The Seto Marine Biological Laboratory of The Kyoto Imperial University. Its Equipment and Activities, with Remarks on the Fauna and Flora of the Environs

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The Seto Marine Biological Laboratory

of

The Kyoto Imperial University. Its Equipment and Activities, with Remarks on the Fauna and Flora of the Environs.

By

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With Plate XII and 8 Text-figures.

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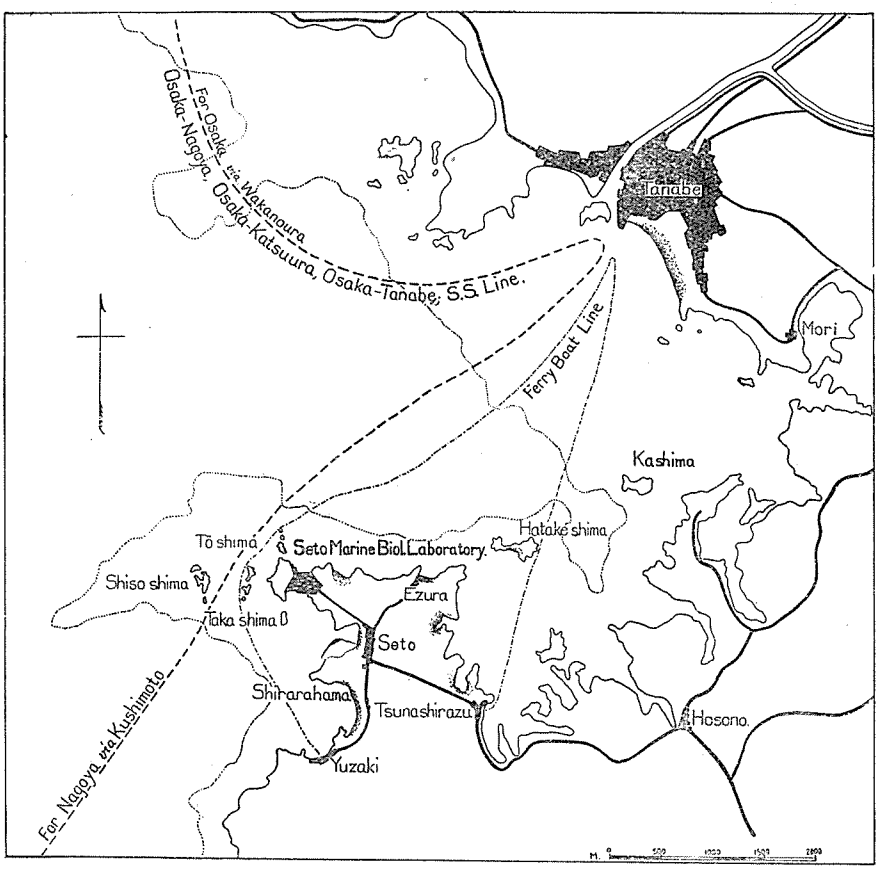
Contents.

Location

The Seto Marine Biological Laboratory of the Kyoto Imperial University is located on a little peninsula on the west coast of Kii, about 40 miles north of the Sio-no-misaki, the southern-most point of the main island of Japan, and about 80 miles south from Osaka. The site is under the administration of the village of Setokanayama in the prefecture Wakayama. Within a few miles to the south-east, there are two hot springs, Yusaki and Sirahama, well-known among the town folks of Osaka and Kobe; and to the north-east, across a bay, Tanabe Bay, is Tanabe, a town with nearly ten-thousand inhabitants (Text-fig. 1).



Text-figure 1. Map of the environs.

A regular local steam-boat service connects Tanabe with Osaka via Wakanoura, boats of the O. S. K. and an affiliated company running three times a day. The fastest boat takes about eight hours from Osaka, and four hours from Wakanoura, to get to Tanabe. From Tanabe it takes about half an hour to the Laboratory either by motor bus along the beach or by motor boat across the bay. It is hoped that communication will be made shorter and more convenient in a few years, when the connection of the railway between Tanabe and Wakayama is completed.

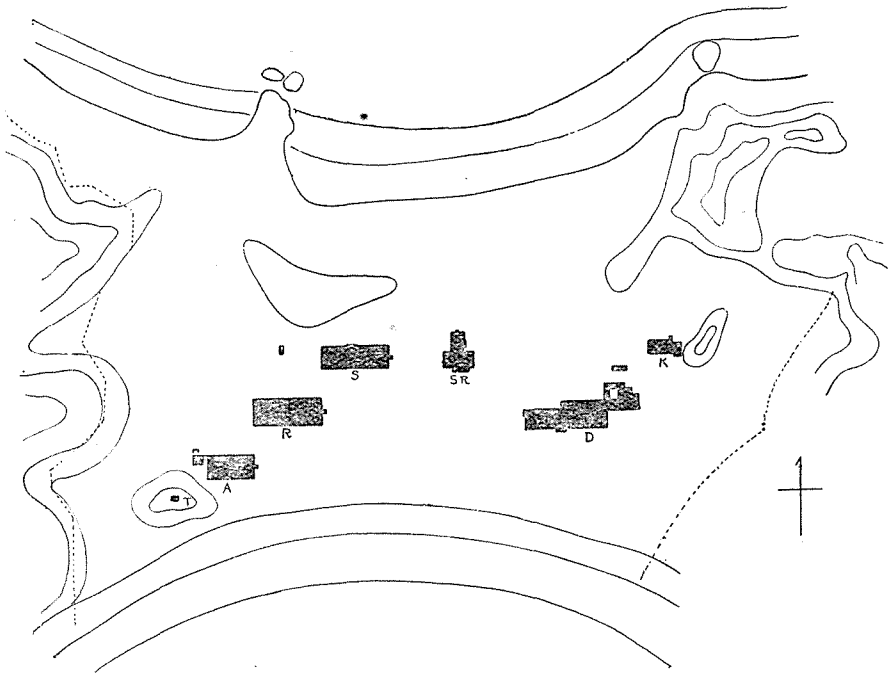
There is a post- and telegraph-office in the village and a telephone in the Laboratory whereby direct communication with Osaka, Kobe or Kyoto is made possible.

History

The Department of Biology (now the Departments of Zoology and Botany) of the Kyoto Imperial University was established in 1917, and four years later, in 1921, the Government granted 150,000 yen toward the erection of a marine biological laboratory to be attached to the department. This sum was spent largely for the building and equipment of the Seto Marine Biological Laboratory. It was supplemented by a contribution of 50,000 yen from Wakayama Prefecture, while a lot of nine acres and a half was given by the village of Setokanayama. The whole building was completed in the spring of 1922, and the activities began in the summer of the same year. One thing to be deeply regretted in connection with the establishment of the Laboratory, was the death of its founder, Professor IWAJI IKEDA, which happened just before the completion of the building.

Buildings and Equipment

The Laboratory (Pl. XII, fig. 1, Text-fig. 2) consists of six separate buildings: Students' Laboratory, Research Laboratory, Special Research Laboratory, Aquarium, Dormitory and Keeper's Lodge.

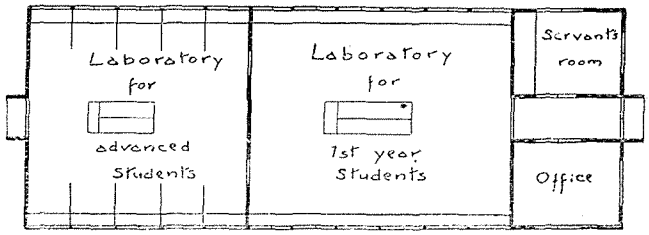


Text-figure 2. Map of the ground of the Seto Marine Biological Laboratory. A. Aquarium building. D. Dormitory. K. Keeper's lodge. R. Research laboratory. S. Students' laboratory. SR. Special research laboratory. T. Salt-water tank.

They are all flat wooden buildings, and are arranged in a zigzag among the pine trees on a spot locally called Saki-no-hama. The red roofs and pink walls are in most pleasant contrast with the evergreen pine trees and the white sandy beach, and afford fine landmarks to the fishermen at sea.

Students' Laboratory

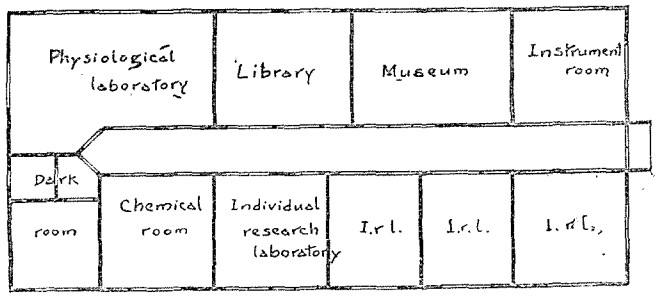
The Students' Laboratory (Pl. XII, figs. 4, 5, Text-fig. 3) contains two large rooms, one for first year students and the other for advanced students. The former is furnished with a long shelf table across the windows, affording working space for twelve persons altogether. In the latter the window space is divided by partitions into compartments ten in all, of which each student can have one to himself. A large concrete sink is placed in the center of each room where both salt and fresh-waters are running. The office and the assistant's room occupy the end of the building.



Textfigure 3. Plan of the Students' laboratory.

Research Laboratory

The Research Laboratory (Pl. XII, fig. 6, Text-fig. 4) which stands close to the Students' Laboratory, is divided into ten rooms, a physiological laboratory, library, museum, instrument room, dark room, chemical room



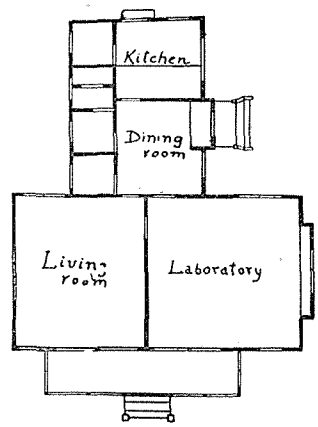
Text-figure 4. Plan of the Research laboratory.

and four individual research rooms. In the museum are exhibited labelled specimens of marine animals and plants which are intended to give visitors to the Laboratory a rough idea of the life of the neighbouring sea. The library contains several complete sets of periodicals, reports of expeditions, monographs, etc., and though most of them have temporarily been transferred to Kyoto for the use of the workers in the Zoological and Botanical Institutes, any of them can be sent from there on application. Some works which are particularly useful for marine biology, such as, 'The Reports of the Plankton Expedition' and 'Nordisches Plankton', have been left in the library of the Laboratory. In the instrument room are kept microscopes, sounding instruments, barometers, collecting apparatus, etc. The individual research rooms are all furnished with electricity, and

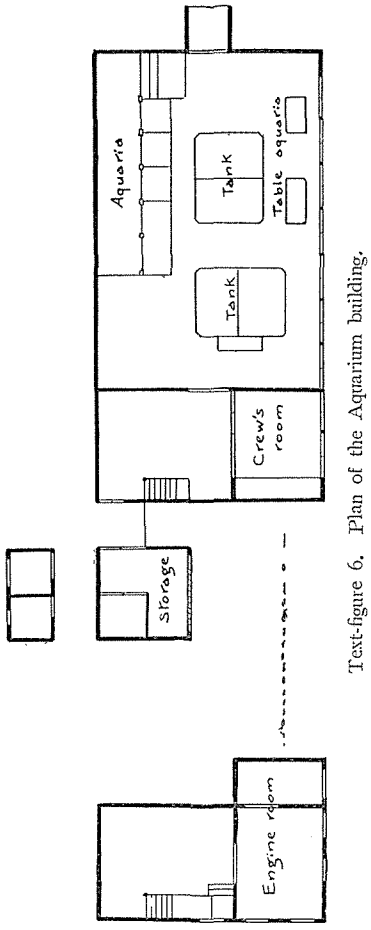
running salt- and fresh-water.

Special Research Laboratory

The Special Research Laboratory (Pl. XII, fig. 7, Text-fig. 5) which stands in the center of the ground, is intended for studies which require an isolated working place. This is a laboratory plus residence, consisting of a research room, parlor, kitchenette, bedroom, etc., arranged in a single small building.



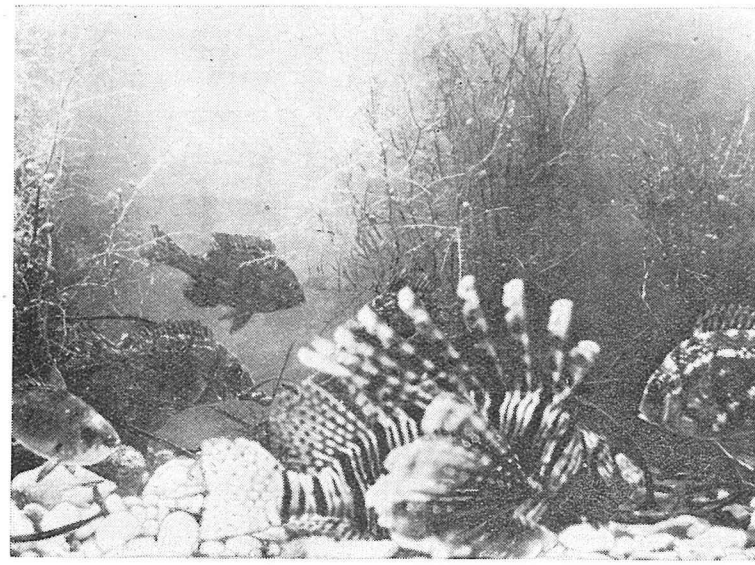
Text-figure 5. Plan of the Special research laboratory.



Text-figure 6. Plan of the Aquarium building.

Aquarium Building

The Aquarium Building (Text-figs. 6, 7), which is located at the west end of the ground, farthermost from the gate, contains two concrete salt-water tanks for storage and culture of marine animals located in the hall, and four aquaria in grotto style for exhibition and observation of the same, arranged on one side of the building. Besides, some table aquaria for exhibition of small animals are placed on concrete tables set close to windows in the hall. In the basement are installed an electric motor of 7·5 horse-power and a turbine pump. A little farther down outside of the building close to the sea, is a salt-water well. A long pipe 57 m. long connects this well to the sea and leads the water into the well. The water is then

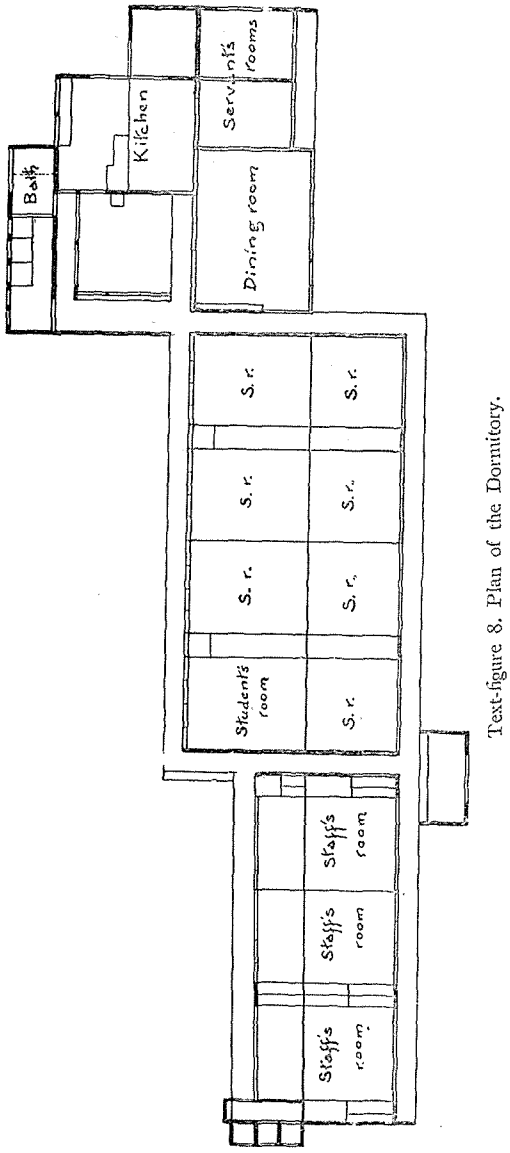


Text-figure 7. Inside of aquarium, with *Pterois lunulata* (middle) *Gerreomorpha japonica* (left in front) and *Gymnocranius griseus* (left behind and right) swimming among *Sargassum* and *Codium*.

pumped up to a large concrete tank placed on a little hill close to the Aquarium Building. The tank has a capacity of 993 gallons and the inside is divided into two compartments by a partition, so that the water of the different compartments can be used in turn. From this tank the water runs down into each laboratory through lead pipes. There is also a fresh-water well 7·5 meters deep between the Students' Laboratory and the Research Laboratory, which provides the whole Laboratory with clean and pure water in spite of its close proximity to the sea. The water is drawn up by an automatic suction pump with an one-horse-power electric motor to a tank placed on an iron-scaffold, and is distributed to each building to be used for laboratory work as well as for cooking and bathing.

Dormitory

The Dormitory (Pl. XII, fig. 8, Text-fig. 8) which is located nearest the gate, is a flat building in Japanese style with mats on the floor and paper screens. It can accomodate about 30 persons at a time, there being



Text-figure 8. Plan of the Dormitory.

three rooms for the staff and visiting workers, eight large rooms for students, a dining room, two servants' rooms, a kitchen and a bath-room.

Collecting Boat and Row Boats

For collecting materials, the Laboratory possesses a boat called the "Nyusin-maru" (Pl. XII, fig. 9), of 19 tons capacity, 48 feet long, and 13 feet broad. She is equipped with a 25 h.p. semi-Diesel gas engine and a mast with full rigging for sails, and contains a cabin with two berths, a hold, etc. The three row boats are all of the style of Japanese fishing boats.

Activities

The Laboratory is established primarily to provide the biologists in the Kyoto Imperial University with facilities for carrying out research works on marine animals and plants, and also to give students in that university object lessons in marine biology. The activities of the Laboratory are scheduled according to this original plan.

Since its establishment, the Laboratory has been visited by several biologists and scientists of other lines, who have carried out research works on material available near the Laboratory. During the summer and spring vacations of the university, the Laboratory is crowded with students of biology to whom courses of two weeks in summer and one week in spring are compulsory. In summer, after the regular course for students is over, the Laboratoty is open for a course on marine biology to teachers of biology in public schools, given by the staff of the Laboratory and the Zoological Institute. The course is attended each year by some thirty persons, most of whom stay in the dormitory and enjoy the simplicity of the life there. Besides these regular activities, the Laboratory receives everyday a number of visitors who take interest in the exhibits of the museum and the aquarium. In fact, the "Rinkai-kenkyûsyo", the Marine Laboratory, is counted among the "sights" of the neighbourhood by the hotel guides of Yusaki and Sirahama. Especially during the spring and autumn months, the Laboratory is often visited by troops of school children who find here the goal of their excursion. To meet all the above demands, the staff of the Laboratory is at present engaged mainly in the improvement of its equipment, and in carrying out the survey of the fauna and flora of the environs, by the daily examination of the plankton and by the explorations of various collecting grounds.

Staff

The present staff consists of;

TAKU KOMAI, Professor of Zoology of Kyoto Imperial University, in charge;

Kôzô AKATSUKA, Assistant Professor of Biology of Kyoto Imperial University, resident in Laboratory, at present temporarily in Kyoto Imperial University;

JIRÔ IKARI, Assistant, resident in Laboratory;

Also, Captain, Engineer and Servant.

Environs

As shown in Text-figure 1, the Laboratory is located on a small peninsula on the south side of the entrance to Tanabe Bay. The bay is rather shallow, being 10 to 30 feet deep throughout, and has a muddy bottom. The coast bordering the bay is marked with profuse indentations especially on the east and south sides. The peninsula itself is composed of sandstone and conglomerate rocks containing various molluscan fossils. The coast is dotted with several reefs and islets, and is known among the sailors as one of the hardest spots to navigate around the whole Kii Peninsula. Such a local condition naturally furnishes naturalists with excellent working grounds, since the rocks and reefs give various marine organisms attachment and shelter, while the mud bottom has fauna characteristic to it. Besides, most of the representatives of the oceanic and littoral pelagic animals are available not far from the Laboratory.

Around the peninsula the hundred feet line of the bottom is far out in the sea about 7 or 8 miles off the shore, 30 to 40 feet being the greatest depth near the Laboratory. The Black Current which runs off Sio-no-misaki northeastward, sends a branch current near the cape, which goes northward through the channel between Kii and Sikoku. An offshort from this branch comes into Tanabe Bay, and brings warm water very close to the coast around the Laboratory. This explains the fact that some tropical plants are found growing on the islets in the bay; for instance, on a rocky islet called Kasima, there grows *Bankinia japonica*, which finds here the northern limit of its distribution.

Kii is one of the warmest districts of central Japan, and the climate as a whole is very mild all year round, freezing weather coming rarely, if at all, and snow very little. The summer is naturally pretty hot; but the local breeze blowing almost all the time, makes it bearable even when the thermometer gets beyond 90 degrees.

Marine Fauna and Flora

As mentioned above, it is less than five years since the Laboratory was established, and we have not yet been able to complete the survey of the fauna and flora of the neighbouring seas. The following is therefore intended to give merely a very rough idea of the marine animals and plants easily accessible around the Laboratory. And, to a comprehensive survey of individual groups, which we hope to carry out some time in near future, we shall devote a separate paper.

Littoral Fauna

Protozoa

Of the Foraminifera, various living forms can be obtained from the mud taken from the bottom a few fathoms deep, of which *Rotalia*, *Globigerina*, *Tretomphalus*, *Miliolina*, *Spirillina*, *Spiroloculina*, *Lagena* and *Bolivina* belong to prevalent genera. *Polytrema miniaceum* is common on stones picked up by dredging.

Porifera

Of the various forms of sponges, *Tethya serica* is very plentiful on the shallow mud bottom of Tunasirazu Bay near the Laboratory. Another form belonging to apparently the same genus, occurs also very commonly on rocky beaches. *Chalina sp.* and *Siphonochalina sp.* may be found among driftweed after storms. Among other monaxon sponges of which there are very many kinds, the two species of *Reniera* found everywhere on Japanese coast, *R. japonica* and *R. okadai*, are the commonest forms growing on rocky beaches. Among calcareous sponges there is the common *Grantessa shimeji*. The glass-sponges are apparently much rarer than at Misaki. *Euplectella oweni* is obtained only from time to time entangled in fishing nets from the deep bottom three to five miles off the shore.

Coelenterata

Hydroids like *Aglaophenia*, *Clytia*, *Sertularia*, and *Plumularia* are

common in crevices of rocks; besides, *Pennaria cavolini* and *Tubularia mesembryanthemum* occur plentifully in tide pools.

Beautiful specimens of the curious hydroid, *Dendrocoryne misakiensis*, can be obtained very easily at certain places of the neighbourhood.

The tide pools and submerged cliffs on the north side of the promontory where the Laboratory stands, abound with colonies of the peculiar scyphozoan polyp, *Stephanoscyphus sp.* which is known to be the scyphistome stage of *Nausithoë*; there are places where several square feet of the rock are covered exclusively with this polyp. This "iramo" (sting alga), as it is called by natives, is much dreaded owing to the fierce sting of the nematocysts with which the polyps are armed, the sting being perhaps worse than that of any other coelenterate.

The cliffs or crevices in rocks where the tidal current runs rapidly, give attachment to beautifully coloured stocks of coelenterate forms like *Dendronephthya*, *Alcyonium*, *Melitodes*, *Euplexaura* and *Astrodes*, while the submerged rocks on the bottom of the parts where the water is clean, are covered with various forms of stone-corals belonging to the genera such as, *Astrea*, *Porites*, *Madrepora*, *Leptoseris*, *Dendrophyllia* and *Turbinaria*.

Like the Madreporaria, the Gorgonacea are remarkable for the richness in species as well as for the variety in form. Only very little, however, has been worked on this group thus far; and we can mention only that there are *Acabaria*, *Melitodes*, *Euplexaura*, *Acanthogorgia*, *Stachyloides*, *Caligorgia*, etc., etc.

Pteroides chinense, *Pennatula fimbriata*, *Scytalium splendens* and *Cavernularia habereri* are the representatives of the Pennatulacea found in the neighbouring sea.

Among the Actiniaria, such forms as *Actinia mesembryanthemum*, *Anthopleura xanthogrammica* and *Cribrina artemisia* are very abundant between the tidal marks. There is also a gigantic sea-anemone, apparently of the genus *Bolocera*, measuring more than one foot across when fully extended, found rather commonly in the crevices in rocks near the low-tide mark. A form of *Zoanthus* is also found in similar places.

Cerianthus misakiensis lives in mud often commensal with *Phoronis australis*.

Some three miles off the shore, there is a bottom where apparently a bush of *Cirripathes spiralis* occurs, a few stocks of which come up often entangled in torn nets. *Antipathes japonicus* is also obtained from the same place.

Turbellaria and Annelida

Among polyclads, *Planocera reticulata*, *Thysanozoon brocchii*, *Prosthiostomum grande* and *Pseudostylochus sp.* are forms rather frequently met with. Among the polychaetes, *Choeia flava*, *Marphysa iwamusi*, *Polynoe* sp. are common on rocky beaches. The gigantic *Eunice aphroditois* which attains sometimes a length more than four feet, is also not rare under stones at similar places. At night in the later part of July, a kind of polychaete worm belonging to Syllidae, appears every year in the sea very near the Laboratory. It gives out a light when swimming and makes a beautiful fire-work display on the surface of the water. The tubes of *Chaetopterus sp.* and the holes of *Arenicola sp.* are found here and there on the mud flat of Hatake-sima, an islet at the entrance to Tunasirazu Bay. Sedentary forms like *Laonome japonica*, *Terebella sp.*, *Sabellella sp.* and various serpuloids occur everywhere in clean shallow water, displaying their beautiful gill-tufts protruded from tubes like flowers in rocky gardens.

Crustacea

The following is the list of cirripeds found near the Laboratory which our friend Mr. S. HAREYAMA has kindly prepared for us:

Balanus tintinnabulum rosa. *Balanus amphitrite albicostatus.*
Balanus trigonus. *B. balanoides.*
Tetraclita squamosa japonica. *Mitella mitella.*
Lepas anatifera. *Lepas anserifera.*
Poecilasma kaempferi (on *Macrocheira*).
P. eburnea (on *Macrocheira* and *Panulirus*).
Alepas minuta (on *Panulirus*).

Peltogaster sp. (on *Pagurus*). *Sacculina sp.* (on crabs).

A vast proportion of the surface of rocks on the neighbouring shore is covered with a few species of these barnacles.

Of the Malacostraca, the Decapoda are very rich in species, so that we shall mention but a few of the forms found commonly in the sea around the Laboratory. *Panulirus japonicus* is probably more important than any other crustacean from the economic view-point. Another species of the same genus, the handsome *P. fasciatus*, though less common, also occurs. Besides these, *Paribacus ciliatus*, *Scyllarus haani*, *Stenopus hispidus*, *Limuparus trigonus*, *Arctus sp.*, *Laomedia astacina* and *Alphaeus spp.* are more or less common macrurans and anomurans. The land hermit-crab, *Coenobita cavipes*, characteristic of tropical islands, also occurs around here, finding shelter in crevices in rocks and stone walls above the tidal marks. *Dromia rumphii* is brought up from time to time entangled in nets spread for catching the spiny lobster. It carries on its back a lump of compound ascidian or sponge tightly fitted to the vaulted carapace. The giant crab, *Macrocheira kaempferi*, is by no means rare. In spring it comes up to rather shallow water near the Laboratory apparently to spawn, and at times two or three are caught in one net spread for fishing *Caranx*. *Ranina ranina* is another remarkable crab found in the neighbouring sea. Among other forms are *Porcellana japonica*, *Galathea spp.*, *Latreillia spp.*, *Dorippe dorsipes*, *Lyreidus tridentatus*, *Leucosia obtusifrons*, *Calappa fornicata*, *C. cristata*, *Mya fugax*, *Matuta victor*, *Thalamita prymna*, *Maia spinigera*, *Neptunus pelagicus*, *Goniosoma miles*, *Casmagnathus convexus*, *Leolophus planissimus*, *Varuna litterata*, *Podophthalmus vigil*, *Schizophrys aspera*, *Scopiomera globosa*, *Carcinoplax longimana*, *Lambrus validus*, *Atergatis integerrimus*, *Ocypode sp.*, etc.

The Isopoda and Amphipoda have been little worked on, and we can give only a few names. *Ligia exotica* is very common, as it is elsewhere, and is collected in great quantity with a trap, to be used for bait. The parasitic *Cymothoa* and *Epipenaeon* are also common isopods. *Orchestia* hops in great numbers on sandy shores, while *Caprella* and

Gammarus are abundant among sea-weeds. The Stomatopoda is represented by *Squilla raphidea*, *Lysiosquilla multifasciata*, *Odontodactylus japonicus* and *O. scyllarus*, while the Tanaidacea by a tiny *Heterotanais sp.*

Echinodermata

Of the apparently few crinoids found in the environs, *Comanthus japonica* is the commonest species. This gives shelter to many small animals among the cirri, *Alphaeus*, *Galathea* and *Caprella* being the forms found almost without exception. These creatures are coloured exactly like the host, showing a marvellous colour-adaptation.

Among the echinoids the following are prevalent forms:

Cidaris baculosa.	*Cidaris tenuispinosus.*
Heliocidaris crassispinosa.	*Pseudocentrotus depressus.*
Diadema setosum.	*Mespilia globulus.*
Strongylocentrotus pulcherrimus.	*Toxopneustes pileolus.*
Echinometra lucunter.	*Tripneustes grabella.*
Brissus agassizi.	*Laganum decagonale.*
Echinarchnius palma.	*Martia sp.*

A curious sea-urchin very large in size and with a soft skin *(Astropyga ?)* was once obtained from a fisherman who had picked it up from a deep bottom.

Starfish are rather meagre in species, having *Astropecten polyacanthus*, *Luidia quinaria*, and *Asterias calamaria* as prevalent representatives, while *Asterina pectinifera* and *Nardoa semiregularis* belong to rarer forms.

There are several ophiurans which have not yet been identified. *Gorgonocephalus caryi* is obtained mostly in spring with its arms caught in fishing nets.

Of holothurians, *Polycheira rufescens* and *Holothuria atra* occur very abundantly under stones of rocky beaches. *Holothuria monacaria*, *Stichopus japonicus*, *Cucumaria echinata* and *Trochodota japonica* are also not rare.

Prosopygi

Phymosoma scolops may be obtained from among the colonies of

Stephanoscyphus. *Phascolosoma nigrum* and *Sipunculus cumanensis* are also common sipunculoids dwelling in muddy beaches. *Lingula anatina* also occurs at similar places, but rather rarely. *Laqueus rubellus* is occasionally brought up from deep bottoms. *Phoronis australis* lives always commensal with *Cerianthus*, the same as at Misaki.

Bugula, *Flustra*, *Schizoporella*, *Microporella* and *Caberea* are only a few representatives of the rich bryozoan fauna. *Barentsia misakiensis* belonging to the Endoprocta, is also found.

Mollusca

The molluscan fauna around here was explored a good deal by the late Mr, Y. HIRASÉ, a well-known conchologist of Kyoto. To mention only a fraction of the rich list: Almost every rock crevice in some parts abounds with *Septifer*, *Ostrea* or *Liolophura*, with some individuals of *Acanthochiton*, *Anomia*, *Chama* or *Patella* mingled with them. Somewhat far from the shore, *Dentalium octangulatum*, *Xenophora pallidula* and *Amusium japonicum* are often secured by dredging. The rare *Pleurotomaria* has also been collected by fishermen.

There are two pearl-oyster farms in the neighbourhood where *Margaritifera martensii* is being cultured. *Pinna attenuata*, *Malleus albus* and *Gafrarium divaricatum* may be obtained from mud flats. Besides, *Arca*, *Spondylus*, *Chlamys*, *Mytilus*, *Cardita*, *Tellina*, *Mactra*, *Tapes*, *Cardium*, *Solen* and *Tresus* are prevalent genera of lamellibranchs.

Among prosobranch gastropods, *Haliotis gigantea* and *H. diversicolor* are most important from the economic view-point; they are collected by divers and sold in the market at high prices. Of the extensive number of other genera of prosobranchs, *Patella*, *Turbo*, *Cypraea*, *Trochus*, *Conus*, *Natica*, *Vermetus*, *Dolium*, *Nassa*, *Strombus*, *Eburna*, *Umbonium*, *Purpura*, *Cerithium*, *Hipponyx*, *Rapana*, *Cymatium*, *Patella*, *Murex*, *Thais* and *Terebra* include each some number of species.

Of opisthobranchs there are *Tethys*, *Dolabella*, *Pleurobranchus*, *Pleurobranchea*, *Hydatina*, *Bullaria*, and *Umbraculum* among tectibranchs, and *Argus speciosa*, *Chromodoris spp.*, *Eolis spp.*, *Melibe vexillifera*, *Pleurophyllidia japonica*, *Ceratosoma cornigerum* and *Doris japonica*

among nudibranchs.

Marine pulmonata are represented not only by *Onchidium verruculatum*, and by an allied form, *Onchidiella sp.*, but also by *Siphonaria sirius*.

There are several cephalopods. Among these, *Polypus octopodia* is eaten by the natives and also used for bait. The nephridial cavity swarms with *Dicyema* which is used much by students for their laboratory work. The shell of *Nautilus pompilius*, as well as that of *Argonauta argo*, has been picked up on the beach. Of the Decapoda, *Sepiella maandroni*, *Ommastrephes sloani pacificus*, *Sepioteuthis lessoniana*, *Sepia elliptica*, *S. kobiensis*, etc. are commonly found. On moonless nights in summer, the dark horizon far out in the sea is beautifully illuminated by the lights of the boats alluring these cuttlefish.

Prochordata

Mud flats exposed by the ebbing tide are covered with holes of *Balanoglossus misakiensis* which can be readily recognized by the pile of peculiar excreta as well as by the characteristic odour of the worm. *Styela plicata* is the commonest ascidian, and is much used as material for dissection. *Styela kroboja*, *Ciona intestinalis* and *Perophora sp.* also occur. Various kinds of compound ascidians are found, but none of them has been identified with certainty.

Vertebrata

The fishes of Seto have been collected extensively by Mr. N. Ui, former teacher of natural history in the girls' school of Tanabe and identified by Professor S. Tanaka of the Tokyo Imperial University. Their work yielded a great number of new species described by the latter scientist and also embodied a few years ago in a fine book entitled "Monograph of the Fishes of Kii Province" written by the former naturalist. According to this book, the coast of Kii, of which Seto is a part, is extremely rich in fishes, there being more than seven hundred species inhabiting this comparatively limited area. But, here we give just a few out of this extensive list. To begin with selachians: *Chlamydoselachus*

anguineus is captured very rarely, *Heptanchias deani* is commoner, while *Heterodontus japonicus* is much more so. *Halaelurus torazame, Cephaloscyllium umbratile, Cynias manazo, C. griseus, Prionace glauca, Carcharhinus japonicus, Alopias vulpes, Isulopsis glauca, Squatina japonica, Rhinobatus schlegeli, Raja kenojei, Narka japonica, Dasybatus akajei, Pteroplatea japonica, Urophus fuscus, Mylobatis tobijei* and *Mobula japonica* are common sharks and rays. *Chimaera phantasma* is found pretty abundantly in winter.

Of teleosts, *Muraena pardalis, Goniistius zonatus, Calotomus japonicus, Calliodon ovifrons, Chromis notatus, Girella punctata, Lethrinus haemopterus, Niphon spinosus, Plectorhynchus pictus, Epinephelus septemfasciatus, Priacanthus sp., Oplegnathus fasciatus, Monacanthus cirrifer, Sheroides vermicularis, Sebastiscus marmoratus, Pterois lunulata, Chelidonichthys kumu, Acanthogobius flavianus, Parapercis pulchella, Uranoscopus japonicus, Callionymus sp., Paralichthys olivaceus, Antennarius tridens*, etc. are shore fishes frequently met with.

After storms, which are particularly prevalent in winter, dead *Hippocampus coronatus, Syngnathus schlegeli, Ostracion immaculatum, Sphaeroides vermicularis* and *Monocentris japonicus* are often found on the beach among the fronds of drift sea-weeds. In the spring month a number of fishing boats coming from distant villages, assemble on the sea a few miles off the shore of Seto. These are all to fishing *Pagrosomus major*, the handsome fish highly valued in this country, which swims along the coast from the open sea into the Inland Sea to seek a breeding place during this season. This fish and *Katsuonus pelamys* are by far the most important of all the marine products of the neighbourhood.

All the villages of the neighbourhood are sometimes greatly excited over the approach of fishes like *Etrumeus micropus, Stolephorus japonicus, Engraulis japonicus* and *Scomber tapeinocephalus*. Incidentally, we may mention of the occurrence of a gigantic eel in a river some five miles from Seto, which measures sometimes as much as 6 feet long and weighs as much as 50 pounds.

Of other vertebrates, the common sea-snake, *Hydrus platyurus* is

caught at times on the neighbouring sea, while the loggerhead turtle, *Caretta olivaceus*, comes up to lay eggs on the sandy shore adjacent to the Laboratory in the nights in early summer.

Zooplankton

The zoo– and phytoplankton do not differ much from those of Misaki, excepting that they show more tropical facies, which appear most pronouncedly in the season from November to March, when most varied forms can be met with.

Of the Foraminifera which appear in plankton, to begin with, *Tretomphalus bulloides* occurs in abundance, besides *Bolivina sp.*, *Globigerina inflata*, *G. bulloides* and *Discorbina sp.*, which are also common. Radiolarians are rich both in species and in quantity from September to December, when *Acanthometra pellucida*, *Collozoum inerme*, *Sphaerozoum geminatum*, *Pterocamium tricolpum*, *Haliomma radians*, *Diplocolpus amalla*, *Amphilonche belonoides*, *Litharachnium spp.*, *Coelodendrum gracilimum*, *Thalassicola pelagica*, *Gazelleta sp.*, *Diplosphaera hexagonalis*, *Aulacosphaera sp.*, *Protocystis spp.*, *Drymosphaera polygonalis*, etc., etc. appear. *Sticholonche zanclea* harbours very commonly the mesozoan *Amoebophrya*, which may be found in *Acanthometra sp.* as well. *Noctiluca miliaris* appears sometimes in spring in such quantities as to discolour a great extent of the surface of the sea. The Ciliatae are represented by *Tintinnopsis mortensi*, *T. fracta*, *Tintinnus fraknoii*, *Fabella ehrenbergi*, *F. scandens*, *Rhabdonella amor*, *Epiprocylis undella*, *Codonellopsis morchella*, *Codonella brevicaudata* and *Petarotricha ampulla*, as also by *Vorticella sp.* found always on the diatom, *Chaetoceras coarctatum*.

The Hydromedusae comprise a number of forms, some large and some minute, such as: *Hypocodon forbesii*, *Sarsia niponica*, *Nemopsis dofleini*, *Cytaeis japonica*, *Tiaranna ikarii*,*Steenstrupia sp.*, *Proboscidactyla ornata var. gemmifera*, *Spirocodon saltatrix* among the Anthomedusae, *Obelia sp.*, *Euchilota sp.*, *Phialidium sp.* and *Eutima japonica* among the Leptomedusae, *Liriope rosacea*, *Geryonia proboscidalis*,

Rhopalonema velatum, *Olindias sp.* and *Aglaura hemistoma* among the Trachymedusae and *Solmaris insisa*, *Aegina citrea* and *Solmundella bitentaculata* among the Narcomedusae. Of these, *Liriope* and *Solmundella* appear at times in great numbers. The Siphonophorae are much varied both in form and in size, of which *Muggiaea atlantica*, *Diphyopsis dispar*, *Sphaeronectes truncata* and *Abyla spp.* represent smaller and transparent forms, while *Rhyzophysa eysenhardtii*, *R. sp.*, *Cupulita picta* and *Physophora hydrostatica* represent large and beautifuly-coloured ones. After a gale, especially in winter and spring, a number of fine specimens of the oceanic *Physalia physalis utriculus*, *Agalma okenii*, *Agalmopsis elegans*, *Crystallomia polygonata*, *Velella lata* and *Porpita umbella* are often brought ashore.

Of the Scyphozoa which may be obtained in the neighbouring seas of Seto, Mr. T. UCHIDA of Tokyo has given the following list in a recent number of "Dobutugaku-Zassi" (Nov. 1926):—

Cubomedusae:	*Tomoya virulenta.*	
Coronatae:	*Nausithoë punctata.*	
Saemostomae:	*Pelagia ponopyra.*	*Dactylometra ferruginaster.*
	Sandaria malayensis.	*Cyanea nozakii.*
	Aurelia aurita.	
Rhizostomae:	*Netrosoma setouchiana*	*Mastigias papua.*
	Cepha cepha.	

Of these, *Mastigias papua*, *Aurelia aurita* and *Dactylometra ferruginaster* lead the list in quantity; the water surrounding the Laboratory swarms with the last two jelly-fishes in early spring, while in late summer their place is taken by the first named form.

Arachnactis, *Zoanthella* and *Zoanthina*, larvae of anthozoans, appear occasionally in plankton in summer.

Hormiphora palmata, *Bolinopsis mikado*, *Cestus amphitrites*, *Beroë cucumis*, *Beroë forskali*, *Leucothea japonica* and *Ocyropsis fusca* are ctenophores which have been found.

Müller's larva of the turbellarian, *Pilidium* larva of the nemertine, *Cyphonautes* larva of the bryozoan, as well as the larva of *Lingula*, are not rare in certain seasons.

The Polychaeta have several larval forms besides *Tomopteris spp.*

In the Crustacea, the Copepoda surpass all other groups both in quantity and in the number of species. To mention only prevalent genera, we have; *Sapphirina, Calanus, Centropages, Lucicutia, Microsetella, Oithona, Oncaea, Temora, Eucalanus, Rhincalanus, Paracalanus, Setella, Calocalanus, Mecynocera, Scolecithrix, Candacia, Acartia* and *Corycaeus.*

Among the adult forms belong to other orders, there are *Evadne sp., Penilia schmackeri, Vibilia spp., Phronima spp., Hyperia spp, Neomysis sp., Gastrosaccus sp.* and *Lucifer sp.*, while various larval forms like *Nauplius, Phyllosoma, Alima, Mysis* and *Zoëa* are always found.

Of the molluscan plankton, various kinds of veligers are among the commonest forms in summer months. Less common are adult forms like *Glaucus lineatus, Janthina janthina, J. globosa, Pterotrachea sp., Atlanta sp., Cavolinia spp., Creseis sp.*, etc., which appear generally after gales.

Various kinds of echinoderm larvae occur especially frequently in summer. *Sagitta spp., Spadella spp.*, and *Krohnia sp.* appear also commonly.

A few kinds of Salpae, such as *S. fusiformis, S. cordiform, S. costata* and *Cyclosalpa affinis*, as well as *Doliolum sp., Oikopleura spp.*, and *Fritillaria spp.*, are sometimes met with.

Phytoplankton

Coming next to the phytoplankton, diatoms lead the list as everywhere, *Chaetoceras, Rhizosolenia, Coscinodiscus, Eucampia, Lauderia, Ditylium, Bacteriastrum, Triceratium. Thalassiothrix* and *Asterionella* comprising each a great number of species. Especially noteworthy is the appearance of *Rhizosolenia amputata*, as also the occurrence of the parasitic *Richeria intracellularis* in frustules of certain species of *Rhizosolenia.* In April, the surface haul often consists exclusively of *Coscinodiscus Janischui*, without any other diatom associated with it.

Next to diatoms, the Peridiniales is the most important group, being

represented by such genera as *Ceratium*, *Peridinium*, *Pyrocystis*, *Amphisolenia*, *Dinophysis*, *Podolampas*, *Oxytoxum*, *Ornithocercus*, *Goniodoma*, *Gonyaulax*, *Pyrophacus* and *Ceratocorys*. Of the Silicoflagellatae, *Dictyocha fibula var. stapedia*, *Distephanus speculum*, and *D. speculum var. septenaria*, and of the Chrysomonadinae, *Phaeocystis Pouchetii*, are prevalent. *Trichodesmium Thiebauti* and *T. erythraeum* occur sometimes in such quantities that the surface of the water appears as if strewn with dust. *Halosphaera viridis* represents the pelagic Chlorophyceae.

Littoral Algae

The littoral algae are rather poor in forms; and there are only a few species which are of economic importance. The following list gives the forms easily collcted in the neighbourhood of the Laboratory:

Cyanophyceae

Brachytrichia Quoyi.

Chlorophyceae

Monostroma sp.	*Ulva pertusa.*
U. conglobata.	*Enteromorpha intestinalis.*
E. compressa.	*Ulothrix sp.*
Rhipidiphyllon reticulatum.	*Boodlea coactata.*
Cladophora Wrightiana.	*C. sp.*
Caulerpa cupresoides var. lycopodium f. amicorum.	
C. racemosa var. laete-virens.	*Codium cylindricum.*
C. adhaerens.	*C. pugniformis.*
C. saccatum.	*C. tenue.*
C. coarctatum.	*C. intricatum.*
Chaetomorpha crassa.	*Dictyosphaeria favulosa.*

Phaeophyceae

Ectocarpus sp.	*Myelophycus caespitosus.*
Sphacelaria tribuloides.	*S. furcigera.*
Colpomenia sinuosa.	*C. sinuosa f. deformans.*
Scytosiphon lomentarius.	*Hydroclathrus cancellatus.*
Endarachne Binghamiae.	*Mesogloia crassa.*
Sporochnus sp.	*Chorda Filum.*

Hirome undarioides.
Ecklonia bicyclis.
Padina pavonia.
Haliseris undulata.
Dictyota dichotoma.
Dilophus marginatus.
Ishige Okamurai.
Turbinaria (?) fusiformis.
S. tosaense.
S. serratifolium.
S. tortile.
S. hemiphyllum.
S. duplicatum.
S. Ringgoldianum.
Laminaria radicosa.
Chlanidophora repens.
P. arborescens.
H. prolifera.
D. divaricata.
Pachydictyon coriaceum.
Cystophyllum sisymbrioides.
Sargassum patens.
S. Horneri.
S. piluliferum.
S. Thunbergii.
S. micracanthum.
S. nipponicum.
S. sagamianum.

Rhodophyceae

Bangia atropurpurea γ. fuscopurpurea.
Porphyra sp.
Nemalion pulvinatum.
Liagora sp.
Galaxaura obtusa.
Actinotrichia rigida.
G. japonicum.
Pterocladia capilacea.
Gigartina intermedia.
Stenogramma interrupta.
Eucheuma papulosa.
Gracilaria confervoides.
G. gigas.
Hynea musciformis.
H. sp.
Champia parvula.
Plocamium Telfairae.
Nithophyllum sp.
Laurencia obtusa.
Helminthocladia australis.
Scinaia japonica.
G. sp.
Gelidium Amansii.
G. subcostatum.
Chondrus ocellatus.
G. tenella.
Gymnogongrus flabelliformis.
Phacelocarpus japonica.
G. chorda.
G. Textorii.
H. seticulosa.
Lomentaria catenata.
Chylocladia sp.
Martensia elegans.
Implicaria reticulata.
Chondria dasyphylla.

Polysiphonia sp. *Leveillea jungermannioides.*
Griffithsia tenuis. *Spiridia sp.*
Ceramium gracillimum.
Campylaephora hypnaeoides (Ceramium hypnaeoides.)
Gloiosiphonia capilaris. *G. furcata var. intricata.*
G. cervicornis. *Grateloupia ramosissima.*
G. flabellata. *G. filicina.*
Carpopeltis rigida. *Dudresnaya japonica.*
Chondrococcus Hornemanni.

In the above list, *Codium saccatum*, *C. tenue*, *Rhipidiphyllon reticulatum* and *Anadyomene Wrightii* belong to rather rare algae. The two *Codium* species are occasionally found among various sea-weeds brought ashore by gales during summer. *Dictyosphaeria favulosa* and *Brachytrichia Quoyi* occur in abundance between the tidal marks. *Caulerpa racemosa* grows in tide pools on reefs facing the sea, while *C. cupresoides* is found in calm bays, somtimes growing to several meters. *Ulva* and *Monostroma* grow on rocks, at times virtually covering the entire surface. They are collected by the natives for food.

Of the brown algae, those belonging to Fucaceae are the commonest. *Turbinaria fusiformis*, among others, is found abundantly on reefs between the tidal marks. It is cut in May, to be dried and utilized as food. Other important forms are *Hirome undarioides*, *Laminaria radicosa* and *Ecklonia bicyclis*.

Of the red algae, *Porphyra suborbiculata* and *P. dentata* grow on rocks near the high-tide mark. The name "Yuzaki-nori" has been given to these algae by natives, and they are sold like their nearest relative *P. tenella*, the famous "Asakusa-nori" of Tokyo. *Gloiopeltis*, the raw material of a kind of glue and *Gelidium*, that of Japanese agar-agar, are both economically important. Corallinaceae, which is excluded from the list, is also very abundant, *Amphiroa*, *Jania*, *Corallina* and *Lithophyllum* being the more prevalent genera.

EXPLANATION OF PLATE XII

Fig. 1. View of the ground from west, with Research Laboratory, Aquarium Building and Salt-water tank in the fore ground, Students' Laboratory and Special Research Laboratory to the left among pine trees, and Dormitory and Keeper's Lodge in the back.

Fig. 2. Southern shore of the peninsula.

Fig. 3. View of the ground from south, with buildings peeping through pine trees and the 'Nyusinmaru' at anchor.

Fig. 4. Students' Laboratory.

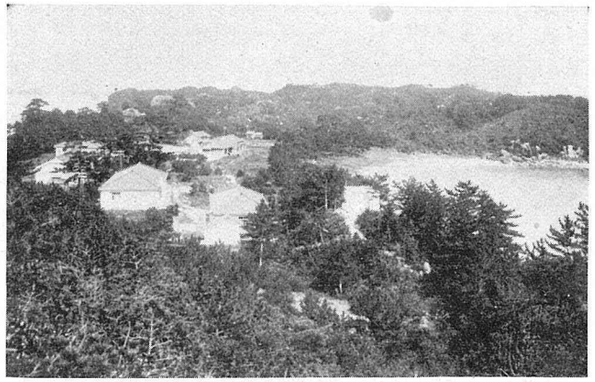
Fig. 5. Inside of the same.

Fig. 6. Research Laboratory.

Fig. 7. Special Research Laboratory.

Fig. 8. Dormitory.

Fig. 9. The 'Nyusinmaru.'



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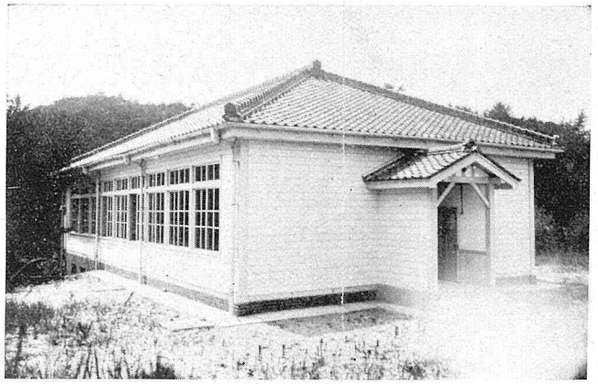

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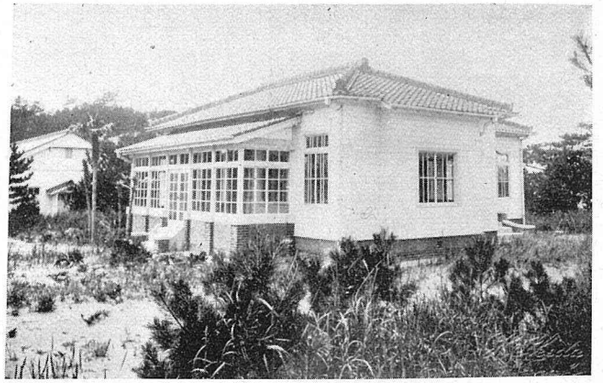

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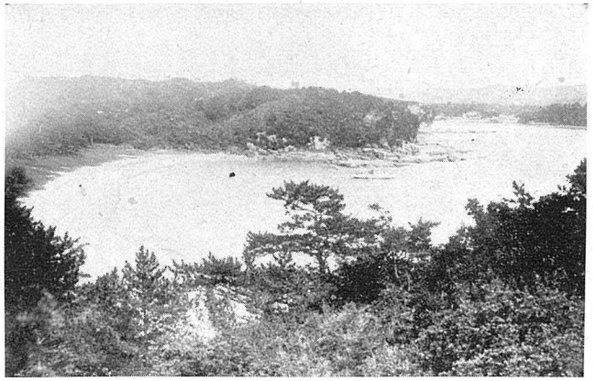

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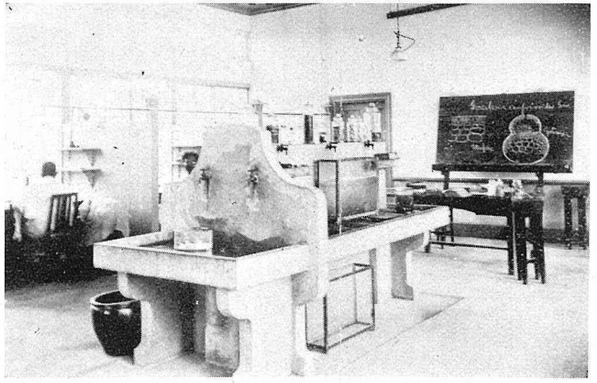

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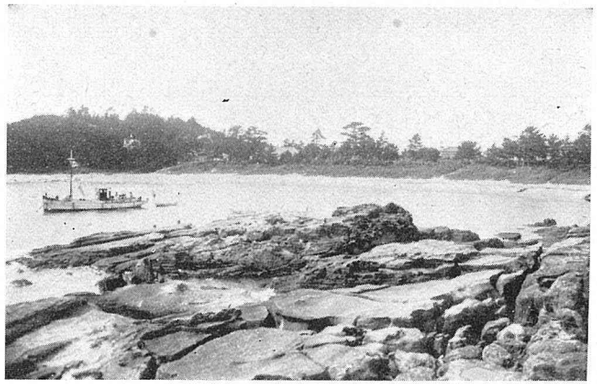

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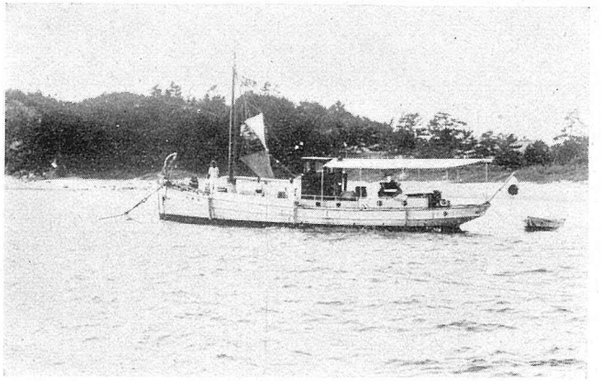

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