthys vacha*. Mukherjee (1964) described a new

species *Glaphyrostomum indicum* and in 1966 another new species *Prosthogominus elongatus* both from domestic pigeons. Mukherjee (1966) studied the life-history of a common amphistome of livestock *Fischoederius elongatus* (Poirier, 1883). In 1966 he also redescribed *Calicophoron calicophorum* Fischoeder, 1901, *Diplodiscus amphichrus* Tubangui, 1933, *Homalogaster paloniae* Poirier 1883, and added a new species *Calicophoron orientalis* from *Capra hircus*. Mukherjee (1967) added a new species *Mesocoelium burdwanensis* from *Calotes versicolor* and recorded a new metacercaria *Clinostomum orientale* along with the redescription of *C. giganticum* Agarwal 1959. Mukherjee and Ghosh (1967) described two new species *Microphallus dicaecus* and *M. bengalensis* from *Rana tigrina tigrina* and *Artatium schistosomum* respectively. Srivastava and Ghosh (1967) erected a new genus *Paramacrolecithus rasborai* in the family Allocreadiidae from hill stream fish *Rasbora rasbora*. Srivastava and Singh (1967) described *Eucreadium jhingrani* from *Puntius chagunio*. Mukherjee and Ghosh (1968) described *Omnatobrephus bengalensis* n.sp. from *Natrix stolata* with a discussion on validity of different species and prepared a key for the identification of all the species of the genus. Mukherjee and Ghosh (1968) reviewed the genus *Arteyfechinostomum* Lane 1915 and settled a long standing controversy regarding the various allied genus and species. Srivastava (1968) described three new species in the genera *Crowcrocaecum* Skrjabin and Koval, 1956 and *Opegaster* Ozaki, 1928 from *Anguilla bengalensis* and *Mastocembalus armatus*. Srivastava and Ghosh (1968) described a new species *Fellodistomum thapari* and redescribed *F. agnotum* Nicoll, 1909 along with a key for all valid species of the genus. Srivastava and Ghosh (1968) added a new distome from Banded Crait *Bungarus fasciatus* and named it *Encyclometra bungara* with new host records for *Encyclometra japonica*. Yoshida et Ozaki, 1929. Soota, Srivastava and Ghosh (1968) studied the collections from Great Nicobar Islands and described four new species *Maculifer spiralis*, *Diacetabulum nicobarensis*, *Acanthoparyphium cambellensis* and *Neodiplostomum elongatum* from fishes and birds.

CESTODA

Southwell and Prashad (1918) initiated the work on parasite of fishes and recorded some cestodes from *Hilsha ilisha* and *Carcharinus gangeticus*. Life-history of a new cestode *Rhynchobothrius ilisha* n.g., n.sp. Southwell and Prashad 1918 was worked out, incidentally this was the first authentic work on the life-history of cestode in India. Southwell and Prashad (1918) provisionally described a new genus *Ilisha parthenogenetica* from *Hilsha ilisha*. Southwell (1930) later found this parasite to be a plerocercoid larva which provides the first instance of endogenous reproduction taking place in a plerocercoid form. Southwell (1921) recorded a larval cestode from medusae *Acromitus rabanchata*. Southwell (1920) revised the genus *Phyllobothrium* Beneden, 1849. In a series of paper between (1921–1930) Southwell made notable contribution to the study of cestodes. His work on cestode order Pseudophyllidae and Trypanorhyncha are works of reference. He was entrusted to write the, 'Fauna of British India—Cestoda' Fauna volumes in two parts were published in the year 1930. Chauhan (1949) recorded *Raillietina tetragona* (Molin), *Paronia* sp. from fowls, *Cotugnia cuneata* var *nervosa* Meggitt from pigeon, *Hymenolepis gracilis* (Zeder) and *Hymenolepis*

oweni Moghe from ducks and some other cysts from *Ophiocephalus punctatus*. Chauhan and Ramakrishna (1958) conducted a survey on the *Ligula* infection of fishes in Dams and reservoirs of Damodar Valley Corporation. Chauhan and Ramakrishna (1959) studied the fish mortality due to cestode cysts infection in a tank at Jabalpur (M.P.) and suggested some remedial measures. Mukherjee (1965) described two new species *Anonchotaenia chauhani* and *Choanotaenia srivastavai* both from *Turodoides somervillei*. Mukherjee (1964) added his new species *Choanotaenia dutti* from *Corvus macrorhynchus* and *Choanotaenia sonoti* from *Acridotheres tristis*. Mukherjee (1962) studied extensively large collection of cestodes from Rajasthan and described eight new species and recorded another eighteen species from various vertebrate hosts.

NEMATODA

Dr. N. Annandale, Director, Zoological Survey of India, forwarded a large number of Nematode parasites collected by the various survey parties of the department to Dr. H. A. Baylis. Baylis and Daubney (1922) published their findings—it included fourteen new species and five new genera besides proposing a few new subfamilies and higher taxa. Another lot of collection was sent from Zoological Survey of India to H. A. Stewart for study. After working out part of the collections he forwarded the collection along with his manuscript notes to Baylis and Daubney. They worked out the collection and published the same in the year 1936—it included the descriptions of many known forms along with diagrams. These studies formed the basis for writing, '*Fauna of British India-Nematoda, Part 1 & 2*' published by Baylis in the year 1939. Chauhan (1947) described a new filariid worm *Squamo-filaria choprai* from sea-tern. Chauhan (1949) recorded several nematodes from new hosts and localities such as *Porrocaecum pristis* Baylis and Daubney from *Wallago attu*, *Polydelphis sewelai* Baylis and Daubney from *Natrix piscator*, *Ascaridia galli* and *Heterakis gallinae* from fowls and some other nematodes. Soota (1954) recorded some variations in the species *Porrocaecum angusticolle* Baylis and Daubney 1922, *Echinocephalus spinosissimus* Baylis and Lane 1920. Chauhan and Ramakrishna (1958) reviewed the work done in India on Plant parasitic and free-living nematodes and stressed the importance of their studies. Mukherjee (1963) described a new nematode *Philometra rajani* from the ovary of fishes *polynemeus tetradactylus* and *Sciaena coitor*. Majumder (1965) described two new species *Camallinides hemidentata* and *Notopteroides alatae* from *Channa striatus* and *Mastocembalus armatus* respectively. Mukherjee (1967) studied the microfilarial infections in the blood of buffaloes and recorded the period of their maximum concentration. Soota and Chaturvedi (1968) described two new species, *Diplotrriaena nepalensis* from *Myiophonus cheruleus* and *D. mirzapurensis* from *Acridotheres tristis*. Soota, Srivastava and Ghosh (1969) studied the Nematode collections from Great Nicobar Island and described two new species *Ascaridia nicobarensis* from *Psittacula longicaude nicobarica* and *Abbreviata indica* from *Bufo* sp. They have also recorded two known species *Tanqua tiara* (Linstow, 1875) from *Varanus salvator* and *Ophiodascaris filaria* (Duj. 1845) from Python.

ACANTHOCEPHALA

Datta (1927) recorded *Echinorhynchus* sp. from *Corvus corax* and *C. splendens*. Van Cleave (1929) described two new genera *Eosentis rigidus* n.g., n.sp. from *Schizothorax zarudnyi* and *Filisoma indicum* n.g., n.sp. from *Scatophagus argus*. He also proposed a new family Filisomidae to accommodate the new genus *Filisoma*. This work was made out of some acanthocephalan parasites sent to him from Zoological Survey of India by Dr. N. Annandale and Dr. B. Prashad. Datta (1932) described a new species *Centrorhynchus maryasis* from *Urocissa melanocephala occipitalis* (Blyth.). Datta (1937) worked out the helminth collections of Yale North India Expedition and described four new species *Acanthocephalus kashmirensis* from *Schizopygopsis stoliczkake*, *Neoechinorhynchus hutchinsoni* from *Diptychus maculatus*, *Eosentis devdevi* from *Schizothorax planifrons*, and *Eosentis yalei* from *Schizothorax esocinus* along with the record of some known species. Datta (1937) described the male *Eosentis rigidus* Van Cleave, 1929 from *Schizothorax zarudnyi*. Datta (1940) described a new genus *Mehrarhynchus prashadi* from *Pangasius pangasius* and in the year 1947 described another new genus *Raosentis podderi* n.g., n.sp. from *Mystus cavasius*. Datta (1954) added a new species *Serrasentis chauhani* from *Psettodes erumei*. Datta and Soota (1954) described two new species *Centrorhynchus knowlesi* from scops owl and *C. bengalensis* from red-backed wood-pecker. Datta and Soota (1954) described a new species *Acanthocephalus kabulensis* from *Rana* sp. and recorded *Centrorhynchus cinctus* (Rud., 1819) from *Ptyas mucosus*. Soota and Sen (1956) reported a new species *Acanthosentis giuris* from *Glossogobius giuris*. Datta and Soota (1962) added two new species *Filisoma scatophagusi* and *F. hoogliensis* both from *Scatophagus argus*. Datta and Soota (1963) described a new species *Neoechinorhynchus roonwali* and recorded another species *Pomphorhynchus kashmirensis* both from *Orienus* sp. Soota, Srivastava and Ghosh (1969) worked out the helminth collection of Great Nicobar and described a new species *Mediorhynchus cambellensis* and recorded another species *M. armenicum* Petrochensko.

TREMATODA

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