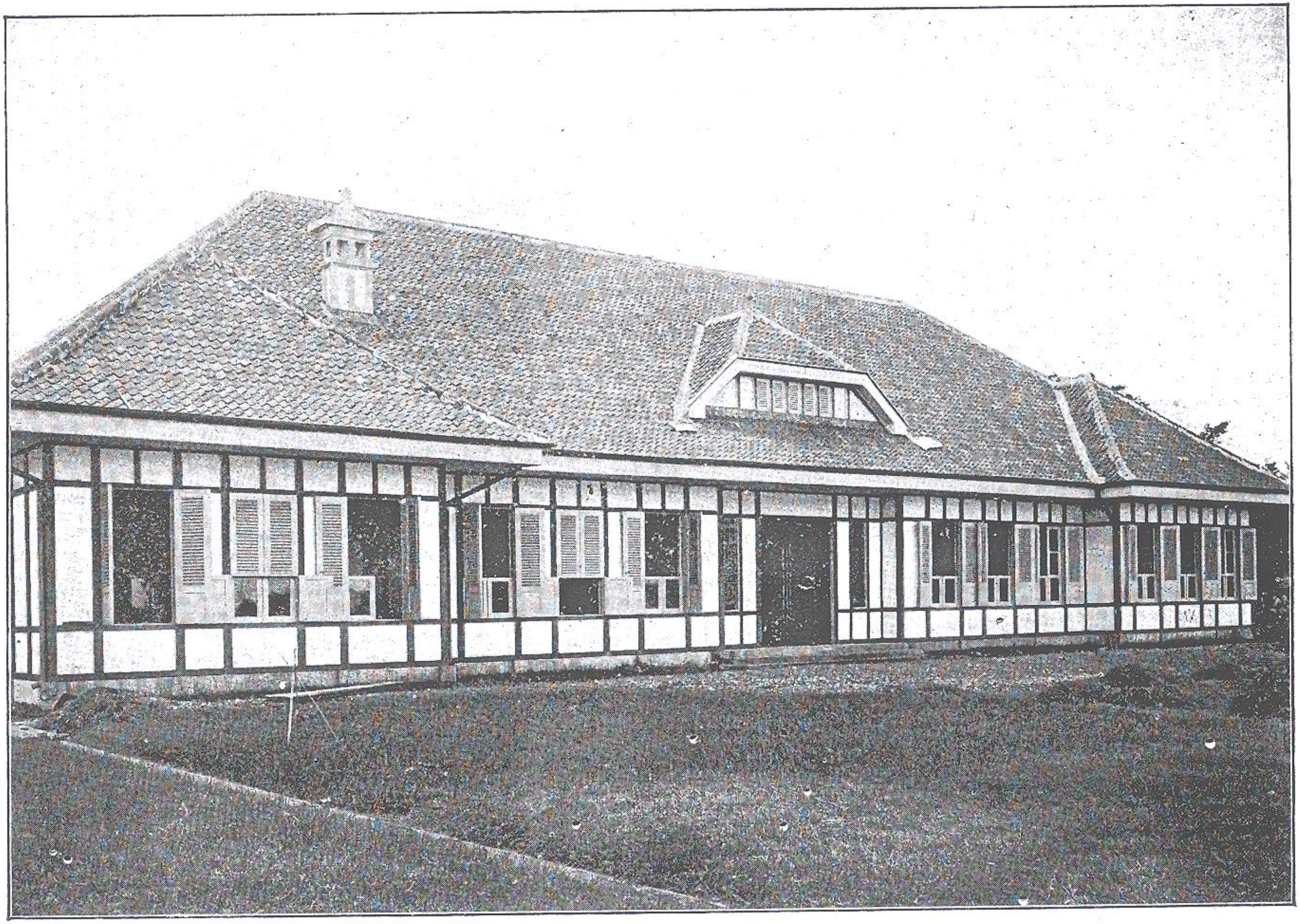

Photo No. 1 Elevation (North side) of the new Laboratory for Marine Investigations by the old Harbour Canal at Batavia (cf. 1, Plan No. 1)

THE LABORATORY FOR MARINE INVESTIGATIONS AT BATAVIA

A NEW TROPICAL MARINE BIOLOGICAL STATION

by

Dr. A. L. J. SUNIER.

(Chief of the Laboratory).

In October 1919 the initial steps were taken for the erection of the building of the new Laboratory for Marine Investigations (Laboratorium voor het Onderzoek der Zee) at Batavia, on the site of the former Fisheries Station (Visscherij-Station, cf. Photo No. 7). At this moment, (September 1922), the work is practically completed.

The site, 1 H. A. in area, is situated north of the Passar Ikan (Fish Market) on the West side of the Southerly extremity of the Old Harbour Canal of Batavia and just South of the widening towards the West of that canal.

This widening (cf. Photo No. 8) which was excavated in 1830-1833 and subsequently enlarged, now serves as a harbour for fishermen. In 1845 it was still named "Freeman's Harbour". This name was due to the fact that in the days of the Dutch East India Company another harbour existed in the immediate vicinity, which has now been filled in, and was the place where the ships of "Freemen" used to lie, i.e., of burgesses who did trade with the outer agencies (buitencomptoiren) on their own account. Hence the name of "Freeman's Harbour".

The site is an historic one, not quite 300 M. from the place where at one time the Castle of Batavia stood.

The Old Harbour Canal itself dates from 1634, that is to say 15 years after the founding, on May 30th 1619, by JAN PIETERSZOON COEN of the town of Batavia, and is the original mouth of the Tji Liwung, the river along whose banks Old Batavia lined itself out, and to which, even in early days, certain stretches, such as the Kali Besar, were canalized.

Now Batavia has always suffered from two inconveniences, i.e., too much water in the West Monsoon, and too little water in the East Monsoon. Added to which, the sea coast of Batavia, after its founding, showed a serious silting up, which was due to a secular rising of a portion of the North coast of Java. In connection with these two facts Old Batavia was seriously troubled during the East Monsoon by the formation of a mud bank in front of the mouth of the Tji Liwung, which rendered it very difficult to transport goods by lighter between the ships lying at anchor in the Batavia roadstead and the trading stores along the Kali Besar.

In order to escape this difficulty, repeated attempts were made during the 17th and 18th centuries, and also in the commencement of the 19th century, to bring the mouth of the Tji Liwung into sufficiently deep water, first by building two jetties and subsequently by continually lengthening them. As early as 1634, these jetties, consisting of pilework and coral dykes, must have been 800 M. long. In 1730 a masonry pitching was carried out. The jetties attained the present length of 3 K.M. early in the 19th century, while the existing masonry wharf sides date from 1865. In 1830-1833, however, by following the advice which VAN IMHOFF had already given in 1741, a definite end was made to this formation of a mud bank, at which date, the policy of repeatedly lengthening the two jetties was abandoned in favour of damming the Tji Liwung mouth just North of the place where the Northern castle moat discharges into said river mouth. By these means, the waters of the Tji Liwung, which carry much silt, were compelled to flow into the sea through the Western half of the Northern outer moat of the town and through the Muara Baru, which is a continuation to the sea of the Western outer moat of the town, originally excavated for carrying off flood water during the West Monsoon.

For connecting the Old Harbour Canal with the Kali Besar two lock sluices were constructed, of which the North West one only is still in use now (see "Lock", Plan No. 1).

On the oldest maps of Batavia as, for example, that of Frans Flors van Berkerode (1629), the place where the Laboratory for Marine Investigations now stands is shewn as being in the sea.

On the map published by Clemendt de Ionghe in Amsterdam about the year 1650, the site of the present Laboratory occurs for the first time; it is shewn at that period close to the sea, and serves as a field for the gallows-tree. This was still the case in 1731, but no longer so about the year 1770, in which year, under the Government of VAN DER PARRA, the well-known map published by Petrus Conradi of Amsterdam and Volkert van der Plaats of Harlingen, was drawn up; on this map the so called "Javasche Kaasjes" [1]), that is to say, poor native dwellings, occupy the site of the present Laboratory; according to a writer of the 18th centry, these dwellings were occupied by fishermen, lightermen and ladies of easy virtue.

In 1846, on the site of the present Laboratory, a large square stone market building was erected, which bore the name of Bazar Burong = Passar Borong (market where all varieties of goods can be bought). This square stone building, whose outer walls were without windows, and which enclosed a square patch of grass in the middle, was divided up

[1]) kaasjes = cagies, from the Portugese casa = house.

into 56 small rooms, giving out into a common verandah which encircled the grass patch.

This building appears to have been diverted from its original purpose early in its history, for ere long it served as a residence of great numbers of "Priestesses of Venus", who laid snares for the seamen whose ships had let drop their anchors in the roadstead of Batavia. In connection with this the building, since called the "Rumah Kuning" (Yellow House) came to stand in very bad odour. Even to day its repellent memory still persists among old residents who, in their youth, were acquainted with the purlieus of the Batavia Passar Ikan. After the harbour of Tandjong Priok came into use, the trade formerly prosecuted in the Rumah Kuning transferred itself there, and shortly afterwards even the building itself disappeared. On laying out the garden at the site of the present Laboratory for Marine Investigations, remains of the foundations only were met with which had to be removed partially with the aid of explosives.

The Northern extremity of the present Laboratory site belonged, as late as in 1888, to the Nederlandsch Indische Stoomvaart Maatschappij, originally an English company and predecessors of the present Koninklijke Paketvaart Maatschappij; it was between 1870 and 1880 used as a coal shed by Maclaine, Watson and Co., Agents of the Nederlandsch Indische Stoomvaart Maatschappij.

The site of the Laboratory for Marine Investigations is a very pleasant place to be in during the day time, and owing to the fact that in the morning between 10.30 and 11 o'clock the sea wind begins to rise, there is never any inconvenience from heat. Dust, one of the plagues of Batavia in the dry season, is unknown here, while noise is conspicuous by its absence, and the surroundings are pleasingly overgrown with vegetation.

On the other hand, the site is very unhealthy for those who stop there at night on account of the fact that the sea fish ponds situated in the immediate neighbourhood, and in which *Chanos chanos* (FORSK.) are reared, produce great numbers of the most dangerous malaria-carrying mosquitos, *Myzomyia ludlowi* THEOBALD, which are in the highest degree infectable with perniciosa and tertiana. From the data collected by Mr. M. L. VAN BREEMEN in 1917, it appears that in that year, in the vicinity of the Laboratory site, the mortality amongst the native population amounted to 100 ‰ and the miltindex amongst native children of from two to twelve years of age to 92% — 96%.

I wish, however, to state most emphatically that an eleven year's experience has taught me that anyone who spends the daytime regularly at the Laboratory for Marine Investigations, but not the night time, will never be infected with malaria there; also that malaria-infected mosquitos apparently never bite, even inside the buildings, during the daytime.

It is common knowledge that Old Batavia, including the site of the Laboratory for Marine Investigations, was very unhealthy; it is perhaps less widely known that this unhealthiness dates only from the second century of the existence of Batavia, which in those days was known as the "Grave of the East", or the "Grave of the Dutch" (Baron VON WOLLZOGEN, 1790). Many writers of the 17th and the commencement of the 18th century praised Batavia as a healthy town.

The high mortality cipher, due to malaria and dysentry [1], rose suddenly in 1733, in connection with the excavation of a canal through the piece of land called Kamal, which was commenced in 1732 but which was never completed.

Probably this excavating in brackish soil led to the formation of breeding places of *Myzomyia ludlowi* THEOBALD [2]), which may quite possibly have been the cause of the well known dying out by fever at that period of whole villages, situated on the North-West side of Old Batavia.

Further, it is not unlikely that the lack of water in the East Monsoon, from which Old Batavia with its large number of moats had to suffer, contributed its share in raising the mortality cipher during the 18th century. Although the Muara Baru and the Muara Embrat (Heemraad = Dyke reeve) were excavated as continuations into the sea of the Western and Eastern town outer moats respectively, so as to carry off flood water during the West Monsoon, yet, on the other hand, during the East Monsoon the Tji Liwung could hardly supply sufficient water to all the moats of Old Batavia.

Even after the excavation, in 1680, of the Mookervaart, in consequence of which not only Tji Liwung water, but also water from the Tji Sedani or Tangerang river, could be delivered to the Batavia moats, stagnant pools formed during the dry season in these moats in many places.

In this connection, it is not unlikely that, during the dry season, brackish water penetrated along the moats quite a good distance southwards into Old Batavia, which possibly caused the formation inside the town of breeding places of the dangerous malaria carrier, *Myzomyia ludlowi* THEOBALD.

Further, on a map published in 1788, I came across sea fish ponds occupying, even in those days, the silted up area not far North of the spot where the Laboratory for Marine Investigations now stands. As has been referred to before, these ponds are, in our days at any rate, very prolific breeding places of the most dangerous malaria carriers of the Netherlands East Indies.

Only after DAENDELS had built the palace on the Waterloo Plein in 1809, and the exodus from Old Batavia in 1816 of Europeans, who went to live in Weltevreden, had commenced, the state of health of the Euro-

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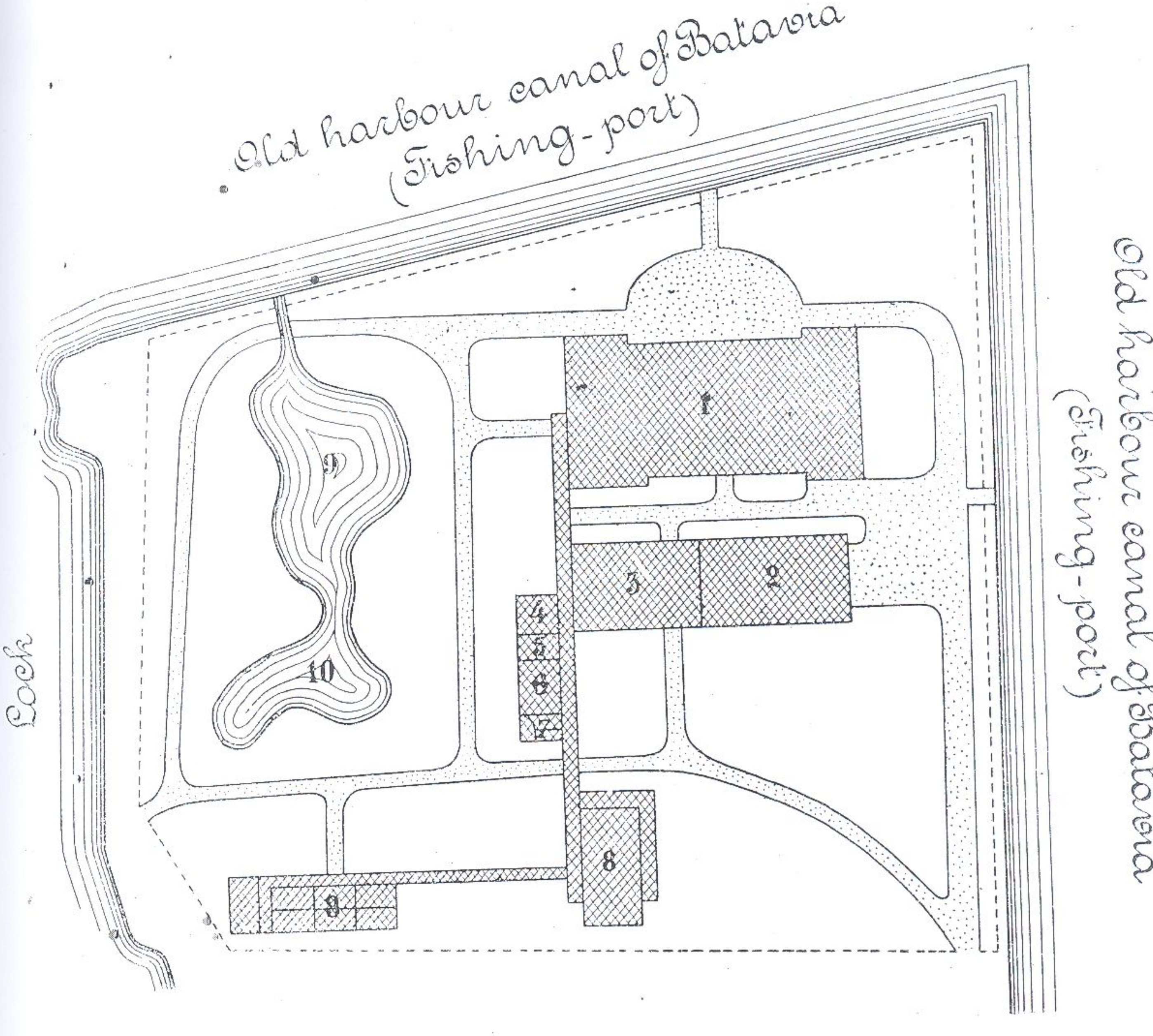
1) The first cholera epidemic in Java was in 1818, imported from British India. Before 1817 the occurrence of cholera was unknown in Java.

2) The existing breeding places of *Myzomyia ludlowi* THEOBALD, lying along the North coast of Java are, at least when they produce large quantities of these malaria carriers, invariably brackish water breeding places.

pean population of Batavia improved considerably. Undoubtedly the introduction in 1820 of the vaccine laws also contributed towards this improvement.

To-day many European districts in Weltevreden can be reckoned amongst the healthiest residential areas in Java; very few cases of intestinal trouble occur in them, while it is practically out of question to become infected with malaria there.

I have referred to the fact that the old lower town of Batavia is quite harmless to those who spend the daytime only there.. For considerations of health, therefore, no one need hesitate to spend lengthy periods in Batavia.



Plan No. 1. Site of the Laboratory for Marine Investigations at Batavia. The cross-hatched areas are buildings, the dotted areas hardened ways and paths. The broken line enclosing the site indicates the wire fence. The parallel lines, at first close together and then gradually separating denote the water's edge. The meaning of the numbers is explained in the text. Scale 1 : 1000 approx.

Plan No. 1 gives a general view of the present site of the Laboratory for Marine Investigations.

The main building, the Laboratory proper (1, Plan No. 1) faces the North, i.e., the sea, and to the South of it lies the Aquarium (2, Plan No. 1) and a rough workshop (3, Plan No. 1), roofed over but open on the sides.

The annexes 4, 5, 6 and 7, consist of:- a dark room; a store room for glass work and reagents; a store for fishing nets and implements and suchlike articles; a bathroom and closet, respectively.

The figure 8 (Plan No. 1) indicates the dwellings for those natives of the Laboratory staff who must live on the spot; these are made mosquito-proof.

The various buildings are connected with one another by means of roofed-over paths (on account of the heavy tropical sun and showers).

On the North Westerly portion of the site a pond (9, Plan No. 1) has been made which communicates to the South with a swamp (10, Plan No. 1).

The whole site is enclosed in a wire fence with angle iron posts set in cement footings.

This fence has four entrances, of which the Northerly, Easterly and Westerly are usually closed; the Southerly being the main entrance.

Just inside the Southerly fence, a hedge of *Lantana camara* L. is growing; a similar hedge, but of *Pluchea indica* (LESS.) runs along the Westerly fence.

An elevated reservoir, for water from the town main, is situated just South of the Westerly extremity of the rough workshop (3, Plan No. 1), but is not yet indicated on Plan No. 1.

The artesian water from the town water main, is lifted into this reservoir by an electrically driven centrifugal pump, whence it is distributed through reticulation pipes to the various buildings, and is also used, during the dry season, to water the lawns.

That portion of the site not built upon is set aside as a garden, in which as great a number as possible of East Indian beach and coast plants will be collected; of every species a pair of specimens.

It is not so much the object to try to grow the plants under circumstances which differ as little as possible from their natural environment, as to bring together a collection of living plants for the preliminary instruction of those investigators who visit the Laboratory for Marine Investigations, and who wish to study the beach and coast flora of the East Indies.

Already a number of living plants have been collected, principally from the coral islands of the Bay of Batavia, and have been transferred to the Laboratory garden.

In fact, there are already growing along the sides of the pond and swamp (9 and 10, Plan No. 1) which contain brackish water [1]), and also

[1]) On the 4th of May 1922 the salinity of this water amounted to 23,6 ‰.

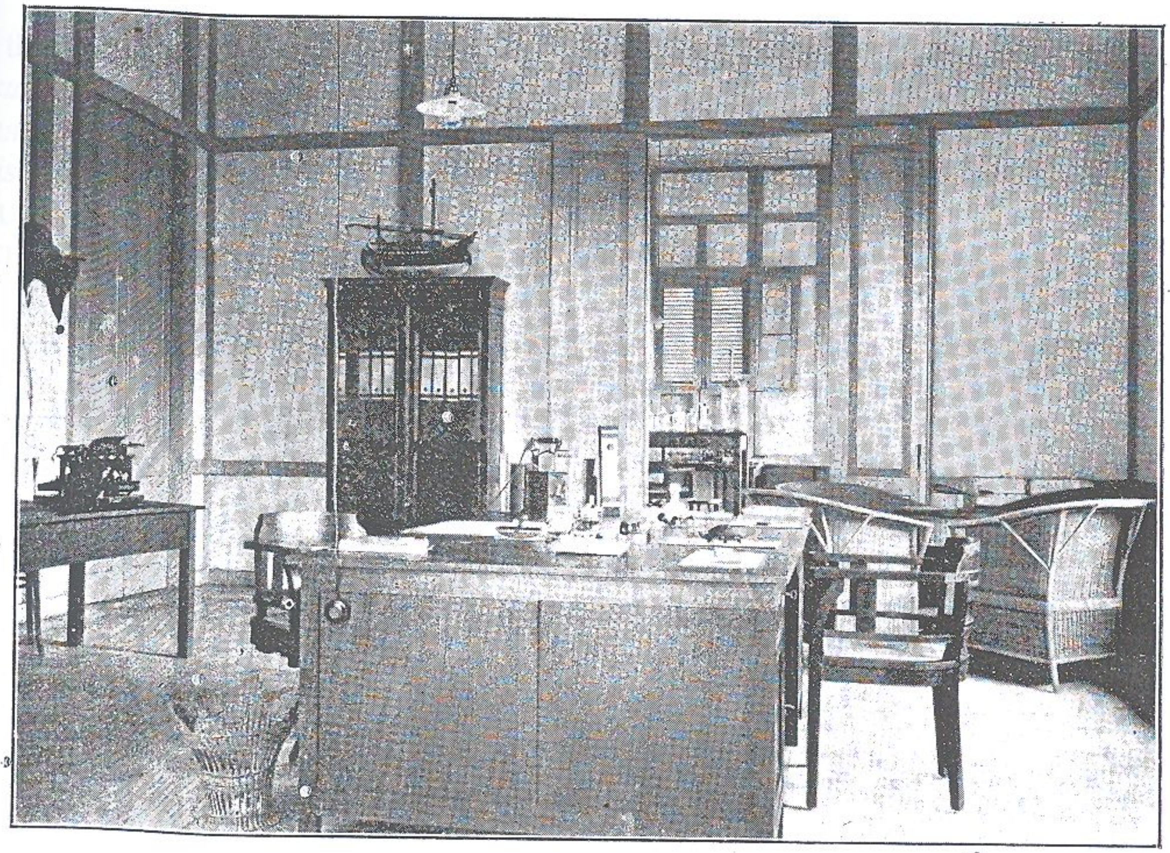


Photo No. 2. Office of the Chief (1, Plan No. 2). Through the open door in the background the Chief's laboratory is to be seen.

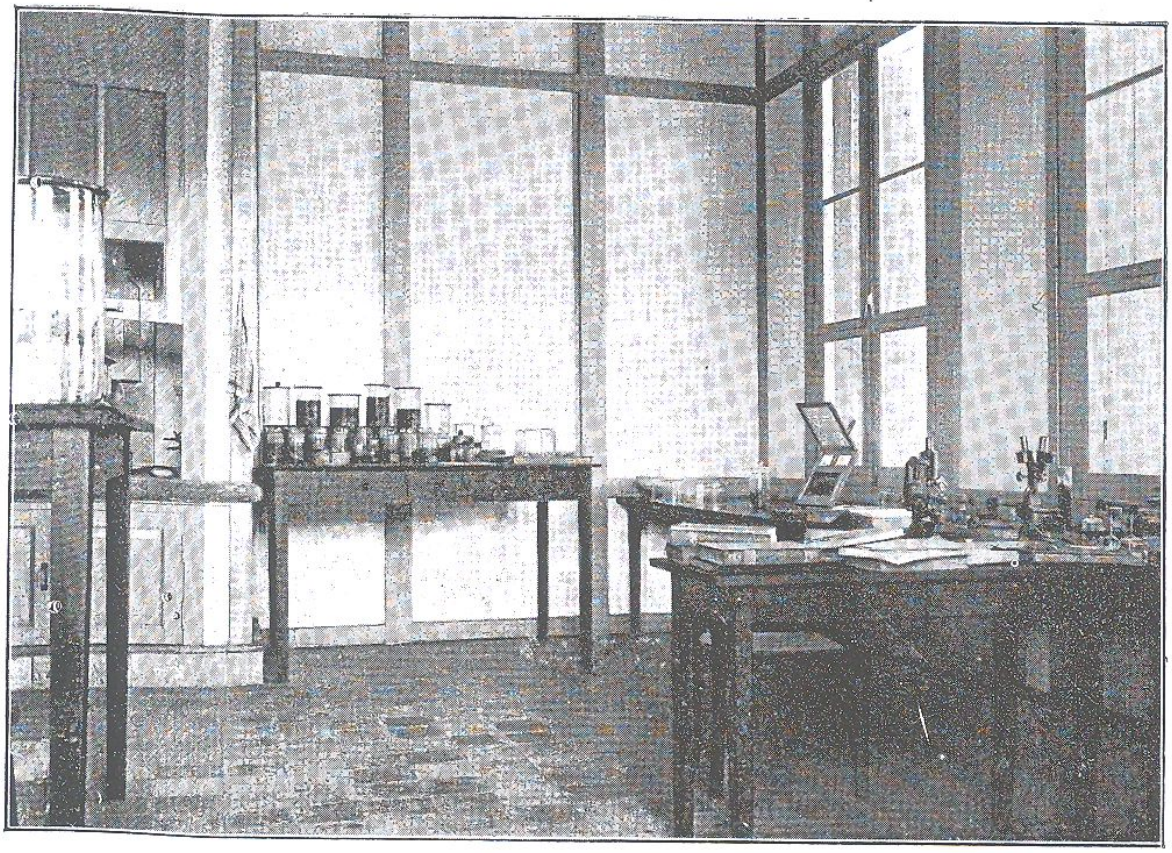


Photo No. 3. North-West corner of the Chief's laboratory (2, Plan No. 2).

in the swamp itself, such plants as:— *Acanthus ilicifolius* L., *Aegiceras corniculatum* BLANCO, *Avicennia sp.*, *Bruguiera caryophylloides* BL., *Cerbera manghas* L., *Ceriops roxburghiana* ARN., *Derris heterophylla* MERR., *Fimbristylis glomerata* NEES., *Lumnitzera racemosa* WILLD., *Nipa fructicans* WURMB., *Pemphis acidula* FORST., *Rhizophora sp.*, *Sporobulus virginicus* KTH., *Suaeda maritima* DUM., *Xylocarpus moluccensis* M. ROEM., etc..

Of the plants which have already been established in the remainder of the garden I mention only:— *Acrostichum aureum* L., *Ardisia humilis* VAHL, *Barringtonia asiatica* KURZ, *Calotropis gigantea* DRYAND, *Casuarina equisetifolia* L., *Clerodendron inerme* GAERTN., *Colubrina asiatica* BRONGN., *Erythrina variegata* L., *Excoecaria agallocha* L., *Phyllanthus reticulatus* POIR., *Pongamia pinnata* MERR., *Premna integrifolia* L., *Scaevola frutescens* KRAUSE, *Sterculia foetida* L., *Terminalia catappa* L., *Tournefortia argentea* L. fil., *Wedelia biflora* D.C., etc., etc..

West of the pond is a low hillock composed of coral blocks and coral sand, where it is the intention to plant out such plants as:— *Canavalia lineata* D.C., *Crinum asiaticum* L., *Euphorbia atoto* FORST., *Ipomoea pes-caprae* ROTH., *Spinifex littoreus* MERR., etc..

The height of the spacious and airy rooms is $4^1/_2$ Metres; gas, town water and electricity are available in all the rooms.

The strangers' work room, whose measurements are 10.5 M. by 6 M. (see 7, Plan No. 2), has, if necessary, sufficient room for five investigators; the chemical laboratory alone is at the moment (September 1922), not yet installed.

Photo No. 1 gives a view of the front (North side) of the main building.

Photo No. 2 gives a view of the office of the Chief of the Laboratory (Room 1, Plan No. 2). Through the open door in the background, one looks into the laboratory of the Chief (Room No. 2, Plan No. 2), the North-West corner of which is to be seen on Photo No. 3.

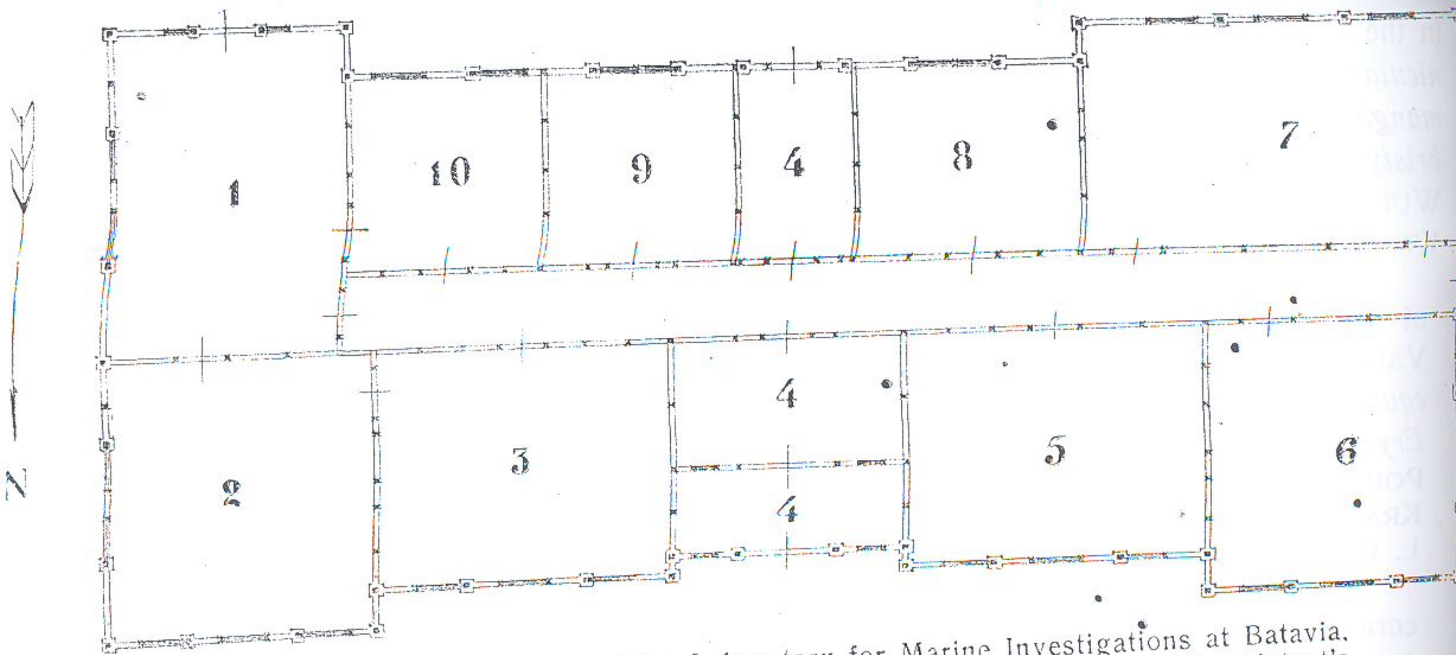
Photo No. 4 shows two of the five working tables in the strangers' work room.

It can be seen on Photo No. 1 (cf. second window from the left), that the top two-thirds of a number of shutters, and of all glass windows, can be opened and shut independently of the lower third.

Whenever the upper two-thirds of the ventilating portion of the shutters is shut, the eyes of a person who is working at a table just in front of a window, are sufficiently protected from the often unbearably strong high light, while the reflector of the microscope can yet receive enough illumination direct from the sky.

On the other hand, the closed under third portion of the glass window can, if necessary, protect the work table and the investigator himself against the strength of the sustained sea winds.

The foundations of the building are of reinforced concrete on which a teak framework is erected; the open spaces in the wooden framework



Plan No. 2. Main building of the Laboratory for Marine Investigations at Batavia. 1 = office for the Chief; 2 = laboratory for the Chief; 3 = zoological assistant's laboratory; 4 = hall; 5 = collectionroom; 6 = chemical and physical laboratory; 7 = strangers' work room; 8 = library; 9 = native draughtman's office; 10 = overseer's office.

Dimensions: Length of the whole building from West to East: 36 M.; room no. 1: M. 8.40 — M. 6.15; room no. 2: M. 7.60 — M. 7; room no. 3: M. 7,80 — M. 6.50; room no. 7: M. 10.50 — M. 6.

are filled in with expanded metal and plaster, owing to which a light but durable building is obtained. The sea-water aquarium, Lloyd's system, which forms part of the Laboratory for Marine Investigations, was ready for use in September 1922.

Firstly, this aquarium will provide a means of studying the live animals of the Java Sea. Further, it will be possible to connect hatching jars for fish eggs to the water circulation ducts.

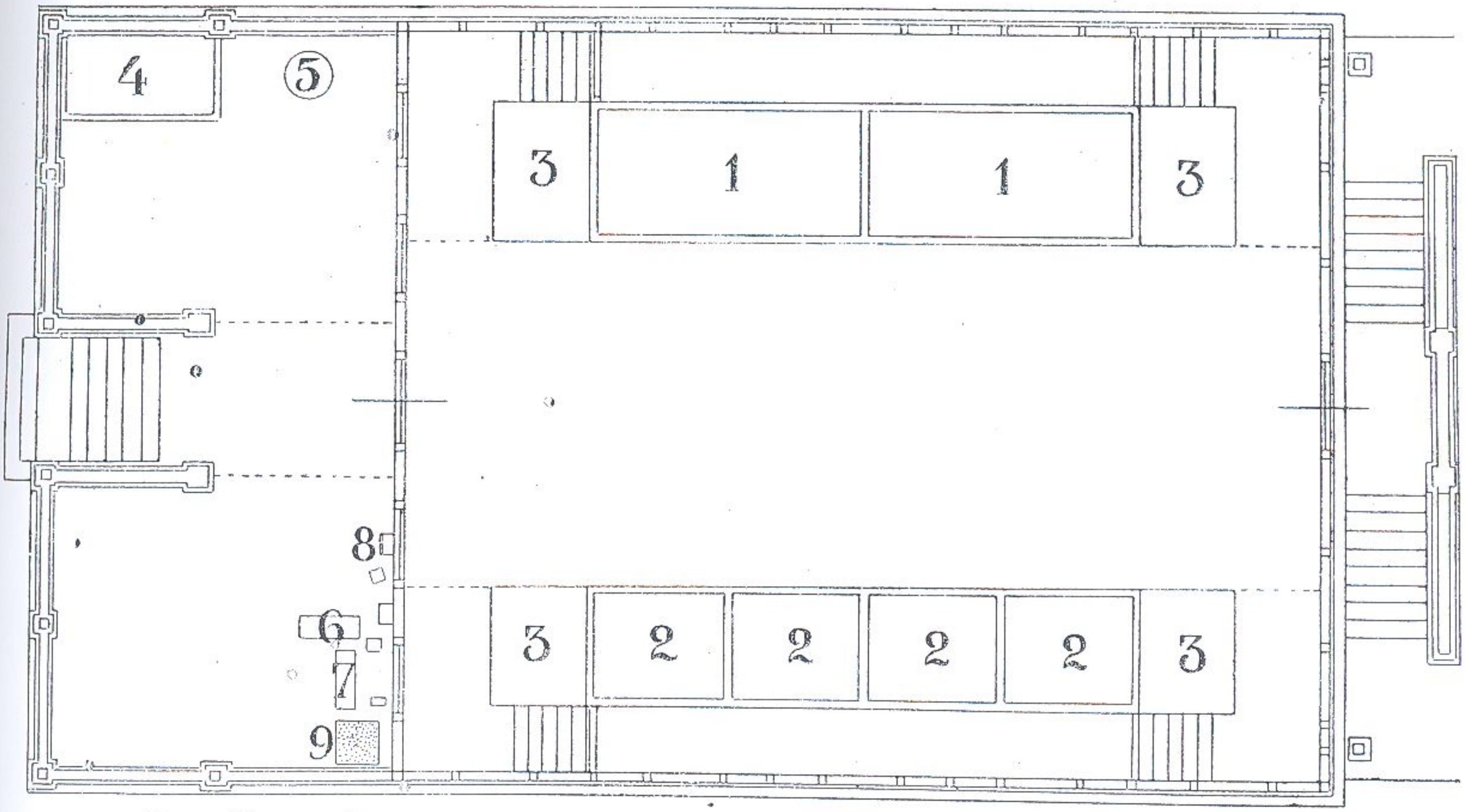
It needs very little demonstration to show that this aquarium, which in the course of time will be available to the public during certain hours, has also educational value.

Photo No. 5 shows the aquarium building (2, Plan No. 1) seen from the South East. This aquarium building, which is partly below ground level, is constructed of reinforced concrete throughout, with the exception of the roof, the walls and the ceiling of the top portion.

The walls of the top portion consist of a framework of teak, filled in partly with plastered brick, and partly with expanded metal and plaster.

The subdivisions of the top portion of the aquarium building, where the tanks are situated, are to be seen from Plan No. 3.

The measurements of the two large tanks (1, Plan No. 3) are 3.65 M. by 1.65 M. by 1.20 M., the capacity therefore, of each of these two tanks, is fully 6000 L.



Plan No. 3. Top portion of aquarium building. 1 and 2 = tanks; 3 tables for small aquaria and hatching jars which can be connected to the circulation ducts; 4 = distilled water reservoir; 5 = distilling apparatus; 6 = centrifugal pump and electric motor set; 7 = centrifugal pump with benzine motor set; 8 = hand pump; 9 = trap-door to cellar.

Length of the whole aquarium building from East to West: M. 18.30.

The dimensions of the four smal tanks (2, Plan No. 3 and Photo No. 6[1])) are 1.75 M. by 1.35 M. by 1.00 M., the capacity of each of these four tanks is, consequently, 2350 L.; from this we get the combined capacity of the six tanks as nearly $21^1/_2$ M^3. The plate-glass panes, which almost entirely make up those walls of the tanks which face the middle of the aquarium chamber, are 2 cm. thick, and are simply built into the concrete walls of the tanks, which is possible without danger of cracking, owing to the small temperature variation in the course of the year, in Batavia.

There is room on the four tables (3, Plan No. 3) for small aquaria and hatching jars, which can be connected with the sea water circulation ducts; these tables are situated on the continuation of the floor of the tanks, that is to say, 1.10 M. above the floor of the aquarium chamber.

Behind each of the two rows of tanks runs an accommodation way whose floor is level with the floor of the tanks; each of these accommodation ways is separated from the aquarium chamber on both sides by wooden doors.

Besides which, the top edge of these walls of the tanks, which form the boundary between tanks and aquarium chamber, carries a wooden partition, which stretches up to the fibro cement ceiling of the aquarium chamber.

[1]) Photo No. 6 was not taken by the writer, but by Dr. H.C. DELSMAN; the remainder were taken by the writer.

Whenever the windows which open into the aquarium chamber are darkened, this chamber only receives that light which penetrates through the tanks and their plate-glass sheets.

The tanks do not receive their light direct from above, but more from the side.

It appeared to be difficult to prevent the water becoming too hot by the employment of light straight from above as we get it in Batavia.

Each of the two rows of tanks receives its light from three windows in the side wall of the aquarium building, which side wall cuts off the accommodation way behind the tanks from the outside world.

Above these two rows of three windows, that portion of the roof which projects from side walls of the aquarium building consists of glass tiles; the spaces behind the tanks are, moreover, entirely painted white, so that, in these spaces it is very light; in this way the tanks are fully and satisfactorily illuminated.

The tanks can also be lit up by electric light, by means of lamps placed at the side of the glass panes, just above the water surface.

In the space, East of the aquarium chamber proper, is in the first place a distilling apparatus, (5, Plan No. 3) and also a tank for distilled water (4, Plan No. 3).

The object of this is to replace the water which has evaporated during the East Monsoon, from the surface of the tanks, so as to maintain the salinity constant.

Evaporation tests, whose results were compared with the data furnished by the Royal Magnetic Meteorological Observatory at Weltevreden, show that the greatest evaporation, calculated on the assumption of exceptionally dry weather, with strong winds, and high temperature, barely amounted to one litre per hour for the 200 cubic metres of aquarium water.

The aquarium of the Laboratory for Marine Investigations has adopted the Lloyd system, in which the same sea water is always in circulation.

The waste water that comes out of the tanks is cleaned in the cellar of the aquarium before being delivered again to the tanks.

This circulation is maintained by a pumping set with two reserve installations.

The two reserve pumping sets are necessary to maintain the circulation, owing to the fact it is necessary to pump day and night because of the absence of an elevated reservoir.

I considered it better to operate this plant without an elevated reservoir, because it did not appear an easy matter to me to protect a reinforced concrete elevated reservoir against the great heat prevailing in Batavia, and also because the cost of an elevated reservoir, so protected, would have raised the cost of construction very considerably.

The pumping unit, (6, Plan No. 3), on which the duty of maintaining the circulation will fall, consists of a Sulzer centrifugal pump, coupled on

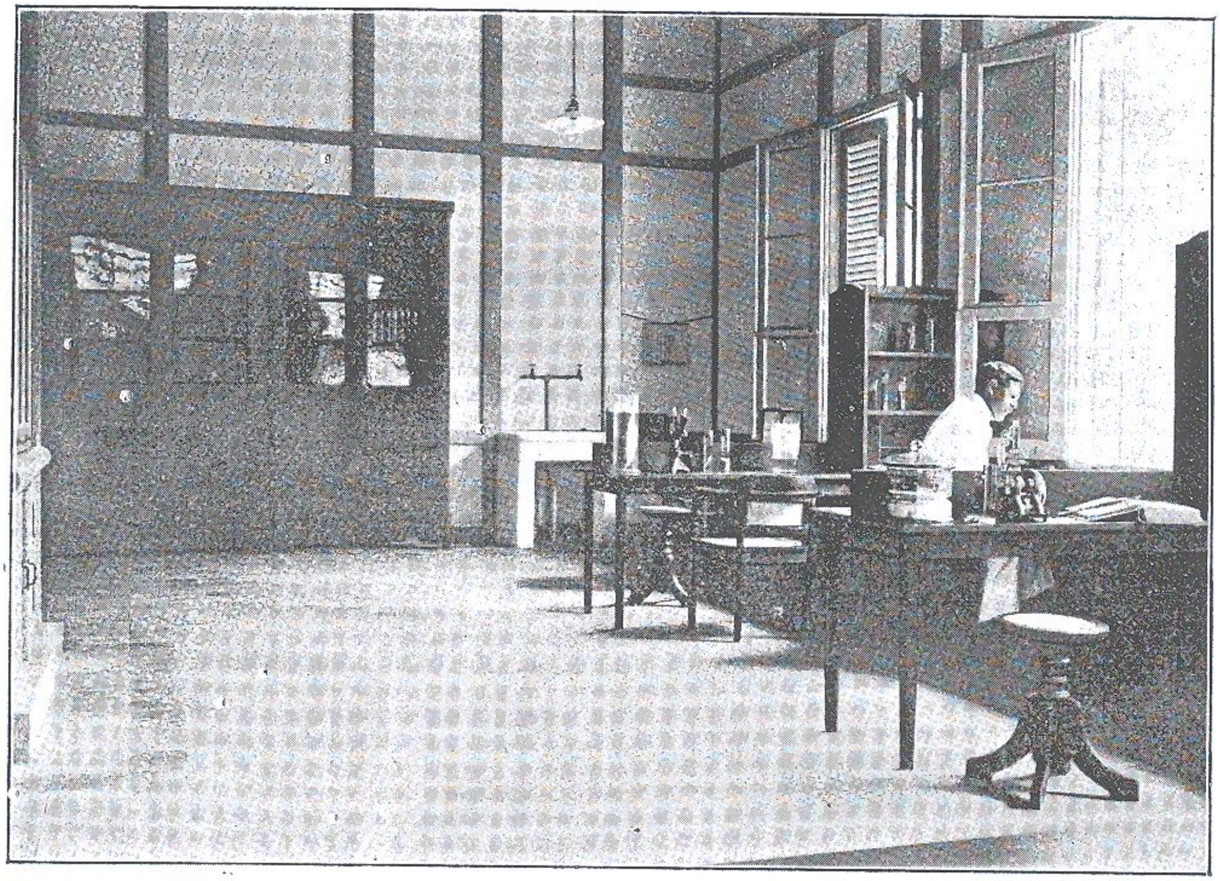


Photo No. 4. Strangers' work room.

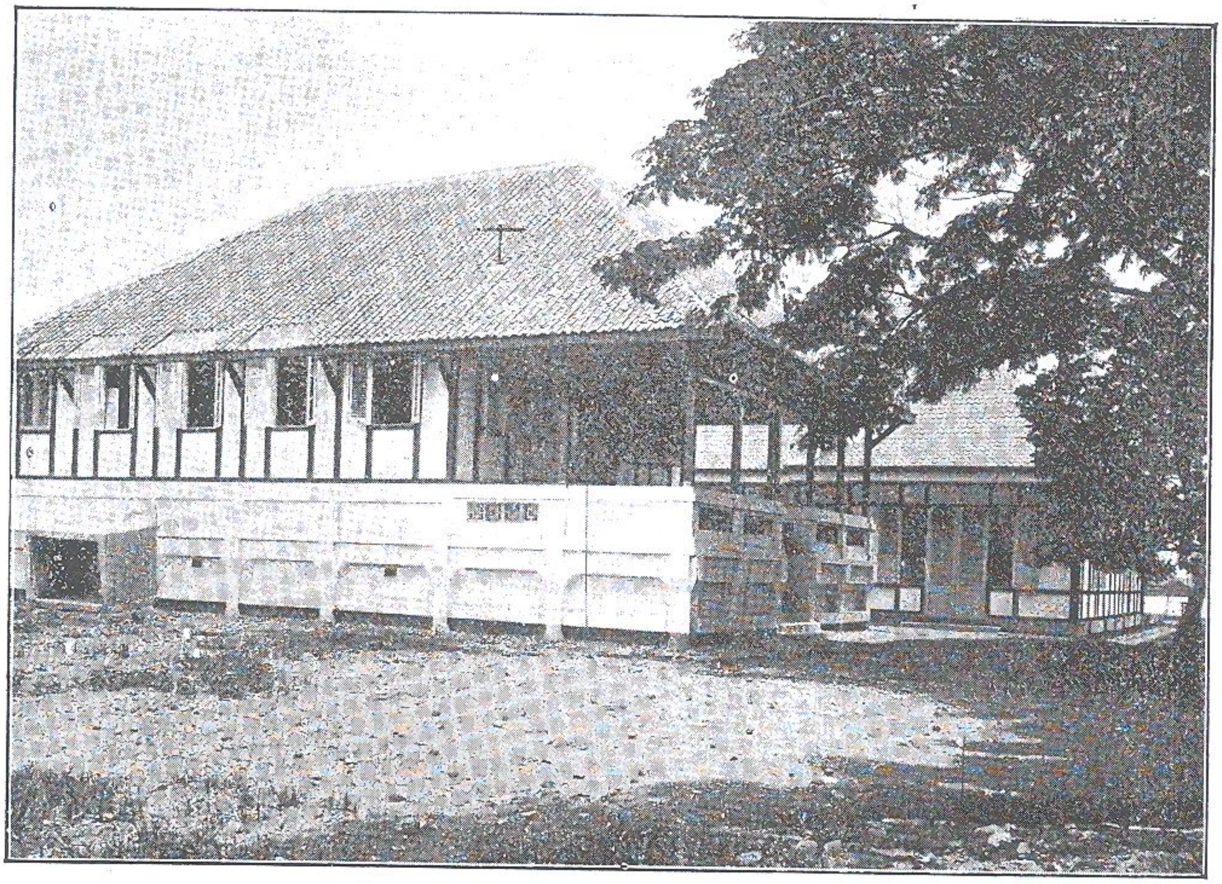


Photo No. 5. Aquarium building, seen from the South-East.

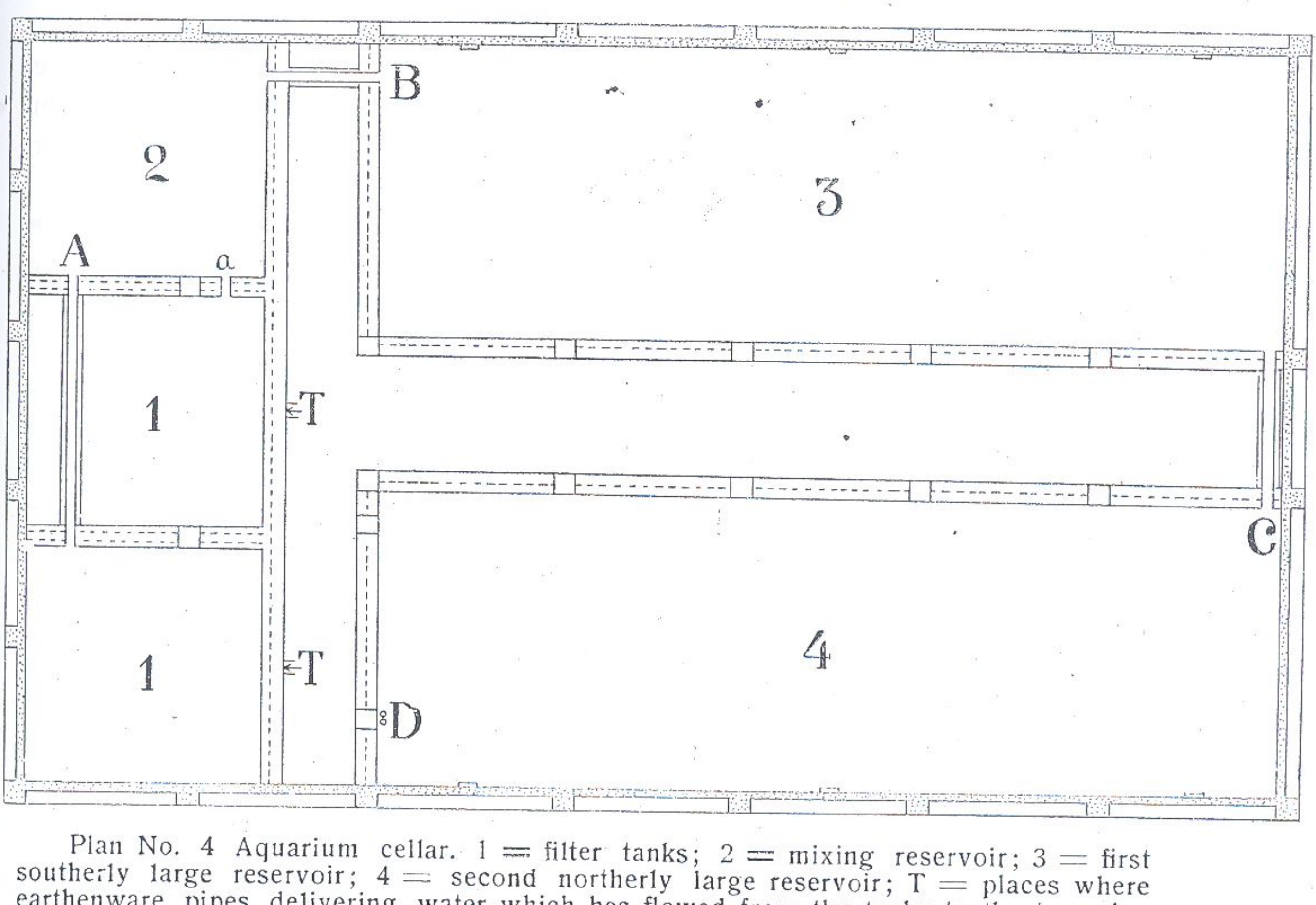
a common bed plate to an A.E.G. induction motor of 1 H.P., 1450 R.P.M., fitted with a starting resistance.

The housing of the centrifugal pump, with which the sea water comes in contact, is made of hard phosphor bronze. Except for this hard phosphor bronze, those portions of the aquarium, that come in contact with sea water consist exclusively of reinforced concrete (resp. cements), earthenware, and hard rubber (ebonite).

The first reserve pumping set, (7, Plan No. 3), is also a Sulzer centrifugal pump, with a hard phosphor bronze housing, and is, however, in this case coupled to a benzine motor of approx. $1^1/_2$ H.P., which can also run at 1450 R.P.M. and is also bolted to a common bed plate. The second reserve pumping set, (8, Plan No. 3,) consists of a hand pump of the Berliner Pumpenfabrik A. G., the discharge of which is 1.3 L. per double stroke.

The capacity of the centrifugal pumps being more than 10 cubic Metres per hour at 1450 R. P. M., it is possible, therefore, to renew the contents of the tanks entirely eleven times in the 24 hours if necessary.

The sole entrance to the cellar of the aquarium is through a trap door, (9, Plan No. 3), under which is found a stairway.



Plan No. 4 Aquarium cellar. 1 = filter tanks; 2 = mixing reservoir; 3 = first southerly large reservoir; 4 = second northerly large reservoir; T = places where earthenware pipes delivering water which has flowed from the tanks to the top edge of the filters, comes out; A, a, B and C, circulating ducts; D = place whence the water is pumped up = commencement of the suction pipes.
Length of the aquarium cellar from East to West = M. 18.30.

Plan No. 4 indicates the arrangement of the cellar, which is nothing else than a reinforced concrete box entirely closed, whose floor carries a number of reinforced concrete walls, 1.30 M. high, which divide the cellar into reservoirs, filter tanks and accomodation ways.

The sides of the square base of the filter tanks are 3.30 M. long in the clear, and the height of the tanks 1.30 M. clear, the contents of each tank is, consequently, fully 14 cubic Metres.

The filter tanks, through which the water percolates from top to bottom (submerged filters), are filled in the reverse order with two layers of bricks laid loosely, one layer of road metal 8 cm. thick, approximately, one layer of gravel from 2 cm. to 5 cm. diameter, 20 cm. thick, and last of all a layer of clean quartz sand, 60 cm. thick.

This quartz sand is procured from Tandjong Ruh, in the Klabat Bay, on the island of Banka.

Through the kind office of the Department of Tin Mining at Banka (Dienst der Banka Tinwinning) and also of the Department of Navigation (Dienst van Scheepvaart), I managed to get 40 cubic Metres of this sand transported to the Laboratory site at Batavia.

The top of the quartz sand layer lies about 15 cm. below the top edge of the filter tanks.

Each of the two filter tanks is able to treat the whole of the circulating water rapidly enough by itself, and the need for this can arise when one of the filter tanks is thrown out of action in order to clean it; normally, however, the water from the aquarium tanks is divided over the two filters.

The water that flows out from underneath the filters, comes into the mixing reservoir (2, Plan No. 4) via the channel A or the duct a (see Plan No. 4) in the manner indicated below.

This mixing reservoir is precisely the same size as the filter tanks, that is to say 3.30 M. by 3.30 M., by 1.30 M., capacity 14 cubic Metres.

Above this mixing reservoir is the distilled water reservoir (4, Plan No. 3). From the latter reservoir distilled water can be added to the seawater in the mixing reservoir by means of a short hard phosphor bronze pipe fitted with a cock, which passes through the reinforced concrete roof of the aquarium cellar.

Below in the cellar, this pipe is coupled to a thick rubber hose with a hard rubber (= ebonite) cock on its end.

It is possible to determine the amount of distilled water to be added every day from an evaporimeter connected above each of the two rows of tanks, while a check on these additions can be effected by ascertaining the salinity of the aquarium water at regular intervals.

The water from the mixing reservoir flows through duct B (Plan No. 4) to the Easterly end of the first large Southerly reservoir (3, Plan No. 4).

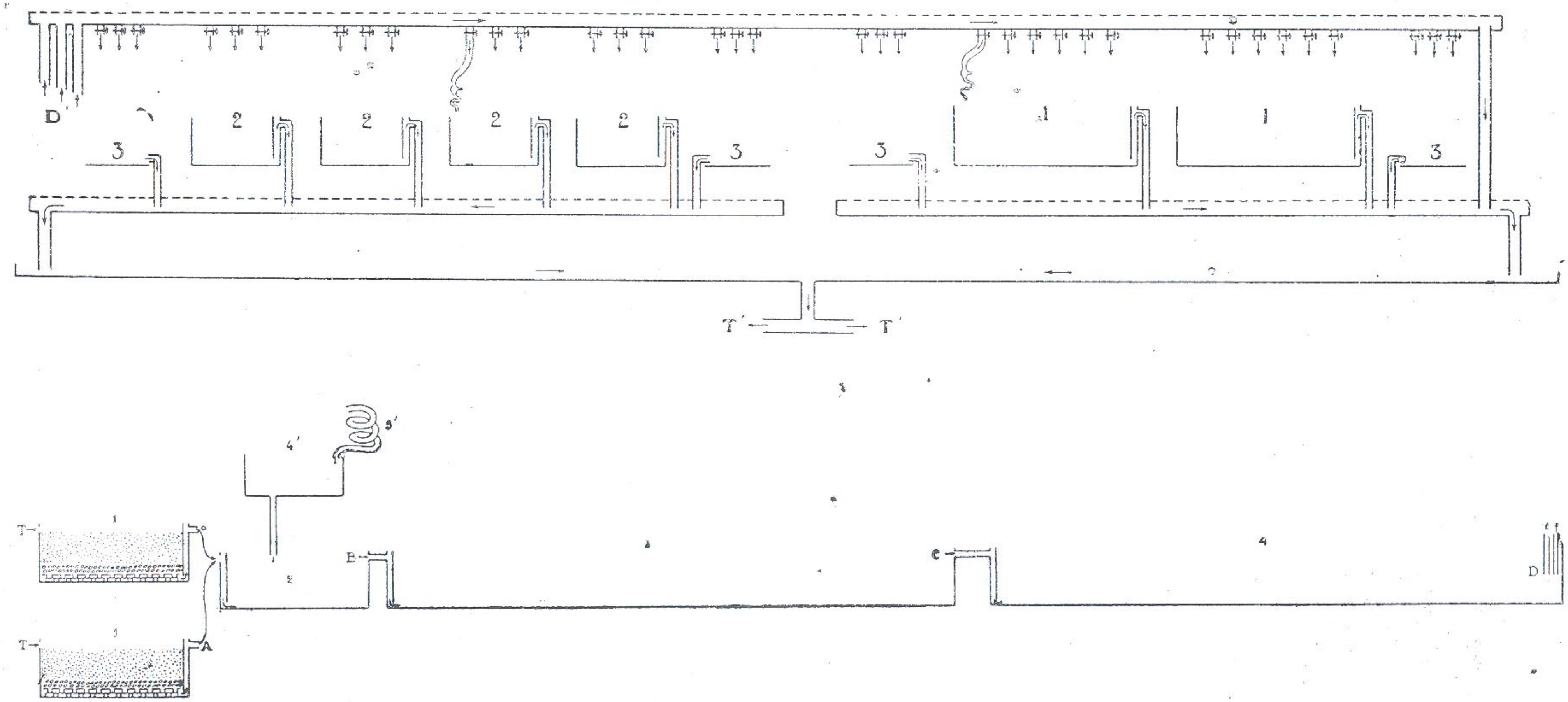


Diagram of the seawater circulation in the aquarium of the Laboratory for Marine Investigations at Batavia.

After-having flowed through this large reservoir, the water discharges from its Westerly end through duct C (Plan No. 4), into the Westerly end of the second large Northern reservoir (4, Plan No. 4).

Finally the water is pumped up at the East end of the last mentioned reservoir, to be delivered to the tanks in the aquarium chamber.

The dimensions of the large reservoirs are 12.70 M. by 4.70 M. by 1.30 M.; the capacity of each reservoir amounts, therefore, to $67^1/_2$ cubic Metres; while the combined capacity of filter tanks, mixing reservoir and large reservoirs totals 178 cubic Metres.

As can be seen from Plan No. 4, there remains a T shaped accommodation way between the filter tanks and the reservoirs.

Under normal conditions the cellar of the aquarium is in complete darkness, but whenever it is necessary to work there it can be lit up by electric light.

Besides which wall plugs are fitted for connecting electric hand lamps, by which means light can be played into all corners and holes.

The extreme dampness in the cellar rendered it necessary to insulate all lighting bables very carefully.

Both in the North and South wall of the cellar are placed three light proof ventilators, closed with mosquito-proof wire-gauze.

Nevertheless, it appeared from a series of observations continued over three weeks and taken with evaporimeters, that the evaporation in the aquarium cellar while the reservoirs were filled with fresh water, was reduced to o.

The accompanying Diagram, page 15, gives one a clear idea of the sea water circulation in the aquarium.

The numbers in the top half of the Diagram agree with those on Plan No. 3, those in the lower half, however, agree with those on Plan No. 4.

The letters T' of the top half of the Diagram, are found back again, without accent, on Plan No. 4; similarly with the top figures 4' and 5' of the lower half of the Diagram, which are found back again on Plan No 3.

Each of the three pumping sets referred to above, has its own suction pipe of hard phosphor bronze, through which the water is pumped from the Eastern end of the second, or Northerly, large reservoir — see D, Plan No. 4, and D in the right hand lower corner of the Diagram [1]).

Each of the three suction pipes is, necessarily, as far as a centrifugal pump is concerned, fitted with a foot valve.

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[1]) Only two instead of three suction pipes are shewn both on Plan No. 4, and in the right-hand lower corner of the Diagram at D.

Also in the left-hand top corner of the Diagram at D, three suction pipes are shewn intead of one.

Both of these errors are due to the fact that the suction and delivery pipes of hard phosphor bronze finally installed, differ a little from the suction and delivery pipes of earthenware which were originally proposed.

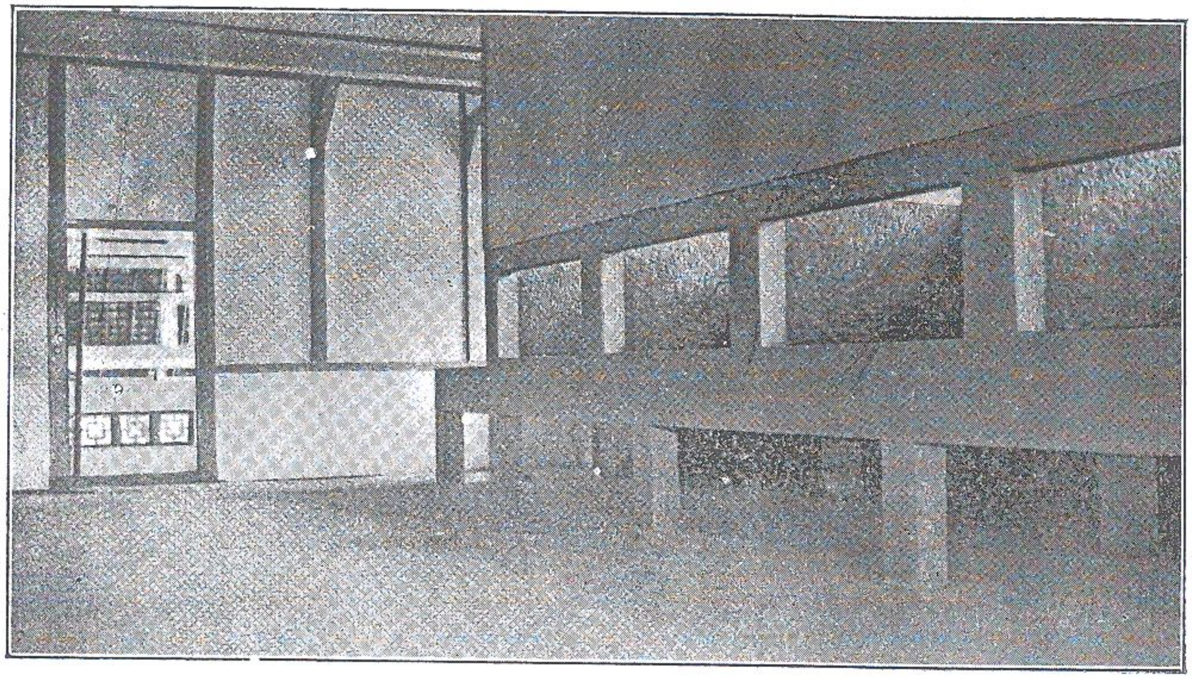

Photo No 6. The four small tanks, seen from the South-East corner of the Aquarium chamber. The plate-glass sheets of the tanks are not yet fitted.

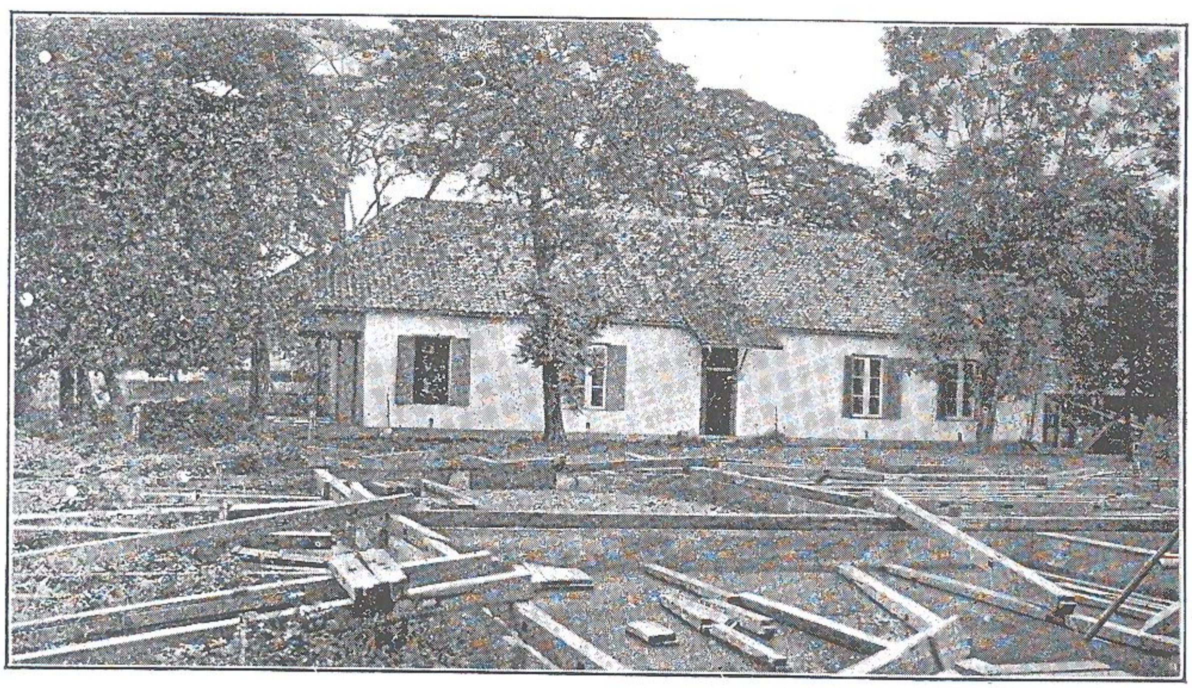

Photo No. 7. The former Fisheries Station, now demolished. In the foreground are the foundations of the new Laboratory for Marine Investigations.

The lowest part of the suction pipes, to which the foot valve is attached, hangs freely in the water and can be detached from the upper portion with a view to possible repairs to the foot valves.

The delivery pipes of the three pumping sets are joined up into one main delivery pipe by means of a three way cock placed just above the pumping sets. Both pipes and three way cock are also entirely of hard phosphor bronze.

This delivery pipe eventually discharges into a reinforced concrete duct open on top but protected against evaporation and dirt by being covered with fibro cement sheets cut to size (cf. top edge of Diagram).

This duct, which is supported just under the ceiling, runs through the aquarium chamber first of all in a longitudinal direction from East to West above the small tanks and the two tables belonging to them (2 and 3, Plan No. 3).

Thence the duct makes a bend of 90 degrees so as to cross the West wall of the aquarium chamber close and parallel to it.

After having made another bend of 90 degrees the duct runs again through the aquarium chamber also in a longitudinal direction, but this time from West to East, above the large tanks and their two tables, (1 and 3, Plan No. 3) finally ending East. of the South Eastern table.

Immediately before this ending the duct opens out into an earthenware pipe of 10 cm. internal diameter, which makes a watertight joint with the floor of the duct (see right-hand top corner of the Diagram.)

Owing to the fact that this pipe projects about 5 cm. through the bottom of the duct it acts as an overflow, and however hard the pump works, the water in the duct remains at a constant level.

The water passing through this overflow discharges into a waste water duct which, as is described below, runs along the back of the large tanks.

In the bottom of the duct which, as recentlv referred to, is suspended from the roof of the aquarium chamber and which serves as an elevated reservoir, a number of ebonite cocks are fitted.

Above each of the four small tanks, (2, Plan No. 3), and each of the four tables, (3, Plan No. 3), are three cocks. Above each of the large tanks, (1, Plan No. 3), are six cocks (see Diagram).

To the lower end of each of the ebonite cocks is attached a thick rubber hose of $2^1/_2$ cm. internal diameter, the bottom end of which is connected to a glass water jet air pump by means of a closely fitting rubber stop with a hole bored in it.

The outlet pipe of this pump projects just beneath the water surface of the tanks.

The water which comes out of the outlet pipes of these water jet air pumps is, from the nature of the plant, throughly mixed with fine air bubbles.

I was compelled to use these air pumps because I could not get a strong enough stream of water in the tanks out of the top duct, which is only 1.60 M. to 1.85 M. above the watersurface of the tanks.

The water outlet from the tanks takes place close to the bottom through an earthenware pipe, 4 cm. internal diameter, which is built in the middle of the tank towards the rear wall.

This vertical earthenware pipe, which is open at top and bottom, ends in a T piece at the top end, whose short horizontal leg pierces the rear wall of the tank a few centimeters under the top edge.

This short leg is connected to an earthenware elbow leading into an earthenware down pipe, which runs outside against the rear wall of the tank.

This latter pipe eventually opens out into the waste water duct, which runs along the back of the tanks, (see Diagram), which we shall presently refer to.

Inside the tanks the lower end of the earthenware outlet pipe is fitted with an ebonite cover pierced by a number of small holes, which allow the water to pass freely through; this cover is easily removed by hand, and its purpose is to prevent the entrance into the outlet pipe of small fish, or other animals.

It will be quite clear that this arrangement, which carries off water, from the lower portions of the tanks, does not act as a syphon, but only as an overflow.

As has already been stated, an open reinforced concrete duct, covered with fibro cement plates cut to size, runs in the accommodation ways under and against the rear walls of the tanks.

Round openings have been cut in the fibro cement plates to admit the vertical earthenware draw off pipes of the tanks, which pipes project through to underneath the fibro cement covers.

The smaller aquaria and hatching jars placed on the tables (3, Plan No. 3) can also let their water flow off into this waste water duct by means of rubber hose.

The waste water ducts running behind the two rows of tanks finally end close to the Eastern wall of the aquarium chamber.

Just before this ending, the bottoms are pierced from under by an earthenware pipe of 10 cm. internal diameter, which also passes through the ceiling of the aquarium cellar.

Both of these large earthenware pipes carrying off the waste water of the tanks to the aquarium cellar, discharge into one of the two extremities of a reinforced concrete duct which is suspended from the roof of the cellar.

This duct runs in a direction North to South, that is to say perpendicularly to the longitudinal axis of the aquarium building.

In the middle of this duct is another opening through which the water is carried off in an earthenware pipe of 10 cm. internal diameter; this pipe branches off into two (see T' and T' in the top half of the Diagram).

Just after this forking and in each of the two pipes resulting therefrom, is fitted a hard phosphor bronze valve, firmly cemented to the connecting pieces of the earthenware pipe so as to be absolutely watertight.

Finally each of these two pipes (at T and T in the lower half of the Diagram) discharges into a reinforced concrete duct which connects the centres of the East and West wall of a filter tank.

The floor of this duct on the inside is about level with the top surface of the quartz sand layer.

The side walls of these ducts are pierced by numerous holes, at different levels and along the whole length of the ducts.

By means of this, and independently of the amount delivered, the water is always spread equally over the filtering sand surface in any case in the direction from West to East.

The outlet of water from the bottom of the filter tanks to the bottom of the mixing reservoir takes place in exactly the same way as is the case with the tanks in the aquarium chamber.

Only the inlet and outlet arrangements of the filter tanks and reservoirs, which also do not act as syphons but as overflows, are not composed of earthenware pipes, but of plastered brickwork.

A comparison of the Diagram with Plan No. 4 shews sufficiently clearly how the sea water flows from the surface of the mixing reservoir (2, lower half of Diagram) to the bottom of the first large Southerly reservoir (3, lower half of Diagram), and from the surface at the other end of that reservoir again to the bottom of the second large Northerly reservoir (4, lower half of Diagram), only finally to be pumped up again from the other end of the last-mentioned reservoir (right-hand lower corner of the Diagram, at D).

The distilled water reservoir and the water distilling apparatus itself are indicated on the Diagram by the numbers 4' and 5'.

From the measurements given above it appears that the combined capacity of the reservoirs and filter tanks is not less than fully eight times as large as that of the tanks in the aquarium chamber. Even if we neglect the capacity of the filter tanks, which are for the greater part taken up by stones and sand, the combined capacity of the mixing reservoir and the large reservoirs is still seven times larger than that of the tanks in the aquarium chamber.

In the literature available to me here, I have been able to find nothing about the theory of the purifying of the water in the cellar of an aquarium, system Lloyd, in which the same water is always circulating.

It appears, however, not unlikely that the filters operate also as oxidation beds and that the nitrates and nitrites formed on these oxidation beds are denitrified by bacteria in the darkness of the large reservoirs.

The reinforced concrete portion of the aquarium was built by the Hollandsche Beton Maatschappij of Weltevreden.

The pumping sets and the earthenware pipes, which latter were manufactured by the N. V. Nederlandsche Gresbuizen Industrie at Deventer, were delivered by the Amsterdamsch Kantoor voor Indische Zaken in Batavia.

The hard phosphor bronze suction and delivery pipes were cast and installed by the N. V. Machinefabriek en Scheepswerf "Batavia" of Batavia, while the ebonite cocks and the ebonite covers of the earthenware outlet pipes were manufactured by the Nederlandsche Gutta Percha Maatschappij of Batavia.

The filling of the aquarium with sea water was performed in two stages on 12th and 19th of September 1922. By the help of a combined tug and auxiliary fire-tender belonging to the Harbour Board of Tandjong Priok and of an iron water-lighter, I fetched pure seawater from a few nautical miles to the North East of the Island of Hoorn in the Bay of Batavia. This seawater was pumped out of the waterlighter and into the aquarium on the next days by means of the motor pump of a municipal watering-cart.

The four compartments of the lighter had been thoroughly cleaned by the Harbour Board, painted with rust-proof paint and finally coated with cement grouting some weeks beforehand.

These four compartments, whose combined capacity amounted to 175 tons approximately, were three-parts filled with seawater within an hour by the fire-tender working with four hoses.

The motor-pump of the watering-cart transferred this quantity of seawater through a delivery-hose, 160 Metres long, to the aquarium in 5 to 6 hours.

The salinity of the first and second shipment of seawater amounted to 32.3 $^0/_{00}$ and 32.7 $^0/_{00}$ respectively.

From the beginning the scientific institution called "'s LANDS PLANTENTUIN" (Botanical Garden) at Buitenzorg has always offered with much success opportunities for study to naturalists of all nationalities. By the building of the new Laboratory for Marine Investigations these opportunities have been extended over an entirely new sphere.

The strangers' work room of the new Laboratory has already been described above. As soon as the aquarium is entirely in working order, students will have access to aquaria placed on the tables No. 3 of Plan No. 3 and connected with the sea water circulating ducts and, if necessary, also to one of the tanks.

A small but seaworthy motor boat which has the distinction of bearing the name of the leader of the Siboga Expedition, "MAX WEBER" (see Photo No. 8), is at the disposal of those who work in the Laboratory for the purpose of collecting marine organisms in the neighbourhood of Batavia.

Professor Dr. C. PH. SLUITER, of the University of Amsterdam, refers to the great riches from a zoological point of view of the Java Sea in the neighbourhood of Batavia (Natuurkundig Tijdschrift voor Nederlandsch-Indië, Volume 47, page 182).

The many coral reefs in the Bay of Batavia respresent, in themselves, an extremely rich field for study.

For the collection of materials, investigators who come to work in the Laboratory for Marine Investigations can accompany the members of the Laboratory staff on their cruises with the research vessel "Brak" (see Photo No. 9).

Dr. TH MORTENSEN of Copenhagen, the first foreigner to visit the new Laboratory, made a trip about the middle of 1922 lasting 14 days on the "Brak" to the South-Western part of the Java Sea and the Strait of Sunda. On this trip Dr. MORTENSEN, with the help of the Sigsbee trawl, brought together a large collection of bottom-animals.

The sphere of operations of the Laboratory scientific staff consists of the collection of as exact and full data as possible concerning the life and the environment of marine animals, and especially of those marine organisms which are important from an economic standpoint.

The main purpose is the obtaining of a true insight into the complex conjuncture of natural, biological and hydrographical factors which influence the production of the fisheries or, in other words, the collection of the knowledge by reason of which, ultimately, a rational exploitation of the sea will be possible.

It is not necessary to point out that this is a very extensive programme when we consider the low numerical strength of the scientific staff of the Laboratory [1]).

Accordingly the execution of this programme is going on only very slowly.

In connection herewith, the territory of research is limited to the shallow, preponderatingly neritic seas which belong to the continental shelf situated in the Western half of the Netherlands East Indian Archipelago, and which are of more importance as fishing grounds than the deep seas of the Eastern half of Insulinde.

A large number of temperature and salinity figures were collected in this region, not only concerning the surface water, but just as much regarding the deeper water layers. This work was done by Mr. K. M. VAN WEEL, Captain in the Government Navy (Gouvernements Marine), first as captain of the research vessel "Brak" and later as assistant hydrographer to the Laboratory for Marine Investigations.

During the foreign leave of Mr. VAN WEEL the hydrographic data were collected by his successor as captain of the research vessel, Mr. P. C. VAN KOESVELD.

In the isohaline and isotherm charts constructed from the numerous temperature and salinity figures collected, the main horizontal movement of the water layers at different depths and during different seasons is clearly expressed.

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1) The scientific staff of the Laboratory for Marine Investigations consists at the moment of the author, as Head of the Laboratory, and Dr. H. C. DELSMAN, as zoölogical assistant.

The biological part of the work was, practically speaking, confined to the Java Sea.

The Eastern boundary of this very shallow transgression sea coincides with that of the continental shelf. This boundary can approximately be indicated by the 100 fathoms line.

Over $^2/_3$ of its area the Java Sea is less then 30 fathoms deep, while depths of 50 fathoms practically never occur.

The surface area of the Java Sea amounts to 450,000 square kilometres approximately, the cubic capacity only to about 20,000 cubic kilometres.

A large number of plankton samples were collected by me, both on the periodical trips to get hydrographical data together, made in May, August, and November 1915 and in February 1916, as well as during a number of trips over the fishing grounds along the North coast of Java.

The plankton samples were collected with the aid of two vertical closing nets. The filtering surface of the largest 4 Metres long net, whose opening has a diameter of 1.30 Metres, consists of No. 3 plankton gauze from the Swiss Silk Bolting Cloth Manufacturing Company Ltd. Thal. The small net 1.50 Metres long, and whose opening is 0.50 Metre diameter, has a filtering surface of No. 25 gauze from the same manufactory.

An analysis of these plankton samples shewed, amongst other things, that the production of organic matter by the phytoplankton is greatly promoted in the Java Sea by the mixing of the sea water with the fresh water supplied by the rivers of Sumatra, Borneo and Java.

It is probable that this river water is the carrier of nutritive substances which are very suitable for the production of phytoplankton.

It appeared to me in every case where the influence of river water discharged into the sea was expressed in the salinity figures, that large quantities of phytoplankton were met with; sometimes this was the case even quite far (up to 250 sea miles) out to sea.

On account of the material collected, as well as from theoretical considerations, I think that the Java Sea must be considered, in the first five months of the year at any rate, a very productive region.

In connection with the investigation of the plankton, I have examined on the fishing grounds of Java, Madura and the Kangean Archipelago the stomach contents of about 16 species of pelagic fishes which feed on plankton

These fishes were caught with the native pajangnet (a kind of seine net).

The most important of these fishes are:— the lajang *(Decapterus kurra* BLKR.), the deles *(Decapterus macrosoma* BLKR.), the selar bentong *(Caranx crumenophthalmus* C. V.), the selar tjomo (*Caranx affinis* K. v. H.), the selar kuning (*Caranx leptolepis* K. v. H.), the kembung lelaki (*Scomber kanagurta* C. V.), and the lemuru or sambolah (*Clupea leiogaster* BLKR.).

At the same time I have measured large numbers of these fishes to gain an insight into the question of their growth and spawning season.

At the places where the fish I was studying were caught, data regarding temperature and salinity, as well as plankton samples, were collected always at various depths.

Further, Dr. H. C. DELSMAN, who has been attached to the Laboratory as zoological assistant since June 1919, is engaged on the study of pelagic fish eggs and larvae of the Java Sea about which, practically speaking, nothing was known previously.

Now, the number of fish species living in the Java Sea is much greater than the number of those fish species met with in the great fishing grounds of the North-West European seas.

Besides which, in the latter seas, each fish species has its own spawning season which is not the case in our Indian waters or at any rate to a much lesser degree.

For these reasons it is to be questioned whether it will ever be possible to identify all the pelagic fish eggs that occur in the Java Sea.

Finally the circumstances induced me to undertake in 1918 and 1919 an investigation into the biology of the sea fish ponds lying along the coast of Batavia, and in which *Chanos chanos* (FORSK.) are reared.

In these ponds large floating masses of algae or conglomerates of algae and higher submerged aquatic plants, reaching up to just beneath the water surface, develop spontaneously.

Chanos chanos (FORSK.) feeds on these algae and higher aquatic plants.

In connection with this the Batavia sea fish ponds produce enormous quantities of the most dangerous of our malaria-carrying mosquitos, *Myzomyia ludlowi* THEOBALD, and this in spite of the presence of great numbers of *Haplochilus panchax* (HAM. BUCH.) which have a certain renown as larvae destroyers.

Ludlowi mosquitos are, however, only found when the salinity of the pond water does not rise much above 30 ‰; at salinities above 40 ‰ they are not produced, although even at much higher salinities large quantities of *Myzomyia rossii* GILES, a species very closely allied to *ludlowi*, but as good as harmless, are still produced.

The highest salinity of many examinations concerning the water of the Batavia sea fish ponds containing *Chanos chanos* (FORSK.) amounted to 84.6 ‰.

During the West Monsoon the water of the Batavia marine fish ponds can be, on the contrary, almost entirely fresh.

The results of the investigations undertaken by the Laboratory are published in "TREUBIA", Recueil de Travaux Zoologiques, Hydrobiologiques et Océanographiques, issued by "'s LANDS PLANTENTUIN" at Buitenzorg.

The latter institution embraces all purely scientific establishments belonging to the Department of Agriculture, Industry and Commerce of the Netherlands East Indies. Accordingly, 's LANDS PLANTENTUIN also includes the Laboratory for Marine Investigations at Batavia.

A description of the eggs and larvae of *Fistularia serrata* CUV., and of *Chirocentrus dorab* (FORSK.) by Dr. H. C. DELSMAN has already appeared in "TREUBIA", Vol. II, Livr. 1, p. 97-108 and Vol. III, Livr. 1, p. 38-46.

Also the results of the marine fish pond investigation have been already published in "TREUBIA", Vol. II, Livr. 2-4, p. 157-400.

The numerous temperature and salinity figures collected and prepared by Mr. K M. VAN WEEL are at the moment in the press, while the results of the remaining investigations referred to above will be published as soon as possible.

I would remind foreign naturalists who may wish to come to work in the Laboratory for Marine Investigations that Batavia with Buitenzorg, so close to it, forms an important scientific centre.

Besides "'s LANDS PLANTENTUIN" and the institutions of the Department of Agriculture, Industry and Commerce devoted to the realms of applied natural science in Buitenzorg, there are, as far as Batavia is concerned, The Royal Society of Natural Science of the Netherlands Indies; the Royal Magnetic and Meteorological Observatory; both the Civil and Military Medical Laboratories, and the Head Office of the Department of Mines, etc.. These, and similar institutions or at any rate the publications issued by them, are known to many outside the Netherlands Indies.

The library of the Department of Agriculture, Industry and Commerce at Buitenzorg and that of the Royal Society of Natural Science at Batavia, will often be of the greatest use to those investigators who visit Batavia.

Batavia can, in all respects, be called a great town.

Some of the big hotels there will be able to satisfy every want of a traveller; besides which there are in this town many large European shops, very good clubs, excellent hospitals, etc., etc.

Batavia is also one of the very few places in the far East where it is possible to hear really good classic music.

I think I may, in fact, state it is sufficiently well known that Batavia, and the whole of Java as well, has much that is interesting and beautiful to put before the stranger who cares to visit our shores.

The cost of living in Batavia is not particularly dear; in fact, at the moment (September 1922), it is not necessary to pay more than 175 Netherlands East Indian Guilders per month for a very decent room with complete board (with very good food). Moreover, prices are still going down.

In the largest hotels the charge is, at the moment, from 300 to 500 Netherlands East Indian Guilders per month with everything included For 500 guilders per month one gets there a roomy well furnished sitting-room with private front verandah, a bedroom with bathroom and offices attached, telephone, light, service, and full board.