OBSERVATIONS ON THE GROWTH AND HABITS OF THE GASTROPOD MOLLUSC, *PYRAZUS PALUSTRIS* (LINNÉ), IN THE ANDAMANS[1].

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(Plate III.)

In the course of a search for *Trochus niloticus* along the east coast of South Andaman in the vicinity of Port Blair in connection with the investigation on the *Trochus* shell fishery, the occurrence of a considerable population of *Pyrazus palustris* (Cerithiidae) on a patch of rocky sea-beach attracted my attention. The fact that Sewell[2] had previously published some notes on the growth of this species from data obtained in the Nicobars, and the close proximity of the Fishery Laboratory to the place of occurrence of *Pyrazus palustris* induced me to obtain additional data, if only to confirm or modify Sewell's conclusions in regard to the age and rate of growth of the species. Moreover, as the conditions under which the species lives in the locality in which Sewell collected his material and in the Andamans seemed to be different, it was thought that a comparative study of the problems of growth in the same species in two different localities would yield valuable results. The determination of the age of a group of individuals of a species and their rate of growth so far as Molluscs are concerned have been very little studied in this country, and the only papers on the subject that have been published are those by Sewell (*loc. cit.*) and by Rao[3]. An attempt to study this problem in Fish was made by Whitehouse[4].

The methods usually adopted for the study of the two closely allied problems of the determination of age and of the rate of growth in Molluscs are the " annual ring " method and the " age-group " method. I am not aware that the former is applicable to Gastropod Molluscs of the tropics in which lines of growth, when present, do not have the same significance attached to them as in the Molluscs of the temperate regions[5]. But the method has been applied with success in temperate regions of the world in respect of Fish and Molluscs, taking into account the lines of growth formed on the scales and otoliths of Fish and on the shells of Molluscs[6]. The determination of age by the " age-group " method is statistical in technique and seems to depend for its success upon the breeding season of the species being limited to a short period of the year. The measurement of the dimensions (length, breadth or height) of a large number of individuals of a population consisting of animals of various sizes in a given locality, and the tabulation of the

[1] Read before the Silver Jubilee Session of the Indian Science Congress at Calcutta, January 1938.

[2] Sewell, R. B. S., *Rec. Ind. Mus.*, XXVI, pp. 542-544 (1924).

[3] Rao, H. S., *Rec. Ind. Mus.*, XXXVIII, pp. 473-498 (1936).

[4] Whitehouse, R., *Madras Fish. Bull.*, XVII, pp. 49-103 (1923).

[5] Rao, H. S., *Rec. Ind. Mus.*, XXXVIII, pp. 476-477, pl. xiv, figs. 3-5 (1936).

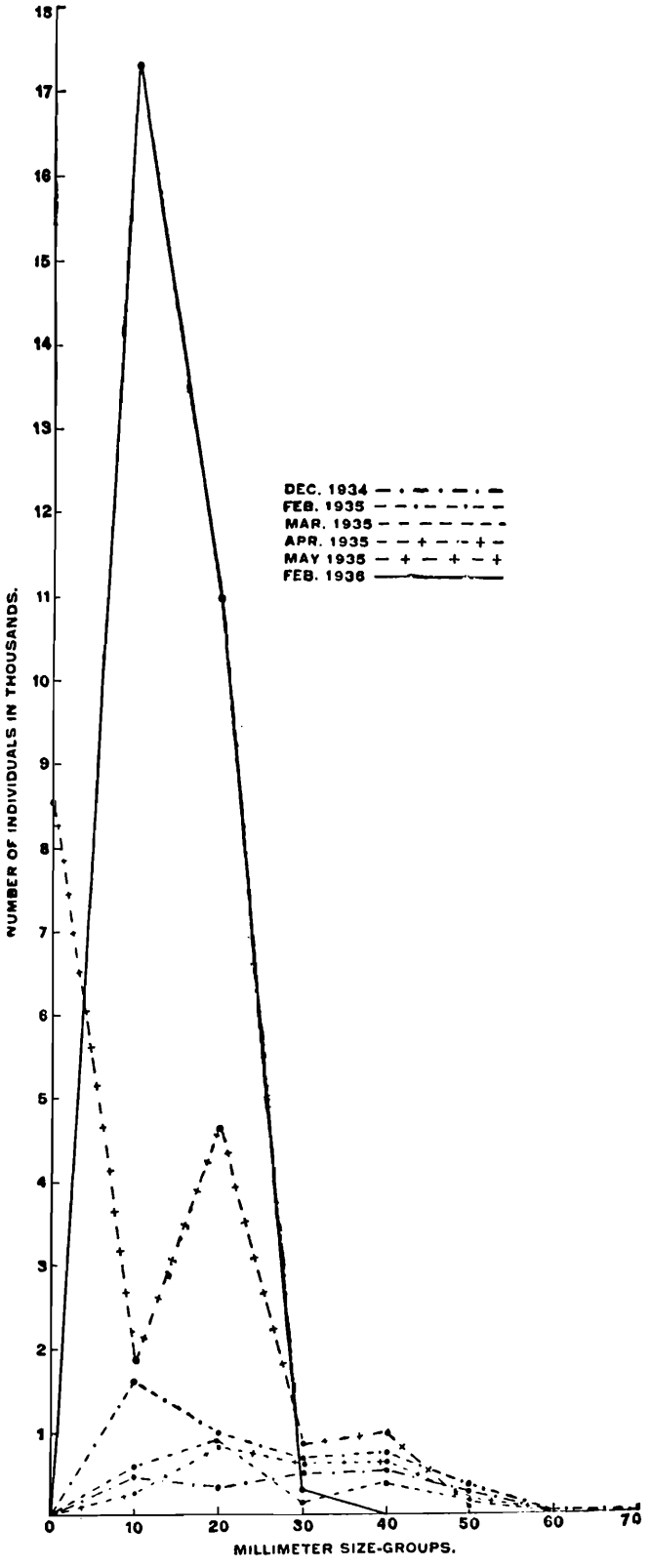
[6] Weymouth, F. W., *State of California Fish and Game Comm.* Fish Bull. No. 7, pp. 5-101 (1923).

measurements obtained will show an approximate grouping of the animals of the same age. Thus the first year group will consist of a majority of small individuals of more or less the same size, the second year group of comparatively larger individuals which are in a majority, the third year group of still larger individuals, and so on. The difference in the majority-size of these groups will indicate the extent of growth between successive years. But as age increases the difference in size between the later year-groups becomes so small that age-determination by this method becomes difficult, if not impossible. The applicability of the " age-group " method is therefore restricted to the younger groups of a species. In regard to the older groups, however, it may be used as a rough and ready method, provided that for accurate results the conclusions are capable of being checked by more reliable methods.

A careful examination of a large number of individuals of *Pyrazus palustris* occurring in Port Blair revealed the fact that a large majority were sexually immature, and that a considerable proportion of the population of this species belonged to the young stages of the first and second year classes. It was, therefore, decided to collect as much material as possible for the determination of age by the ' age-group ' or ' majority-size ' method.

The occurrence of *Pyrazus palustris* in a restricted area not more than 2,400 sq. ft. in extent along the ten-mile coast line investigated was a remarkable fact. The area (Plate III, fig. 3) in question lies between tide-marks, and is well-covered by 3 feet of water in exceptionally high tide, by 6 inches to a foot of water in places in ordinary low tide, while barely moist in others. It lies about 3 furlongs south of South Point Light and immediately north of Murdakhari Bay (Plate III, fig. 2). The rocks, worn out by wind, rain and surf, lie parallel to the shore in regular lines, and in the channels between the rows of rocks the species occurs in great numbers. Similar channels between the high ridges near the South Point Light (Plate III, fig. 1) which are a continuation of the same rocks are singularly devoid of individuals of *Pyrazus palustris*, and so are the rock-pools (Plate III, fig. 4) on the coasts in the vicinity of Port Blair. The bottom of the channels where the Mollusc occurs is covered in some places with coarse sand and gravel, and in some with soft mud, while in others it is bare and consists of rock. The entire area 2,400 sq. ft. in extent was divided, for the sake of convenience, into 12 equal plots, 200 sq. ft. each, the limits of which were demarcated by arrow-marks chiselled on the rocks. As the population of shells in the area was so large that all the individuals present could not be collected on the same day, it was decided to visit the area periodically. During the period of investigation from December 1934 to May 1935, and in February 1936 the area was visited once or twice a month, and shells (both living and dead) of various sizes found in selected plot or plots, from A to L, were collected on the same day. The shells from each plot were kept separately, and the maximum height of each shell from the apex of the spire to the anterior margin of the peristome was measured by callipers in fractions of millimeters. The measured shells were removed to a sandy bay north of the South Point Light from which access to the original place of collection was difficult.

The removal of the shells to a distant place was only a safeguard against the possibility of measured individuals mixing up with the unmeasured ones, and it was also my intention to estimate the entire population of the shells of *Pyrazus palustris* found in the area. The subdivisions of the area being contiguous and without insurmountable barriers, the animals could move about freely in search of food from one subdivision to the other. It was, therefore, found that after all the shells in a plot were removed, those from adjacent plots had crawled



TEXT-FIG. 1.—Graph showing the number of shells of *Pyrazus palustris* of various size-groups collected at Port Blair during each month of the period December 1934 to May 1935, and in February 1936.

over to the depleted one. This frequent migration of individuals from one plot to another did not frustrate my object of estimating the population of shells in the whole area, and as pointed out above, the subdivision of the area into plots was only a matter of convenience for the systematic collection of shells.

The first observation in the area under discussion was made on the 29th December 1934, and the last was concluded on the 29th May 1935, exactly five months later. Collections of shells and their measurement were also undertaken during the intervening months, *i.e.*, from February to April 1935. All the shells 10 millimeters in maximum height and those above 10 mm. were removed from the area leaving only the very young ones below 10 mm. in height. The dead shells which occurred along with the living ones were, however, not measured as many of them had their spire and peristome damaged, but the number of dead shells taken in each plot was counted and recorded. The details of these data are shown in Table I. On a subsequent visit to Port Blair in February 1936, I took the opportunity of collecting more data from the same area, which had been repopulated with shells of various sizes of the same species none of which, however, exceeded 40 mm. in height. It was also observed that the number of young shells below 10 mm. in height which could be counted in thousands in May 1935 had been reduced to less than 150. Presumably, the residual population of young shells below 10 mm. in height which was left undisturbed in the area had grown up to these sizes during the interval of about 9 months from June 1935 to February 1936. The fact that very young shells of the category 2 to 9 mm. occurred in insignificant numbers (less than 0·5 per cent. of the total population) shows that no new incursion of larval forms from the open sea had taken place during this period.

Diagrammatic representation of the Plots in relation to one another.

Names of contiguous plots.		K	F	D	C	A	B
No. of shells 10 mm. and above in height.	1935	306	2,674	2,966	1,236	4,578	2,801
	1936	3,831	36	109	445	3,431	5,873
No. of shells below 10 mm. in height.	1935	..	..	..	..	8,590[1]	2
	1936	35	..	..		..	27
		← 200 ft. →					12 ft.
No. of shells 10 mm. and above in height.	1935	1	606	1,909	2,358	464	258
	1936	1,111	2,027	4,431	5,556	832	973
No. of shells below 10 mm. in height.	1935	..	..	..	..		..
	1936	41	17	2	1	2	7
Names of contiguous plots.		L	J	I	H	E	G

[1] This number does not represent the entire population of young shells in this plot, as only specimens found in a small patch of mud 6′ × 6′, approximately one-fifth of the area of the plot, were collected. Probably, the entire population of young shells in this plot would exceed fifty thousand.

The diagram on page 196 represents the position of the 12 plots in relation to one another, the number of shells of *Pyrazus palustris* above and below the 10 mm. category taken in each plot during the years 1935, 1936. It above all shows one thing clearly, namely, the exclusive occurrence of the very young shells in Plot A during 1935 and their scanty distribution in the various plots in February 1936. The larger shells above 10 mm. in height are relatively well spread-out in the plots both in 1935 and in 1936. The exact numbers of live and dead shells found in the area in both years are shown below :

Years.	Live.	Dead.	Percentage of Dead to Total Population.
1935	28,749	4,914	14·6
1936	28,787	4,403	13·3

The plots that had a rocky bottom and were covered only with coarse sand had usually a sparse population of shells, while those in which there was abundant growth of minute algae on the bottom or a fine deposit of silt or mud had a relatively much larger population of shells, particularly of the younger forms. The very young forms below 10 mm. in height were, however, found in parts of the area where fine mud brought down from land by the rains has been deposited and left practically undisturbed during the incoming and outgoing tides. The absence of larger individuals exceeding 70 mm. in height was also remarkable, only two shells of the 70 mm. category having been found in the whole area from December 1934 to February 1936. Several of the larger examples of *Pyrazus palustris* were dissected and smears of the sexual glands examined. The visceral mass of the larger male shells is distinguished from that of the larger female shells by the presence of the yellow gonad developed round the digestive gland, which occupies a greater part of the long spiral portion of the visceral mass and is of a greenish colour with a median white streak. The visceral mass of the female is of a dull brown colour. The smears of the sexual glands of the females showed no trace of ova, while those of a few males above 50 mm. in height showed fully developed spermatozoa. Presumably, the development of the sexual products in the female takes place at a much later age than in the male. Sewell (*op. cit.*) found no sexually mature individuals at all in his collection of 212 shells of the same species in the Nankauri Harbour, Nicobars, although 44 of them were between 58 and 125 mm. in height[1].

The rocks and the mud on which *Pyrazus palustris* was found in Port Blair were carefully examined on several occasions, but no trace of the eggs or larvae of this species was detected. Some of the largest individuals obtained were kept in aquaria in the Laboratory for observations from the beginning of January 1935 to the middle of July of the same year, but as the individuals were sexually immature no eggs or larvae were observed in the aquaria. The occurrence of a large number of very young shells in the month of May 1935, which were

[1]In the Indian Museum collection there are a few large specimens of this species from an unknown locality, the largest of which is 130 mm. high. von Martens (in Max Weber's *Zool. Ergebn. Niederland. Ost. Ind.*, IV, p. 176, 1897) mentions that a specimen 160 mm. high is present in the collections at Turin.

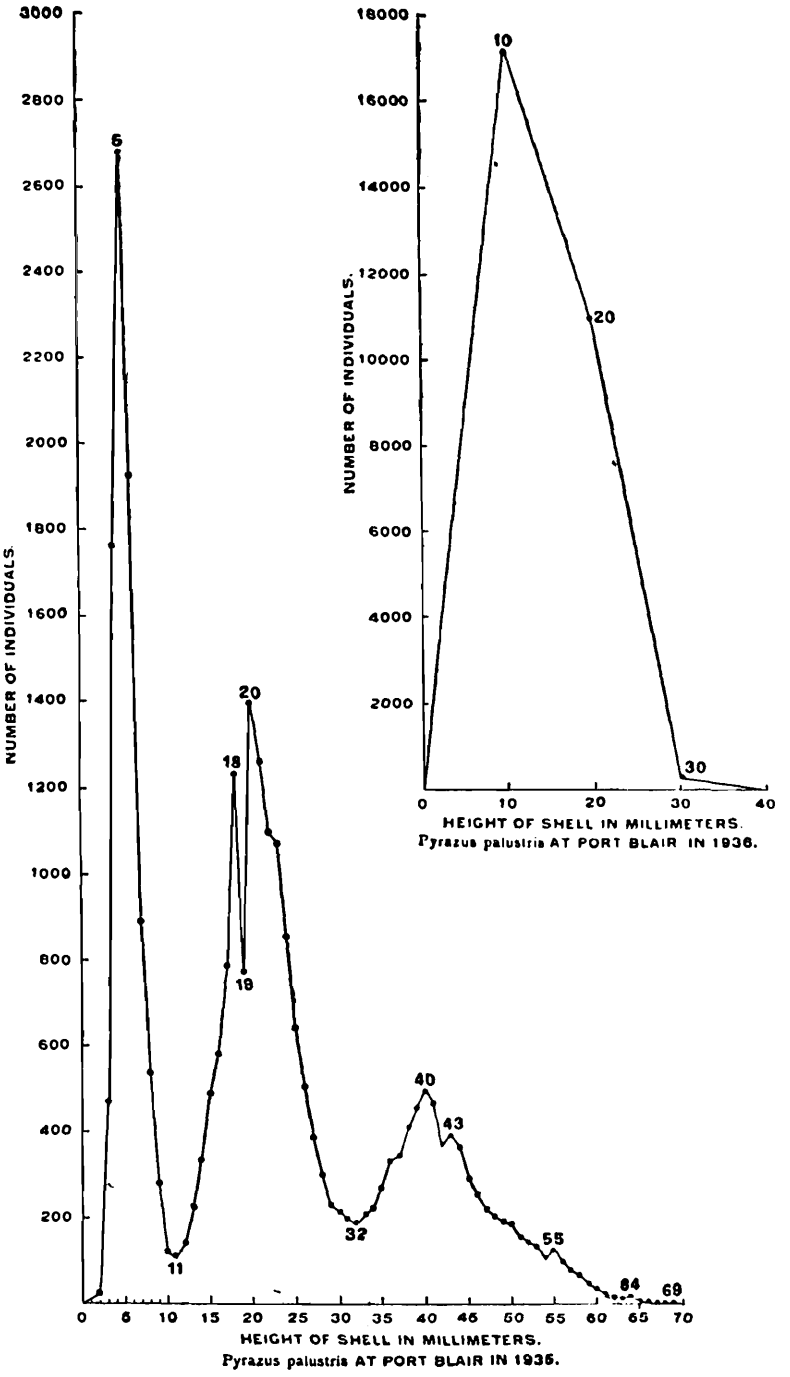
not found in the previous months from December 1934, suggests the possibility of post-larval forms from the open sea having settled down in the area. As was already pointed out, the fine silt and mud deposit in the channels between rocks being a favourable environment for the rapid growth of young forms, the post-larval population of *Pyrazus palustris* which drifted into that area must have found a foot-hold there and colonised it successfully. Examination of the plankton obtained along the coasts near Port Blair during the months December to April has revealed that a large variety of post-larval forms of Gastropods occurs in the off-shore waters of which those which resemble, in general form and sculpture, the Cerithiid shell are common. Presumably, some, at any rate, of the Cerithiid-like shells belong to *Pyrazus palustris*. Of this, however, there can be no certainty until the development of the post-larval forms is closely followed in the Laboratory[1]. One thing, however, is certain, that no adult forms of *Pyrazus palustris* have ever been observed by me along the Port Blair coast between North Bay and Beadonabad, a distance of over ten miles; and the population of this species observed in the restricted area near Port Blair could only have been derived from a much larger adult population occurring in some part of the South Andaman coast where conditions for the growth of this species are more favourable than at Port Blair.

The absence at Port Blair of very young shells between 2 and 9 mm. in height during the months, December 1934 to April 1935, and their occurrence in very large numbers in May 1935 lead to the conclusion that breeding amongst the adults of the species must have taken place elsewhere in the intervening months between January and April, or even earlier. The fact that in February 1936 the young shells of 2 to 9 mm. in height were so few in number makes it probable that the breeding season is either March or April. Until the life-history of the animal is studied in further detail, the breeding-period will be a matter for conjecture.

Considering the data presented in Table I relating to the measurements of shells collected between the months of December 1934 and May 1935, and in February 1936, it will be seen that the shells fall into eight distinct size-groups the range of which lies between 2 mm. and 72 mm. The smallest size-group consists of individuals with a height of 2 to 9 mm., and the next size-group of those with a height of 10 mm. to 19 mm., and the next of 20 mm. to 29 mm. and so on. The numbers of shells belonging to each group are plotted in the graph (Text-fig. 2) which shows several peaks in the curve, the first at the 5 mm. category, the second between the 18 to 20 mm. category, and the third at the 40 mm. category. Between the 40 mm. and the 70 mm. categories there are a few relatively low peaks which are not of much significance in the application of the majority size method to the determination of age in older individuals. Thus it is shown that in a large collection of the shells which represent the entire population of the species occurring in that particular locality, the largest numbers of individuals

[1] There were no facilities in the Laboratory at Port Blair to study the development of larval forms.

belong to three dintinct size-groups. Each of these groups seems to represent a year-class, the 5 mm. group to the first year, the 18-20 mm. group to the second year, and the 40 mm. group to the third year. The rate of growth of the 5 mm. class in a year seems therefore to be about 13-15 mm., and of the 18-20 mm. class 20-22 mm. in a year.



Text-fig. 2.—Graph showing the number of shells in the majority-sizes of *Pyrazus palustris* occurring in Port Blair in the years 1935 and 1936.

Sewell's (*op. cit.*) estimates of the year-classes in the Nicobar shells of the same species are at variance with those presented in this paper. This is to be expected as Sewell was dealing with only a small collection of shells whereas in this paper the estimates of the year-classes are based on a collection nearly 270 times as large as his, and in statistical methods of age determination the larger the sample of population measured the more accurate are the results. The comparative statement of the two estimates which is given below reveals the extent of

this variance. The range of height in mm. in each year class is taken as the criterion for determining the limits between the majority size-groups.

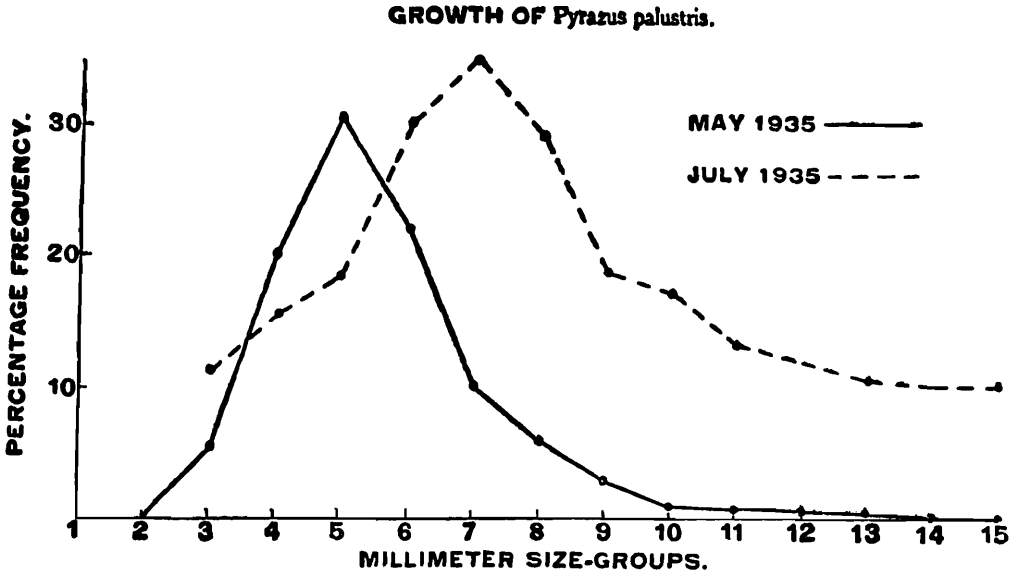
	1st year.	2nd year.	3rd year.	4th year.
Nicobar shells	9—19	24—38	58—91	109—120
Andaman shells	2—11	11—32	32—72	unknown. (probably 72—150).

The gaps in the range of size of shells from the Nicobars would probably have disappeared had a much larger collection been measured. In the Andaman shells, the difference between the lower and upper limits of the range of size of each year class exhibits a curious regularity in approximately doubling itself with each year of growth. Thus the difference in the 1st year class is 9, in the 2nd year class 21, and in the 3rd year class 40. If this phenomenon is of any significance, it should be possible to estimate the range of size of the 4th year class, which, taking the difference in the 4th year class to be about 80, would be approximately 72-150 mm.

With a view to study the rate of growth in the young individuals of *Pyrazus palustris*, a sample of mud from the Plot A containing young forms of the species was removed to the Laboratory and kept in a large basin of sea-water. The specimens contained in the sample of mud were measured and left in the basin undisturbed. The sea-water was changed everyday. A small lot of the young shells, approximately a sixth of the number present in the basin, was measured again after six weeks. The numbers of shells present in each size-group are shown in the following table. Unfortunately, further observations on growth had to be discontinued as the *Trochus* Fishery work was abandoned and I had to return to Calcutta. The specimens under observation were, however, removed to Calcutta, but a majority of them were found dead a few days after my arrival.

28th May 1935.		13th July 1935.	
MM. Size-groups.	Number of shells.	MM. Size-groups.	Number of shells.
2·0—2·9	22	2·0—2·9	..
3·0—3·9	478	3·0—3·9	15
4·0—4·9	1,761	4·0—4·9	77
5·0—5·9	2,685	5·0—5·9	121
6·0—6·9	1,935	6·0—6·9	294
7·0—7·9	891	7·0—7·9	371
8·0—8·9	539	8·0—8·9	280
9·0—9·9	276	9·0—9·9	125
10·0—10·9	115	10·0—10·9	104
11·0—11·9	61	11·0—11·9	47
12·0—12·9	32	12·0—12·9	25
13·0—13·9	5	13·0—13·9	4
14·0—14·9	3	14·0—14·9	2
15·0—15·9	1	15·0—15·9	1

The percentage frequencies of the individuals in each size-group both in May and July of 1935 shown plotted in text-fig. 3 show clearly how the mode has moved on from the 5 mm. group to the 7 mm. group. That is to say, the majority of the individuals taken in May 1935 belonged to the size-groups, 4-6, while the majority of the same lot measured again in July 1935 belonged to the slightly higher size-groups 6-8. This indicates the growth of the shell in height from 5 mm. to 7 mm. in a period of about six weeks.



Text-fig. 3.—Graph showing the growth of young *Pyrazus palustris* under Laboratory conditions determined by the majority-size method.

The movements of the individuals of the population of *Pyrazus palustris* within the boundaries of the area described in the earlier paragraphs were very considerable, but curiously, no specimen, dead or alive, was found outside the limits of the area during the period of my investigation. This is perhaps to be explained by the fact that the barriers set up by the barren rocks and sand in the surrounding regions which were practically dry when the tide had run out were sufficient to check the further colonisation of the species. Besides, heavy surf which prevails at all hours of the day along the Port Blair coast-line seems to be inimical to this species, and consequently no individuals are found on the sea-ward side of the rocky beach. Within the boundaries of the habitat of *Pyrazus palustris* at Port Blair, the rocks on the sides of the channels are covered at high tide with sea water. At this time, some examples of the species cling to the top of the rocks, but as the tide recedes they descend into the channel again or crawl into fissures and crevices on the sides of the rocks. The younger examples, particularly those below 30 mm. in height, are gregarious in their habit and congregate together in cracks and fissures at the base of the rocks or under stones. The larger examples, although slow in their movements, seem to exhibit considerable activity and are found scattered singly or in small groups of threes and fours all over the area. A great majority of the dead shells are occupied by hermit-crabs, but a few which have a worn-out spire and peristome are empty.

The features of the visceral mass in this species have already been referred to, but there are a few other points in the gross anatomy of the animal which are worthy of mention. In all the examples that

I have examined considerable reserves of food material in the form of refringent granules were found accumulated in and around the digestive gland. The long cylindrical crystalline style[1] which is lodged in a caecum, the numerous chitinous folds in the thickened walls of the stomach and the long cord-like intestine are other interesting features of the anatomy[2].

The presence of large accumulations of refringent granules around the digestive gland suggested an experiment with these animals to test their capacity to survive adverse conditions of life. Two examples, 5·58 cms. and 5·40 cms. in maximum height respectively collected on the 4th January 1935 were weighed in a chemical balance after wiping away the water adhering to the shells, and left in a large enamel basin of sea-water just enough to keep them immersed in it. The sea-water was changed everyday, and the shells (with the animal inside) were weighed (after wiping away the water) every week at first, and every month later, until they were found dead on the 4th June 1935. In the absence of mud, sand, or algal growth in the basin, the animals were completely starved. The loss of weight at the end of the first week and a month before their death was quite appreciable, but in the intervening period it was comparatively low or even negligible. The total loss of weight over a period of four months was, in the case of the larger specimen, 21·3 per cent. of its original weight, and in that of the smaller 28·8 per cent. of the original weight. The details of weighment on each occasion and other information in regard to this experiment are given below. The results having been obtained from inadequate data may not prove to be of much value in drawing conclusions from this experiment. There seems to be no doubt, however, that *Pyrazus palustris* is a species capable of tiding over adverse periods when food is not available, subsisting, presumably, on the reserves of food in the form of refringent granules accumulated in the digestive gland.

Table showing the weights of two individuals of Pyrazus palustris *starved during a period of 4 months.*

Dates on which shells were weighed.	Shell—5·58 cms. high.		Shell—5·40 cms. high.		
	Weight of shell in grams.	Loss of weight in grams.	Weight of shell in grams.	Loss of weight of grams.	No. of days.
4. i. 35	15·23	..	14·46	..	..
11. i. 35	14·76	0·47	13·63	0·83	7
18. i. 35	14·75	0·01	13·55	0·08	7
25. i. 35	14·59	0·16	13·50	0·05	7
8. ii. 35	14·54	0·05	13·50	..	14
1. iii. 35	14·54	..	13·40	0·10	21
2. iv. 35	14·52	0·02	13·39	0·01	32
4. v. 35	14·04	0·48	12·90	0·49	32
Total loss of weight in four months.	..	1·19	..	1·56	120

[1] Yonge, C. M., *Sci. Rep. Great Barrier Reef Exped.*, 1928-29, I, pp. 274-279 (1932); Seshaiya, R. V., *Rec. Ind. Mus.*, XXXIV, pp. 171-175 (1932).

[2] The anatomical features of an allied species, *Telescopium telescopium* (Brug.), are described by Berkeley, M. J. and Hoffman, G. H., in the *Zool. Journ.* V, pp. 431-436, 2 pls. (1831).

Summary.

1. From a large population of *Pyrazus palustris* occurring in a restricted area near Port Blair, the ages of the various sizes of shells have been determined by the 'majority-size' or 'age-group' method. From a study of the entire populations occurring in the area in two consecutive years it has been shown that shells 5 mm. high are in their first year of growth, shells 18-20 mm. high in the second year of growth, and shells 40 mm. high in the third year of growth.

2. The large population of young shells of the 2-9 mm. size-group of the 1935 year class reached in about nine months the next size-group 10-19 mm.

3. Growth is rapid in the very young shells under Laboratory conditions closely approximating to those in nature. 5 mm. shells grow up to the 7 mm. size in a period of about 6 weeks.

4. The habits of *Pyrazus palustris* have been studied in some detail. In early life the Mollusc seems to prefer a muddy habitat to a rocky or sandy one. The distribution of this species in Port Blair is restricted to a very small area. From the fact that no sexually mature individuals occur in Port Blair, it is surmised that the area has been colonised by post-larval stages of the species occurring in the off-shore plankton.

5. The breeding period is believed to be March or April. This is deduced from the fact that no young shells of the 2-9 mm. class occur in Port Blair between December and April.

6. The species is capable of living without food for a considerable period. The loss of weight in individuals due to want of food is demonstrated. It is presumed that during periods of starvation they live on reserves of food present in the digestive gland in the form of refringent granules.

Table I.

Table showing the number of living shells of each size-group and the number of dead shells collected on various dates in each of the twelve plots of the area in Port Blair.

Names of Plots.	Dates of collection.	Millimeter Size-groups.								No. of Shells.		Total No. of shells.
		70	60	50	40	30	20	10	2—9	Living.	Dead.	
A	29. xii. 34	..	34	313	584	513	336	478	3	2,261	370	2,631
	2. ii. 35	..	30	226	387	189	74	92	..	998	246	1,244
	22. iii. 35	..	22	151	282	105	30	5	..	595	245	840
	19. iv. 35	..	15	109	206	59	28	11	..	428	73	501
	2. v. 35	..	1	7	23	10	4	3	..	48	70	118
	28. v. 35	..	..	2	23	3	6	217	8,587	8,838	..	8,838
	7. ii. 36	..	..	..	..	7	1,490	1,934	..	3,431	725	4,156
Total No. in Plot A		..	102	808	1,505	886	1,968	2,740	8,590	16,599	1,729	18,328

TABLE I—*contd.*

Names of Plots.	Dates of collection.	Millimeter Size-groups. 70	60	50	40	30	20	10	2—9	No. of shells. Living.	Dead.	Total No. of shells.
B	12. ii. 35	..	5	25	37	317	561	1,404	2	2,351	325	2,676
	19. iv. 35	..	12	50	99	33	143	115	..	452	185	637
	15. ii. 36	..	..	..	..	..	1,414	4,459	27	5,900	168	6,068
Total No. in Plot B		..	17	75	136	350	2,118	5,978	29	8,703	678	9,381
C	12. ii. 35	2	16	111	354	195	381	141	..	1,200	430	1,630
	29. v. 35	..	1	3	20	8	4	..	..	36	70	106
	18. ii. 36	..	..	..	..	11	291	143	..	445	281	726
Total No. in Plot C		2	17	114	374	214	676	284	..	1,681	781	2,462
D	22. iii. 35	..	4	28	105	84	897	572	..	1,690	710	2,400
	22. iv. 35	..	3	29	255	339	557	93	..	1,276	600	1,876
	18. ii. 36	..	..	..	2	28	67	12	..	109	113	222
Total No. in Plot D		..	7	57	362	451	1,521	677	..	3,075	1,423	4,498
E	19. iv. 35	..	3	13	80	207	113	48	..	464	100	564
	18. ii. 36	..	..	..	..	3	97	732	2	834	630	1,464
Total No. in Plot E		..	3	13	80	210	210	780	2	1,298	730	2,028
F	16. v. 35	..	4	58	396	386	1,228	602	..	2,674	440	3,114
	18. ii. 36	..	..	..	1	5	24	6	..	36	280	316
Total No. in Plot F		..	4	58	397	391	1,252	608	..	2,710	720	3,430
G	2. v. 35	..	1	25	45	65	109	13	..	258	23	281
	18. ii. 36	..	..	..	..	..	50	923	7	980	170	1,150
Total No. in Plot G		..	1	25	45	65	159	936	7	1,238	193	1,431
H	2. v. 35	..	2	12	63	129	1,923	229	..	2,358	195	2,553
	19. ii. 36	..	..	..	2	38	3,333	2,183	1	5,557	328	5,885
Total No. in Plot H		..	2	12	65	167	5,256	2,412	1	7,915	523	8,438
I	16. v. 35	..	1	13	135	142	1,087	531	..	1,909	250	2,159
	18. ii. 36	..	..	..	1	207	2,925	1,298	2	4,433	137	4,570
Total No. in Plot I		..	1	13	136	349	4,012	1,829	2	6,342	387	6,729

TABLE I—*contd.*

Names of plots.	Dates of collection.	Millimeter Size-groups. 70	60	59	40	30	20	10	2—6	No. of shells. Living.	Dhad.	Total No. of shells.
J	28. v. 35	..	2	14	113	80	220	177	..	606	135	741
	18. ii. 36	..	..	..	3	36	725	1,263	17	2,044	504	2,548
Total No in Plot J		..	2	14	116	116	945	1,440	17	2,650	639	3,289
K	28. v. 35	..	..	13	78	57	80	78	..	306	435	741
	19. ii. 36	..	..	..	..	8	541	3,282	35	3,866	1,026	4,892
Tot al No in Plot K		..	..	13	78	65	621	3,360	35	4,172	1,461	5,633
L	28. v. 35	..	..	1	..	..	..	..	..	1	12	13
	19. ii. 36	..	..	..	..	..	32	1,079	41	1,152	41	1,193
Total No in Plot L		..	..	1	..	..	32	1,079	41	1,153	53	1,206
Total No. in Plots A to L.		2	156	1203	3,294	3,264	18,770	22,123	8,724	57,536	9,317	66,853

TABLE II.

Table showing the number of living shells of each size-group and the total number of dead shells collected during each month of the period of investigation.

Months.	Millimeter Size-groups. 70	60	50	40	30	20	10	2—9	Living shells.	Dead shells.	Total No. of shells.
December 1934	..	34	313	584	513	336	478	3	2,261	370	2,631
February 1935	2	51	362	778	701	1,016	1,637	2	4,549	1,001	5,550
March 1935	..	26	179	387	189	927	577	..	2,285	955	3,240
April 1935	..	33	201	640	638	841	267	..	2,620	958	3,578
May 1935	..	12	148	896	880	4,661	1,850	8,587	17,034	1,630	18,664
February 1936	..	..	..	9	343	10,989	17,314	132	28,787	4,403	33,190
Total No. of shells collected during the period of investigation.	2	156	1,203	3,294	3,264	18,770	22,123	8,724	57,536	9,317	66,853

TABLE III.

Table showing the total number of living shells collected in the years 1935 and 1936.

Year.	Millimeter Size-groups.							
	70	60	50	40	30	20	10	2—9
1935	2	156	1,203	3,285	2,921	7,781	4,809	8,592
1936	..	..	..	9	343	10,989	17,314	132