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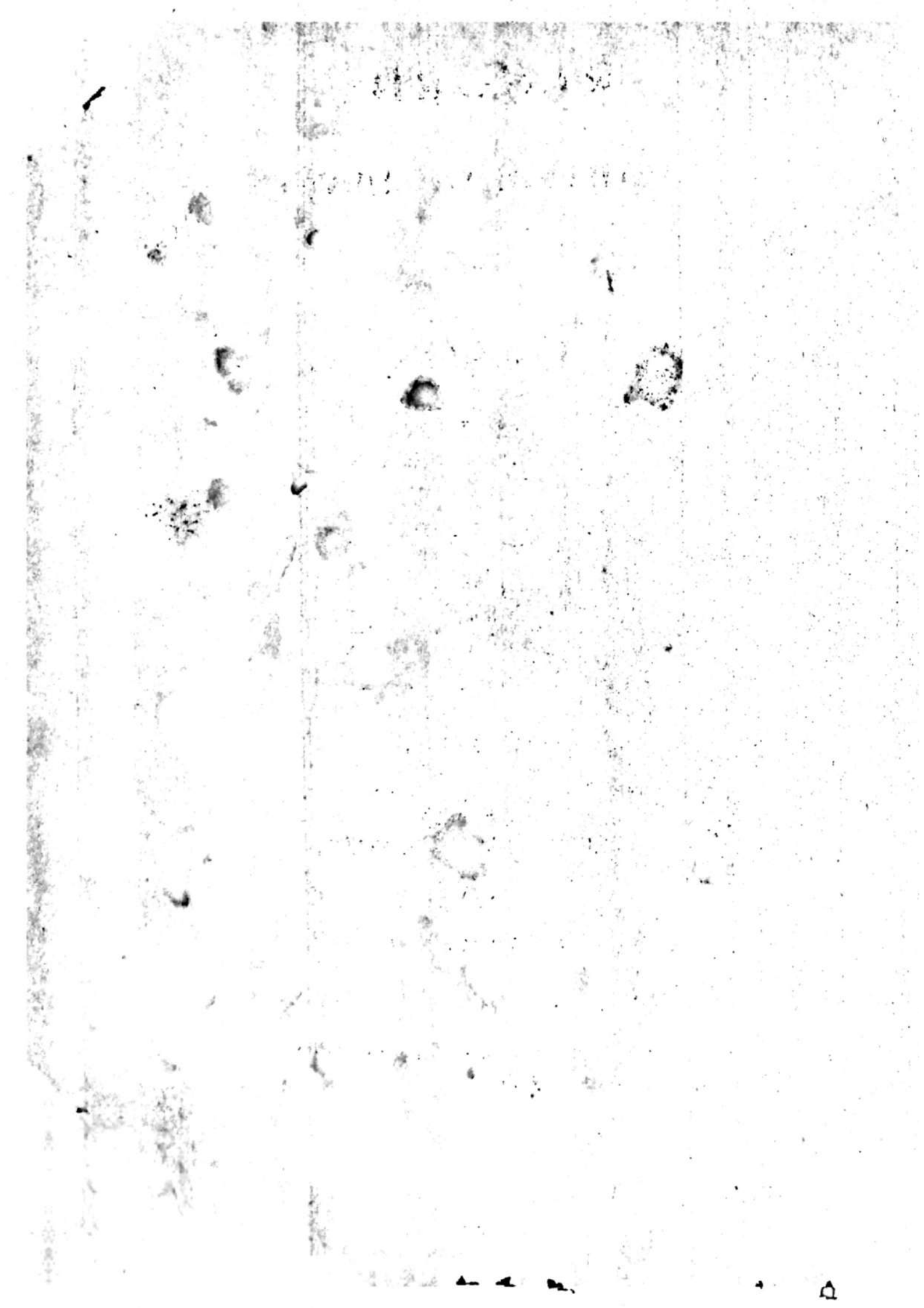


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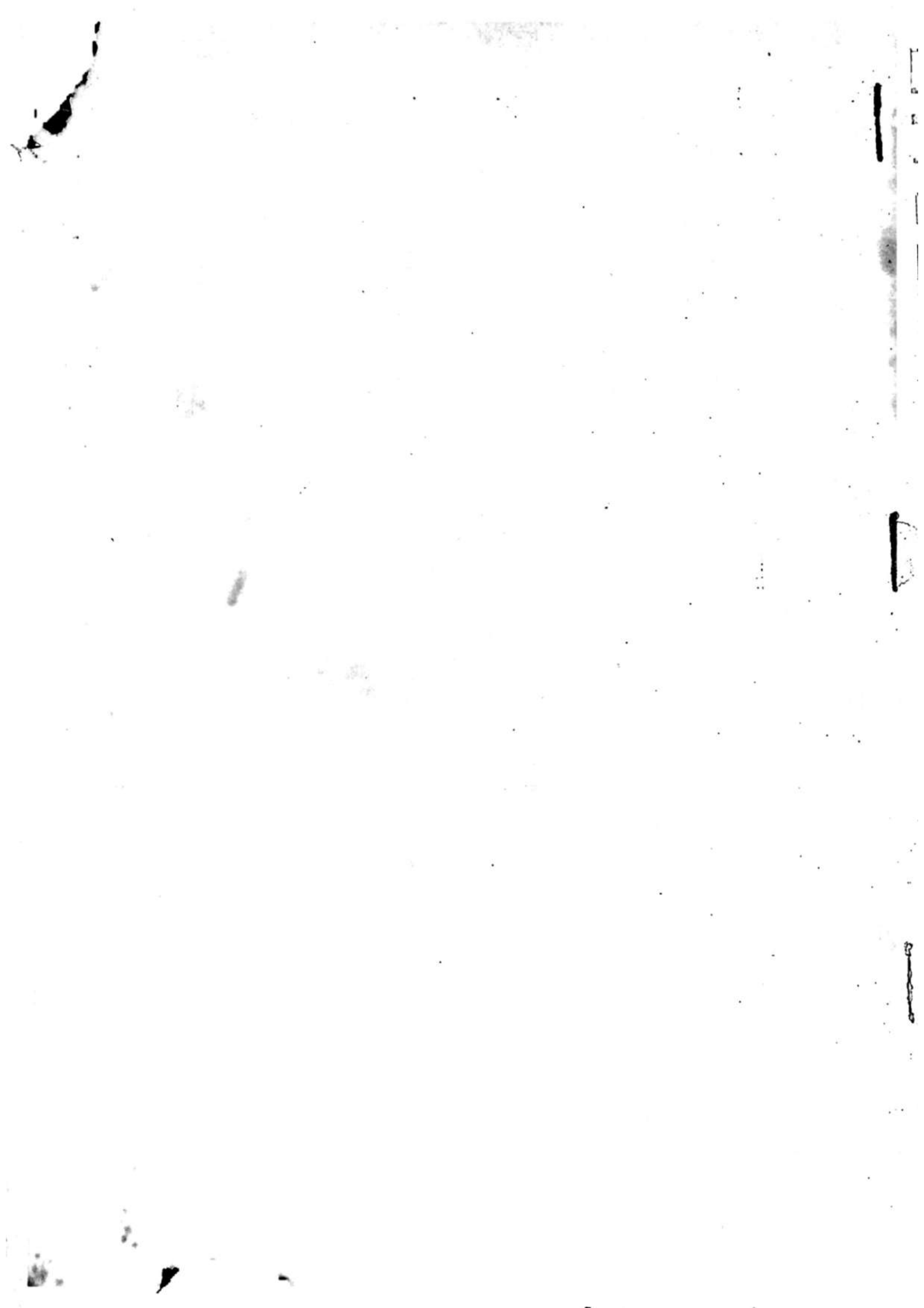
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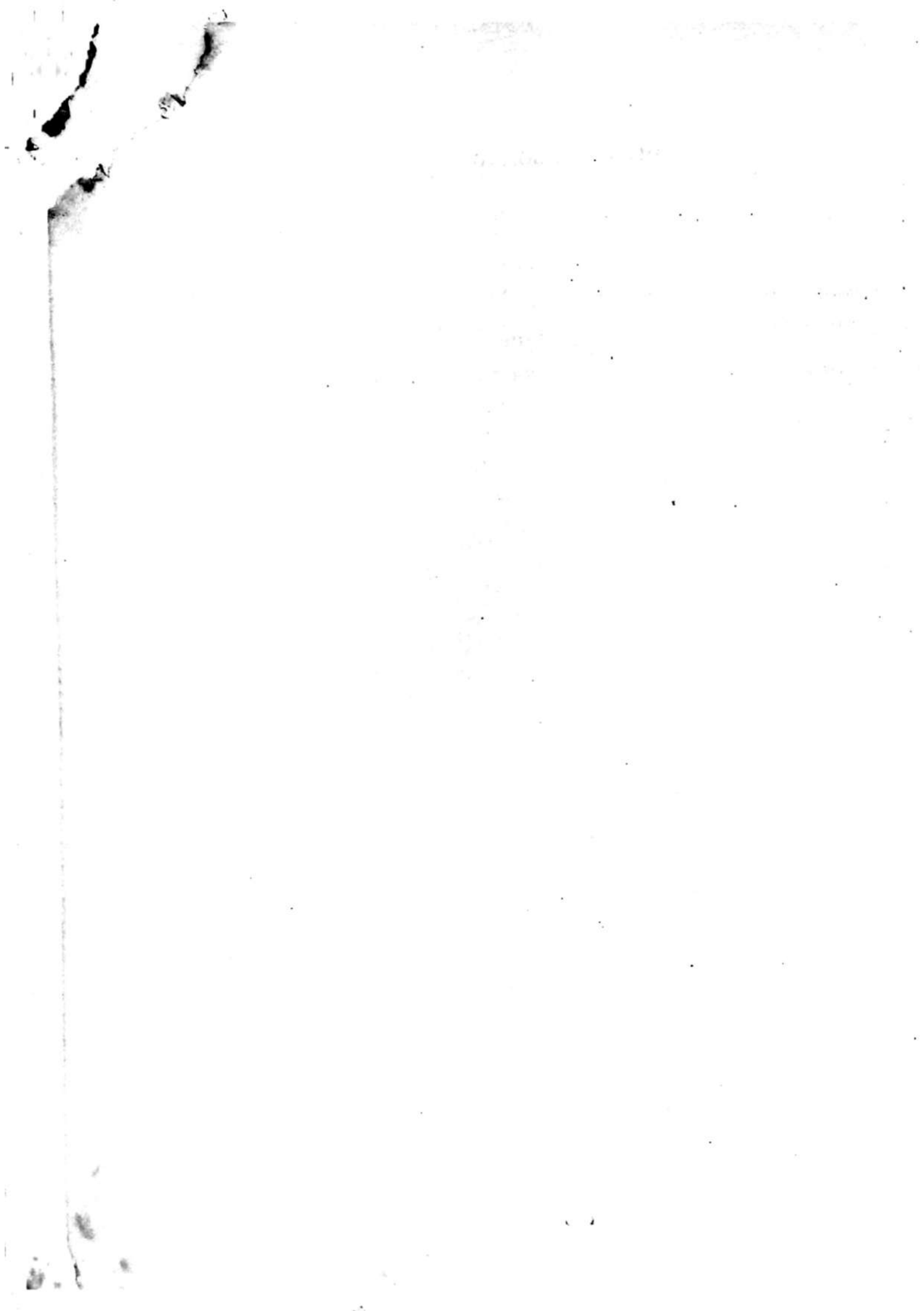
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OBSERVATIONS ON TUBING, INTERTIDAL DISTRIBUTION AND
MIGRATION OF THE COMMON LUGWORM *ARENICOLA BRASILIENSIS*
NANATO AT BULEJI COAST, KARACHI.

BY

M. Farooq Ahmed & M. Sadiq Niazi

Zoological Survey of Pakistan, Karachi

ABSTRACT

Raised patches of sandy-mud at Buleji Coast, Karachi constitute the bed for the common lugworm *Arenicola brasiliensis* Nanato. Various types of burrows of the lugworm alongwith detailed studies of the bed, distribution of the lugworm and some aspects of its migration and behaviour have been described. It appears in late October and disappears in the middle of March, the population is observed to be on peak during December-January.

INTRODUCTION

Tampi and Rangarajan (1963) were the first to record *Arenicola brasiliensis* Nanato from Indian waters, and Ashraf (1968) from Buleji Coast near Karachi, and Ormara & Gwader Coasts of Baluchistan (Northern Arabian Sea). Tampi & Rangarajan have given a very brief account of the *Arenicola* bed but Ashraf has given some brief account of tubing and egg-masses of the worm in addition to its distinctive characters. Much of the work regarding biology and mode of life of the European lugworm, *Arenicola marina* L. has been done. Wells (1944, 1945, 1948, 1952, 1962); Chapman (1947, 1948, 1949); and Newell (1947, 1948, 1949) are some of the distinctive workers who have contributed much to the knowledge about this species. Therefore, we tried to find out some biological and bio-ecological facts about *Arenicola brasiliensis* Nanato. Present paper deals with tubing, intertidal distribution and migration of *Arenicola brasiliensis* Nanato based on observations made in the field as well as in the laboratory spread over a period of three consecutive years.

Material and Method :

For biological and bio-ecological studies of the lugworm, regular visits of Buleji Coast were made fortnightly during the period 1973-75. Lugworms were also kept in aquaria in Marine Biological Research Laboratory and various experiments were set in order to study the behaviour of the worm in captivity. The observations made during field studies as well as during the laboratory experiments are summarised below :—

Description of the study area :

Buleji is basically a rocky beach extending from the western high rocky patch to the eastern sandy flat. Area in between these two points is low, about 1 k.m. long and $\frac{1}{2}$ k.m. wide, and is a curved outlet to form a pocket in the land. The low rocky patch mentioned above constitute the bed of lugworm. Whole area is covered with flat rocky stones, some are hard, fixed and others are soft having compact masses of sandy-mud with a little clay. Besides these, there are large turnable stones, small

rocky or sandy stones, shell-gravels, hard pieces of animal remains and pebbles. Peculiarity of this part of the beach is deposition of mud, clay, muddy-sand and sand over the rocky area in such a way that the whole patch is divided in two types, the raised irregular sandy or muddy patches with few large fixed or turnable stones surrounded with low clay-patches containing water, large and small stones, abundance of algae and typical fauna of tidal pools and the large sandy and rocky stones have attached fauna like coelenterate colonies, sea-anemones, Bugula, polychaete tubes etc. The low rocky face of the beach is partially covered in the low clay patch or completely covered in the raised islands of muddy sand. In the raised muddy patches, the flat rocky or stony substratum is covered with black mud with an excess of sulphides with the peculiar odour of sulphurated hydrogen. The black mud contains shell gravel, hard pieces of animal remains, small stones and pebbles. This, in turn, is covered with deeper layer of black and yellow mud with variable ratio of fine sand, sand and shell gravels, pebbles, shingles, decaying pieces of algae and fine or large pieces of animal remains. This part of the raised muddy area constitute the living place of the lugworms. The top-soil, is fine sandy covering mixed with yellow mud and is a vital layer for lugworms containing fine sand, pieces of algae, shingle, fine pieces of animal remains—the whole together with the mud constitute the food of the worm. The muddy or sandy areas contain minute interstitial fauna. Among burrowing fauna, sea-cucumber, squalids (*Gonodactylus* Sp.) and many polychaetes etc. are met with. At low tide the surfaces of the raised patches are exposed containing jelly-fish and detached parts of algae left behind by the receding tide.

Burrows of the worm :

(a) Kind of Burrows : (Fig. 1.) :

The burrow of *Arenicola brasiliensis* resembles with that of other allied species such as *Arenicola marina*. A lot of work has been done on this aspect of *Arenicola marina* by Wells (1945), Ashworth (1912), Thamdrup (1935), and Chapman & Newell (1947), but very little work on this aspect of the common lugworm of Buleji Coast is seen in published form.

The burrow of the worm at Buleji Coast typically consists of a gallery, a tail shaft and a head shaft. The gallery and a tail shaft constitute a curved, L-shaped or a zigzag tunnel that opens at one end to the outside through an opening of the tail shaft. The other end of the tunnel ends at the base of the head shaft which is a blind connection to outside. The gallery forms the major part of the burrow. The walls of the gallery are impregnated by the secretions of the worm having typical markings of its neuropodia. These conditions are not seen in the recently tunneled burrows. Connected to one end of the gallery is a tail shaft which contains tail during defaecation but lacks any marking. The head shaft is a sand filled tunnel connecting the other end of the gallery with exterior.

The tube, though simple in nature, is a variable thing in life of the lugworm. The different varieties of the tubes depend on the conditions of the environment, and nature of the bed. Different varieties met with during field studies are U-shaped, V-shaped, wide zigzag tube and vertical tube. All these varieties are observable in one type of soil or different ones.

U-shaped tube is more widely dispersed in the field and easily demonstrable one in the laboratory. In this form the horizontal end of the gallery continues to grow upwards for a few cms. and abruptly ends in the head-shaft. The to-and-fro movement of the head of the worm in this shaft results in a series of upward and downward movement of the sand of the topsoil. The nearer sand is engulfed and passed away through the tail in the form of castings over the tail-shaft. As a result of which new sand sinks down into the head shaft. Moreover respiratory and reeding currents working together give a peculiar shape to the head-shaft a vertical tunnel filled with soft end fine sand moving up and down. It is found in the bed containing a thin layer of sandy topsoil over a compact mass of mud opened to the air for a comparatively long period of time in the low tide. If the same bed is of rapidly drying nature, the sand of the head-shaft is completely engulfed or passed through the circumference of the gallery to outside in the form of defaecated casting marking a deeper depression over the head shaft. This depression over the head shaft may continue in the gallery due to dry nature of the surface sand which fails to fill the gap and leaves the head shaft, and open tunnel. Such tube is a variety of U-shape burrow and generally termed as open-U-type. It can also be easily demonstrated in the laboratory aquaria.

Very few burrows of V-shaped were observed in the field, specially in the thick gravelly or stony bed with a thin layer of sandy mud, the topsoil. If the lugworm happens to burrow in such a peculiar ground, it fails to get rid of the hurdles. It, then, finally burrows in the upwards direction making an angular tunnel the vertex being resting on a hard stone or large gravels. In such tubes the gallery ends at the end of the black mud. Unlike open U-tube this is generally closed at this end.

In an exceptional case a vertical burrow was observed in muddy sand with rocky bottom. It was resting in a conical burrow of the rocky stone and bifurcated a few cms. (4.5 cms.) below the topsoil of muddy sand with grawels and pebbles. The worm in this case, probably could not deviate in any direction in the burrow except the backward direction which it was forced to continue in the same tunnel. This happened due to its peculiar feature, the reversal in tube, and started a new branch in the upper layer. In this case the two ends lie nearer and the gallery being a vertical tunnel.

If the whole muddy patch and the topsoil of the muddy sand is packed with hard stones or large gravels the burrow is tunnelled in a zigzag manner finally ending in a head-shaft in the soft part of the topsoil.

It has been noted during field studies as well as experimental observations that the head-shaft is always vertical in position and the outer portion dilated. It tapers to the deeper end facing head of the worm. The depth of the shaft depends on the conditions of the bed specially that of the topsoil. If the topsoil layer is thick and soft the head-shaft is comparatively deep; in fact the worm rests in the burrow in such a condition that its head lies just below the topsoil layer. The head may shift from this position if forced by adverse conditions. In dry condition the worm may move to the tail-shaft in a shranked or coiled condition, or if the bed is extremely rocky the worm may move towards the head-shaft.

(b) *Colouration of the Burrow :*

The interesting thing in the burrow of the worm is the peculiar colour of the gallery. Wells (1945) in case of *Arenicola marina* states "the gallery is seen to be surrounded by a yellow brown layer often several mm. thick, this layer is generally firmer than the surrounding mud, due, apparently, to mucus exuded by the worm. Its colour is largely caused by the oxidation of the black iron sulphide in the mud to yellow oxide. But sometime, it exhibits greenish or rusty orange tint, to which coloured secretion from the worm probably contribute". The colouration of the inner walls of the gallery at Buleji Coast are observed to be light brownish with slight changes of shade in different points of the bed. Shade of olivaceous green is observed in the burrows tunnelled near high tide marks, it is olivaceous in areas of low tide marks and yellowish in still farther areas. The colouration, thus, seems to be due to the position and condition of the bed aided by the worm's secretion. Greenish shade is displayed in the deeper blackish mud intermingled with fine yellow sand, the whole body of the mud being compact, solid, and tough specially at low tide. The olivaceous and sometimes light pale is observed in the bed with shallow black mud containing a considerable ratio of fine yellow sand. This bed contains interstitial water for a long period of time. In still others, the bed is soft, more shallow, mud being black and yellow, with always water at least to some extent in the mud. These varieties of colours are not simply due to oxidation of the black iron-sulphide, but instead these seem to be the result of complex chemical changes brought about by the environmental factors catalysed by the worms secretions.

In fact the mud contains a lot of sulphides, which are oxidised in the tube to various oxides showing varieties of colours. The preliminary analysis of the mud of the gallery deducted iron, hydroxyl and oxide ions. In laboratory the worms displayed colouration after twenty days. The coloured mass of the gallery was analysed which showed the same result. So we think the colouration of the gallery is due to oxidation brought by the animals' secretions.

The coloured layer of the gallery was never observed to be thicker than 1.5 mm. General thickness, as observed was 1 mm. The layer was thicker in the bed near the high tide marks. The layer was very thin in the bed at lowest low tide mark.

Intertidal Distribution : (Figs. 2 & 3) :

The lugworm is haphazardly distributed over the beds of Buleji in the intertidal zone. The whole bed is composed of raised patches of sandy mud. For present studies seven patches between HHTM and LLTM near the rocky margin ranging from 30 Meters to 90 Meters were considered. Each patch was dug out upto the rocky substratum at ten different spots of 1 Sq. Meter each and the number of lugworms so found counted, number of castings, and egg-masses were also counted. Nature of the soil and thickness of topsoil and the submerged muddy soil was noted. The results are detailed below :—

Point—0 :

A 45 meter wide patch of purely dry sand which is stretched along the shore. During May—July this area is covered with water leaving

jelly fish, blue bottles, and floating algae when tide recedes. In the rest period of the year this narrow patch remains untouched and hence devoid of any burrowing fauna. Exceptionally few sand crabs may be observed running here and there. No lugworms were seen in this area.

Point—1 :

It is situated at a distance of 90 meters from HHTM, separated from 0-Point by a narrow clayey furrow of 12—20 meters with small rocky stones forming shallow tidal pool. It is an oval-shaped area of 15 × 35 meters and 45 meters from the rocky belt of the coast. Here the muddy sand is 10 to 15 cms. deep over large flat stones, shell gravels, and pebbles. The mud possesses shell gravels, hard pieces of animal remains, pebbles and fine sand. The mud is almost black.

Average depth of this area was calculated to be 30.5 cms. with a maximum depth of 50 cms. in the middle. Upper part of the soil, the topsoil, is distinct from the lower one consisting of fine sand, algal pieces and fine hard pieces of animal remains. The average depth of the topsoil was observed to be 11.7 cms. with 17 cms. in the middle. The lower part of the soil is almost black mud. The upper half of the area remains dry and hard for a considerable length of period in the day in cold season.

Upper two-third of the topsoil is light greyish brown while the lower one-third is black. Due to this, black soil, the hidden stones, gravels, pebbles etc. are blackish producing a peculiar smell of H_2S .

This point was observed after half an hour when tide receded and ten areas of 1 sq. meter each were apparently observed and then dug for lugworms count and size. The data of this point is summarised below :—

1M ² Area	No. of Castings	No. of Egg-masses	No. of Lugworms
1	4	2	4
2	5	4	5
3	1	Nil	1
4	6	4	5
5	7	5	6
6	3	1	2
7	4	1	4
8	2	1	3
9	5	4	4
10	4	4	4
Total :	41	26	38
Average :	4.1 OR 4	2.6 OR 3	3.8 OR 4

This point contained an average of 4 castings, 4 lugworms and 3 egg-masses per sq. meter area. The length of the worms ranges between 10.3 to 15.5 cms.

Point—2 :

It is located at a distance of 120 meters from HHTM and 90 meters away from the rocky patch of the western rocky shore. It is a circular island of raised muddy sand with a diameter of 15 meters. The bed is 30—45 cms. thick over the flat stones. The mud is almost black containing gravels, pebbles, sand, hard pieces of animal remains and algal pieces; gravels are finer and numerous as compared to previous point. Over the flat rocky stones, there is a number of mud-stones too.

Average depth of the topsoil is 8.5 cms. It is comparatively soft. The surface is greyish with black patches here and there. Some muddy stones, partly buried, are also present. The nature of the topsoil is exactly similar to the previous one except that this zone is soft having comparatively more chance to retain the intertidal water.

This point of the bed is encircled with shallow water channels. The whole covering mass constitutes a series of tide pools with abundance of variable stones both fixed and free. The population of the algae is remarkably thicker. The count of the lugworm is as under :—

1M ² Area	No. of Castings	No. of Egg-Masses.	No. of Lugworms
1	6	7	6
2	9	8	8
3	3	5	4
4	5	5	6
5	7	8	7
6	4	5	5
7	5	4	4
8	6	3	6
9	6	2	7
10	5	3	4
Total :	56	50	57
Average :	6/Sq. Meters	5/Sq. Meters	6/Sq. Meters

The point contains an average of 6 castings, 6 lugworms and 5 egg-masses per sq. meter. The length ranges between 9.1 cms. to 12.5 cms.

Point—3 :

It is situated at a distance of 40 meters from 2nd point and 90 meters from the rocky patch. The second point lies just in the middle of the third and the first points. It is a triangular patch of raised muddy sand surrounded with shallow water pool to the sea-side and moist clayey curved channel forming a semicircle to other sides.

The bed of this very point is 10 to 35 cms. deep with average depth calculated to be 21.5 cms. The topsoil, consisting of fine sand, shingle and minute pieces of animal remains, formed about the one-third of the total depth. The lower part was observed to be completely black with a peculiar smell of H_2S gas. The peculiarity of this point is the shell gravels and pebble forming the base of the mud. Below these gravels and pebbles were found small hard and soft stones of irregular shape. Unlike the previous points these stones are few and not inflated. The count of the worms is given below :—

1M ² Area	No. of Castings	No. of Egg-Masses	No. of Lugworms
1	20	21	20
2	18	20	19
3	11	10	11
4	12	8	13
5	13	14	13
6	15	12	13
7	9	11	9
8	8	10	8
9	16	12	15
10	17	13	16
Total :	139	131	137
Average :	13.9 or 14/Sq. Meter	13.1 or 13/Sq. Meter	13.7 or 14/Sq. Meter

The point contains an average of 14 castings, 14 lugworms and 13 egg-masses per sq. meter. The length ranges between 8.7 cms. to 11.5 cms.

Point—4 :

This point lies at a distance of 240 meters from high tide mark and is in line with the previous one being 50 meters apart, separated from each other with shallow tidal pool with clayey bottom containing hard and soft rocky stones thickly covered with varied forms of algae. The bed was 7 to 29 cms. deep with average depth observed to be 19.8 cm. The average depth of the topsoil was found 5.3 cms. The colour of the

surface was observed to be greyish pale rather than brown. The bed contained almost the same matter as mentioned in the previous one but comparatively finer. There were no traces of hard stones upto the bottom, however, compact mass of gravel and pebbles was present mixed with muddy or sandy rocks. The area remains submerged for greater period of time and hence the soil contained more interstitial water due to which it was soft. Moreover the patch consisted of fine sand with a little combination of mud, due to which collection of the worm was very easy. The count of the point is given below :—

1M ² Area.	No. of Castings	No. of Egg-Masses	No. of Lugworms
1	20	21	20
2	21	21	21
3	23	22	22
4	18	16	17
5	17	15	18
6	22	20	20
7	20	20	21
8	19	18	20
9	24	23	23
10	22	21	21
Total :	206	197	203
Average :	20.6	19.7	20.3
	or 21/Sq. Meters	or 20/Sq. Meters	or 20/Sq. Meters

The point contains an average of 21 casting, 20 egg-masses and 20-Lugworms. The lugworm ranges between 8.1 cms. and 10.2 cms.

Point—5 :

The point is situated at a distance of 290 meters from HHTM and about 50 meters away from the previous one separated by a shallow tide pool. The patch has almost no hard obstacles like stones or shell pieces etc. upto the bottom which is 25.5 cms. deep in the highest area with an average depth of 18.2 cms. There is no distinction of topsoil as the whole mass is sandy with a little percentage of brown mud and light yellow clay. The bottom consists of a thick layer of gravel and pebbles which constitute a compact mass with fine sandy mud and clay. Below this layer are small and large sandy or muddy stones. The whole sandy mass contains fine pieces of animal remains, algae and shingle. As this

area is generally submerged for longer period of time, it is soft to touch and easy to dig, count of the lugworms as observed is given below :—

1M ² Area.	No. of Castings	No. of Egg-Masses	No. of Lugworms
1	14	15	14
2	17	17	17
3	16	15	15
4	15	13	14
5	18	16	10
6	16	12	16
7	9	10	11
8	17	15	16
9	13	14	15
10	16	15	17
Total :	151	143	144
Average :	15.1 or 15/Sq. Meter	14.3 or 14/Sq. Meter	14.4 or 14/Sq. Meter.

The area contains 15 Castings, 14 Egg-Masses and 14 Lugworms per Sq. Meter. The worms range between 7.8 and 9.1 Cms.

Point—6 :

This very area is circular in shape with a diameter of 7 Meter and about 350 Meters from the shore. The depth ranges from 10.5 to 17.5 Cms. with an average of 16.4 Cms. Major part of its periphery remains covered with sea-water. This submerged part contains some Egg-masses but as it is difficult to dig in water, it was omitted and five areas of the exposed portion were studied. There is no distinction of topsoil. There is little quantity of mud mixed with fine sand. Main character of the soil of this area is the presence of loose sand, shingle and less proportion of pebble and gravel. There is much interstitial water in the sand and hence the whole mass is softer than the previous points. Count of the lugworms is given below :—

1M ² Area	No. of Castings	No. of Egg-Masses	No of Lug worms
1	7	9	6
2	8	8	5
3	6	7	6
4	7	7	4
5	8	9	7
6	?	(7)	? } Sumerged areas
7	?	(7)	? }
8	?	(9)	? }
9	?	(6)	? }
10	?	(7)	? }
Total :	36	40+(36)	28
Average :	7.2 or 7/Sq. Meter	8/Sq. Meter	5.6 or 6/Sq. Meter

This point contains 7 Castings, 8 Egg-Masses and 6 Lugworms per Sq. Meter. The worms range from 7.3 to 8.4 Cms.

Point—7 :

This is the deepest zone of the bed that opens to the free air in cold season and is situated at a distance of about 400 Meter from the shore. This patch of irregular shape remains open to air for a shorter period of time other-wise it remains submerged in the water round the clock. It is very difficult to dig out ten different areas of 1 Sq. Meter each in a limited period of low tide ; hence only five such portions were studied. The soil is soft without any hard stones or large pieces of shells in the way. The average depth of the area is calculated to be 13.5 Cms. The whole mass consists of fine sand with some clay near the bottom and loose shingle and gravel in the upper part. The count of the lugworms is given below :—

1M ² Area	No. of Castings	No. of Egg-Masses	No. of Lugworms
1	3	3	1
2	2	3	2
3	2	2	2
4	1	1	1
5	2	2	2
Total :	10	11	8
Average :	2	2.2	1.6
	or 2/Sq. Meter	or 2/Sq. Meter	or 2/Sq. Meter

This point contains 2 Castings, Egg-Masses and Lugworms per Sq. Meter. The worms are less than 7 Cms. in length.

Above studies together with regular observations of the bed showed the following facts regarding distribution of the worm :—

1. Population of the lugworm is haphazard rather than linear.
2. They are thickly populated on the margins of the raised patches of sandy-mud as compared to the central raised areas that are dry and hard.
3. Larger specimens are located near the high tide mark whereas smaller ones near the low tide mark.
4. Population of the worm is thick where the topsoil is well marked, mud is soft, and the area remains submerged for a comparatively longer period of time round the clock.

5. The Egg-masses are small, transparent and colourless at the areas near low tide mark ; these are light brown, opaque and larger near high tide mark. In the middle region, the egg-masses are milky and translucent.
6. Open holes over the head-shafts are occasionally seen at the places near high tide mark and are seldom seen in the areas located near low tide mark.
7. The worms avoid clay, dry sand, rocks, hard substratum, draught and high-temperature. They prefer soft mud with sufficient quantity of algal pieces, animal remains and fine sand.

Table showing Summarised Data of the distribution of the worms at different Points.

S. No.	Point	Distance from HHTM to center of the point	Average No./Sq. M.			Length of lugworms (Cms.)	Average thickness of the bed (Cms.)	Average thickness of topsoil
			Castings	Egg-Masses	Lugworms			
1.	0	17	x	x	x	x	x	x
2.	1	97	4	3	4	10.3—15.5	30.5 (10—50)	11.7
3.	2	128	6	5	6	9.1—12.2	26.3 (30—45)	8.5
4.	3	170	14	13	14	8.7—11.4	21.5 (10—35)	6.1
5.	4	240	20	21	20	8.1—10.2	19.8 (7—29)	5.3
6.	5	290	15	14	14	7.8—9.1	18.2 (7—25.3)	4.1
7.	6	357	7	8	7	7.3— 8.4	16.4 (0.5—17.5)	2.5
8.	7	415	2	2	2	Upto 7	13.5 (11—14)	—

Migration :

The lugworm as observed in the field does not stay in a single tube but instead it changes its burrow every now and then. In laboratory one living specimen was placed in a flat round glass jar with sandy mud, and after twenty four hours three castings and three wide depressions containing fine sand representing the tail shaft and head shaft respectively were observed. The soil was excavated and the burrows were traced. These were found to be complete tubes interconnected each other ; the connections were hardly traceable. Change of tube also depends on the nature of the soil, availability of the food and the season

of maturity. Thinner the sandy topsoil and thicker the black soft mud the more occasional tube change displayed by the worm. The worm tends to avoid the hardness and high temperature and occupy a place with plenty of food and oxygenated sea-water. If the worm happens to face unfavourable conditions of the environment, it leaves the burrow, swims for a distance in the high tide and burrows in a fresh area of sandy mud.

Chapman and Newell (1949) have demonstrated this fact of *Arenicola marina* in the field by digging a few pits in the clay and refilling them with soft matter of topsoil. These were found populated with the worms later on. We have demonstrated the same behaviour of *Arenicola brasiliensis* in laboratory. A rectangular glass aquarium filled with sandy mud—soft mud containing an upper thin layer of sandy topsoil—was divided into two equal aquaria by inserting a glass sheet in the middle upto the level of topsoil touching the side walls completely so as to leave no space for transport through mud. Some fresh sea-water was added to the mud so as to make it soft. To one part of the aquarium 5 specimens of freshly collected lugworms were introduced. After the worms had burried in the mud, the top layer of this part containing fine sand, algal pieces and fine gravels was scratched and then filter sea-water was added slowly so as to rise the level about 8 Cms. above the mud in both the aquaria. After 24 hours one specimen was found shifted to the other compartment. Within 30 hours heads of two lugworms were raised up to reach the level of the mud in the head shaft of their respective burrows. Later on these worms were found shifted to the other half. Experiment was continued and after 90 hours, one more worm migrated to other half. The remaining one was found dead. This migration from one half of the aquarium to the other could not possibly occur through glass sheet. The only possible way obviously remained was the upper layer of water and migration occurred through swimming for some distance.

A series of similar experiments were carried out with different environmental conditions like light, temperature, food and the bed to find out the time and cause of migration. These experiments showed that migration occurred in high tide, at night and more occasionally in adverse conditions of food and oxygen.

In addition to this normal migration, there is another type of migration displayed too, the seasonal migration. They disappear in the month of March and remain out of sight during whole worm season and reappear in October. It could not be find out as to where they migrate. Perhaps they burry deep in the mud beyond the enflated stones or they occupy the deeper tidal zone that remains submerged by the water to avoid the high temperature of the shore. During this period some attempts have been made to dig out some points beyond the stones but no worm could be detected.

Acknowledgement :

Our thanks are due to Mr. Azhar Hassan of D.S.T.O. for his suggestions and also to Mr. M. Ahmad Khen, Asstt. Prof. Deptt. of Zoology, Univ. of Karachi for going through the manuscript and valuable criticism.

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Explanation of the figures

Fig. 1 : Diagramatic illustrations of different types of lugworm-tubes at Buleji Coast.

(a) Typical L-type.

(b) Open U-type.

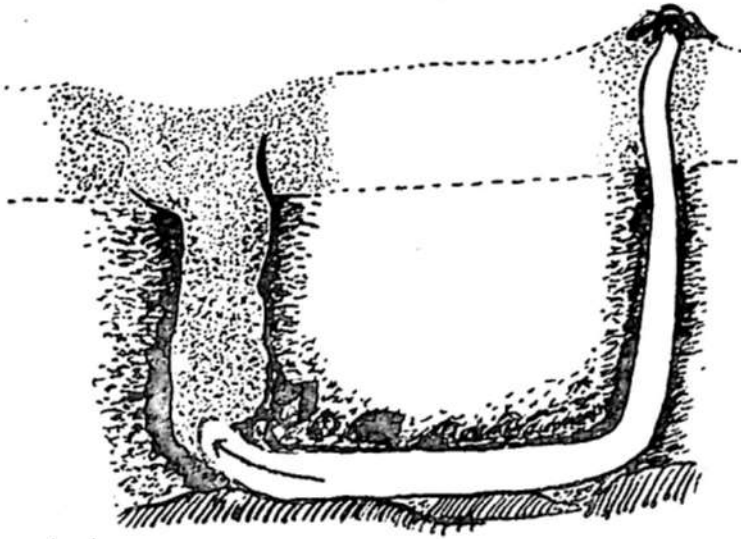
(c) Vertical type.

(d) Zigzag type.

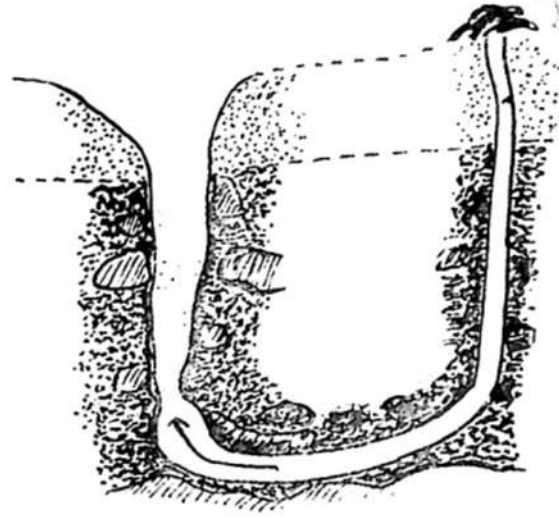
(e) V-type.

Fig. 2. : Graph showing population density (No./Sq. m.) of the lugworm in the intertidal zone of Buleji Coast.

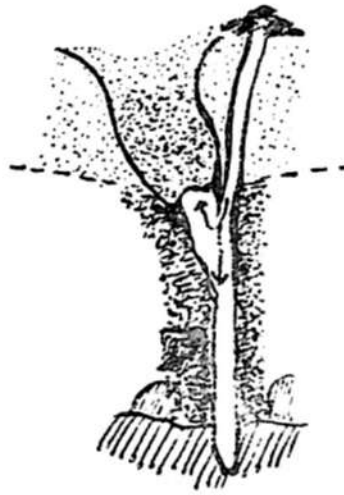
Fig. 3 : Diagramatic illustration showing respective locations of different points of the lugworm studied at Buleji Coast.



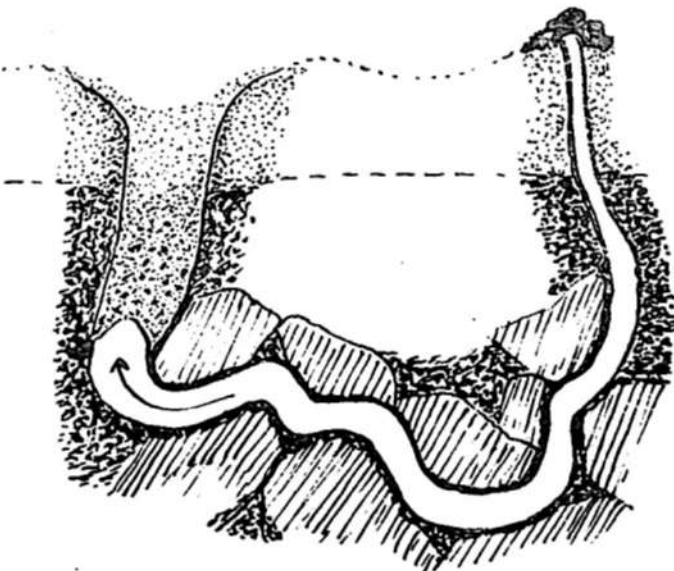
a



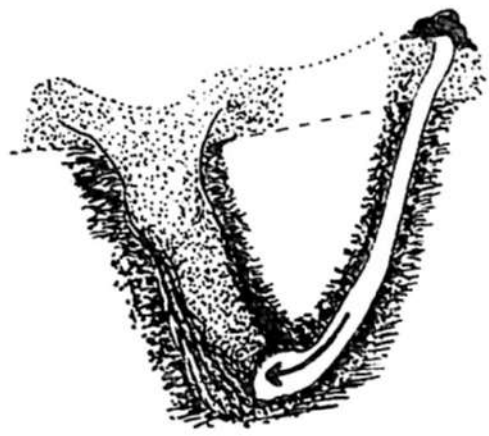
b



c

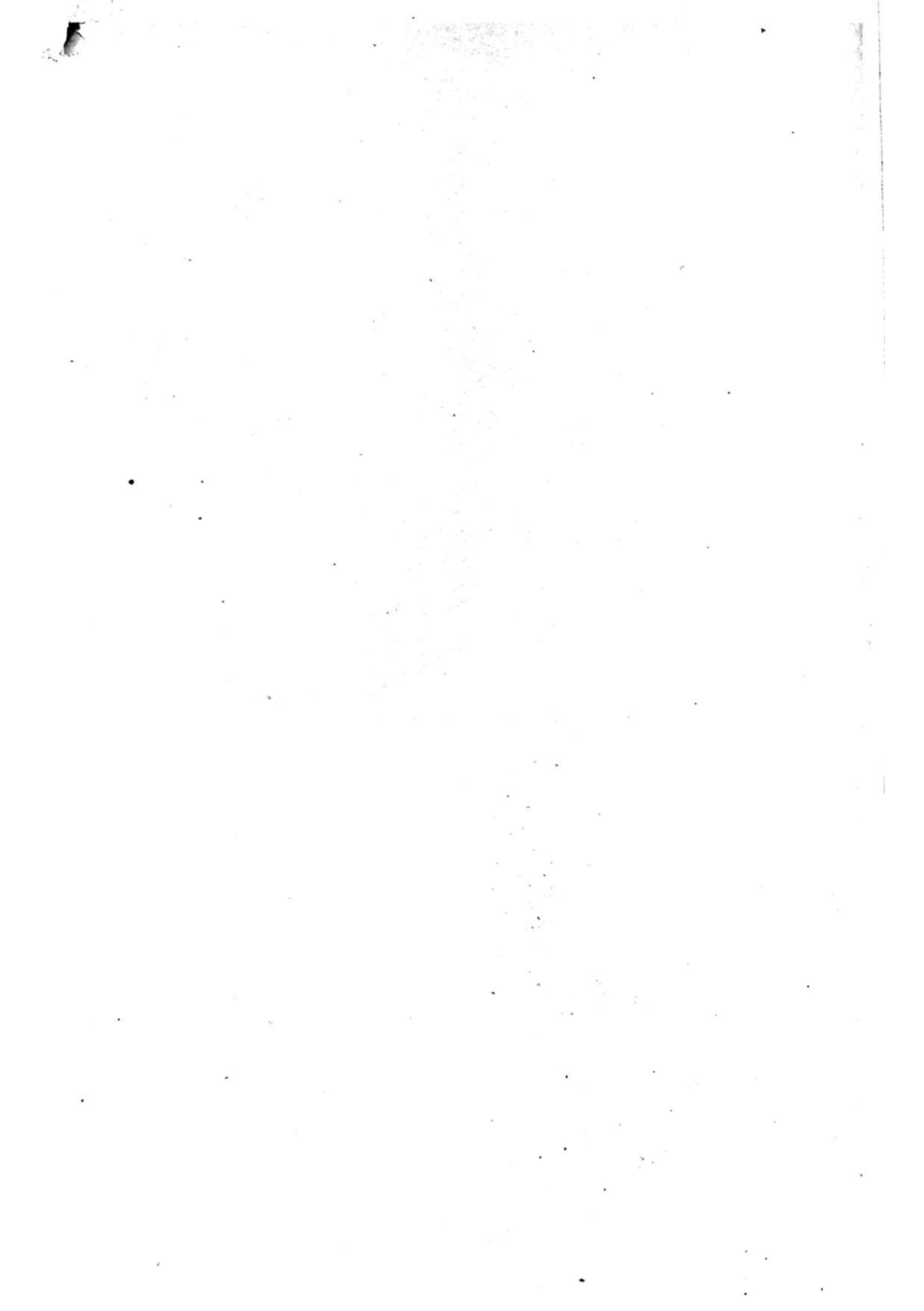


d



e

Fig. 1



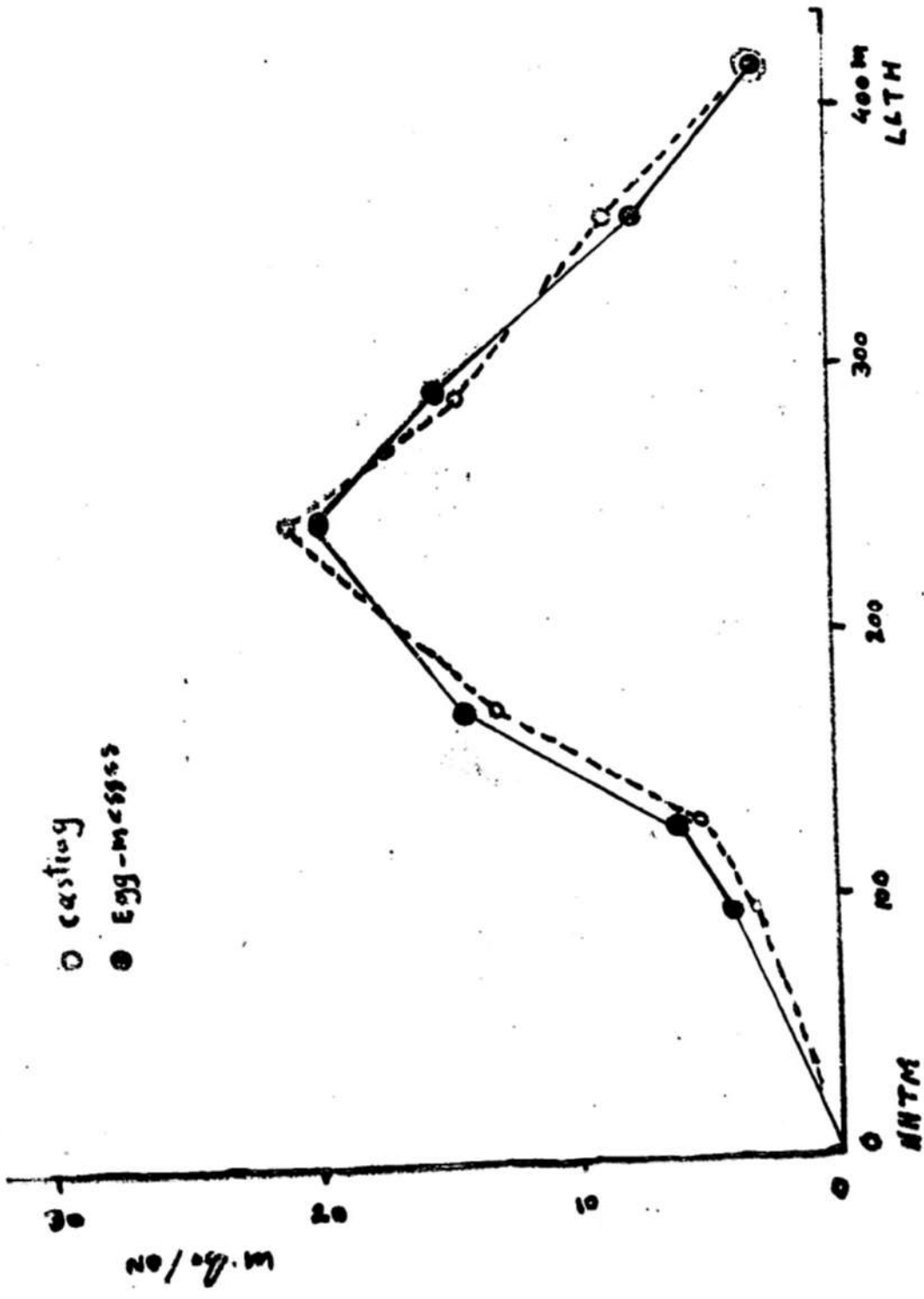
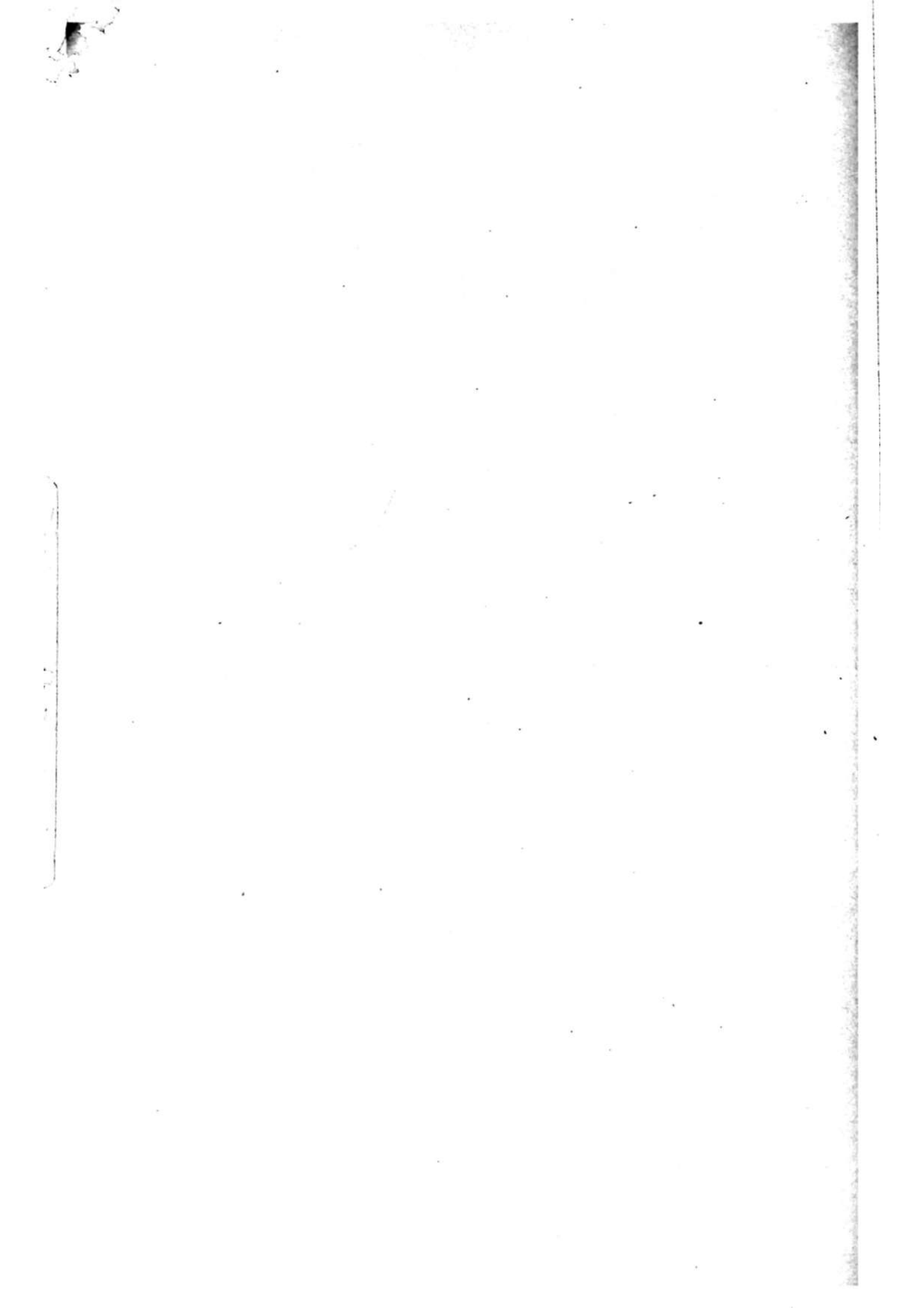


Fig. 2



-  Dry sand
-  Rocky belt
-  Points

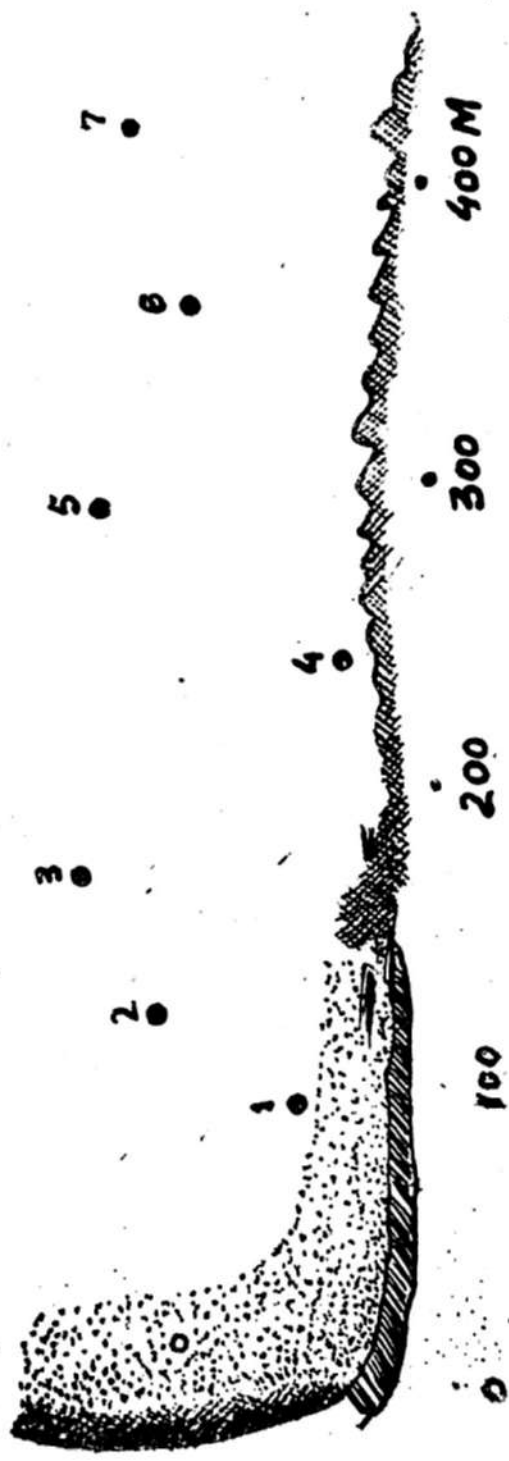


Fig. 3



ASPECTS OF MORPHOLOGY OF ALIMENTARY AND REPRODUCTIVE ORGANS OF *MACROSCYTUS SUBAENEUS* (DALLAS), (HEMIPTERA: CYDNIDAE) WITH REFERENCE TO PHYLOGENY.¹

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ABSTRACT

Aspects of morphology of the alimentary and male and female reproductive organs of *Macroscytus subaeneus* (Dallas) are described to evaluate these characters in ascertaining the phylogenetic position of the family Cydnidae within the super family Pentatomoidea.

INTRODUCTION

Ahmad and Abbasi (1971) and Ahmad and Khan (1973) reviewing the earlier literature have already emphasized the importance of the characters of reproductive and alimentary organs in ascertaining the phylogenetic positions of many disputed groups within Pentatomoidea. More recently Ahmad and Moizuddin (1975) and Moizuddin and Ahmad (1977) have used these characters in ascertaining the phylogenetic positions of the families Plataspidae and Scutelleridae respectively of lower Pentatomoidea (of Leston 1958a & b).

Except the earlier significant works of Pendergrast (1957), Miyamoto (1961) and Kumar (1962) on alimentary and male and female reproductive organs and more recently that of Ahmad and Moizuddin (1977) in which the characters of scent apparatus were used, until todate these aspects have largely been ignored in ascertaining the phylogenetic position of the present family. Considering above the present work on *Macroscytus subaeneus* (Dallas) was undertaken.

Materials and Methods :

Adult males and females of *M. Subaeneus* on roots of *Withenia somnifera* (L.) Dunal and from light trap were collected from Karachi University Campus. Live specimens were dissected either in tap water or sodium citrate solution (10%). The drawings of alimentary and male and female reproductive organs were made after removing the overlying viscera and using eye piece graticule under Leitz binocular microscope. All the diagrams were made to the given scales.

1. Partly supported financially by ARC—USDA Research Project A-17 ENT-37 (FG-pa-181)

RESULTS

Alimentary Organs (Fig. 1).

The alimentary organs include an alimentary canal and a pair of salivary glands opening through principal salivary ducts independently into the salivary pump. The alimentary canal is divided into tubular oesophagus, an elongated sac-like midgut 1, a tubular midgut 2, a sac-like midgut 3 and a long tubular midgut 4 provided with two rows of gastric caeca, opening into a bulbus pylorus. Two pairs of thin coiled and convoluted malpighian tubules arise from either side of the pylorus. This region is continuous and appears like anterior prolongation of a bladder-like posteriorly located rectum.

Oesophagus :

It is a thin and remarkably elongated tube extending on to the mesothorax and is slightly less than midgut 1 in length. It is of whitish colour and at its junction with midgut 1 terminates into a bulbus region in the lumen of which the oesophageal valve is probably located. Anteriorly it is continued into a poorly developed pharyngeal region.

Midgut 1 :

This is represented by a large bulbus structure, uniform in appearance and light yellowish in colour. It abruptly tapers posteriorly and opens into a tubular midgut 2.

Midgut 2 :

This is rather short and narrow tube and is greyish in colour. The midgut 2 after emerging from midgut 1 turns downward and passes underneath midgut 1 to emerge on right side of the body cavity. It opens perpendicularly into an oval sac-like midgut 3.

Midgut 3 :

This oval section lies adjacent to the distal portion of midgut 1 in the same parallel line. Yellowish fluid in its middle reflects from its greyish surface. It terminates posteriorly into a long tubular midgut 4.

Midgut 4 :

This is an elongated, rather wide tubular portion, milky white in colour and runs slightly in irregular fashion. Its medial portion is placed over the distal portion of midgut 1. Posteriorly it opens into the centre of anterior portion of pylorus. The anterior and posterior portions are slightly tapering at the junctions and the whole tube is provided with two rows of gastric caeca.

Pylorus :

It appears like the anterior prolongation of the posteriorly located bladder-like saccular rectum and is placed adjacent to the posterior region of the midgut 1. It is, squared in shape and elongated at the points where extremely convoluted, coiled and very much elongated malpighian tubules from its either side arise in two pairs. The tubules are separated from each other. The posterior portion of the pylorus is continuous with rectum.

Rectum :

It is the hind most portion of the alimentary canal and is bladder-like in appearance, tapering at the anterior and posterior ends. It terminates posteriorly into a small tubular region opening to the exterior through the anus.

Salivary Glands :

Each gland consists of a principal gland, a principal salivary duct, an accessory gland and an accessory salivary duct.

The principal salivary gland is distinctly divided into anterior and posterior lobes. The anterior lobe is broadly conical with tapering anterior and broad posterior ends. The posterior lobe of the salivary gland is divided into three elongated lobules. The inner and outer lobules are almost straight but the inner lobule is slightly longer than the outer and is curved out-wardly. The middle lobule is much elongated and its posterior portion is curved inwardly like a hook. At the junction of the anterior and posterior lobes arises the principal salivary duct, originating from a ring-like structure in which also opens the accessory salivary duct. The accessory salivary duct immediately after meeting the principal salivary duct passes anterior to the head region in slightly convoluted fashion, forming a loop turning down to the posterior region of the head and finally terminates in a slightly wider diverticula-like accessory gland. It is much elongated reaching almost to the length of middle lobule of the posterior salivary gland.

Male Reproductive Organs (Fig. 2) :

These include a pair of kidney-shaped, broad testes, a pair of long tubular vasa deferentia which is anteriorly swollen to form seminal vesicles on each side, a pair of coiled tubular mesadene accessory glands attached to the terminal position of vasa, a median thin globular bulb, a pair of short tubular ectadene accessory glands located attached to the middle region of bulb, a common ductus ejaculatorius and a common ductus ejaculatorius opening directly into inflatory pump of the aedeagus, within the pygophore.

The Testes :

The testes are paired, wider anterior and comparatively narrower posterior, white in colour, each consisting of seven follicles. The follicles are separated by septa-like partitions but appear compact, covered within white granulated sheath (scrotum).

The Vasa Deferentia :

The vasa deferentia are paired, long narrow tubes connecting testes to bulb, ejaculatorius. The tubes appear milky white, anteriorly swollen to form seminal vesicles. The latter taper again into narrow elongated, coiled tube opening into the anterior portion of bulb, ejaculatorius on either side.

The Accessory Glands (Mesadenia) :

The accessory glands (mesadenia) are paired, long tubular coiled structures and white in colour. Each gland is attached to the terminal portion of vasa.

The Bulbus Ejaculatorius :

The bulbus ejaculatorius is a thick greyish-white, bulb-shaped muscular organ, anteriorly rounded and posteriorly narrowed and continuous into a common ductus ejaculatorius.

The Accessory Glands (Ectadenia) :

The accessory glands are paired ectodermal, thick tubular and greyish white structures attached on either side to the middle region of bulbus ejaculatorius.

Female Reproductive Organs (Fig. 3) :

The female reproductive organs, consist of a pair of elongated ovaries, a pair of lateral short oviducts, a common median oviduct opening into the genital chamber at the posterior portion of which opens the spermathecal duct.

The Ovaries :

The ovaries are white, elongated, structures, consisting of seven ovarioles and extending on to the posterior margin of the abdomen. The ovarioles anteriorly are narrowed into terminal filaments. The ovarioles are held together by tracheoles. The tracheae also keep a balance on to the terminal filament of each ovariole. Each ovariole opens into a broad calyx.

The Lateral Oviducts :

The lateral oviducts are paired, long and broad tubes and appear white in colour. The tubes are anteriorly connected with the calyces of the ovaries and posteriorly form the common oviduct. Anteriorly near the calyx each lateral oviduct shows marked constriction. At the distal most part of each oviduct fibrous, ring-like structures probably represent the accessory glands.

The Median oviduct :

The median oviduct connects the lateral oviducts to the gynatrium (Stys 1961). The former is a thick tube appearing white, greyish in colour and wider at the anterior than at the posterior end.

The Spermatheca :

The spermatheca or the sperm receiving sac of the female comprises a flask-shaped apical bulb, strongly developed with a short pump region bordered with prominent cap-like proximal and distal flanges. The spermathecal duct is slightly long and coiled without a Pentatomid-type median dilation or dorsal outgrowth as reported by Pendergrass (1957).

DISCUSSION

Miyamoto (1961) studying alimentary organs of 8 species noted variations in the characters of salivary glands as well as in the gastric caeca of midgut 4 and commented that the group might have been heterogenous. At the same time he held that two rows of gastric caeca is characteristic through out the family and on this basis regarded the family primitive.

On the basis of the structure of accessory duct and two rows of gastric caeca the above author also regarded Cydnidae related to Plataspidae but considered the latter most specialized among those with two rows of gastric caeca (lower Pentatomoidea of Leston 1958 a and b). The findings of Kumar (1962), Ahmad and Moizuddin (1975) and present studies also confirm the above conclusion.

Similarly seven testicular follicles and seven ovarioles, (Woodward 1950, Pendergrast 1957, Miyamoto 1957, Kumar 1962 and present studies) relate the group with other lower Pentatomoid families, specially to Plataspidae with which it also shares Kidney-shaped testes and anteriorly located seminal vesicles (Pendergrast 1957, Kumar 1962, and present studies). The ectodermal sacs reported by Kumar (op. cit.) appear to be absent in the present species but similar to that in his species the mesadene glands are coiled, tubular attached to distal portion of vesdeferens and small tubular actadenes appear attached to the middle of buibus. These characters also relate Cydnidae with Plataspidae.

On the other hand the absence of ectodermal sacs in the present species appear to be a variation within Cydnidae for not only Kumar (op. cit.) has shown these sacs in all the Cydnids he studied but probably he rightly interpreted Pendergrast's (op. cit.) anterior lobes of ectodermal glands as ectodermal sacs. As Kumar (op. cit.) has rightly concluded, probably this misinterpretation of Pendergrast (op. cit.) led him to erroneous conclusion that Cydnids are related to Pentatomines.

The spermatheca of the present species is also very simple in contrast to that reported by Kumar (op. cit.), without a median dilation or without a sac-like outgrowth of spermathecal duct as reported by Pendergrast (op. cit.) in a Cydine and in this character appears similar to that of Plataspids (Pendergrast 1957, Kumar 1962 and Ahmad and Moizuddin 1975). Lack of median dilation on one hand could be a variation but on other hand it probably shows a primitive condition of lower Pentatomoids including those of Plataspidae. Ahmad and Moizuddin (1977) on the basis of scent apparatus have also related Cydnids to Plataspidae.

ACKNOWLEDGEMENT

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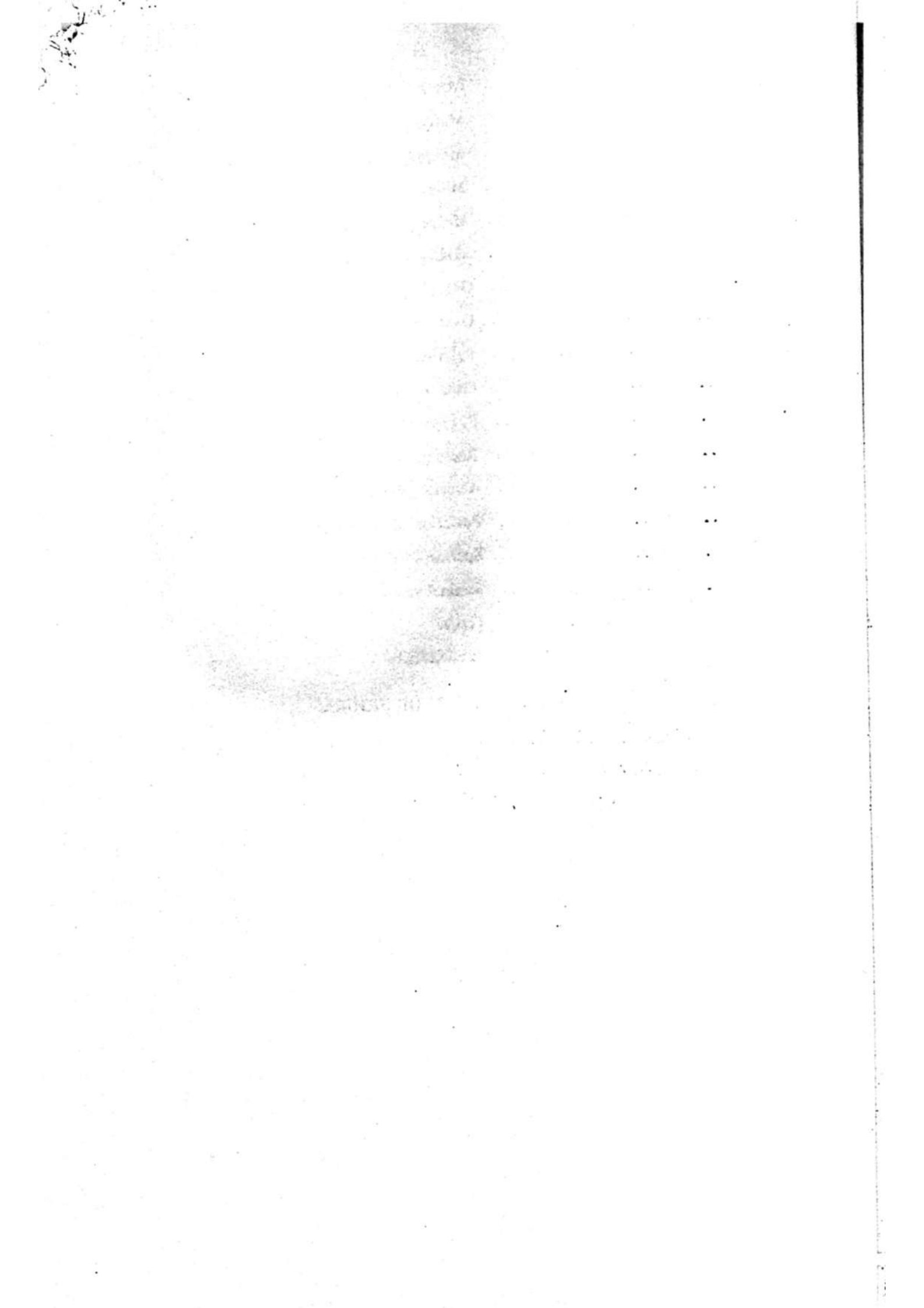
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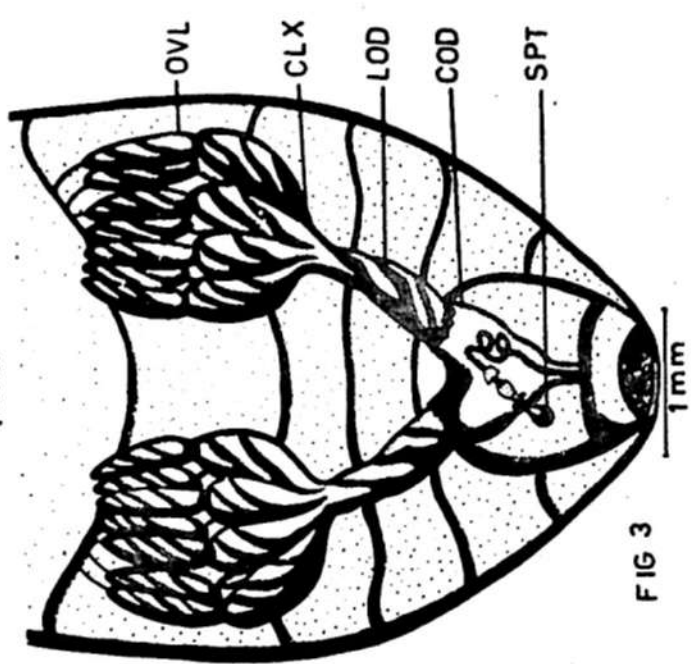
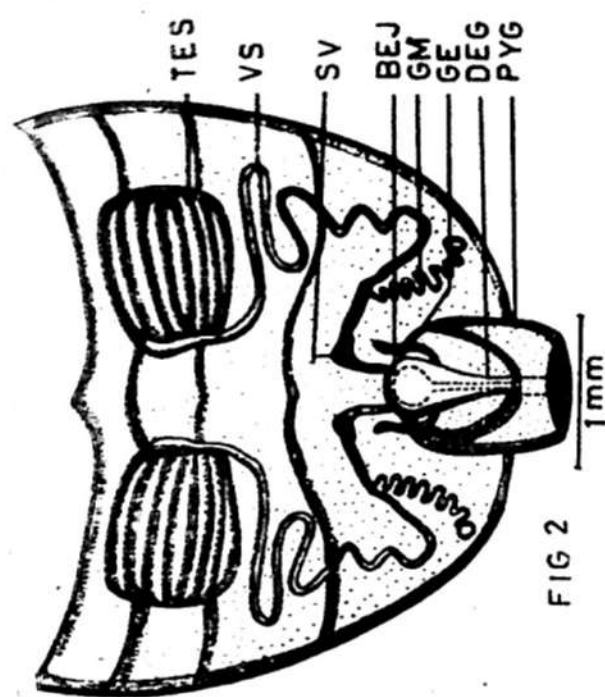
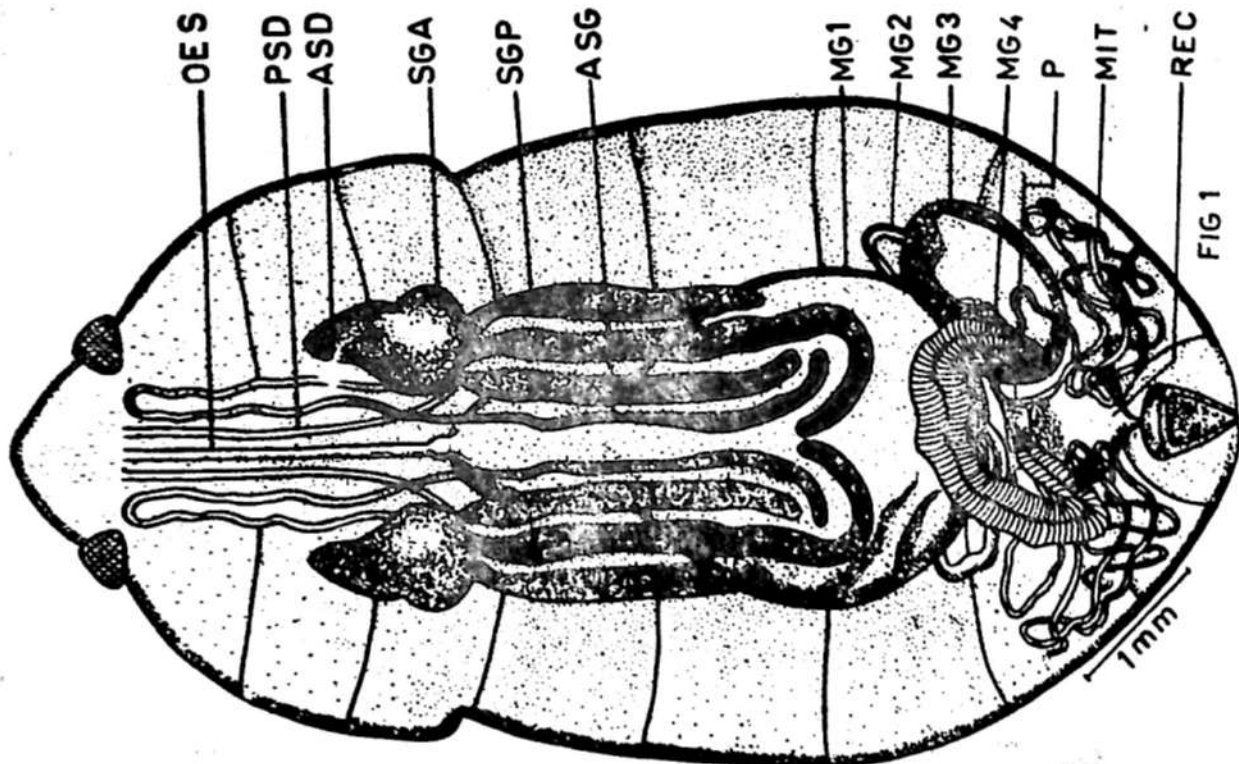
ACG	Accessory gland.
ASD	Accessory salivary duct.
ASG	Accessory salivary gland.
BEJ	..	..	..	..	Bulbus ejaculatorius.
CLX	..	..	..	..	Calyx.
COD	..	..	..	..	Common oviduct.
DEJ	..	..	..	..	Ductus ejaculatorius.
GE	..	..	..	..	Accessory gland (Ectadenia).

LOD	..	..	..	..	Lateral oviduct.
MG ₁	..	..	..	..	Midgut ₁ .
MG ₂	..	..	..	..	Midgut ₂ .
MG ₃	..	..	..	..	Midgut ₃ .
MG ₄	..	..	..	..	Midgut ₄ .
MIT	..	..	..	..	Malpighian tubules.
OES	..	..	..	..	Oesophagus.
OVL	..	..	..	..	Ovariole.
P	..	..	..	..	Pylorus.
PSD	..	..	..	..	Principal salivary duct.
PYG	..	..	..	..	Pygophore.
RE	..	..	..	..	Rectum.
SGA	..	..	..	..	Anterior lobe of principal salivary gland.
SGP	..	..	..	..	Posterior lobe of principal salivary gland.
SPTB	..	..	..	..	Spermethecal bulb.
SV	..	..	..	..	Seminal vesicle.
TES	..	..	..	..	Testis.
VS	..	..	..	..	Vas deferens .

ILLUSTRATION OF FIGURES

- Fig. 1. Alimentary organs including salivary glands of *Macroscytus subaeneus*.
 Fig. 2. Male reproductive organs of *Macroscytus subaeneus*.
 Fig. 3. Female reproductive organs of *Macroscytus subaeneus*.





OCCURRENCE OF CHANOS CHANOS (FORSKAL) (ORDER : CLUPEIFORMES, FAMILY : CHANIDAE), A SALMON HERRING OR MILKFISH IN SIND CREEKS.

BY

Mohammad Sadiq Niazi

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INTRODUCTION

Chanos chanos (Forsk.) a milkfish is a single species of the family *Chanidae* with circumtropical distribution in the Indian and Pacific Oceans. According to Day (1878—88, 1889) and Webber & De Beaufort (1913) this oceanic fish may inhabit brackish waters or even ascend rivers. These authorities, particularly Day failed to refer any specimen to be collected from the coasts of Arabian Sea now in Pakistan. Qureshi (1955, 1957) was the first to study in particular the marine fishes of Pakistan but he could not come across this fish. Misra (1962) has mentioned this fish in his work but he, too, is not sure about its occurrence in coastal areas of Pakistan as he has not included any locality of Pakistan in the distribution of the milkfish. Jaleel and Khaleel Uddin (1972) have also not included this fish in their check-list. The author while working on fishes of Sind Creeks has collected a number of specimens from Korangi, Phitti and Paitiani Creeks during the period of October to December, 1976. The present paper deals with the taxonomy and a brief account of the morphology of this fish.

DESCRIPTION

ORDER : Clupeiformes

FAMILY : Chanidae.

SPECIES : *Chanos chanos* (Forsk.).

Mugil chanos Forskal, Descript. Animal, 1775, p. 74.

Chanos slamoneus Day Fish. India 1878—88, p. 651, Pl. CLXVI, Fig. 2.
Fauna British India, Fishes. Vol. I, 1889,
Pp. 403-404. Species No. 517, Fig. 127.

Chanos chanos Munro, Mar. Fresh Water Fish, Ceylon, 1955, P. 34,
Species No. 95, Pl. 6.

Branchostegals 4 ; D. 13—16 (generally 14—16, rarely 13) ;

A. 9—11 (generally 10-11, rarely 9) ; p. 15-16 (rarely 15) ;

Ll. 75—85 ; Ltr. 12|15.

Length of head 5 to 5.3 or slightly more in the total length of the body. Height of body 4.7 to 5.4 in the total length. Eyes 3.5 to 3.7 in head about one diameter from the end of snout and a little more apart.

Body moderately elongated and slightly compressed with caudal deeply forked. Abdomen smooth and round. Mouth small, anterior and transverse. Head naked with large subcutaneous eyes. Gill membranes united. Dorsal inserted over the middle of the body with its outer margin concave and having two compact rows of small scales along its base. Ventrals abdominal, located at the level of the dorsal, below its middle.

Pectorals much low, located in the lower half of the body. Anal small with its outer margin slightly concave. Pectorals and Ventrals possessing long axillary scales above and below their bases.

Colour :

Bluish above silvery below. Dorsal and caudal greyish, dotted with light brown and margins being black. Other fins white.

Remarks :

Milkfish or Salmon Herring is a large oceanic fish attaining a length up to 6 ft. and widely distributed in different parts of Indian and Pacific Oceans. The fish can tolerate high range of salinity and can successfully keep on in the estuarine environment and even fresh water (rivers). For this fact the fish can be cultured in fresh water tanks also. Young fish move to the shallow coastal waters and enter creeks and estuaries for food and shelter. These fish were collected from Korangi Creek, Phitti Creek, and Paitiani Creek. They range from 12.5 cm. to 21.5 cm.

ACKNOWLEDGEMENT

Thanks are due to Mr. Mohammad Farooq Ahmad, Director, Zoological Survey Department for his valuable suggestions, guidance and critically going through the manuscript.

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ON SOME CARIDES OF KARACHI COASTS

BY

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INTRODUCTION

Cracker Shrimps or Carides are very peculiar and important forms of marine crustacea. They are chiefly found at the rocky-cum-muddy shores under the stones. They easily snatch the attention of the visitors of the shores due to the cracking sound produced by them, a well known characteristic of the tribe. On this group much work has already been done by Borradaile (1907), Calman (1909), Stebbing (1910), Kemp (1914-25), Gurney (1924), Burkenroad (1939), Barnard (1950). An attempt is being made to describe some of the Carides of Karachi Coasts as no work appears to have been done in Pakistan on this group.

Four species, representing three genera viz. *Alpheus*, *Saron* and *Hippolysmata* have been described here. In determining these species the specific characters have been adopted after Barnard (1950).

Species worked out :

The carides were collected from different localities of Karachi Coasts.

Temporary slides were made and figures drawn from Camera Lucida.

Species worked out :

1. Tribe..... Caridea.
 Family..... Hippolytidae.
 Genus *Saron*.
 Species *S. marmoratus* (Olivier).

(Fig. 1-6).

DESCRIPTION

The carapace of the animal is deep. It bears tufts of setae at the base of post rostral teeth and in few places of the carapace. There are three teeth on post rostral crest. Supra orbital spine is absent and the orbit is oval. The rostrum is strongly curved upward. Seven spines including the epigastric are present on the upper margin of the rostrum, where two are situated distally. The lower margin of the rostrum bears seven spines where as the proximal one is projecting strongly downward and obliquely forward. Wrist of the second leg bears seven jointlets. The 4th joint of the third, fourth and fifth legs bear two spines on the lower distal margin. The fifth pleopod differs in size from the rest i.e. it is smaller than the 1st, 2nd, 3rd and 4th pleopods. There is a small movable spine present at the base of the uropod.

Length : 75 mm.

Habitat : Found burried in the mud under the rocks.

Locality : Buleji (Karachi Coast).

- Distribution* : East Coast of Africa, Red Sea, Indian Coasts, East Indies, Pacific, Australia, Pakistan.
2. *Family* : Hippolytidae
Genus : Hippolysmata
Sub-Genus : Hippolysmata
Species : *H. vittata* (Stimpson)
 (Fig. 1—6).

DESCRIPTION

The carapace is smooth. There is no spine except on the anterolateral corner of the carapace. The rostrum is shorter than the carapace, nearly straight. It bears eight teeth on the upper side. The last one being a little away from the seventh one while the lower side bears only five. The fingers and thumbs of the chela of 1st leg are rather convex and meet at the tip only. All the dactylus of last three legs have five spines, increasing in size towards the apex. The apex of the telson bears two pairs of unequal spines.

- Length* : 31 mm.
Habitat : Found hidden under rocks.
Locality : Manora Island, Karachi Coast.
Distribution : Red Sea, Persian Gulf, India, Andaman Island, East Indies, Japan, Pakistan.
3. *Family* : Alpheidae
Genus : Alpheus
Species : *Alpheus lobides lobides*
 (Fig. 1—5a).

DESCRIPTION

The animal has a short triangular rostrum, having its keel extending a little beyond hind margin of the eyes. There are shallow grooves on either side of the eyes. There are no supra orbital spine. The first chela is large in the male, comparatively smaller in the female but similar in both the sexes. The second leg is about $1\frac{1}{2}$ times bigger than that of the length of the Carapace. A movable spine, each on the lower surface of the third and the 4th legs is present. The telson is $1\frac{1}{2}$ times as long as broad and has two pairs of dorsal spinules of which the anterior pair is situated at about middle of the telson. The postero-lateral corner of the telson bears two unequal spines having the apical margin slightly convex.

- Length* : 29 mm.
Habitat : Rocky-cum-muddy shore.
Locality : Korangi Creek, Goni, Buleji Coast, Karachi.
Distribution : Nicobar Island, Coast of India, East Indies, Red Sea, North Australia, Pakistan.

4. *Family* : Alpheidae
Genus : Alpheus
Species : Alpheus inopinatus

(Fig. 1—4b).

DESCRIPTION

The carapace is smooth. It has no spine. Its apex is produced into an acute, flattened and feebly concave spine like rostrum which is a little longer and narrower in male than in female. In both male and female large chela is similar but in case of female it is smaller in size. On the inner apex of the 4th joint of the large chela there is a sharp tooth. The outer and inner margins of Palm has blunt end before the transverse groove. The groove on inner surface extends proximally as a triangular depression. The apex of the upper margin of the merus of the small cheliped in the male is obtuse and unarmed. The margins of the other two joints are also unarmed but has a few setae inserted on them.

ACKNOWLEDGEMENT

The authors wish to thank Mr. Mohammad Farooq Ahmad Director, for providing research facilities, encouragement & valuable criticism.

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EXPLANATION OF THE FIGURES :

*Plate—I**Saron marmoratus*

- Fig. 1. The whole animal.
 Fig. 2. Carapace showing characteristic of the rostrum.
 Fig. 3. Mandible.
 Fig. 4. 1st Chela.
 Fig. 5. Telson.
 Fig. 6. Uropod.

*Plate—II**Hippolysmata vittata*

- Fig. 1. The whole animal.
 Fig. 2. Carapace.
 Fig. 3. 1st Chela.
 Fig. 4. 2nd Chela.
 Fig. 5. 3rd Chela.
 Fig. 5a. Dactylus.
 Fig. 6. Telson.

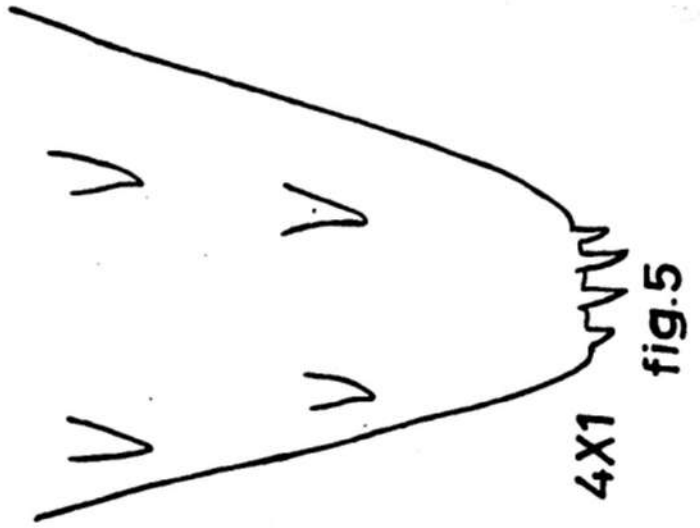
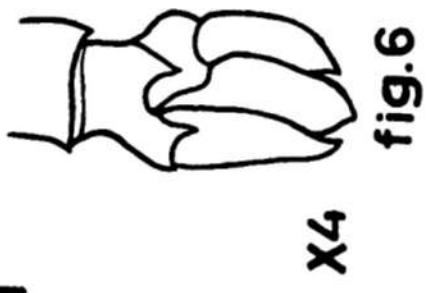
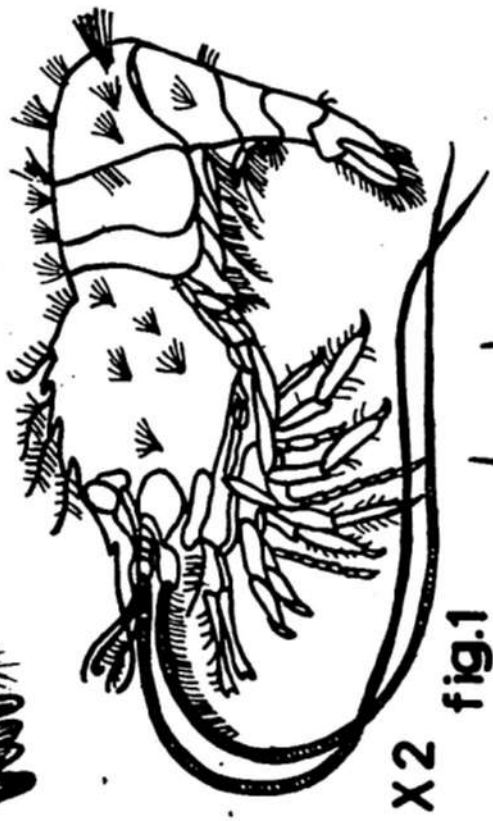
*Plate—III**Alpheus lobides*

- Fig. 1. The whole animal.
 Fig. 2. Carapace.
 Fig. 3. 2nd Chela of Male.
 Fig. 4. 2nd Chela of Female.
 Fig. 5. Telson.
 Fig. 5a. Posterolateral corner of Telson showing two unequal spines.

*Plate—IV**Alpheus inopinatus*

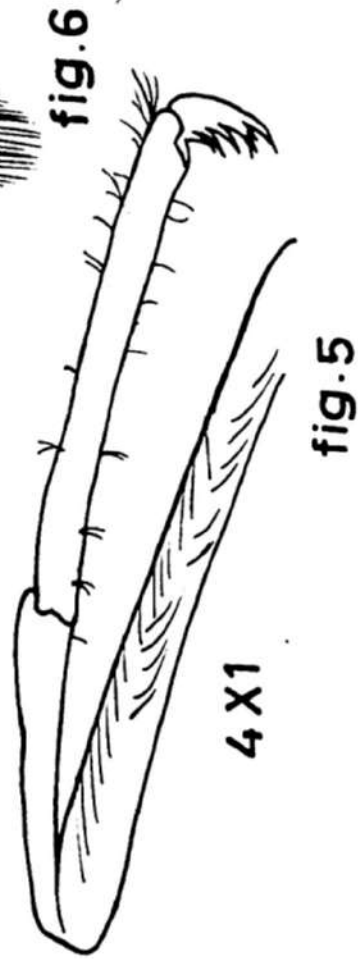
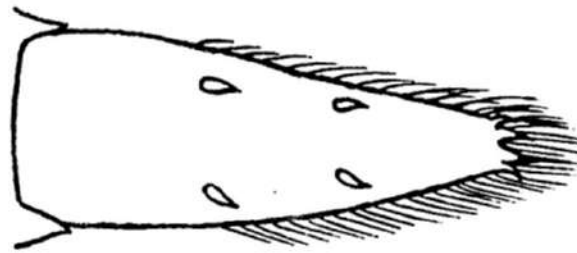
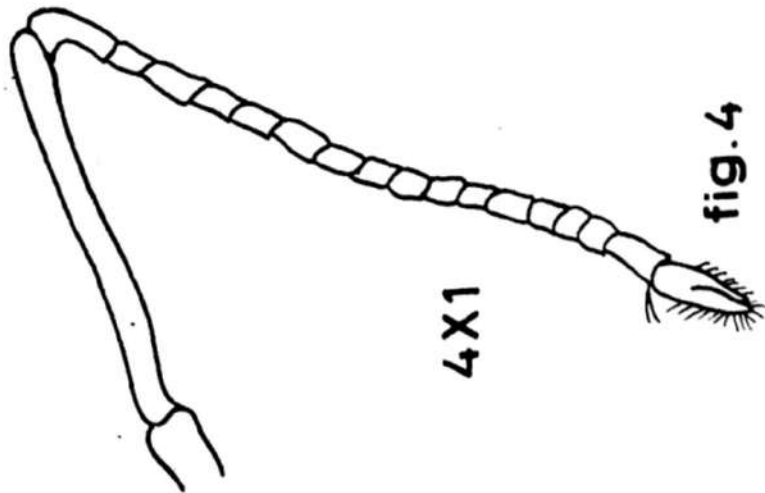
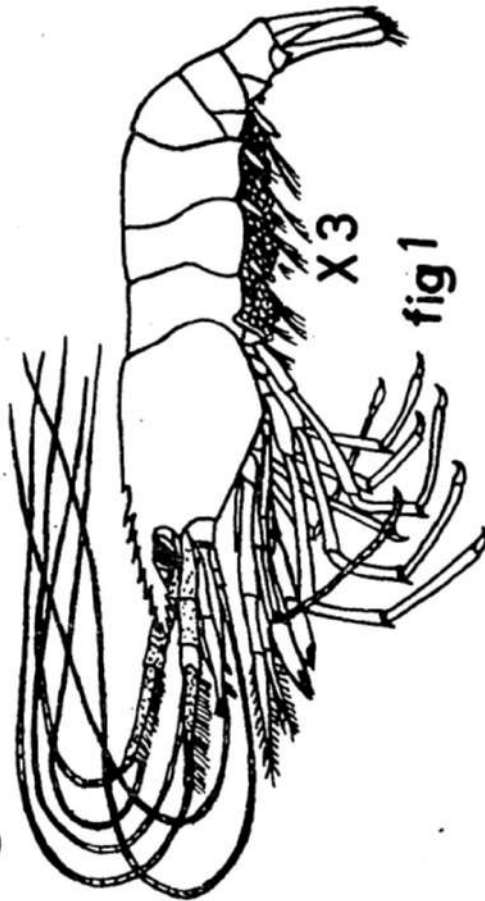
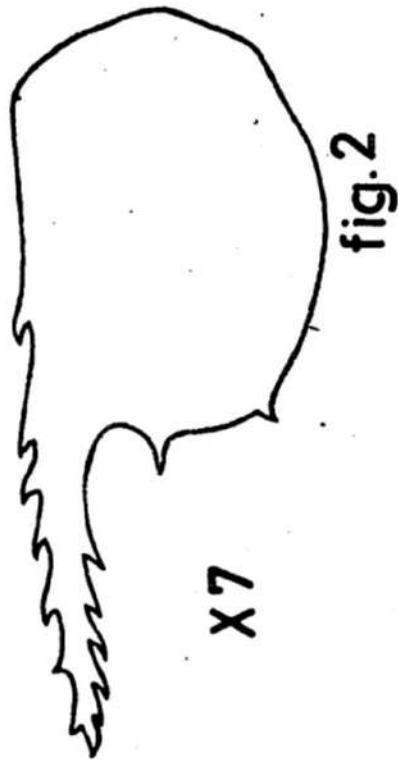
- Fig. 1. The whole animal.
 Fig. 2. 2nd Chela of male.
 Fig. 2a. 2nd Chela of female.
 Fig. 3. Telson.
 Fig. 4a. Carapace of male.
 Fig. 4b. Carapace of female.

Saron marmoratus
Plate-1





Hippolysmata vivaa
Plate-2

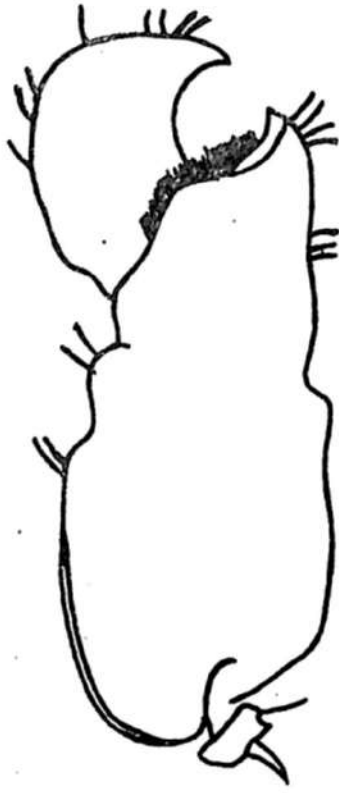


Alpheus lobidens

Plate-3



X5
fig.3



X5
fig.4

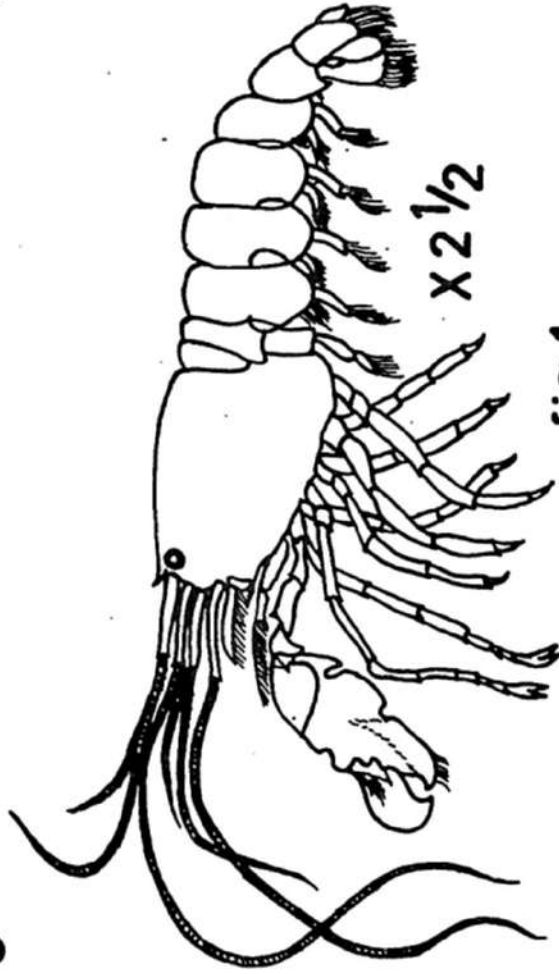
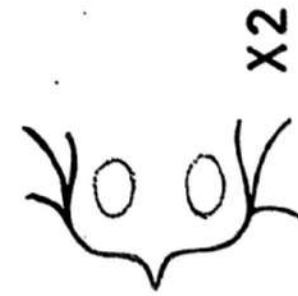


fig.1



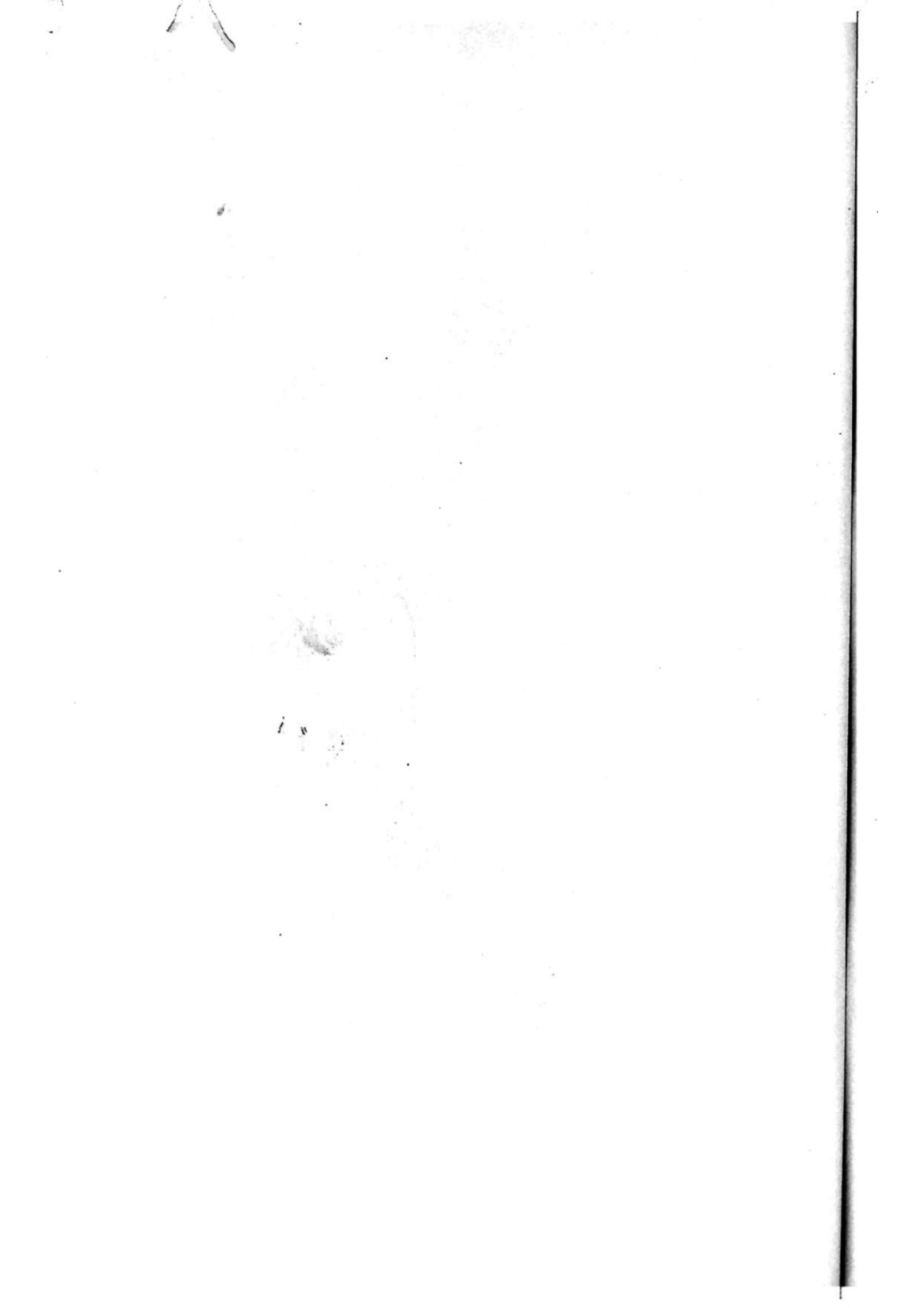
X2
fig.2



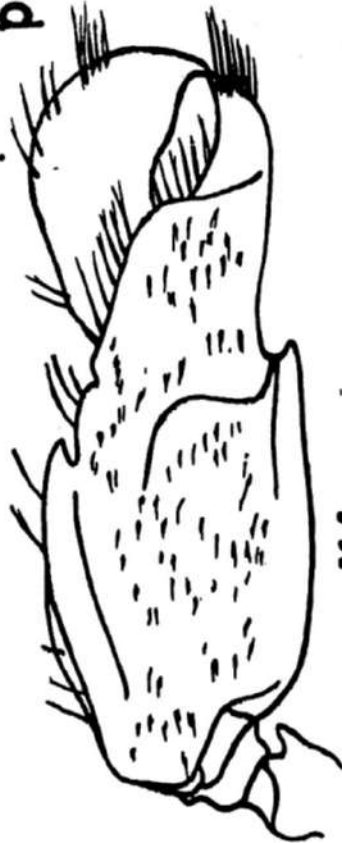
fig.5a



X20
fig.5



Alpheus inopinatus
Plate-4



X4
fig.2a



X4
fig.2b



X3
fig.1



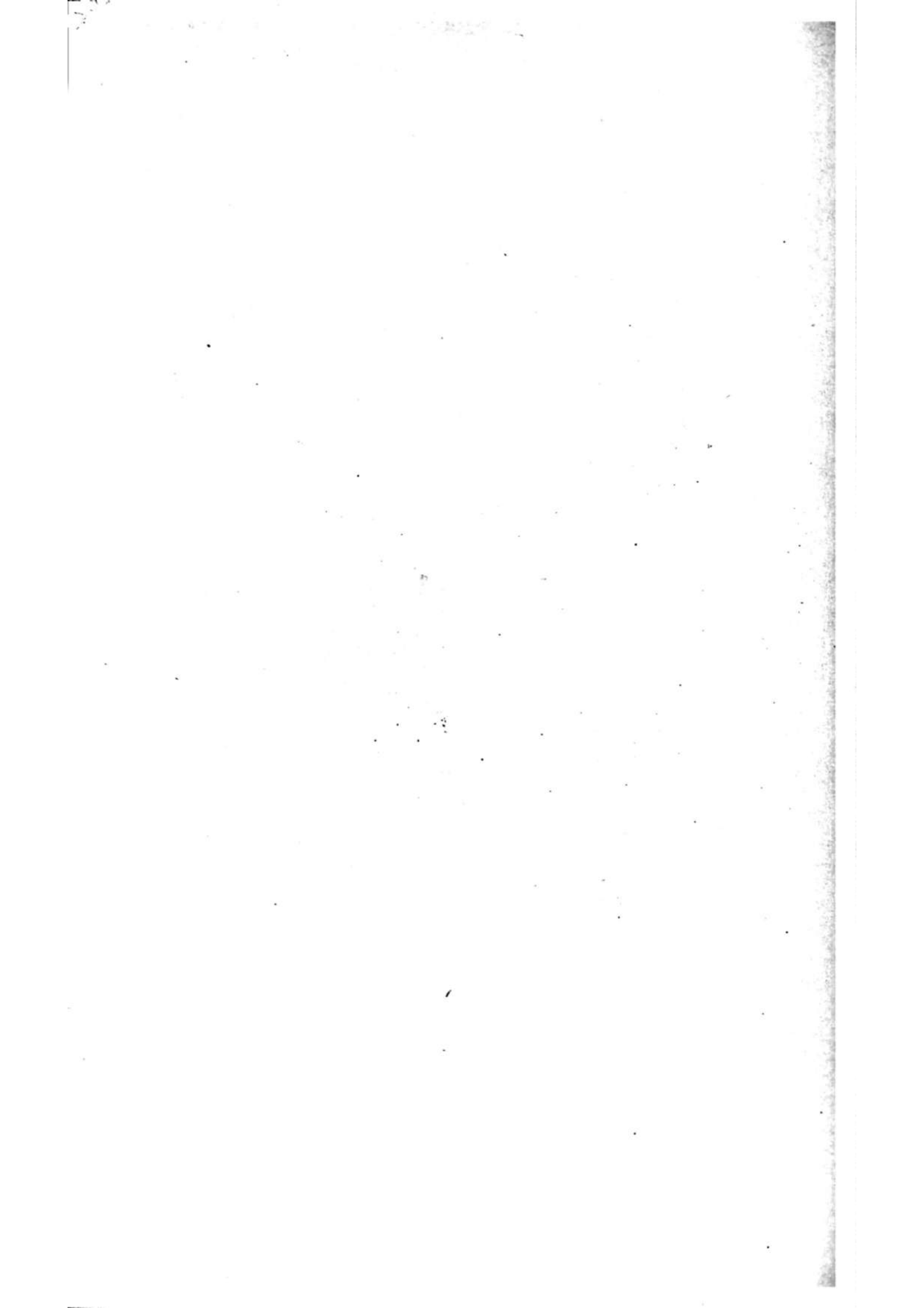
4X1
fig.3



2X1
fig.4b



2X1
fig.4a



Rec. Zool. Sur., VI (1&2), pp. 29—31, 1974.

NEW RECORD WITH DESCRIPTION OF *ACTIAS SELENE* HUBNER
(LEPIDOPTERA-HETEROCERA) FROM PAKISTAN

BY

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ABSTRACT

The present paper deals with a new record of occurrence of the moth, *Actias selene*, Hubner (Heterocera, Saturnidae) from Pakistan. Specimens collected from N.W.F.P. and Baluchistan have been examined in the Department and detailed description along with variations, noted there in, have been given.

INTRODUCTION

The Zoological Survey of Pakistan has a very rich collection of insects in general and Lepidoptera in particular. During the cataloguing of the moths collections, two interesting specimens, comprising one male and one female have been observed.

The object of the present paper is, therefore, to give a new record of occurrence of *Actias selene*, Hubner (Fig. 1 and 2) belonging to family Saturnidae. The species under reference had been described earlier by Leech (1889) from Kiukiang, by Hampson (1892) from the Indian sub-continent and Sevastopulo (1892) reported the occurrence of *Actias selene* throughout India, China, Ceylon and Burma, but he did not specify definite localities in the region now constituting Pakistan.

It appears that this species is not found in Sind since neither Cotes and Swinhoe (1887) have reported it from Karachi and its adjoining areas, nor the present author has been able to pick it up from the huge collection of moths of Sind in the Department made from 1950—1975. The specimens have been collected from Quetta (Baluchistan) and Abbotabad (North West Frontier Province).

Synonymy :

- Actias selene*, Hubner, Samml. exot. schmett. 1. Pl. 172, fig. 3; (1806-19).
Phalaena attacus luna, Cramer, pap. Exot. i. pl. 31 figs. A, B (1775).
Actias selene, Macleay, Zool. miscl. 11, pl. 70 (1815).
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 _____ Lep. Ceyl. ii. p. 123, pl. 126, figs. 1, 1a (1882).
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Plectopteron selene, Hutton, Trans, Ent. Soc. Lond. v, p. 85 (1847—49).

DESCRIPTION

Male (Fig. 1) Large moth. Head thorax and abdomen white. Head half the size of thorax in breadth, eyes small, antenna pinkish white, pectinate and produced into a hooked tip. Clypeal area of the head and the whole body covered with thick spurs; Labrum and labium small, palpi minute. Prothorax with a dark pink band. Legs pink, short slender and hairy towards the inner sides.

Fore wings produced and acute, pale greenish white at the base and covered with thick spurs. The subcostal nervure dark pink. Veins pale yellow. A round ochreous spot with light pink centre at the end of discocellulars. Hind wing as the forewing. Anal angle produced into a long pinkish tail. Veins 2, 3, 4 being curved and running along the tip of the tail.

Female (Fig. 2).

The female differs from male in having the fore-wing waved, nervures and tail of light colour.

Measurements :

Length :—	Male 120 mm. Female 112 mm.
Expanse of Wing :—	Male 120 mm. Female 146 mm.

Male :

Length of Antenna	12 mm.
Breadth of Antenna with pectinated branches in the middle :	5 mm.
Length of Head :	5 mm.
Breadth of Head :	5 mm.
Length of thorax :	12 mm.
Breadth of thorax :	8 mm.
Length of abdomen :	22 mm.
Breadth of abdomen :	9 mm.

Habitat :

One female specimen (52.7.502|123) was collected in July 1952 from Quetta (Baluchistan) by M. S. U. Siddiqi, and one male specimen (57.8.503|124) was collected in August 1957 from Abbotabad (N.W.F.P.) by Sohrab Ali.

Remarks :

Hampson (1892) reported that the male ranged between 132—166 mm and female between 140—182 mm. The small size of both male and female of *Actias selene* in the collection of Zoological Survey of Pakistan may be attributed to drought or other unfavourable climatic conditions which prompted their larvae to pupate early. No specimen has so far been collected from Punjab Province and attempts are being made for the same in future collecting programmes.

ACKNOWLEDGEMENTS

I am greatly indebted to Mr. Mohammad Farooq Ahmad, Director, Zoological Survey of Pakistan for his inspiring guidance, sustained interest and for providing facilities and encouragement during the work.

I express my sincere gratitude to Mr. S. A. Ghalib, of Zoological Survey of Pakistan and Dr. S. Shujat-ul-Akbar of Benghazi University, Libya for their critical review and correction of the manuscript.

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Actias selemne

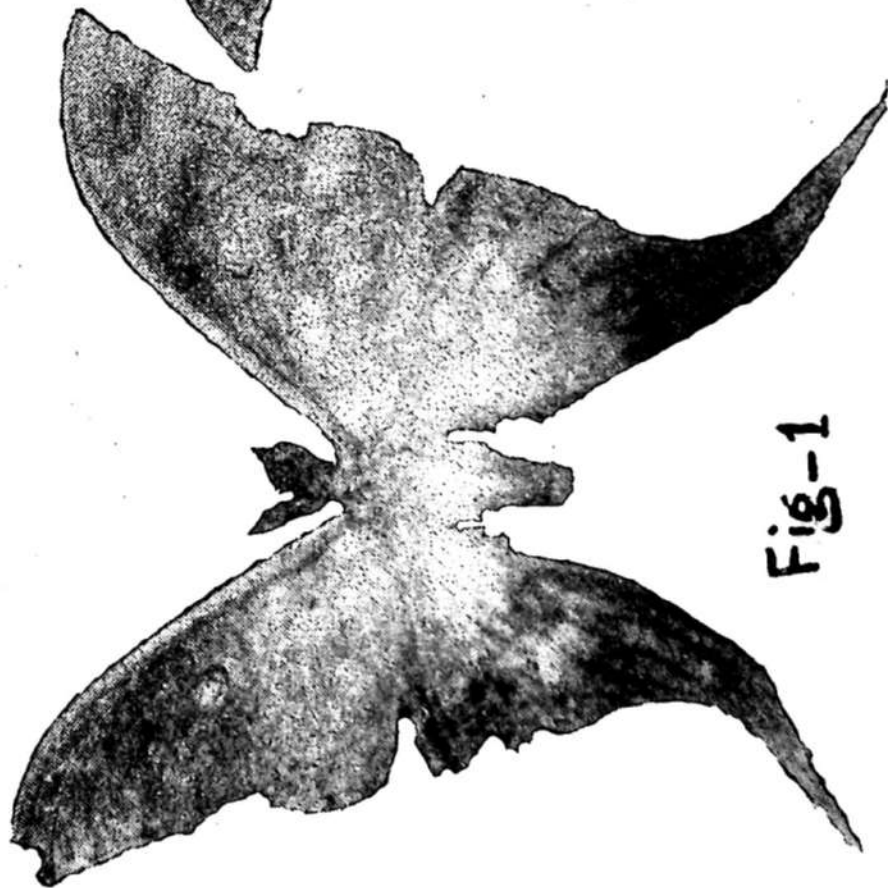


Fig-1

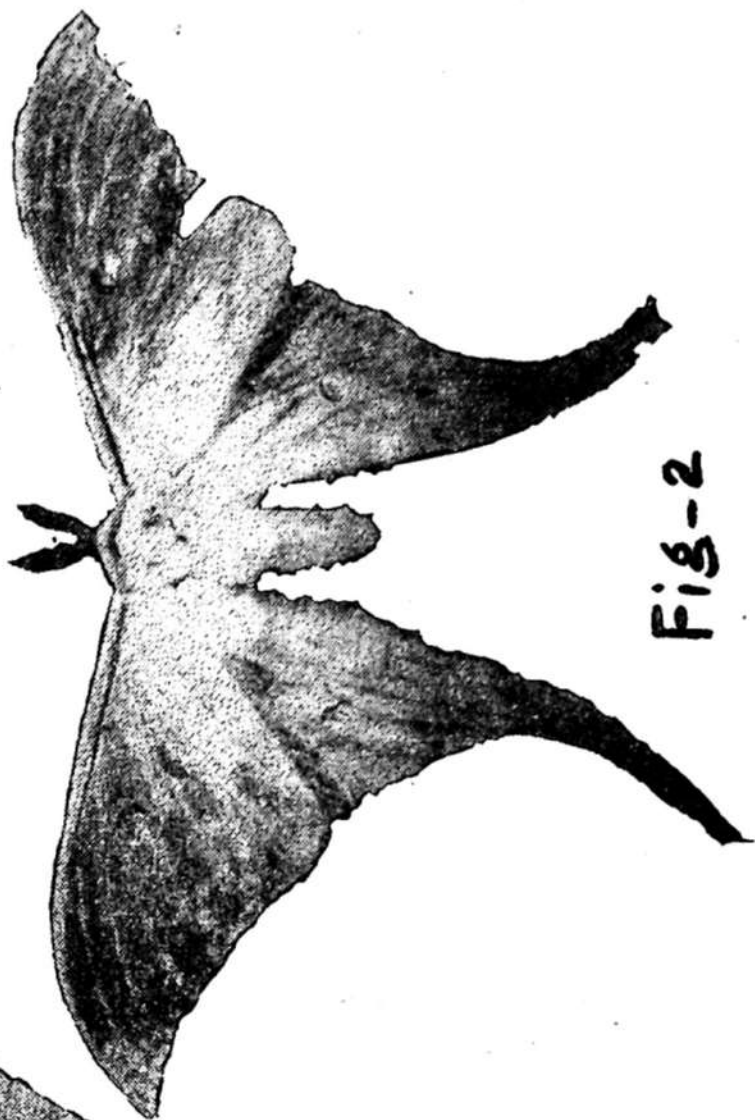


Fig-2

5-12-17



amylor
part 5/6

1/2

Rec. Zool. Sur., VI (1 & 2), pp. 33—36, 1974.

A REVIEW OF THE SKINS OF WILD ANIMALS BANNED FOR EXPORT FROM PAKISTAN (PART I).

BY

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Like living animals, the skins of rare wild animals of Pakistan are no less a source of attraction to the Pakistani exporters and for this very reason, various kinds of Mammals and Reptiles *viz.*, Panther, Snow Leopard, Caracal, Lynx, Otter, Fox, Wild Cats, Monitor Lizards, Crocodile, Alligator, Python and Marine Turtles had been subjected to reckless hunting in the ambition to earn as much foreign exchange as possible through the export of skins. Consequently unrestricted exports of the skins of these animals continued for a long time for want of any legal embargo on the export of the skins of rare/endangered species.

The World Wildlife Fund Expeditions in 1966 and 1967, through their surveys and local reports, came to the conclusion that the various species of animals had been over-exploited in Pakistan and they recommended, *inter alia*, that the export of the skins of all wild animals be banned. Accordingly, the Government approved the recommendation and in pursuance of this decision, a Notification banning the export of the skins of the following 15 species of animals was issued by the Government in 1966, (*vide* Ministry of Commerce Notification S.R.O. 37(R)|68, dated 21st March 1968, and S.R.O. 1174(I)|73, dated 9th August 1973) :—

- (1) Tiger, *Panthera tigris*.
- (2) Panther, *Panthera pardus*.
- (3) Snow Leopard, *Panthera uncia*.
- (4) Asiatic Caracal, *Felis caracal*.
- (5) Fishing Cat, *Felis viverrina*.
- (6) Leopard Cat, *Felis bengalensis*.
- (7) Marbled Cat, *Felis marmorata*.
- (8) Clouded Leopard, *Neofelis nebulosa*.
- (9) Palm Civet, *Paradoxurus hermaphroditus*.
- (10) Smooth Otter, *Lutra perspicillata*.
- (11) Marsh Crocodile, *Crocodylus palustris*.
- (12) Gaviol, *Gavialis gangeticus*.
- (13) Monitor Lizard, *Varanus spp.*
- (14) Python, *Python molurus*.
- (15) Mongoose, *Herpestes spp.*

It was latter realised that the above mentioned lists was by no means comprehensive, as the list contained only broad species, and the exporters took advantage of exporting various varieties of Martens, Bears, Foxes, Hares, Flying squirrels, Lynx, Marmot, Badger and Wolf, the population of which was on the decrease.

The Federal Government, on the advice of the Zoological Survey Department, revised the list of skins of animals banned for export, in 1974, and the said list was amended by excluding the names of the species found in (former) East Pakistan, and by adding the names of certain other rare species, the export of which was not desirable. The revised and amended list was notified through Ministry of Commerce Notification S.R.O. 299(I)|74, dated 4th March, 1974 and S.R.O. 591(I)|76, dated 19th June, 1976 and S.R.O. 599(I)|77, dated 9th July, 1977, published in the Gazette of Pakistan (Extraordinary). The list contained the names of the following 29 skins banned for export and it also restricted the export of stuffed Mammals, Birds and Reptiles :—

- (1) Panther (*Panthera pardus*).
- (2) Snow Leopard (*Panthera uncia*).
- (3) Asiatic Caracal (*Felis caracal*).
- (4) Fishing Cat (*Felis viverrina*).
- (5) Leopard Cat (*Felis bengalensis*).
- (6) Civet Cats (*Viverra* and *paguma* spp.).
- (7) Smooth Otter (*Lutra perspicillata*).
- (8) Marsh Crocodile or Mugger (*Crocodylus palustris*).
- (9) Gharial (*Gavialis gangeticus*).
- (10) Monitor Lizards (*Varanus* spp.).
- (11) Mongoose (*Herpestes* spp.).
- (12) Python (*Python* spp.).
- (13) Lynx (*Felis lynx*).
- (14) Wolf (*Canis lupus*).
- (15) Indian Fox (*Vulpes bengalensis*).
- (16) Red Fox (*Vulpes vulpes* including *domani* fox).
- (17) Brown Bear (*Ursus arctos*).
- (18) Himalayan Black Bear (*Selenarctos thibetanus*).
- (19) Indian Hare (*Lepus nigricollis*).
- (20) Cape Hare (*Lepus capensis thibetanus*).

- (21) Arabian Hare (*Lepus arabeus craspedotis*).
- (22) Common Giant Flying squirrel (*Petaurista petaurista*).
- (23) Kashmir Woolly Flying squirrel (*Eupetaurus cinereus*).
- (24) Kashmir Flying squirrel (*Hylopetes fimbriatus*).
- (25) Stoat or Ermine (*Mustela erminea*).
- (26) Beach or Stone Marten (*Martes foina*).
- (27) The Himalayan Yellowthroated Marten (*Martes flavigula*).
- (28) Longtailed Marmot (*Marmota caudata*).
- (29) Honey Badger (*Mellivora capensis*).

Note :—(1) Trophies (i.e. dead animals or horns antlers, skins, feathers and eggs) of all wild mammals, birds and reptiles, including those mammals, birds and reptiles the export of which is subject to export quota shall not be allowed.

- (2) Any stuffed Mammals, Birds, Reptiles or Amphibian shall also not be allowed for export from Pakistan except for scientific Research with the prior permission of Zoological Survey Department of Pakistan.

With further detailed knowledge acquired on the basis of population dynamics studies, about the existing distribution and status of the various species of animals, it has been felt that the said list of the skins banned for export still needs further revision to conform to the Government policy for the protection and conservation of the rare|endangered species of the Fauna of Pakistan.

The Zoological Survey Department has taken up the matter with the Government for the amendments in the existing list and has suggested that certain species of Civet Cats, Foxes, Desert Cats, Jungle Cats and Marine turtles need special attention for their protection against excessive killing for the export of their skins, and hence it is recommended that the skins of following nine animals may be added in the existing list of banned skins :—

- (1) Common Palm Civet or Toddy Cat (*Paradoxurus hermaphroditus*).
- (2) Blanford's Fox (*Vulpes cana*).
- (3) Pale Weasel (*Mustela altaica*).
- (4) Marbled Polecat (*Vormela peregusna*).
- (5) Small Indian Civet (*Viverricula indica*).
- (6) Himalayan Palm Civet (*Paguma larvata*).

- (7) Desert Cat (*Felis libyca*).
- (8) Pallas's Cat (*Felis manul*).
- (9) Marine Turtles (*Chelonia*, *Lepidochelys*, *Caretta*, *Eretmochelys* and *Dermochelys* spp.).

It is also recommended that Note (1) and (2) appearing after S. No. 29 in the existing list may be replaced by the following to make the position more clear :—

Note (1) Trophies i.e. horns, antlers, feathers and eggs of all wild animals including those animals the export of which is subject to export quota, shall not be allowed for export.

Note (2) Any dead, stuffed or preserved animals shall also not be allowed for export except with the prior permission of the Zoological Survey Department.

After the said additions and alterations, the total number of skins banned for export will increase from 29 to 38.

