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The Rearing of Lobster Larvae at Flødevigen

By

ALF DANNEVIG

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A.S. JOHN GRIEGS BOKTRYKKERI

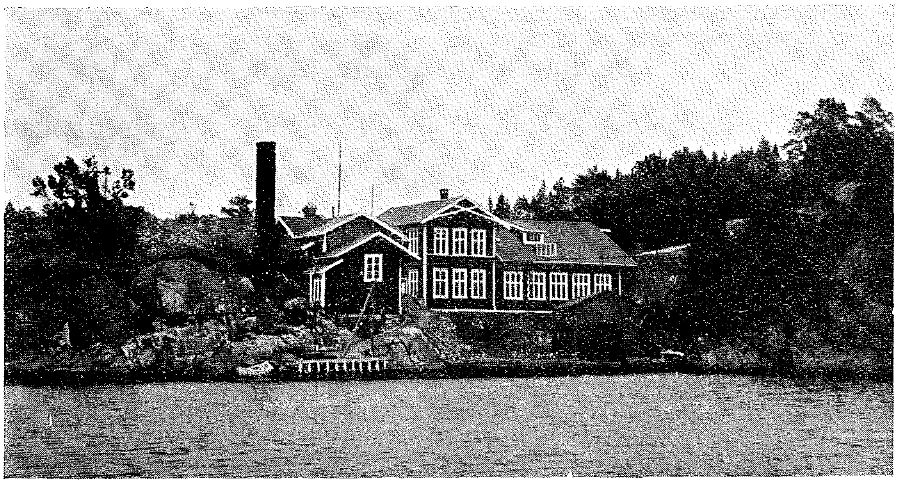


Fig. 1. The Flødevig Sea-fish Hatchery.

The apparatus now used at the Flødevig Sea-fish Hatchery for rearing of lobsters have been tried for several years, and as the results attained last summer are satisfactory I intend to give a description of them, inasmuch as I am aquainted with the fact that the problem of lobster culture is of interest to the fishery experts of several countries.

During the years 1916 & 1917 I worked with an apparatus constructed by konsulent O. Sund after the system of Dr. Mead, but with poor results. And as the apparatus was too large to be utilised for experimental work, I had to give it up, and instead undertake experiments on quite a small scale. From the experiments I soon learned that the following conditions were obligatory:

1. Quick renewal of the water.
2. Cleanliness.
3. Suitable food.

When one of these requirements failed then the larvae died or were eaten by their comrades. During 10 seasons I have now worked to find out how these requirements could be met with.

I do not intend to give a description of the many experiments (& failures) — it will be of very little interest to the reader- and perhaps less to me. I prefer to give a description of the apparatus & methods of to-day.

The hatching of the eggs.

The berried lobsters are secured from the lobster merchants during the first week of July. This is rather late as some of the lobsters have already hatched in June, and many eggs are lost by the rest by being rubbed off inn the boxes where the lobsters are kept in confinement. It will be better to take the lobsters to the hatchery at an earlier date — but this has not been done on account of the greater costs.

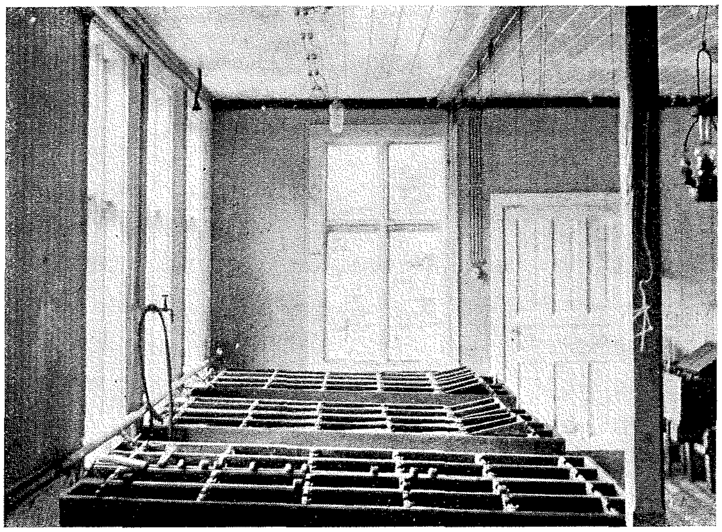


Fig. 2. The hatching apparatus.

When brought to the hatchery the breeding lobsters are placed in the apparatus normally used for cod hatching. The construction of the apparatus will be seen from the figures 2 & 3. These boxes are built of wood. The dimensions are 230 × 70 × 33 cm. By a partition board in the middle it is divided lengthwise in two compartments. These are again divided crosswise in 7 compartments each, the first and last pair being 10.5 and the others 39 cm. long. They are all watertight with the exception that the smaller ones communicate with each other through an aperture in the centerboard. In the top of each of the transverse boards is a depression 2 cm. deep and 8 cm. wide, into which is fixed a brass spout.

The apparatus is mounted 9 cm. higher in one end, and when the water is put on here, the compartments are filled — a slow current is running through the spouts. When used for lobster hatching a lesser slanting is to be preferred, about 5 cm. will be better. In the lowest compartment is placed a box with bottom made of silk net through which the water must pass.

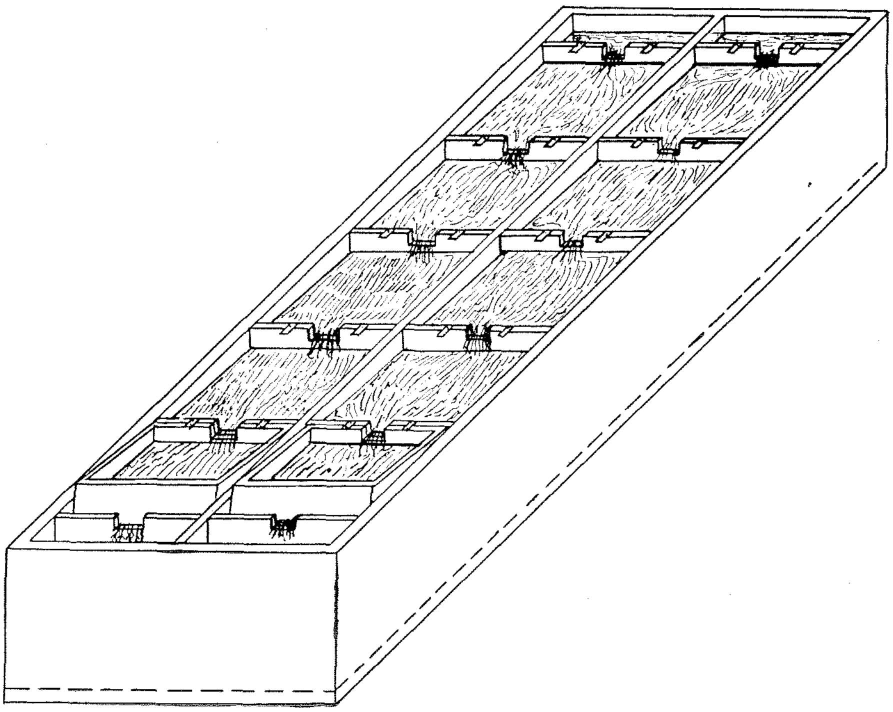


Fig. 3. The hatching apparatus (drawn in the perspective of Cavalieri).

In the left 8 compartments a lobster is placed in each, it is fed on fresh fishes, and here it will hatch the eggs in due time. On account of the temper of the lobsters we can not have two individuals in the same compartment — they will fight each other, and the eggs will be lost.

Two times a week the lobsters are lifted up and the apparatus scrubbed. It seems that the lobsters like cleanliness — when they are put back again, and the water is turned on they will at once begin to hatch. They put head down and tail upwards and by setting the pleopods going the larvae are whirled to the surface. Here they are caught by the current and carried down in the collecting box. If the larvae stay too long in the hatching room they will be eaten by the »mother.[1])

[1]) Cfr. O. Sund: Statens hummeravlsstation, Korshavn. Norges Fiskerier 1915.

Each morning the larvae are taken up from the collecting boxes, counted, and put into the rearing apparatus.

The rearing.

The method now used was arrived at in 1922. The following year three new apparatus were built, and the experiences of the preceding year were taken into consideration. The apparatus were not quite alike, however, as I wanted to make some experiments on different details. The system of current etc. was the same, however.

The results attained at in 1923 were encouraging although several details had to be altered.

In 1924 two of the apparatus (I & II) were rebuilt.

In the years 1924 — 1925 — 1926 the work was continued — but with poorer results. A new difficulty had to be overcome.

In earlier years *Cancer pagurus* had been utilised for food — but in a few years that animal disappeared from the Norwegian Skagerrack coast. Different food stuff was tried: Boiled hen-eggs, fish, *Carcinus maenas, Pandalus borealis, Mytilus edulis* and cod liver — but without success. In 1927 an experiment with beef liver, however, proved very successful — and this is now our chief food supply. In 1926 a suctoria, *Ephelota gemmipara* occurred in enormous quantities, and settled in hundreds on the larvae. The larvae suffered much and the rearing had to be discontinued. The source of the epidemy was found in the salt-water reservoir.

The experiences made by using the apparatus of 1923 were this year, 1927, utilised in the construction of a new one, still of the same system, but much greater and built of cement and iron, the former were of wood. It was found convenient to try a larger model, and a stronger & cheaper material in the rearing boxes — a point of importance when the question arises to extend the work beyond the experimental stage.

The apparatus in use summer 1927 have the following dimensions. See Fig. 4 & 5.

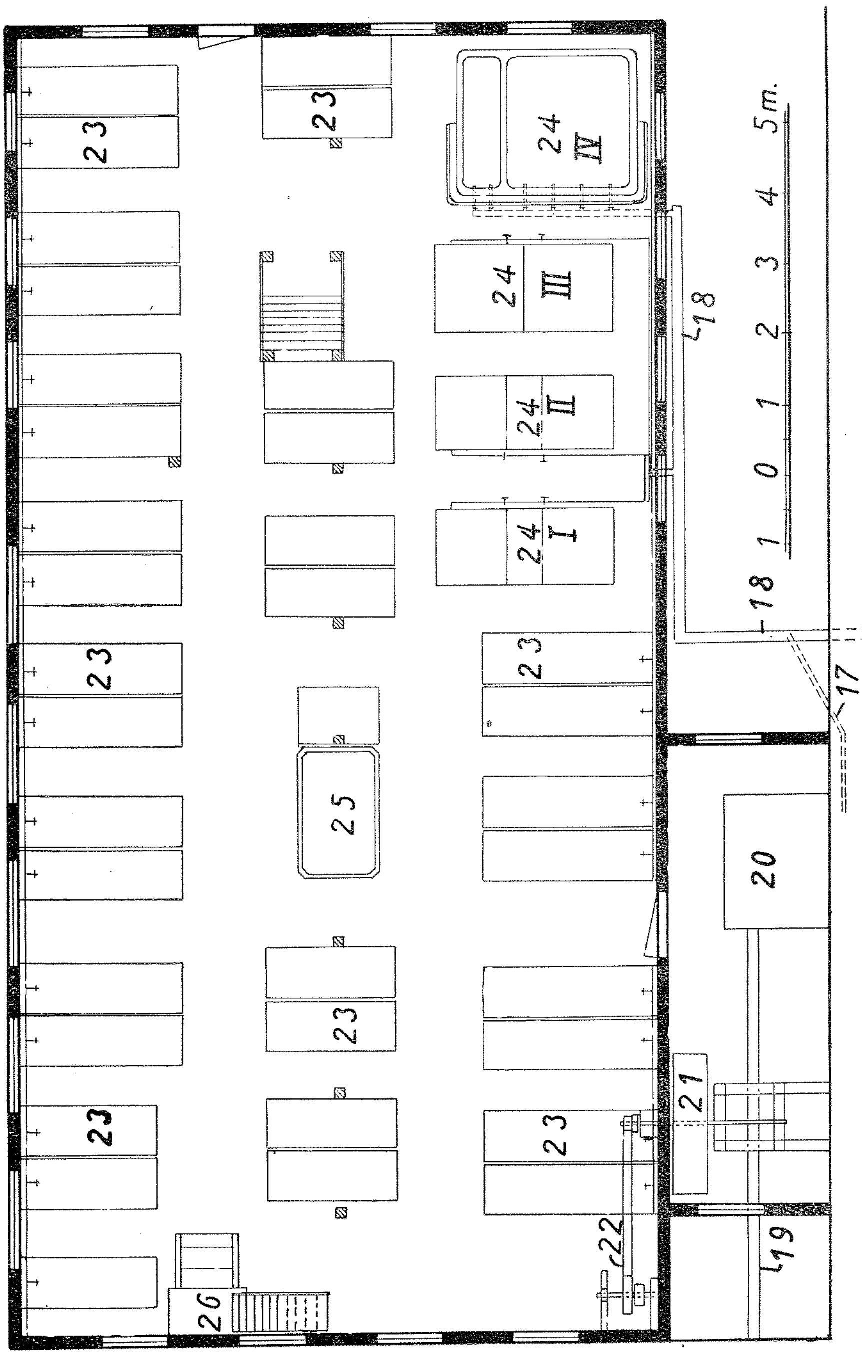


Fig. 4. Plan of hatching room.

17. Waterpipe coming from pump.
18. Waterpipe from water reservoir to the rearing apparatus.
19. Waterpipe from water reservoir to the hatching apparatus.
20. Box for the distribution of water for the hatching apparatus.
21 — 22. Waterwheel & transmissions for cod hatching.
23. Hatching apparatus for cod and lobsters.
24. Rearing boxes for lobster larvae.
25. Aquarium.
26. Staircase.

No. I. Two rearing compartments 100 × 100 × 69 cm. each with an effective capacity of ab. 500 dm.^{3}, and one spare room for cleaning purposes.

No. II. Two rearing compartments 100 × 100 × 58 cm. with an effective capacity of ab. 500 dm.^{3} each, and one spare room.

No. III. Two rearing compartments 125 × 125 × 70 cm. each with an effective capacity of 1000 dm.^{3}.

No. IV. One rearing compartment 185 × 185 × 105 cm. Effective capacity 3350 dm.^{3}. One spare room.

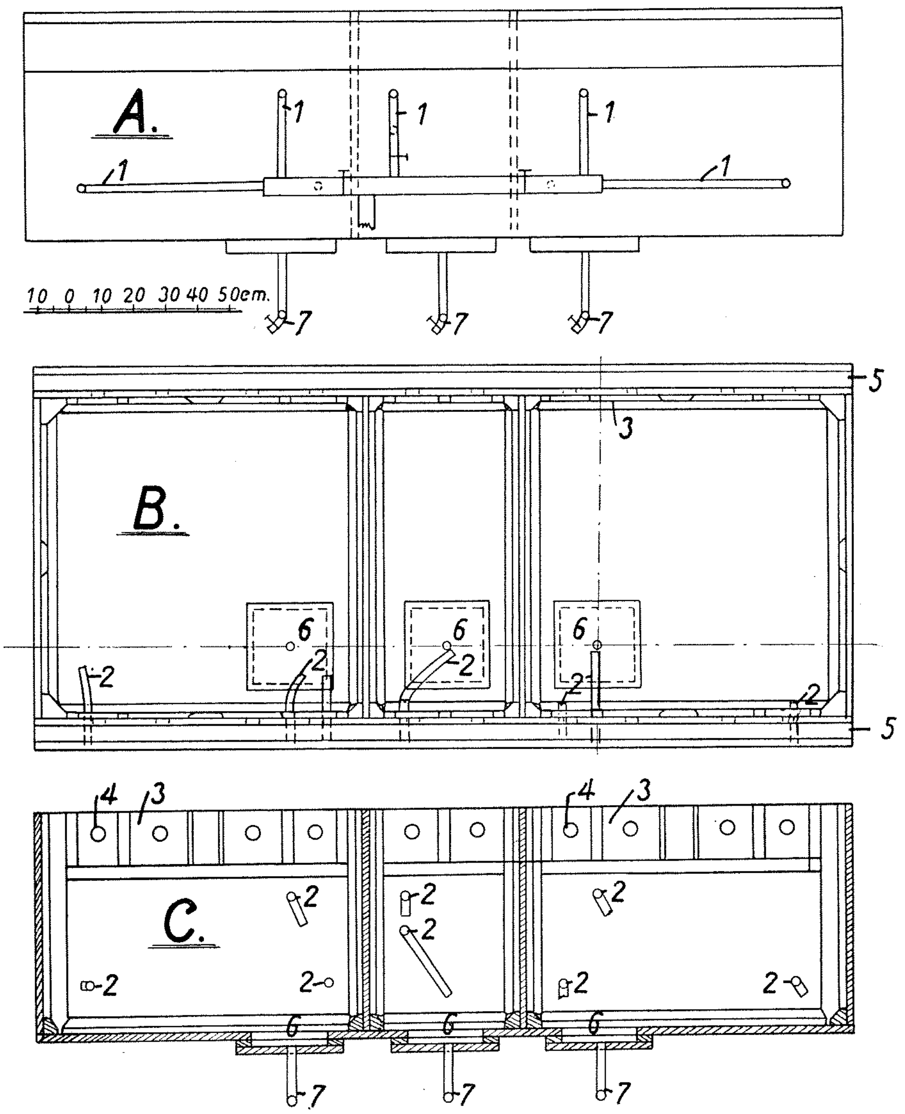
The Figures 5, A—D will show the arrangement of Apparatus I. The box is divided into 3 compartments of which the small one is intended only for keeping the larvae when the other compartments are cleaned. Each of the rearing rooms are provided with three water inlets ¾″ in one side (1), and placed as shown in fig. 4 A. all controlled, however, with the same water-cock. Indside the water pipes are supplied with bends (D 2) at about 135° to 170°. These are directed in such a way that the water mass in the box will circulate round a horizontal axis, and without forming eddies in the corners. The water is let out through a filter (3) of celluloid placed near the top of the box on both sides, the holes (4) in the box placed so high that the effective filtering space is the greatest possible to avoid pressure on the net. In each compartment of app. I & II, 2.5 Tons sea-water is used pr. hour. For emptying the compartment a waterpipe is inserted in the bottom (7), covered by a filter (6) of celluloid or brass-wire.

The middle compartment is equipped in the same way, but has two water inlets.

The transverse-boards between the compartments are equipped with ports of metal (D 8) with an effective diameter of 8 cm. These can be opened — or shut — from above.

When one of the compartments is to be cleaned (scrubbed) the ports are opened and the water outlets (4) in the rearing room are stopped in order to direct the current through the ports into the reserve room. The current in this from (2) is but strong enough to prevent the young from crowding on the bottom.

In this way the larvae are automatically carried from one room to the other. The few left are taken by a flat catcher of silk-net, the ports



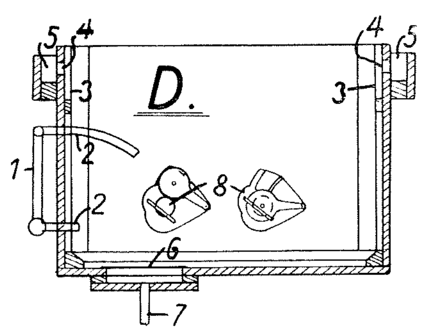


Fig. 5. A — D.
Apparatus for rearing of lobster larvae.

A. Sideview.
B. Plan.
C. Cut, longitudinal.
D. Cut, transverse.

1. Pipe for water supply.
2. Pipe for water supply, inside.
3. Filter for outlet.
4. Outlet.
5. Main outlet.
6. Filter for drainage.
7. Drainage.
8. Port.

are shut, and the compartment scrubbed. Then it is filled again, the ports opened, and the young will pass back again by the current. Such a cleaning is performed at least 3 times a week.

During the work, however, it is necessary to get away the food remnants & the empty »skins« of the larvae. A good deal of it will be pressed on the nets and may be removed by a brush, but care has to be taken to avoid the young. This will not suffice, however, the water will still be unclean. To remove the remnants of food particles & skins, fine suspended air bubbles are brought into the water pipe (18 Fig. 4) leading to the rearing apparatus. The bubbles will settle on all particles and bring them afloat as a lather, and can then easily be taken off with a flat catcher. In this way all the rearing boxes can be cleaned simultaneously in a quarter of an hour. This operation is undertaken each 6 hours and is very important. Care must be taken however not to put on too much air — or the bubbles will settle on the young ones and bring them to the surface.

Ordinarily the water supply comes from the great pond — when »air« is wanted, however, a portion of the water is taken direct from the pump through the pipe 17, Fig. 4. This freshly pumped water is always »sparkling«.

Feeding.

As mentioned previously the question of convenient food has given a great deal of trouble. Originally the *Cancer pagurus* was used — but one day that animal had disappeared from our Skagerrack coast. Different food was tried — especially *Mytilus edulis* and hen-eggs boiled for 10 minutes. Neither gave good results.

The Mytilus food was very heavy, it would not keep suspended. The yolk of eggs was taken freely — but not digested, the ventricle might be quite full but nothing in the gut. An experiment with beef liver gave fine results, however, and was last season our main food, now and then accompanied with the flesh of *Cancer pagurus* which now again began to appear along the coast.

The beef liver is cut up into pieces in order to let the heat of the animal escape and put into an icebox. When cooled it is grained fine on a meat mill — and again put into the icebox.

The larvae are fed every two hours day & night and with a portion great enough to make the water cloudy. For the apparatus I & II about 25 grammes is taken for each compartment (a 500 liters), it is mixed up in seawater and poured through a filter into the apparatus. For the first stage larvae a fine filter is used, openings nearly 1 mm., to prevent the young from getting too big pieces. If this occurs they will eat too much — and become unwell, turn pale and will not swim as quickly as before. As the young ones advance into stage 2 now and then a filter with greater holes (2 mm. openings) is used and when stage 3 is reached only this is used. Now and then greater pieces (as small peas) are given to stage 3 especially of the soft part of *Cancer pagurus.* This will hinder canibalism. For the lobsterlings in 4 stage only the coarse filter is used.

The use of a filter is convenient in order to detain the small pieces of veines & ligaments from the liver.

The rearing summer 1927.

Apparatus I & II, with an effective capacity of about 500 l. In each compartment, the following experiments were undertaken.

Experiment 1.

During the days $^{8}/_{7}$—$^{11}/_{7}$ 2 640 newly hatched larvae were put into the apparatus.

Food: The yolk of eggs boiled for 10 minutes.

$^{16}/_{7}$. The experiment had to be discontinued, the larvae died. Only 395 individuals were left on that day mostly stage 2.

Eggs as food were abandoned, all later experiments are made with beef liver (occasionally supplemented by crabs).

Experiment 2.

$^{12}/_{7}$.	Put into the apparatus	3 080	larvae
$^{31}/_{7}$—$^{1}/_{8}$.	Taken up	76	4 stage
	The rest	790	3 —
	transferred to experiment 3.		

Experiment 3.

$^{13}/_{7}$.	In	3 180	larvae
$^{1}/_{8}$.	Counted	1 104	2 & 3 stage

	From experiment 2	790	3 stage
$^{1}/_{8}$—$^{6}/_{8}$.	Taken up	1 708	4 —
$^{31}/_{7}$—$^{1}/_{8}$.	Taken up from experiment 2 ..	76	4 —
	Total	1 784	4 stage = 28 %
$^{6}/_{8}$.	Transferred to experiment 4. ..	111	3 —

Experiment 4.

$^{14}/_{7}$—$^{15}/_{7}$.	In........................	8 000	larvae
$^{6}/_{8}$.	From experiment 3..........	111	3 stage
$^{1}/_{8}$— $^{7}/_{8}$.	Taken up	2 833	4 — = 35 %
$^{7}/_{8}$.	Transferred to experiment 5...	133	3 —

Experiment 6

$^{18}/_{7}$— $^{19}/_{7}$.	In........................	10 850	larvae
$^{5}/_{8}$— $^{9}/_{8}$.	Out	3 470	4 stage = 32 %

Experiment 9

$^{7}/_{8}$— $^{8}/_{8}$.	In........................	6 150	larvae
$^{20}/_{8}$—$^{22}/_{8}$.[1]	Out........................	692	4 stage
	+	2 463	3 —
	+ preserved	100	2 —

Experiment 10

$^{9}/_{8}$.	In........................	5 400	larvae
$^{22}/_{8}$.	Out	2 725	2 & 3 stage

Experiment 12.

$^{13}/_{8}$—$^{16}/_{8}$.	In	5 405	larvae
$^{22}/_{8}$.	Out	3 161	1 & 2 stage
	+ preserved	100	1 —

Thus the four experiments 2, 3, 4 & 6, for which liver was used as food, and which were brought to a proper end, gave 8 087 lobsterlings in 4 stage out of 25 110 larvae.

And the effect of the apparatus was in the two last experiments as high as near 6 and near 7 lobsterlings per liter water.

In apparatus III (two apartments of ab. 1 000 dm.^{3}) the following experiments were carried on.

[1]. The rearing had to be stopped that day, $^{22}/_{8}$, the money granted for lobster-culture had come to an end.

Experiment 5.

16/7—17/7.	In	11 350	larvae	
7/8.	From experiment 4	133	3 stage	
9/8.	— — 6	275	3 —	
4/8—12/8.	Out	3 936	4 —	= 35 %
12/8.	Transferred to experiment 8	97	3 —	

Effect of the apparatus: near 4 lobsterlings pr. dm.³ water.

Experiment 11.

10/8—12/8.	In	9 700	larvae
22/8.	Out	2 717	2 & 3 stage

In *Apparatus* IV effective capacity 3350 dm:³.

Experiment 7.

19/7—25/7.	In	58 750	larvae
3/8.	Out	ca. 25 000	2 stage

The apparatus had to be emptied, the cement was dissolved by the sea-water so that the sharp sand stuck out and cut the larvae.

Experiment 8.

6/8.	In collected in the days 1/8—6/8.	29 950	larvae	
12/8.	Transferred from experiment 5	97	3 stage	
15/8—22/8.	Out	8 660	4 —	= 29 %
22/8.	Out	457	3 —	
	Conserved	100	3 —	

The totals of the year are:

Berried lobsters	160	
Collected	178 705	larvae
Put direct in sea for want of room	24 150	—
	154 555	larvae
Conserved for investigations	100	—
Used for rearing experiments	154 455	larvae
Reared to 4 stage & liberated	21 290	4 stage
Conserved or kept alive for further experiments	90	4 —

Liberated in other stages ca. 36 898
Conserved in other stages 320

For details as to temperature, salinity and number of larvae see the accompanying table.

Before next season the beton apparatus will be somewhat modified, it required too much water (the current was too strong) to work well. It is also necessary to find a good paint to make the surface quite smooth.

Date	Temperature C in the apparatus	S ‰	Larvae	4th Stage
1927.				
July				
8	—	—	240	—
9	—	—	380	—
10	—	—	600	—
11	—	—	1 420	—
12	17.4	29.83	3 080	—
13	17.0	29.07	3 180	—
14	16.3	28.75	3 520	—
15	16.6	29.65	4 480	—
16	16.3	29.42	4 520	—
17	15.1	28.99	6 830	—
18	14.2	29.14	5 250	—
19	14.5	29.87	6 600	—
20	14.5	29.87	8 600	—
21	14.9	27.89	8 000	—
22	15.5	27.23	8 500	—
23	15.9	24.20	10 200	—
24	14.9	25.79	6 150	—
25	13.8	28.03	9 300	—
26	13.8	29.96	7 000	—
27	13.7	30.68	6 800	—
28	14.4	30.36	4 800	—
29	14.3	30.61	3 400	—
30	14.1	31.09	3 950	—
31	15.0	28.69	5 200	41

Date	Temperature C in the apparatus	S ‰	Larvae	4th Stage
August				
1	15.5	28.55	5 600	245
2	17.2	24.13	4 900	850
3	16.2	24.94	4 750	1 000
4	16.9	24.45	5 950	1 830
5	16.2	27,16	4 150	1 675
6	17.8	26.13	4 700	3 051
7	18.1	20.70	2 800	2 010
8	18.4	23.66	3 350	743
9	17,3	25.21	5 400	370
10	17.4	24.45	3 980	110
11	16.9	26.82	3 550	75
12	16.3	29.28	2 170	23
13	15.7	30.17	2 350	—
14	15,6	30.52	1 440	—
15	16.4	28.39	770	800
16	17.0	27.11	845	1 400
17	17.3	26.53	—	1 660
18	17.2	27.68	—	1 755
19	16.9	27.74	—	1 550
20	16.7	27.55	—	785
21	16.1	28.84	—	977
22	15.0	30.77	—	435