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A SURVEY OF THE HELMINTH PARASITES OF FRESH-WATER FISH IN CHIANG MAI PROVINCE

Somchai Ratanasritong, B.Sc. (Med. Tech) *
Michael Kliks, M.S. **

ABSTRACT

Between November 1971 and February 1972, 12 species of helmimth parasites were recovered from 95 fishes, representing 15 fresh-water species from different areas in Chiang Mai Province: The following helminths are described : 3 species of trematode; **Oreintocreadium** sp, **Acanthostomatid** sp., metacercaria of **Opisthorchis** sp, and one unkonwn metacercaria from **Anabas testudineous.** Four species of nematod, including **Procamalanus** sp, **Camallanus anabantis, Cucullanus** sp. and **Gnathostoma spinigerum** larva. Three species of cestode, **Bothriocepphalus** sp., **Caryophyllaeides** sp. and the sparganum larvae of **Spirometra.** Two species of Acanthocephala; **Pallisentis gaboes**, and **Neoechinorhynchus** sp. Public health implications and effect on commercial fisheries are discussed.

INTRODUCTION

In the northern region of Thailand, edible treshwater fish are an important source of animal protein, and the fisheries industry, provides both work and cash income for thousands, of famllies varous species of fish are raised commercailly, or caught in the rivers, canals and ponds and sold alive in local markets.

Certain northern specially dishes include raw or partially cooked or fermented fish. The methods of preparation are such that several helmith parasites are regularly transmited to man in such dishes as Koi-pla, pla-ra, pla-som, and pla-lab (6). The infective stages of **Opisthorchis viverrini Gnathostoma spinigerum** and **Spirometra mansoni** have all be reported from edible fish (1, 6, 8, 9, 10). A recent survey of 2,000 school children in Chiang Mai city reported 12.6 % positive for **Opisthochis** eggs in the stool.

* Medical Technologist, Department of Pathology, Ramathibodi Hospital, Bangkok.
** Instructor, Department of Parasitology, Faculty of Medicine, Chiang Mai University, Chiang Mai.

Besides the public health aspects of helminth parasites of fishes, endemic disease within the fish population is also a potential treat to the fishing industry itself. Other than the rather informal work of Pearse, 1933 (4), no systematic survey of the helminth fauna of fish in Thailand has been cried out. At the suggestion of the Department of Parasitology, the present survey hopes to contribute more knowledge to this important subject.

Materials and Methods:

During the period of survey 95 fish belong to 8 families, 10 genera and 15 species (TABLE I) were collected at random from stalls in local market and from the Department of Fisheries Station at San Sai northeast of Chiang Mai. Most of the fish from the markets were caught in the Mae Ping or Mae Chem rivers south of Chiang Mai city in Chom Tong district. Most specimens were examined immediately after death, being kept alive in the laboratory in tanks until studied. The external surface gills and mouth were carefully examined for ectoparasites and all organs and tissues were dissected and pressed between glass plates. Attention was given to recording accurate counts of helminth populations found. All data was recorded on accession number cards in the Department of Parasitology, Faculty of Medicine, Chiang Mai University.

Standard methods of fixation, preservation and staining were used: Nematodes were fixed in acetic acid, washed in 70% alcohol with 5% glycerine and evaporated into pure glycerine for mounting and examination. Trematodes were washed first in saline and placed in tap water in the refrigerator to expell the eggs and relax the specimens for fixation; cestodes and acanthocephala were left in the refrigerator until scolex or probosis were everted; both were fixed in hot A. F. A., stained in carmine, dehydrated through alcohols and mounted in permount. Specimens not immediatly examined were stored in labled glass vials in 70% alcohol with 5% glycerine.

RESULTS AND DISCUSSION

Helminth parasites belonging to 12 genera were recovered during the survey (Table 2), one unidentified species of metacercaria was also found. Three helminth found are of know public health importance, i. e. the metacercaria of **Opisthorchis viverini** the infective larva of **Gnathostoma** and the sparganum larva of **Spirometra** sp. All of the other helminths encountered may be presumed to be of some importance in the commercial fisheries industry, although no obvious pathology was noted in the host examined. Measurements are in microns, unless othewise noted.

TREMATODA

Oreintocreadium sp.

Figure 1

Definition : Allocreadiidae Stossich, 1903; Oreintocreadiinae Yamaguti, 1958; **Oreitocreadium** Tubangui, 1931.

Description : (based on 13 fixed and stained specimens) Boby small, elongate, 990 to 1452 (1119) long; spinulate. Oral sucker 110 to 154 (132) in dimeter, simple; prepharynx subterminal; pharynx comparatively large 66 to 88 (74.3) wide. Esophagus short 110 to 154 (127) long; intestinal ceca terminal at posterior extremity. Testes 66 to 110 (93.3) in diameter, in posterior half of body, median, tandem or slightly diagonal, entire. Ovary 60 to 80 (75), median, between acetabulum and anterior tests. External seminal vesicle present. Cirrus pouch clavate, 110 to 198 (176) long, not extending beyond acetabulum posteriorly. Uterus extending as far as posterior extremity, eggs small 18 to 22 by 15 to 18; Vitellaria numerous distributed in lateral fields of hindbody from the ovary anteriorly, to the posterior extremity

Host. Clarius batrachus.

C. macrocephalus.

Anabas testudineus

Habitat. intestine

Discussion : The genotype, **O. batrachoides** Tubangui, 1931, from Luzon and four other species from India have been reported from the same host as in the paesent studies, **C. batrachus.** Two additional species are reported **Channa (Ophicephalus) punctatus,** both from India. Khalil (1961) reported and additional species from **C. lazera** in the Sudan. Cupta (1951) has reviewed the genus and devised a key to the Indian species, but until such time as his paper or type specimens, are available, species diagnosis is not possible. The finding of **Oreintocreadium** in **C. macrocephalus** constitute a new host record, and Thailand, a new range for this parasite.

Acanthostomatid sp.

Figure 2

Description : (2 poorly preserved specimens, fixed and stained). Body elongate 690 to 850 heavily spined. Oral sucker funnel shaped, 66 to 88 wide by 44 to 55 deep, with circumoral crown of spines. Pharynx directly behind oral sucker; esophagus long, bifurcating just anterior to acetabulum. Acetabulum 55 to 66. Testes diagonal, posterior to ovary. Uterus extending posterior to testes; eggs small, 18 to 22.

Host. Clarius batrachus

Habitat. Interestine.

Discussion : The condition of the specimens precludes accurate generic definition and it is described here as an aid

to future workers. Although resembling echinostome flukes, with the characteristic pharynx and spined oral sucker, the fact that few of the former have been reported from fishes, lead the author to tentatively assign the specimen to the family. Acanthostomatidae, Poche, 1926.

Metacercaria of Opisthorchis viverrini

Description : (10 fixed and stained specimens) Body oval shaped, length 330 to 360 (348), width 240 to 260 (248); oral sucker 55 to 66 (62), excretory vessel present, primordia of sex organs present.

Host. Puntius gonionotus

Habitat. Flesh of fins, muscle and beneath scales.

Discussion : Specimens were recovered from the flesh of dorsal, pectoral and tailfins and from beneath body scales. Several hundred metacercaria were usually found. **Opisthorchis** infection in human has long been known in northern Thailand (8) and its distribution in local edible fishes has been recently studied (9).

Unknown metacercaria

Figure 3

Description : Body oval shaped, length 242, width 220; oral sucker 55, ventral sucker 66. Esophagus 88 long from oral sucker to intestinal bifurcation.

Host. Anabas testudineous

Habitat. in the flesh of body.

Discussion : 3 specimens were recovered in the flesh of **Anabas testudineous**, only one specimen is complete.

CESTODA

A total of 62 specimens were obtained from the intestine and body cavity of **C. batrachus** and **C. macrocephalus.** The most abundant was sparganum larva, occuring in 41 % of fish examined. (TABLE 4)

Bothriocephalus sp.

Figure 4

Description : Body small, total length 12 mm, 560 wide at midbody. Scolex elongate 110 long by 55 wide, club-shaped with apical disk, indented on each surfical edge, without hooks. Bothria, shallow, longitudinally elongate. Neck lacking. Strobila with distinct segmentation. Proglottides craspedote, with more or less distinct median furrow and distinct marginal glove.

Host. Clarius batrachus.

Habitat. Intestine.

Discussion : Only one specimens was recovered, immature, without sex organs. Specific indentification was therefore not possible. **Bothriocephalus sp.** are reported from a wide variety of fresh - water fish and marine fish of different families (13).

Caryophyllaeides sp.

Figure 5

Definition : Caryophyllidea Olssen,

1893; Caryophyllaeidae Leuckart, 1878; Caryophyllaeinae Nybelin, 1922.

Description: Body elongate 1.5 to 3.8 (2.6) mm. in total length, width at mid-body, 264 to 374 (300); scolex undifferentiated, Testes numerous, medullary, anterior to ovary and uterus, median field. Cirrus pouch oval, large; cirrus opening in preovarian region. Uterus not extending anterior to cirrus pouch. Ovary "A" shaped.

Host. Clarius macrocephalus,

C. batrochus

Habitat. Intestine

Discussion: Three specimens of this parasite were recovered, one was broken during recovery. This species has been reported from Europe, Russia, Finland, but not in Asia, therefore the occurence of **Caryophyllaeides** in **C. macrocephalus** is a new host record and new range for this parasite in Asia.

Sparganum larvae of **Spirometra** sp.

Description: Body small, total length 3 to 8 (5.2) mm, 350 to 500 (435) wide. Other features unknown.

Host. Clarius batrachus

C. macrocephalus.

Channa striatus

Habitat. Intestine

Discussion: Spargana were found in large numbers in 41% of fishes examined, particularly in **Channa stritaus** and both **Clarius** species (Table 4). When fed to cat, the spargana developed into typical adults of the genus **Spirometra.**

NEMATODA

Camallanus anabantis, Pearse, 1933

Figure 6

Definition: Camallanidae Railliet et Henry, 1915.

Description: Mouth slit-like, buccal capsule consisting of two lateral chitinous valves with longitudinal lip-like thickenings internally, teeth absent. From the point of junction of the valves, dorsally and ventrally, a trident-shaped chitinous process is directed backwards. Esophagus consisting of a short anterior muscular portion and a long posterior glandular portion enlarged posteriorly.

Male: (one adult specimen)

Body lenth 1.94 mm., maximum width 88 at midbody. Esophagus 264 long, maximum width 55 at base; slightly swollen at posterior end. Nesve ring 44 from anterior extremity. Tail length 132 from anus coiled ventrally. Small caudal alae present, about 7 pairs of costiform preanal papilae, 2 pairs of small adanal and a number of postanal papillae, spicules simple, unequal 55 to 67 long.

Female: (4 specimens)

Body length 2.2 to 5.65 (3.43) mm., maximum width 88 to 110 (99) at mid-body. Esophagus 220 to 308 (258) long

and 44 to 66 (53) wide at base. Nerve ring 44 to 55 to 55 (49.5) from anterier end. vulva about midle of body, 1.00 to 2.54 (1.44) mm. long from posterior end; uteri opposed, posterior ovary lacking, viviparous.

Host. Anabas testidineus

Habitat. Stomach.

Discussion : This species has been previously described by Pearse, from the same host, as well as **Clarius batrachus** and **Channa (Ophicephalus) punctatus**, neither of which was found infected in this survey. Another species, **C. ophicephali** was also reporeed by Pearse from Thailand in **Channa striatns**, but did not occur in fishes examined by the author.

Procamallanus sp.

Figure 7, 8

Definition : Spiruridea Diesing, 1861; Camallanidea Raiiet et Henri, 1915; **Procamallanus** Baylis, 1923.

Description : Small delicate worms, tapering slightly at anterior end. Cuticle with uniform conspicous transverse striations. Head bluntly rounded without lips, mouth opening round, directed anteriorly. Buccal capsule, subglobose, walls thickened posteriorly without obvious teeth, placgues, or stylet. Esophagus tapering slightly, broader at base, not clearly divided. Exeretory pore in middle third of esephagus. Nerve ring near junction of first and second third of esophagus. Intestine simple, without divertricula.

Female : (8 adult specimens)

Length 3.3 to 5.1 (4.3) mm. maximum width 77 to 121 (95.5) at midbody. Esophagus 260 to 410 (358.5) long and 33 to 88 (63.5) wide at base. Nerve ring 44 to 121 (91.7); average 25.6% from anterior end. Ovary in anterior half of body, 0.8 to 1.6 (1.21) mm. Uteri amphidelphic, extending to near anus posteriorly and to esophageal-intestinal junction anteriorly, filled with large globose eggs; gravid specimens with numerous developing embryos. Vulva 1.2 to 2.1 (1.7) mm. from anterior (average 37.6%). Tail conical, 66 to 121 (88) long; dorsoventral thickness at level of anus 39.6 to 44. Posterior extremity with two small lateral papillae; papillose at tip. Ratio of tail length to thickness at anus 1.6 : 1 to 2.7 : 1.

Male : (3 adult specimens)

Body length 2.0 to 2.1 (2.0) mm., maximum width 80 to 84 (82) at midbody. Esophagus 280 to 330 (305) long maximum width 33 to 39 (36) at base; slightly swollen at posterior end. Nerve ring 185 to 220 (200) from anterior extremity. Spicule single, slender, conspicuously straited; distal end pointed, and bent like a hook, 88 to 99 (93.5) long. Tail curved, 66 to 88 (80.6) long and 39.6 to 44 (42.4) wide at level of anus. Papillae paired, sixteen on either side: eleven preanal pedunculate, three postanal pedunculate, two adanal (one pedunculate and one sessile).

Posterior portion terminates in bursa - like structure divided into a dorsal and a pair of lateral lobes : each of the later contains short lateral lobule and a thick ventral lobule with a pair of papillary terminations on its inner surface; dorsal lobule thick more or less divided into a pair of latetal lobules and a papilla-like dorsal lobule all supported by broad caudal alae.

Host. Clarius macrocephalus
Anabas testudineous

Habitat : Stomach.

Discussion : The taxonomy of the genus is rather confused. Yamaguti lists more than 30 species, many of which are probably synonymous. Pearse (1933) reported finding 2 distinct species, **P. kerri** and **P. glossogobii** from **Glossogobius giuras** in Siam but did not describe them **Clarius batrachus** in both Ceylon and India is the host for **P. planoratus** (Annereaux, 1946) and in India for **P. clarius** (Ali, 1957) as well. Neither of the hosts recorded here has been previously reported. Until type maternal from the work of Pearse and Ali can be examined, no species diagnosis can be at attempted.

Cucullanus sp.

Figure 9

Difinition : Spiruridea Diesing, 1861; Cucullnidae Cobbold, 1864; Cucullaninae York of Maplestone, 1926; **Cucullanus** Mueller, 1777.

Description : Head with two lateral lips, each bearing two or three papillae. Esophagus muscular throughout with a club-shaped swelling posteriorly, and dilated anteriorly into a false buccal cavity.

Female ; (6 specimens)

Body length 8 to 11.2 (9.4) mm., 366 to 380 (374) wide. Tail conical. Vulva behind middle of body, 2.64 to 3.88 (320.4) mm. from posterior end. Ovary amphidelphic, oviparous; eggs thin-shelled.

Male : (4 Specimens) 6 to 9 (7.7) mm. in total length, maximum width, 260 to 340 (296) at midbody. Tail conical, bent ventrally, 245 to 250 (246) long. Precloacal sucker absent, caudal papillae present : 6 pairs of preanal, 2 pairs paraanal and 3 pairs postanal pappiliae. Spicules simple equal, distally alate, 154 to 156 (154.8) long; gubernaculum present.

Host. Puntius altus

Habitat. Intestine

Discussion : Species of Cucullanus have been widely reported from fishes of several different families but not from **Puntius altus**, therefore this is a new host record for this parasite. Yamaguti, 1941 reported the presence of another species, **Cucullanus cyprini**, from **Cryprinus carpio**, Japan; in the present investigation this parasite was not recovered from eight fishes of the same species. Yamaguti records 59 species of **Cucullanus**, many of which are

synonymous; it is evident that this genus is in need of revision.

Gnathostoma spinigerum larva

Host. Channa (Ophicephalus) striatus

Habitat. Small intestine.

Discussion: Only one specimen was recovered from the intestine of **Channa (O) striatus,** collected from Amphur Jom tong, Chiang Mai. The complete experimental cycle has been demonstrated by Prommas and Daengsvang (6).

ACANTHOCEPHALA

The Acanthocephalans are permanent parasites whose adult stages live in the intestine of vertebrates. Their name is derived from the spiny proboscis by mean of which they attach themselves firmly to the host's intestine. The sex are separate, and an intestine is lacking (7).

Two species of Acanthocephala were recovered during the survey.

Pallisentis gabaes (MacCallum, 1918)

Neoechinorhynchidea south well et Macfie 1952; Pallisentidae Van Cleave, 1928; Pallisentis Van Cleave, 1928.

Description : Body length 2.78 to 14.79 (5.99) mm., trunk with a collar spines arranged in 6-14 closely set rings near anterior extremity. Posterior to this collar of spines is an unspined region which is followed by 20-25 widely spread rings of spines, remaining part devoid of spines. Procoscis short, 440 to 572 (470.4) long, cylindrical to globular, with four circles of 6-10 hooks each. Proboscis receptacle cylindrical to saccate, with single layer muscular wall. Testes cylindrical, contiguous. Cement gland long, cylindrical, syncytial, containing 6 to 9 nuclei.

Host. Channa striatus

Clarius batrachus

Habitat Intestine.

Discussion : Two hundred specimens were recover from both hosts. These specimens fitted closely to that of **P. gaboes** (Mac Callum, 1918). Other species of **Pallisentis** found in the **Channa sp.** are reported by Agarwal, 1958, in **C (Ophicephalus) punctatus;** India. Bhalerao, 1931, and Balis, 1933, in **C (O.) striatus**, India; Thapar, 1930, in **C (O.) marulius**, India.

Neochinorhynchus sp.

Definition : Neoechinorhychidea South well et Macfie, 1925; Neoechinorhychidae Van Clave, 1919; Neoechinorhynchinae Travassos, 1926, emend; **Neoechinorhynchus** Hamann, 1892.

Description : Body usually small, cylindrical, aspinose. Lacunar system consisting of medium dorsal and ventral longitudinal vessels and circular vessels which anatomose. Giant hypodemic nuclei almost always few (usually 4-5 dorselly and 1-2 ventrally). Proboscis short, globular; proboscis hooks in six spiral lows of three each; anterior hooks longer and stouter than other. Proboscis receptacle subcylindrical, raeher short, single layered.

Adult female : 7 to 11.2 (8.7) mm. long, bearing 6 spiral rows of 3 hooks each. The eggs are elipsoidal measuring 50 to 60 by 17 to 28.

Male : Body length 3.50 to 5.00 (4.4) mm., 350 to 540 (430)., maximum width. Testes contiguous tandem, followed by elongate syncytial cement gland, containing eight large nuclei; cement reservoir incorporated in posterior part of cement gland. Bursa bell-shaped.

Host. Pangasius lanaudii.

Habitat Large intestine.

Discussion : Yamaguti lists 44 species of the genus from all over the world, occuring in more than 50 species of fish representing many families. Of these species, **Neoechinorhynchus australe** Van Cleave, 1931, North America, and **N. hutchinsoni** Datla, 1936 India, are similar in size range. There is no previous record of **Neoechinorhynchus** from Thailand and none from the present host, **P. lanaudii.** The auther feels that there are insufficient grounds on this evidence alone to create a new species, pending examination of type material or the key to the species by Petrochenko, 1956.

Conclusions

Three species of helminths encountered in this survey are of potential public health importance. All are from popular food fishes in this area and have been well studied in the past : **Opisthorchis** metacercaria from **Puntius gonionotus ; Gnathostoma spinigerum** larva from **Spirometra sp.** from several hosts. The habitual consumption of raw or partially cooked fish will continue to be a source of infection despite widespread knowledge of the dangers involved.

Although 56% of the specimens in the survey harbored at least one helminth, and several were found to be infected with 2 or more species simultaneously, the parasites appeared to be well tolerated and their was no evidence of gross pathology noted. Infection of **Pangasius larnaudii**, on economically important food source with **Neaechinorhynchus sp.**, were generally very heavy and could potentially be a cause of morbidity in this host. The results of this survey indicate parasitism does not constitute a threat to fish population in the Mae Ping River or commercial fish ponds at this time.

Two species, previously described from Thailand by Pearse (1933) **Camallanus anabantis**, and **Procamallanus glossogobii** were recovered and are redescribed. Pearse also reported but did not describe on acanthocephalan worm, **Farzandia (Pallisentis) ophiooephali** from **Ophicephalus (Channa) striatus.** A similar species, **Pallisentis goboes** differing in the distribution of body spines. was recovered from

the same host, as well as from **Clarius batrochus**.

The intestinal fluke, **Oreintocreadium** is reported here for the first time in Thailand and **C. macrocephalus** is a new host record for the genus. Likewise, **Neoechinorhynchus**, though distributed throughout the world, has not been previously reported from Thailand, nor from **Pangasius**, its local host.

Both of the cestode parasites, **Caryophyllaeides** and **Bothriocephalus** are newly reported from Thailand and from new host. The former has not been here to fore recorded outside of Europe.

Lack of adequate, in country, library facilities together with the many toxonomic uncertainties among the genera encountered in this study, have made it extremity difficult to make reliaible identification at the species level. It is hoped future work will clarify these problems of taxonomy and further investigate the ecology and life history of these parasites.

Summary

During a survey on fresh - water fish in Chiang Mai Province, twelve species of parasites were reoccured, including 3 trematodes; 3 cestodes, 4 nematodes, 2 acanthocephala and one unknow metacercaria found in the flesh of **Anabas testudineous**.

Three are of importance as sources of human infection. **Opisthrochis** sp., **Sparganum** and **Gnathostoma spinigerum**.

TABLE 1

Family	Scientific Name	Common Name
Nandidae	Tilapia mosambica	Pla moh
	T. melanopleura	Pla moh kanglai
	T. nilotica	Pla nin
Anabantinae	Anabas testudineous	Pla moh Thai
Cyprinidae	Pantius viehoeveri	Pla cao
	P. genionotus	Pla cao
	P. altus	Pra tapientong
	Morulius chrysophekadion	Pla ka
	Cyclocheilichthys armatus	Pla tapien
Cyluridae	Wallagonia attu	Pla kao
Clariidae	Clarius batrachus	Pla duk dan
	C. Macrocephalus	Pla duk oi
Schilbeidae	Pangasius lanaudii	Pla ta poh
Bagridae	Mystus nemurus	Pla kott
Ophicepha lidae	Channa (Ophicephalus) striatus	Pla chon

Table 2 PARASITES RECORD FOR 53 INFECTED FISHES

Species	No. fish infected	Incidence %	Total no recovered	Range of number	Site of infection
Trematode					
Opisthorchis sp. metacercana	2	3.77	1000		fins, scales
Metacercaria type 2	1	1.88	3	3	meat
Oreintocreadium sp.	8	15.1	38	1–20	small intestine
Acanthostomatid sp.	4	7.54	21	1–10	small intestine
Nematoda					
Procamallanus sp.	4	7.54	47	2–20	stomach
Camallanus anabantis	3	5.4	5	1–3	stomach
Cucullanus sp.	1	1.88	8	8	intestine
Gnathostoma larva	1	1.88	1	1	small intestine
Cestoda					
Sparganum (larva of Spirometra)	10	18.8	59	4–12	intestine
Bothriocephalus sp.	1	1.88	1	1	intestine
Caryophyllaeides Nybelin	1	1.88	3	1	intestine
Acanthocephala					
Pallisentis gaboes	15	28.3	200	5–40	intestine
Neoechinorhynchus	3	5.4	70	20–35	stomach

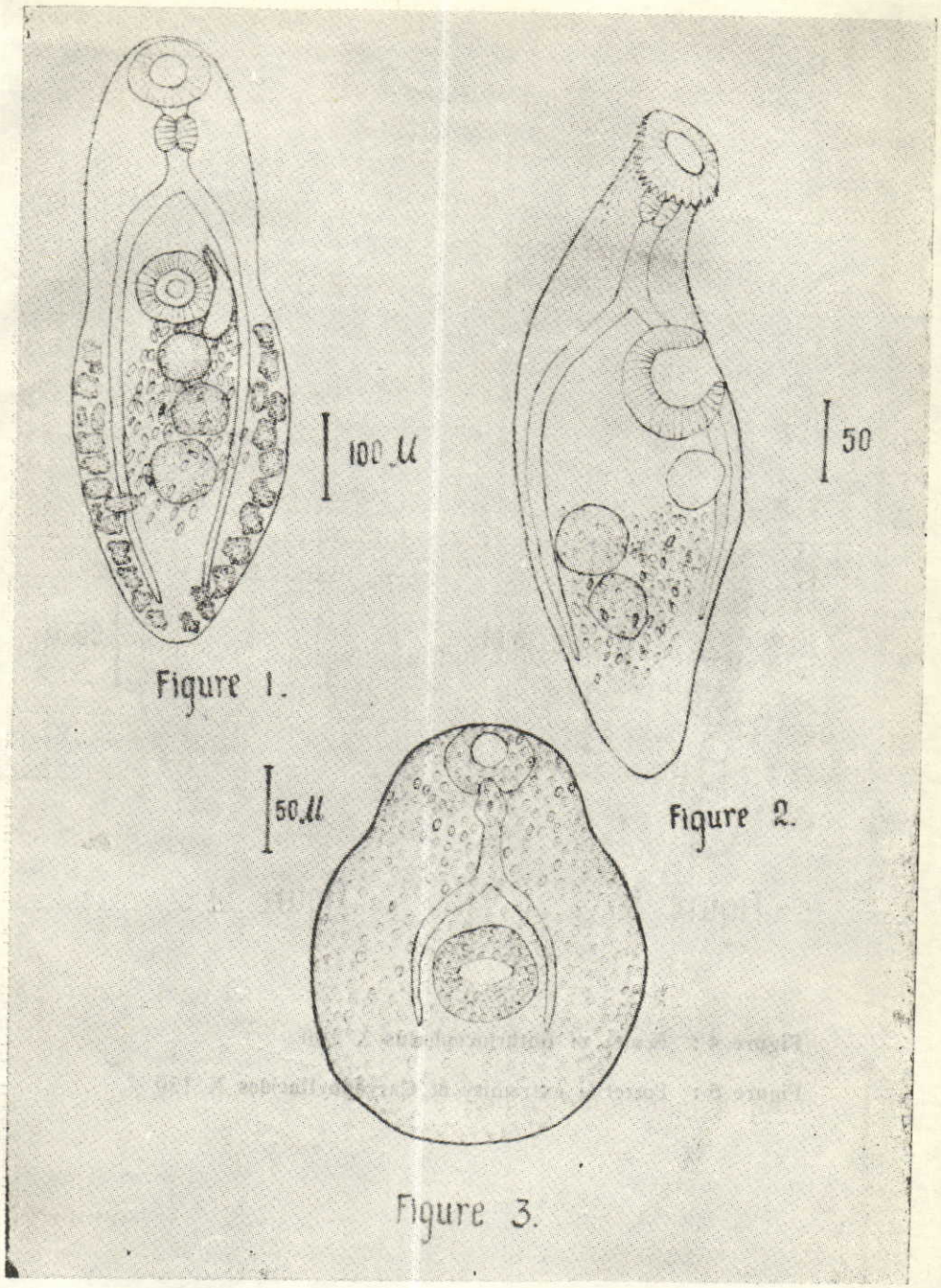

Figure 1 : Adult **Orientocreadium** from fixed and stained specimens X 50

Figure 2 : Adult **Acanthostomatid** from fixed and stained specimens X 300

Figure 3 : Unknown metacercaria in the flesh of Anabas testudineous X 300

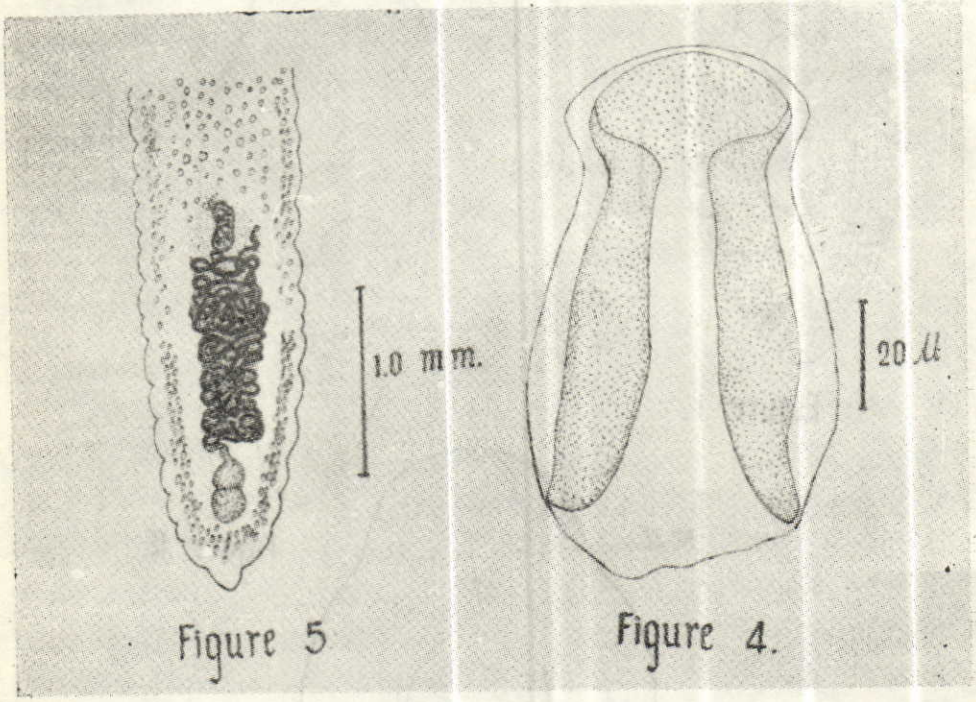

Figure 4 : Scolex of **Bothriocephalus** X 100

Figure 5 : Posterior extremity of **Caryophyllaeides** X 130

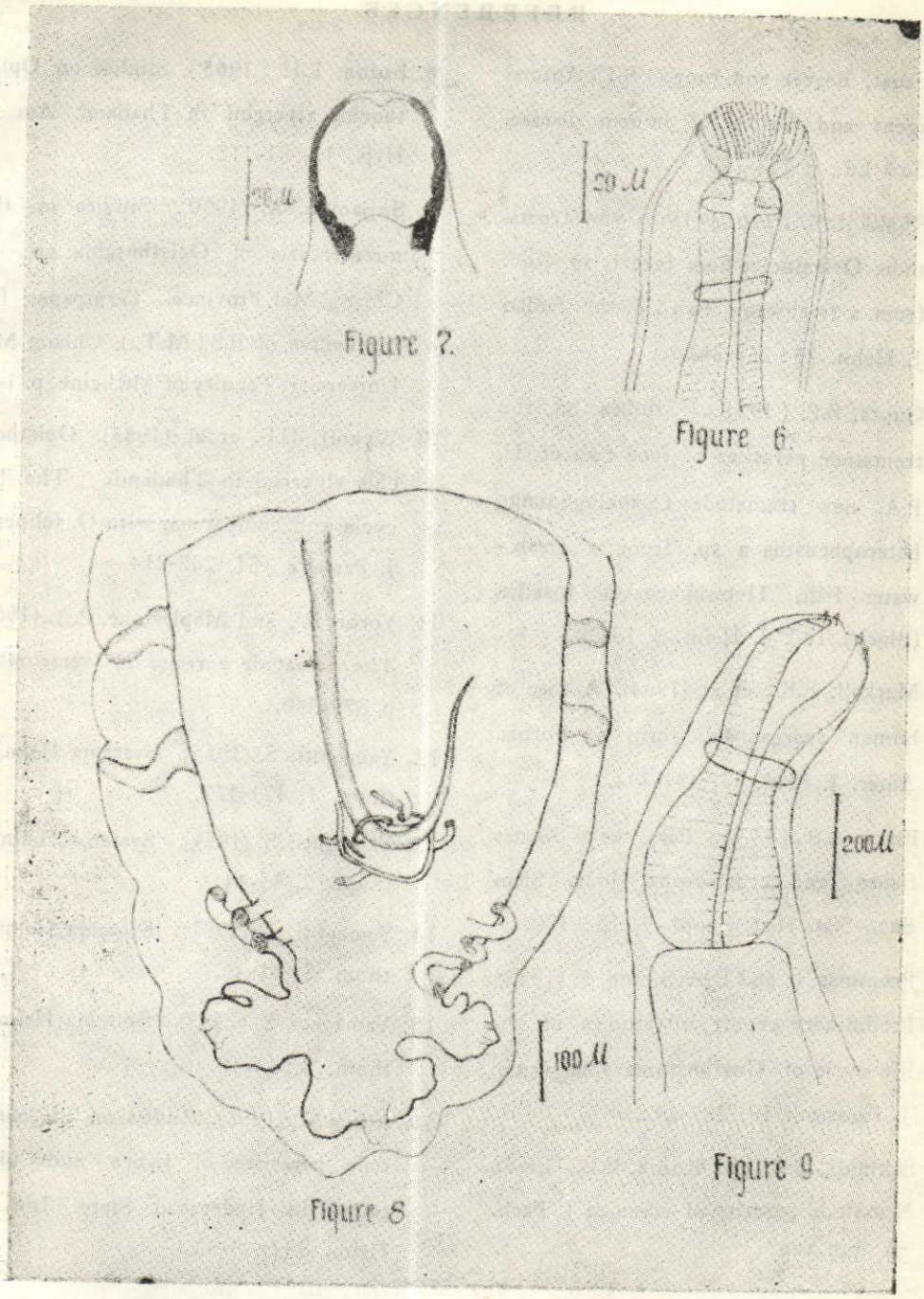

Figure 6 : Head of **Camallanus anabantis** X 55

Figure 7 : Head of **Procamallanus** X 120

Figure 8 : Posterior extremity **Procamallanus** X 450

Figure 9 : Head of **Cucullanus** X 50

REFERENCES

1. Faust, Beaver and Jung (1961). Animal agent and vectors of human disease. 3 rd Ed., p 124-150.
2. Khalil, L.F. (1961) On a new trematode, **Orientocieadium lazevi**, sp. Nov. from a freshwater fish in the Sudan J. Helm. 35 : 259-262.
3. Gupta, S.P. (1951). Studies on the trematode parasites of food fish of U. P.A. new trematode **Cephalogonimus heteropneustus n sp.** from a fresh - water fish, **Heteropneustes fossiles** (Bloch). Ind. J. Helm. 3, 13-20.
4. Markell, E.K., et al. (1964). A case of human sparganosis form California. Amer. J. Med. 37, 491-494.
5. Pearse A.S., (1933). Parasites of Siames fishes and crustaceuns. Jour. Siam Soc., Nat. Hist. Suppl. 9, 182 190.
6. Prommas, c. and Daengsvang, 5. (1933). Preliminary report of studies of the life cycle of **Gnathostoma spinigerum**. J. Parasitol. 19, 287-292.
7. Schmidt, G.D. and Kuntz, R.E., (1969). Nematode parasite of oceanica J. Parit. 59, 389-396.
8. Sadun, E.H. (1965). Studies on **Opisthochis viverrini** in Thailand. Am. J. Hyg., 12, 81-115.
9. Sujjanum, A. (1960). Studies on the metacercaria of **Opisthorchis** sp. in Chiang Mai Province. Termpaper for the degree of B.S (M.T.), Chiang Mai University, Faculty of Medicine. p. 1-2.
10. Wykoff, D.E. et al. (1965). **Opisthorchis viverrini** in Thailand. The life cycle and comparison with **O. felineus.** J. Parasite., 51, 207-214.
11. Yorke, W. and Maplestone, P.A. (1962). The nematode parasite of vertebrates. p 379-380.
12. Yamaguti, S. (1958). Systema Helminthum. 1, 171-172.
13. Yamaguti, S. (1959). Systema Helminthum. 2, 43-44.
14. Yamaguti, S. (1961). Systema Helminthum. 3, 41-46.
15. Yamaguti, S. (1963). Systema Helminthum. 5, 34-35.
16. Ali, S.M. (1957). Studies on the nematode parasites of fishes and birds found in Hyderabad State. Ind. J. Helm. 8 (1), 1-83.